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D3.2.1 POTENTIAL USE CASE MODELS

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Content

1. Introduction

1.1 Background and Objectives

The automotive industry in Central Europe is currently experiencing one of the most far-reaching transformations in its history. The combined pressures of climate change, regulatory demands, digitalization, and shifting consumer preferences are driving systemic changes that affect virtually every part of the value chain. At the heart of this transformation lie four megatrends that are shaping the future of mobility: **Electrification, Automation, Connectivity and the Platform Economy**. These trends are not isolated phenomenon. Instead, they are interwoven and mutually reinforcing. Electrification requires new infrastructures and component suppliers; connectivity opens opportunities for smart mobility services but also creates demands for secure data and communication systems; automation redefines not only vehicles but also logistics, urban planning, and labor markets; and the platform economy challenges traditional business models by introducing new forms of intermediation and value capture.

For Central European regions, which rely heavily on the automotive sector as an industrial backbone, the stakes are high. Small and medium-sized enterprises (SMEs), which form most suppliers and innovators in the sector, face particular challenges. Many of them are highly specialized and deeply embedded in existing combustion-engine value chains. The shift toward electrified, digital, and service-oriented mobility puts pressure on these companies to rethink their core offerings and adapt to new technological, regulatory, and market realities. At the same time, this transition opens opportunities for entirely new value chains, products, and services that can secure long-term competitiveness if identified and developed early enough.

It is against this backdrop that the **Drive2Transform** (D2T) operates. The project aims to strengthen the innovation capacity of Central European regions by enabling cross-border collaboration and the co-creation of new business opportunities. Rather than focusing only on incremental improvements within existing structures, the project seeks to identify **new transnational value chains** that address the megatrends in a holistic way. Work Package 3 (*Building Transnational Use Cases*) plays a pivotal role in this ambition, as it provides the framework for creating, testing, and evaluating use cases that can later be scaled and exploited beyond the project duration. Deliverable D3.2.1 is the first output in this process and marks the starting point for developing a portfolio of innovation opportunities.

The objective of Deliverable D3.2.1 is to generate a set of **potential use case models** that can serve as building blocks for the automotive (mobility) industry's transition across Central Europe. These models are intended to function as early innovation hypotheses: they are not yet final business cases, but rather structured concepts that demonstrate where opportunities exist, what needs they address, and how they might evolve into new products, services, or collaborative projects. In this sense, the deliverable acts as a **bridge between foresight (A1.2 Develop Transformation Scenarios for businesses) and strategy (A3.3 Transnational exploitation plans)**, translating broad megatrends and abstract challenges into more concrete directions for innovation.

The specific objectives are threefold. First, the deliverable seeks to identify critical problem fields that arise from the four thematic areas, thereby offering a structured overview of the most pressing transformation challenges. Second, it translates these challenges into preliminary use cases that combine technological, and business perspectives into coherent use case ideas. Third, it validates these use cases by assessing their transnational relevance across shared EU challenges, cross-border digital enablers, regulatory alignment, regional synergies, key industries, and SME-driven innovation. The results presented here will not remain static; instead, they will feed into subsequent deliverables — most notably D3.2.2, the *Transnational Use Case Strategy Report*, and the exploitation-oriented activities in D3.3, where the most promising models will be prepared for real-world application transnational wide.

One of the defining characteristics of Deliverable D3.2.1 is its **transnational orientation**. The development of use cases was not conducted in isolation within single regions or by individual institutions, but rather through **expert teams composed of participants from all partner countries**. These teams included representatives from SMEs, OEMs, tier-one suppliers, research and higher education institutions and business support organizations (BSOs). The inclusion of such diverse stakeholders was crucial to ensure that the results are both scientifically sound and practically relevant. Furthermore, this transnational approach ensured that regional differences and complementarities were considered, enabling the creation of use cases that are robust enough to function across borders and adaptable to different national contexts.

This collaborative process was essential given the complexity of the transformation: no single company or region can address electrification, automation, connectivity, or the platform economy alone. Working in transnational expert teams enabled the project to pool knowledge, compare experiences, and uncover synergies that a purely national or regional approach would miss.

To move from scenarios and challenges to potential solutions, the consortium applied the Design Thinking approach defined in the proposal. This user-oriented, iterative method integrates diverse perspectives and offers practical tools that help translate abstract discussions into structured outputs such as problem statements, value propositions, and business model prototypes.

However, the consortium faced real-world constraints, particularly regarding the availability of experts. The workshops were conducted during periods that overlapped with national holiday schedules, and stakeholders had to balance their participation with other professional obligations. In response, the Design Thinking process was deliberately **condensed and adapted**. Rather than extending over long periods, it was organized into **short, highly focused sessions**, supported by digital tools and careful preparation. This ensured that even under time pressure, the workshops remained productive, inclusive, and outcome-oriented. The adapted process unfolded in three interconnected steps:

- **Use Case Expert Workshop I: Problem Identification**

  Focused on identifying transformation challenges and opportunities across the four thematic areas. Participants developed structured problem statements using the *Problem Defining Canvas* and trend mapping techniques. The outcome was a portfolio of innovation gaps and problem fields.

- **Use Case Expert Workshop II: Development**

  Dedicated to transforming problem fields into preliminary use case ideas. Through the *Value Proposition Canvas* and the *Crazy 6* method for ideation, participants created structured concepts outlining potential products, services, and collaboration opportunities. Each thematic area developed at least three initial use case ideas.

- **Use Case Expert Workshop III: Evaluation**

  Aimed at refining and validating the developed use case ideas into more concrete use case models. Using evaluation frameworks and comparative discussions, participants assessed the use cases' transnational relevance across shared EU challenges, cross-border digital enablers, regulatory alignment, regional synergies, key industries, and SME-driven innovation.

This deliverable follows the methodological steps outlined above. Chapter 2 details the approach, timeline, preparation activities, tools, and challenges. Chapter 3 reports on trend research conducted during the Use Case Preparation phase. Chapter 4 presents the transformation problems identified in the first workshop, and Chapter 5 documents the preliminary use case ideas developed in the second. Chapter 6 summarizes the evaluation results from the third workshop, and Chapter 7 consolidates the most relevant use cases. Finally, Chapter 8 offers conclusions, situates the results within the wider project, and outlines next steps.

Overall, Deliverable D3.2.1 documents the full journey from problem identification to early solution concepts, demonstrating both the diversity of ideas generated and the ability of transnational expert teams to produce solid, actionable outcomes despite challenging conditions.

1.2 Overview of Activities

The development process within WP3 was guided by a clear conceptual framework distinguishing between three complementary levels: **Scenarios (A1.2)**, **Use Cases (A3.2)**, and **Best Practices (A3.3)**. This differentiation ensured consistency across activities and helped to structure the innovation process from contextual understanding to the identification of actionable solutions and validated examples:

1. **Scenarios (A1.2)** describe the overarching contextual framework and environmental conditions that shape future European mobility systems. They serve to define the macro-level assumptions, policy directions, and technological trends that influence the strategic orientation of the project. Through these scenarios, the consortium established a shared understanding of key transformation drivers and boundary conditions for future mobility in Central Europe
2. **Use Cases (A3.2)**, by contrast, represent concrete application ideas or solution concepts derived from the challenges and opportunities identified in the scenario work. They translate strategic insights into actionable, innovation-oriented concepts with a clear value proposition and a focus on cross-border collaboration. The use cases form the central output of WP3, demonstrating how regional strengths and expertise can be combined to address common European challenges
3. **Best Practices (A3.3)** refer to existing, validated approaches or models that have already been implemented successfully in specific contexts. These examples provide evidence of effective solutions, offer inspiration for replication, and support knowledge transfer across regions and sectors. By documenting such best practices, the project created a valuable reference base that complements the forward-looking nature of the use cases

Together, these three conceptual layers form a coherent methodological continuum:

- *Scenarios* define **what the future context might look like**,
- *Use Cases* explore **how innovation can take place within that context**, and
- *Best Practices* demonstrate **which approaches already work and can inform further development**.

To develop transnational use case ideas, the four thematic groups followed a structured co-creation process informed by preliminary desk research and three workshops per topic, conducted on the dates listed in Table 1. The combination of expert insights and interactive ideation helped refine key problem areas, align regional perspectives, and translate knowledge into shared solution directions. This process was supported by regular coordination meetings and guided by a strategic outlook toward 2035. More detailed information on the methodology and workshop activities can be found in *Deliverable D3.1.2*.

Table 1: Overview of D2T Expert Group Meetings on Use Case Development (Dates and Participants)

Meeting s Expert Groups	(Max.) Participants	(Main) Moderators	Use Case		
			Problem Identification	Development	Evaluation
Electrification	18	SEVA	10.09.2025	08.10.2025	12.11.2025
Automation	12	Biz-UP & KSSE	08.07.2025	29.09.2025	12.11.2025
Connectivity	12	NOI	26.09.2025	13.11.2025	13.11.2025
Platform Economy	13	PU	22.09.2025	20.10.2025	17.11.2025

2. Methodology

This chapter outlines the methodological approach applied throughout the use case development process. Section 2.1 presents the adapted Design Thinking Approach, detailing how its seven phases were tailored to the project's specific activities. Section 2.2 provides the activity timeline, while Section 2.3 describes the method training conducted to prepare and align the workshop moderators. Section 2.4 explains the workshop preparation process, structured around the three phases of Use Case Problem Identification, Use Case Development, and Use Case Evaluation. Additional information on digital tools, framework conditions, and expert-related challenges is documented in Deliverable D3.1.2.

2.1 Design Thinking Approach

Design Thinking is a human-centred innovation approach that combines creative problem-solving with structured, analytical methods. At its core, it encourages teams to explore problems from multiple angles, challenge assumptions, and iterate toward solutions that are both feasible and meaningful for users. The approach is commonly visualised through the Double Diamond, which separates the innovation journey into two key stages: the Problem Space, where challenges are explored, analysed, and clearly defined, and the Solution Space, where ideas are generated, tested, and gradually refined into implementable concepts. This cyclical, iterative process helps teams avoid premature conclusions and ensures that solutions are grounded in real needs rather than assumptions.

This methodology is particularly suited for the D2T project context. It enables cross-border collaboration by giving diverse experts—such as SMEs, cluster organisations, research institutions, and policy actors—a common language and set of tools for working together. By combining analytical evidence with creative exploration, Design Thinking helps uncover transnational innovation opportunities that might remain invisible in purely technical or regionally isolated processes. Moreover, its structured framework ensures that complex topics such as mobility transformation, digitalisation, and platform-based value creation can be translated into clear, comparable, and transferable outputs for all participating regions.

Within D2T, the Design Thinking framework was deliberately adapted into seven project-specific phases to support the collaborative development of use cases across the four thematic fields: Electrification, Connectivity, Automation, and Platform Economy. These phases provided a step-by-step structure—from initial preparation and capability building to the identification and analysis of core challenges, the creation and validation of solution concepts, and finally their refinement and documentation. This ensured a consistent methodological flow throughout the project while allowing enough flexibility for each expert group to address its own thematic priorities and knowledge base we used the following seven phases:

- **1. Kick-off**
- **2. Method Training**
- **3. Use Case Preparation**
- **4. Use Case Problem Identification**
- **5. Use Case Development**
- **6. Use Case Evaluation**
- **7. Refinement & Deliverable**

Each phase builds upon the previous one, creating a continuous flow The overall process is illustrated in **Figure 1** and the individual phases are described in detail below.

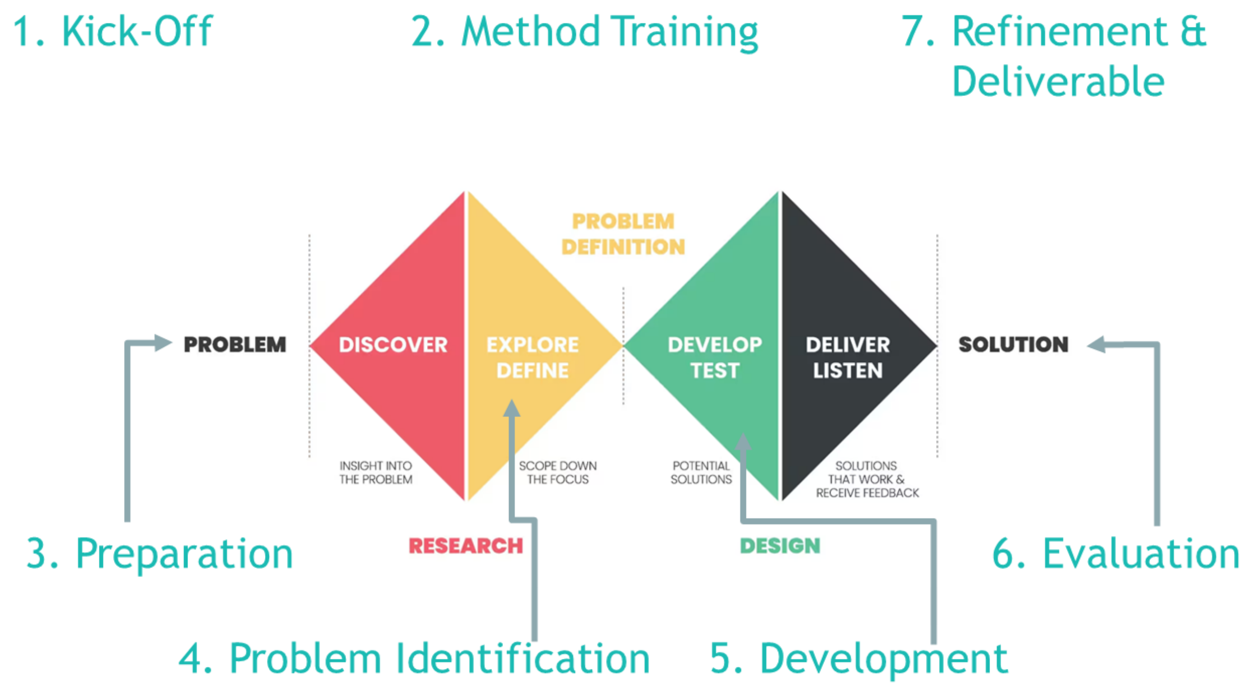

Figure 1: Adapted Design Thinking Process according to D2TExpert Groups for Use Case Development

2.1.1 Phase 1: Kick-off: Setting the Frame

Purpose: Phase 1, the Kick-off, sets the foundation for the entire project by ensuring that all partners and expert groups have a common understanding of the project's vision, objectives, roles, and the design thinking framework that will guide their work. This initial alignment is crucial for establishing a united approach among participants from different organizations or regions. Everyone gains clarity on what the project aims to achieve and how they will collaborate to reach those goals.

Methodological Logic: Methodologically, the Kick-off serves as a preparatory step that takes place *before* the first "Discover" stage of the Double Diamond design process begins. In the Double Diamond model (which consists of the stages Discover, Define, Develop, Deliver), this means Phase 1 happens even before formally exploring the problem space. The logic here is to align expectations and create a joint mental model for how the process will unfold. By discussing the overall approach at the outset, the team can ensure that when they do enter the Discover phase, everyone is on the same page regarding the methods and terminology to be used.

Key Activities: During the Kick-off, several key activities take place in a collaborative meeting or workshop setting. First, the facilitators present the overall D2T methodology, emphasizing that it will be an iterative and participatory process. This presentation highlights that the project will likely cycle through multiple rounds of brainstorming and refinement, and that active participation from all members is expected at each step. Next, the team clarifies the interdependencies between various project components, for example, explaining how the work done on Scenarios (Activity A1.2) feeds into the Use Case development (A3.2), and how both are informed by the collection of Best Practices (A3.3). By understanding these links, participants see the "big picture" of how different tasks support one another. Another important activity is introducing the digital tools and templates that will be used throughout the process. Tools like Microsoft Teams (for communication) and Miro (an online collaborative whiteboard for brainstorming and mapping ideas) are demonstrated so that everyone knows how to access and use them. Standard templates for things like personas or canvases might be shared at this point, ensuring a consistent format in future workshops. Finally, the group establishes clear communication routines and defines responsibilities. This includes identifying who will act as moderators or facilitators for sessions, who the key participants are in each activity, and setting up a schedule or cadence for regular check-ins. By assigning roles (such as a moderator for workshops, note-takers, etc.) and agreeing on how they will communicate (for example, weekly update meetings or a Teams channel for quick questions), the project gains a structured workflow from the very start.

Added Value: The Kick-off phase provides several important benefits. It creates transparency because every participant can see the overall plan and how their work fits into it. It builds trust by opening up lines of communication early and making sure that no partner is left in the dark about process or expectations. It also brings procedural clarity, in other words, everyone understands not only *what* they are expected to do, but also *how* the process will be carried out and *why* a design thinking approach is being used as the unifying methodology. Emphasizing why design thinking underpins the project helps participants appreciate the value of activities like empathy research or iterative prototyping, so they are more likely to embrace these methods wholeheartedly.

Result: By the end of Phase 1, the consortium has achieved a shared methodological foundation and a clear roadmap for the upcoming phases. All partners know their roles and responsibilities moving forward. In practical terms, this means the team has a common language and agreed-upon tools for collaboration. There is a collective understanding of the project's direction and the steps that will follow. This strong start lays the groundwork for smoother teamwork and sets the stage for the next phase, ensuring that subsequent efforts in research, ideation, and development are built on aligned expectations.

2.1.2 Phase 2: Method Training: Building Capability

Purpose: Phase 2 focuses on building the capabilities of all participating partners and especially those who will moderate or facilitate workshops. The purpose is to equip the entire team with a shared toolkit of methods and a common mindset for conducting design thinking-based workshops. In essence, this phase is about training everyone in the techniques and tools they will need to actively participate in or lead the upcoming collaborative sessions. By the end of this training, every partner should feel comfortable with the design thinking approach and confident in applying specific tools like canvases and maps in the project's context.

Methodological Logic: This phase aligns with the idea that a successful design thinking process requires all contributors to "speak the same language" in terms of methodology. It is not an official part of the Double Diamond stages, but rather a preparatory step to ensure methodological consistency and competence across the consortium. Here, the principles of design thinking – such as empathizing with end-users, embracing iteration (repeatedly refining ideas), and using prototyping to test concepts – are introduced and instilled in the team. Building this capacity early on means that when the actual workshops and creative sessions begin, each participant has the skills and understanding to contribute effectively. It prevents situations where only a few individuals know how to use the tools or frameworks while others feel lost; instead, everyone has a baseline proficiency.

Key Activities: The Method Training phase typically involves interactive training sessions or a workshop dedicated to learning and practice. Key activities include introducing core design thinking tools and techniques and then practicing them. For example, participants might be trained to use a Persona Canvas, which helps in characterizing and empathizing with target users by outlining their characteristics, needs, and pain points. They would also learn how to use the Value Proposition Canvas to align proposed solutions with user needs and values, and how to conduct Stakeholder Mapping to identify all the parties affected by or involved in a project scenario. Additionally, if the project uses specific Use Case Templates for documenting ideas, the training will cover how to fill these out effectively. The training doesn't stop at just introducing these tools – it also demonstrates how to move from problem exploration to solution ideation. For instance, the trainers might show how once you've mapped out a user persona and their challenges, you can brainstorm solution ideas and then capture those ideas in a value proposition canvas or a use case format. Digital collaboration platforms like Miro are used here to simulate real workshop conditions: participants might engage in a mock brainstorming session on Miro, learning how to post virtual sticky notes, cluster ideas, or sketch user journeys on the online whiteboard. There are also hands-on exercises where partners break into small groups and tackle short practice design challenges using the new tools. These exercises could involve a hypothetical problem to solve – for example, improving a customer experience for a service – where the group would interview each other as "users," define a problem statement, brainstorm ideas, and maybe even sketch a quick prototype concept. Throughout these training activities, there is an emphasis on facilitation techniques and moderation skills. This means that the people who will act as workshop moderators get guidance on how to guide discussions, encourage quieter team members to speak up, keep brainstorming sessions on track, and use time-boxing (allocating fixed time to tasks) effectively. They learn how to ask open-ended questions, how to deal with dominant voices in a discussion, and other practical moderation tips. Even participants who won't moderate gain insight into good workshop practices – like active listening and building on others' ideas – so that the overall collaboration culture improves.

Added Value: By investing time in methodological training, the project ensures that all partners share a common understanding and skill set when it comes to design thinking. This has huge added value for the coherence of the process. When everyone is trained, future workshops can be run more smoothly and efficiently because participants are already familiar with the processes (for example, they know what a "persona" is or how an ideation session operates). It levels the playing field – partners from different regions or backgrounds might have varying degrees of experience with design thinking, so training brings everyone to a comparable level of competence. This consistency leads to outputs that are easier to compare and combine because they were developed using the same approaches and vocabulary. It also likely improves the **quality of the outcomes**: when people know how to properly frame problems and think creatively within a structured method, the use case ideas they generate will be more robust and well-considered. Moreover, having a shared methodology fosters better collaboration – partners trust the process and each other's contributions more because they know everyone is following the same guiding principles.

Result: The result of Phase 2 is a trained and methodologically aligned consortium. In practical terms, the group now has a toolkit of design thinking methods at their disposal and the confidence to apply these tools in the upcoming phases of the project. Moderators are prepared to facilitate sessions effectively, and participants are ready to engage using the design thinking mindset. The team has essentially created the conditions for consistent and innovative collaboration. This means that as they move forward into research, ideation, and development of use cases, they will be able to work together smoothly, with less need to stop and explain basic concepts or tools. Everyone is prepared to dive into the content of the project (the actual challenges and solutions for SMEs and regional innovation ecosystems) using the design thinking techniques they've practiced.

2.1.3 Phase 3: Research & Preparation: Framing the Challenge

Purpose: Phase 3 is all about understanding the problem space in depth and framing the challenge that the project will address. The purpose here is to identify and define the relevant challenge areas and opportunity spaces by using evidence and research, including insights from previous project findings. In simpler terms, this phase is where the team asks, "What problem are we trying to solve, and what do we need to know about it first?" By the end of this phase, the goal is to have a well-defined problem or set of problems that are backed up by data and insights, rather than assumptions. This ensures that subsequent brainstorming and solution design efforts are tackling the *right* problems – those that are truly important to the stakeholders (like SMEs, in this case) and grounded in reality.

Methodological Logic: Research & Preparation corresponds to the "Discover" stage of the Double Diamond model of design thinking. In the Discover stage, the aim is to cast a wide net to gather information and understanding about the context, users, and issues at hand. The methodological logic here is to explore the problem space *comprehensively* before jumping to solutions. That means understanding current barriers in the system, the needs and pain points of stakeholders (for example, what small and medium-sized enterprises are struggling with), and the broader systemic dynamics (like market trends or technological changes affecting the industry). By doing thorough discovery, the team ensures that they are not relying on guesswork. It's a shift from any initial assumptions the team might have, towards evidence-based understanding. Essentially, Phase 3 is about learning and exploration: looking at data, conducting research, and maybe even preliminary stakeholder interviews or surveys to ground the project in facts and real experiences.

Key Activities: Several important activities take place in Phase 3 to achieve a well-framed challenge. One of the first tasks is a review of previous analytical deliverables from earlier in the project. For instance, the team will revisit the findings from deliverables or tasks like A1.1, A1.2, and A3.1 (which likely contain earlier research, scenario results, or assessments done in the project). These documents might include analyses of the current state of SME digital transformation, baseline studies, or initial scenario reports. By reviewing them, the team can extract key insights that have already been gathered so they don't reinvent the wheel. Next, the team conducts additional desk research on relevant external sources. This could involve studying European Union policy frameworks that relate to the project's domain (perhaps policies on digital innovation, SME support, regional development, etc.), examining current technological trends (for example, new technologies impacting SMEs or certain industries), and looking at user behavior or market trends that could influence the success of future solutions. The idea is to gather as much contextual and background information as possible. With both the internal (project deliverables) and external (desk research) knowledge in hand, the team then works on identifying pain points, gaps, and opportunities that are particularly relevant to the SMEs and innovation ecosystems targeted by the project. This might involve pinpointing where SMEs struggle in the current environment – e.g., difficulty in adopting new technologies due to lack of skills or funding, or gaps in support networks for innovation. It also means looking for opportunity spaces: areas where an intervention or new solution could make a big difference, perhaps because no one has addressed that need yet or because conditions (like new technology or policy changes) make it timely to tackle now. As these pain points and opportunities are identified, the team transforms these insights into structured visual formats – for example, creating "Problem Boards" or other canvases that summarize the findings. A Problem Board could be a Miro board or a flipchart where they organize information under headings such as "User Needs", "Barriers", "Current Solutions (or lack thereof)", and "Opportunities". The structured visual canvases might also be thematic, focusing on one challenge area per board. These boards serve as a discussion tool in workshops: they visually lay out what the research has uncovered, making it easier for participants to understand and refer to key points during ideation. Essentially, by the end of Phase 3, the team prepares materials that clearly communicate the research findings and frame the core challenges to address. This could be presented in a workshop or meeting where everyone gets aligned on what problems will be the focus moving forward.

Added Value: The Research & Preparation phase adds tremendous value because it shifts the focus from assumptions to evidence. Instead of going with the loudest opinion or an educated guess about what SMEs might need, the team now has validated data and research to support their focus. This evidence-based approach often uncovers issues that might not have been obvious at first and can sometimes debunk preconceived notions. Moreover, doing this groundwork means that when the creative brainstorming sessions start, participants won't waste time debating basic facts or the nature of the problem – that groundwork has been laid, and they can trust that they're starting from a solid foundation. The phase also ensures that all participants begin ideation with a common knowledge base. This is important in a consortium that might include partners from different regions or sectors; everyone might have had different perspectives on the problem initially, but after Phase 3's thorough research and the creation of the Problem Boards, they all share a unified understanding of the current situation and the needs to be addressed. In short, Phase 3 increases the relevance and focus of the later phases – any solutions devised will be more on-target because they respond to well-defined and researched problems.

Result: By the end of Phase 3, the project has a clearly framed problem space supported by research. Practically, this means the team has a set of documented insights (e.g., a summary report or a set of visual boards) that define the challenge in detail. They likely have specific problem statements or thematic areas that will guide the next phase. For example, a result might be something like: "SMEs in our regions are struggling with accessing advanced manufacturing technologies due to a lack of skilled personnel and high costs." That statement (backed by data and examples from research) would then set the stage for ideating solutions in Phase 4. With the problem space well-defined, the team is ready to guide the ideation of use cases – they have the map of what needs to be solved, so they can confidently embark on brainstorming potential solutions or use cases that address those needs.

2.1.4 Phase 4: Use Case Identification: Exploring and Defining Problems

Purpose: Phase 4 marks the transition from pure research into the beginning of solution design. The purpose of this phase is to collaboratively explore the identified challenge areas and start converting them into initial use case ideas that respond to real needs uncovered in the previous phase. Essentially, now that the team knows *what* the key problems are, Phase 4 is about discussing *how* these problems might be addressed, in the form of use cases. A "use case" here refers to a concept for a solution or an application scenario that could potentially be implemented to help SMEs or other stakeholders. The idea is to not jump straight into detailed solutions, but rather to define the problem more concretely and outline solution ideas at a high level. By the end of this phase, the team should have a collection of promising use case concepts, each linked to the challenges identified earlier.

Methodological Logic: Phase 4 acts as a bridge between the "Discover" and "Define" stages of design thinking. In the Double Diamond framework, this is the point where the process goes from *divergent thinking* (generating a broad set of ideas or exploring many possibilities) to *convergent thinking* (narrowing down and defining the core problems or opportunities to pursue). At the start of Phase 4, the approach is divergent: the team opens up the discussion to explore all facets of the problem area and all sorts of potential solution ideas without immediately filtering or judging them. As the phase progresses, it becomes more convergent: through discussion and prioritization, the group defines which problem-solution avenues are most worth pursuing (particularly those with high transnational potential, meaning they are relevant across multiple regions or can benefit from cross-country collaboration). The methodological logic is to first ensure a broad exploration – so that no innovative idea or critical aspect of a problem is overlooked – and then to distill from that creative chaos a set of clearly defined use case ideas. This way, the team can move forward with concepts that are both imaginative and strategically chosen.

Key Activities: Phase 4 is usually very interactive and creative, often realized through expert workshops that involve co-creation exercises. One of the key activities is bringing together experts and stakeholders (perhaps project partners, SMEs, industry experts, etc.) in workshops to deeply explore the problem areas identified in Phase 3. Using the "Problem Boards" or research findings as a starting point, participants discuss their perspectives, share experiences from their regions, and ensure that the understanding of each problem is well-rounded. Co-creation methods might include brainstorming sessions where participants freely suggest solution ideas or "how might we..." questions to frame challenges in an open-ended way. As ideas flow, the group will generate many possible ways to address the needs of SMEs or fill the gaps identified. After a wealth of ideas and potential directions are on the table, the next key activity is group discussion to prioritize which challenges and ideas have the most merit and transnational relevance. This might involve voting or ranking exercises – for example, giving participants dot stickers to mark the ideas they find most promising, or a structured conversation where each person advocates for the idea they think should be taken forward. The criteria for prioritization often include factors like: impact (will this idea significantly help SMEs or solve the problem?), feasibility (is it realistic to implement, given resources and time?), and transnational value (does this idea benefit multiple regions or could it be stronger by involving partners from different countries?). Through this, the group might narrow down from, say, twenty broad ideas to a handful of top candidates that everyone agrees are worth fleshing out. Once the priority areas or ideas are chosen, the team begins the creation of early use case drafts. These drafts are structured outlines that describe the potential use case in terms of who it's for, what need it addresses, and how it might work. Often they include elements like: the target users or persona (for example, "a small manufacturing business owner in Central Europe"), the specific needs or pain points of that user that the use case will focus on (e.g., "needing affordable access to digital training"), and the envisioned solution's gains or benefits (e.g., "a platform that provides subsidized e-learning for manufacturing SMEs, improving their skill sets"). The team might utilize visual frameworks to help structure these drafts. For instance, they could use Persona Maps to ground the use case in a real-world character, ensuring empathy for the end-user. They could craft clear Problem Statements (sometimes using a template like "<User> needs a way to <need> because <insight>" to articulate the core problem from the user's perspective). They might also return to the Value Proposition Canvas to outline how the proposed concept will create value and tackle pain points, ensuring the idea has a sound value proposition. Throughout this process, tools like the persona profiles and canvases guide the teams to cover all important aspects of a use case: who it's for, what it does, and why it's valuable. By the end of these activities, each prioritized idea from the brainstorming is captured as a more concrete *use case concept*. These are not yet fully detailed solutions, but they are well-defined ideas with enough detail to understand their essence and to evaluate them in the next phase.

Added Value: The Use Case Identification phase adds value in a couple of significant ways. Firstly, it transforms broad and abstract challenges into tangible, discussable concepts. Instead of talking in general terms about "improving innovation for SMEs," the team now has specific scenarios or ideas – like "an SME digital skills training platform" or "a cross-border innovation voucher scheme" (hypothetical examples) – that can be debated, refined, or combined. This makes the next steps much more concrete and manageable. Secondly, this phase is where alignment happens among experts from different regions around shared opportunities. Because the workshops involve input from diverse partners, the resulting use case ideas aren't just one partner's wish list; they represent common ground and synergy between regions. This is crucial in a transnational project – it ensures that the concepts have relevance in multiple contexts and that partners feel a joint ownership of the ideas. It effectively bridges local insights with a European or transnational perspective, meaning the ideas carry weight in each region and also benefit from being part of a larger network or platform of solutions. In summary, Phase 4's value lies in narrowing the focus to the best ideas and ensuring those ideas are well-articulated and commonly supported.

Result: By the conclusion of Phase 4, the project has a set of clearly articulated use case ideas that form the conceptual basis for the next phase (Use Case Development). Typically, the team might have a shortlist – for example, maybe three to five use case concepts – each documented in a preliminary way (with a title, target users, the need being addressed, a brief description of the solution concept, and perhaps notes on feasibility or impact). These are ready to be further developed in Phase 5. The result is significant because it represents the first concrete outputs of the design thinking process: the creative leap from "we understand the problems" to "here are some ideas for solutions we could pursue." Everyone in the consortium can see these ideas and has a hand in shaping them, which sets the stage for collaborative development and deeper exploration of how to implement these ideas in the next phase.

2.1.5 Phase 5: Use Case Development: Co-Creating Solutions

Purpose: Phase 5 is dedicated to taking the initial use case ideas identified in the previous phase and developing them into mature, actionable concepts. The purpose here is to elaborate on each chosen use case in detail – to flesh out how it would work, what it would require, who would be involved, and why it would be valuable. This is the creative *development* part of the process, where ideas get prototyped on paper (or digitally) and refined collaboratively. By the end of Phase 5, each use case concept should be well-structured and ready for evaluation – almost like a draft blueprint of a solution that could be implemented in the real world or a pilot project.

Methodological Logic: This phase corresponds to the "Develop" stage of the Double Diamond, where the focus shifts from understanding the problem (which was covered in Discover and Define) to exploring solutions. In the Develop stage, teams work on creating prototypes or detailed concepts, often iterating on them multiple times. The methodological logic is grounded in creative experimentation and co-design. That means the team doesn't simply write down a plan in one go; rather, they brainstorm the components of the solution, discuss feasibility, perhaps create some mock-ups or flowcharts of how the solution might function, and continuously refine the idea through feedback and testing with one another. This iterative development ensures that issues are spotted early and improvements are made before anything is finalized. It is a space for creativity (coming up with innovative features or approaches within the use case) combined with structure (using frameworks to cover all necessary aspects of the concept). Co-creation remains key: multiple stakeholders or experts contribute to each concept, which enriches the solutions and ensures they are well-rounded.

Key Activities: In Phase 5, the team typically breaks out into working groups (often each group focusing on one use case concept) and uses a variety of design and business development tools to build out the details of each idea. One of the central activities is holding group work sessions (often on Miro or similar collaborative platforms) using structured frameworks to guide the concept development. For example, the Business Model Canvas (BMC) might be used for each use case. This canvas helps the team map out how the proposed solution could create, deliver, and capture value by prompting them to think about key partners, key activities, resources needed, the value proposition for the customer, potential customer segments, cost structure, and revenue streams (if applicable). Filling out a BMC for a use case ensures that the concept isn't just desirable for users, but also viable and feasible in a real-world context. Another framework that could be used is Impact Pathways (a tool often used to plan how an intervention leads to certain outcomes and impacts). With an Impact Pathways approach, the team would outline the chain of events or conditions needed for the use case to achieve its intended impact on SMEs or the ecosystem. For example, if the use case is a training platform, the impact pathway might link activities (delivering training content) to outputs (number of SMEs trained), to outcomes (SMEs applying new skills, improved productivity), to ultimate impact (more competitive regional industries). Alongside these frameworks, the team will explicitly identify all the practical elements of making the use case work: who are the actors involved (e.g., SMEs as end-users, regional agencies as facilitators, tech providers as partners, etc.), what resources are required (funding, technology infrastructure, human expertise), what data might be needed or produced (for instance, does the solution require data sharing or collecting user data?), and what enabling conditions must exist (such as certain regulations in place, or a minimum number of users for network effects, etc.). This thorough analysis can reveal any hidden challenges or requirements for the idea early on. Another key activity during development is the validation of assumptions. When the group drafted the use case, they likely made some assumptions about user behavior, technical feasibility, or market acceptance. In Phase 5, the team tests these assumptions through discussion or simple internal tests. For instance, if a use case assumes that SMEs would be willing to share data on a common platform, the team might validate this by referencing research or even doing a quick consultation with an SME representative to see if that holds true. Internal testing could also involve lightweight prototyping – perhaps creating a mock interface or a storyboard of the user experience and getting feedback from colleagues or a small subset of users. Based on the insights gained from these validation steps, the use case concept is iteratively refined. Iteration might mean altering parts of the concept that proved unrealistic, simplifying features to make the idea more feasible, or adding elements to increase its value. The team might cycle through a few mini-iterations: discuss → sketch out changes on the canvas → review against criteria like feasibility, scalability, and transnational impact → adjust again. Through this creative refining loop, the use case becomes more solid. Importantly, throughout development, there's attention to feasibility (can we actually do this, given constraints?), scalability (could this solution grow or be replicated in multiple regions or countries?), and transnational impact (does this solution benefit from being developed cooperatively across borders, and will it have positive effects in multiple countries?). These considerations help the team tailor the use case to be not just an interesting idea, but a practical and high-impact one.

Added Value: The Use Case Development phase is where the project really adds meat to the bones of its ideas, combining creativity with structure. The value of this phase lies in how it transforms what could be a fuzzy idea into a concrete plan. By using structured frameworks like the Business Model Canvas, the team ensures that each concept is evidence-based and thought-through from multiple angles – including user desirability, technical and economic viability, and operational feasibility. This structured creativity means that the use cases are no longer just innovative; they are grounded in reality and come with a logic of how they would create value. This drastically increases the chances that these concepts could later be implemented successfully. Another benefit is that during this phase, participants collaborate closely and align on details. This deepens the shared understanding and commitment to each use case. People see how their different perspectives (business, technical, user-centric, policy, etc.) come together to shape the solution. It often leads to the discovery of even more synergies between partners – for instance, one region might volunteer data or a pilot location, while another offers a software tool – enhancing the concept's strength. Overall, Phase 5 ensures that when the project moves to presenting or evaluating these use cases, they are well-crafted, realistic, and compelling, with a clear storyline of how they could work and why they matter.

Result: By the end of Phase 5, the team has a set of fully developed use case concepts. "Fully developed" here means that for each concept, there is a detailed description or documentation covering its purpose, how it functions, who is involved, and what is required to implement it. The use cases have clear structures – one could almost take the documentation and use it as a basis for writing a project proposal or implementation plan for that concept. Each use case will also have a clearly articulated value proposition (why it's needed and how it helps) and may include elements of a business model or sustainability plan if relevant. Essentially, the ideas from Phase 4 have matured into concrete solution outlines. These are ready to be evaluated, compared, and refined further in the next phase. The consortium, at this point, has a tangible portfolio of proposed innovations or interventions they could undertake, each one born from collaborative design thinking and ready for critical review.

2.1.6 Phase 6: Use Case Evaluation: Deepen Understanding of Ideas

Purpose: Phase 6 is about stepping back and critically evaluating the developed use cases, then refining them to ensure they are as strong and aligned as possible. The purpose is twofold: first, to validate each use case concept – essentially checking which ones stand up to scrutiny in terms of feasibility, innovation, stakeholder value, etc. – and second, to harmonize the set of use cases as a whole by comparing them and aligning them with the project's strategic objectives. By the end of this phase, the goal is to have a polished and coherent portfolio of use cases that have been vetted and improved through feedback.

Methodological Logic: This phase corresponds to the "Deliver" stage of the Double Diamond, where the focus is on testing, getting feedback, and making final improvements. In design thinking terms, it's a phase of validation and iterative improvement. The methodology behind Phase 6 is to prevent the project from running with ideas that are unfeasible or misaligned. Instead of going straight from development to final documentation, the team takes a critical look (and possibly seeks external input or fresh eyes) to ensure each concept is solid. This often involves both divergent and convergent thinking again: divergent in the sense of opening up discussion for honest feedback, and convergent in synthesizing that feedback into concrete changes. Additionally, by comparing use cases with each other, the team ensures there's no unnecessary overlap and that they complement each other well. Essentially, Phase 6 is about quality control and strategic alignment – making sure what they will deliver has been tested for soundness and fits together as a unified set.

Key Activities: The first key activity in Phase 6 is a structured evaluation of each use case. The consortium establishes jointly defined criteria for what makes a "good" use case in their context. Typical criteria might include: feasibility (can this be implemented with available resources and technology, or are there major roadblocks?), degree of innovation (does this represent a new or creative approach that adds value beyond existing solutions?), involvement of SMEs (does the concept effectively engage small and medium enterprises, and is it user-centered for them?), and transnational value (does doing this collaboratively across countries yield benefits, or could it just as well be done by one region alone?). There could be additional criteria too, such as sustainability, cost-effectiveness, or alignment with EU priorities, depending on the project goals. Each use case concept is then examined against these criteria. This could take the form of a scoring workshop or a SWOT analysis (analyzing strengths, weaknesses, opportunities, threats for each concept). Experts and partners might discuss questions like: "Is this technically doable within our timeframe?" "Is this idea truly novel or is someone already doing it?" "Will SMEs find this idea attractive and easy to adopt?" "How will multiple regions work together on this, and does that collaboration bring something extra?" Through such discussions, the team identifies which use cases are strongest and which ones might have weaknesses. The next activity is a comparative analysis across all the use cases. Rather than looking at each concept in isolation, the group now looks at the portfolio as a whole. In doing so, they check for overlaps or redundant ideas – for instance, two use cases might be very similar or address the same user need, in which case it might make sense to merge them or drop one. They also look for synergies – opportunities where two use cases could actually connect or support each other to create a bigger impact. For example, if one use case is about a training platform and another is about a network for SME collaboration, perhaps they could be linked or jointly implemented. The comparative view helps ensure that the final set of use cases is well-rounded and not repetitive. Following evaluation and comparison, the team works on integrating feedback and refining the use cases. This means any weaknesses found are addressed if possible. If a use case scored low on feasibility, maybe the concept is adjusted to be more realistic (like scaling down the scope or finding a different technical approach). If innovation was lacking, perhaps the team brainstorms an additional feature or differentiator to make it more unique. If SME involvement was unclear, they clarify how SMEs participate or benefit at each step. This refinement is done through discussion and perhaps another mini-iteration of the canvas or documentation for each use case. In some cases, integration of feedback might also come from outside the core team – for instance, the project might present the developed use cases to an advisory board or a small group of stakeholders for comments, and then incorporate that external feedback. Another important activity is the simplification and consolidation of concepts when necessary. If two concepts overlap, the team may consolidate them into one coherent "transformation pathway" (meaning a broader concept that covers both ideas). Simplification might also mean stripping away extraneous elements of a concept that seemed nice-to-have but aren't core to its success, to make the use case more focused and clearer. By the end of this rigorous evaluation and refinement, each use case should be sharpened – any unclear parts clarified, any weak aspects bolstered or noted, and all aligned to avoid conflict or duplication with each other.

Added Value: The Evaluation & Refinement phase greatly enhances the quality of the project's outputs. Its added value lies in catching potential issues or shortcomings *before* the final deliverable is locked down. By evaluating each concept, the team can confidently stand behind the use cases that move forward, knowing they've been vetted. This phase also ensures alignment with strategic objectives – meaning the final use cases are not just individually good ideas, but also collectively support the overarching goals of the project (for example, ensuring regional SME growth, fostering innovation, etc.). The comparative analysis part ensures the portfolio of use cases is coherent and consistent. Stakeholders or decision-makers who later read the final deliverable will see a set of initiatives that make sense together, rather than a random collection of ideas. The harmonization process might also improve transnational collaboration: when overlaps are identified and resolved, partners avoid duplicated effort; when synergies are found, partners can plan to join forces on those areas. Furthermore, this phase often increases buy-in from the consortium and external stakeholders – because the use cases have been transparently evaluated, everyone can trust that these concepts aren't just pet projects of one partner, but truly the best collective choices. In summary, Phase 6 turns a bunch of draft concepts into a polished, validated portfolio of solutions, thereby increasing the credibility and impact of the project's outcomes.

Result: The result of Phase 6 is a consolidated and validated set of use cases that are ready for final documentation and later dissemination. "Consolidated" means the use case list has been cleaned up – any overlaps have been merged, any weaker ideas have been dropped or improved, leading to a refined list (for example, the top three or four robust use cases that the project will present). “Validated” means each of these has essentially passed a quality check; the team has evidence or rationale for why each concept is feasible, innovative, and valuable. At this stage, the use cases likely have final titles and summaries that clearly communicate their essence, and possibly an outline of an implementation plan. The consortium members are all in agreement that these are the use cases they want to put forward. This set is now ready to be written up formally in the deliverable and to be shared with stakeholders, funders, or any audience interested in the project’s solutions. In short, by the end of Phase 6, the project knows exactly what it’s delivering: a well-vetted package of transnational use case concepts that address the challenges identified at the start.

2.1.7 Phase 7: Refinement & Deliverable: Documenting and Transferring Results

Purpose: Phase 7 is the final phase of the process, focused on synthesizing, structuring, and documenting all the outputs from the earlier phases. The purpose is to take everything the team has developed – the use case concepts, the findings, the methodologies – and compile them into a clear, standardized, and shareable format. In the context of the project, this means preparing the official deliverable (referred to as D3.2.1) that will report the results of the design thinking process. Additionally, this phase aims to ensure that the knowledge gained during the process is captured in a way that it can be transferred or communicated to others (for example, other regions, stakeholders, or future projects). It’s not just about writing a report; it’s about packaging the results so they can be understood and used beyond the immediate team that developed them.

Methodological Logic: This final phase can be seen as a post-iteration and reflection stage following the Double Diamond’s implementation. After Deliver (where concepts are finalized), it’s important to consolidate learnings and formalize them. The methodological logic is to prevent any loss of information or insights – often during creative processes, there are many discussions and ideas that don’t all make it into the final concepts, but still could be valuable for future reference or learning. By thoroughly documenting, the team ensures that the knowledge is not just in people’s heads, but recorded in a structured way. It also enforces a consistency check: as the deliverable is compiled, everything is cross-checked for coherence, which might highlight any last small inconsistencies to fix. Moreover, since the deliverable will be read by others who were not in the workshops, it needs to be self-explanatory and standardized, which this phase ensures. Essentially, Phase 7 is about closing the loop: taking an iterative, and sometimes messy, creative process and solidifying its outcomes into a polished product and a set of lessons learned.

Key Activities: The Deliverable Preparation phase involves a good deal of writing, reviewing, and editing work. One of the first activities is compiling all the use case descriptions and materials produced in previous phases. This means gathering the detailed concept documents, any visuals (like canvases or diagrams) that were created, and summaries of the research, etc., and bringing them into one place. The team will then perform an editorial refinement of these descriptions. Editorial refinement includes making sure each use case description is clear, concise, and well-articulated. It might involve rewriting technical jargon into plainer language for broader audiences or fleshing out sections that are too sparse. If multiple people wrote different sections, the editorial process will adjust the tone and style so that the whole deliverable reads consistently (sounding like one unified report rather than a patchwork of different authors). Another key activity is a cross-check of terminology, visual templates, and structure across the document. Since the project had many parts (scenarios, use cases, best practices, etc.), it’s important that the final document uses terms in a consistent way. For example, if one section refers to “SMEs” and another says “small businesses,” they might standardize on one term throughout. Or ensuring that if an acronym was introduced (like D2T or names of tools), it’s spelled out the first time and used correctly thereafter. Visual templates (like how each use case is presented) should also be uniform: if a certain table or canvas format is used for the first use case, the same layout should be applied to the others for easy comparison. The structure of the document is also finalized – typically, an official deliverable has a predefined format or sections, so the team maps their content into that: e.g., an introduction, methodology section, results section (where each use case is described), and perhaps a conclusion or recommendations. The team integrates all the key findings and outputs into this structure, essentially turning the collective work into the official deliverable D3.2.1. This might involve writing an introduction that explains the design thinking approach used, summarizing the phases (perhaps much like we've done here), and then presenting the use cases as the core results. They might also include case studies or examples from workshops, quotes from participants, or other elements to enrich the document. After documenting the results, the team engages in reflection on methodological learnings and process improvements. This could be an internal debrief meeting or simply a section in the deliverable that talks about "lessons learned" from using this design thinking methodology in a transnational context. They would consider questions like: What worked well in our process? What challenges did we face (for example, coordinating across countries, using Miro, etc.)? How could we improve such a process in the future? Capturing these reflections is valuable for the consortium and also for others who might read the deliverable and try to implement a similar approach. Including these insights in the documentation turns the deliverable into not just a report of results, but also a guide or resource for methodology. Finally, there's often a review and sign-off step where the compiled deliverable is checked by project leaders or an editorial team to make sure everything is in order and meets any funding program requirements before submission.

Added Value: This final phase ensures that all the hard work done throughout the project is converted into tangible, shareable results. The added value here is that the outcomes of the design thinking process don't just live within the project team's minds or dispersed in workshop notes, but are assembled into a coherent form that can inform others. Because the document is standardized and polished, it's much easier for someone outside the project (say, a policymaker or a stakeholder in another region) to understand what was achieved and to potentially replicate or build upon it. Essentially, Phase 7 maximizes the transferability of the project's results. Another benefit is that the act of documenting and reflecting often crystallizes insights that might otherwise be lost. Team members might realize, as they write, the broader significance of a particular use case or an observation about how transnational design thinking works best, and these insights get recorded. Moreover, by focusing on consistency and comparability in the document, the phase ensures that if multiple thematic areas or regional contexts were addressed, the results can be easily compared side by side. For example, if one use case came from the manufacturing sector and another from the tourism sector (hypothetically), presenting them with the same template allows readers to see parallels and differences clearly. Overall, this phase adds value by turning the process into a product – a deliverable that not only meets the project's obligations but also serves as a learning tool for a wider audience.

Result: At the end of Phase 7, the project has a coherent documented deliverable (D3.2.1) that represents the collective results of the entire design thinking process. This deliverable likely includes an overview of the methodology, the research insights, detailed descriptions of each final use case (with all their components, diagrams, etc.), and any recommendations or conclusions. It is formatted according to whatever standards are required (for instance, including an executive summary, tables of contents, references to project activities like A3.2, etc.). As a result of this phase, the consortium has distilled all their knowledge into a form that can be disseminated – meaning they can share these findings with the European Commission, project stakeholders, and even publicly if appropriate, confident that the document accurately and clearly conveys the work done. In summary, Phase 7 produces the final output that not only fulfills the project requirements but also transfers the knowledge gained to all relevant audiences, thereby amplifying the impact of the project beyond the immediate team that worked on it.

2.2 Activity Timeline

The implementation of activities A3.2 followed a structured and methodologically coherent sequence of seven phases, as illustrated in **Table 2**. Each phase built upon the previous one, ensuring a continuous process from conceptual preparation to finalization of the deliverable. This approach enabled a transparent, iterative, and well-coordinated workflow among all project partners and expert groups.

- **Phase 1: Kick-off (June 2025)**

  The work package started with a joint Kick-off phase aimed at aligning all partners on objectives, scope, and methodology. A detailed schedule was established, milestones were confirmed, and roles were clarified among consortium members. The Kick-off Workshop served as a platform to introduce the structure of the forthcoming activities, including the upcoming expert workshops and methodological tools. Preparatory materials, such as the Kick-off presentation and workshop agenda, were developed collaboratively to ensure a shared understanding of the overall process.

- **Phase 2: Method Training (June - October 2025)**

  To prepare partners and moderators for the co-creation process, a series of 3 online training sessions were organized. These sessions introduced the methodological framework, digital tools, and templates that would later be applied in the expert workshops. The subsequent Method Training Workshops reinforced a common methodological foundation across the four thematic areas — Electrification, Connectivity, Automation, and Platform Economy — ensuring consistency and comparability of results.

- **Phase 3: Use Case Preparation (July - August 2025)**

  In the preparation phase, partners conducted a review of Deliverables A1.1 and A1.2 to extract relevant findings from previous analytical work. This was complemented by targeted research and thematic deep dives to identify emerging technological and market trends, stakeholder needs, and regional priorities. The collected insights helped define the strategic focus for the upcoming expert workshops, ensuring that the discussions would build on evidence and real-world challenges.

- **Phase 4: Use Case Problem Definition (July - September 2025)**

  The first series of expert workshops focused on identifying and defining problem areas with the highest potential for transnational cooperation. These sessions combined structured ideation methods with open discussion formats, allowing experts to validate and prioritise key challenges. Workshops were held as follows:

  - Automation: 8 July 2025 (hosted by NOI)
  - Electrification: 10 September 2025 (hosted by SEVA)
  - Platform Economy: 22 September 2025 (hosted by PU)
  - Connectivity: 26 September 2025 (hosted by Biz-UP & KSSE)

  The outputs of this phase included clearly formulated problem statements, aligned with both Expert knowledge and European mobility objectives.

- **Phase 5: Use Case Development (September - October 2025)**

  Building on the problem statements, the second series of workshops focused on the collaborative development of concrete use case concepts. Moderated sessions enabled partners and experts to co-create ideas, define value propositions, and explore cross-border implementation pathways. Workshops took place on the following dates:

  - Automation: 29 September 2025
  - Electrification: 8 October 2025
  - Platform Economy: 20 October 2025
  - Connectivity: 13 November 2025

  This phase resulted in a portfolio of structured use case concepts, supported by detailed descriptions of objectives, actors, and potential impacts.

- **Phase 6: Use Case Evaluation (October - November 2025)**

  The third and final workshop round centred on the evaluation and validation of developed use cases. Using jointly defined criteria — including feasibility, innovation potential, and transnational relevance — experts provided feedback and prioritised the most promising concepts. Evaluation workshops were conducted as follows:

  - Automation: 12 November 2025
  - Electrification: 12 November 2025
  - Connectivity: 13 November 2025
  - Platform Economy: 17 November 2025

  The evaluation results formed the basis for harmonised transformation pathways and served as input for the final deliverable.

- **Phase 7: Refinement and Deliverable Preparation (November 2025)**

  The final phase focused on consolidating results and preparing the official documentation. A joint review session was held during the project meeting in Bolzano, where partners refined the outcomes, verified consistency across thematic areas, and aligned the final report content. This collaborative process concluded with the completion and submission of Deliverable D3.2.1, summarizing the results of all workshops and expert interactions.

Across all phases, the structured and iterative process enabled the consortium to collaboratively define, develop, and validate transnational use case ideas. Continuous coordination, expert involvement, and methodological alignment ensured that the outputs reflect both the shared European vision and the regional strengths of the participating partners.

Table 2: Timeline of A3.2 including Workshop Activities (June – November 2025)

		June					July				August				September					October				Novemver		
	CW23	CW24	CW25	CW26	CW27	CW28	CW29	CW30	CW31	CW32	CW33	CW34	CW35	CW36	CW37	CW38	CW39	CW40	CW41	CW42	CW43	CW44	CW45	CW46	CW47	CW48
Phase 1 – Kick-off																										
Organisation: Scheduling and definition of objectives																										
Preparation: Kick-off presentation and materials																										
Execution: Kick-off Workshop																										
Phase 2 – Method Training																										
Preparation: Online training sessions on methods and tools																										
Execution: Method Training Workshops																										
Phase 3 – Use Case Preparation																										
Review: Analysis of Deliverables A1.1 and A1.2																										
Research: Thematic deep dives on priority topics																										
Phase 4 – Use Case Problem Definition																										
Preparation: Online Ideation Session																										
Execution: Use Case Ideation Workshop																										
Phase 5 – Use Case Development																										
Preparation: Online Co-creation Session																										
Execution: Use Case Development Workshop																										
Phase 6 – Use Case Evaluation																										
Preparation: Online Evaluation Session																										
Execution: Use Case Evaluation Workshop																										
Phase 7 – Refinement & Deliverable Preparation																										
Refinement: Joint review during Bolzano Project Meeting																										
Finalisation: Compilation of Deliverable D3.2.1		PU	All																							

2.3 Method Training

The Method Training phase represented a key preparatory step in the D2T Use Case Development Process. Given the project's ambitious objectives and the methodological complexity of applying the Design Thinking approach across multiple countries, ensuring a common understanding of tools, procedures, and roles was critical to the success of *Activity A3.2*. A well-prepared and consistently trained team of moderators formed the foundation for the subsequent expert workshops and for achieving the methodological continuity required for later stages, including *A3.3 – Transnational Exploitation Plans*.

The D2T consortium brings together partners with diverse cultural, linguistic, and professional backgrounds. This diversity is one of the project's strengths, fostering cross-sectoral and cross-regional perspectives — yet it also adds a layer of complexity when applying a unified methodological framework. To ensure a consistent and effective facilitation of workshops, it was essential to prepare all moderators thoroughly and align their understanding of both the *Design Thinking process* and the *digital collaboration tools* to be used (in particular, Miro).

The training aimed to provide moderators with:

- A clear understanding of the **objectives and structure** of each workshop phase
- The ability to apply and explain **Design Thinking tools and templates**
- The confidence to guide mixed expert groups towards actionable results within limited timeframes

The method training sessions were designed and conducted by PU (Lead Activity A3.3), in close coordination with the WP 3 Lead. Four moderators—each responsible for one of the thematic expert groups (*Electrification, Connectivity, Automation, Platform Economy*)—participated in a series of three comprehensive training sessions, each corresponding to one of the workshops introduced in Section 2.4:

- **Use Case Problem Identification** – *26 June 2025*
- **Use Case Development** – *24 September 2025*
- **Use Case Evaluation** – *29 October 2025*

Each training followed a structured format, ensuring continuity and clarity across the sessions:

- **Theoretical Input**

  Introduction to the underlying principles of Design Thinking and the methodological goals of the upcoming workshop (e.g., problem definition, ideation, evaluation). This part clarified the conceptual link between A1.2 (Scenarios), A3.2 (Use Cases), and A3.3 (Best Practices / Exploitation).

- **Practical Application and Tooling**

  Presentation of digital tools, primarily **Miro**, and a walkthrough of the relevant templates and methods (e.g., Value Proposition Canvas, Transnational Use Case Canvas). Each method was illustrated using a concrete example from the project context to ensure practical understanding.

- **Interactive Q&A and Discussion**

  Moderators had the opportunity to raise questions, test the tools in real time, and clarify potential challenges related to facilitation, cultural differences, or time constraints. This exchange helped identify possible risks early on and build a common problem-solving mindset.

Central learning from this phase was the critical importance of preparation. In transnational and time-limited workshops, success depends on how well the moderators can anticipate potential obstacles, manage discussion dynamics, and maintain focus on the workshop objectives. The training emphasised the role of moderators not as subject experts but as process facilitators who structure discussions, keep sessions on track, and create an environment conducive to collaboration and creativity. They were encouraged to strike a balance between openness to diverse expert opinions and the discipline required to achieve tangible outcomes within a limited timeframe.

The method training sessions ensured a shared methodological foundation across all moderators and regions. They provided not only technical competence in using Design Thinking tools but also soft skills for managing intercultural collaboration and facilitating structured discussions.By the end of the training, all moderators were fully equipped to conduct high-quality expert workshops in alignment with the D2T methodology. In retrospect, the method training proved to be an essential enabler for the success of A3.2. It transformed an ambitious and complex task into a well-structured, coordinated, and consistently executed process. The acquired competencies continue to add value beyond A3.2, forming a solid methodological basis for subsequent project phases, particularly the transnational exploitation activities under A3.3.

2.4 Workshop Preparations

Before the workshops, the content was jointly defined and refined during the (bi-)weekly coordination meetings, with all preparatory materials shared in Miro (see Deliverable 3.1.2). Three expert workshops were conducted for each group, each prepared individually to fit the group's specific needs. Moderators were encouraged to clarify objectives, methods, and expected outcomes early to ensure a coherent overall process. The detailed content and results of the workshops are presented in the following sections.

2.4.1 Use Case Problem Identification (Phase 4)

The initiative set out to develop three transnational use cases for the platform economy by November 2025, providing a transferable approach for structuring and validating future business ideas. Instead of seeking immediate solutions, the workshops focused on identifying key challenges in the European mobility market, which then formed the basis for the Problem Framing Canvas and guided the subsequent development process. The insights from this phase were later used to develop and validate the three use cases in the following expert workshops. The Problem Framing Canvas by the Design Sprint Academy was applied to define these core challenges, structuring the analysis across Business Context and Customer Context and the Past, Present, and Future perspectives, concluding with a reflection on Needs and Goals. This systematic approach ensured a shared understanding of the problem space before solution development began. An illustrative example of the canvas is shown in **Figure 2**.

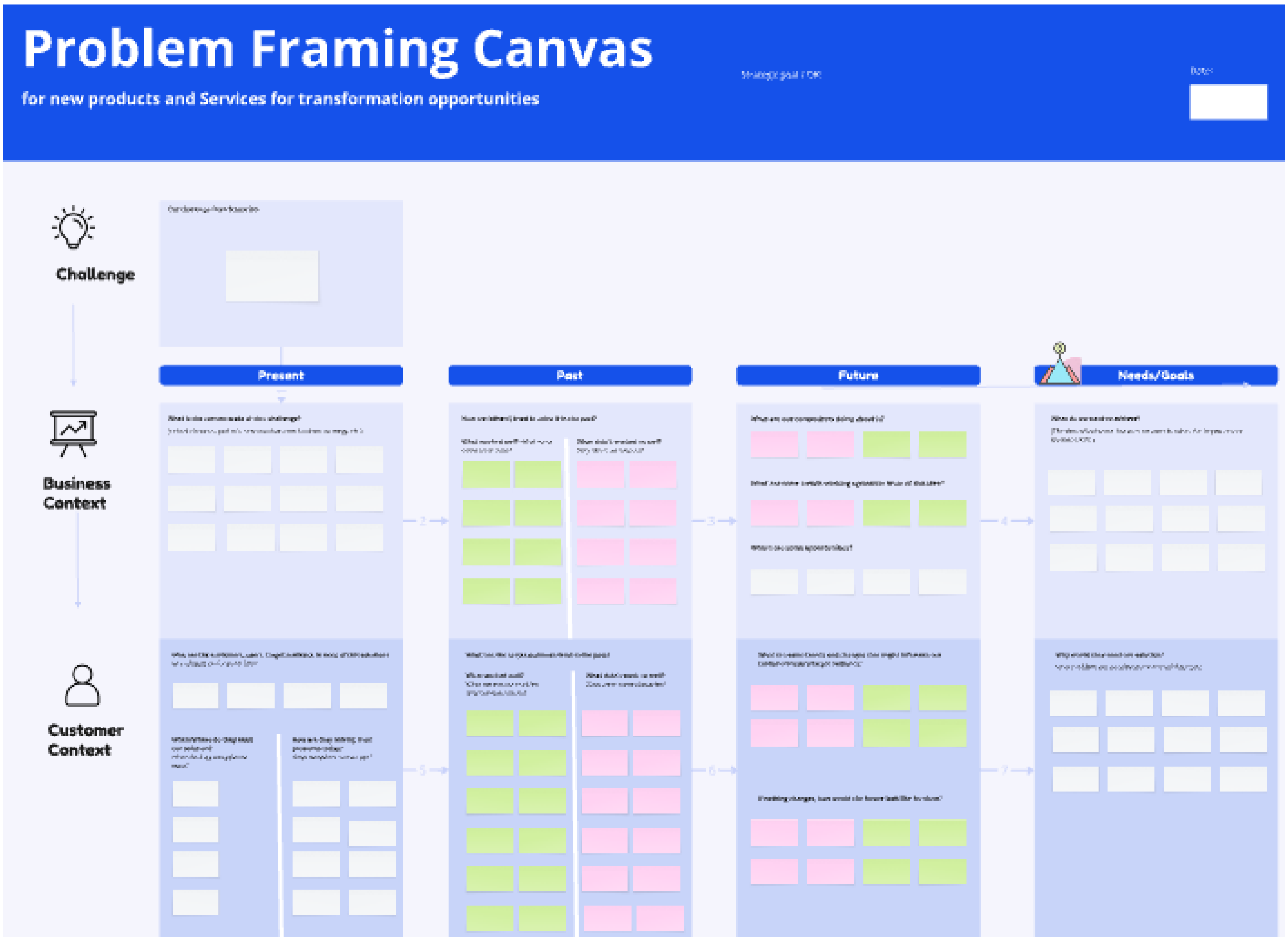

Figure 2: Template (Problem Framing Canvas) for D2T Expert Workshops for Use Case Problem Identification

Step 1 – Business Context (Organization Perspective)

The **Business Context section** helps explore the challenge from an internal and strategic viewpoint. It guides the team to assess how the organization perceives the issue, what has been tried before, and how the external environment and business goals shape the problem space.

1.1 Present - Current State

This step captures the status quo of the challenge within the organization (in this case SME Perspective). Teams reflect on questions such as:

1. What is the current situation or pain point?
2. Is this challenge part of a broader transformation, a new business strategy, or an innovation initiative?
3. Why is this topic relevant now, and what makes it critical?

1.2 Past - Previous Attempts

The focus is on learning from experience. Participants recall earlier efforts — internal or external — to address similar challenges:

- What approaches or initiatives were previously undertaken?
- What worked well and led to small wins or insights?
- What didn't work, and why? Were there resource, process, or alignment issues?

1.3 Future - Competitive and Trend Perspective

This step broadens the lens to include the external landscape and potential opportunities. Key guiding questions include:

- What are competitors or industry peers doing about similar challenges?
- Which market, technological, or behavioral trends could work *for* or *against* this idea?
- What emerging opportunities could be leveraged

1.4 Needs / Goals - Desired Business Outcomes (Pains)

Finally, the business perspective is linked to strategic intentions.

- What do we want to achieve by tackling this challenge?
- Which business pain points do we intend to solve?
- What impact do we expect on performance indicators such as efficiency, growth, customer satisfaction, or innovation capability?

Step 2 - Customer Context (User Perspective)

Customer Context complements the internal view by examining the same challenge from the perspective of those affected — customers, users, or target audiences. It uncovers needs, behaviors, and experiences that might shape how a solution should be designed or delivered.

2.1 Present – Understanding the Audience

This step defines who the main target groups are and how they currently experience the challenge. Questions to explore include:

- Who are our customers or users in need of this solution?
- Which segment or persona should we focus on first?
- When and where do they encounter the most difficulty?
- How are they currently solving their problems or compensating for them?
- What behaviors, routines, or coping mechanisms can we observe?

2.2 Past – Previous User Attempts

Here, the focus shifts to what users have already tried to overcome the issue.

- What workarounds, products, or services have they used before?
- What worked well, and what enabled some degree of success?
- What didn't work, and what obstacles or frustrations did they encounter?

2.3 Future – Trends and Changes

This step anticipates how external factors might affect users in the future.

- What emerging trends, technologies, or social changes could influence their behaviors and expectations?
- If nothing changes, what would their situation look like in the future?
- How might these shifts redefine their needs or priorities?

2.4 Needs / Goals – Value for the User (Gains)

The Canvas explores *why* users would need or value a new solution.

- What core problems will it alleviate?
- What functional, emotional, or experiential benefits will it provide?
- What will users gain — in terms of efficiency, satisfaction, convenience, or meaning?

The key challenges were defined during the expert group's first meeting in May 2025 and then used to complete the Problem Framing Canvas. By working through the Business and Customer Contexts, the team documented the current situation, past experiences, and emerging trends, clarifying both business and user needs. This process created a shared, evidence-based understanding of the problem space. It ensured that all subsequent workshops and design activities proceeded with clarity and strategic alignment.

2.4.2 Use Case Development (Phase 5)

The second phase of the expert workshops focused on Use Case Development, translating the previously identified challenges into structured, solution-oriented concepts. In this context, a use case describes how future value creation will occur. The aim was to establish clear, transferable methods for systematically validating new business model ideas. Building on the results of the Problem Identification Workshop, this session generated transnational ideas for the European mobility and automation sectors. These concepts formed the basis for the subsequent evaluation workshops, where the most promising ideas were further refined and validated. The overall methodological approach applied in this phase is illustrated in **Figure 3**.

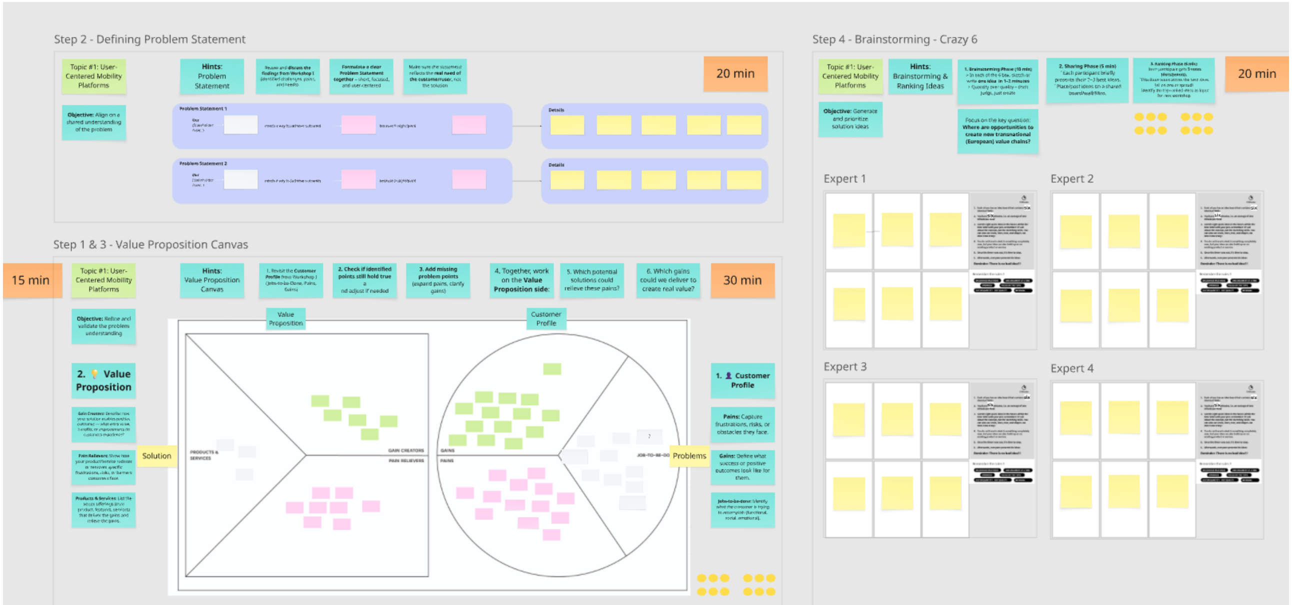

Figure 3: Templates (Value Proposition, Problem Statement, and Crazy Six brainstorming) used in the D2T Expert Workshops for Use Case Development

Step 1 – VPC Customer Profile

The first step aimed to refine and validate the understanding of the identified problems based on the results from the first expert workshop. Participants revisited the Customer Value Profile developed earlier and reviewed the three core dimensions of the *Value Proposition Canvas*:

- **Jobs-to-be-Done** – the tasks or goals the customer seeks to accomplish
- **Pains** – the frustrations, risks, or obstacles encountered
- **Gains** – the benefits or outcomes customers strive for

Through guided discussion, the completeness and relevance of these findings were critically assessed. The group then engaged in a structured dot-voting process to prioritize the most significant problems based on the identified *Pains* (and, where relevant, *Gains*). This collective prioritization ensured a shared understanding of which challenges were most essential to address in the next steps.

Step 2 – Problem Definition

The second step focused on achieving alignment on a shared and precise definition of the problem. Drawing from the prioritized customer pains and insights gathered in Step 1, participants collaborated to formulate a concise and user-centered Problem Statement.

The Problem Statement followed a standardized format to ensure clarity and consistency across teams:

Our [stakeholder/user] needs a way to [achieve desired outcome] because [insight/pain].

This structure encouraged participants to express the **true need of the user** without implying or suggesting any solution. By articulating the problem in this way, the group established a unified understanding of the customer's underlying challenges and motivations, setting a clear foundation for the subsequent exploration of value creation opportunities.

Step 3 – VPC Value Proposition

In the third step, the focus shifted from problem identification to developing the Value Proposition based on the jointly defined Problem Statement. Participants concentrated on the "Value Proposition" side of the *Value Proposition Canvas* to connect user needs with potential business opportunities.

The discussion centered on three elements:

- **Pain Relievers**, describing how the proposed solution could mitigate or remove user pains
- **Gain Creators**, identifying ways to enhance positive user outcomes or experiences
- **Products and Services**, outlining what concrete offerings could deliver these values in practice

This structured approach ensured a smooth transition from problem understanding to early idea generation and helped to frame the use cases around clear user value and transnational relevance.

Step 4 - Crazy 6 Brainstorming and Idea Ranking

The fourth step applied the Crazy 6 brainstorming method to generate and prioritize new use case ideas that build upon the previously developed Value Proposition. Each participant received a *Crazy 6 template* divided into six boxes, with the task of sketching or describing one idea per box in short, timed intervals (around one to two minutes per idea). The emphasis was on quantity over quality, encouraging spontaneous creativity and avoiding premature evaluation.

The guiding question for this exercise was:

- *Where are opportunities to create new transnational (European) value chains?*

Following the individual brainstorming phase, participants shared their **two to three most promising ideas** with the group. All ideas were collected on a shared board (physically or in Miro), and the team then conducted a quick dot-voting session. Each participant received three votes to allocate across the most compelling ideas — either concentrating on one or spreading them across several. The top-ranked ideas were selected as the starting point for the next evaluation workshops, where they would be developed into validated use case concepts. Through this structured, four-step approach — combining analytical validation with creative ideation — the D2T expert workshops successfully bridged the gap between challenge identification and concrete use case concept development. The process ensured that each idea was grounded in validated user needs, strategic alignment, and cross-European value creation potential. As a result, the outcomes of this phase provided a robust and methodologically sound foundation for the forthcoming evaluation and implementation stages within the D2T project.

2.4.3 Use Case Evaluation (Phase 6)

The third phase of the D2T expert workshop series focused on Use Case Evaluation, marking the transition from ideation to the structured validation and formalisation of the concepts developed during the earlier Use Case Development phase. Building on the outcomes of the Use Case Development Workshop, this session evaluated transnational solution approaches for the European automotive and mobility sectors. Participants collaboratively analysed, prioritised, and refined the proposed use cases, assessing their strategic, technological, and cross-border innovation potential. In this phase, the ideas were further detailed, including initial business model considerations. The overall evaluation methodology applied in this phase is illustrated in **Figure 4** to **Figure 6**.

Step 1 – Prioritizing Use Case Ideas

The session began with a prioritisation exercise to establish a shared focus for the evaluation. Participants reviewed all ideas from the previous workshop and assessed their potential in relation to European collaboration and innovation goals. Each expert selected their three preferred ideas using red voting dots and recorded them on individual sticky notes, ensuring a transparent and efficient voting process. The moderator then consolidated the results and presented the top three use cases, which formed the basis for the subsequent in-depth analysis and validation. This prioritisation step is illustrated in **Figure 4**.

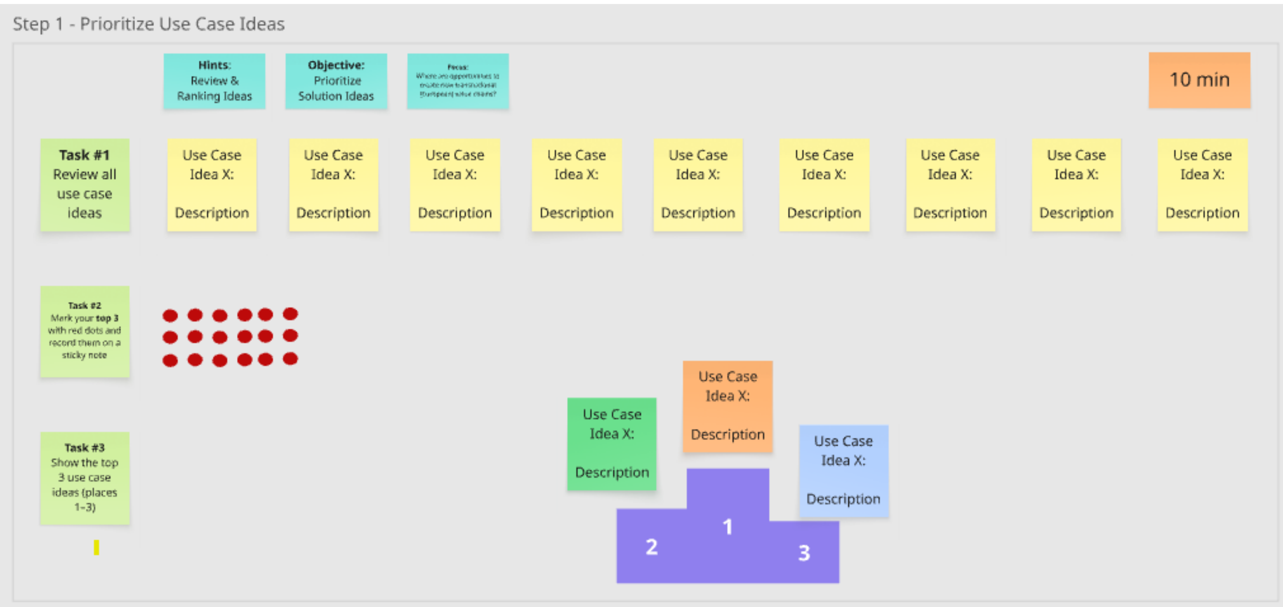

Figure 4: Canvas Template (Prioritize Use Case Ideas) used in the D2T Expert Workshops for Use Case Evaluation

Step 2 – Ideating Transnational Solution Approaches

In the second step, the group applied the Transnational Use Case Canvas, a specialised framework for systematically exploring cross-border business opportunities and European collaboration potential. Its objective was to assess the framework conditions of the top-ranked use case ideas and identify how they could create shared European value through technology, cooperation, and regulatory alignment. This analytical step is illustrated in **Figure 5**.

The Transnational Use Case Canvas guides participants to analyze six key domains that determine the feasibility and impact of a cross-border innovation initiative:

- **Opportunity** – Identification of a shared European challenge or market gap and its corresponding value potential. This includes reflecting on how the use case contributes to addressing EU-wide mobility, sustainability, or competitiveness goals.
- **Technology** – Exploration of digital and automation technologies that can serve as enablers across borders, ensuring interoperability, data exchange, and scalable deployment within the European ecosystem.
- **Regulation** – Consideration of the relevant EU policies, standards, and legal frameworks that may influence or enable the use case. The discussion often includes identifying regulatory barriers and opportunities for harmonization.
- **Synergies** – Mapping of existing European or regional initiatives, networks, or competencies that could be linked to strengthen the use case and leverage complementarities among participating regions.
- **Industry** – Analysis of targeted industrial sectors and markets to determine where the use case could generate the highest value or create new economic linkages across borders.
- **SMEs** – Emphasis on the role of small and medium-sized enterprises as core drivers of innovation, flexibility, and scalability within the European context. The discussion focuses on how SMEs can contribute to and benefit from the use case.

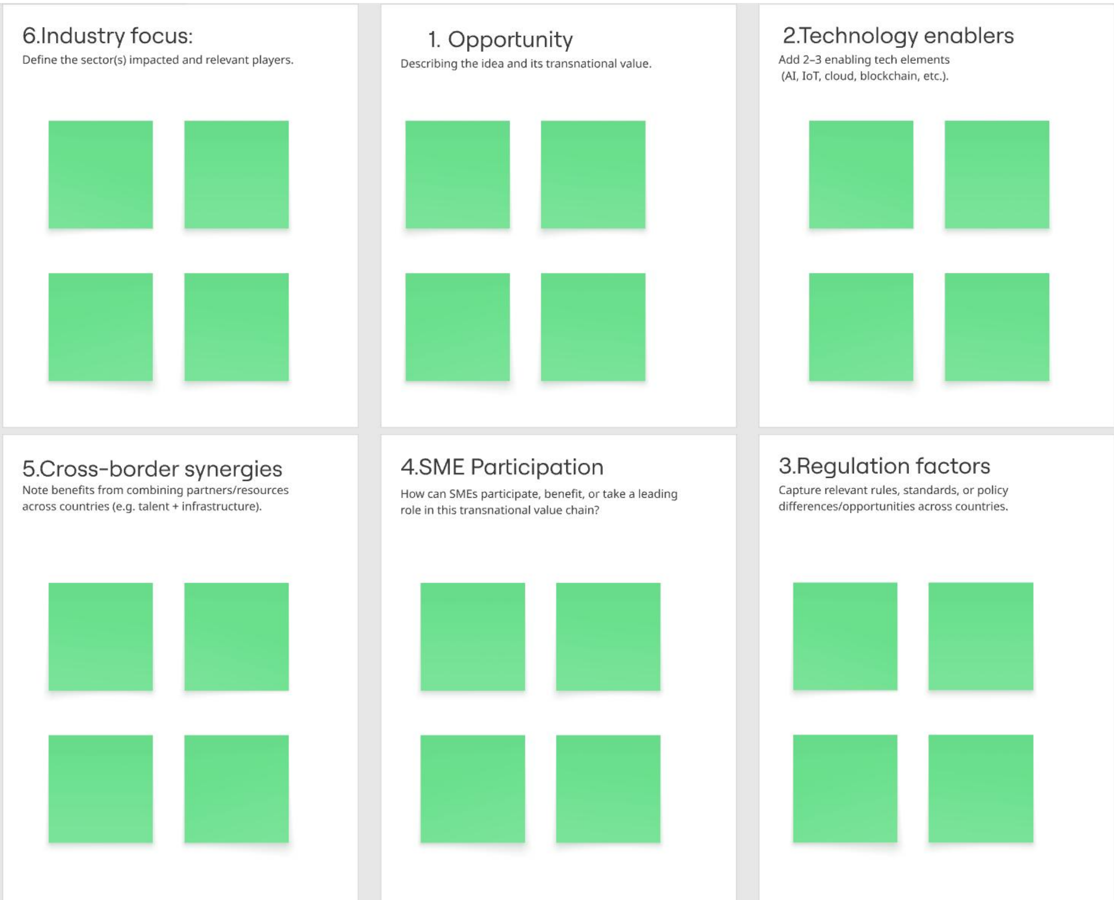

Figure 5: Template (Transnational Use Case Canvas) for the D2T Expert Workshops for Use Case Evaluation

Step 3 – Defining and Structuring Use Case Ideas

The third step focused on transforming the prioritised use case ideas into high-level business models, clarifying the structure and value logic of each concept. Using the BMC as a standard framework, participants collaboratively developed and refined their concepts step by step. This modelling process is illustrated in **Figure 6**. The group systematically worked through all nine components of the BMC:

- **Customer Segments** – identifying the primary beneficiaries or markets;
- **Value Propositions** – defining the unique value created;
- **Channels** – specifying how the value will be delivered;
- **Customer Relationships** – determining how users or partners will be engaged;
- **Revenue Streams** – identifying how value is monetized;
- **Key Resources** – defining assets and capabilities required;
- **Key Activities** – outlining core processes to deliver value;
- **Key Partnerships** – identifying essential collaborators and stakeholders; and
- **Cost Structure** – estimating the main cost drivers.

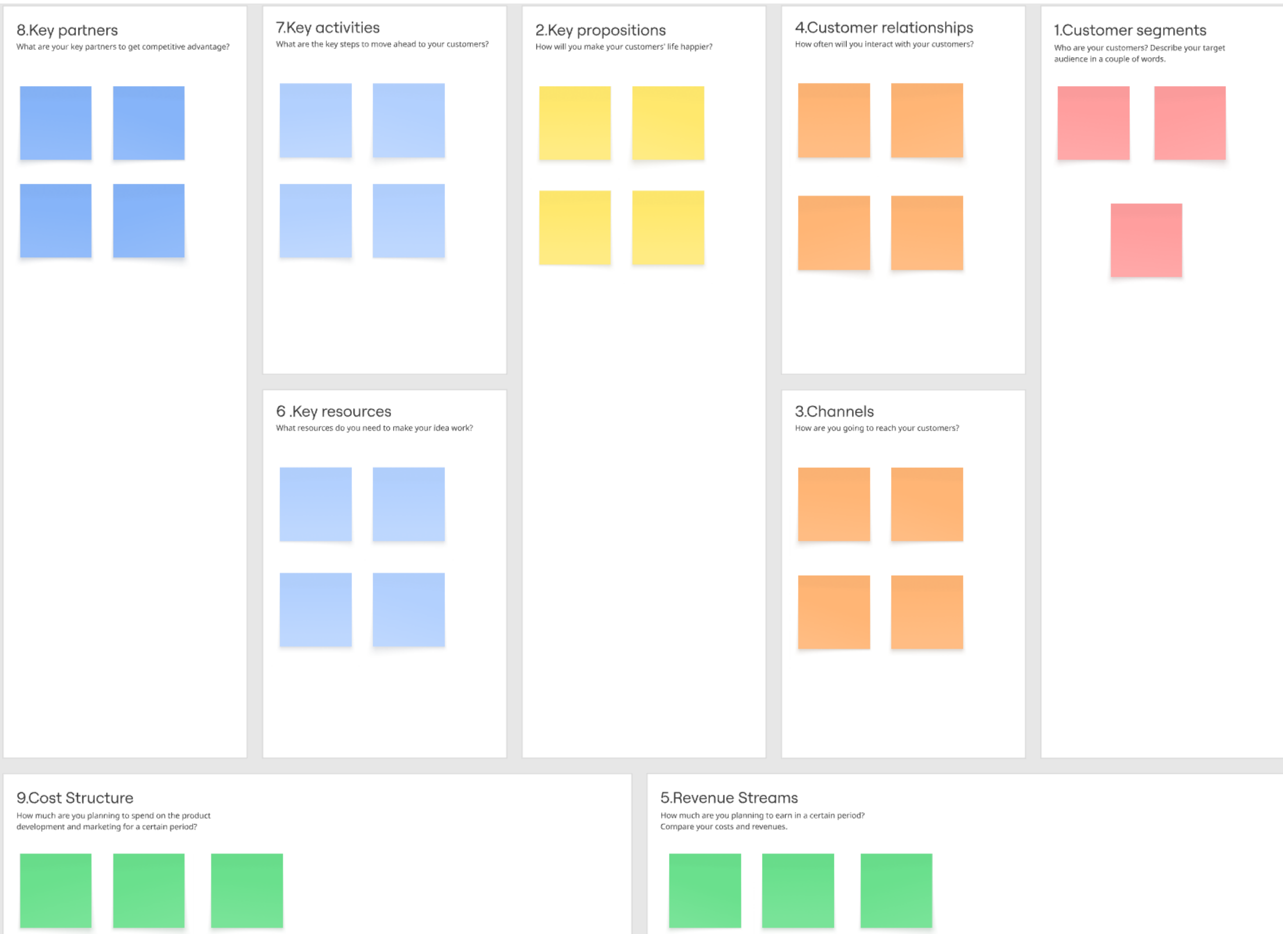

Figure 6: Canvas Template (BMC) used in the D2T Expert Workshops for Use Case Evaluation

Throughout this process, the teams jointly discussed and validated each component, building on insights from the earlier workshops. The discussions clarified the business logic of each concept and highlighted potential stakeholder roles and interests for future implementation. This exercise turned abstract ideas into coherent, actionable use case models ready for further refinement and evaluation.

The Use Case Evaluation Workshop was a key step in the D2T process, moving from creative ideation to structured business validation. By prioritising, contextualising, and modelling the ideas, the expert group identified the concepts with the strongest strategic and transnational potential. Using the **Transnational Use Case Canvas** and the **BMC**, the workshop enabled a rigorous assessment of feasibility, value contribution, and alignment with European innovation goals. This structured evaluation provides the basis for the final project stage, where selected use cases will be further assessed and prepared for implementation.

3. Use Case Preparation

Before initiating the expert workshops, a structured preparation phase was undertaken to ensure methodological coherence and thematic depth across all four D2T focus areas — Electrification, Connectivity, Automation, and the Platform Economy. This stage aimed to ground the co-creation sessions in a robust understanding of the current transformation landscape of the European mobility sector.

The preparation combined desk research, policy analysis, and trend mapping to identify key drivers, barriers, and emerging opportunities relevant to each domain. By reviewing scientific studies, industry reports, and EU strategic frameworks (e.g. the Sustainable and Smart Mobility Strategy, Fit for 55, Horizon Europe CCAM), the consortium established a shared evidence base to support subsequent expert discussions.

Given the limited time available for interactive workshops and the diversity of participating experts, this prior research ensured that the sessions could focus directly on problem validation and opportunity creation rather than background exploration. The following sections summarise the main insights from this preparatory work for each thematic area.

3.1 Electrification

Macro Trends & Industry Shifts

Electrification is reshaping the mobility landscape across Central Europe through several powerful macro trends. Ambitious climate policies at EU and national levels are accelerating a historic shift from combustion engines to electric drivetrains, fundamentally altering industry dynamics and market behavior. These macro-level shifts include:

Policy-Driven Decarbonization: Europe's policy environment has made electrification *inevitable*. The EU's "Fit for 55" climate package and Green Deal initiatives set stringent emissions targets - including a 100% reduction in new vehicle CO_2 emissions by 2035, effectively phasing out new internal combustion car sales by that date. All Central European countries must align with this continental mandate. Governments are enforcing lower fleet emissions and incentivizing electric vehicle (EV) adoption through subsidies, tax breaks, and infrastructure investments. For example, updated EU regulations mandate that all new cars from 2035 onward be zero-emission, underscoring the political will to decarbonize transport (Reuters, 2025). This clear regulatory push has catalyzed automakers to ramp up EV portfolios and gives market certainty that electric mobility is the future. In short, climate policy is a primary driver making electrification the non-negotiable path forward for the auto industry in Central Europe and beyond.

Surging EV Adoption & Market Shifts: Spurred by policy and growing environmental awareness, EV sales have risen sharply across Europe - though with variations by country. As of 2024–25, roughly one in five new cars in Europe is electric (battery-electric vehicles or BEVs). In Q1 2025, BEVs reached 15.2% of total EU new car sales, up from ~12% a year prior. Hybrids (HEVs/PHEVs) are serving as an important bridge technology, now making up over one-third of new car sales (35.5% in Q1 2025). Meanwhile, petrol and diesel models are rapidly declining - their combined market share fell to ~38% by early 2025 (from ~48% a year earlier). Notably, Germany saw BEV sales jump ~39% in early 2025 thanks to innovation and charging investments, whereas France experienced an EV sales dip after cutting purchase incentives (Electric Cars Report, 2025). Overall, the trend is clear: *electrified vehicles are steadily eroding the dominance of traditional internal combustion engines*. Central European markets historically trailed Western Europe in EV uptake, but they are now catching up as prices fall and charging networks expand. By 2030, the EU aims to have at least 30 million zero-emission cars on European roads, indicating the scale of adoption expected this decade (Institut Delors, 2025). This mass transition is reshaping market composition and forcing incumbents to adjust their strategies region-wide.

Technological Advancements: Rapid innovation in clean mobility technology both drives and responds to electrification. **Battery technology is improving year by year** – next-generation lithium-ion batteries and emerging solid-state designs promise higher energy density, faster charging, longer lifespans, and lower costs. These advances are steadily closing the performance and cost gap between EVs and conventional cars. Key EV components – battery cells, electric motors, power electronics, and battery management systems – are benefiting from intensive R&D, an area where European engineering expertise (e.g. in power semiconductors and automotive software) provides an edge. Charging infrastructure is likewise evolving: ultra-fast chargers (150–350 kW) are being deployed along major corridors and in cities, cutting typical charge times and alleviating consumer **"range anxiety"**. By 2025, EU law requires fast-charging stations *at least every 60 km* on core highways, with an eye toward ubiquitous coverage. Meanwhile, smart-grid technologies are integrating vehicles as dynamic energy assets (through vehicle-to-grid services), and standards for interoperability (plug types, payment systems) are maturing. These technological drivers – better batteries, faster chargers, smarter energy integration – are enabling EVs to be more convenient and affordable. They also open new business opportunities (from battery manufacturing to software-driven energy services) and require industry players to continuously innovate or partner to keep pace. In Central Europe, tech advancements are crucial for addressing local concerns like winter range loss in alpine regions or providing cost-effective charging solutions in smaller cities.

Global Competition & Supply Chain Localization: The race to electrify is global, and European automakers face **intense competition from North America and Asia**. China in particular has surged ahead – over 50% of new cars sold in China are now electric, supported by massive domestic investment and scale advantages. U.S. policies like the Inflation Reduction Act (2022) pour subsidies into American EV and battery production, aiming to localize their supply chain. As a result, Europe's once-dominant auto industry has seen its **global market share slip below 25%** and is at risk of further erosion. To *"reclaim their edge"* in the EV era, European OEMs (including those in Central Europe like VW, Stellantis, BMW, etc.) are being urged to **localize their supply chains** and build up domestic manufacturing for batteries and components. This is spurring industrial strategy measures: the EU's European Battery Alliance and Critical Raw Materials Act support new gigafactories, battery material refining, and mining projects within Europe. Major battery cell plants are now planned or under construction in Germany, Hungary, Poland, and Italy, aiming to reduce reliance on Asian imports. By investing in local battery production and securing raw materials (lithium, nickel, etc.), Europe seeks to improve its economic **resilience** and ensure Central European factories have stable supply. Governments are also looking at "local content" rules and inbound investment conditions to protect strategic EV sectors. In sum, geopolitical and competitive pressures are pushing Europe toward a more regionally self-sufficient EV value chain – a trend very relevant to Central Europe, given its strong automotive supplier base. We can expect a wave of new factories, R&D centers, and supplier networks across the region, all focused on electrification technology (from battery cells in Poland to power electronics in Austria). This *localization push* is both a defensive move against foreign competition and a growth strategy to create jobs and expertise in the new electric paradigm.

Industry Restructuring & New Entrants: The shift to electric powertrains is fundamentally **restructuring the automotive value network**, lowering barriers to entry for new players and altering the roles of incumbents. EVs contain far fewer moving parts than combustion vehicles and rely more on software and electronics – this change opens the door for **technology firms, startups, and specialist suppliers** to claim a bigger role in the industry. Traditional Tier-1 suppliers focused on engines or transmissions face disruption, while agile newcomers specializing in batteries, e-motors, charging systems, or vehicle software are in high demand. Industry analysts observe that **power in the supply chain is shifting toward these specialist newcomer suppliers**, often SMEs, as their expertise becomes critical (Bierau et al., 2015). In Central Europe, which has many SME suppliers, this represents both a threat and an opportunity: firms tied to diesel engines or fuel injection systems must reinvent themselves or risk decline, whereas those developing battery components or EV software can become major players. We are already seeing alliances and ecosystem formation: automakers are partnering with battery tech startups; energy utilities are teaming up with EV charger manufacturers; and electronics companies are entering automotive. Traditional Original Equipment

Manufacturers (OEMs) are moving away from a vertically integrated model to a more networked one – co-developing technology with partners and even competitors. Collaborative **"innovation clusters"** are emerging (for example, in Germany's Bavaria or northern Italy's Motor Valley) where automakers, suppliers, universities, and tech firms co-locate to accelerate EV innovation. As one S&P analysis suggests, European OEMs will need to foster Silicon Valley-style partnerships and local tech hubs to remain competitive. This influx of new entrants also brings fresh business models (direct-to-consumer EV sales, battery leasing, charging-as-a-service, etc.) that challenge legacy practices. For Central European countries with strong engineering talent, there is an opening to incubate new EV startups (for example, Slovenia's Tier One developing e-motorcycle tech, or Polish firms in battery recycling). Overall, the industry is becoming more plural and dynamic: traditional carmakers, big tech companies, energy providers, and entrepreneurs are all vying for slices of the emerging EV ecosystem. Consolidation is likely as well – larger players are acquiring innovative startups to integrate EV capabilities. By 2035, the automotive sector in Central Europe will look very different: leaner on mechanical complexity, richer in software and electronics, and with a more diverse cast of contributors beyond the historical OEM-supplier hierarchy.

Political, Regulatory, and Technological Drivers

Several drivers are propelling the electrification of mobility in Central Europe. These drivers provide concrete push factors and enabling conditions behind the macro trends:

Government Policy & Regulation: Strong top-down policy support is a hallmark of Europe's electrification journey. The EU has enacted a comprehensive Sustainable and Smart Mobility Strategy that includes phased targets like *30 million EVs by 2030* and climate-neutral cities. The headline regulatory driver is the 2035 ban on new ICE vehicles, agreed in 2022–2023, which legally binds all EU member states (thus Germany, Italy, Poland, etc.) to reach zero-emission new car sales by that year. In the lead-up, increasingly tight CO_2 emission standards for vehicles are ratcheting down allowable fleet emissions (e.g. a 55% cut by 2030 vs 2021 levels). These rules force automakers to sell a high share of EVs or pay hefty penalties, effectively making EV production not just environmentally desirable but commercially necessary. In addition, many Central European countries offer purchase incentives or tax benefits at the national level: for instance, Germany provided EV purchase bonuses (which it is now phasing down), Poland offers grants for electric vans and cars, Slovenia has purchase subsidies and lower EV VAT, etc. Some of these incentives have been volatile (France's subsidy cuts caused a short-term sales slump), but overall they have helped reduce the upfront cost barrier for consumers. On the infrastructure side, the EU's new Alternative Fuels Infrastructure Regulation (AFIR) is a major regulatory driver: it mandates the deployment of charging stations at regular intervals (at least every 60 km on core Trans-European Network corridors by 2025) and sets requirements for power levels and interoperability. This is pushing member states and private operators to rapidly install chargers along highways and in cities. AFIR and related national programs (like Germany's "Deutschlandnetz" charging initiative) aim to ensure that adequate charging access is in place by the time EV adoption peaks. Cities, too, are using local regulations as levers – many urban centers in Europe have introduced or announced low-emission zones and outright diesel/petrol car bans in city centers in the 2025–2030 timeframe. For example, Rome and Paris plan to ban ICE cars from parts of the city by 2030. Such urban policies directly stimulate demand for EVs and shared electric mobility. Finally, new EU regulations beyond vehicles are shaping the ecosystem: the EU Battery Regulation (2023) imposes strict sustainability rules on batteries – including required levels of recycled content (e.g. minimum 12% cobalt, 4% lithium in new EV batteries by 2030) and high collection/recycling targets by 2030–2035. This encourages a circular economy around EV batteries (discussed further in scenarios) and addresses concerns about resource security.

Public and Private Investment: Hand-in-hand with regulations, significant public investments and incentive programs are driving electrification. The EU is channeling billions into green mobility through recovery funds and programs like Horizon Europe (funding EV R&D, battery innovation, etc.) and the Connecting Europe Facility (funding charging infrastructure). Central European governments are also investing in charging networks (often via public-private partnerships) – e.g. Austria's climate fund supports nationwide fast charging deployment; Poland's National Fund for Environmental Protection co-finances EV chargers and e-buses for cities. Moreover, Europe's Just Transition mechanisms are helping coal-dependent regions (like parts of Czechia and Poland) diversify into EV component manufacturing and battery plants, aligning economic development with electrification. On the private side, automakers have announced massive electrification budgets: the major German OEMs (VW, BMW, Daimler) together committed over €100 billion for EV development and battery supply deals through 2030. Companies are retooling factories in Central Europe (e.g. VW converting its Zwickau and Emden plants in Germany fully to EV production, Škoda investing in EV lines in Czechia). International battery firms (from Asia and the West) are investing in Central Europe thanks to incentives – such as SK Innovation's battery gigafactory in Hungary or LG Chem's in Poland. These investments are technological drivers too, since they build local know-how and supply chains. Additionally, power utilities in the region are investing in grid upgrades and charging services to accommodate EV growth. Governments are encouraging this via grants and favorable regulation (for instance, EU recovery funds in Italy and Slovenia allocate money for grid modernization and charging hubs). In summary, substantial financial commitments by both public institutions and industry stakeholders are underpinning the EV rollout, ensuring that infrastructure, manufacturing capacity, and R&D keep pace with policy ambitions.

Technological Drivers & Innovation: Ongoing advances in technology are a key enabling driver that makes electrification viable and attractive. Battery cost decline is paramount – lithium-ion battery pack prices have fallen about 80% since 2010 and are projected to approach or achieve cost parity with combustion engines by late this decade. This is crucial for Central and Eastern European consumers, who are often more price-sensitive; lower battery costs translate to more affordable EV models in all segments. Battery energy density improvements (thanks to better cathode chemistries, packaging, and the prospect of solid-state batteries by the early 2030s) mean newer EVs will offer 500+ km ranges routinely, addressing consumer needs for longer range on par with fuel cars. Charging technology innovation is also driving change: ultra-fast chargers (350 kW) can add ~300 km of range in 15-20 minutes and are being deployed along Europe's major corridors (the "FastCharge Network"). Meanwhile, new solutions like bidirectional charging and vehicle-to-grid (V2G) are turning EVs into mobile energy storage units. For instance, an EV can discharge power back to the grid or a home during peak times – pilots in Europe (including some in Hungary and Italy) are demonstrating how EVs can support grid stability and allow owners to earn revenue by selling energy back (a concept expected to mature by 2035). Another technological driver is the integration of digital connectivity and AI in e-mobility: smart charging apps optimize when and where EV owners charge (e.g. to use off-peak renewable energy), and connected car platforms enhance the user experience (like navigation to nearby free chargers, automated payment, etc.). In Central Europe, where some areas have weaker grid infrastructure, smart energy management and distributed storage (including second-life EV batteries) are being developed to mitigate grid bottlenecks – leveraging tech to ensure the electrical grid can handle widespread EV adoption. Additionally, renewable energy expansion in the region (solar, wind) dovetails with transport electrification: as the grid gets greener, the lifecycle emissions of EVs improve, and initiatives arise to directly link EV charging with local green electricity (for example, solar carport chargers in Slovenia or Austrian hydroelectric-powered charging stations). In essence, continuous technological progress – in batteries, charging, software, and energy – is a driving force that is steadily improving the value proposition of electrification.

Stakeholder Dynamics in the Electrification Ecosystem

Electrification in mobility is a multi-stakeholder transformation. In Central Europe, a diverse array of stakeholders – automakers, suppliers, tech companies, utilities, governments, cities, and citizens – are each adapting their roles and strategies. Understanding these stakeholder dynamics is key to grasping who the major players are and how they interact in the emerging e-mobility ecosystem:

Automakers (OEMs): Traditional automotive manufacturers remain central actors but are under immense pressure to transform. Europe's carmakers (Volkswagen, Stellantis, BMW, Daimler, Škoda Auto, etc.) are investing billions into EV development – from designing new dedicated electric models to building battery assembly lines and retraining their workforce for high-voltage systems. They face a dual challenge: meet regulatory targets (to avoid fines and maintain market access in an EV-only future) *and* fend off new competition (Tesla and Chinese EV brands, as well as domestic startups). Central European OEMs are lobbying for consistent policies and support (e.g. harmonized charging standards, incentives to stimulate EV demand uniformly across EU markets) to ensure a smoother transition. Strategically, many are pursuing joint ventures or alliances for costly components – for instance, several German and Italian OEMs have partnered to co-develop battery cells and share platforms to achieve scale. Some are also vertically integrating into battery production to secure supply. As incumbents, OEMs have the manufacturing capacity and brand trust, but they must become more agile and innovation focused. European OEM executives often note that software and electronics are new core competencies they must build or buy. We see OEMs in Central Europe increasingly partnering with tech firms (for connectivity, autonomous features in EVs) and energy providers (to offer home charging and renewable energy deals with car sales). Overall, automakers are repositioning themselves from solely car builders to *mobility providers* in an electric, digital age. The success of Central European OEMs in electrification will heavily influence the region's economic future, given the automotive industry's weight in employment and exports.

Suppliers and SMEs: The thousands of smaller suppliers that make up the automotive value chain are experiencing disruptive change. Many SME suppliers that built engines, transmissions, or exhaust systems for decades must radically adapt or risk obsolescence. In Central Europe, which hosts numerous Tier-2 and Tier-3 suppliers, this transition is painful: their traditional products see declining orders, and they need to re-tool factories and reskill staff to produce electric motors, power electronics, battery casings, charging cables, and other EV components. Access to capital and know-how is a hurdle for these smaller firms. Policymakers recognize this and have begun offering support – for example, the EU and national governments have earmarked subsidies, grants, and R&D programs specifically to help auto suppliers (often SMEs) switch to e-mobility products (Institut Delors, 2025). In some cases, large OEMs are actively guiding their supply base, sharing forecasts of EV component needs or even financially assisting key suppliers in their transition. On the flip side, electrification is also an *opportunity* for new entrants and agile SMEs. The EV era opens niches for specialized firms: some European startups now excel in battery management software, lightweight materials for EVs, or EV charging hardware. Central Europe has seen new SME entrants become critical suppliers of, say, battery thermal management parts or public charging station equipment. For those SMEs that can innovate, remarkable opportunities await – a local example is a Polish family-run company that pivoted to manufacturing battery heating systems and now supplies multiple European EV makers. Indeed, industry observations show that influence is shifting toward these specialist suppliers and away from some traditional combustion-centric giants. To thrive, SMEs need integration into emerging EV supply chains – meaning they must network with OEMs and tech firms. Cluster initiatives (e.g. the Slovak Battery Alliance or Austria's "EV clustering" programs) aim to connect SMEs with larger players and research institutes. Still, competition is tough: big Tier-1 suppliers are also pivoting and could dominate new component domains, potentially squeezing out smaller firms. SMEs frequently voice the expectation that the EV transition should *not* leave them behind – calling for "a level playing field" and measures like SME-friendly standards, open innovation platforms, and public procurement policies favoring innovative local companies. In summary, among suppliers and SMEs the dynamics are a mix of peril and possibility – electrification is forcing consolidation and shakeout, but it's also enabling a new cohort of winners to emerge.

Governments and Local Authorities: The public sector – from the EU level down to city halls – plays a pivotal role as both rule-maker and market enabler. National governments in Central Europe set the overarching regulations (transposing EU directives into national law) and often provide financial carrots (incentives, subsidies) and sticks (taxes, bans). For instance, the Hungarian government offers import tax exemptions for EVs and has a robust e-bus procurement subsidy for municipalities; Poland set up a Low Emission Transport Fund to co-finance EV charging and fleet electrification projects. Consistency (or lack thereof) in these policies can greatly impact industry confidence – abrupt subsidy cuts, as seen in some countries, can stall EV sales (creating a **"stop-and-go" market effect). Stability and clear long-term signals are thus critical demands from industry stakeholders. Local authorities (cities and regions) are on the front lines of implementation. Cities benefit from electrification via reduced air pollution and noise, so many are actively encouraging the switch. Major Central European cities like Prague, Budapest, Warsaw are expanding charging infrastructure on city streets (often via partnerships with private charging operators) and electrifying public transport (e.g. Ljubljana in Slovenia has committed to 100% electric buses by 2035). Some cities provide perks to EV users – such as access to bus lanes, free parking, or exemptions from congestion charges – to spur adoption. Importantly, cities are also experimenting with integrated mobility solutions: combining electrified public transit, e-car-sharing, and e-bikes to offer alternatives to private cars. Public-private collaboration is a notable dynamic: many local governments lack the expertise or funds to roll out charging networks or EV-sharing services alone, so they partner with companies and often SMEs. A common model is a city providing space and permits while a private firm installs and operates charging stations. In Central Europe, one example is a regional consortium in Carinthia (Austria) where municipalities and an SME co-op built a network of solar-powered EV chargers. National governments support these local efforts by disbursing EU funds or setting national strategies (for instance, Germany's KfW bank offers grants to cities for public charging projects). Overall, the public sector is transforming from a regulator-only role to a more complex one: part investor, convenor of stakeholders, standard-setter (for things like building codes requiring charging in new buildings), and even *participant* in mobility services (some cities operate their own EV car-sharing fleets or bus services). The expectation from other stakeholders is that governments will continue to "set the stage" – providing a stable regulatory framework, funding critical infrastructure, and ensuring that the electrification transition is fair and inclusive (addressing, for example, rural charging needs and workforce retraining).

Energy Providers and Utilities: The electrification of transport is causing a convergence of the automotive and energy sectors. Utilities, grid operators, and charging point operators (some of which are utility-owned) are key stakeholders, ensuring that all these new EVs can be charged reliably. For electricity providers in Central Europe (e.g. Germany's RWE, Austria's Verbund, Poland's PGE), EVs represent both a challenge and a major new business opportunity. On one hand, power demand is rising – thousands of EVs plugging in create new loads on the grid, especially if many charge simultaneously. Utilities must invest in upgrading distribution networks (like neighborhood transformers) and implementing smart grid technologies to manage peak loads. There are concerns in some regions that aging grid infrastructure could become a bottleneck if not reinforced (e.g. parts of rural Hungary or Poland's grid). In response, utilities are deploying "smart charging" solutions that stagger EV charging or throttle it during peak grid usage, often with the help of IoT and AI systems. On the other hand, EVs are attractive to energy companies because they increase electricity sales and open avenues for new services. Many utilities have launched dedicated e-mobility divisions or subsidiaries to install and operate public charging stations (for example, Austria's Verbund and Germany's E.ON both have extensive charging networks across Central Europe). They often partner with municipalities or highway services for site access. Energy companies are also exploring vehicle-to-grid (V2G) and energy storage opportunities: EVs can collectively act as a huge battery resource. For instance, pilot programs in the Netherlands and Germany allow electric car owners to feed energy back to the grid at peak times, helping balance renewable energy fluctuations (JointCharging, 2025). By 2035, such V2G services could be common, effectively turning EVs into distributed energy assets that improve grid stability (while earning credits for vehicle owners). Moreover, utilities are increasingly ensuring the power used by EVs is green – through renewable energy tariffs or on-site solar at charging hubs. Some have committed to powering all public chargers with 100% renewable electricity, addressing the consumer expectation that EVs deliver full environmental benefits. In summary, energy providers have become active participants in the mobility ecosystem: they are not only adapting the grid but also *shaping the EV charging experience*, from offering subscription-based charging plans to integrating charging into home energy management systems.

Consumers (Citizens): Ultimately, it is European citizens as drivers, riders, and community members whose choices will determine the pace of electrification. Consumers are a dynamic stakeholder group – their growing demand for cleaner, cheaper-to-run vehicles is a primary pull factor, but their concerns and needs also pose potential brakes on the transition. Recent surveys show that European consumers are increasingly open to EVs: in 2024, 58% of car buyers globally (and a similar share in Europe) expressed intent to purchase an EV, up from 30% in 2020. This reflects rising environmental consciousness and also practical considerations like high fuel prices. However, consumers also voice specific pain points that must be addressed to convince the broad market (beyond early adopters) to switch to electric. The most common concerns are: charging availability, driving range, and vehicle cost. Indeed, an EY index found 27% of prospective buyers cite lack of charging infrastructure as their top worry, 25% cite range anxiety, and 18% cite charging time inconvenience. Central European citizens share these concerns – for example, a lack of ubiquitous public charging in parts of Poland or Slovakia still makes some hesitant to go electric. There is also a knowledge gap among consumers about EV ownership (questions like battery lifespan, resale value, maintenance differences). Thus, consumer education and trust-building are key tasks. It's notable that a core expectation of consumers is that EVs should become cost-competitive with conventional cars. While total cost of ownership (fuel+maintenance) for EVs can already be lower, the higher upfront price of many EVs is a barrier, especially in lower-income segments. Consumers anticipate that as the market scales and technology matures, EV purchase prices will fall – and indeed governments expect automakers to introduce more affordable electric models by mid-decade (IEA, 2023). Until parity is reached, many Europeans are turning to alternatives like second-hand EVs or new usage models (leasing, car subscriptions) to access electric mobility. Another expectation is that charging will become as convenient as refueling – drivers want to charge easily at home, work, or on highways without hassle. This means consumers place value on interoperability (one payment system across chargers), reliability (stations that work 24/7), and speed. European initiatives like "plug & charge" and roaming agreements between charging networks are emerging in response. Finally, citizens as a collective stakeholder expect electrification to genuinely deliver on environmental promises: cleaner air in their cities, lower carbon emissions, and responsible end-of-life handling of batteries. There is a social expectation that the EV transition be equitable – not just an "urban rich" phenomenon. People in smaller towns or less affluent communities want to see benefits too (be it via used EV markets or better public transit). If these expectations are met, consumer demand will accelerate; if not, adoption could stall due to skepticism. Notably, younger Europeans are leading the shift in attitudes: around 40% of 18–34 year-olds in Europe say they are willing to give up owning a car if viable alternatives exist, reflecting changing mobility preferences. This attitude is fueling interest in shared electric mobility services (like car-sharing, e-scooters, etc., see scenarios below). In sum, consumers stand at the center of the electrification transition – their needs and pain points must be the focal point for technology providers, service operators, and policymakers to ensure the shift to electric mobility is both rapid and sustainable.

Future Customer Needs, Pain Points, and Hidden Expectations

Electrification is not just a technological shift; its success ultimately hinges on how well it addresses the needs of end users. In the Central European context, we consider two broad groups of "customers" in the mobility ecosystem: (a) Citizens and communities – i.e. individual consumers, drivers, passengers, and the public who use transportation services or are affected by them; and (b) SMEs and entrepreneurs – i.e. the businesses (especially small and mid-sized) that will implement, support, or build new services around electrified mobility. Each group has distinct needs, pain points, and often unspoken expectations for the electric future. Below we outline these, as they will shape demand and innovation opportunities through 2035:

3.1 Citizens and Communities: Needs & Pain Points

For the general public, adopting electric mobility must fit into their daily lives in a **practical, affordable, and reliable** way. Key consumer needs and pain points include:

Affordable Electric Mobility: Cost remains the foremost concern for many consumers. Today, EVs are still *significantly more expensive upfront* than comparable gasoline cars – a critical barrier to mass adoption. While total cost of ownership can be lower , the high purchase price or monthly lease of EVs puts them out of reach for some middle- and lower-income Europeans. Many prospective buyers in Central Europe worry about whether they can afford an EV, especially larger family models. There is strong expectation that EV prices will come down as technology scales. Indeed, policymakers are nudging industry in this direction: upcoming EU CO_2 targets for 2025 and 2027 are prodding carmakers to introduce more affordable entry-level EV models to broaden consumer appeal (IEA, 2023). Until price parity is achieved, alternative solutions are growing: demand for second-hand EVs is rising (creating a nascent used-EV market), and innovative ownership models are expanding. For example, car subscription services and long-term rentals allow consumers to use EVs without hefty down payments. In some Central European cities, there are even experiments with EV car-sharing and community carpools that give people access to electric driving on demand at low cost. *Hidden expectation:* consumers assume that as EVs become mainstream, they won't have to pay a premium for going green – electric mobility should ultimately be *economical* mobility for it to be embraced widely.

Charging Convenience and Infrastructure Reliability: The availability, convenience, and reliability of charging is one of the most acute pain points for consumers. Drivers want to recharge as easily as – or even more easily than – refueling a petrol car. "Range anxiety" – fear that the EV will run out of charge with no charger nearby – remains common, especially in regions where charging infrastructure is still sparse. Surveys consistently rank a "lack of charging infrastructure" as a top obstacle for potential EV buyers (EY, 2024). Even current EV owners often complain about charging time and the inconvenience of finding a working, available charger on long trips (S&P Global, 2025). This pain point is particularly sharp for citizens who cannot charge at home – for instance, many urban Europeans live in apartment buildings with no private parking, meaning they rely on public chargers. If those are few or often occupied or broken, it's a major deterrent. Communities worry that inadequate public charging could leave certain groups (like renters or rural drivers) behind in the transition. Hidden expectation: Drivers expect a future where charging is ubiquitous, fast, and seamless. In practical terms, they anticipate the ongoing infrastructure rollout will lead to "accessible charging for all" – be it a curbside charger on their street, a fast charger at every highway rest stop, or a charger at work or shopping centers. They also look forward to *smarter* solutions like integrated charging hubs , streetlight chargers in residential areas, or even wireless charging pads embedded in parking spots. Another implicit expectation is interoperability – charging should be user-friendly, with common plug standards and easy payment. By 2035, consumers hope the charging experience will be as routine as plugging in a phone – a mundane convenience, not a source of anxiety.

Adequate Driving Range and Battery Confidence: Range anxiety ties into the need for sufficient driving range on a single charge for all typical uses. Early EV models often had limited ranges (100–200 km), which many consumers found inadequate. Today, ranges of 300–400 km are common, yet drivers still place high importance on range when considering EVs. For those in rural areas or who frequently drive long distances (say across Central European countries or on holiday trips), this need is even more pronounced. Additionally, consumers need confidence in battery longevity – there are lingering worries about how quickly an EV's battery might degrade (losing capacity) and what that means for range after 5–10 years. The idea of expensive battery replacement is a concern (indeed, 26% of potential buyers globally cite battery replacement cost as a worry). Hidden expectation: The public expects ongoing battery innovation to continue extending range year by year. Many foresee that by the 2030s, a standard family EV might easily have 500+ km real-world range, which covers almost all use cases (a summer road trip, inter-city drives, etc.) without frequent stops. They also expect transparency and assurances about battery health – e.g. manufacturers providing warranties (commonly now 8 years/160,000 km) and perhaps new services like battery health reports or even optional battery upgrades/swaps to alleviate concerns. Essentially, people want EVs that "meet all my mobility needs without compromise." By 2035, the goal is that an EV, even an affordable one, can handle a long highway journey or a subzero winter day (which can reduce range) with ease – thus eliminating range anxiety as a concept.

Energy Cost and Grid Impact: As vehicles electrify, consumers become *energy customers* in a new way, leading to concerns about electricity costs and grid reliability. In parts of Europe with high electricity prices, the benefit of EVs can erode – consumers want to be sure that charging an EV remains cheaper than filling a tank with petrol. Thus, there's demand for *affordable charging options*: off-peak/nighttime electricity tariffs, special EV plans from utilities, or the ability to install solar panels at home to charge the car for "free" from sunlight. Some forward-looking consumers are already interested in home energy storage or integrating their EV into a home solar setup to achieve energy independence. Communities and citizens also worry about whether the power grid can handle a surge of EV charging. Questions like "Will my neighborhood transformer overload if everyone plugs in their cars at 6pm?" arise. They expect utilities and authorities to upgrade the grid and implement smart charging management so that their lights stay on and their car charges reliably without causing outages. There's also a strong sustainability expectation tied to energy: people want the electricity powering their cars to be green. Driving an EV charged by a coal-heavy grid is seen as undercutting the purpose. This drives interest in renewable energy integration – from wind-powered public chargers to guarantees that charging networks source renewable electricity. Many EV drivers explicitly choose green energy contracts. Additionally, a *hidden expectation* is that EVs will truly deliver a lower carbon and pollution footprint across their lifecycle – which means consumers expect issues like battery recycling and ethical sourcing of battery materials to be addressed. Citizens increasingly ask: *What happens to the battery when it's worn out? Will it be recycled or create toxic waste?* They anticipate robust recycling systems (as mandated by new EU rules) so that electrification doesn't create a new environmental problem. In short, the consumer needs cheap and clean electricity to fuel their EVs, and they trust that stakeholders will align the power sector with the transport transition.

Environmental and Health Benefits: On a community level, one of the core promises of electrification is reduced air and noise pollution. Citizens – especially urban residents in dense cities like Warsaw, Prague, or Milan – have endured decades of smog (NOx, particulate matter from diesel) and traffic noise. There is a powerful public desire for EVs to help improve quality of life in neighborhoods via cleaner air and quieter streets. Many European cities routinely breached EU air quality limits due in part to vehicle emissions; electrification is seen as a crucial solution. Thus, one key *need* for communities is realizing these health benefits: fewer asthma and respiratory issues, less grime on buildings, and a more pleasant acoustic environment (EVs are near-silent at low speeds). Hidden expectation: People assume that the shift to EVs, combined with renewable energy, will significantly help meet climate goals – transport is a major CO_2 source, so decarbonizing it is pivotal. They also expect authorities to ensure that this transition yields *real* environmental gains. This includes everything from ensuring power generation is green to enforcing proper battery recycling (so that EVs don't just export pollution to mines or recycling plants). Essentially, citizens expect electrification to make their communities more sustainable and livable, delivering on the public health rationale that has often been used to justify EV-supportive policies. If, for any reason, EV adoption doesn't translate into noticeable air quality improvements (say, due to slow grid decarbonization or a flood of used batteries with no recycling), public support could wane. But assuming current trajectories hold, by 2035 many Central European cities should see markedly cleaner air and calmer noise levels – a key social outcome that citizens are eagerly awaiting.

Convenience and User Experience: Beyond big-picture items like cost and environment, consumers also have everyday practical expectations. They want EVs to be as convenient to use as conventional cars, without trade-offs. This covers things like: heating and cooling – EVs should provide instant heat in winter and effective AC in summer (early EVs had some issues here due to energy draw, but heat pump technology is solving this); maintenance and repair – drivers expect a robust service network where EVs can be fixed or serviced easily. Currently, many independent garages are not yet EV-trained, and authorized service centers can be expensive or sparse. By 2030s, consumers assume EV maintenance will be as straightforward as any car (in fact, EVs need less maintenance overall, but things like software updates or battery checks become new service items). Resale value is another aspect – people worry whether an older EV (with an aged battery) will hold value or be hard to resell. They expect the industry to solve this, perhaps via battery certifications or easy battery replacements to extend vehicle life. Hidden expectation: Many mainstream consumers essentially want "an EV without any drawbacks" – a vehicle that delivers all the modern comforts and capabilities they're used to, plus the environmental benefits. They might not say this explicitly, but the expectation is that industry and policymakers will sort out the kinks (like standardizing charging plugs – the EU already mandated the CCS plug, ensuring battery longevity of 15+ years, etc.). There is also an expectation of support and information: early adopters aside, the general public wants clear guidance on using this new tech. For example, buyers appreciate when dealers or utilities provide tutorials on home charging installation, or when there are guarantees like roadside assistance if you run out of charge (mitigating a new kind of "breakdown"). Some European automakers offer concierge services for EV owners – e.g. free loaner petrol cars for long trips, or battery health guarantees – to reduce perceived risk. As EVs become the norm, such measures may phase out, but for now they play to hidden expectations that switching to an EV should not come with *stress*. Finally, the user experience of driving an EV (instant torque, quiet ride) is actually a positive that consumers enjoy – but they also expect continuous improvement (like more charging stations with amenities or apps that make trip planning with an EV effortless). By focusing on these day-to-day convenience factors, the industry can ensure that consumers not only choose EVs for rational reasons but *love* using them, driving word-of-mouth and broader adoption.

SMEs and Entrepreneurs: Needs & Challenges

For European entrepreneurs, startups, and SMEs in the mobility domain, electrification presents a mix of opportunities and substantial challenges. Whether they are part of the automotive supply chain or offering new mobility services, these smaller businesses have specific needs to survive and thrive in the electrified future:

Strategic Guidance and Market Insights: Many SMEs need help understanding where the future market opportunities lie in an electrified industry. The traditional automotive value chain is being upended, and a small supplier that for decades made, say, fuel pumps or mufflers might be unsure how to pivot. These firms crave insights into *emerging niches* – for example: *Which EV components or subsystems could we manufacture? Should we invest in power electronics, charging equipment, or perhaps software services?* They often lack internal research departments to analyze global EV trends. Thus, there is a need for accessible market intelligence and roadmaps tailored for SMEs. Industry bodies, consultants, or public agencies can play a role here by disseminating forecasts and conducting training or workshops. In fact, the EU has funded coordination actions (like the GO4SEM project) aimed at spreading awareness of global e-mobility trends and mapping European SME capabilities to those opportunities. Hidden expectation: SMEs expect that industry leaders and policymakers will offer clearer direction and support to help them identify viable niches. For instance, a small automotive machine shop hopes to be pointed toward making casings for electric motors or components for charging stations if those are growth areas. They also hope for networking platforms that connect them with OEMs and large Tier-1 suppliers, because being part of new partnerships or consortia is crucial for winning business in the EV era. Essentially, SMEs need a compass to navigate the transition – without a strategic rethink, they risk betting on the wrong horse or missing the EV wave entirely.

Financial and Technological Support for Transition: Shifting from ICE-focused operations to EV-related products can require costly retooling, new machinery, and worker retraining. SMEs, with limited capital and smaller cash flows, often struggle to finance this transition. There is a clear need for access to funding – be it loans, equity, or grants. They look to public programs and banks to provide favorable financing for electrification projects. European industrial policy is indeed moving to provide such support: for example, the EU and national governments have launched funds for SMEs to upgrade equipment or invest in R&D for electrification (Institut Delors, 2025). Some countries offer tax incentives for SME investments in green tech or subsidized loans via development banks. Still, many small businesses report difficulty securing the funds needed, indicating that programs may need scaling up or simplification. Another aspect is technological support: SMEs may lack in-house expertise in areas like battery chemistry, power electronics, or software. Partnerships with research institutes, technical universities, or collaboration in clusters can help fill this gap. Some governments sponsor SME-research cooperation projects or innovation labs specifically around e-mobility (e.g. Austria's "LMO" e-mobility lab connects SMEs to testing facilities). Hidden expectation: Entrepreneurs expect that the broader ecosystem (government programs, larger OEM partnerships, etc.) will "help de-risk" their investments in electrification. They anticipate measures like co-funding of pilot projects, grants for prototype development, or tax breaks for purchasing new tooling. Many also hope for support in upskilling their staff – as an example, a small manufacturer might need to train mechanical engineers in high-voltage safety or software basics; they expect vocational training systems to offer such courses. In short, SMEs look for an environment that *nurtures innovation* rather than leaving them to shoulder the entire burden (given that their larger competitors have far more resources to absorb the transition costs).

Skilled Workforce and Training: As the industry's focus shifts from mechanical engineering to electrical and software engineering, SMEs face a skill gap. A company that excelled at precision machining of engine parts might now need battery engineers, electronics technicians, or software developers – talent they never required before. There is a pressing need for upskilling and retraining programs to prepare the existing workforce for EV technologies. In Central Europe, many regions have a strong industrial workforce but in traditional skills (machining, welding, etc.). These workers could be retrained in assembling battery packs or operating new digital machinery, but it requires investment and proper curricula. Attracting new talent is also a challenge: SMEs not located in trendy tech hubs may struggle to lure software developers or data scientists who are in high demand. Often, large tech companies or automakers snap up the limited pool of experts, leaving SMEs talent starved. This is exacerbated by "brain drain" trends – e.g. many skilled engineers from Central/Eastern Europe might migrate to Western Europe or Silicon Valley, so local SMEs must work harder to retain talent. Hidden expectation: SMEs expect education systems and vocational training institutes to adapt to industry needs – for instance, introducing new courses on EV maintenance, battery production, high-voltage system design, etc., in technical schools and apprenticeship programs. Already, we see some progress automakers are partnering with universities on e-mobility programs, and EU-funded projects (like DRIVES) are developing curricula for electric vehicle skills. SMEs hope to tap into this pipeline of talent. They may also expect assistance through internship programs or apprenticeships that funnel newly trained talent into smaller companies, not just big ones. Additionally, SMEs often rely on open knowledge and tools – there is an implicit hope that as EV tech matures, more open-source frameworks or common standards will emerge, lowering the knowledge barrier. For example, open-source vehicle software (like Autoware for autonomous EVs) or reference designs can help SMEs not reinvent the wheel. Without the right skills and knowledge, SMEs know their ability to innovate is constrained – thus solving the talent puzzle is critical for their participation in the electrified future.

Market Access and Fair Competition: For entrepreneurs developing EV products or services, obtaining access to markets and customers is a make-or-break issue. A pain point can be the increasing industry consolidation – as large automakers and Tier-1 suppliers pivot to EVs, they might dominate new component supply chains, leaving little room for smaller entrants. SMEs need opportunities to get their foot in the door, whether as part suppliers to big OEMs or as service providers to communities. For instance, a startup making a novel EV charger would want to secure contracts with highway operators or city authorities; a small bus manufacturer of electric shuttles would want to bid on public tenders. There's an expectation that the EV transition should incorporate SMEs as vital contributors, not squeeze them out. Policymakers often hear SMEs call for measures to ensure a *level playing field*. This could include open innovation platforms where large firms and SMEs collaborate, SME-friendly standards (so that compliance costs don't inadvertently favor only large players), and public procurement rules that give innovative smaller companies a fair shot (e.g. by breaking large contracts into lots or evaluating not just on lowest price). For example, if a city is procuring a fleet of electric buses or installing chargers, local SMEs hope they won't be automatically overshadowed by multinational corporations – perhaps the city could require a portion of the work to involve local providers or run pilot programs specifically with startups. Similarly, as big carmakers establish software ecosystems or battery plants, SMEs hope for "open doors" to contribute their innovations – maybe through supplier diversity programs, startup challenges, or being invited into consortium projects. *Hidden expectation:* SMEs expect regulators and industry leaders to recognize that fostering a diverse ecosystem is beneficial. The narrative often is that SMEs bring agility and niche innovation, so keeping them in the game will accelerate overall progress. If the EV ecosystem becomes too closed or vertically integrated, it could stifle that innovation. Thus, SMEs count on explicit support for their market access – one real example is the EU's encouragement of MaaS (Mobility-as-a-Service) platforms that are open, allowing small mobility service providers to join city platforms rather than being locked out by a single app run by a giant company. By 2035, an ideal outcome is a rich tapestry of providers – where an SME in Slovenia providing battery diagnostics software can sell to a German automaker, or a Czech startup making conversion kits for electric trucks can find customers across Europe. Achieving that means addressing current market access frictions.

Customer Trust and New Business Models: Many SMEs are at the forefront of innovative business models or services in electrification – for example, a startup offering EV car-sharing in a mid-sized city, or a company selling retrofit kits to electrify old vehicles or providing mobile charging vans. These new services face the challenge of building customer trust in a nascent market. As a small player without an established brand, an SME must work hard to convince customers (be they individual consumers or businesses) to try something that didn't exist a few years ago. Reliability and convenience are paramount – if an EV car-sharing SME has frequent vehicle downtime or a clunky app, users will drop off quickly. Thus, these entrepreneurs need to deliver excellent service quality on limited resources and often need supportive conditions to get a foothold. For example, a local EV taxi startup might benefit if the city grants it access to bus lanes or prime parking spots – policy support can lend credibility and practical advantage. There's also a cultural shift needed: consumers have habits and biases, and SMEs pioneering (for instance) a service where you rent out your private home charger to others, or where you subscribe to an "Energy-as-a-Service" plan for your EV battery, must educate and persuade the public. Hidden expectation: These entrepreneurs often expect *supportive local policies and public openness* to innovation. Pilot-friendly regulations (like cities allowing new mobility services to operate on a trial basis) are very helpful. SMEs also hope to ride broader social trends – such as younger consumers valuing access over ownership and prioritizing sustainability – which can drive early adoption of their new models. Essentially, they need an ecosystem where early adopters are willing to use their offerings, and where they have enough runway to iterate and improve. Trust can be bolstered by partnerships: if a reputable city authority or big company partners with a startup, it signals to customers that it's credible. By 2035, we expect many of today's experimental models (from vehicle subscription packages to peer-to-peer charging networks) to either prove themselves or evolve, but getting there will require that these small innovators find a receptive customer base willing to break old habits. SMEs are betting that the ongoing generational shift in attitudes – and the urgency of climate action – will make consumers more adventurous in trying new mobility solutions.

Regulatory Clarity and Incentives: Finally, a crucial need for both manufacturing SMEs and service startups is a clear and supportive regulatory environment. Uncertainty or complexity in regulations can be a severe obstacle for small businesses that lack armies of lawyers. For instance, an SME developing a new battery recycling process needs to know what the regulations will require in terms of recycled content or safety standards; a startup converting petrol cars to electric needs a clear homologation process to get those converted vehicles street-legal. If rules are a moving target or differ widely by country, it can deter investment. In the EU, one challenge historically has been regulatory fragmentation – different countries had different rules on things like EV incentives, charger installation, or vehicle approvals. SMEs often don't have the capacity to navigate 27 sets of rules. They therefore value moves toward harmonized EU-wide rules for electrification, whether it's technical standards or incentive structures. (For example, the EU's new battery regulation applies uniformly, which helps a recycler plan for the whole EU market.) At the same time, SMEs appreciate regulatory flexibility – like sandbox programs or temporary exemptions that let them trial innovations without immediately meeting every strict requirement. Some European countries have created e-mobility "innovation zones" or special permits for pilot projects (e.g. allowing an autonomous electric shuttle on public roads under certain conditions). Ensuring that these are accessible to SMEs (not just big companies) is important. Moreover, compliance costs – from cybersecurity in connected EV charging to privacy rules for mobility apps – can be burdensome, and SMEs hope regulators calibrate requirements to not disproportionately burden smaller actors. Policymakers have indeed acknowledged the principle that regulations *"should not put undue burden on SMEs"* (European Commission, 2023). Hidden expectation: Entrepreneurs expect regulators to continue pushing a supportive policy framework – one that creates demand (through EV mandates, fleet electrification targets, etc.) but also provides transitional support to those delivering the solutions. They also hope for better communication and dialogue – SMEs want their voices heard in policy discussions, so that rules take into account their realities (e.g. longer lead times for compliance, or lack of dedicated compliance teams). By having a seat at the table, SMEs believe regulations can be made more innovation-friendly. In summary, what SMEs seek is a *stable yet adaptive regulatory climate* – stable in that it offers long-term clarity (so they can plan investments securely), and adaptive in that it accommodates experimentation and iteratively updates rules as technology evolves. If this balance is struck, SMEs can be powerful engines of innovation in the electrified mobility ecosystem.

Four Future Scenarios and Use Cases (2035)

To illustrate how the trends and needs discussed could unfold in practice, we present four scenario-based use cases set in the 2030s. These scenarios are plausible futures – imaginative narratives grounded in current macro trends, emerging technologies, and stakeholder dynamics – that showcase potential business models or service innovations by 2035. Each scenario highlights how certain pain points might be addressed and what new value networks could emerge, particularly with opportunities for SMEs in Central Europe. These are not predictions, but rather explorations of what *could* happen if key drivers play out in certain ways:

Scenario 1: *Community Charging Cooperatives – Local Infrastructure for EVs*

Use Case Summary: By the late 2020s and into the 2030s, many towns and rural regions form community-based charging cooperatives to fill gaps in the charging infrastructure. In this scenario, local stakeholders – municipalities, citizen groups, and local SMEs – collaborate to plan, install, and operate EV charging stations, with a model that keeps profits and decision-making within the community. This bottom-up approach emerges in response to the rapid growth of EVs (even in smaller communities) and the recognition that purely market-driven charger rollouts were leaving certain areas underserved.

Details: Consider a mid-sized town in 2030 in southern Poland, with outlying villages around it. EV ownership has grown, but most private investments in charging focused on big cities or highways. Tired of waiting, the town's council teams up with a local energy-tech startup and a cooperative of residents to create a *"Charging Co-op."* They pool funding (helped by an EU rural mobility grant) and deploy public charging hubs at strategic locations – the town square, the train station, and in several nearby villages (like at grocery store parking lots). These hubs include a mix of fast chargers and Level-2 chargers, many covered by solar panel canopies with battery storage on-site. The cooperative structure means community members can buy a share for a modest fee; as co-op members, they get discounted charging rates and a voice in decisions (like where to add the next charger). Local electricians and installers (SMEs) get the contracts to build and maintain the stations, ensuring the investment benefits the local economy. The result: residents and small businesses in the area now have reliable charging "within 5 km of every home," and range anxiety fades away. A farmer on the outskirts who bought an electric pickup can charge it at the village hub while delivering produce, confident a charger will be free. The renewable energy integration (solar + batteries) addresses grid constraints and aligns with citizen values for clean energy. During sunny days, excess solar power is stored and then used for EV charging in the evening, reducing peak load on the grid. Essentially, the community has taken ownership of the charging challenge, rather than being dependent on big charging networks that had been slow to arrive.

Enabling Factors: This scenario is supported by favorable policies and local initiative. The EU's Alternative Fuels Infrastructure rules and funding streams (like the Connecting Europe Facility) began providing grants for charging in underserved areas, which these co-ops leverage. By 2030, thanks to AFIR and efforts like these co-ops, Europe surpasses 1 million public chargers deployed (hitting the EU's earlier goal later than 2025 but eventually achieving it as EV numbers soared). Technology trends also help: charging hardware became cheaper and more modular by the late 2020s, making it feasible for a small town to purchase fast chargers (some manufacturers are SMEs themselves, offering co-op friendly business models). The prevalence of standardized payment and roaming agreements means the co-op's chargers are interoperable – any EV driver can use them easily, but co-op members get the best rates. Stakeholder dynamics: local authorities in this scenario take on an entrepreneurial role (unlike the old paradigm of leaving infrastructure entirely to private companies). Utilities partner by offering special tariffs or grid upgrades in collaboration with the co-op (recognizing the mutual benefit). The cooperative model directly addresses the pain point of uneven infrastructure distribution: previously, private charging companies focused on high-profit highway corridors or dense cities, but community co-ops bring infrastructure to smaller towns and rural areas that were at risk of being left behind. By 2035, a patchwork of these community-run charging networks spans Europe, often interlinked via roaming to create a truly comprehensive web. For Central Europe, this is especially impactful in countries like Slovenia or Hungary where outside main cities charger density was low – now local initiatives ensure even a mountain village or a lakeside town has charging available. The business model is sustainable because revenue stays local (reinvested or shared with co-op members as dividends or local tax relief). It empowers SMEs (electricians, software providers for the co-op's apps, etc.) to build new business, and it strengthens community buy-in for EVs (people see tangible benefits and have ownership). In essence, this scenario shows a future where electric mobility is accessible to all, not just an urban privilege, achieved through community innovation and cooperation.

Scenario 2: *Circular Battery Ecosystem – SMEs Driving Battery Recycling and Reuse*

Use Case Summary: As millions of EVs hit the roads, Europe by the early 2030s faces the growing challenge (and opportunity) of used batteries. A robust circular battery economy emerges, led by specialized SME consortia that handle end-to-end battery collection, recycling, and second-life repurpose at scale. This scenario capitalizes on the macro trend of securing raw materials and meeting sustainability expectations by turning battery waste into a resource. It illustrates new business models where smaller firms collaborate across borders to close the battery loop.

Details: By 2030, the first big wave of EV batteries from vehicles sold in the mid-2010s is reaching end-of-life. Rather than seeing mountains of e-waste, Europe has nurtured dozens of battery recycling startups. For example, a small family-owned recycling company in Slovakia partners with a clean-tech startup in France and a local metallurgy institute in Italy. Together, they form a consortium called *ReBattery Europe*. They operate facilities in several countries that safely disassemble used EV battery packs and extract valuable materials like lithium, cobalt, nickel, and copper. Thanks to years of R&D (some funded by EU Horizon programs), these SMEs use advanced recycling methods – a mix of hydrometallurgical and new electrochemical processes – that achieve very high recovery rates of critical metals. Crucially, by 2030 the EU's Battery Regulation is in force and mandates that new EV batteries must include a minimum percentage of recycled content (e.g. at least 12% cobalt, 4% lithium, 4% nickel from recycled sources). This creates a guaranteed market for the recovered materials. Automakers need recycled lithium and cobalt to comply with the law, so they sign supply contracts with the SME consortia. The recycled metals are refined to high purity by the consortium and sold back to European battery manufacturers to make new cells – establishing a closed-loop supply chain in the region. This not only reduces dependency on imported raw materials (aligning with the supply chain localization trend) but also turns what was a waste problem into an economic opportunity. One could say these SMEs are mining "urban mines" (old batteries) instead of the ground, with significant climate and environmental benefits.

In addition to recycling, the consortiums find creative ways to give batteries a "second life." Another set of entrepreneurs specializes in taking EV batteries that are retired from cars when they dip below ~80% of original capacity (which is insufficient for driving range but still plenty for stationary uses). They refurbish or reconfigure these battery modules into stationary energy storage systems. For instance, a startup in Hungary acquires used EV battery packs, tests and reassembles them into containerized storage units. These are then sold to, say, a community solar project in Italy to store excess solar power, or to a factory in Germany for peak shaving. Communities benefit: imagine a small town that installs a second-life battery storage unit next to a local solar farm – the unit stores daytime surplus and releases it in the evening when residents charge their cars, thereby stabilizing the local grid. This meets the sustainability expectations of citizens – people are pleased that EV batteries aren't just discarded after use, and that the EV revolution contributes to broader clean energy goals (by enabling more renewable integration via storage). It also indirectly addresses cost concerns: efficient recycling and reuse eventually help lower the cost of new batteries (since recycled materials supplement mined ones) and provide cheaper storage options to keep electricity prices stable, making EV charging cheaper in the long run.

Enabling Factors: Strong policy was key to this scenario. The EU Battery Regulation (approved in 2023) phased in requirements through 2030 and beyond, including high recycling efficiencies (e.g. by 2030, at least 70% of lithium in batteries must be recovered, and 95% of cobalt, nickel, copper, etc.) and the aforementioned recycled content mandates for new batteries. Producer responsibility laws force automakers to take back batteries – rather than handle it in-house, most partner with or outsource to these specialized recyclers. The EU and national governments also helped seed the industry: funding from innovation programs (Horizon Europe, etc.) supported several SME-led projects developing safer and more efficient recycling tech (like robots for battery disassembly or new chemical processes to recover lithium). By 2030, those efforts paid off and many SMEs had cutting-edge techniques ready just as the volume of used batteries surged. Another driver was the economics of raw materials: cobalt, nickel, and lithium prices remained relatively high due to global demand, so recovering them made good business sense – no longer just an environmental mandate, but a profit center. Technological innovation is central here too: improved recycling methods (e.g. direct cathode recycling) increased yields and lowered costs, making small-scale plants viable. *Stakeholder dynamics:* It's noteworthy that this circular economy is largely driven by SME networks. Unlike the automotive manufacturing dominated by big firms, battery recycling saw new players jump in. The trust and cooperation among them (often facilitated by EU networks or industry associations) allowed cross-border consortiums to form, pooling expertise (one might be great at logistics/collection, another at chemical processing, another at refining). Consumers also play a role – aware of the importance of recycling, by the 2030s people willingly return their old EV or battery to designated points (sometimes incentivized by a deposit refund or rebate on a new car). Thus, a steady stream of feedstock flows to the recyclers. Impact: By 2035, the scenario yields a *circular value network* where SMEs capture value at multiple points – collection, materials processing, repurposed second-life product sales – turning electrification into a cradle-to-cradle system. This squarely addresses the customer/community need for environmental responsibility: EV owners can be confident their vehicle's battery will be handled in an eco-friendly way at end-of-life, bolstering the green credibility of going electric. It also improves Europe's resource security and cost structure: recycled materials reduce the need for imports and buffer against raw material price swings, contributing to making EVs more affordable and sustainable.

Scenario 3: *Fleet Electrification-as-a-Service – Empowering SME Logistics*

Use Case Summary: By the early 2030s, electrification in the commercial sector accelerates as many small businesses and municipal fleets seek to decarbonize. A new service model emerges: "Fleet Electrification-as-a-Service," provided by specialist SMEs, which offers a one-stop solution to convert and operate entire fleets of vehicles on electric power. In this scenario, an SME service provider handles everything – from vehicle procurement to charging infrastructure and energy management – for clients like delivery companies or city services, making it easy for those clients (often SMEs themselves) to go electric with minimal hassle or upfront cost.

Details: Imagine a regional delivery company in Czechia with 20 diesel vans in 2025; by 2030 it is under pressure to go electric. Cities in Europe have started implementing zero-emission zones where only EVs can enter for deliveries (for example, many city centers allow only electric delivery vans by 2030 as part of clean air plans). Additionally, the company's large retail clients demand cleaner logistics in their sustainability reports. However, this delivery SME lacks the capital to buy 20 new EVs at once, and it worries about how to charge them or maintain them. Enter a new kind of firm: *ElectraFleet Co.*, an SME founded by former automotive engineers, operates on a servitization model. It offers the delivery company a package: ElectraFleet will supply electric vans (the delivery company can lease them per month, no huge purchase needed), install and manage charging stations at the company's depot and key delivery points, and provide software that optimizes vehicle charging schedules and routes for efficiency. They even train the delivery drivers in eco-driving techniques to maximize range. All the delivery business does is pay a monthly fee, which is calibrated to be on par with what they used to spend on diesel fuel and maintenance – sometimes even lower, thanks to cheaper electricity and fewer mechanical issues. Essentially, the client's fleet is electrified *as a service*.

For example, a bakery chain in Slovenia signs on with such a provider: overnight, the provider's team outfits each bakery location with smart chargers. Their software ensures each delivery van charges during the cheapest grid hours and is fully ready by morning. If any van's battery health drops, the provider takes care of replacement or repair under the contract. The bakery's operational routine barely changes – but now all their bread is delivered emission-free, and they can market that to eco-conscious customers. From the perspective of these fleet-operating SMEs (be it a plumbing company, a taxi cooperative, or a municipal service fleet), this model removes the complexity and risk of electrification. They don't need in-house specialists or large upfront investment; they get predictably priced, turnkey electric mobility. This addresses a huge pain point for small operators: lack of capital and expertise to transition to EVs. On the flip side, for the service provider SMEs, this model is a huge opportunity. By 2035, tens of thousands of small fleet operators across Central Europe need electrification solutions. Some ElectraFleet-type startups specialize by sector: one might focus on last-mile delivery fleets, setting up ultra-fast chargers at logistics hubs and offering battery leasing so couriers never worry about battery degradation. Another might target public-sector fleets, helping city governments replace buses or garbage trucks with electric versions through performance contracting (the provider gets paid from the fuel savings over time, for example). These providers often act as aggregators of demand: they might place bulk orders for electric vehicles from manufacturers (getting volume discounts) and then allocate vehicles to various clients, or negotiate special energy tariffs with utilities because they manage hundreds of chargers. In effect, they form a value network linking EV manufacturers, charging infrastructure companies, and end-user fleets – with themselves in the integrator role.

Enabling Factors: Several trends support this scenario. First, regulatory pressure on commercial transport is increasing: as noted, many European cities implement low-emission zones barring fossil vehicles, and new EU regulations may push corporate fleets to report and reduce emissions. By 2030, delivering goods in major EU city centers likely requires zero-emission vans, forcing businesses to act (and making them seek help). Second, the total cost of ownership (TCO) for EVs in commercial use keeps improving – EVs typically have lower operating costs, and as carbon taxes or fuel prices rise, running diesel vehicles becomes more expensive. By late 2020s, many companies realize EV fleets could save money *if managed well*. That "if" is where the service providers come in, using telematics and analytics to squeeze maximum efficiency (e.g. scheduling charging when electricity is cheapest or coordinating routes to fit vehicles' range). Third, financial innovation is enabling this model: seeing the demand, some banks or green funds offer financing to these service startups, letting them buy vehicles and infrastructure up front and recuperate costs via client fees over years. Government green banks or EU investment funds also support such intermediaries, recognizing they accelerate uptake among SMEs. Stakeholder dynamics are favorable too: utilities are often eager to partner with fleet-as-a-service providers to get more load on their grids, and vehicle OEMs sometimes partner with these startups to reach SME customers (for instance, a van manufacturer might co-develop a package deal with a local service provider to offer "van + charger + software" bundles for small businesses). An example dynamic: a major electric van OEM in 2030 partners with a startup in Hungary to bundle 10 vans, installation of a solar+storage charging depot, and fleet management software in one lease contract for small logistics firms – a departure from the old model of simply selling a vehicle.

Impact: This scenario directly addresses customer needs: small fleet operators (SMEs, municipalities) get a hassle-free path to electrify, solving their pain point of not knowing how to deal with new tech or high upfront costs. They also gain stability – a predictable monthly service fee and compliance with regulations without having to become EV experts. Society benefits from cleaner urban logistics and transit without waiting for each small player to figure it out individually. For the service-providing SMEs, this is a booming business segment; some grow rapidly and even expand internationally, managing tens of thousands of vehicles by mid-2030s. In Central Europe, this empowers local startups to be part of the electrification wave – instead of everything being done by large multinationals, these nimble SMEs fill the gap for tailored, local solutions. By 2035, one can imagine that Electrification-as-a-Service companies are as common as third-party IT providers – any company that doesn't want to deal with fleet ownership just outsources it to these specialists. This greatly accelerates the transition in sectors that might otherwise lag, like craft businesses, regional delivery, or small-town public services. In essence, scenario 3 shows a future where electrifying a fleet is no more complicated for an SME than subscribing to a phone plan – lowering the barrier significantly and ensuring the benefits of e-mobility (lower operating costs, cleaner air) are widely and quickly realized.

Scenario 4: *Smart Mobility in Small Cities – EV Sharing and MaaS for All*

Use Case Summary: By 2035, not only megacities but also smaller cities and towns across Central Europe have embraced innovative mobility solutions. This scenario envisions a typical town of ~50,000 people that develops a smart electric mobility system tailored to local needs. It combines EV-based car-sharing, on-demand electric shuttles, and integration with public transit – essentially a local Mobility-as-a-Service (MaaS) ecosystem. What's notable is that this is often led by local entrepreneurs or SMEs in partnership with the city, ensuring that even outside major urban centers, citizens have convenient, affordable, and low-carbon transport alternatives to private car ownership.

Details: Consider a town where traditionally most people drove their own cars. By the early 2030s, a group of tech-savvy young entrepreneurs, some fresh out of university, see an opportunity: many residents (especially younger ones) are open to not owning a car if good options exist (indeed, by then many under-30s prefer an app-based solution over the costs of ownership – recall ~40% of young Europeans in surveys said they could imagine living without a personal car). They are launching an EV-based mobility service startup in the town, with the blessing and support of the forward-thinking city council. The service has multiple components: a station-based e-car-sharing fleet of small electric cars scattered around town (at ratio maybe 1 car per 300 residents to start); an on-demand e-shuttle service that uses electric minibuses to pick up and drop off people around town or to nearby villages based on app bookings; and a user app that also links to the existing public transit schedule (the town still has some bus lines, now gradually electrified, and a train station). A user can, for example, take a shared shuttle from their home to the train station in the morning, and in the evening maybe rent a small EV from a nearby lot to run errands. The city government partners closely in this. They provide seed funding (perhaps reallocated from a budget for building a new parking structure that's no longer needed), designate free parking spots around town for the shared EVs, and allow the on-demand shuttles to use bus lanes or semi-pedestrian zones to ensure quick service. The city's motivation is to reduce congestion, free up land from parking, and meet climate goals – and this service aligns perfectly, being electric and shared. For residents, convenience quickly becomes apparent. Families that used to feel they needed a second car realize they can do without: the car-share EVs are always available for a few euros when needed. Older folks and those in peripheral neighborhoods appreciate the on-demand electric shuttle that can be summoned with a phone or simple phone call, providing more flexible service than the old hourly bus. By 2035, car ownership in the town drops significantly – many young adults choose not to buy a car at all, and some existing car owners sell one or both of their vehicles because the local MaaS covers their needs. The town enjoys less traffic and noise, and more people make use of public spaces previously occupied by parking lots (some turned into parks or cafes). Importantly, the mobility solutions are locally tailored: for instance, the car-sharing fleet might include a couple of larger electric vans that people can rent on weekends if they need to move furniture or take a family trip, as well as e-bikes or e-cargo bikes for shorter trips. The local operators know the community – they add more shuttles on market day, and they coordinate with event organizers if there's a festival to ensure enough vehicles are available.

Enabling Factors: This scenario is enabled by several developments. Digital platforms and connectivity matured in the 2020s to a point where even small operators can deploy robust apps for booking, payment, and vehicle routing. White-label MaaS software became available that an SME could customize for their town, rather than needing to build everything from scratch. By the 2030s, most people have smartphones (across age groups), and those who don't can access services via call centers – so acceptance of app-based mobility is widespread, not just in big cities. Secondly, the cost of EVs and batteries continued to fall, making it economically feasible to deploy a fleet of vehicles without prohibitive expense. The reliability and low maintenance of EVs is crucial for shared vehicles that see heavy use – fewer breakdowns means a small fleet can serve more people. Another factor is demographics: many small towns in Central/Eastern Europe have aging populations, and providing mobility for seniors who can no longer drive is a growing need. On-demand shuttles fill that gap cheaply compared to fixed bus routes. Policy support extended beyond big cities as well: by 2030, national governments realized that to meet EV adoption and climate targets, *smaller communities must not be neglected*. Thus, incentives and funding that initially targeted private EV purchases expanded to include support for shared mobility projects and electrification in towns. For example, some countries gave grants to municipalities or co-ops to set up car-sharing in towns under 100k population, or made rural mobility a priority in climate investment plans. EU regional development funds also pivoted to support e-mobility pilots in cohesion regions, etc. This helped startups secure initial capital (the entrepreneurs in our town may have won an EU prize or national innovation grant for new mobility). Car manufacturers also got involved: seeing a new market, some offer specialized fleet programs for car-sharing operators, even designing vehicles optimized for sharing (easy to clean, durable interiors, maybe a city EV that's very compact for narrow streets).

Impacts: For citizens, this scenario delivers convenient, affordable mobility without needing personal car ownership. It directly addresses the hidden expectation of *equity* – ensuring that the benefits of electrified, digital mobility are not just in wealthy urban centers but available beyond big cities. A student in a small city can now live car-free but still get around easily; an elderly person in a nearby village can call a shuttle instead of being isolated. For SMEs and local entrepreneurs, it opens a new playing field – they can become mobility providers in their area, a space previously dominated by public agencies or large ride-hailing firms. By focusing on community scale, they find viable business models with loyal local user bases. The town benefits from reduced emissions and a more vibrant, less car-clogged environment, helping meet climate commitments and improve quality of life. Regionally, by 2035 one can envision a network of hundreds of small-city mobility providers across Europe. They might share best practices through associations or EU-sponsored platforms, and even interlink their apps so that, for example, a traveler can seamlessly use the MaaS service in the next town over with the same account. This scenario showcases how electrification + digital innovation can transform mobility habits even outside the megacities, with SMEs innovating in service delivery and public authorities enabling the change. It paints a picture of a future where owning a private car in a town is optional because clean, smart mobility is readily accessible – fulfilling both the sustainability promise of electrification and the convenience needs of modern consumers. Each of these four scenarios demonstrates a different facet of the future mobility ecosystem in Central Europe under electrification: infrastructure innovation (charging co-ops), circular economy (battery reuse), new service models (fleet electrification-as-service), and integrated mobility (small city MaaS). They highlight plausible business models that address today's pain points: whether it's charging access, resource sustainability, ease of adoption for businesses, or equitable mobility access. Notably, in all scenarios SMEs play key roles, suggesting that Central Europe's innovative small businesses can be instrumental in making the electric mobility transition a success on the ground.

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3.2 Automation

Macro Trends & Industry Shifts

In Central Europe – encompassing Germany, Austria, Poland, Czechia, Hungary, Slovenia, and Italy – the mobility ecosystem is being reshaped by several powerful macro trends. Sustainability and Decarbonization: Ambitious climate policies are driving a historic shift from combustion engines to electric and other zero-emission vehicles. The EU has set a *100% CO_2 reduction target for new cars by 2035* (effectively banning new petrol/diesel sales) to reach climate neutrality by 2050 (European Parliament, 2023). This regulatory push makes electrification *inevitable* for automakers. In turn, automation is seen as a complement to sustainability – for example, autonomous driving technologies can enable smoother traffic flow and eco-driving, further cutting emissions. Digitalization and Connectivity: Vehicles are becoming "computers on wheels," equipped with advanced electronics and always-on connectivity. This sets the stage for automation: cars can exchange data with infrastructure and cloud systems in real time, which is essential for higher levels of autonomous driving. Nearly *95% of new vehicles globally are expected to be connected by 2030* (McKinsey, 2020) – a foundation for widespread vehicle-to-everything communication. Advancements in Automation Technologies: Europe views *Cooperative, Connected, and Automated Mobility (CCAM)* as a core future paradigm. Already, today's new cars often come with *Level 2* driver assistance (lane keeping, adaptive cruise control), and the first *Level 3* semi-automated systems (hands-off driving in certain conditions) have been approved (e.g. Germany allowed a Level 3 system in 2022) (Oliver Wyman, 2025). There is a surge of R&D in sensors (LiDAR, radar), AI for perception and control, and high-definition mapping – much of it led by European firms or research consortia. These advancements are steadily pushing the boundary from assisted driving to higher autonomy. Shifting Mobility Behaviors and New Models: Consumers, especially younger generations, are increasingly open to *shared and on-demand mobility* over car ownership. This social shift is evident across Europe – about *40% of 18–34-year-olds would consider giving up owning a car*, and roughly one-third of all European car owners can imagine not owning a personal car in the future (Oliver Wyman, 2025). As people prioritize access over ownership, concepts like robotaxis, autonomous shuttles, and Mobility-as-a-Service gain traction. Automakers and mobility providers are thus moving toward "service" business models – from car subscriptions and autonomous ride-hailing to logistics-as-a-service – in which automation plays a key enabling role.

These macro trends are interrelated. Central Europe's industry is adapting quickly: traditional OEMs (like those in Germany and Italy) are investing heavily in electrification and autonomous tech concurrently, aiming to stay competitive against global rivals. Meanwhile, the push for sustainability and digitalization has strong government backing. The result is an unprecedented transformation: the region is shifting from an auto industry rooted in mechanical engineering and driver control, to one focused on electric powertrains, software, and self-driving capabilities. Europe's policymakers often describe the vision as "green, connected, and automated" mobility – a triad where electrified vehicles, pervasive connectivity (5G, V2X), and autonomous driving converge (European Commission, 2024) In summary, automation in mobility is not occurring in isolation; it is part of a broader shift toward a cleaner, digital, service-oriented mobility ecosystem in Central Europe.

Political, Regulatory, and Technological Drivers

Strong political and regulatory drivers in Europe are accelerating automotive automation. The EU's Strategic Priority on CCAM (Connected, Cooperative, Automated Mobility) is backed by substantial funding and supportive policies. Through programs like Horizon Europe, the European Commission is investing around €500 million (matched by industry) into CCAM R&D partnerships to ensure Europe leads in autonomous mobility (European Commission, 2024). This has already funded dozens of pilot projects (from autonomous shuttles to truck platooning trials) across EU member states. Regulators are also actively adapting the legal framework: in 2022, an amendment to UN/ECE regulations allowed Level 3 automated driving up to 60 km/h, which Germany promptly adopted – enabling the first hands-off driving features on German roads

(Oliver Wyman, 2025). The EU Vehicle General Safety Regulation (applicable from July 2024) now mandates advanced driver-assistance systems (emergency braking, lane-keep assist, drowsiness detection, etc.) in all new cars (Oliver Wyman, 2025). This not only improves safety, but also creates a baseline hardware platform (sensors, processors) on new vehicles that can support higher automation. Additionally, several countries in Central Europe are establishing legal sandboxes for AV testing – for example, Austria and Hungary have designated test zones for driverless vehicles, and Italy has updated its road code to allow autonomous vehicle trials under certain conditions. These regulatory moves reduce barriers for companies to develop and deploy automated driving technologies. On the political side, strategic goals around road safety and efficiency bolster the case for automation. The EU's Vision Zero aims to eliminate road fatalities by 2050, and national governments see automation (which can eliminate human error) as a key tool toward that goal. Similarly, many governments grapple with issues like driver shortages and transit accessibility. In Germany, for instance, a looming shortage of around 80,000 bus and truck drivers by 2030 is prompting authorities to support autonomous buses and trucks as a solution (McKinsey, 2025). The Amsterdam Declaration (2016) brought together European transport ministers to coordinate on automated driving, and follow-up EU communications (2018 and 2020) have laid out roadmaps for interoperable AV deployment (European Commission, 2024). Thus, there is high-level political alignment in Europe to enable automated mobility in a safe and phased manner.

Key **technological drivers** are also propelling automation forward. One is the rapid improvement and cost reduction in sensors and computing. Lidar, once extremely expensive, is becoming cheaper and more robust; camera and radar systems are now standard in mid-range cars. Crucially, the rollout of 5G networks and edge computing along major corridors in Europe provides the low-latency communications needed for vehicle-to-infrastructure (V2I) and vehicle-to-vehicle (V2V) coordination. The EU has funded "5G corridors" to ensure that by 2025, major highways (including those crossing Central European countries) have 5G coverage for connected and automated driving (European Commission, 2024) Another driver is the maturation of AI software, especially in perception (thanks to better machine vision and datasets) and decision algorithms. European firms – from big OEMs to startups – have been investing in autonomous driving software stacks and self-driving AI. For example, multiple pilot projects under the EU's CCAM partnership have demonstrated AI-driven shuttles in real traffic. Finally, data is a critical enabler: Europe is moving toward a Common European Mobility Data Space (an EU initiative to improve data sharing across vehicles, operators, and authorities) (European Commission, 2023) This will make it easier for different stakeholders to exchange traffic data, HD maps, etc., which in turn supports safer and more reliable autonomous operation. In summary, a combination of forward-looking regulation, public funding, and technological breakthroughs (in sensors, connectivity, and AI) is accelerating the deployment of vehicle automation in Central Europe's mobility sector.

Stakeholder Dynamics

The push toward automated mobility is reshaping the roles and relationships of stakeholders across Central Europe's transport landscape. Traditional vehicle manufacturers (OEMs) – including German and Italian automotive giants – remain at the center, but they are being joined (and sometimes challenged) by new actors. The major OEMs are investing billions in developing autonomous driving capabilities, often through partnerships or acquisitions. For instance, Volkswagen (via its Autonomous Intelligent Driving unit and partnerships with Argo AI, etc.) and BMW/Mercedes (through consortia and tech partners) are actively testing robo-taxis and automated features. These incumbents face a dual challenge: meeting regulatory requirements (for safety and emissions) while also fending off competition from tech entrants. They have been lobbying for harmonized EU rules on AVs to avoid fragmentation and to ensure a level playing field (S&P Global, 2023). Many have also called for public co-investment in infrastructure like smart roads and digital networks. In Central Europe, where automotive manufacturing is a big part of the economy (e.g. in Czechia, Hungary, Poland), OEMs are also leaning on governments to support the transition so that local factories and jobs adapt to the new technology (through worker re-training programs, etc.).

Technology companies and startups are crucial stakeholders gaining prominence. Large global tech firms (from Silicon Valley or China) provide key software platforms, AI chips, and cloud services for autonomous driving – for example, various European pilot projects use AI software from specialist firms or mapping data from high-tech providers. Within Europe, numerous startups and SMEs are innovating around autonomous systems: companies making lidar sensors, AV software, simulation tools, or specialized autonomous vehicles (like delivery robots or shuttles). Many of these are in Central Europe or collaborate with institutions there. However, SMEs face hurdles in this domain – the R&D is costly and the regulatory approvals complex. The EU and national governments are aware of this and have programs to support SMEs. There are innovation hubs (e.g., in Austria and Germany) offering testing facilities for autonomous tech, and grants to help startups participate in large consortium projects. A notable trend is *collaboration*: we increasingly see consortia where an OEM partners with a telecom company, a university, and a startup to trial AV technology on public roads (European Commission, 2024). For example, in Poland and Czechia, telecom operators have teamed up with car manufacturers to test 5G-enabled autonomous driving on highways. This reflects the reality that no single actor can “go it alone” – connectivity and automation require a networked ecosystem of vehicles, digital infrastructure, and services.

Public authorities – from EU institutions down to city governments – play a multifaceted role: regulator, facilitator, and even customer. The European Commission sets the overall regulatory framework and provides funding incentives, as discussed. National governments in Central Europe are implementing EU directives into local laws (for instance, updating traffic laws to legalize autonomous vehicle operation under certain conditions). They also often co-fund research and pilot programs (such as Germany’s funding for autonomous bus pilots in rural areas, or Slovenia’s grants for smart mobility innovation). Importantly, many city and regional authorities have become *proactive stakeholders*. Cities like Vienna, Munich or Milan are not just permitting AV pilots but in some cases initiating them – for example, launching tenders for autonomous shuttle services to complement public transport. Municipalities see potential in AVs to solve urban issues like first-mile/last-mile transit gaps and to provide mobility for disabled or elderly residents. However, they also have to manage public concerns (safety, privacy, potential job losses for human drivers). Some cities form advisory panels including citizen groups, transit unions, etc., to guide how autonomous tech is introduced. In Central Europe, public acceptance is a key variable: a strong cultural preference for well-regulated, safe transport means authorities are deliberately phasing in automation with careful communication and transparency (McKinsey, 2025).

Another stakeholder dynamic is the **role of infrastructure operators and telecom companies**. Highway authorities, road operators, and rail companies are increasingly involved, since automation benefits greatly from smart infrastructure. For example, highway agencies in Austria and Italy are installing connected corridor systems (sensor stations, HD mapping) so that autonomous trucks and cars can get real-time road information. Telecom providers (like Deutsche Telekom or Telecom Italia) are key partners providing the 5G networks and edge cloud services that AVs rely on for data. This blurs industry lines – telecom and automotive find themselves in a closer partnership than ever before. We also see **tier-1 suppliers** (Bosch, Continental, ZF, etc. – many with big presence in Central Europe) evolving their business models, offering entire “automated driving modules” to OEMs, and working directly with software firms. Many suppliers and even SMEs are part of new alliances (e.g., the EU’s CCAM Platform) where stakeholders across sectors meet to set technical standards and share findings to speed up deployment (European Commission, 2024).

Lastly, **citizens and civil society** can be considered stakeholders as well – their trust and acceptance will ultimately determine success. In some Central European countries, public skepticism toward self-driving cars remains significant, especially after widely publicized accidents elsewhere. This has led to stakeholders emphasizing education and demonstrating safety. For instance, pilot projects in Hungary and Poland with autonomous shuttles in city centers have had operators on-board initially, partly to reassure passengers. In sum, stakeholder dynamics around automation are defined by **cross-sector collaboration**. The automotive value chain in Central Europe is becoming an integrated network of automakers, tech firms, telecoms, SMEs, government entities, and end-users – all negotiating new roles. Europe’s approach is often described as a *"cooperative ecosystem"*: the belief is that through partnership and aligning interests (safety, innovation, economic opportunity), automated mobility can be rolled out in line with European values and market conditions (European Commission, 2024). This cooperative model is seen as a strength for Europe in competing with the more Silicon Valley-driven or government-driven (China) approaches elsewhere.

Future Customer Needs and Pain Points

As autonomous driving technology moves from labs and pilots into real services, its success hinges on addressing the real needs and concerns of end users. We examine two broad user groups – **citizens (passengers, drivers, communities)** and **businesses/entrepreneurs (e.g. mobility SMEs)**, to understand their future needs, pain points, and "hidden" expectations regarding automated mobility.

Citizens and Communities: Needs & Expectations

For the general public, autonomous mobility promises to solve some long-standing transportation pain points, but it also introduces new concerns that must be managed. A primary need is Safety and Trust. People expect AVs to *reduce accidents and save lives* by eliminating human error – one of the selling points often cited for self-driving cars. In countries with high road accident rates, this is a compelling benefit. However, paradoxically safety is also the top concern: many individuals are wary about trusting a machine to drive. High-profile incidents involving experimental self-driving cars (mostly abroad) have made headlines in Europe, so the public harbors fears of malfunctioning AI or situations where an AV might make a "wrong decision." To win consumer trust, AV operators and regulators will need to demonstrate extremely high safety standards and transparency. For example, European trials have shown that providing clear information to riders – like an in-car display that explains what the AI is "seeing" and doing – can make people more comfortable. A *hidden expectation* here is that AVs should not only be statistically safer, but feel safe. This means driving behavior that is not too aggressive or robotic; an autonomous shuttle should handle turns and stops in a comfortable, humane way. Communities will also expect strong oversight: they want regulators to certify AVs through rigorous testing and to have clear liability rules. Indeed, ongoing EU discussions about an "*AI Act*" and updates to product liability laws reflect the public expectation that someone is accountable for an AV's actions.

Another major need is Accessible and Inclusive Mobility. In Central Europe (as across Europe), aging populations and people with disabilities face mobility challenges – many cannot drive or find public transport difficult to use. Autonomous vehicles could be a game-changer by providing *independent mobility for those who are currently underserved*, if the services are designed with accessibility in mind. An elderly person in a rural Czech village, for instance, could summon an autonomous shuttle to their door to go to a clinic, whereas today they might have no convenient option. About *25% of Europeans have some mobility impairment* (physical or cognitive), yet today many are effectively "stranded" or reliant on others (McKinsey, 2025). There is a clear expectation that AV services will be universally accessible – meaning vehicles that accommodate wheelchairs, interfaces that are easy for visually or hearing-impaired users, and systems that are intelligible even to those not tech-savvy. Communities will demand that automated mobility does not just cater to young urban professionals, but also serves seniors, rural residents, and disabled citizens. A hidden expectation might be personalization for special needs (e.g. an AV that a blind person uses should provide audio cues and confirm verbally that it has identified the passenger and their destination). If these expectations aren't met, public sentiment could quickly sour on AV projects.

Convenience and Reliability are also key needs. For consumers to embrace autonomous services, they must perceive them as *more convenient than current options*. One aspect is on-demand availability: people imagine being able to summon a robotaxi or autonomous shuttle via smartphone exactly when they need it, rather than being tied to a bus schedule. In cities, this means short wait times and efficient routing. In smaller towns, this might mean reaching areas that buses don't go. Central Europeans will expect AVs to help fill the notorious "last-mile" gaps in transit – e.g., getting from a train station to one's home in a suburb. Another aspect is time efficiency: an AV should ideally optimize the trip (using AI to avoid traffic jams) and also free the passenger from driving so they can use travel time productively or for rest. We often hear the promise that commuting in an AV could let you answer emails or relax instead of stressing over traffic. People certainly will expect that benefit. Reliability is crucial as well: if an autonomous shuttle is supposed to pick up a child from school at 3pm, parents need absolute confidence it will be there. Thus, consistency and uptime of these services will be scrutinized. Hidden expectations here include the ability to track and communicate – riders will assume they can see the AV's location in an app, get an alert "your vehicle is 2 minutes away," and contact customer support if needed. Essentially, the user experience around AV services must be seamless and reassuring to gain widespread adoption.

Cost and Affordability also come into play (tied to convenience). Consumers will compare the cost of autonomous mobility with alternatives. There is an expectation – often fueled by industry – that automation can eventually *lower the cost* of rides (by eliminating driver labor and optimizing vehicle utilization 24/7). Indeed, some companies have claimed robotaxis could be half the cost of today's taxis or even cheaper than public transit (McKinsey, 2025). Whether that proves true remains to be seen, but certainly, Europeans will expect AV options to be affordable. If only the wealthy can use them, they won't fulfill the promise of broad mobility improvement. In Central Europe, where public transit is generally affordable and popular, an autonomous service needs to be priced competitively (or subsidized) to lure users. Many citizens might be willing to pay a bit more than a bus for a door-to-door autonomous shuttle, but not an order-of-magnitude more. Affordability will also affect rural inclusion: if AV services are too expensive to operate in low-density areas without high fares, that undercuts the societal benefit. Thus, one pain point to manage is keeping costs down – possibly through shared rides, government support in early phases, or innovative business models (advertising-supported rides, etc.).

Finally, citizens care about the **Community and Environmental Impact** of autonomous mobility. On the positive side, people hope AVs will *reduce congestion and pollution*. If AVs enable more ride-sharing and better traffic flow, cities could see fewer cars on the road and less idle time, which means lower emissions. Communities dream of "reclaiming" city space currently used for parking – if robotaxis reduce private car ownership, maybe fewer parking lots are needed and can be turned into parks or bike lanes. In places like Milan or Munich, city planners are indeed considering scenarios where, by 2035, a significant portion of mobility is served by shared autonomous fleets, allowing removal of some parking spaces. Quality of life improvements (quieter streets, cleaner air) are an anticipated benefit – a *hidden hope* is that autonomous electric vehicles lead to notably quieter, more livable neighborhoods. However, there are also anxieties. One is job displacement: professional drivers (taxi drivers, bus drivers, truck drivers) worry that automation will threaten their livelihoods. In Central Europe, tens of thousands work in road transport; the rise of AVs creates understandable fear. Communities expect that this transformation will be handled *equitably* – e.g., through retraining programs to help drivers transition to new jobs (like remote vehicle operators, fleet managers, or other roles). Policymakers are under pressure to ensure that the benefits of AVs don't just accrue to tech companies or riders, but also that workers and smaller communities are not left behind. In summary, the public's perspective is a mix of optimism (for safer, easier travel) and concern (about safety, inclusion, cost, and societal impact). Meeting these needs – through thoughtful design, regulation, and public engagement – will be crucial for the success of autonomous mobility in Central Europe.

SMEs and Entrepreneurs: Needs & Challenges

Beyond end-users, the future of mobility will also be shaped by SMEs, startups, and local businesses that hope to thrive in the autonomous vehicle ecosystem. Central Europe has many automotive SMEs (suppliers, tech startups, mobility operators), and their needs and pain points in the face of automation are distinct. One key need is clear market opportunities and viable business models in the autonomous era. Entrepreneurs are seeking to identify where they can add value. As vehicles become more software-defined and data-driven, new niches emerge: a startup might specialize in a particular sensor, or develop AI software to license to OEMs, or run an autonomous shuttle service in small towns. However, *uncertainty* about the timeline and adoption of AVs makes planning difficult. The industry has seen hype cycles with overoptimistic timelines (e.g., predictions a few years ago that by 2021 we'd have widespread robo-taxis, which didn't materialize). Now the consensus is more cautious, expecting gradual deployment through the 2020s and early 2030s. For example, fully driverless taxis in most European cities are now expected around the later 2020s or early 2030s, not mid-2020s. This uncertainty is a pain point for SMEs: it's hard to know *when* to launch a product or service so as not to be too early (and burn through capital) or too late. SMEs need *roadmaps and realistic forecasts* – often looking to public agencies or industry groups for guidance. European bodies have begun providing this; e.g., the EU's CCAM roadmap suggests staged deployment (first highway freight, controlled urban pilots, etc., scaling by 2030s). Knowing this helps an SME decide whether to focus on trucking tech versus urban shuttles, etc.

Another need is **access to testing and innovation support**. Developing autonomous vehicle technology is *resource intensive*. Big companies can afford large test tracks, expensive prototypes, and teams of safety engineers – small startups usually cannot. SMEs in Central Europe therefore benefit greatly from *shared testing facilities and pilot programs*. Many governments in the region have set up or funded AV testbeds: for instance, there's an autonomous vehicle test track in Hungary open to companies, and cross-border corridors (like a 5G-enabled highway section between Germany and Austria) for testing connected automated driving. These allow SMEs to validate their solutions in real conditions. Moreover, regulatory sandboxes – temporary loosening of certain regulations in a controlled way – are valuable. An example: a startup in Poland working on autonomous delivery robots might get a permit under a sandbox to operate on sidewalks in one city district, even before full national legislation for such robots exists. This lets them refine their service legally. Funding is another critical factor: European mobility startups have historically raised less capital than their U.S. or Chinese counterparts (McKinsey, 2020) – venture capital in Europe for AV has been smaller, which can impede scaling (indeed, one major U.S. AV firm raised over $10B, dwarfing the entire European AV startup investment). Entrepreneurs in Central Europe therefore expect public support in filling that gap, whether via grants (EU's Horizon programs, national innovation funds) or loans (European Investment Bank initiatives). The EU's recent *"Tech EU" investment fund* is one example, aiming to channel more money into high-tech EU startups (European Commission, 2024). **Collaboration networks** also help: SMEs benefit from being part of consortia or clusters where they can partner with larger firms to access knowledge and resources. In the mobility domain, alliances like *EU CAD (Connected Automated Driving) partnership* provide forums where SME and researchers collaborate.

Regulation is a double-edged sword for SMEs: **clarity and consistency** are needed, but overly strict rules can burden smaller players. A major need is *harmonized and clear regulations* for autonomous vehicles across Europe. In the past, differing national rules made it hard for an AV developer to operate in multiple countries (what's allowed in one country might be illegal across the border). SMEs want a **single European market** for automated mobility – so that if they get approval in, say, Italy, they can expand to Austria or Poland without starting from scratch. There are positive moves here: the EU is working on common rules (for instance, on type-approval for automated vehicles, expected mid-decade) (European Commission, 2024). Flexibility is also important: SMEs appreciate when regulators create exemptions or special regimes to experiment. For instance, allowing an autonomous shuttle pilot with a safety steward even if normal laws wouldn't yet allow it – many countries have done this case-by-case. On the flip side, **compliance costs** can be a big pain point. Meeting stringent safety validation standards, cybersecurity requirements, and data privacy laws (all critical for AVs) is costly and complex. Larger companies have whole departments for this; an SME might struggle. Policymakers have recognized this and often say regulations "should not put undue burden on SMEs" (European Commission, 2020) – but achieving that is tricky when safety is paramount. One expectation of SMEs is that their voices are heard in the regulatory process. They want to be part of standard-setting discussions, so rules don't end up inadvertently favoring only large incumbents. The EU's approach of involving stakeholders in consultations is valuable here, and SMEs expect it to continue (European Commission, 2024).

Finally, SMEs and startups need talent and partnerships to thrive in the AV space. There is competition for software engineers, AI specialists, and systems engineers. Smaller companies in Central Europe may struggle to attract top talent when competing with big brand OEMs or flashy Silicon Valley firms. Thus, a broader need is for development of skills and talent pipelines – which ties into educational initiatives in the region (technical universities in Central Europe are expanding programs in AI, robotics, and automotive software). Some SMEs form partnerships with universities to tap into graduate talent and joint R&D. The *ecosystem factor* is also key: an entrepreneur in a smaller country like Slovenia might need partnerships across Europe to bring a product to market (maybe a lidar startup in Slovenia partners with a Slovak vehicle integrator and a German OEM test program). The good news is that the push for automation has spawned a quite connected European network – many projects funded by the EU deliberately include SMEs from multiple countries to encourage this cross-pollination. In summary, SMEs in Central Europe see big opportunities in the shift to autonomous mobility – new markets to enter, niches to exploit – but they also face challenges of uncertainty, high development costs, complex regulations, and fierce competition. They need supportive policies (funding, testbeds, harmonization) and an inclusive ecosystem to help them participate. If those needs are addressed, the *hidden expectation* of many European SMEs is that they can collectively form a competitive edge for Europe in autonomous tech, even if no single company is as dominant as the largest American or Chinese players (European Commission, 2024). In other words, a network of specialized SMEs might ensure Europe has home-grown solutions for sensors, AI, etc., maintaining technological sovereignty. That vision underpins a lot of the SME support efforts underway.

Future Scenarios and Business Models (2035)

To illustrate how these trends and stakeholder dynamics might play out, we present four scenario-based use cases set in the 2030s. Each scenario describes a plausible **business model or service innovation** in Central Europe's mobility ecosystem, centered around automation. These scenarios are not predictions, but **exploratory visions** that combine the macro trends with specific user needs. They show how a variety of actors – from startups and OEMs to city governments and telecoms – could interact in delivering new mobility value. All scenarios assume that by the early-to-mid 2030s, autonomous vehicle technology has matured to be commercially deployed in specific contexts under supportive regulation.

Scenario 1: Smart City Autonomous Transit Network

Overview*:* In this scenario, a medium-sized European city has implemented a fleet of autonomous electric shuttles that operate as part of the public transportation system. The project is a joint venture between the city authorities, a local transit SME, and a technology provider. By 2032, Brno's "SmartShuttle" network connects residential areas with key hubs (downtown, university, hospitals), offering on-demand rides in self-driving minibuses. This came about as cities look to improve urban mobility while facing driver shortages and sustainability goals. Brno, like many cities, had struggled to recruit enough bus drivers and wanted to extend transit to areas not well-served by big buses. With national laws permitting Level 4 autonomous shuttles under certain conditions (and a successful pilot), they scaled up to a full network.

Key Features*:* The autonomous shuttles are electric 8-seaters. They operate in two modes: during peak hours, they run along fixed routes with virtual stops (like a bus line without a driver); in off-peak or in less busy neighborhoods, they switch to on-demand, summoned via a smartphone app or public kiosks. The shuttles communicate constantly with city traffic infrastructure – traffic lights broadcast their status and can be changed to prioritize the shuttle's approach (for example, holding a green light an extra few seconds if a shuttle is nearing). The vehicles are connected via 5G to a central control center that monitors them and can tele-assist if needed. Importantly, the system is integrated with Brno's existing public transport: the city's mobility app allows users to plan a journey mixing an autonomous shuttle ride with a tram or train, all in one ticket. This integration ensures the shuttles complement rather than compete with high-capacity transit.

Stakeholders & Value Network*:* This service operates as a public-private partnership. The city owns the overall service and sets coverage areas, fares, and standards (e.g., each shuttle must have wheelchair access and a "steward" on call). The local SME (let's call it *Morava Mobility*) runs day-to-day operations – they manage the fleet, the remote supervisors, and maintenance. A tech company (perhaps a startup from Austria specialized in self-driving software) provides the autonomous driving system and regular software updates. Telecom operators ensure the connectivity – a telco upgraded the area with edge computing nodes so that data from shuttles can be processed with minimal latency (important if a shuttle needs a remote operator to take over in an unusual situation). The business model for revenue is primarily city-funded (as public transit usually is), supplemented by fares from riders. Because the autonomous shuttles reduce operational cost (no drivers, optimized routing), the city can run more service for the same budget. The project also got EU smart mobility grant funding at the start (helping with capital costs of vehicles and infrastructure). For the SME operator and tech provider, Brno is a showcase that they can replicate in other cities – they envision exporting this model to other mid-sized Central European cities.

User Benefits and Needs Addressed: This scenario directly tackles several citizen needs. **Accessibility:** The autonomous shuttles serve *neighborhoods that lacked good transit*. For example, an outer suburb on a hill now has frequent shuttle connections to the nearest tram stop, whereas before residents had to walk 20 minutes or rely on cars. Elderly and disabled residents benefit from the door-to-door aspect – they can call a shuttle to a specific address. The vehicles are designed with low floors and an automatic ramp for wheelchairs, aligning with inclusivity expectations. **Convenience:** From a user perspective, the wait times are short (the city ensured a dense fleet so that average wait is <5 minutes during day, <10 at night). Payment is seamless – since it's integrated in the city transit pass, users don't even perceive it as a separate service. They just select a destination and the system tells them "take Shuttle A, then transfer to Tram 5" and handles the ticketing.

Reliability & Safety: The service runs 24/7, improving on conventional buses that stopped at midnight. This addresses the need for reliable late-night mobility (e.g., for shift workers or students out late). Regarding safety, the shuttles have an excellent record – millions of km driven with only minor incidents. Each vehicle has redundant sensors and failsafe systems. Initially, some riders were nervous, so the city had a policy to have a human *remote operator* monitoring a set of shuttles at all times, ready to intervene. Over time, as confidence grew, the presence of a standby teleoperator became just a comforting fact in the background. The city's communications emphasized that "autonomous does not mean unguided" – there are eyes on the system 24/7. This helped gain trust. Notably, an early public consultation board was set up, including citizen representatives, to oversee safety and data privacy matters, further boosting public acceptance.

Outcomes: By 2035, Brno's autonomous shuttle network is considered a model for second-tier cities. Commuters are pleased because their travel is smoother – average commute times dropped since the on-demand shuttles feed into high-speed tram lines efficiently, reducing the number of private cars on roads. The city measured a *10% decrease in congestion* on key corridors after launch, partly because many former car trips (school drop-offs, etc.) shifted to the autonomous shuttle service. The scenario fulfills environmental goals too: being electric and optimizing routes, it cut local transport CO2 and pollutant emissions. Surveys in Brno show high user satisfaction, especially noting that mobility is now available to groups who lacked it (like teens or elderly who don't drive). Economically, the city found that while upfront costs were high, the operating cost per km is now lower than a manned bus, so the system is financially sustainable with subsidies similar to any public transit. For the stakeholders, the SME operator gained prestige and know-how that allowed it to win contracts in two other cities in the region. The tech provider has improved its autonomous system through real-world data and positioned itself as a leading European AV software firm for public transport. This scenario demonstrates a future value network where a city, local SME, and tech startup cooperate to deliver Mobility-as-a-Service, leveraging automation to improve urban transit. It addresses the community's need for accessible, efficient transport while also creating a replicable business model that can be scaled to other areas.

Scenario 2: Autonomous Rural Mobility for Communities

Overview*:* Not all autonomous mobility innovations will be urban. In this scenario, by 2030 a coalition of rural towns in Southern Poland has deployed an *autonomous ridesharing service* to solve chronic connectivity issues in the countryside. The region – comprising several villages and small towns spread over rolling hills – was facing dwindling public transport (too costly to run many bus lines for sparse populations). Many residents without cars (especially the elderly) were left isolated. To address this, the regional government, with EU support, creates an "Autonomous Village Shuttle" program. They introduce small self-driving electric vans that connect villages to town centers and to each other. Importantly, this is not a tech giant's project but a locally-driven initiative: a Polish startup provides the AV software, local municipalities manage the service, and citizen co-ops are involved in operations (for instance, local volunteers act as on-call attendants if needed).

Context & Enablers*:* Several trends enable this scenario. First, the cost of autonomous vehicle technology has lowered by the 2030s, making it feasible to use in simpler environments. Rural roads (with less traffic complexity than city centers) became a target use-case for early deployment of Level 4 autonomous vans. Second, social and political pressure for inclusive mobility pushed the government to innovate – EU policy emphasizes that automation should benefit all regions, not just cities, and funding was made available for pilots in remote areas as part of digital cohesion programs. This region secured such funding. Third, connectivity infrastructure improved: even rural areas got 5G coverage (perhaps via 5G satellite or rural broadband initiatives), ensuring the shuttles have the data links needed for remote monitoring and GPS accuracy.

Service Details*:* The autonomous rural mobility service consists of a fleet of say 10 vans, each seating about 6 passengers. They operate in two modes: scheduled loops and on-demand trips. During morning and late afternoon (peak times), each village knows a shuttle comes, say, every hour on a fixed loop linking key points (the market square, the next town's train station, etc.). This provides a predictable backbone that people can rely on for regular needs (commuting, school runs). In between, the shuttles switch to on-demand: villagers can request a ride via a phone app or by calling a local call center (important for older folks not using smartphones). The system's algorithm dynamically routes the van to pick up multiple passengers going in the same direction, like a shared taxi. Because population is low, even with sharing, riders often have direct or one-stop journeys. To ensure coverage, the service area might span 15-20 km radius, including some very small hamlets.

Crucially, **local community integration** is part of the model. Each shuttle stop (or main pickup point) is at a familiar community spot (church, post office), and the project was advertised through town hall meetings. To build trust early on, they started with a safety driver in the shuttles for a trial year. Once data showed safe performance, they transitioned to full driverless operation. However, recognizing the concern "will an AV find my remote farmhouse?", they implemented a feature: the system has a remote operator who can speak to passengers or passers-by through an intercom if needed, and each shuttle is equipped with a manual control pad that authorized community members (for example, a volunteer firefighter) could use to steer or stop the vehicle in an emergency. This human-touch safety net helped get buy-in from skeptical residents.

Needs Addressed*:* This scenario squarely addresses the pain point of rural isolation. Residents who previously had no easy way to travel now have a reliable method to reach shops, medical appointments, or social gatherings *without needing to own a car*. For example, an elderly couple can book a shuttle to take them to the nearest town's clinic and back. Teenagers can visit friends in the next village in the evening and come home safely. The service dramatically improves social inclusion – mobility for those who can't drive (or can't afford a car) is no longer a barrier. The community reports higher satisfaction as people feel *connected* again. Interestingly, this also supports local economy: folks can more easily reach local markets and businesses, and inter-village tourism (visiting a neighboring village's folk festival) becomes feasible, strengthening community bonds.

Affordability was designed in: the service is subsidized by the regional government like public transport, so fares are minimal (e.g., a monthly pass for unlimited rides might be priced low or free for seniors, funded by public welfare budgets). The convenience factor of on-demand helps break the stigma that public transport is infrequent or unreliable in rural areas. Now one can summon a ride much like one would call a taxi, but at little to no cost. Importantly, the trust issue with new tech in a traditional community was managed by transparency and gradual introduction. During the pilot, villagers got to meet the vehicles and the team in a demo day. They voiced concerns (like "what if it encounters my livestock on the road?"), and the project team tuned the system (the shuttles are programmed to stop for animals, and have low max speed on farm lanes). Over time, as no incidents occurred and people tried it, *confidence grew*. The hidden expectation that "technology should not completely replace human care" is met by keeping humans in the loop – a remote supervisor and local responders – which reassures users that if something odd happens (like an AV stops because a fallen tree blocks the road), there's someone to resolve it.

Stakeholders & Business Model*:* This scenario shows SMEs and local government co-creating a solution. An SME tech startup provides the AV system and maybe manages the software platform. The municipalities or a cooperative of them owns the vehicles (possibly purchased with EU grant help) and covers operating costs. They employ a small team for monitoring and maintenance – this even created a couple of tech jobs locally (e.g., a technician in the town who services the shuttles, a remote operator who could be physically located anywhere but in this case they opted to base it in the region to create local employment). For funding, beyond initial grants, they use public transport subsidies that used to go into very inefficient bus lines. By replacing a nearly empty 40-seater bus that ran twice a day with agile shuttles, they actually saved money while providing more service. Additionally, once success was shown, the region got sponsorship from a national telecom company that wanted to showcase 5G usage – in exchange for branding, the company offset some operational costs. There's also exploration of *advertising or delivery services* using the shuttles (like the vans might carry parcels between villages too), for a small revenue stream.

Outcomes: By 2035, this rural AV network is still running and has expanded to more villages. The model proved that autonomy is not just an urban luxury but can indeed serve rural public good. The community has embraced it: people treat the shuttle almost like a community minibus. Other regions (in Czechia, Hungary, etc.) have sent delegations to study the model and started their own pilots. From a mobility perspective, it significantly reduced car dependency locally – some families chose not to buy a second car, or even gave up a car, because they can rely on the shuttle for daily needs. This contributes to environmental goals (less fuel use). It also had subtle social benefits: more spontaneous travel means people visit each other more, reducing loneliness among elderly (an unexpected but welcome outcome noted in surveys). For technology, operating in harsh winter and on gravel roads gave the AV provider valuable experience to improve their product (they tuned the sensors for fog and snow common in rural Poland, making their system more robust). If one looks at the big picture, this scenario combines the trend of technology democratization with the need for rural access. It showcases a future where autonomous mobility isn't just in flashy robo-taxis in Berlin or Rome, but is a backbone of inclusive community development – ensuring even a small village has equitable access to transportation. In doing so, it preserves the social fabric (people can age in place without losing mobility) and demonstrates Europe's commitment to leaving no region behind in the mobility revolution.

Scenario 3: Autonomous Freight Corridors & Logistics Revolution

Overview: Automation is not only for moving people – it's also transforming how goods are transported. In this scenario, by the early 2030s Central Europe has established **autonomous freight corridors** on major highways, fundamentally changing logistics and supply chains. Imagine a continuous flow of self-driving trucks (platoons of 2-3) carrying goods along the corridor from northern Germany through Austria to Italy, and another from Poland through Czechia to Germany. These corridors have been outfitted for *Level 4 autonomous trucks*: they feature smart infrastructure like sensor-embedded roads, dedicated "platooning lanes" in some stretches, and high-speed 5G coverage everywhere. The logistics industry, facing driver shortages and pressure to reduce costs, embraced this. Large transport companies in Germany and Poland partnered with tech firms to deploy autonomous trucking at scale on these routes, with transfer hubs at each end where human drivers or local autonomous solutions handle first/last-mile to warehouses.

Key Drivers: Europe's strong trucking industry was dealing with *two big issues*: not enough drivers (the average age of truck drivers was high and younger replacements were few), and strict EU regulations on drivers' working hours (which limit how far goods can move in a day by human driving). Automation promised relief: a truck that drives itself can operate almost non-stop, greatly increasing utilization. Additionally, **platooning** (trucks following each other closely to save energy) could cut fuel costs by 10-15%. By 2025, EU regulators created a framework for cross-border autonomous truck trials, and by 2028, allowed conditional driverless operation on certain approved corridors (European Commission, 2024). Central Europe is crisscrossed by major trade routes (e.g., the North Sea to Black Sea route via Austria/Hungary), making it a priority region for this innovation. Investment from both public (infrastructure upgrades via the Connecting Europe Facility) and private (trucking and retail companies pooling funds) enabled the corridors.

How It Works: A logistics operator dispatches an *autonomous truck convoy* from a hub outside Warsaw heading towards Germany. At the hub, cargo is loaded and a human supervisor checks the vehicle and inputs the route. The convoy of two trucks sets off – initially with a human in the lead truck as backup, but by 2035 perhaps completely driverless under remote supervision. Once on the designated highway, the trucks engage autonomous mode and platoon at a short gap, wirelessly linked. The highway has virtual "checkpoints" where sensors verify the trucks are in autonomous mode and transmit road condition data (e.g., an upcoming construction zone). The trucks self-navigate, maintaining efficient speed and spacing. Other vehicles on the road are mostly aware (since by 2030s many cars have V2X communication too, they receive alerts like "platoon approaching, 2 trucks, 80 km/h"). The trucks can communicate with traffic systems – e.g., a smart traffic management system might open a dedicated lane for them approaching a border crossing. At border checkpoints, streamlined policies allow them to pass quickly (customs data transmitted ahead). If regulations still require a human in the loop at certain points (say, a human must take over to exit highway and navigate local streets), a remote control center operator can assume control or a standby driver at a rest area hops in. On reaching a *logistics hub near the destination (Milan, Italy for example)*, the autonomous system hands off to local drivers or robotic unloaders. The long-haul part, however, was 95% autonomous. The result: goods that used to take 2 days with mandated rest breaks now arrive in 1 day; trucks that were idle at night now run around the clock. The cost per km is significantly reduced. This scenario doesn't just change one company's operations – it has **ecosystem effects**. Supply chains start to adjust; for instance, manufacturers can rely on faster shipping and reduce inventory.

Stakeholders: The major stakeholders are logistics companies, technology providers, and transport authorities. Large haulage firms in Central Europe invest in autonomous technology or partner with tech startups providing the self-driving systems. Some OEMs offer "autonomous-ready" trucks by 2030 – pre-equipped with sensors and redundant steering/braking, which the operators then outfit with their chosen AI driver software. For example, a Czech logistics consortium might use German-made trucks running software from a Swedish AV company. Collaboration is key: multiple transport companies might share the cost of infrastructure upgrades on the corridor, since all benefit. Telecom companies are heavily involved as well, ensuring continuous connectivity and even positioning services (precise GPS enhancements) along the route. Governments (national transport ministries of Germany, Austria, Italy, etc.) coordinate to unify regulations – possibly establishing a *special autonomous corridor permit* that is recognized by all transit countries, so an operator doesn't need separate approval for each country. Police and highway authorities also adapt: new rules for how regular drivers interact with platoons, and emergency procedures (if a driverless truck has an issue, how traffic officers respond – they've been trained and provided with override devices in worst-case scenarios).

SME involvement: While big companies run the trucks, many *smaller logistics SMEs* plug into this network by using the corridor service. For instance, a small Hungarian freight company without its own AV trucks can book slots to have its trailer hauled by an autonomous convoy operated by a larger partner – similar to how today one might book rail freight. This keeps SMEs in the game rather than being outcompeted; essentially the big companies might offer *"autonomy-as-a-service"* to smaller shippers.

Benefits and Impact*:* The **efficiency gains** are huge. Transport costs drop, benefitting the economy – studies indicated autonomous trucking could reduce freight costs per km by ~30%. In this scenario, we see that realized: shipping goods from a factory in Poland to a warehouse in Germany is faster and cheaper, which can lower prices or improve competitiveness of Central European businesses. **Environmental impact:** Though one might worry more trucks running 24/7 means more emissions, two factors mitigate that. First, many trucks are by this time *electric or hydrogen-fuel-cell powered*. Indeed, part of the corridor project in the EU required zero-emission trucks to qualify for autonomous operation (to meet climate goals). Second, platooning and smoother traffic flow improve efficiency – even diesel trucks would burn less fuel due to drafting and fewer stop-and-go events. Also, optimized utilization might mean fewer total trucks needed to move the same goods. The scenario thus contributes to decarbonizing freight transport, aligning with Europe's climate targets for transport (which include a significant shift of freight to rail and zero-emission vehicles by 2030-2035). Here, automation complements that by making road freight cleaner and more efficient for the loads that remain on roads.

Safety: On highways improves as human error is reduced in truck operations (human truck drivers' fatigue, for example, was a major cause of accidents; autonomous ones don't get tired). One can imagine that on these corridors, accident rates dropped noticeably by 2035. There might even be sections of highway with dedicated autonomous lanes which have near-zero accidents over years of operation. Regular motorists initially were nervous about sharing the road with robotrucks, but as those proved predictably well-behaved (they don't tailgate other vehicles aside from intentional platooning with each other, they react faster to hazards), comfort grew. Some countries put signage "Autonomous driving zone" on these corridors to alert drivers, and public awareness campaigns explained how the systems work.

Labor market: This scenario does have the disruptive effect of reducing demand for long-haul truck drivers. By 2035 perhaps many older drivers retired and their roles were not refilled. However, new jobs emerged: remote fleet supervisors, technicians maintaining the complex sensors and networks, and more short-haul/local drivers who take over first/last mile legs. It's also possible there's political negotiation – e.g., driver unions might have secured agreements that a human will always be in a convoy in some capacity until 2040, or that companies fund retraining programs. In any case, this is a major socio-economic change.

Stakeholders' business models: big logistics firms see higher margins with lower operating costs. Tech companies supplying the automation might charge usage-based fees (like a software license per km). Infrastructure operators might monetize the corridors by charging tolls for autonomous use (perhaps premium lanes with dynamic pricing). A likely development: **digital platforms for freight orchestration** arise– essentially scheduling and matching loads to autonomous convoys, optimizing efficiency. By 2035, an Uber-like platform for freight might be common: shippers post a load, the system assigns it to an autonomous truck leaving in the next convoy, minimal human involvement needed.

This scenario highlights how **automation can revolutionize B2B mobility services**, not just consumer travel. Central Europe's strategic position as a freight crossroads makes it a prime beneficiary of autonomous logistics. The region's economy gains in competitiveness, and it addresses a real problem. It also shows the importance of cross-border coordination in Europe: the success came from countries working together so that technology didn't stop at each border. By 2035, we could see the concept extended – perhaps an autonomous freight corridor from Hamburg all the way to Istanbul through Central/Eastern Europe. The scenario's success would likely accelerate such plans, continuing to blur the line between traditional road transport and a **high-tech, continuous logistics network**.

Scenario 4: SME-Centric Autonomous Mobility Ecosystem

Overview*:* In this scenario, we zoom out to envision a **holistic autonomous mobility ecosystem** in Europe by 2035, one in which *SMEs* play a central collaborative role. Instead of a single service, this scenario describes how a network of smaller companies collectively drive innovation and deployment of AV technologies, ensuring Europe has a diverse and competitive mobility sector. We imagine that by 2035, Europe did not end up with just one or two big tech giants controlling autonomous mobility (as many had feared), but rather a vibrant ecosystem: for example, a *Finnish SME* makes a world-leading LiDAR sensor, an *Austrian startup* provides an open-source AV operating system, a *Slovak company* specializes in autonomous vehicle validation tools, a *Italian mobility cooperative* operates autonomous shuttles in several cities – and they all interconnect through partnerships and standards. This is a plausible outcome given Europe's industrial landscape and policy inclination to support SMEs.

Key Idea*:* An **open platform approach** underpins this ecosystem. Early on, European industry and policymakers decided to promote interoperability and data sharing. For instance, common technical standards for AV interfaces were established (so any certified sensor can plug-and-play with any certified autonomous driving software). The EU also possibly mandated that large players cannot "lock out" smaller ones – similar to how EU's open data rules and competition laws work. This means the barrier to entry for an SME with a great technology is lower, because they can integrate into vehicles or services without needing to build everything themselves. By 2030, this gave rise to what one might call a *"Lego block" model of autonomous mobility*: many companies providing pieces that can be assembled.

Example Ecosystem Flow*:* Consider a European autonomous shuttle in 2035. It might be assembled by a mid-sized vehicle manufacturer in France, but it uses a sensor package from a Dutch SME, AI driving software from a German startup, battery tech from a Slovenian company, and a simulation-tested safety certification from an Italian firm. These components work together because they adhere to the European AV interoperability standards. When the shuttle is deployed in, say, a city in Poland by a local mobility operator SME, it connects to a mobility platform that shares data (with permission) into a public Mobility Data Space. Local startups might tap into that data to offer services – for instance, analyzing traffic patterns to improve routes, or providing infotainment to passengers. **No single corporation dominates**; instead, value is created by the network and competition in niches.

Needs and Benefits*:* This scenario addresses SME needs for *market access and reduced barriers*. Historically, one fear was that only huge companies (with deep pockets to develop full self-driving stacks) would survive, marginalizing Europe's many automotive SMEs. Here, the "modular" ecosystem ensures even a small company can thrive by specializing. An SME with a niche expertise – say a Czech company excelling in snowy-weather sensor calibration – finds a market because larger systems can incorporate its solution. The ecosystem fosters **innovation** because each niche player competes to be the best at its element, rather than one or two companies trying to do everything (which can slow innovation). It also aligns with Europe's values of competition and avoiding monopolies. For consumers and society, this ecosystem means more choices and potentially lower costs. Multiple firms competing in each sub-component (sensors, software, vehicles) drives efficiency. It also avoids dependency on one foreign supplier; Europe achieves a level of *technological sovereignty* in AVs. Because of open standards, cities or operators are not "locked in" to one vendor – they could mix and match solutions or switch providers if one underperforms. This flexibility encourages more adoption (a city is more willing to deploy AV services if they know they aren't beholden to a single vendor forever).

Policy and Collaboration: In this scenario, regulators and industry bodies actively supported the ecosystem approach. The EU might have set up innovation clusters where big and small companies collaborate on reference designs. There could be *co-created regulations*: regulators work closely with consortia of SMEs and larger firms to quickly update rules as new business models appear (European Commission, 2024). For example, when startups began testing autonomous delivery robots on sidewalks, instead of banning them or letting chaos ensue, regulators engaged the SMEs to craft appropriate guidelines. This agile governance means Europe can adapt and deploy new mobility innovations faster, benefiting society while keeping risks in check.

Economic impact: By 2035, this SME-centric ecosystem helped Europe remain a leader in automotive and mobility innovation, even if no European "Google of AV" appeared. A network of European SMEs collectively ensures that Europe has its own *full-stack AV capability* (European Commission, 2024) – i.e., all the pieces needed for autonomous vehicles can be sourced internally. This was a strategic goal to reduce reliance on foreign tech. It also creates jobs across many regions: instead of a few big tech campuses, hundreds of SMEs across Central Europe are employing engineers, technicians, and service workers, distributing economic benefit. We can imagine regional tech hubs – e.g., Linz (Austria) is known for a cluster of autonomous vehicle software firms, or Wrocław (Poland) for a group of robotics startups feeding into this ecosystem.

Use Case Illustration: To make it concrete, consider a futuristic mobility service in 2035 enabled by this ecosystem: a "last-mile autonomous delivery" service in a city. A small startup in Slovenia makes autonomous delivery droids. They didn't have to build every component; they use open-source navigation software from a French firm and sensors from a Spanish SME. They adhere to EU's standard for sidewalk robots (for example, a standard size and safety protocols). The city of Ljubljana contracts them for robotic delivery in downtown. Meanwhile, a local app developer uses open mobility data to integrate those robots into a broader delivery platform that also involves human couriers for certain tasks. Because everything uses open interfaces, it all meshes smoothly. From a citizen's perspective, they just see convenient delivery and transport options. From an SME perspective, they see a market where they can slot in and work with others without large barriers.

Challenges and Resilience: One challenge that had to be overcome for this scenario was ensuring *interoperability without stifling innovation*. The risk of too many standards or forcing companies to share intellectual property could discourage investment. But Europe managed a balance: core interfaces became standardized (like how the Internet has standard protocols but companies innovate on top). Another challenge was competition from giant foreign players – e.g., a big U.S. company might dump cheap self-driving software on the market. However, European stakeholders – perhaps with some protective procurement policies or by emphasizing privacy/data rules – gave local ecosystem a chance to compete on quality and trust, not just price. As a result, by 2035 there are non-European components in the mix too, but European SMEs hold significant market share in many parts of the AV value chain.

These four scenarios – an urban autonomous transit network, a rural on-demand mobility service, an automated freight corridor, and an SME-driven innovation ecosystem – highlight the **diverse ways automation could unfold by 2035** in Central Europe. They show that automation in mobility is not a single technology or business model, but a spectrum of possibilities touching public transit, personal travel, goods movement, and industry structure. Common threads across scenarios include the importance of **collaboration** (public-private or consortium-based approaches), the focus on **user needs and acceptance**, and alignment with Europe's policy goals (safety, sustainability, inclusivity, economic competitiveness). Central Europe, with its mix of advanced economies, strong industrial base, and shared EU regulatory space, is poised to be at the forefront of these autonomous mobility innovations – crafting solutions that are not only high-tech, but also human-centric and publicly accountable.

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3.3 Connectivity

Macro Trends & Industry Shifts

The digital linking of vehicles with networks, infrastructure, and each other has become a cornerstone of innovation in the automotive and mobility sector. In Central Europe several interrelated trends are redefining mobility through connectivity.

Pervasive In-Vehicle Connectivity: Modern vehicles are increasingly "born digital." Already today, nearly *90% of new cars sold in Europe come with built-in connectivity features* – such as embedded telematics units or the ability to sync with smartphones (Copenhagen Economics, 2022). This share is only growing: by 2030, roughly *95% of new vehicles globally are expected to be connected* (McKinsey, 2020). In Central Europe, new EU regulations like the eCall mandate (which since 2018 requires every new car to have an automatic emergency call system) have accelerated this trend (European Commission, 2018). The result is that connectivity is becoming a standard feature – just like power steering or ABS – effectively making cars part of the Internet of Things. This ubiquitous connectivity lays the groundwork for advanced services and for vehicles to act as data-generating platforms throughout their life.

Data-Driven Services & "Software-Defined" Vehicles: As cars get connected, they are generating *vast amounts of data*. A typical modern car might produce gigabytes of sensor and usage data each day. A crucial industry shift is toward leveraging this data for new services and business models. Automakers are transitioning to a software-defined vehicle paradigm: where the value of a car increasingly comes from software and digital services rather than just hardware. Over-the-air (OTA) software updates are a prime example – many cars can now receive firmware upgrades, feature enhancements, or bug fixes remotely via connectivity, improving over time (instead of deteriorating). Companies are building app ecosystems for cars, similar to smartphones. For instance, drivers can subscribe to services like real-time traffic information, remote diagnostics, or even feature upgrades (like activating an ADAS feature for a monthly fee). McKinsey (2021) estimates that continuous digital services could account for a significant portion of automotive revenue by 2030, as one-time vehicle sales give way to ongoing customer relationships (McKinsey, 2021). In Central Europe, both premium and mass-market automakers are embracing this: e.g., BMW's and VW's newer models offer in-car app stores and functions on demand.

Vehicle-to-Everything (V2X) and Smart Infrastructure: A major trend is extending connectivity beyond just linking vehicles to the cloud – it's about connecting vehicles *with everything around them*. V2X technology (Vehicle-to-Everything) enables direct communication: vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian, etc. In practice, this means a car can "talk" to traffic lights, receiving signal phase timing so it can adjust speed to catch a green wave; cars can talk to each other to warn of a hazard around a blind curve. Central Europe has been active in this area through EU initiatives: for example, the C-Roads platform has pilot projects in many countries (Austria, Slovenia, Czechia, etc.) deploying V2X along highways and urban corridors. Cities are installing smart traffic infrastructure: connected traffic lights, roadside sensors, and camera systems that all communicate. The goal is a cooperative intelligent transport system (C-ITS) where everything on the road network shares information to optimize safety and flow. By 2025, Europe is rolling out *5G corridors* on main highways to support reliable V2X communication for connected and automated driving (European Commission, 2021). In Central European cities like Vienna and Linz, pilot programs have used V2X at intersections to reduce accidents – for example, giving drivers warnings about pedestrians or cyclists in blind spots, and giving emergency vehicles priority by switching lights (Yunex Traffic, 2022). These pilots showed tangible benefits like reduced collision rates and smoother traffic flow. Thus, connectivity is becoming the digital backbone of smart cities and mobility systems, enabling everything from adaptive traffic management to connected electric vehicle charging (where cars, chargers, and the grid exchange data).

Convergence of Connectivity with Electrification and Automation: Connectivity doesn't exist in isolation – it's tightly intertwined with the other big mobility trends of electrification and autonomous driving. The industry often refers to "ACES" (Autonomous, Connected, Electric, Shared) as the four pillars shaping the future (McKinsey, 2019). Each amplifies the other. For instance, *autonomous vehicles (AVs) rely heavily on connectivity*: an AV can use connectivity to get more information than its onboard sensors alone (such as receiving up-to-the-minute HD maps or coordinating maneuvers with other vehicles). If a self-driving car ahead detects black ice, it can instantly send a warning to cars behind via V2V – something only possible with connectivity. Conversely, connectivity features are increasingly leveraging AI and automation on the backend – like predictive maintenance systems that automatically schedule service when the car's self-diagnostics detect an anomaly. Electrification benefits too: connected electric vehicles can participate in smart charging or vehicle-to-grid schemes, communicating with charging stations and the power grid to optimize when and how charging happens (charging when electricity is cheapest or even feeding energy back to the grid at peak times). In Central Europe, where EV adoption is rising (on the back of EU CO2 targets and incentives), such connectivity-driven energy management is important for grid stability. In sum, connectivity is the enabler that ties these trends together into a cohesive ecosystem. The EU's vision for *Cooperative, Connected, Automated Mobility (CCAM)* explicitly links connectivity and automation as co-requisites for a safer, cleaner transport future (European Commission, 2020).

Evolving Ecosystem and Stakeholders: The rise of vehicle connectivity is fundamentally changing industry dynamics. Traditional automakers in Central Europe find themselves partnering with or competing against tech and telecom companies. Software is king – leading to collaborations like car companies working with cloud providers for data platforms, or mobile network operators forming joint ventures to provide automotive connectivity solutions. We're seeing new entrants in the mobility ecosystem: app developers, data analytics firms, and mobility start-ups offering services that piggyback on vehicle data. At the same time, consumers' relationship with cars is evolving – the expectation now is that a car is always online, up-to-date, and integrated into one's digital life. This puts pressure on OEMs (and opportunities for them) to continuously improve digital user experience, not just sell a product and forget it.

Policy and regulation act as both drivers and shapers of connectivity trends. The EU has been a proactive enabler – from mandating eCall to adopting the **ITS Directive** that pushes member states to build out digital transport infrastructure. Just in late 2023, the EU adopted a strategy for a *European Common Mobility Data Space* (as mentioned earlier) to break down data silos (European Commission, 2023). This would make it easier for different players (public transit, ride-share, car OEMs, etc.) to share and access mobility data securely, leading to more integrated services for users. Central European countries, being part of the EU single market, are aligning with these policies and often are among the early implementers. For example, Slovenia and Austria have some of the first national access points (NAPs) for transport data under the ITS Directive, making standardized datasets (on traffic, road works, etc.) available to service providers. These efforts underscore a trend: **connectivity is increasingly viewed as public infrastructure** (much like roads or railways), with a push for open standards and interoperability that particularly benefits smaller companies and facilitates innovation.

Political, Regulatory, and Technological Drivers

The acceleration of connectivity in mobility has been strongly influenced by policy and regulatory initiatives as well as technological advancements. On the policy side, the European Union and national governments have acted as key drivers by setting mandates, standards, and funding programs. A prime example is the EU's ITS (Intelligent Transport Systems) Directive, which requires member states to implement certain digital services (like real-time traffic info, safety warnings) and establish National Access Points for sharing transport data. This directive, and its updates, essentially force the creation of a digital ecosystem where data like traffic speeds, travel times, or road closures are accessible (in standardized formats) to any service developer. For Central Europe, this has spurred countries to invest in data platforms and ensure, for instance, that a Polish navigation app can access Austrian traffic data when guiding a driver across borders. Additionally, the EU's GDPR and upcoming Data Act influence how vehicle data can be used – emphasizing user consent and fair access. Regulators are keen to prevent a scenario where automakers lock away all vehicle data; proposals under discussion aim to give independent service providers (like repair shops or app makers) *access to in-vehicle data with owner permission*, to encourage competition (European Commission, 2022). Such regulatory moves underpin a future where connectivity isn't monopolized, but rather fuels a diverse marketplace of services.

Safety Regulation: National governments in Central Europe also push connectivity through safety regulations. For instance, beyond eCall, there's the European General Safety Regulation (2019/2144) which starting in 2024 mandates new cars to have features like ISA (Intelligent Speed Assistance) and event data recorders – both effectively connectivity-related. ISA uses map connectivity to warn if you exceed speed limits, requiring cars to know the local speed limit (through a map database or sign recognition and likely a backend service). Event data recorders (the "black box") are not connected by definition, but as soon as an accident happens, connectivity can be used to transmit that recorder data for emergency response or analysis. Furthermore, governments are investing in pilot programs for CCAM (Cooperative, Connected, Automated Mobility). For example, the Horizon Europe program has allocated hundreds of millions of euros to CCAM projects (~€500M in R&D funding), many of which explicitly focus on connectivity aspects like platooning (European Commission, 2024). Central European stakeholders (universities, companies) are actively involved in these projects, effectively subsidizing leaps in connected tech.

On the **technological front**, rapid advancements have propelled connectivity. The rollout of 5G networks is a major enabler. Unlike 4G, 5G was designed with features for low latency and high reliability communications – crucial for real-time interactions like V2X. In Central Europe, telecom providers (often in partnership with governments) have been deploying 5G along key transport routes. For instance, by 2025 there may be a continuous 5G coverage on the highway from Munich to Prague as part of an EU corridor initiative (5G-PPP, 2023). Also, the development of edge computing – servers located nearer to end-users (like at cell towers or regional data centers) – means data from cars can be processed locally with minimal delay. This is important for things like coordinating platoons of cars or analyzing sensor data for hazards and feeding it back to nearby vehicles. Another tech driver is the satellite navigation improvement. Europe's Galileo satellite system, combined with ground augmentation, now provides very precise positioning (to the order of centimeters with corrections). Accurate positioning is foundational for many connected services – whether a connected car knows exactly which lane it's in for delivering lane-specific alerts, or a geofenced service that activates or deactivates vehicle features based on location (e.g., automatic EV switching to zero-emission mode in a city center). As Galileo has come fully online and with new signals, European vehicles can leverage that for superior navigation and geo-awareness (European GNSS Agency, 2021).

Data Analytics and AI: The sheer volume of data from connected vehicles has spurred the development of platforms that can ingest and analyze it in real-time. Cloud platforms (some provided by big tech, others by consortiums of automakers like the **Neutral Server** concept for sharing car sensor data) can now manage millions of data points per second. With machine learning, patterns can be detected – such as identifying slippery road sections from a cluster of cars where ESP activated – and then broadcast warnings to vehicles approaching those spots (this is already happening via services like HERE's traffic cloud or BMW's Hazard Preview). These capabilities make connectivity much more than a communication pipeline; it becomes an intelligent system improving as more data flows.

Political support for connectivity is also about funding infrastructure. The EU's Connecting Europe Facility (CEF) has awarded grants for projects like building out 5G corridors and urban pilot zones. For example, some Central European highways are part of the 5G cross-border pilot projects (e.g., the "5G Prague – Munich" or "5G Mediterranean corridor" initiatives) (EU Digital Strategy, 2022). Moreover, several countries have included digital infrastructure for mobility in their national recovery and resilience plans (post-COVID EU recovery funding). Poland, for instance, earmarked investment for digitizing its rail and road systems with connectivity for safety improvements. These investments accelerate deployment of the technology that private sector alone might roll out more slowly.

In short, the push towards connected mobility in Central Europe is being *pulled* by tech progress and *pushed* by policy. Regulations mandate baseline capabilities (making connectivity ubiquitous in new vehicles), while public and private investments build the communication networks and data ecosystems needed. Combined with the spread of smartphones (which means nearly all travelers have connectivity in their pocket too) and emerging tech like IoT sensors on infrastructure, the stage is set for connectivity to deeply integrate into everyday mobility.

Stakeholder Dynamics

The proliferation of connectivity in mobility is reshaping the stakeholder landscape, fostering new collaborations and power shifts among industry players, governments, and users. Unlike the traditional automotive value chain (which was linear and dominated by OEMs and their suppliers), the connected mobility ecosystem in Central Europe is much more **networked and cross-sectoral**.

Automakers (OEMs): Traditional car manufacturers remain key stakeholders, but their role is evolving from solely building vehicles to also being platform providers and data managers. OEMs in Central Europe (like Volkswagen, BMW, Stellantis' German/Italian brands, etc.) are developing their own connected car platforms – for example, Volkswagen's "We Connect" or BMW's "ConnectedDrive" – in attempts to maintain control of the customer relationship and data. These companies are gathering enormous amounts of data from their vehicles and trying to monetize it or use it to improve products. However, with connectivity, OEMs have had to partner with tech firms to a greater degree. Many have inked alliances with cloud providers (VW with Microsoft for cloud, BMW with Amazon Web Services, etc.) to handle data storage and computing. There's also a competitive dynamic: tech companies encroaching into what was OEM territory (think Google's Android Automotive OS now running infotainment in some European cars, which cedes some control of the in-car experience to Google). In response, some OEMs together with European partners are working on European alternatives (for instance, the coalition developing "Automotive Grade Linux" or other open platforms, to avoid dependence on Silicon Valley). The overall dynamic for OEMs is a balancing act between collaboration and competition with new entrants.

Suppliers and Tech Companies: Tier-1 suppliers (like Bosch, Continental, Valeo) have embraced connectivity as a growth area. They not only supply hardware (sensors, connectivity modules) but now offer software and services. For example, Continental has a backend platform for connected vehicle data services. These large suppliers sometimes partner directly with cities or fleets to provide solutions (effectively stepping beyond just supplying automakers). Then there are IT and telecom companies – e.g., Ericsson, Nokia, Deutsche Telekom, etc. – which are active in providing V2X communication technology, 5G networks, and even edge computing solutions targeted at automotive. In Central Europe, telecom operators are increasingly mobility stakeholders because, without their networks, many connected mobility services cannot run. Some telecoms have gone as far as launching automotive-specific divisions or products (like 5G-enabled traffic management). Big tech firms (Google, Apple) also play a role via smartphone integration (Android Auto, Apple CarPlay) and mapping services. Notably, Google's subsidiary Waze and others gather crowd-sourced data that competes with or complements data from vehicles. All this means that traditional automotive companies must engage with a broader set of stakeholders, often forming consortia. A good example is the *Car Connectivity Consortium* (which includes OEMs, tech firms, etc. working on standards like digital keys for cars), or the *5G Automotive Association* bringing together telecom and automotive sectors to ensure 5G meets vehicle needs.

Governments and Public Sector: National transport ministries and regulators are not just rule-makers but increasingly enablers and even platform providers. Many Central European governments have set up open data portals for mobility (often as part of fulfilling the ITS Directive). For instance, Austria's Verkehrsauskunft Österreich and similar portals gather and provide multi-modal transport data, enabling app developers to create journey planners, etc. City governments are also very involved. Urban authorities have a stake because connectivity can help solve city problems (congestion, pollution). Cities like Budapest or Munich have traffic management centers now ingesting connected vehicle data to manage signals in real-time. In stakeholder terms, public authorities have moved towards a co-creation approach: partnering with private companies in pilot projects and sometimes sharing infrastructure. For example, a city might allow telecom companies to mount roadside units on public poles, or might share its traffic light data into an automaker's vehicles so drivers get red-light countdowns (this is happening in Audi's "Time-to-Green" feature in Ingolstadt, etc.). The public sector is also a customer for connected solutions (like procuring connected fleet management for public bus fleets) and sometimes even a provider (some cities provide their own mobility apps integrating various services).

Mobility Service Providers and Startups: The connectivity trend has given rise to many new mobility services – from ride-hailing and car-sharing to micro-mobility and MaaS (Mobility-as-a-Service) platforms – and these players are stakeholders that rely on connectivity. For instance, a car-sharing operator in Warsaw uses telematics to monitor and control their fleet (lock/unlock cars via app, track usage). These operators sometimes collaborate with car manufacturers (Peugeot working with a car-share company to ensure their cars have the right connectivity tech) but sometimes they retrofit connectivity into vehicles independently. Moreover, startups offering data-driven services have joined the fray: companies that do predictive maintenance analytics based on vehicle data, or insurance tech firms using driving data for usage-based insurance. Many of these are SMEs trying to get access to vehicle data. This has led to some tension: startups and aftermarket service providers want open access to connectivity (with user permission) so they can offer competing services, whereas some OEMs have favored a closed approach where data flows only to their backend. Regulators (as mentioned) are mediating this to ensure fair competition (European Commission, 2022 draft Data Act is relevant). So, the stakeholder dynamic includes a bit of a tug-of-war between open vs closed ecosystems: incumbents vs new entrants.

Citizens/Consumers: Finally, the end-users are stakeholders whose collective behavior influences the direction of connected mobility. Consumers in Central Europe increasingly *expect* connectivity – many won't consider a new car without smartphone integration or built-in navigation with live traffic. Their usage patterns (like heavy use of Google Maps or TomTom traffic apps) influence what automakers and cities prioritize. Privacy-conscious European consumers also voice concerns about data privacy, influencing stakeholders to be cautious. For instance, German car buyers and ADAC (a large automobile club) have pushed OEMs to give clearer options for opting in/out of data collection. This societal stance on privacy is a stakeholder dynamic specific in Europe that sometimes contrasts with the more laissez-faire approach in the US. It has given rise to things like **"trust labels"** or certifications for connected car data handling, and companies advertising how they protect user data as a selling point.

Future Customer Needs and Pain Points

Connectivity is an enabler, but ultimately its value is measured by how it improves the mobility experience for people (and businesses) – or fails to, if not implemented with user needs in mind. We consider how **future customers** – both individual travelers (citizens) and organizational customers (cities, enterprises, SMEs) – will experience connected mobility in Central Europe, what needs it addresses, and what pain points or concerns might arise.

Citizens and Communities: Needs & Expectations

For everyday people using transport, connectivity is often invisible, but it powers features that they directly care about. One core need is Seamless, Convenient Travel. In an increasingly multi-modal world, travelers expect digital integration – planning a journey combining bus, train, and e-scooter should be as easy as using Google Maps. Connected mobility promises Mobility-as-a-Service (MaaS) platforms that unify planning, booking, and payment across all modes. Many Central European cities are piloting or have launched such apps (e.g., WienMobil in Vienna or Jelbi in Berlin) that rely on connectivity (real-time data from all modes, one-click payments, etc.). By 2035, customers will likely expect that they can open one app and see all available options (bike, autonomous shuttle, tram, etc.), choose the best route and pay once. The need here is convenience and information transparency – no need to juggle multiple tickets or guess arrival times.

Connectivity fulfills this by aggregating data. The pain point if not solved is the fragmentation: even today, too many separate apps or unclear info can frustrate riders. So a future hidden expectation is *everything is connected in the background* so that the front-end for the user is unified and smooth.

Another key need is **Safety and Security**. Connectivity can dramatically enhance safety for citizens – e.g., connected emergency call (eCall) brings help faster after a crash, connected warning systems alert drivers to hazards, and connected cameras on buses can deter crime. People want to feel safe on the road and in transit. Already vehicles that can call emergency services automatically provide peace of mind. By 2035, communities might expect that *no serious accident goes unnoticed* (because connected cars or even nearby connected infrastructure will report it). Also, vulnerable road users (pedestrians, cyclists) need protection – connectivity could allow a smartphone in a pedestrian's pocket to broadcast presence to cars to avoid collisions. There is an expectation of "intelligent safety": that the system will prevent or mitigate incidents proactively. Pain points that remain include concerns about hacking or malfunctions – ironically, connecting everything introduces cybersecurity risks. Citizens will need assurance that their connected car won't be hijacked remotely or that the data it shares (like location) won't be misused in ways that could harm them (stalking, etc.). Thus, one expectation is strong cybersecurity and privacy protection baked into these systems (European consumers do worry about data misuse, surveys show).

Personalization and Comfort is another emerging need. As connectivity turns the car into a kind of personal device, people expect their digital life to extend to mobility. For instance, one might want a car's infotainment to sync seamlessly with one's music or calendar (already happening), or route planning that considers personal preferences (avoid highways, etc.). Looking ahead, with more autonomous features possibly available, the in-vehicle time can be used for work or leisure, so connectivity enabling streaming, video calls, etc., becomes more important. In a shared mobility context, people might expect that when they enter a shared autonomous pod, it recognizes them (via an app or digital ID) and automatically adjusts settings (lighting, music, seat position). This kind of personalization requires connectivity to user profiles in the cloud. The pain point if unmet is a *generic or inconvenient experience* that deters people from using new mobility options. If every time you use a different vehicle you have to set it up from scratch, that's a barrier. Connectivity can solve it by pulling your profile from the cloud.

For communities (the broader social perspective), one need is **Efficiency and Sustainability**. People want less congestion, less pollution, better quality of life in their cities and towns. Connectivity is a tool to optimize traffic flow – e.g., reducing stop-and-go waves through coordinated signals can cut emissions and travel time. Central European cities often suffer from congestion and associated smog (e.g., Krakow or Milan had air quality issues partly from traffic). Citizens increasingly expect authorities to manage these issues, and indeed many city transport plans cite digitalization as a solution for more efficient use of infrastructure (rather than just building new roads). So there's a community expectation that the *network will be smart*. A visible manifestation could be: fewer traffic jams because navigation apps intelligently route cars and prevent overload, or smart tolls (enabled by connectivity) manage demand. The pain point if not addressed is continued gridlock and frustration despite tech being available. On sustainability, connectivity enables things like eco-routing (cars suggesting routes that use less energy) or facilitating EV usage (like helping find and reserve charging). As EV adoption grows in Central Europe, drivers need connected services to alleviate "charging anxiety" – being able to see available chargers in real time, for example.

Equity and Inclusion: A subtle need is that connectivity benefits should be accessible to all, not just tech-savvy or affluent. For instance, if public transport moves to app-based payment, there must be solutions for those without smartphones. Cities are aware of this and likely will maintain alternatives, but ideally connectivity behind the scenes makes even traditional use easier (like contactless bank cards doubling as transit tickets – it's a connectivity solution requiring backend integration). The risk/pain is creating a digital divide: older or rural populations left behind by app-centric mobility. Policies and designs will need to be inclusive (which in Europe, they tend to consider).

In summary, citizens want reliable, hassle-free, and safer travel, and they increasingly see digital connectivity as a means to those ends, even if they don't think of it in technical terms. They also want control over their data and usage – e.g., drivers may want the option to opt out of certain data sharing, or to know what's being collected. A hidden expectation is *trust*: trust that connected mobility systems are working for their benefit, not just for companies. Stakeholders will need to maintain that trust through transparency and delivering clear benefits (like "because your car shares data, you got an early hazard warning that prevented a crash" – people see the value, they're more likely to consent to data use).

Businesses and Mobility Stakeholders: Needs & Opportunities

For businesses, including SMEs, transport operators, and cities (from an operational perspective), connectivity offers powerful tools but also poses challenges. **Fleet operators (logistics, public transport, company fleets)** have a need for *efficiency and cost-effectiveness*. Connectivity enables **fleet management systems** that track vehicles in real time, optimize routes, monitor driver behavior, and predict maintenance needs. A trucking SME in Central Europe can use a telematics platform to know where all its trucks are, whether they're meeting delivery windows, and to dynamically reroute them if needed (e.g., to avoid a traffic jam, as signaled by connected traffic data). By 2035, such systems will likely be ubiquitous – an SME that doesn't use connectivity would be at a disadvantage because their competitors will have lower fuel and maintenance costs and higher on-time performance. The need is essentially **competitiveness**: connectivity is becoming table stakes for running a modern transport/logistics operation. The pain point if not fulfilled could be smaller players being left behind due to cost or complexity of these systems – which is why many telematics providers offer scalable solutions now. Another aspect: **predictive maintenance** – businesses need to avoid downtime. Connectivity allows continuous monitoring (engine diagnostics data sent to cloud) and AI to predict failures. For example, a bus operator in Prague can get an alert "Bus 17 may have a battery issue in 2 weeks, schedule service," preventing breakdowns. The expectation is increasing that vehicles will rarely break down unexpectedly thanks to these systems.

Cities and transport authorities, as stakeholders, need **system-level optimization**. They want to move more people with less congestion and emissions. Connectivity provides data for better planning: anonymized movement data from vehicles and phones helps urban planners understand travel patterns. It also enables dynamic traffic management – a city might implement connected adaptive traffic lights that adjust timings based on current flows (which has been shown to improve throughput). The *need for real-time control* is something cities have, especially as mobility becomes more on-demand (with ride-hailing, etc.). Without connectivity, city authorities are "blind" to what's happening between fixed sensor points; with it, they have a richer picture. A future expectation from city leaders might be the ability to implement policies like **dynamic road pricing or low-emission zones** that are enforced via connectivity (e.g., a car's onboard unit knows it's entering a low-emission zone and either reports it for billing or switches to electric mode). London and others already use camera networks for congestion charges; by 2035, many European cities might use in-vehicle connectivity to manage access in a more nuanced way (charging vehicles based on actual distance driven in a zone, etc.). The pain point for authorities is balancing *privacy and acceptance* when implementing such measures – they must ensure systems are secure and that the public accepts them.

From an **industry innovation perspective**, businesses (especially startups and SMEs in the mobility tech space) need access to data and interoperability. A big need is **standardization**: if every car maker uses a proprietary interface, a startup offering, say, a parking app that tells you if you left your car locked, would have to deal with dozens of integrations. Standard APIs (application programming interfaces) for vehicle data can lower this barrier. The EU pushing for a common Mobility Data Space and standards is in response to this need. The hidden expectation among these innovators is that Europe will create a level playing field – so an SME can build a service that works across many brands and countries, rather than facing a fragmented environment. If this fails, the pain point is that only large corporations can realistically provide connected services at scale (because they have resources to do all integrations), stifling innovation from smaller players.

Another perspective: **Insurance companies** and other sectors are stakeholders as well. They have begun using connectivity (telematics insurance uses driving behavior data to adjust premiums). Their need is *accurate risk assessment* and new product opportunities. With more connectivity, they can roll out more refined insurance models (e.g., pay-as-you-drive, or real-time risk warnings to drivers). However, they also face the challenge of getting that data (again ties to data access debates).

In terms of **pain points**, a big one across the board is **data privacy and cyber-security**. Businesses and authorities worry about hacking (a hacked traffic system could cause chaos, a hacked car could be stolen or worse). They also worry about liability – if a connected service gives a faulty recommendation that leads to an incident, who is responsible? These issues are being worked through in legal and technical forums, but by 2035 the framework will need to be clear. A likely expectation of both consumers and businesses is that **cybersecurity is robust** – perhaps vehicles and infrastructure will carry security certifications (similar to how credit card systems do) to assure stakeholders.

Finally, **environmental and social governance (ESG)** goals influence needs: many companies (logistics, mobility operators) have carbon reduction targets. Connectivity helps by enabling *eco-driving*, optimizing routes to cut fuel, integrating EVs smoothly. So there's a need for connectivity to deliver on its promise of greener operations. If done right, companies see lower fuel costs and progress on sustainability metrics; if connectivity data isn't utilized or if systems are siloed, that benefit might not fully materialize.

Future Scenarios and Business Models (2035)

To crystalize how connectivity might transform mobility in Central Europe, we present four illustrative scenarios set in the 2030s. Each scenario describes a plausible service or business model that leverages connectivity, showing how key trends and stakeholder needs coalesce into new mobility solutions. These scenarios – focused on urban traffic management, vehicle maintenance, integrated mobility services, and logistics – demonstrate diverse facets of the connected future. They are not exact predictions, but grounded explorations of what could emerge by 2035, given current trajectories.

Scenario 1: Smart City V2X Network for Safer and Smoother Traffic

The Vision: An urban region in Central Europe (e.g., Ljubljana, Slovenia) deploys a citywide Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) network to dramatically improve road safety and traffic flow. The city teams up with automotive tech SMEs and telecommunication firms to create a cooperative traffic management system. By 2030, major intersections and road segments are equipped with connected sensors and transmitters. All new vehicles and many older ones (via retrofitted dongles or smartphone apps) communicate in real-time with this city infrastructure and with each other, forming an integrated network.

Key Features: At its core, this scenario is about connected traffic coordination. Traffic lights broadcast their signal phases and timing to approaching vehicles; vehicles in turn send data about their speed, location, and if they detect hazards (like sudden braking or slippery road conditions). A central cloud-based "traffic brain" (run by a tech provider in partnership with the city) aggregates data from thousands of vehicles plus roadside sensors (cameras, lidar at intersections) to get a live bird's-eye view of traffic. Using this, the system optimizes traffic light timing on the fly across the city – creating "green waves" for platoons of vehicles, and minimizing stops.

Safety: If a pedestrian enters a crosswalk unexpectedly, smart cameras detect it and broadcast a warning to nearby vehicles in milliseconds, potentially triggering automatic braking in connected cars. Vehicles share alerts: if one car's ESP activates due to ice, within a second all cars behind get a "ice ahead" warning on their dash. Emergency vehicles are given a "connected priority": ambulances and fire engines broadcast their route so the system turns lights green along their path and alerts all vehicles nearby to yield, significantly cutting response times.

Public transport is integrated too – trams and buses are connected and can request priority at junctions to stay on schedule. Even cyclists and e-scooters join the network via a city mobility app that communicates their presence (so cars turning right get an alert "bike approaching on your right"). By 2035, almost every road user, directly or via devices, is part of this city-wide digital conversation on the road.

Stakeholders & Collaboration*:* This model involves close collaboration between municipal authorities, automotive OEMs, SMEs, and telecom providers. The city initiated the project aiming to improve safety and reduce congestion (policy goals). It set up a public-private consortium: a local tech SME provided the intelligent traffic management software; a telecom company ensured 5G coverage and edge computing so V2X messages have ultra-low latency; automakers cooperated by equipping new cars with the standardized V2X radios and by sharing certain data streams into the city traffic cloud (with privacy measures). The city upgraded infrastructure (traffic signals, etc.) to be V2X-compatible. Importantly, citizens were part of the stakeholder mix – the system design considered public input (for example, ensuring that data shared does not violate privacy, and offering opt-outs for those who don't want their vehicle data used beyond safety purposes).

Business Model: Isn't about direct profit (traffic management is a public good), but there are value flows: the city's investment is justified by reduced economic losses from congestion (time saved, emissions reduced) and improved safety (fewer accidents means lower emergency and healthcare costs). There might also be *data monetization or sharing*: anonymized traffic data from this system is valuable for urban planners, navigation services, and local businesses (e.g., understanding flow patterns). The city could license some data to map providers or researchers. Additionally, it is a platform for growth for local tech SMEs – the homegrown SME that built the system can export the solution to other cities, leveraging the success in Ljubljana as a case study, benefiting the regional economy. For citizens, the "value" is intangible but real: safer streets, time saved, and a more pleasant driving experience (less stop-go stress).

Benefits and Needs Addressed*:* This scenario directly addresses citizen needs for safety and efficiency. For example, connected warnings prevent collisions – a driver might receive an alert "Collision ahead, prepare to stop" before they even see brake lights, avoiding pile-ups. The city reported, say, a 20% reduction in injury accidents after deploying V2X safety messages and adaptive signals, a huge public health win. Traffic efficiency improvements mean commute times drop. In our Ljubljana example, travel times across downtown in peak hour might improve by 15-20% because the system optimizes flow and reduces bottlenecks. Also, the dreaded experience of sitting at a red light with no cross-traffic (inefficient fixed timing) is largely eliminated; signals adapt to actual demand.

Environmental benefit: smoother traffic (less idling, fewer abrupt accelerations) cuts fuel consumption and emissions. The city likely meets climate targets easier; perhaps it measured a reduction of several thousand tons of CO2 per year thanks to this. For public transport, connected priority makes buses and trams more punctual and attractive to riders (supporting the need for reliable service).

Citizen experiences perspective: Driving or moving around the city becomes less stressful and safer. People might not even realize all the tech behind it - they just notice that traffic flows better and they get timely warnings. Pedestrians notice cars stopping for them more consistently (because vehicles get alerts about crosswalk occupancy). Cyclists feel safer knowing vehicles are "aware" of them via the network.

Feasibility and Challenges*:* By 2035, this scenario assumes enough penetration of V2X tech in vehicles (maybe aided by regulations requiring it). Older vehicles without it might have been fitted with aftermarket units or rely on vehicle-adjacent connectivity (like a smartphone app that listens to V2X messages and warns the driver). The scenario's success required standardization (ensuring a BMW and a Škoda and a Tesla all speak the same V2X "language" in the city network – which in reality has been happening via EU standards like ITS-G5 or C-V2X). It also required addressing privacy (hence most data is anonymized; perhaps the city only collects aggregate data and doesn't track individual vehicles). Cybersecurity is paramount: the city system has heavy encryption and failsafes to prevent spoofing of signals or data hacks.

By 2035, Ljubljana's model is considered a best practice in Europe for a digitally connected city. It demonstrated that a mid-sized city can harness connectivity not just for gimmicks but to genuinely improve quality of life. Other Central European cities, including some smaller towns on important corridors, replicate scaled-down versions (maybe just a few intersections or a highway segment with V2X). This scenario showcases how connectivity, when orchestrated in a cooperative model, meets public needs and creates a win-win for safety, efficiency, and stakeholder collaboration.

Scenario 2: Remote Diagnostics and Predictive Maintenance Ecosystem

The Vision*:* By the early 2030s, vehicle maintenance has been transformed from a reactive, inconvenient chore to a mostly proactive and remote service thanks to pervasive connectivity. In this scenario, a network of automotive SMEs, dealerships, and service providers forms a remote diagnostics and predictive maintenance ecosystem. Essentially, vehicles continuously self-monitor and communicate their health status to cloud platforms; AI algorithms predict maintenance needs; and many issues are fixed *over-the-air (OTA)* or via mobile service units, minimizing the need for drivers to visit workshops.

How it Works*:* Imagine a driver of a 2032 connected car in rural Hungary. Her vehicle is linked to the manufacturer's cloud and a third-party maintenance service platform. Every time the car is running, hundreds of sensor readings (engine performance, battery health, tire pressure, brake wear, etc.) are being sent periodically to a cloud database (with the owner's consent obtained at purchase). Advanced analytics run on this data. One day, the system flags an anomaly: the car's coolant pump is drawing slightly higher current than normal and showing a vibration pattern that, historically, precedes failure within a few weeks. The driver receives a notification on her smartphone: "Your car's water pump may need replacement soon. We suggest scheduling service. Choose an option: 1) Send a mobile mechanic to you, 2) Schedule at our partner workshop, 3) Defer and continue monitoring." She opts for a mobile mechanic at home. The platform automatically checks her calendar availability and books a slot the next day when she'll be home. The next day, a van from a network-affiliated garage arrives with the correct water pump (the system already ordered the part anticipating her approval) and tools. The mechanic has AR glasses that link to the car's diagnostics too. He replaces the pump in her driveway in an hour. The car never actually broke down – the failure was pre-empted. Payment and warranty logging are handled digitally through the platform. The car's digital service record is automatically updated across the ecosystem. In other cases, **over-the-air fixes** suffice: for example, a minor software bug causing an intermittent infotainment reboot is identified by the manufacturer through uploaded error logs. They beam a patch to the car overnight – the owner might just get a note: "We improved your infotainment performance last night." Similarly, if a sensor malfunctions, sometimes a remote technician could guide the car's system to recalibrate or reset it, avoiding a workshop visit.

Stakeholders*:* This scenario involves OEMs, independent service SMEs, tech companies, and customers in a symbiotic network. Automakers enable remote access to vehicle data and OTA updates (something many already do). Independent repair shops or chains in Central Europe join the platform to receive predictive maintenance leads and instructions – instead of waiting for customers to show up with a broken car, they get alerted by the system that customer X's car will need Y in Z days. This smooths their workflow and brings business. A central tech company (or consortium) might operate the cloud platform analyzing multi-brand data – perhaps an SME specializing in automotive analytics or a collaboration like the European Data Space for vehicle maintenance. Insurers could also be part of it, as they benefit from fewer breakdown-related accidents (maybe offering premium discounts for customers enrolled in this maintenance program).

The business model relies on value-added service revenue: Customers might pay a subscription for "Smart Care" service that includes continuous monitoring and some OTA updates, possibly bundled when buying the car (e.g., the first 5 years of predictive maintenance service are included in the vehicle price, after that a monthly fee). OEMs and service providers likely share revenue; also OEMs gain efficiency by OTA fixing many warranty issues without physical intervention (saving costs). Independent garages in the network might pay a small commission to the platform for each lead/job or pay a subscription to get access to the analytics for cars they service. It's also a competitive differentiator for OEMs – selling a car with the promise that "you'll never be surprised by a breakdown" is compelling.

User Benefits*:* This scenario addresses the customer pain point of unexpected breakdowns and the hassle of maintenance. Traditionally, many drivers dread the "check engine" light or the annual service visit. Here, maintenance becomes largely predictive and convenient. Vehicles schedule their own care, and often come to you (via mobile service) rather than you going to them. For a busy professional or an elderly driver, this is a huge benefit. It also *reduces breakdowns* – meaning fewer times stranded on the side of the road (which is a significant safety and stress improvement). The overall uptime of vehicles increases. Financially, addressing issues early can prevent bigger failures, saving customers money long-term. For example, replacing a wearing part before it fails might avoid collateral damage that a sudden failure could cause. Insurance companies might eventually factor this in – connected-maintained cars could get lower premiums due to lower risk of breakdown accidents. From a community perspective, fewer breakdowns on roads means less random congestion from stalled cars, and potentially environmental benefits – well-maintained engines run more efficiently and cleanly. If everyone's car is proactively tuned and fixed, we reduce the long tail of gross polluters or oil-leaking wrecks on roads.

SMEs and business angle: The local garages in, say, small-town Slovakia benefit because instead of car owners driving problems until something big breaks (and perhaps then going to the dealership or scrapping the car), they get jobs routed to them proactively. It helps them plan inventory (since they get forecasted demand for parts). It can be a new revenue stream for them to conduct remote diagnostics support as well. For instance, a mechanic at a central office could virtually "jack in" to a car's computer (with owner permission) to troubleshoot a dashboard warning - perhaps telling the owner "It's just a false sensor error, I reset it remotely, no worries" or "This needs fixing, I'm dispatching a van." This is a more skilled, tech-oriented service, potentially improving job quality in the automotive service sector.

Feasibility by 2035*:* Much of this is already technically feasible and partly happening. By 2035, enough cars (including most new EVs and ICEs) have continuous connectivity and enough standardization (perhaps via EU legislation on OBD data access or the data space initiative) that multi-brand platforms can operate. Data analytics would have matured – by analyzing millions of cars' data, AI gets good at predicting failures of components with high accuracy (e.g., "starter battery likely to fail in ~3 weeks"). Of course, unpredictable sudden failures won't be entirely eliminated, but far fewer people will experience random breakdowns.

One challenge is data privacy and consent: drivers must opt into sharing vehicle health data. Many will if the value is clear ("share data so we can save you from breakdowns"). Regulation may require that such services remain voluntary and that data be well-secured (cybersecurity is critical here to prevent malicious interference with vehicles). The ecosystem also requires trust between OEMs and independent service providers – possibly facilitated by neutral platforms or data trusts that ensure fairness and no misuse of data (e.g., OEMs must not use data to unfairly steer all service to their dealerships, excluding independents – competition authorities will keep an eye on that).

By 2035, it's plausible that in Central Europe a large portion of the vehicle parc (especially newer and fleet vehicles) are under some form of connected maintenance plan. For consumers, this scenario delivers on the desire for convenience, peace of mind, and cost transparency in car ownership – your car takes care of itself, mostly, and you avoid nasty surprises. The adage "prevention is better than cure" becomes reality for mobility via connectivity.

Scenario 3: Personalized In-Car Infotainment and Services Platform

The Vision*:* In this scenario, vehicles become extensions of our digital lives – personalized, connected digital hubs on wheels. By the 2030s, the car is not just a mode of transport but also a platform for infotainment, e-commerce, and productivity, tailored to each occupant. A dedicated ecosystem of apps and services emerges within vehicles, delivered through connectivity. Automakers, tech companies, and content providers form alliances to create an “app store for cars” where users can download services (from streaming media to productivity tools to travel-related commerce).

What it Looks Like: Consider a family driving in a 2035 connected vehicle from Vienna to a holiday in Lake Bled, Slovenia. Each family member’s profile is recognized by the car (through their smartphone or biometrics). The kids in the back say “Hey car, play Cartoon Network” – the in-car entertainment system streams their favorite show on rear-seat screens (5G connectivity pulling high-definition video seamlessly). Meanwhile, the driver’s profile has a preference for scenic routes and local cuisine. The car’s navigation app, integrated with travel services, suggests: “There’s a beautiful viewpoint 5 km ahead; shall I reroute for a stop? Also, a top-rated local bakery in the next town has a drive-thru – would you like to preorder some pastries and coffee?” The driver agrees by voice. The order is placed via an in-car commerce app (payment handled via the car’s digital wallet). As they approach, the bakery (which has IoT sensors) knows their car’s ETA and ensures the order is ready; they pick it up without leaving the car. The mother in the passenger seat decides to use the drive time to catch up on work. She uses the car’s built-in video conferencing app. The cabin’s sound system creates a personal sound zone so her meeting audio doesn’t bother others (tech like directional speakers). The car’s connectivity and an interior camera allow her to join a video call using dash cameras as her “webcam” – essentially turning the car into a mobile office. Meanwhile, the car’s voice assistant, synced with her calendar and email, reads out and replies to messages by voice command, so she’s productive hands-free. For the driver, the car provides context-aware information – as they cross into Slovenia, the infotainment pops up a brief update on different road rules (e.g., “in Slovenia, headlights are required at all times”). The driver can ask the assistant for a summary of Slovenian phrases or nearest EV charging stop (if it’s an electric car). When the family hits traffic, the kids get restless. The father says, “Car, launch game mode” – the car has built-in games or can connect to cloud gaming. Perhaps the screens let the kids play a car-themed quiz that uses real surroundings (“I spy something that starts with T – is it a Tree?” integrating outside view via cameras). Essentially, infotainment merges with the journey itself, making travel more engaging. All these services (video streaming, route-based suggestions, in-car shopping, cloud gaming, productivity apps) are enabled by robust connectivity and a digital services platform probably managed by either the automaker or a consortium. It’s analogous to a smartphone’s ecosystem, but adapted for safe use in a vehicle (voice control, limited driver interaction, more for passengers when vehicle is in motion).

Stakeholders & Value: The backbone is a digital ecosystem alliance: automakers provide hardware and vehicle OS, tech giants provide software frameworks (some cars might run Android Automotive OS, etc.), and numerous content and service providers plug in. For example, Spotify, Netflix, or local European content channels have car-optimized apps in the store. Navigation companies (TomTom, Google) integrate travel commerce like restaurant reservations or hotel booking on the go. Even governments might be stakeholders – e.g., national tourism boards providing content through the platform (“interactive audio guides as you drive through historical regions”).

The business model is largely services and transactions: Many basic services are free/included to make the car attractive (navigation, assistant, some music). Additional ones might be subscription or pay-per-use. For instance, a premium video streaming subscription specifically for car (maybe bundled with home subscription), or paying a small fee for an AR tour guide that narrates sights as you drive through them. E-commerce partnerships bring commissions: if the car platform directs you to a business (like that bakery or a certain hotel), perhaps there’s a referral fee or revenue share. Automakers may also sell data-driven insights (with user permission anonymized) to help businesses or city planners – e.g., aggregated info on routes taken by tourists. Advertising could also play a role but would be done cautiously (nobody wants a car that spams ads while driving). However, context-based suggestions (like the bakery) are a form of advertisement integrated as helpful service. If done tastefully, users accept it because it’s relevant and convenient. The car might say “It’s almost lunchtime, there’s a family-friendly restaurant 10 minutes ahead with excellent reviews; shall I guide you there?” – that restaurant likely partners with the platform.

For users, this scenario satisfies the modern expectation of constant connectivity and personalized content. It addresses the need for entertainment on long drives (keeping kids happy, reducing driver boredom when appropriate, etc.), the need for productivity for business travelers (turn idle passenger time into working time), and even well-being (the assistant can play calming music when traffic is stressful, or suggest a break if it senses driver fatigue via sensors). Importantly, it's personalized – each person's preferences, streaming accounts, etc., are recognized in any car they use (they log in or it's tied to their phone). So if you rent a car or use a car-sharing, you could log in to a "guest" profile and get your usual settings and content, wiping when you log out. This scenario also highlights shared mobility: The platform extends to robo-taxis or shared shuttles. If you summon an autonomous ride, you could still stream your Netflix show from where you left off in your living room, because it knows your profile. This continuity is something users will increasingly expect.

Feasibility & Considerations: By 2035, technical feasibility for high-bandwidth, low-latency in-car connectivity is high with 5G/6G networks and possibly satellite backup. Many cars already come with built-in SIMs and Wi-Fi hotspots. Standardization is underway (CCC's Digital Key for phone-as-key, Android Automotive OS adoption, etc.). The main challenge is interoperability and not fragmenting into too many ecosystems (e.g., if each automaker has a totally separate app store, developers may not support all). We might see a few dominant platforms (like an Android-based one and maybe a competing alliance around a European OS or Apple's rumored vehicle system if it comes). EU regulators might ensure openness – e.g., requiring that third-party apps can be offered, not just automaker's own.

Privacy is also key: what happens in your car (music choices, places you go, conversations you have) – users need confidence that data isn't misused. Likely there will be strong controls (the system might do a lot on-device or only send anonymized data out). Also, driver distraction is a concern – all this infotainment must be designed to not impair driving. That means heavy reliance on voice control, passenger-lockout for videos when car is moving (only back-seat or only when autonomous mode engaged). By 2035, if Level 3 or 4 autonomy is available on highways, then drivers can partake in more infotainment during those phases (the car might say "autopilot engaged, you may now watch the news" – something not allowed when manual driving). So connectivity and autonomy synergize here: as cars drive themselves more, the cabin is truly an entertainment or work lounge.

This scenario demonstrates how mobility merges with the digital lifestyle. In Central Europe, where people travel frequently across countries, such connected services add convenience (multi-language support, seamless connectivity across borders without crazy roaming fees – likely by then EU ensures in-car data isn't roaming-billed even if you cross countries, similar to phone roaming being free in EU). It also opens new revenue for automakers who traditionally only sold hardware. Now they can partake in the **digital services economy** – crucial for their financial health as margins on hardware tighten and as EVs have less maintenance revenue. They become more like tech companies, and customer engagement becomes continuous (not just selling a car and that's it, but providing services throughout the car's life).

Scenario 4: Seamless Mobility-as-a-Service through Connectivity

The Vision: Building on the concept of integrating modes, this scenario envisages a truly seamless MaaS ecosystem across a Central European region by 2035. In cities and regions, people forego personal car ownership in large numbers because a connected network of shared mobility options (from trains and buses to car-shares, e-bikes, and shuttles) provides door-to-door mobility with one subscription and app. Connectivity is the glue that binds together public transit, private operators, and municipal services into a single platform where users can plan, book, and pay for multimodal trips effortlessly.

How it Works: Consider someone living in the suburbs outside Munich, Germany. Through a MaaS app (say, "BavariaGo") on her phone, she enters a destination – for example, a friend's house in Prague, Czechia. The app instantly gives her a combined itinerary: a demand-responsive autonomous shuttle will pick her up at home in 5 minutes, take her to a mobility hub where an express bus or train goes to Prague, and at arrival a reserved e-scooter or ride-hail will cover the last mile to the friend's house. All this is booked in one go; the payment is one combined fare, possibly covered by her monthly subscription (she has a platinum MaaS plan that gives unlimited local transit and X intercity trips per month). During the journey, if any disruption occurs – say the train is delayed – the system automatically rebooks her next connection (perhaps scheduling a later shuttle or ride-hail) and sends her an update/notification. She doesn't need to navigate the complexities; the platform handles it proactively through real-time connectivity with all transport services. The connectivity between services is total: the shuttle that picks her up knows the train's status in real time and can adjust pickup if needed; the Prague metro or ride-share knows the bus arrival ETA for her to coordinate handoff. All vehicles and mobility points are instrumented. When she enters the shuttle at home, a sensor detects that she's on board (via her phone's Bluetooth or a QR code scan), so the system knows pickup is done. When she arrives at the station, indoor navigation on her phone (connected to beacons at station) guides her to the right platform because the system knows she's unfamiliar with this station. On the train, she can use connectivity to stream or work (tying with scenario 3's services) – possibly the MaaS subscription includes free high-speed Wi-Fi on all partner transports. At her destination, if she opted for an e-scooter for the last mile, it's held in reserve at a docking station. She unlocks it with the same app. If it's cold/rainy, perhaps the system would have suggested a covered autonomous shuttle instead; preferences and AI play a role.This scenario also covers local daily commuting: A user might input "I need to be at work by 9am" and the system will propose a combination daily – maybe on Mondays she carpools via a connected app, Tuesday she drives her own car but offers two others a ride (coordinated by the system to reduce single occupancy), Wednesday she bikes and the system gives her a small incentive or reward points for using a healthy, green mode. All of it tracked seamlessly.

Stakeholders: Achieving this requires unprecedented cooperation between public transit authorities, private mobility providers (like ride-hailing, scooter companies), technology platform providers, and governments. Likely a public-private MaaS consortium operates the platform – in Finland, they pioneered MaaS with Whim app; by 2035 more regions will have integrated systems. Telecom operators might ensure continuous cross-border connectivity (with EU policy, roaming charges are gone and network coverage is ubiquitous even in rural legs, making sure the app and vehicles are always connected). Importantly, standardization and data sharing agreements are in place: every mode from rail companies to bike-shares expose APIs for bookings and status so the platform can knit them together. Governance agreements ensure fair revenue splitting: e.g., if a person's €10 journey uses a bus and a ride-hail, the platform allocates each their share.

Business model: Revenue can come from subscriptions (like Netflix for mobility), pay-as-you-go commissions , and possibly subsidies – cities may subsidize the MaaS to encourage usage of greener modes, e.g., offering cheaper intermodal trips than single-car use costs (charging congestion fees on private cars and using funds to support MaaS passes). By reducing private car dependency, cities save on infrastructure and externality costs, which can justify investment into this system.

For **users**, the big needs addressed are *convenience, simplicity, and flexibility*. Instead of juggling multiple tickets, cards, and apps (one for train, one for bus, one for scooter etc.), they have one interface and account. Travel planning stress is greatly reduced – they don't need to know the schedules or routes; the system, with its connectivity and AI, figures it out and adapts dynamically. If there's a road closure or transit strike, the system finds alternatives and notifies users. People also gain **time and cost transparency**: they can see options sorted by fastest, cheapest, greenest, etc., and they know in advance how long and how much. No hunting for parking, no surprises. For those in rural areas, this could greatly improve mobility: MaaS can incorporate demand-responsive shuttles and existing bus lines into one network, making it easier to live car-free or with fewer cars outside cities too. That addresses a social need for mobility access.

Environmental and social benefits: A well-run MaaS can significantly reduce car usage, hence emissions and congestion. If the convenience gets high enough, many city dwellers might not own a car at all (as is already trending among some young people). This plays into EU climate goals (mode shift to public and active transport). It can also be more equitable: a subscription might cover an entire family's mobility or offer student/senior discounts, ensuring everyone can use mobility without owning vehicles.

Incentives: the platform might gamify or reward certain choices (e.g., take a bike or transit instead of car and earn points that give you free ride credits). Because the platform sees all travel, it could tailor incentives to policy goals or personal health goals.

Feasibility: Already, cities like Helsinki, Vienna, etc., have partial MaaS offerings. By 2035, many regulatory and technical barriers (like differing ticketing systems, reluctance of some operators to share data) will likely have been resolved, pushed by user demand and possibly EU directives for open mobility data. There will be roaming between MaaS services too: someone's Vienna mobility subscription might automatically give them access to partner services in Prague or Budapest when traveling, just as phone roaming or banking works seamlessly across Europe now.

Challenges: Building trust and cooperation among stakeholders (public vs private operators historically haven't always aligned). Data security – lots of personal travel data flows, which must be safeguarded to protect privacy. Avoiding monopolies – regulators will want to ensure one platform doesn't exploit its position unfairly (which is why often a public agency might have a stake or even run it to ensure public interest). However, the complexity means likely a specialized tech company will handle the tech under oversight.

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3.4 Platform Economy

Macro Trends & Industry Shifts

Digitalization and Platform Ecosystems: Mobility is increasingly driven by data and software. Cars are becoming “rolling software platforms” offering connected services, and mobility is delivered via digital apps and services rather than just physical vehicles. This shift has attracted new players – tech giants and start-ups – into a domain once dominated by traditional automotive OEMs. As a result, the industry is transitioning from a product-centric model (selling cars) to a platform economy model where value comes from software, data, and services. Notably, Europe has lagged in producing digital mobility champions – only about 1% of global mobility unicorns are based in Germany (despite Germany’s industry representing ~10% of global mobility market volume). The digital mobility landscape in Europe remains fragmented across countries and providers, and is often dominated by U.S. or Chinese platforms. In response, the EU is promoting initiatives for data sharing and ecosystem-building. A flagship effort is the creation of a Common European Mobility Data Space (EMDS) to securely pool and share transport data among companies and public authorities. The goal is to break down data silos – currently “the transport and mobility data landscape is fragmented” – and enable an interoperable, multimodal system. By knitting together data and services, Europe aims to spur innovation and ensure *home-grown* players (including SMEs) can compete in the platform era (European Commission, 2023). At the consumer level, digitalization is fueling expectations for integrated, one-stop mobility solutions. In fact, 80% of Europeans expect to use a single app/platform for all mobility services by 2030 (for planning, booking, paying across car, transit, micromobility, etc.). This trend is a massive shift in user behavior and will underpin new mobility business models. Overall, digital platforms and ecosystems are becoming the backbone of future mobility, promising seamless experiences but also demanding new capabilities from incumbents.

Decarbonization and Electrification: The push for climate-friendly transport is another macro force reshaping mobility – and it complements the platform economy. EU policy-driven decarbonization (e.g. the Green Deal and 2035 engine emission bans) is accelerating the shift to electric vehicles (EVs) and other zero-emission modes. By 2030, at least 30 million zero-emission cars are expected on European roads. This electrification wave is giving rise to platform-based services such as EV charging networks and energy management platforms. For example, the EV charging services market in Europe is projected to grow from about $0.5 billion in 2023 to $35 billion by 2035, a ~43% annual growth – fueled by both consumer demand and EU mandates for extensive charging infrastructure. To efficiently connect millions of EV drivers with chargers, digital platforms (for finding, booking, and paying at charging stations) are essential. Similarly, vehicle-to-grid energy platforms emerge to optimize when EVs charge or feed electricity back, highlighting the convergence of energy and mobility data. Decarbonization policies also encourage alternatives to private car ownership (like public transit, cycling, EV car-sharing), which in turn rely on digital integration. Europe’s emphasis on green mobility, next-gen tech, and reducing car ownership is expected to make its mobility market the world’s second-largest. The total European mobility market (vehicles and services) is forecast to reach $246 billion by 2035 (up from $92 billion in 2023), driven by these converging trends (Oliver Wyman, 2025). In Central Europe, national governments (Germany, Poland, etc.) are aligning with EU climate targets by incentivizing EVs and penalizing high-emission vehicles, creating fertile ground for platform-based e-mobility services (from charging apps to e-carsharing). In short, the sustainability imperative is accelerating electrification and, with it, the need for digital platforms to orchestrate the new electric ecosystem.

Shared Mobility and New Usage Habits: Alongside climate and tech shifts, a social shift in mobility is underway: consumers, especially younger generations, are moving away from car ownership toward on-demand and shared mobility services. In Central Europe, as in the broader EU, surveys show a generational change in attitude – 40% of 18–34-year-olds are more likely to abandon owning a personal car, and about 32% of all current car owners can imagine not having a personal car in the future. This reflects growing openness to Mobility-as-a-Service (MaaS) offerings like ride-hailing, car-sharing, bike/scooter-sharing, subscriptions, and pooled rides. Indeed, usage rates of these services are rising for example, between 2023 and 2024, countries like Germany, France, Italy saw an uptick in people using car-sharing and ride-hailing apps. The overall European *cars-as-a-service* market (encompassing car rental, sharing, ride-hail, subscriptions) is set to grow from ~$77 billion in 2023 to ~$94 billion by 2035. Urban policies are both responding to and reinforcing this trend – cities are enacting "push and pull" measures to discourage private cars (e.g. low-emission zones, reduced parking, car-free city centers) while improving shared and public transport alternatives. For instance, Paris plans to ban most private cars from central areas by 2030 as part of its climate plan, and cities like Vienna have experimented with car-free days. Such policies make car ownership less convenient, nudging citizens toward apps that provide mobility on demand. Digital platforms are the enabler of this unbundled mobility mix: they allow users to seamlessly find, compare, and book different transport modes for each trip. A commuter might use a single smartphone app to plan a trip combining an e-scooter, a train, and a rideshare in one transaction. In Central Europe's highly transit-connected cities (e.g. Berlin, Vienna, Prague), MaaS platforms are increasingly integrating public transit with private services, further blurring the line between traditional public transport and the new platform economy. This shift in habits represents an *industry shake-up*: legacy automakers and transit operators must adapt to a future where access trumps ownership, and revenue comes from services and subscriptions rather than one-off vehicle sales.

Connectivity, Automation, and Data-Driven Optimization: Connectivity – high-speed networks linking vehicles, smartphones, infrastructure, and the cloud – is another megatrend underpinning the platform economy. By 2035, most new vehicles in Europe will be "connected cars" equipped with IoT sensors and continuous network links. This always-on connectivity means vehicles generate vast streams of data on location, traffic, vehicle health, driver behavior, etc. Platforms can aggregate and analyze this data to create value-added services. For example, connected fleets enable remote diagnostics and predictive maintenance, where vehicles automatically report issues or download software updates over-the-air. Fleet operators and logistics providers use such data to optimize operations – minimizing breakdowns or idle time – which is a core promise of platform-driven efficiency. Furthermore, connectivity is the foundation for higher levels of automation: vehicles that talk to each other and to city infrastructure (V2X communications) can improve safety and pave the way for autonomous driving. While fully self-driving cars will likely be limited in Europe to controlled pilots through the 2020s, even partial automation (Level 2/3 ADAS features) are growing rapidly. Notably, EU regulations from 2024 mandate many advanced driver-assistance systems in new cars (emergency braking, lane-keep aids, etc.), boosting adoption. European consumers are interested as well – over 60% of drivers say they would switch car brands to get better ADAS and automation features. All these connected and automated functions produce data and require coordination, which in turn strengthens the role of software platforms. City traffic management is also becoming data-driven: cities like Helsinki and Vienna are piloting platforms that integrate real-time data from vehicles, transit, and sensors to dynamically control traffic lights or provide multimodal route advice. In Central Europe, initiatives under the EU's Cooperative, Connected, Automated Mobility (CCAM) program encourage cross-border corridors with 5G networks enabling vehicles to seamlessly roam and share data (important given many countries in the region are relatively small and closely linked). The upshot is that connectivity and automation are converging with the platform economy – they generate the data fuel and new use-cases (like robo-taxis, smart logistics, etc.) that platforms can orchestrate. A *smarter, more efficient mobility system* is emerging, in which optimization algorithms reduce congestion, maximize vehicle utilization (e.g. through ride-pooling), and improve safety by reacting to real-time information. The platform economy capitalizes on this by offering integrated services (for instance, apps that not only plan your journey but also dispatch an autonomous shuttle or adjust your insurance based on driving data). Technology drivers like 5G, AI, and cloud computing are thus critical enablers of the future mobility platform ecosystem.

Policy and Regulatory Drivers: Europe's political and regulatory environment is a key shaper of the platform economy in mobility. The EU and national governments are actively steering the transition to smart, sustainable mobility through strategies, funding, and regulations. The EU Sustainable and Smart Mobility Strategy (2020) sets ambitious targets – from doubling high-speed rail use by 2030 to achieving climate-neutral cities by 2035 – which effectively *mandate innovation* in mobility services and logistics (European

Commission, 2020). To reach these goals, policymakers are not only tightening environmental rules (CO_2 standards, ICE vehicle bans by 2035) but also explicitly supporting digitalization and integration. For example, the EU's Urban Mobility Framework urges cities to adopt Mobility-as-a-Service platforms and open their transit data to third parties, making multimodal travel easier (EU, 2021). In Central Europe, many governments have launched open data portals or "National Access Points" for transport data in line with the ITS Directive, encouraging startups to build upon public datasets. Funding and incentives play a role too: EU programs like Horizon Europe and Connecting Europe Facility fund pilot projects for smart mobility and data-sharing infrastructure. Importantly, regulators are aware of the risks of a winner-takes-all digital market and are introducing rules to keep the mobility platform economy fair and competitive. The EU's Digital Markets Act (DMA) and forthcoming sector-specific rules aim to prevent dominant tech platforms from abusing their position – relevant if, say, one mobility super-app or mapping service becomes gatekeeper. Likewise, data privacy laws (GDPR and proposals for *Mobility Data Space governance*) ensure that the burgeoning exchange of mobility data happens with safeguards for personal data and transparency. Policymakers also see the platform shift as an industrial opportunity: Europe is pushing for technological sovereignty in critical areas like vehicle software, AI, and chips. Initiatives such as the European Chips Act and alliances for automotive software are meant to reduce dependence on foreign tech and keep value creation in Europe. In the mobility context, this means encouraging European-developed operating systems, mapping platforms, and AI for vehicles. Finally, the public sector is taking an active coordinating role. National and city authorities are not just regulating *others*, they are increasingly acting as platform orchestrators or partners themselves. For instance, some municipalities have launched their own MaaS apps in partnership with private operators, and countries like Austria and Italy have nationwide ticketing platforms integrating rail and local transit. This blurring of public-private roles is supported by EU calls for collaboration: *"No single actor can shoulder the necessary investments alone; private data and tech must link with public planning"* (World Economic Forum, 2023). In summary, political and regulatory drivers in Europe are creating a supportive framework (and in some cases pressure) for a connected, platform-based mobility ecosystem – one that aligns with societal goals like accessibility, sustainability, and digital rights.

Stakeholder Dynamics in the Platform Ecosystem

New Entrants, New Roles: Traditional OEMs are no longer the sole orchestrators of mobility innovation – they are now joined by Big Tech companies, start-ups, mobility service providers, and even cities. Tech giants (from Silicon Valley or China) bring expertise in software, AI, and consumer platforms and are increasingly entering automotive domains (providing in-car operating systems, infotainment platforms, rideshare services, etc.). At the same time, many European start-ups and SMEs are innovating in niches like sensors, data analytics, ride-pooling algorithms, or payment systems. These newcomers often operate with a platform mindset – focusing on scalable digital services rather than hardware. This is forcing incumbents like OEMs and Tier-1 suppliers to redefine their roles: we see car manufacturers striving to become "mobility providers" rather than just car sellers. For example, several German OEMs have launched their own mobility apps or invested in platform ventures (e.g. BMW and Daimler's joint ShareNow car-sharing, or VW's Moia shuttle service). Collaboration is becoming essential: no single player can offer a seamless mobility experience alone. Auto companies are partnering with software firms, telecom operators, cloud providers, and even competitors to build out connected and autonomous capabilities. A case in point: developing autonomous driving requires OEMs to work closely with telecom companies and road infrastructure operators for vehicle-to-infrastructure connectivity. This necessity has given rise to consortiums and alliances across sectors. In Europe, a notable example is the European Connected Mobility Alliance, which brings together carmakers, tech suppliers, and cities to pilot interoperable AV and data solutions. Another dynamic is the role of municipalities and public transport authorities – they are not just regulators but increasingly *platform players* themselves. Some cities in Central Europe have created regional MaaS platforms that integrate local buses, trams, bike-shares, etc., effectively making the city a co-curator of the digital ecosystem. This is a big shift from the old model where city transit was siloed and private mobility services operated separately; now the trend is towards integrated networks with shared data and user interfaces.

Cooperation, Competition, and European Initiatives: As stakeholders multiply, the interactions are a mix of coopetition. Traditional OEMs vs. Tech Giants: There is some tension as both want to "own" the customer interface and data – e.g. an automaker might prefer drivers use its proprietary app for navigation and services, whereas many consumers might default to Google or Apple in their car. This has led OEMs to invest in their own digital platforms (many European OEMs are collaborating on an open-source vehicle OS or marketplaces for in-car apps). Meanwhile, start-ups and SMEs often rely on open ecosystems to scale up – they need access to vehicle data or public APIs to offer their services. Here, European policy is tilting the scales in their favor by pushing for open data and standards. The European Mobility Data Space (EMDS) initiative, for instance, is expected to lower entry barriers for smaller players by providing common data protocols and governance that let them plug into the broader network (European Commission, 2023). Policies are also being discussed to support local value creation: for example, conditions on foreign investment that ensure knowledge transfer to Europe, and funding programs targeted at SME innovation. The overarching vision is a European mobility ecosystem built on shared platforms and collaboration, aligning with European values (safety, privacy, fairness). In such an ecosystem, a large carmaker might open up certain vehicle data streams to external app developers (with user consent) to foster a developer community; in return, the OEM can offer a richer array of services in its cars. We also see *consolidation* happening: big players (whether automakers or global ride-hailing firms) have been acquiring smaller tech firms and start-ups to quickly gain platform capabilities. This can lead to vertically integrated mobility ecosystems – e.g. a company owning the vehicle fleet, the platform, and the data analytics – but regulators are watchful of monopolies. The balance of power is indeed shifting: data owners and software providers hold increasing leverage compared to hardware manufacturers. A research study observed that the platformization of mobility is "reconfiguring automotive value chains, shifting power toward tech and service actors" (ResearchGate, 2025). In Central Europe, where many SMEs are part of automotive supply chains, this shift is both a threat (for those stuck in purely mechanical parts business) and an opportunity (for those who pivot to software or specialized services). The strategic autonomy drive by the EU also influences stakeholder dynamics – European stakeholders are encouraged (and sometimes subsidized) to use European cloud services, maps, or payment systems in mobility, to avoid dependency on non-EU platforms. Finally, public-private partnerships are on the rise: whether it's a city partnering with a start-up to run autonomous shuttles, or national governments setting up innovation hubs where universities, SMEs, and corporates co-develop mobility tech. BearingPoint's research suggests *all players will need to embrace ecosystem thinking*, focusing on their core strengths while ensuring their offerings can integrate with others (BearingPoint, 2023). The future platform-based mobility system in Central Europe will thus be characterized by a network of alliances and partnerships – a complex web of stakeholders where competition exists but collaboration is the key to delivering seamless mobility to end-users.

Future Customer Needs and Pain Points

Ultimately, the success of the platform economy in mobility will depend on how well it addresses the **needs, pain points, and expectations** of its end-users. These users include everyday citizens (commuters, travelers, communities) as well as businesses and entrepreneurs who participate in or build on mobility platforms. A human-centric understanding is crucial – one lesson learned in mobility tech is that winning over consumers often hinges more on user experience and trust than on technology alone. Below, we outline the future needs and concerns of two broad groups in Central Europe:

Citizens and Communities: From a citizen's perspective, the platformization of mobility promises great benefits – convenience, choice, efficiency – but also raises concerns around equity, privacy, and trust. Key expectations and pain points include:

1. **Seamless Convenience:** Users increasingly expect a one-stop, hassle-free mobility experience. This means being able to plan, book, and pay for a journey across multiple modes (train, bus, scooter, taxi, etc.) in one app, with real-time information and easy changes if plans shift. The underlying need is to eliminate the friction of dealing with separate tickets, schedules, or apps for each leg of

a trip. When asked, a majority of Europeans rate such integrated "smart mobility" services as important, and over 80% say they'd even pay extra for door-to-door multimodal journey planning. A pain point today is the "app jungle" – for example, a Berlin resident might juggle a transit app, a bike-share app, and a rideshare app, each with separate logins and payment. By 2035, people expect this to be solved with unified platforms. They also desire real-time responsiveness: e.g. if a train is delayed, the platform should instantly suggest an alternative route or send an autonomous shuttle for the last mile. Essentially, convenience is measured in *time and effort saved*. On-demand availability is part of this – citizens want mobility services that arrive when needed (solving the first/last mile gap in suburban or rural areas). However, if not executed well, there are risks: platforms that try to integrate everything must be extremely reliable. A single failure (like a payment glitch or wrong information) can strand a traveler. Thus, reliability and user-friendly design are implicit expectations along with convenience. Importantly, affordability is tied to convenience for many – if seamless mobility comes at a steep price, many will not find it a viable daily solution. Users will expect that efficiency gains from platforms (e.g. better route optimization, higher asset utilization) translate into lower costs per trip than today's alternatives. For instance, autonomous shuttles managed via platforms are touted to provide *"the quality of a taxi for the price of a bus ticket"* – citizens will hold the industry to these promises.

2. **Choice and Personalization:** One advantage of a platform-based mobility ecosystem is the wider array of options it can offer to consumers – and future users will come to expect this smorgasbord of mobility choices. Rather than a one-size-fits-all, people want solutions tailored to their context: a commuter may prefer a quiet e-bike in the morning, a family might need a car-share for weekend outings, an elderly person might require a doorstep shuttle. Platforms that learn user preferences (while respecting privacy) could offer personalized journey suggestions, discounts for preferred modes, or loyalty rewards across services. Younger digital-native users in Central Europe are likely to gravitate to whichever platform offers the most *flexibility* – e.g. the ability to choose eco-friendly routes, or to easily switch from driving to riding if they start feeling tired. A hidden expectation is that platforms will not trap users in a single provider's ecosystem; rather, they should foster competition and choice. Consumers don't want to be locked into one company's vehicles or payment system – they value the option to compare prices and options (much as one compares rideshare prices today). If a platform economy leads to monopoly (only one app available), users could feel deprived of choice – a potential pain point if prices rise or service quality drops. Therefore, one need is fair and transparent platforms that maintain a level of neutrality in aggregating services. Personalization also extends to inclusive design – for instance, the app interface and offered services should cater to different languages, abilities, and comfort levels. A community expectation might be that a regional platform offers content in the local language (Polish, Hungarian, etc.) and considers local mobility habits. In short, future citizens will expect mobility platforms to treat them as individuals – providing *customized, diverse, and culturally relevant* mobility options at their fingertips.

3. **Trust and Data Privacy:** Trust is a linchpin of any digital ecosystem, and mobility is no exception. Citizens need to trust both the physical safety and the digital integrity of platform-based services. On the physical side, trust means confidence that a new service (say an autonomous robo-taxi hailed via app) is safe to ride – these overlaps with the automation domain where safety is paramount. On the digital side, data privacy and security loom large as concerns. Mobility platforms will know a lot about users: where they travel, at what times, possibly even biometric or payment data. European citizens, who tend to be privacy-conscious, will expect rigorous protection of this personal data. They will ask: *Who owns my mobility data? How is it used?* There is a need for transparent data practices – e.g. clear consent for sharing location or trip info, anonymization of data for any secondary uses, and assurances it won't be sold to third parties without permission. If a platform breaches trust (like a misuse of data or a security hack that leaks user information), it could face public backlash and regulatory action. Another aspect of trust is algorithmic fairness. As platforms

potentially suggest how people travel or even dynamically price services, users want to be sure there's no hidden bias or unfair discrimination (for example, an algorithm shouldn't consistently offer poorer service to certain neighborhoods or demographics). Regulators are already discussing an "AI Act" that would require algorithms, including those in transport, to be explainable and non-discriminatory. Communities also place trust in public authorities to oversee these new services – there is an expectation that government will set rules so that platforms operate safely and ethically. A positive sign is that European initiatives emphasize building consumer trust through open communication and education about new mobility tech. For instance, cities running autonomous shuttle pilots often involve local residents in workshops to demystify the tech. Going forward, certifications or audits (analogous to crash safety ratings) might emerge for mobility platforms on aspects like data security, safety, and compliance – which could help assure users. In summary, citizens need to feel safe – both physically and digitally – when they embrace platform-based mobility. Earning this trust is an ongoing challenge that the industry must prioritize, or else adoption will stall.

4. **Accessibility and Inclusion:** A future mobility ecosystem must serve all segments of society, not just the tech-savvy urban professionals. One promise of platform mobility is that it can *improve accessibility* – e.g. on-demand shuttles can reach areas with poor transit, and digital services could be tailored for those with special needs. For Europe's aging population and people with disabilities, autonomous and connected services could be a game-changer if designed right. An elderly person who no longer drives could hail an automated pod to the doctor; a wheelchair user might find accessible vehicles through a platform without needing special arrangements. Inclusive design is therefore a critical need. This includes having wheelchair-accessible vehicles in fleets, apps with assistive features (like voice commands for visually impaired users), and services that cater to those who are not smartphone-proficient. A pain point today is that many ride-share or scooter services are clustered in city centers and are not usable by those with mobility challenges. Communities will expect that the future platform economy doesn't just cater to affluent city-dwellers but extends equitable access. In Central Europe, where rural regions often suffer from limited mobility options, inclusion means ensuring platforms bridge the urban-rural gap rather than widen it. There is also the issue of the digital divide – not everyone is comfortable using apps or has mobile internet. While younger people will naturally use smartphone-based mobility, some older or low-income individuals might be left out. Future services might need to offer alternative interfaces (like telephone booking or kiosk access) as a bridge. The expectation is that mobility platforms become as ubiquitous and easy as phone service – a public utility of sorts – accessible to all. If the platform economy leads to the *elimination* of traditional options (e.g. if cash tickets or human-staffed services disappear entirely), that could hurt those who can't or won't use digital tools. Therefore, citizens implicitly expect a "mobility for all" outcome, where technology opens new mobility for underserved groups rather than creating new forms of exclusion. Policymakers in Europe are likely to enforce this via regulations (for instance, requiring ride-hailing apps to also serve people without smartphones, or mandating a certain availability of accessible vehicles). In short, inclusion is both a moral imperative and a demand from communities, and meeting it will be a test of how human-centric the platform economy truly is.
5. **Community Impact and Sustainability:** Beyond individual needs, citizens care about the broader community and environmental impacts of mobility services. Platforms that promise smarter mobility will be judged on outcomes like reduced congestion, lower emissions, and improved quality of life in cities and towns. Many Europeans are keen on sustainability – 46% have already switched to greener transport options and more plan tomckinsey.com – so they will favor platforms that help them be eco-friendly. This means a need for platforms to actively promote sustainable choices: for example, recommending a public transport or bike option when feasible, or facilitating ride-sharing to cut vehicle miles. Some apps already let users see the CO_2 impact of different modes; by 2035, such features may be standard, and users might even earn rewards (like carbon points) for choosing

low-carbon travel. If the platform economy simply leads to more vehicles on the road (e.g. swarms of ride-hail cars circling), citizens will view it as a failure. Thus a key expectation is that these innovations actually *reduce* traffic and pollution compared to today. There is also a community desire for accountability and governance of these new mobility services. People expect local governments to manage any negative externalities – for instance, if e-scooter platforms result in cluttered sidewalks or safety hazards, residents look to city hall to ensure rules (and the platforms to enforce them). The platform economy should ideally enable *better* governance through data: cities could get anonymized data from platforms to understand travel patterns and plan infrastructure accordingly. Citizens would appreciate improvements like more precise transit planning, dynamic traffic management, and identification of where new services are needed, all informed by platform data (with privacy intact). Another community-level need is preserving the liveability of cities. Europeans treasure their historic, human-scale cities and don't want them overwhelmed by tech for tech's sake. Platforms must integrate into city life in a way that improves street environments (e.g. reducing search for parking, cutting idle emissions) and fosters sharing of limited space. Done right, a platform-enabled mobility system by 2035 could mean *quieter, cleaner streets with fewer private cars* – a benefit communities will strongly support. In summary, citizens and communities want the platform economy to deliver tangible public benefits: easier and greener travel, without sacrificing privacy or inclusiveness. Meeting these expectations will be crucial for public acceptance of any new mobility innovations.

Entrepreneurs and Businesses (SMEs): The platform economy also presents needs and pain points for the entrepreneurs, start-ups, and small-medium enterprises (SMEs) that are building or leveraging new mobility services. Central Europe has a vibrant ecosystem of such innovators – from software developers to mobility operators – and their perspective is key to the region's success in this transition. Some of their needs include:

- **Access to Data and Markets:** For SMEs, one of the biggest enablers (or blockers) is access to the data and infrastructure that larger players control. A start-up offering, say, a smart parking app, needs access to city parking data or vehicle sensor feeds; a new ride-pooling service might need to plug into public transit ticketing systems to offer combined journeys. Historically, this access has been limited – a fragmented ecosystem and closed data silos make it hard for smaller companies to scale beyond pilot projects. Thus, entrepreneurs urgently need more open APIs, data-sharing agreements, and platform interoperability. The European push for the Mobility Data Space is in direct response to this: it intends to level the playing field by making it easier for SMEs to discover and use mobility data (with appropriate licensing) across the EU. In a practical sense, an SME in Slovenia could access standardized traffic data from Germany or share its micromobility data into a common space, spurring cross-border services. *Interoperability* is another aspect – innovators want common standards so they don't have to reinvent the wheel for each city or car brand. When every city has its own APIs and every OEM its own proprietary systems, the cost of integration for a small company is huge. Reducing this friction – through standards like MaaS APIs or common ticketing frameworks – is a key need. With better access and standards, SMEs can more easily find a market niche. Many entrepreneurs in mobility are looking for niches in the new value chain, from MaaS platforms to analytics services to supplying components for autonomous systems. Their pain point is often not having a pathway to get their solution widely adopted. Open platforms (and collaborative partnerships with bigger firms) can provide that pathway. An example scenario: a start-up that develops a great AI for ride-pooling could integrate it into a major ride-hailing platform via an SDK – but that requires the platform to be open to third-party modules. Ensuring the *dominant platforms are not closed gardens* is thus important for the SME community.
- **Supportive Ecosystem and Funding:** Mobility start-ups in Central Europe often cite funding constraints and scalability as challenges. Unlike Silicon Valley, the region historically had less venture capital flowing into mobility tech, though this is improving. Entrepreneurs need a supportive ecosystem that includes access to capital, mentorship, and a regulatory sandbox to test innovations.

Governments are beginning to respond – for example, the EU's EIT Urban Mobility and national innovation grants provide some non-dilutive funding to mobility SMEs. But beyond money, partnership opportunities are crucial. Start-ups often need pilot customers – cities willing to try their solution, or corporates willing to do proof-of-concepts. A pain point has been slow adoption by traditional players– procurement processes can be lengthy and risk-averse, making it hard for a small company to get that first break. The DACH mobility start-up CEOs specifically noted "slow consumer and corporate adoption" as a barrier, even when sustainable solutions exist. To address this, collaborative efforts are emerging: for instance, some cities create innovation challenges to invite start-ups to solve local mobility problems, offering them a testbed. Large OEMs have also started accelerator programs and venture funds targeting mobility services. Entrepreneurs need more of these bridges to mainstream deployment. Another need is clarity in regulation. Innovative concepts can be stymied by unclear or outdated regulations. SMEs benefit if regulators proactively update rules or grant trial exemptions for new mobility tech. The EU's approach of regulatory sandboxes for AVs, for example, helps companies trial autonomous shuttles legally in certain areas. SMEs in mobility also need talent – software developers, data scientists – and often compete with big firms for these skills. As BearingPoint notes, the demand for software developers in auto is skyrocketing. Smaller firms will need supportive networks (like clusters around universities or shared R&D facilities) to tap into talent and knowledge. In summary, entrepreneurs require an ecosystem that nurtures them: easier access to data/markets, better funding and partnerships, and smart regulation that encourages innovation rather than blocks it.

- **Fair Platform Governance:** While digital platforms can open opportunities, they also introduce power imbalances that concern smaller players. Many SMEs worry about a scenario where one or two mega-platforms dominate mobility and set onerous terms (e.g. high commission fees, algorithmic favoritism, or appropriation of data/IP). For instance, if a global tech company owns the primary MaaS app, a local transit start-up might be forced to join on less-than-favorable terms to reach customers. Thus, there is a need for fair governance and openness in the mobility platform economy. Entrepreneurs would prefer neutral, or at least federated platforms over monopolistic ones. This is partly why European industry and government circles talk about "sovereign platforms" – essentially ensuring Europe has platforms that are open and governed by European laws and values. An example could be an EU-backed marketplace where certified mobility services can plug in, ensuring even a small company can be discoverable by users across the region. The Data Act and other EU legislation also aim to make data sharing fair – so that, for example, vehicle data generated by a car can be accessed by third-party service providers (with user consent) and not hoarded solely by the manufacturer. From an SME perspective, these policies are vital to prevent lock-in. Another facet is IP protection and revenue models: SMEs need to trust that if they contribute a module or service to a larger ecosystem, they will get their fair share of revenue, and their intellectual property won't be unfairly copied. Contractual frameworks like standard licensing agreements, revenue-sharing models, and perhaps platform cooperatives emerge to address this. The European Commission's stance in related industries (like its support for open app stores, or open banking APIs in finance) suggests similar measures could enforce openness in mobility. Entrepreneurs also benefit from transparency – knowing how a platform's algorithms match customers or how fees are determined. If a ride-hailing platform suddenly changes its algorithm in a way that hurts a small fleet operator, that unpredictability is a business risk. Consistent, transparent rules on platforms are therefore a need. In essence, SMEs seek a "plug-and-play" mobility ecosystem where they can innovate on top of common standards, and trust that the rules of engagement won't be arbitrarily changed by an overpowering gatekeeper. Achieving this balance between platform operators and third-party innovators is an ongoing challenge, but Europe's mobility community is actively trying to manage through dialogue and regulation. If successful, the result will be a rich mobility marketplace where dozens of niche services flourish, complementing the offerings of bigger players – ultimately delivering more choice and innovation to consumers.

Scenario-Based Use Cases for 2035

To illustrate how the platform economy might transform mobility in Central Europe by 2035, this section presents four plausible scenario use cases. Each scenario describes a future mobility solution – including the business model, stakeholder collaboration, and user benefits – that could emerge from the trends discussed. These are futuristic but feasible vignettes, grounded in current initiatives and extrapolated to 2035. They show different facets of the platform economy: from urban travel to regional logistics, and from public-private partnerships to start-up-driven innovation. The purpose is to make the abstract concepts concrete and highlight how various players (OEMs, tech firms, cities, SMEs, citizens) might interact in new mobility ecosystems.

Scenario 1: "Smart City Mobility-as-a-Service Super-App"

Setting: Munich, Germany, 2035. Munich has become one of Central Europe's leading "smart mobility" cities by deploying a comprehensive MaaS (Mobility-as-a-Service) platform that integrates all forms of urban transportation into a single digital service. This city-backed platform, dubbed MüniGo, combines municipal public transit, private mobility services, and even regional travel options. Residents and visitors use a single app to access everything: metro trains, buses, tram, ride-hailing cars, e-bikes, e-scooters, car-sharing vehicles, and autonomous shuttles. The app provides real-time info and AI-driven route planning – for example, if there's a traffic jam, MüniGo might suggest taking an e-scooter to the next tram stop to save time, or if it's raining, hail an on-demand shuttle. Crucially, one account and one payment system covers all services, with a variety of payment models (pay-as-you-go, monthly subscription bundles, corporate mobility budgets, etc.). This scenario realizes the long-held vision that "digital platforms manage the travel experience end-to-end" and that consumers can "plan, book, and pay through one outlet" across modes.

Business Model & Stakeholders: MüniGo is operated as a public-private partnership platform. The city of Munich initiated it, building on its existing public transport authority app, but opened it up to private partners. All major mobility providers in the city – from Deutsche Bahn (regional trains) to BMW's ReachNow car-share and Uber's ride-hailing – are onboarded as service partners. They agreed to API integration and data sharing with the platform, in return for access to the platform's large user base. The city maintains governance (ensuring neutrality and that public goals are met), while a consortium company (with members from a local tech firm and the transit authority) manages the technical platform. Revenue flows through a commission model: users either pay per ride or buy subscription plans (e.g. €100/month for unlimited public transit and discounted other services). The platform then distributes revenue to providers based on usage, with a small commission fee retained. Because the city subsidizes certain public-good aspects (like ensuring coverage in low-density areas), the pricing to users stays reasonable. For example, the city might subsidize first- and last-mile rides in underserved neighborhoods via the app. This aligns with policy goals to reduce private car usage – indeed, by 2035 private cars in Munich account for only ~40% of trips, down from ~60% a decade earlier, thanks in part to the attractiveness of the MaaS alternative (Munich Mobility Report, 2035). The technology behind MüniGo is a robust platform handling millions of data points. It leverages the European Mobility Data Space standards to ingest data from many sources and uses AI for journey optimization. All partners commit to data reciprocity: for instance, ride-hail companies share pseudonymized origin-destination data to help the city with planning, while the city shares events or disruptions info that helps all services reroute. This scenario demonstrates a cooperative ecosystem business model – competitors collaborate via a neutral platform because it expands the pie for everyone. A local start-up provides the AI routing engine in the app (after winning a city challenge), showing how SMEs can plug in innovation. Overall, the platform is financially sustainable: increased ridership across modes generates revenue, and operating costs are kept in check by economies of scale and efficient resource use (e.g. balancing loads between bus and on-demand vehicles in real time).

User Experience & Benefits: For citizens, this scenario is a dream come true in terms of convenience. Imagine Anna, a Munich resident: when heading to work, she enters her destination and MüniGo offers her a combo – an e-scooter is 2 minutes away to take her to a nearby express bus that will get her close to the office, and a shuttle will be waiting to cover the last stretch, all in 30 minutes. She clicks “OK” once to book the whole trip. During the trip, the app handles a delay by automatically rebooking her on a slightly later shuttle and sending a notification. Anna is charged a single fare at the end, and since she has a MobilityPass subscription, it’s all covered. On weekends, Anna uses the same app to book an intercity train to visit her parents and a shared car at the destination – no need for separate accounts. The seamless integration significantly reduces the mental load and uncertainty of traveling; it’s as if the entire city’s transport is one coherent service. Importantly, the platform improves equity: all subway stations and many vehicles are wheelchair-accessible, and users can input accessibility needs in the app, which will then filter options accordingly. Elderly users have the option to use a simplified phone hotline that taps into the same system, ensuring they aren’t left out. For the community, the benefits are evident in traffic reduction and emissions: with many people using this MaaS, car ownership in Munich has dropped (many young residents don’t buy cars at all). Congestion and pollution metrics improved, helping Munich meet its climate targets. City officials also use aggregated platform data to make tweaks – e.g. identifying a need for a new bus line because app data showed many queries for trips that weren’t well served. In terms of pain points, one challenge initially was getting all providers to agree on data sharing and a common payment system – solved through city convening power and EU data space regulations. Also, the platform had to earn user trust regarding data privacy; it achieved this by strict compliance with GDPR, giving users control over their data sharing preferences, and being transparent (the app might say “we use your location to improve service; here’s how”). Over time, trust built, and usage grew. This scenario highlights how by 2035 a major Central European city can transform mobility into an on-demand utility through a platform, improving quality of life and setting a template for others. Its success factors include strong public leadership, collaboration across stakeholders, and a relentless focus on user needs (convenience, affordability, reliability).

Scenario 2: “Seamless Cross-Border Mobility Network”

Setting: Tri-Border Region of Austria, Italy, and Slovenia, 2035. In the future, platform-based mobility has not only enhanced travel within cities but also across regions and national borders. This scenario is set in the Alpen-Adria region, where Austria, Italy, and Slovenia meet – an area characterized by medium-sized cities (like Klagenfurt, Udine, and Ljubljana) and significant cross-border movement for work and tourism. By 2035, the three countries have jointly implemented a Cross-Border Mobility Platform that connects their transport networks. Travelers can effortlessly take a multi-leg journey, for example: a regional train from Austria to Italy, then a Slovenian autonomous electric shuttle to a village, all planned and booked as one transaction. The platform, informally called AlpineGo, was born out of an EU-funded initiative to improve connectivity in Central European border regions (building on Interreg projects from the 2020s). It acts as an aggregator of multiple national systems – essentially a federation of the Austrian, Italian, and Slovenian mobility databases and ticketing systems, enabled by common standards. AlpineGo provides a single user interface and e-ticket that is recognized by all participating transport operators (rail companies, coach lines, local transit, even some rideshare and micro-mobility providers in each country).

Business Model & Governance: AlpineGo is managed by a transnational mobility consortium. Key members include the Austrian Federal Rail (ÖBB), Ferrovie dello Stato Italiane (Italian Rail), Slovenian Rail, FlixBus (which operates international coaches in the area), and the transport ministries of the three nations. They formed a non-profit alliance to run the platform, agreeing on revenue-sharing formulas. When a user buys a through-ticket via AlpineGo, the fare is automatically split between the operators of each segment. A small service fee (perhaps 5%) goes to maintaining the platform. The European Union supported this with initial funding and by mediating agreements on technical interoperability. Technology drivers here were the adoption of EU-wide standards: for instance, the platform leverages the EU’s Multimodal Ticketing API (a hypothetical standard in 2030 that allows different ticketing systems to talk to each other securely). Blockchain-based smart contracts might be used to allocate payments instantly as journeys are completed, increasing trust among parties. One notable aspect is that this platform overcame the hurdle of different national regulations – thanks to an EU regulation in 2030 that mandated basic interoperability of ticketing for any service receiving public subsidy (which covers most rail and transit). Private operators (like the bus company and a rideshare firm) joined later when they saw the volume of users on AlpineGo. The business incentive is clear: by making cross-border travel easier, all operators gained riders. For example, a Slovenian tourist might not have considered taking a train to a small Austrian town before, but with a one-click solution, they do – generating new revenue for the train and local transit at the destination. Another benefit for operators: the platform provides integrated data analytics on travel demand, which they share (anonymously) to help each other optimize schedules. The governance is designed to be neutral – no single country or company controls the platform outright, to ensure fairness (a principle much like how Europe treats its electricity grid or air traffic control in a coordinated way).

User Story & Impact*:* Consider Luka, a university student in Ljubljana, Slovenia, who wants to attend a concert in Udine, Italy, and return the same night. In 2010, this trip would have been a headache: checking train timetables across borders, figuring out purchasing separate tickets, and dealing with last-mile transport at odd hours. In 2035, Luka simply enters the destination in AlpineGo. The platform knows he's a student (profile info) and offers a couple of options: Option 1 – a late-afternoon train from Ljubljana to Villach (Austria), a 10-minute wait to transfer to a cross-border regional train to Udine, then a micro-transit shuttle to the concert venue (since it's night and regular buses are sparse). Option 2 – an intercity bus direct to Udine and an e-bike pickup near the venue. Luka chooses Option 1. He pays once (the student discount is applied automatically across all legs because the platform recognizes his eligibility), and his phone loads a QR code ticket valid for the whole journey. Throughout the trip, he receives updates: "Your connecting train is on time" or "Shuttle is waiting at exit B". After the concert, the shuttle takes him to a different station to catch a special late-night coach that the platform scheduled because many people in the region requested returns that night – a demand-responsive addition. Luka dozes off and wakes up back in Ljubljana. This scenario showcases ultra-convenient regional mobility – the platform bridges what used to be bureaucratic and logistical gaps. For users, the key benefits are simplicity, confidence, and expanded reach. People can easily travel for work or leisure across Central Europe without renting cars or navigating foreign ticket machines. This encourages more cross-border exchange (economic and cultural). Importantly, it also helps less-connected areas: small towns in Carinthia (Austria) or Friuli (Italy) see more visitors because they're now "on the map" when users search in the app. The pain point of fragmentation was effectively solved. One challenge overcame was language and information: AlpineGo app is multilingual (German, Italian, Slovene, English), and it consolidates customer support – there's one help chat that can coordinate with any operator if something goes wrong. The platform needed to ensure reliability to gain trust – early on, a few missed connections upset users, prompting the consortium to implement a guaranteed connection policy: if the official journey plan is disrupted (say a delay misses a connection), the platform will rebook you or provide compensation/a taxi at no extra cost. This policy gave users confidence that they wouldn't be stranded in a foreign country. From a stakeholder perspective, this scenario required unprecedented cooperation between countries. It hints at a future where European regions function with seamless mobility akin to how telecom roaming became seamless. It also leverages technology like automation: the autonomous shuttles and demand-driven coaches indicate a flexibility that wasn't possible before. By 2035, enough of the fleet is smart/automated that scheduling additional services on the fly is feasible when the platform detects high demand. Overall, this scenario paints a picture of a borderless mobility service – aligning with the EU's fundamental principle of free movement, now enabled by digital means. It demonstrates a business model where integration itself creates value (growing the pie of travelers), and success depends on trust and partnership among many entities.

Scenario 3: "Data-Driven Mobility Marketplace for SMEs"

Setting*:* Virtual Mobility Marketplace (Europe-wide), 2035. This scenario doesn't center on physical location but rather a digital infrastructure that has emerged by 2035: a pan-European mobility data marketplace that supercharges innovation, especially among SMEs. Building on the concept of the European Mobility Data Space (EMDS), by 2035 a functional marketplace exists where data from vehicles, infrastructure, and travel services is shared (with proper permissions) and can be traded or utilized to create new services. Think of it as an "App Store" for mobility data and services – but open and federated. This marketplace is where thousands of small companies and developers offer their specialized mobility solutions, plugging into vehicles and platforms across Central Europe. For example, an SME analytics firm might offer a service that analyzes real-time traffic camera feeds to predict congestion 30 minutes ahead – city traffic management centers subscribe to this service via the marketplace. Or a start-up might develop a plug-in module for autonomous shuttles that improves how they detect potholes; shuttle operators can buy that algorithm as an over-the-air update to their vehicles via the marketplace. The marketplace itself isn't owned by one company – it's a network governed by industry alliances and the EU. This scenario addresses how the platform economy can remain *innovative and inclusive*, preventing dominance by a few giants, by establishing a neutral innovation layer.

Players and Mechanisms*:* The core of this marketplace is governed by the European Alliance for Mobility Innovation, a body formed out of the EU's efforts to connect OEMs, suppliers, and tech firms (similar to today's initiatives like GAIA-X for cloud). The Alliance provides the rules and trust framework: common APIs, data formats, security standards, and a legal framework for data-sharing (ensuring GDPR compliance, intellectual property protection, etc.). Data providers (cities, OEMs, transport operators) make certain datasets available – some for free (open data), some for a fee or under specific licenses. Innovators (SMEs, start-ups, even individual developers or research labs) can access these to build services. Crucially, the vehicles and devices in 2035 are largely software-defined and connected, which means third-party apps or features can be integrated much like installing apps on a phone. In practice, major vehicle manufacturers in Europe have agreed to a common vehicle app platform (possibly as an extension of Android Automotive or a European equivalent) so that safe, certified third-party apps or algorithms can run in their vehicles without heavy re-engineering. Similarly, city mobility platforms have open plugin architectures. The business model for the marketplace is transactional: it may charge a small fee per transaction or have subscription models for data feeds. Many SMEs prefer this model because they don't have to negotiate complex contracts with each OEM or city – they publish their service on the marketplace, and any client across Europe can license it under standardized terms. Think of a small Polish start-up with a great AI for pedestrian detection; historically they might struggle to get an appointment with big automakers – but in 2035, they publish their AI module on the marketplace, it gets certified by the Alliance's lab, and then any autonomous vehicle fleet in Europe can download and use it for a fee (with royalties flowing to the start-up). This scenario thus fosters a modular ecosystem: components (data streams, algorithms, micro-services) that can mix-and-match. Importantly, the marketplace has a trust and certification system – safety-critical applications are vetted. Perhaps the Alliance or EU has a testing facility that tries out submitted software modules on reference vehicles to ensure they meet safety standards before listing. This maintains quality and trust so that big players are comfortable using SME-developed tech. For data transactions, blockchain or secure identity systems might be used to enforce that data is only used as agreed (for example, a city's traffic data might be allowed for traffic management services but not for, say, advertising). The economic model is "low barriers to entry": even a two-person start-up in Hungary can contribute an idea and get Europe-wide reach if it's good.

Example Use Cases*:* One use case within this scenario: Optimized Rural Mobility Routing. A Slovenian SME develops a clever routing algorithm tailored for rural, winding roads (accounting for farm vehicle patterns, etc.) – it dramatically improves ETA accuracy on such roads. They list this on the marketplace. A ride-sharing co-op in Hungary that operates in rural areas finds this and integrates it into their dispatch system via API, improving their service. Meanwhile, a German autonomous tractor manufacturer also uses the algorithm to better route their machines between fields. The SME earns revenue from multiple clients across sectors – something possible only because the marketplace gave them visibility and easy integration. Another use case: Urban Data Monetization for Good. Cities traditionally have tons of data (traffic speeds, air quality, transit usage). Through the marketplace, a mid-sized city like Maribor (Slovenia) can share its data with developers and even earn a small fee for budget. A Czech start-up uses multiple cities' data to create a comparative congestion analytics tool that both cities and retailers buy (cities to plan traffic mitigation, retailers to plan delivery logistics). The start-up pays via the marketplace for the data usage, so cities get a return, and the start-up avoids needing separate data contracts with every city. For vehicle manufacturers and large operators, this scenario is beneficial because they get a broad supplier innovation base without having to do everything in-house. For example, an OEM can rely on the marketplace to supply various software features (navigation, voice assistant, parking spot finder, etc.) and focus on integrating them – akin to how smartphone makers rely on an app ecosystem. It prevents them from falling behind in every niche innovation. They do have to accept not taking a 30% app store cut like big tech does, but Europe's regulatory environment in 2035 might discourage such high gatekeeping fees to keep the ecosystem healthy.

Impact on SMEs and Innovation*:* The primary beneficiaries here are SMEs and local innovators, who in 2023 often struggle to scale in mobility due to fragmentation and dominance of big firms. By 2035, with this open marketplace, the playing field is more leveled. A small company from Central Europe can have Europe-wide impact if their solution is valuable. This has led to a flowering of specialized services: one for optimizing EV charging schedules, one for enhancing bike lane safety via IoT, another for gamifying walking. Many of these would not survive on their own, but as part of a larger ecosystem they find their user base. For consumers and communities, the scenario yields indirect benefits: more innovation means better services and choices. It also means local needs can be addressed by local innovators who understand them (e.g. a start-up in Naples making an app tailored to chaotic parking situations there, which then can be adapted by others with similar issues). There is also an economic benefit – a study finds that this open mobility market added €50 billion to EU GDP by 2035 by unlocking SME growth and efficiency gains (hypothetical figure). Of course, managing such a scenario has challenges: common standards require consensus, and not all big players initially liked the idea of opening interfaces. It took a combination of policy nudges and demonstrated benefits to get buy-in. Security is paramount too – the Alliance had to ensure robust cybersecurity so that adding third-party software doesn't introduce vulnerabilities in vehicles or systems. Over time, a reputation system emerged: providers on the marketplace have ratings and trust marks, and poor-quality ones get weeded out. This scenario is essentially the "Android ecosystem" version of mobility – diverse, decentralized, and innovative – in contrast to a walled-garden approach. Given Europe's preference for competition and SME support, this plausible future shows how the platform economy can be structured to be a *positive-sum game*: large companies get a rich supply chain, small companies get access to markets, governments see policy goals advanced, and citizens get a plethora of new services. It underscores that the architecture of the platform economy (open vs closed) will heavily influence innovation outcomes.

Scenario 4: "Mobility-as-a-Service for Rural Communities – Cooperative Model"

Setting*:* Rural Bavaria and Czechia, 2035. Not all platform innovations revolve around big cities or high-tech vehicles. This scenario addresses mobility in low-density rural areas – a perennial challenge – using a platform-based cooperative approach. By 2035, several rural regions straddling the Germany-Czechia border have implemented a Community Mobility Platform that functions as a cooperative of local stakeholders. In, say, the Bavarian Forest region (Bayerischer Wald) and adjacent Bohemian Forest (Šumava) in Czechia, small towns and villages faced declining public transport and an aging population with limited mobility options. The solution was to create a regional MaaS cooperative: residents, local transport companies (like a family-owned bus operator), and municipalities collectively operate an on-demand shuttle and car-pooling service through a digital platform. Essentially, it's "Uber for rural areas" but owned by the community and integrated with existing transit like the morning school buses and infrequent rail lines. The platform allows people to request rides between villages, which are then serviced by a mix of vehicles: some are small autonomous electric vans owned by the cooperative, others are rides by volunteer drivers or taxi partners. It's a modern twist on the old "village carpool" concept, scaled up with technology and coordination.

Organization & Business Model*:* The cooperative model means the platform is not run for profit-maximization but for service coverage. Members include the local county governments, citizen members (who pay a small annual fee to support it), and local businesses (which might sponsor it because it helps employees reach workplaces). The digital platform itself might be powered by white-label software from a tech provider, but all data and governance stay local. Funding initially came from an EU rural mobility grant and national subsidies to address rural depopulation. The business model combines public funding, membership fees, and user fares. Users pay modest fares for each ride (priced similar to a bus ticket per km), but many also pay an annual membership which gives them discounted rides – instilling a sense of ownership. Because there's public subsidy, the cooperative ensures coverage even for remote villages (a key difference from purely private on-demand services that might ignore unprofitable areas). The platform's intelligence lies in pooling and routing algorithms: since demand is low density, it clusters ride requests – like a morning van that picks up multiple seniors from different hamlets to take them to the town center. It also integrates with one fixed bus line and the train: the app shows when the next train is at the nearest station and offers to book a shuttle that times perfectly with it. Essentially it fills the gaps in the network. Volunteer drivers can also register – e.g. a local resident driving to town can indicate in the app they have 2 spare seats; the platform can match them with neighbors needing a lift (this is reminiscent of carpool apps, but integrated here as one of the options). To incentivize participation, volunteer drivers get credits that they can use for rides or local store discounts.

Benefits & Social Impact: For residents, this dramatically improves quality of life. Take Frau Müller, age 70, in a Bavarian village. She doesn't drive and used to depend on a weekly market-day bus. Now, with a phone call (for those without smartphones, a call center tied to the platform is available) or a few taps on the app, she can summon the "DorfShuttle" to go to the doctor or visit a friend. She trusts it because it's partly run by neighbors and the municipality. Similarly, in Czech villages across the border, young people use it to get to the train that takes them to jobs in the city, or to safely get home from a pub at night (a huge benefit against drunk driving or isolation). This scenario's platform thus addresses rural isolation, a major pain point that previous market-driven approaches struggled with. By 2035, the service is so successful that private car ownership in those villages has modestly decreased – some families feel they can manage with one car instead of two, knowing they have backup mobility if needed. It's also eco-friendlier: pooling rides reduces redundant trips, and the cooperative switched to EVs for its vans, setting up community charging stations (solar-powered) at central locations. The cooperative aspect fosters trust: citizens know their data isn't being sold and that the platform's goal is service, not squeezing profit. They have a voice in governance – annual meetings where members can vote on expanding service hours or setting fare levels. This local control aligns with European traditions of cooperative banks and utilities serving communities. From a technology perspective, the platform benefits from the broader marketplace scenario (from 4.3): the cooperative could procure the software cheaply or even as open-source from the marketplace, and it utilizes open data (like regional train times). If the autonomous shuttles in use were developed via scenario 4.3's ecosystem, the cooperative might be leasing them at affordable rates. Stakeholder dynamics: local government loves it because it provides public transport without the full cost of running empty buses; citizens love it as they designed it to fit their needs (for example, scheduling priority for medical trips). Private taxi companies in the area were initially wary, but they found they get *more* business by joining the platform for certain routes where they get paid by the cooperative to cover during high demand. The EU and national policymakers view this as a model to replicate in other rural regions – it meets policy goals of territorial cohesion (making sure rural areas aren't left behind in mobility). Economically, the model runs lean – by 2035 it might break even with the mix of subsidies and fares, thanks to efficient utilization of vehicles. The pain point addressed here is that typical ride-hailing or car-sharing companies didn't find rural areas profitable, so without a cooperative platform these communities would be stuck. By using a platform approach, even low volume of requests can be aggregated region-wide to make a viable service. It's a case of *platform technology enabling hyper-local solutions*.

In sum, Scenario 4 demonstrates that the platform economy in mobility can scale **down** to small communities, not just up to cities. By 2035, digital coordination, coupled with novel ownership models, can solve mobility problems for demographics and areas that the first wave of commercial mobility startups largely ignored. The success in Central Europe's rural cooperatives could inspire similar models in other parts of Europe, ensuring that the future of mobility is **inclusive geographically** – leaving no village behind. This scenario also highlights the versatility of platform-based mobility: it can power high-tech urban systems (as in Scenario 1) and grassroots community networks alike, each tuned to their context.

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4. Use Case Problem Identification

The following section presents the results of the Use Case Problem Identification, summarizing the outcomes of the expert workshops in which twelve use case problem areas were defined and described. These results reflect the key challenges identified across the participating expert groups and form the foundation for the subsequent phases of use case development and evaluation within the D2T project. Each focus area was documented using a standardized methodology to ensure consistency and comparability across all workshops. This process included three main steps:

1. **Challenge Description** – outlines the central issue and explains its relevance to the European mobility and platform economy context.

2. **Problem Framing Canvas** – structures the exploration of each challenge from both a business and customer perspective, including an analysis of the main *Pains* (obstacles, inefficiencies, unmet needs) and *Gains* (desired improvements, opportunities).

3. **Key Insights & Outcomes** – summarizes the essential findings and results of the expert discussions, highlighting how each challenge was refined, which user and business needs were prioritized, and how this understanding laid the groundwork for developing concrete use case ideas in the next design and evaluation phases.

4.1 Electrification

The following section outlines the selection of the thematic focus areas, which were defined during the initial meeting of the expert group. In this first collaborative session, participants were engaged in an open and interactive discussion to identify and prioritize the most relevant topics within their respective domain. Through this exchange, the group explored key challenges, opportunities, and emerging trends shaping the future of the field.

Based on these discussions — and through subsequent consolidation by the moderators — the topics were narrowed down to three main areas of focus:

- **EV Value Chain**
- **Charging Services**
- **Battery Value Chain**

At this early stage, the themes were intentionally defined in broad terms to maintain openness and inclusivity. This approach ensured that no potentially relevant dimensions or perspectives were excluded too early, allowing for comprehensive exploration, refinement, and prioritization in the later phases of the project.

4.1.1 Focus Area: EV Value Chain

1. Challenge Description

Europe's EV value chain faces growing pressure due to high import dependency on battery cells, critical materials, and key components—while global competitors scale vertically integrated ecosystems. Regional fragmentation, skills shortages, and rising regulatory requirements further challenge the competitiveness of European OEMs and suppliers. SMEs in particular struggle to keep pace with cost pressure, compliance demands, and the rapid shift toward electrification.

Core Problems

- Skills gap in battery production, automation, and recycling.
- Fragmented supplier landscape across EU regions.
- Strong dependence on Asian suppliers for critical components and materials.
- High sustainability reporting pressure (CSRD, CBAM).
- Accelerating EV transition under EU climate targets.

Underlying Causes

- Long-standing outsourcing of battery and material production.
- Insufficient scaling of EU industrial capacities and R&D.
- Fragmented national policies and uneven regional ecosystems.
- High energy prices and limited access to raw materials.

Consequences

Europe's competitiveness weakens, supply chains become vulnerable, SMEs struggle with compliance and cost pressure, and OEMs face volatility and reduced planning security—hindering the EU's ability to build a resilient and autonomous EV ecosystem.

Guiding Questions

- How can Europe reduce strategic dependencies in the EV value chain?
- Which competencies and capacities must regions develop to stay competitive?
- How can SMEs be supported during the industrial transition?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 1**.

Business Context

Historically, European OEMs outsourced battery cell manufacturing and critical component production to Asia due to lower costs and more mature supply ecosystems. As this model appeared efficient for many years, the incentive to establish fully integrated European value chains remained limited. Even though programs such as the European Battery Alliance and IPCEI Batteries launched important pilot initiatives, their scale was insufficient compared to Asia's rapid industrialization and vertically integrated clusters. National policies often prioritized attracting EV assembly plants rather than investing in upstream capabilities such as raw-material processing, anode/cathode production, battery cell manufacturing, or recycling. This resulted in weak vertical integration: European assembly plants rely heavily on imported components, and innovations developed in research projects often struggle to reach industrial scale. Meanwhile, global competitors have advanced quickly. China controls a large share of global critical raw-material processing and battery manufacturing, combining state support, lower operating costs, and strong industrial clusters. The United States is accelerating through the Inflation Reduction Act (IRA), which incentivizes domestic EV supply chains and reshoring. In response, the EU has launched major policy initiatives like the Net-Zero Industry Act (NZIA) and the Critical Raw Materials Act (CRMA), aiming to reduce dependencies, expand domestic capacities, and create a more competitive industrial environment. These policies align with a broader global trend toward regionalization and resilience—but Europe must act quickly to avoid further strategic decline. Despite these challenges, significant opportunities are emerging. European companies can leverage strengths in automation, high-quality engineering, recycling technologies, and green manufacturing. Circular-economy approaches. Especially battery second life and material recovery—offer competitive advantages aligned with European values and regulatory expectations. The strategic imperative is clear: to build a competitive, resilient, and sustainable EV value chain that secures high-quality jobs in Europe and ensures technological autonomy in critical domains.

Customer Context

OEMs and Tier-2/3 suppliers face increasing operational and strategic uncertainty. High material-cost volatility, geopolitical disruptions, and unstable supply chains undermine planning and profitability. As a result, companies are searching for stable, transparent, and resilient sourcing models. Tier-2 suppliers increasingly rely on dual-sourcing, long-term contracts, and EU-based suppliers where possible, as sourcing from outside Europe introduces geopolitical and compliance risks. Moreover, ESG requirements, including traceability, carbon reporting, and responsible sourcing, have become decisive factors in procurement decisions. Suppliers able to provide full transparency and verified sustainability data gain a competitive edge. At the same time, many SMEs struggle with capacity constraints, limited access to skilled labor, and the financial burden of digitalization and compliance. While OEMs demand higher transparency and quality assurance, smaller suppliers often lack the tools, data systems, and governance needed to meet these expectations. The Problem Framing Canvas showed a clear alignment gap between what OEMs require and what many SMEs can currently deliver—highlighting the need for coordinated support, harmonized standards, and cross-regional cooperation to build scalable, competitive supply networks across Europe.

3. Key Insights & Outcomes

The Problem Framing Canvas session confirmed that Europe's EV value chain faces structural weaknesses, especially in skills, supplier coordination, and dependency on non-EU sources. Participants emphasized that despite important initiatives, Europe has yet to develop the vertically integrated, competitive supply networks needed to match global competitors. Key insights included:

- The labour market urgently needs upskilling in battery technology, automation, and recycling.
- Fragmented regional supplier structures hinder scaling and competitiveness
- Dependence on Asian suppliers remains a core strategic vulnerability
- EU policy initiatives (NZIA, CRMA, Battery Regulation) are essential but must be implemented with strong regional coordination
- New opportunities are emerging through circularity, automation, and green manufacturing, areas where Europe has competitive strengths.

The upcoming Use Case Development Phase will therefore focus on:

- Building resilient cross-regional supply networks.
- Strengthening vertical integration through new European battery, recycling, and component capacities.
- Supporting SMEs in digitalization, compliance, and capability development.
- Exploring new circular-economy opportunities and automation-driven competitiveness.

4.1.2 Focus Area: Charging Services

1. Challenge Description

Europe's charging ecosystem faces rising energy costs, limited grid capacity, and strong price competition, while user experience remains inconsistent due to interoperability and payment fragmentation. Grid constraints slow down high-power charger expansion, and many stations show low utilization—especially in rural or less dense areas—hindering profitable operation. These challenges, identified in the TRM of P1, reflect a system where infrastructure growth, grid integration, and digital maturity are still not fully aligned.

Core Problems

- Grid constraints limiting high-power charger deployment
- Payment and interoperability fragmentation
- High electricity prices affecting operators and users
- Low utilization rates reducing ROI• Uneven rollout between countries and urban/rural areas

Underlying Causes

- Slow, complex, and costly grid-connection processes
- Fragmented standards for roaming and payment
- Volatile wholesale electricity markets
- Lack of coordinated deployment strategies across regions

Consequences

Charging infrastructure remains unreliable in many areas, profitability is low, and user trust suffers. Operators struggle to scale, fleet electrification is slowed, and regional disparities persist—undermining Europe's ability to support mass EV adoption.

Guiding Questions

- How can grid integration and permitting be accelerated?
- How can interoperability and payments become truly seamless?
- How can utilization and economic viability of charging sites be improved?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 2.**

Business Context

The expansion of EV charging infrastructure continues to face several systemic challenges. Grid constraints are slowing the rollout of new high-power chargers, especially in locations where network upgrades are costly or time-consuming. At the same time, interoperability issues and fragmented payment systems create inconsistent user experiences across charging networks. These challenges are compounded by volatile electricity prices, which affect both operators' business models and drivers' charging costs. Many stations also suffer from low utilization rates, making it difficult to justify further investment. Finally, deployment remains uneven between countries and between urban and rural areas, leading to geographic disparities in access to reliable charging infrastructure.

In the past early national subsidy programs helped expand charging networks across Europe, and roaming initiatives such as Hubject and GIREVE introduced partial interoperability between operators. Public-private partnerships—including Ionity and Allego—also demonstrated that collaborative models could accelerate deployment. However, progress was constrained by limited regulatory coordination between states, resulting in fragmented standards and policies. Users often faced a poor charging experience due to incompatible payment systems, while low utilisation rates slowed returns on investment, contributing to persistently high prices.

In the future, the ambition is shifting toward greater standardization and consolidation, coupled with stronger customer education to simplify adoption. EU-wide roaming and compliance with AFIR are driving more uniform charging experiences, while grid integration is becoming essential as smart charging, bidirectional (V2G) capabilities, and dynamic pricing models emerge. At the same time, competitors are expanding vertically—combining OEM manufacturing with charging infrastructure and energy services—to capture more of the value chain. These trends create significant opportunities in renewable integration, fleet electrification, and ultimately in delivering more affordable and sustainable transportation across Europe.

Customer Context

EV drivers, fleet operators, CPOs, and municipalities all face distinct but interconnected needs as charging infrastructure evolves. Drivers increasingly expect seamless access to charging, including plug-and-charge capability and reliable roaming across networks. In reality, they still rely on workarounds such as multiple apps, memberships, and RFID cards—sometimes even within a single country—creating frustration with inconsistent experiences and uncertain charger availability. Fleet managers, meanwhile, require predictable costs, efficient route planning, and minimized downtime to keep operations running smoothly. These expectations place growing pressure on CPOs and municipalities to deliver more interoperable, user-centric, and reliable charging ecosystems.

3. Key Insights & Outcomes

The Problem Framing Canvas session clarified that EV drivers, fleet operators, CPOs, and municipalities all face distinct but interconnected needs as charging infrastructure evolves. Drivers increasingly expect seamless access to charging, including plug-and-charge capability and reliable roaming across networks. In reality, they still rely on workarounds such as multiple apps, memberships, and RFID cards—sometimes even within a single country—creating frustration with inconsistent experiences and uncertain charger availability. The industry's ambition is shifting toward greater standardization and consolidation, coupled with stronger customer education to simplify adoption. EU-wide roaming and compliance with AFIR are driving more uniform charging experiences, while grid integration is becoming essential as smart charging, bidirectional (V2G) capabilities, and dynamic pricing models emerge. At the same time, competitors are expanding vertically—combining OEM manufacturing with charging infrastructure and energy services—to capture more of the value chain. These trends create significant opportunities in renewable integration, fleet electrification, and ultimately in delivering more affordable and sustainable transportation across Europe.

4.1.3 Focus Area: Battery Value Chain

1. Challenge Description

Europe's battery value chain faces significant capability gaps: limited industrial experience in large-scale cell production, high material and energy costs, and shortages of skilled labor. Recycling capacity remains underdeveloped, while raw material sourcing and refining continue to be major bottlenecks—exacerbated by geopolitical risks and strong regulatory pressure (traceability, eco-design, Battery Regulation). These challenges reflect a system still far from achieving strategic autonomy.

Core Problems

- Limited experience in large-scale battery production
- Insufficient recycling capacity
- High logistics costs across the value chain
- Bottlenecks in raw-material sourcing and refining
- Geopolitical vulnerability of critical raw materials
- Strong regulatory pressure on sustainability and traceability

Underlying Causes

- Historic underinvestment in refining, precursor materials, and cell production
- Fragmented R&D landscape and slow industrial scaling
- Dependency on Asian suppliers for components and materials
- Shortage of specialized skills in materials, automation, and recycling

Consequences

Europe remains heavily dependent on non-EU suppliers, faces high production costs, and lacks sufficient circularity. Industrial scaling is slow, investment risks remain high, and OEMs struggle to secure sustainable, traceable, high-quality batteries—undermining competitiveness in EV and energy-storage markets.

Guiding Questions

- How can Europe secure access to sustainable, traceable raw materials?
- How can recycling and circularity reduce dependency and cost?
- How can industrial scaling and skills development be accelerated?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 3**.

Business Context

Today, the sector faces significant challenges: limited industrial experience in large-scale battery production, insufficient recycling capacity, and high logistics costs. Raw material sourcing and refining remain major bottlenecks, compounded by geopolitical tensions that position critical materials as strategic leverage. At the same time, the industry must navigate increasingly stringent regulatory requirements related to sustainability, eco-design, and traceability. In the past, Europe made progress but not at the scale required. Public-private alliances such as Northvolt and ACC established the first industrial capacities, and early wins emerged in recycling and second-life applications. However, Europe fell behind Asia in cell production volume, struggled to secure stable raw-material supply chains, and suffered from fragmented IP landscapes and slow technology transfer. Underinvestment in refining and precursor stages further weakened the region's strategic autonomy. Looking forward, the industry faces both urgency and opportunity. With limited political movement currently driving the agenda, strategic focus is shifting toward circular economy models, value-chain ownership, and reducing dependency on Chinese OEMs and suppliers. Lowering market entry barriers and strengthening domestic recycling loops will be key enablers for long-term resilience. Success will require coordinated action across the ecosystem to integrate production, materials, and recycling into a competitive, self-sustaining European battery value chain.

Customer Context

Stakeholders across the value chain—OEMs, cell manufacturers, energy companies, recyclers—face shared challenges: securing stable, low-carbon, high-performance batteries; managing regulatory and traceability requirements; and ensuring long-term profitability amid uncertain feedstock and supply risks. Strong partnerships, co-located production clusters, and transparent, reliable supply chains are increasingly essential for reducing risk and ensuring competitiveness.

3. Key Insights & Outcomes

Historically, the region has relied heavily on Asian imports, with only limited EU R&D and pilot production lines. Small-scale successes include pilot recycling plants and joint ventures, supported by enablers such as IPCEI funding and the EU Battery Alliance. However, the sector remains constrained by lack of scale, weak integration between R&D and industrial deployment, permitting and financing delays, skill shortages, and high capital intensity. Key priorities for the European battery industry include securing sustainable and traceable battery supply chains, developing scalable recycling and second-life infrastructure, fostering cross-sector collaboration across mobility, energy, and materials, and establishing predictable investment and regulatory frameworks to accelerate growth and competitiveness.

4.2 Automation

The following section outlines the selection of the thematic focus areas, which were defined during the initial meeting of the expert group. In this first collaborative session, participants engaged in an open and interactive discussion to identify and prioritize the most relevant topics within their respective domain. Through this exchange, the group explored key challenges, opportunities, and emerging trends shaping the future of the field. Based on these discussions — and through subsequent consolidation by the moderators — the topics were narrowed down to three main areas of focus:

- **Microbus/Shuttle & Fleet Operations in Public Transport**
- **Transnational Logistics Operations**
- **Special Vehicles: Agricultural & Forestry Work Machines**

The focus areas were intentionally defined in broad terms to maintain openness and inclusivity. This approach ensured that no potentially relevant dimensions or perspectives were excluded too early, allowing for comprehensive exploration, refinement, and prioritization in the later phases of the project.

4.2.1 Focus Area: Microbus/Shuttle & Fleet Operations in Public Transport

1. Challenge Description

Autonomous shuttles in public transport face high operational costs, lack of interoperability as well as lack of acceptance, and safety concerns. The challenge is to create scalable, secure, and integrated solutions for European cities.

The identified core problems are

- Autonomous shuttle services in urban and regional areas face significant challenges due to high operational costs and limited scalability.
- Regulations vary widely across European countries, creating a fragmented framework that makes cross-border deployment complicated and time-consuming.
- Safety and liability remain major concerns, as stakeholders need clear standards and trust in autonomous driving technologies.
- In addition, interoperability between fleet management systems and public transport platforms is still lacking, which hinders seamless integration.
- Finally, user trust and acceptance are not yet strong, particularly in rural or mixed-use regions where scepticism towards automation persists.

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 4**.

Business Context

In the past, attempts to introduce autonomous shuttles in Europe were largely limited to small-scale pilot projects conducted in controlled environments such as university campuses or designated test tracks. While these initiatives demonstrated technical feasibility, they lacked interoperability and were constrained by local regulations (because of legal constrains, testing driverless autonomous vehicles on public roads is not allowed in many countries) making it impossible to scale beyond regional contexts. These pilots often operated under temporary exemptions rather than permanent regulatory frameworks, which hindered long-term investment and broader adoption. Currently, most European cities still rely on conventional fleet operations that are heavily dependent on human drivers, resulting in high labour costs and limited flexibility. Digital integration remains fragmented, with fleet management systems often operating in isolation from public transport platforms. Regulatory fragmentation across Member States continues to be a major barrier, as safety certification, liability rules, and operational standards differ significantly between jurisdictions. Public authorities and operators face uncertainty about compliance requirements, which slows down decision-making and discourages private investment. Additionally, user trust in autonomous technologies remains low, particularly in rural or mixed-use areas where infrastructure and connectivity are less developed. Looking ahead, the ambition is to establish a harmonized European framework for autonomous fleet operations that enables cross-border services under consistent safety and interoperability standards. The strategic goal is to reduce operational costs through automation, improve passenger convenience with on-demand and flexible services, and support sustainable urban mobility by deploying zero-emission fleets. This future vision aligns with broader EU objectives such as the Green Deal and the Digital Europe Programme, positioning autonomous shuttles as a cornerstone of integrated, climate-friendly transport systems. Achieving this will require coordinated efforts across technology providers, regulators, and mobility operators to create scalable solutions that combine technical innovation with robust governance and user-centric design.

Customer Context

Passengers and local communities increasingly demand public transport systems that are reliable, safe, and user-friendly. Current challenges include extended waiting times, inflexible timetables, and limited-service coverage, particularly in rural and peri-urban areas. While there is growing interest in autonomous shuttle solutions, scepticism persists regarding operational safety, passenger comfort, and liability in the event of accidents. Furthermore, customers expect digital integration, characterized by a unified booking platform, transparent pricing structures, and real-time service updates. Accessibility remains a critical requirement, especially for elderly individuals and persons with reduced mobility. Overall, the expectation is for transport services to be seamless, trustworthy, and socially inclusive.

3. Key Insights & Outcomes

The Problem Framing Canvas session clarified that the challenge in rural and suburban mobility is not the absence of technology but the lack of service flexibility, trust in automation, and integrated digital experiences. Participants highlighted that user concerns encompass safety, accessibility, and convenience rather than technical feasibility. This alignment created a shared understanding of what matters most for passengers and operators.

Prioritized Pains

- Long waiting times and rigid schedules, especially outside urban centres.
- Safety and liability concerns regarding autonomous shuttle operations.
- Fragmented digital experience: multiple apps, unclear pricing, and lack of real-time updates.
- Limited accessibility for elderly passengers and those with reduced mobility.
- Low public trust in autonomous transport solutions.

Prioritized Gains

- Reliable and flexible transport services that adapt to user needs.
- Clear safety standards and transparent liability frameworks.
- One integrated digital platform for booking, payment, and real-time information.

- Inclusive design ensuring accessibility for all passenger groups.
- Increased social acceptance and confidence in autonomous mobility.

4.2.2 Focus Area: Transnational Logistics Operations

1. Challenge

Cross-border logistics in Europe remains fragmented due to manual customs procedures, inconsistent data standards, and limited real-time information sharing. These barriers cause delays, higher costs, and low predictability. The challenge is to enable interoperable, transparent, and digitally integrated logistics operations that support reliable, efficient, and sustainable flows across borders.

Core Problems

- Fragmented data exchange and siloed digital systems
- Manual, slow customs and approval procedures
- Lack of real-time visibility and tracking across networks
- Regulatory disparities between Member States
- Limited access for SMEs to shared platforms and data

Underlying Causes

- Historically isolated pilot projects without scalability
- Absence of harmonized EU standards for data, automation, and approvals
- Low digital maturity among some operators
- Restrictive access to proprietary systems and data

Consequences

Logistics chains remain unpredictable, costly, and vulnerable to disruption. Operators face delays, inefficiencies, and compliance burdens; SMEs are disadvantaged by limited data access. Fragmentation slows automation adoption and prevents Europe from building competitive, sustainable supply chains.

Guiding Questions

- How can cross-border data exchange and interoperability be ensured?
- How can customs and approval processes become faster and more automated?
- How can SMEs be better integrated into digital, transnational logistics networks?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 5.**

Business Context

In the past, cross-border logistics automation in Europe was primarily explored through isolated pilot projects, often limited to single corridors or regional hubs. These initiatives demonstrated the potential of digital freight management and automated handling systems but lacked interoperability and scalability. Regulatory complexity and the absence of harmonized standards prevented these pilots from evolving into permanent solutions. Data exchange between operators was minimal, and most systems operated in silos, reducing the overall impact of innovation efforts. Currently, European logistics networks remain fragmented, with significant inefficiencies in cross-border operations. Manual processes dominate customs clearance and freight coordination, leading to delays and high operational costs. Digital maturity varies widely among stakeholders, and real-time data integration across borders is still rare. Regulatory disparities between Member States—covering safety, liability, and data governance—create uncertainty for operators and technology providers. These barriers discourage investment in automation and hinder the development of integrated European supply chains. SMEs, in particular, face challenges accessing proprietary data and complying with complex approval procedures, limiting their ability to innovate. Looking ahead, the strategic vision is to establish a harmonized European framework for automated logistics that enables seamless cross-border operations. This includes creating interoperable data platforms, standardizing approval processes, and deploying AI-driven optimization tools for routing and capacity management. The goal is to reduce costs, improve reliability, and enhance sustainability by minimizing empty runs and optimizing resource use. This future aligns with EU priorities such as the Green Deal and the Digital Europe Programme, positioning automated logistics as a key enabler of competitive and climate-friendly supply chains. Achieving this vision will require coordinated efforts among regulators, technology providers, and logistics operators to create scalable solutions that combine technical innovation with robust governance and trust-based data sharing.

Customer Context

Logistics stakeholders—including manufacturers, retailers, and freight carriers—prioritize predictability and cost-efficiency in cross-border delivery chains. Presently, operations are hindered by manual customs procedures, fragmented data exchange, and insufficient coordination among actors, resulting in delays and inefficiencies. Real-time shipment visibility is a paramount requirement, enabling rapid response to disruptions and enhancing resilience. Customers also demand pricing transparency and adherence to sustainability standards. For small and medium-sized enterprises (SMEs), a major barrier is the lack of access to shared digital infrastructures and standardized data, which limits competitiveness against larger market players. Solutions that simplify complexity, accelerate cross-border flows, and establish trust through harmonized standards and reliable information are highly valued.

3. Key Insights & Outcomes

The session highlighted three central challenges: fragmented data systems, manual cross-border processes, and limited visibility across networks. Participants agreed that harmonized standards, interoperable data platforms, and automated customs procedures are essential to unlocking efficiency and resilience. For the next phase, focus will be on:

- Improving cross-border data interoperability and transparency
- Automating customs and approval procedures
- Integrating SMEs through accessible, shared digital infrastructures

4.2.3 Focus Area: Special Vehicles (Agriculture & Forestry)

1. Challenge

Agriculture and forestry face growing labour shortages, hazardous working environments, and high costs for adopting automation. Limited local support, technical complexity, and weak equipment interoperability slow down uptake. The challenge is to create affordable, practical, and easily maintainable automation solutions that enhance safety, productivity, and sustainability in rural operations.

Core Problems

- Labour shortages in rural and seasonal operations
- Hazardous and high-risk working environments

- High automation costs and limited local technical support
- Low interoperability between machinery and digital tools
- Uneven digitalization and lack of enabling infrastructure

Underlying Causes

- Fragmented innovation and limited collaboration across the ecosystem
- Historic focus on incremental rather than transformative automation
- High upfront investment costs and unclear regulatory requirements
- Lack of digital skills and support services in rural regions

Consequences

Automation adoption remains slow, operational risks stay high, and productivity potential is not realized. SMEs struggle to justify investments, while farms and forestry operators face increased safety risks and rising costs—limiting sustainability and economic resilience.

Guiding Questions

- How can automation become affordable and easy to maintain for rural operators?
- How can machinery interoperability and compatibility be improved?
- How can safety and productivity be increased despite labour shortages?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 6**.

Business Context

Historically, automation in agriculture and forestry was limited to incremental improvements in machinery, such as GPS-based guidance systems and semi-automated harvesting tools. While these technologies improved efficiency, they did not fundamentally change operational models or address systemic challenges like labour shortages and safety risks. Innovation efforts were often fragmented, with limited collaboration between equipment manufacturers, research institutions, and SMEs, resulting in slow adoption and high costs. Today, the sector faces mounting pressure from demographic and economic trends. Labor shortages are becoming critical, particularly in rural areas, while safety concerns persist in hazardous environments such as forestry operations. Digitalization remains uneven, and many farms and forestry enterprises lack the infrastructure or expertise to adopt advanced automation solutions. High upfront investment costs and uncertainty about regulatory compliance further discourage adoption. At the same time, sustainability requirements and climate targets are driving demand for more efficient and environmentally friendly practices, creating both challenges and opportunities for innovation. Looking forward, the ambition is to develop fully automated and connected machinery ecosystems that enhance productivity, safety, and sustainability. This includes deploying autonomous harvesting machines, robotic forestry equipment, and sensor-based monitoring systems to optimize resource use and reduce environmental impact. The strategic goal is to create interoperable solutions that integrate with broader digital platforms for agriculture and forestry, enabling predictive maintenance, real-time data analytics, and collaborative innovation across borders. This vision supports EU objectives such as the Farm to Fork Strategy and the Green Deal, positioning automation as a cornerstone of resilient and sustainable rural economies. Achieving this will require joint efforts among manufacturers, SMEs, and research institutions to develop cost-effective, scalable technologies supported by harmonized standards and funding mechanisms.

Customer Context

Agricultural and forestry operators seek machinery that optimizes productivity and ensures operational safety, particularly in light of labour shortages and hazardous working conditions. While there is openness toward automation technologies, concerns persist regarding capital expenditure, technical complexity, and the availability of localized support services. Customers expect compatibility with existing equipment ecosystems and tangible benefits such as enhanced resource efficiency, improved sustainability compliance, and measurable productivity gains. Ultimately, the demand centres on solutions that are practical, economically viable, and maintainable, while simultaneously improving safety and profitability.

3. Key Insights & Outcomes

The session highlighted three central issues: labour shortages, safety risks, and high automation costs. Participants emphasized the need for affordable, interoperable systems with strong local support. For the next phase, focus will be on:

- Developing cost-effective, scalable automation solutions
- Improving interoperability across machinery and digital tools
- Enhancing safety and productivity through connected, data-driven systems

4.3 Connectivity

The following section summarizes the selection of thematic focus areas defined during the initial expert meeting on Connectivity. In this expert group kick-off session, participants discussed key challenges and emerging developments, identifying the most relevant topics for further exploration. Based on this exchange — and subsequent consolidation by the moderators — three focus areas were defined:

- **Regulation of Mobility Services**
- **Infotainment and Digital Services**
- **V2X, V2V and Connectivity**

At this early stage, the topics were deliberately kept broad to remain inclusive and ensure that no important perspectives were excluded before the detailed analysis phase.

4.3.1 Focus Area: Regulation of Mobility Services

1. Challenge Description

Brie Europe's mobility-services landscape remains highly fragmented, with differing regional regulations, inconsistent standards, and uneven adoption of digital mobility frameworks. Cities and municipalities face growing complexity as they attempt to integrate charging, connectivity, and smart-mobility services, yet lack harmonized rules, shared data frameworks, and sufficient technical capacity. This regulatory fragmentation slows innovation, increases deployment costs, and limits the scalability of new mobility services across borders.

Core Problems

- Fragmented regulatory landscape across cities and Member States
- Missing harmonized standards for V2X, charging, and digital mobility
- Limited municipal resources and expertise to deploy integrated services
- Resistance to new mobility providers (fear of backlash, lack of clarity)
- Unclear data-sharing, trust, and interoperability frameworks

Underlying Causes

- Historical reliance on local pilots rather than EU-wide guidance
- Slow regulatory harmonization and lack of unified approval processes
- Varied national procurement and permitting rules

Consequences

Deployment of connected mobility infrastructure becomes slow, costly, and inconsistent. Cities struggle to meet user expectations, SMEs face high entry barriers, and cross-border interoperability remains limited — preventing scalable, user-centric service ecosystems.

Guiding Questions

- How can Europe harmonize rules for connected mobility services?
- How can cities and SMEs be supported in deploying integrated systems?
- How can regulatory complexity be reduced to accelerate cross-border adoption?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 7**.

Business Context

Regulation of mobility services in Europe has evolved unevenly over time. Historically, mobility initiatives were implemented through local pilots, each with their own rules, data standards, and approval processes. This resulted in a patchwork of systems that often failed to scale or interoperate across borders. EU-funded projects such as C-Roads reinforced the need for a unified trust and security domain, yet uptake varies widely across Member States. Municipalities frequently struggle with the complexity of integrating charging infrastructure, connectivity services, and digital mobility offerings — resulting in delayed deployments and inconsistent service quality. Current conditions reveal a widening gap between EU-level regulation (Data Act, ITS Directive, AFIR) and local implementation capacity. Many cities lack the technical workforce or financial resources to manage backend service provision, interoperability, or V2X deployment. Grid operators are hesitant toward new functionalities such as bidirectional charging, citing stability concerns. At the same time, OEMs and mobility-service providers push into local markets with proprietary platforms, creating further fragmentation. The result is a multi-layered regulatory landscape where each stakeholder operates under different assumptions, requirements, and technical maturity levels. Looking forward, regulatory harmonization is becoming essential: interoperable charging networks, unified V2X communication, cross-border data sharing, and standardised certification processes will be required to support mass-scale connected mobility. Yet policy alignment alone will not be enough — cities and SMEs must be empowered with guidance, tools, and stable frameworks to implement these regulations effectively and sustainably.

Customer Context

Key The primary users impacted by regulatory fragmentation are municipalities, EV users, fleet operators, grid operators, and mobility-service providers. Cities face significant operational burdens: they must deploy and maintain charging infrastructure, integrate mobility data, and coordinate with private operators — often without dedicated expertise or digital systems. Many rely on outsourcing or national recovery funds, resulting in inconsistent quality and uncoordinated development. Fleet operators and EV users struggle with fragmented billing systems, inconsistent service availability, and the lack of standardized connected services (e.g., parking+charging integration). Grid operators must navigate new regulatory demands without clear data frameworks or coordinated guidelines, further slowing progress. SMEs experience high compliance and certification costs, limiting their ability to participate in EU-wide mobility ecosystems. Customers want predictable, fair, and simple regulatory environments that allow frictionless deployment of mobility services. They need uniform rules for data access, procurement, permitting, and interoperability — alongside clear benefits such as reduced administrative complexity, lower cost, improved service quality, and faster rollout cycles.

3. Key Insights & Outcomes

The expert group highlighted that fragmentation, inconsistent standards, and municipal resource constraints are central barriers. A harmonized EU framework is required to enable predictable, scalable connected-mobility services. Next phase focus:

- Support cities via unified guidance, playbooks, and shared service layers
- Harmonize regulations for data, V2X, charging and service integration
- Enable SME participation through simplified standards and clear processes

4.3.2 Focus Area: Infotainment and digital Services

1. Challenge Description

Infotainment and digital services in Europe continue to evolve, but remain fragmented across OEMs, systems, and national markets. Vehicle data ownership is unclear, personalization is limited, and interoperability between platforms is low. OEMs struggle to monetize digital services and risk losing market relevance as tech giants enter the mobility-service ecosystem.

Core Problems

- Lack of interoperability across OEM infotainment systems
- Fragmented data access, unclear ownership, and limited sharing
- Siloed digital services with minimal cross-platform integration
- Low personalization and inconsistent user experiences
- OEMs unable to scale or update proprietary services efficiently

Underlying Causes

- Legacy proprietary systems and lack of shared standards
- Slow adoption of EU-level data frameworks
- Regulatory uncertainty on privacy and third-party data access
- Strong competition from tech platforms dominating user experience (Android Auto, Apple CarPlay)

Consequences

Users switch to smartphone apps, bypassing vehicle-native systems; OEMs lose data access, service revenue, and customer engagement; cities receive incomplete data for mobility planning; innovation remains slow and fragmented.

Guiding Questions

- How can interoperable, user-centric infotainment platforms be enabled?
- How can secure, standardized vehicle-data access be implemented?
- How can Europe strengthen competitiveness against global tech platforms?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 8**.

Business Context

Infotainment and digital mobility services have undergone rapid transformation, but the ecosystem remains dominated by proprietary solutions and fragmented data architectures. OEMs historically built in-house infotainment platforms with limited third-party integration and slow update cycles. While smartphone integration (e.g., Android Auto, Apple CarPlay) improved the user experience, it simultaneously shifted value creation away from OEMs and reduced their ability to leverage vehicle-native data for new services. OEMs often struggle to scale their own platforms due to inconsistent standards, legacy architectures, and slow over-the-air update capabilities. The regulatory environment is evolving: the EU Data Act and Data Governance Act aim to clarify data ownership and enable user-controlled access to vehicle data. However, regulatory uncertainty persists regarding privacy, cross-border data processing, cybersecurity, and third-party service integration. Municipalities and smart-city operators encounter fragmented datasets that complicate mobility planning and integration of connected services (e.g., parking, traffic, charging). Meanwhile, global tech companies and digital-platform providers are entering the vehicle domain with high-quality infotainment offerings, cloud ecosystems, and AI-driven personalization. This intensifies competitive pressure and risks marginalizing OEMs and European SMEs. The absence of unified data standards and interoperability frameworks prevents Europe from unlocking innovation potential around vehicle-generated data, digital ecosystems, and personalized mobility experiences.

Customer Context

Customers include vehicle owners, drivers, OEMs, Tier 1 suppliers, app developers, digital-service providers, and municipalities. Drivers expect consistent, intuitive, personalized experiences across devices — from real-time navigation to contextual mobility services. Today they rely heavily on smartphones because vehicle-native systems lack interoperability, personalization, and seamless cross-platform integration. This leads to fragmented usage patterns and reduced trust in OEM digital ecosystems. OEMs require reliable frameworks for data access, monetization, and service deployment. Many struggle with unclear ownership of vehicle data, creating hesitation to open their platforms to third parties. Municipalities and planners need integrated mobility data to design efficient traffic systems but currently encounter fragmented interfaces and limited access to real-time information. The core customer need is interoperability: secure, standardized access to vehicle data, unified digital-service ecosystems, consistent interfaces across brands, and personalization engines that work across platforms. Customers want convenience, transparency, and trust — with minimal effort and maximum integration.

3. Key Insights & Outcomes

Participants agreed that Europe must shift from fragmented, OEM-specific platforms to interoperable, user-centric ecosystems with standardized data access. Next phase focus:

- Establish data-interoperability frameworks enabling cross-OEM services
- Unlock vehicle data for innovation under GDPR-aligned governance
- Develop scalable digital-service models supporting European competitiveness

4.3.3 Focus Area: V2X, V2V and Connectivity

1. Challenge Description

V2X and V2V deployment in Europe remains fragmented, with inconsistent communication protocols, unreliable real-time connectivity, and limited cross-border interoperability. Despite successful pilots, large-scale roll-out is slowed by certification gaps, municipal capacity constraints, and missing unified standards. This prevents efficient traffic management, cooperative safety functions, and integrated EV charging-parking experiences.

Core Problems

- Connectivity reliability issues and frequent network dropouts
- Lack of harmonized V2X/V2V standards and certification
- Fragmented infrastructure and incompatible regional systems
- Limited real-time data availability for drivers, fleets, and cities
- Slow OEM activation of V2X capabilities (e.g., bidirectional charging)

Underlying Causes

- Pilot projects remained isolated and not scalable

- National PKI/security domain differences
- High infrastructure costs and grid-integration challenges
- Municipalities lack expertise to deploy and manage V2X systems
- Missing global harmonization in communication protocols

Consequences

Cross-border operation remains inconsistent, safety features underperform, and smart-city integration remains limited. EV adoption is slowed by unreliable charging information and missing cooperative services. Without unified standards, Europe cannot scale automated or cooperative driving functions.

Guiding Questions

- How can Europe achieve reliable, harmonized V2X communication?
- How can scalable deployment across cities and borders be enabled?
- How can V2X create new value chains for fleets, SMEs, and cities?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 9**.

Business Context

V2X and V2V connectivity is one of the most promising enablers for future mobility, yet large-scale deployment remains fragmented. Although Europe achieved an important milestone by agreeing on a common trust and security domain for V2X communication, real-world implementation still varies significantly by region. Past V2X pilots in Europe (e.g., Regensburg, Vienna) and Asia (e.g., Shenzhen, Guangzhou) demonstrated technical feasibility, but lacked scalability due to inconsistent communication protocols, limited certification processes, and infrastructure heterogeneity.

Current conditions show clear deployment barriers:

- Network reliability issues (dropouts, latency fluctuations)
- No unified EU-wide hardware/software certification
- High infrastructure costs, especially for heavy-duty EV charging
- Municipalities overwhelmed by the complexity of integration
- Grid operators hesitant to enable bidirectional charging

These factors result in slow uptake of cooperative safety services, inconsistent hazard notifications, and missing real-time traffic intelligence across borders. Future ambitions include seamless cross-border connectivity, harmonized protocols, and AI-driven V2X communication layers capable of enabling cooperative driving, efficient routing, and smart-city integration. Heavy-duty vehicle electrification will heavily depend on reliable V2X for optimized charging, lane prioritization, and real-time freight management. Europe risks falling behind global competitors unless deployment becomes easier, cheaper, and standardized.

Customer Context

Customers include drivers, fleet operators, public authorities, infrastructure providers, telecom operators, and grid companies. Drivers and fleets depend on reliable real-time warnings, hazard information, parking and charging integration, and cooperative routing functions. Today, users face inconsistent coverage, unreliable real-time information (e.g., inaccurate charging availability), and incomplete routing data —

often resulting in inefficiencies, safety risks, and user frustration. Cities and road authorities need stable tools for managing traffic flows, construction sites, emergency response, and congestion reduction. Yet they lack unified platforms, face complex procurement rules, and rely on fragmented backend systems. Grid operators require predictable data flows and coordinated charging behavior to maintain network stability — but currently receive limited integration support. Customers want reliable, standardized, cross-border connectivity that is easy to deploy, maintain, and integrate. They need intuitive APIs, certified hardware, shared data layers, and deployment playbooks that reduce uncertainty and accelerate roll-out.

3. Key Insights & Outcomes

The session confirmed that reliability, interoperability, and scalability are the core barriers. Europe must move from pilot silos to harmonized deployment frameworks. Next phase focus:

- Develop unified EU V2X standards and pre-certified modules
- Support municipalities with deployment playbooks and starter kits
- Enable cross-border hazard data, routing services, and shared APIs

4.4 Platform Economy

The following section presents the thematic focus areas that were initially defined during a lively discussion on 5th May 2025, when the expert group on *Platform Economy* met for the first time. During this introductory session, participants explored and debated the most relevant aspects of the platform economy, identifying key challenges and opportunities for further examination. Based on these discussions — and through subsequent consolidation by the moderators — the topics were ultimately narrowed down to three main areas of focus:

- **User-Centered Mobility Platforms**
- **Data-Driven and Emerging Mobility Solutions**
- **Integration of Transport Systems**

At this early stage, the themes were deliberately kept broad to ensure that no potentially relevant dimensions or perspectives were excluded prematurely, allowing for open exploration and refinement in the later phases of the project.

4.4.1 Focus Area: User-Centered Mobility Platforms

1. Challenge Description

Despite major progress in digitalization, Europe's mobility landscape remains fragmented along national and regional borders. Most mobility platforms—covering ticketing, journey planning, and payment—are designed for local or national use, not for cross-border travel. For commuters, tourists, and businesses moving between regions in Central Europe, this creates a "digital border" even where physical infrastructure is fully connected. A typical example is the daily commuter traveling from Strasbourg (France) to Kehl (Germany), who must use several apps and payment systems to combine tram, bus, and regional train services across a few kilometers. Similar patterns occur between Austria and Hungary, Czechia and Poland, or Slovenia and Italy—showing that the issue is systemic rather than local.

Core Problems

- **Fragmented Systems** – Ticketing, payment, and information platforms use incompatible standards and fare structures, preventing seamless integration.
- **Regulatory and Institutional Barriers** – Distinct national rules on pricing, data, and competition hinder coordination between operators.
- **Data Access and Privacy** – Proprietary systems and differing GDPR interpretations restrict real-time data sharing and exclude SMEs.
- **User Friction and Low Trust** – Travelers face language barriers, multiple logins, and unclear pricing, reducing confidence in public or shared mobility.
- **Limited Incentives for Cooperation** – Cross-border digital integration often relies on short-term pilots without sustainable governance or financing.

Underlying Causes

- Legacy national structures and fare systems not designed for interoperability.
- Reluctance of local authorities to open data or revenue flows.
- Absence of common European standards for APIs, ticketing, and identity management.
- Design processes focused on operators rather than user experience.

Consequences

This fragmentation reduces the attractiveness of public and shared mobility, discourages modal shift, and undermines cross-border accessibility. Users encounter complexity and higher costs; SMEs cannot scale digital services beyond national markets; and regions lose efficiency and competitiveness. Ultimately, the persistence of digital borders contradicts the EU's vision of a single European transport area.

Guiding Questions

- How can Europe overcome the technical and institutional fragmentation of digital mobility?
- Which interoperability and data-governance standards are most critical for cross-border integration?
- How can trust, transparency, and user needs drive the design of future mobility platforms?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 10**.

Business Context

The European mobility landscape is currently characterized by a high level of fragmentation, both technologically and institutionally. Mobility platforms—those digital environments through which users plan, book, and pay for their journeys—are central to modern transportation systems. Yet, most of them have been designed for national or local contexts. The consequence is a patchwork of solutions: each city or country runs its own app or ticketing system, using different technical standards, regulatory frameworks, and payment infrastructures. From a business perspective, this fragmentation creates several structural limitations. Market entry for new providers is difficult due to incompatible data formats and closed systems. Cross-border interoperability remains largely absent, which restricts scalability and prevents European companies from building transnational business models. SMEs in particular face high development costs because each deployment requires a different integration effort, often including new contracts with local authorities, operators, and payment intermediaries. Past attempts to address these challenges show mixed results. Early MaaS (Mobility-as-a-Service) pioneers—such as *Whim* in Helsinki or *WienMobil* in Vienna—demonstrated the technical feasibility and user value of integrated mobility offerings. However, their success remained localized, as each service was embedded in specific governance structures and national frameworks. Efforts to create cross-border ticketing systems, such as through regional pilot projects (e.g. Euregio initiatives), often failed to scale beyond experimental phases. These initiatives highlighted the importance of public-private cooperation but also revealed the absence of a pan-European framework for interoperability, legal harmonization, and business model alignment. Today, new dynamics are emerging. EU-level initiatives, including the Digital Europe Programme, the Green Deal, and open-data mandates under the ITS Directive, are setting the stage for greater connectivity between systems. There is also growing pressure from global technology players—Google, Apple, Uber, and others—that already dominate the digital interfaces through which users access mobility services. Their platforms act as gatekeepers, aggregating information and setting de facto standards, which further weakens the strategic autonomy of European actors. For businesses, the main insight is that technological capability alone is not sufficient. The real challenge lies in creating *common governance models and shared value frameworks* that allow mobility platforms to operate seamlessly across borders while remaining rooted in European values such as accessibility, fairness, and data protection. The strategic objective is twofold: to strengthen the competitiveness of European digital mobility ecosystems and to enable cross-border scalability without losing national or local flexibility.

Customer Context

From the user's point of view, the digital mobility experience in Europe is highly fragmented. A commuter traveling from France to Germany, or a tourist moving between Austria, Hungary, and Slovakia, must often use multiple apps, purchase separate tickets, and navigate different languages and interfaces. Even though most services claim to be digital, users still encounter friction at nearly every step, especially when crossing borders. Users within large metropolitan areas such as Paris, Berlin, or Vienna have access to efficient public transport platforms that allow for easy trip planning and integrated ticketing. However, once they move beyond these urban networks, the experience quickly deteriorates. In smaller cities and rural regions, digital services are often incomplete or unavailable. This leaves significant segments of the population, particularly elderly citizens, people with disabilities, and cross-border commuters—excluded from the digital transformation of mobility. In earlier stages, local journey planners and national transport apps improved convenience within cities, offering clear schedules and integrated payments. Yet, the lack of standardization and coordination across systems meant that these benefits could not extend beyond regional boundaries. Language differences, inconsistent pricing models, and non-compatible tickets remain among the biggest sources of user frustration. Users also express growing concern about data privacy and trust. Many are reluctant to use new platforms that require personal information without clear guarantees about how that data will be used. This mistrust particularly affects international services, where users fear their data might be stored or shared in other jurisdictions. At the same time, expectations have evolved significantly. Citizens are used to intuitive, frictionless digital experiences in other industries—such as e-commerce, banking, and hospitality—and expect the same simplicity from public mobility platforms. They want one app that "just works" across borders, supports multiple languages, ensures transparency in pricing, and respects their privacy.

3. Key Insights & Outcomes

The Problem Framing Canvas sessions helped refine the understanding of Europe's fragmented mobility landscape and align perspectives between business stakeholders and users. Participants agreed that the challenge is less about the absence of technology and more about the lack of interoperability, shared governance, and user-centered design across borders. The discussion clarified where the pain points lie and what users and operators most value — forming the foundation for the next stage of use case development.

Prioritized Pains

- **Fragmented digital systems:** Too many disconnected national and local apps, each with different ticketing, payment, and data standards.
- **Unequal service availability:** Limited access to integrated digital mobility in smaller cities and cross-border regions.
- **Low trust and transparency:** Unclear data handling, privacy concerns, and varying service quality across countries.
- **High operational barriers for SMEs:** Difficult cross-border scaling due to legal and technical incompatibilities.

Prioritized Gains

- **Simplicity and usability:** One intuitive entry point for planning, booking, and paying for mobility across Europe.
- **Cross-border continuity:** Ticketing and information flows between countries and operators.
- **Inclusivity and accessibility:** Platforms designed for all users, including those with disabilities or language barriers.
- **Transparency and data trust:** Clear rules for GDPR-compliant data sharing and user consent.

Impact on the Use Case Development Phase

The prioritization of these pains and gains shifted the group's focus from isolated national solutions toward transnational, user-centered mobility ecosystems. The upcoming Phase will therefore:

- Explore cross-border interoperability for ticketing, payment, and data systems.
- Test user-centric design principles that ensure accessibility and inclusion.
- Define shared governance and business models that enable SMEs to scale beyond national borders.
- Demonstrate how common European frameworks for trust, transparency, and standardization can create new value chains and improve competitiveness.

4.4.2 Focus Area: Data-Driven and Emerging Mobility Solutions

1. Challenge Description

Across Europe, the development of data-driven and emerging mobility solutions such as on-demand services, connected vehicles, and autonomous driving, remains fragmented and uncoordinated. While many regions successfully run pilot projects, they often operate in isolation under differing national regulations, technical frameworks, and data governance systems. The absence of a common European approach limits interoperability and prevents these innovations from scaling across borders.

Core Problems

- **Fragmented Data Ecosystem**: Mobility data is collected under incompatible formats and access rules, hindering reuse and interoperability.
- **Regulatory Disparities**: Each Member State applies distinct approval, safety, and liability frameworks for autonomous and on-demand mobility.
- **Inconsistent GDPR Implementation**: Divergent interpretations of data protection law create uncertainty about what data can be shared or processed.
- **Siloed Pilot Projects**: National initiatives rarely exchange data or results, duplicating efforts and slowing collective learning.
- **Limited Access for SMEs**: Proprietary data and closed interfaces restrict smaller innovators from entering or scaling in European markets.

Underlying Causes

- National legislation and legacy governance structures not designed for transnational data sharing
- Lack of common European data standards and APIs for real-time mobility and vehicle data
- Institutional reluctance to open or federate datasets across public and private sectors
- Absence of a coherent EU-level framework for testing and approving connected and autonomous mobility services

Consequences

This fragmentation prevents the formation of an integrated European innovation ecosystem. Promising solutions remain confined to local contexts, and investments fail to achieve economies of scale. Cross-border services cannot operate efficiently, leading to slower technological adoption and reduced competitiveness compared to global peers. SMEs and startups are particularly disadvantaged, facing barriers to data access and interoperability that favor large incumbents. Ultimately, Europe risks losing momentum in key areas such as AI-driven transport, automation, and data-based mobility management.

Guiding Questions

1. How can Europe establish **common data standards and open interfaces** for mobility systems?
2. What mechanisms can consolidate and scale successful national pilot projects at the EU level?
3. How can regulatory frameworks for **autonomous and on-demand mobility** be aligned across Member States while respecting national differences?
4. What governance and data-sharing models best balance **innovation, privacy, and fair competition** in a transnational context?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 11**.

Business Context

Transport systems across Europe have developed historically within national frameworks. Rail, road, and public transport infrastructures were built, operated, and regulated at the state level, creating a legacy of fragmentation. Even where physical networks are connected, operational and institutional integration often stops at the border. For operators and authorities, this fragmentation results in inefficiencies and duplication of effort. Separate tariff systems, ticketing structures, and service standards limit the ability to coordinate timetables or share data. The cost and complexity of integration discourage cross-border cooperation, particularly for small and medium-sized operators. In recent years, several European initiatives have aimed to overcome these barriers. The Trans-European Transport Network (TEN-T) framework and the Connecting Europe Facility (CEF) have supported infrastructure development and interoperability. Regional cross-border programs—such as the Euregio schemes between Germany and the Netherlands or Austria and Italy—have introduced integrated ticketing pilots. However, these projects often face institutional inertia, regulatory misalignment, and short funding cycles that prevent long-term adoption. Another persistent challenge is the lack of consistent governance. Many transport services are managed by regional or municipal authorities with limited order to collaborate internationally. Private mobility providers face additional complexity navigating national transport laws, competition rules, and procurement requirements. As a result, successful integration projects remain isolated best practices rather than scalable European models. From a strategic business perspective, the integration of transport systems represents both a necessity and an opportunity. The European Green Deal and Fit for 55 initiatives call for massive modal shifts from private cars and aviation toward rail and shared mobility. To achieve this, seamless multimodal connectivity is essential. Businesses that can create or enable interoperable systems—connecting buses, trains, ferries, micromobility, and on-demand services—will be able to unlock new value chains across borders, from ticketing to infrastructure maintenance and data analytics.

Customer Context

For users, fragmented transport systems translate into a daily source of frustration and inefficiency. Many commuters in cross-border regions—such as between Strasbourg (France) and Kehl (Germany), or between Bratislava (Slovakia) and Vienna (Austria)—face poorly synchronized timetables, long waiting times, and limited information about delays. A single journey often requires several tickets, each valid only in one region or country. In smaller towns and peripheral regions, connectivity gaps are even more pronounced. While high-speed rail connects major capitals, secondary and local transport links remain underdeveloped. This creates a growing divide between well-connected metropolitan areas and rural communities that rely on private cars for lack of alternatives. Past attempts to improve integration, such as city-wide mobility cards or regional passes, have proven that users value convenience and predictability. Yet, these solutions tend to remain within national boundaries. For cross-border travelers, the lack of integrated ticketing and harmonized fare systems continues to be a barrier. The biggest pain points for users include uncertainty about schedules, difficulty accessing consistent real-time information, and the inability to complete a journey with a single ticket. Conversely, the biggest gains would come from predictability, time savings, and reduced administrative complexity. Travelers want to feel that European transport works as one system, even if operated by multiple providers. The Problem Framing Canvas highlighted that users' expectations and business objectives are closely aligned in this area: both demand greater reliability, efficiency, and connectivity. What stands in the way is not technology, but the lack of standardized governance mechanisms and incentives for collaboration. A stronger European framework for multimodal integration—linking policy, funding, and data—would unlock not only customer value but also new cross-border business opportunities.

3. Key Insights & Outcomes

The discussions on data-driven and emerging mobility solutions revealed that Europe's innovation potential in areas such as on-demand transport, connected vehicles, and autonomous driving is being held back not by technological gaps, but by fragmented governance, incompatible data systems, and lack of shared standards. The Problem Framing Canvas helped participants reframe the issue from a purely technical challenge to a structural and institutional one—centered around interoperability, data trust, and scalability across borders.

Prioritized Pains

- **Fragmented data ecosystem:** Data is collected under incompatible formats and access rules, making it difficult to share or reuse across countries.
- **National regulatory disparities:** Autonomous and on-demand mobility projects operate under differing approval and safety frameworks.
- **Unclear data protection practices:** Divergent GDPR interpretations create uncertainty and discourage data sharing.
- **Isolated pilots:** Successful local projects fail to connect, leading to efforts and slow learning.
- **Limited SME participation:** Smaller innovators face barriers due to closed data systems and high entry costs.

Prioritized Gains

- **Interoperable data standards:** Common APIs and frameworks for mobility data exchange.
- **Cross-border scalability:** Transfer successful pilot projects across multiple Member States.
- **Open and fair data access:** Governance that allows SMEs to participate in data-driven ecosystems.
- **Predictive and adaptive services:** Using AI to improve reliability, efficiency, and safety.
- **Collaborative innovation:** Partnerships to combine infrastructure, data, & technology capabilities.

Impact on the Use Case Development Phase

The prioritization of these pains and gains provided a clear direction for the next phase of the project. The Use Case Development will focus on demonstrating how shared data infrastructures, harmonized regulations, and transparent governance can create new European value chains in connected and autonomous mobility. In particular, the upcoming use cases will:

- Test **cross-border data-sharing frameworks** that balance innovation with privacy.
- Explore **AI-enabled mobility services** (e.g., predictive routing, automated fleet coordination).
- Build **trust mechanisms** that make data use transparent and ethical.
- Identify **scalable governance models** allowing SMEs and regions to participate in European data spaces.

4.4.3 Focus Area: Integration of Transport Systems

1. Challenge Description

Europe's transport systems have evolved largely within national boundaries, resulting in fragmented networks with separate operators, tariffs, and infrastructure standards. While physical connections exist across borders, institutional and operational integration often stops at the frontier. As a result, many cross-border routes, especially regional rail, bus, and ticketing systems—remain poorly coordinated, creating inefficiencies for commuters, travelers, and logistics operators alike. This fragmentation is particularly visible in Central Europe, where cross-border urban regions and smaller towns struggle to maintain consistent, continuous mobility despite strong economic interdependence.

Core Problems

- **Lack of Cross-Border Coordination** – Timetables, fare structures, and service planning are rarely aligned between neighboring countries.
- **Institutional Fragmentation** – Multiple operators and authorities manage adjacent networks without shared governance or planning tools.
- **Unequal Infrastructure Quality** – High-speed corridors receive heavy investment, while smaller regional or rural links remain underdeveloped.
- **Ticketing and Tariff Incompatibility** – Passengers must purchase multiple tickets or use different systems for a single cross-border journey.
- **Limited Data and Operational Interoperability** – Transport data and standards are not harmonized, hindering multimodal coordination.

Underlying Causes

- Evolution of national rail and public transport systems with minimal cross-border integration.
- Regulatory and institutional barriers, including differing public service obligations, fare policies, and funding mechanisms.
- Limited incentives for operators to cooperate across borders
- Focus of EU and national investments on major corridors rather than regional cross-border connectivity.

Consequences

The lack of integration undermines seamless European mobility and reduces accessibility for citizens and businesses in border regions. Commuters face long travel times, higher costs, and poor reliability, discouraging cross-border labor mobility. Smaller towns and rural areas risk economic isolation as investments concentrate on metropolitan corridors. At the systemic level, this fragmentation prevents Europe from realizing the full benefits of the Trans-European Transport Network (TEN-T) and weakens the goal of a truly connected single transport area.

Guiding Questions

1. How can European cities and regions better align their transport planning, ticketing, and operations across borders?
2. What role can EU programs such as TEN-T and the Connecting Europe Facility play in closing regional gaps?
3. How can policy frameworks address the imbalance between metropolitan and peripheral regions to ensure equitable access and cohesion?

2. Problem Framing Canvas

The detailed workshop results can be found in **Appendix 12**.

Business Context

Data has become one of the most critical assets in modern mobility. Every movement—of vehicles, passengers, and goods—generates valuable information that can be used to optimize operations, predict demand, and design new services. Yet, in Europe, the potential of mobility data remains largely untapped. The main reason is structural fragmentation: thousands of operators across the continent generate data in different formats, with inconsistent quality, and under varying legal frameworks. The current situation is shaped by a paradox. Europe has some of the most advanced policy instruments promoting open data—such as the ITS Directive, Open Data Directive, and national access points—but implementation and usage remain uneven. Public authorities often lack the technical capacity to collect, process, and share data effectively, while private companies hesitate to make data available without clear commercial incentives or safeguards. Previous attempts to create shared data infrastructures were valuable but limited in impact. For instance, several national real-time traffic databases and open transport portals were established but did not achieve interoperability beyond their borders. As a result, valuable information about cross-border traffic, passenger flows, and logistics remains siloed within national or regional systems. Emerging trends indicate both opportunity and urgency. The forthcoming EU Data Act and the creation of Common European Data Spaces are expected to provide legal and technical frameworks for data sharing. Artificial Intelligence (AI), Internet of Things (IoT), and 5G technologies are transforming how mobility data can be collected and applied, opening pathways to predictive analytics, dynamic pricing, and autonomous transport systems. However, without coordination, these innovations risk reinforcing existing fragmentation. For European businesses, particularly SMEs and startups, access to interoperable data is key to innovation. New data-driven services—such as demand forecasting, fleet optimization, or multimodal trip planning. The main business goal identified in this problem area is therefore to establish a trusted, standardized, and scalable data ecosystem that allows for both competition and collaboration within a European regulatory framework.

Customer Context

For end users, data fragmentation manifests as unreliable, incomplete, or inconsistent information. Travelers frequently encounter discrepancies between apps: one service shows a delay, another does not; one offers live data, another only static schedules. This inconsistency undermines user trust and leads to poor decision-making. In rural or less-developed regions, the lack of data-based services means that users simply do not have access to the same level of convenience as those in major cities. Moreover, many citizens remain unsure how their data is being used when they access mobility platforms. Concerns about privacy, surveillance, and misuse of information persist—especially when data crosses national borders or involves multiple private actors. Past experiences with digital innovation projects have shown that when data is used transparently and responsibly, it can significantly enhance user satisfaction. Real-time tracking, predictive information, and adaptive route planning make travel more efficient and less stressful. However, when data is incomplete, inaccurate, or inaccessible, it quickly erodes confidence. Users are increasingly aware of the potential of technology but also of the risks it poses. They expect mobility systems that not only deliver better information but also respect their rights and ethical expectations. The main user gains identified during the Problem Framing Canvas sessions include: improved reliability through real-time data, personalization of travel options, and smoother coordination between different modes of transport. The key pain points include: missing data integration, lack of transparency, and limited control over personal information. The overarching insight is that data trust and usability are now as important as physical infrastructure. For Europe to remain competitive, data governance must evolve from fragmented, national approaches to a shared European model that balances innovation with ethical responsibility. This would allow both companies and citizens to benefit from an integrated, data-driven mobility ecosystem that supports new cross-border value chains—from predictive maintenance and AI analytics to autonomous driving and multimodal coordination.

3. Key Insights & Outcomes

The Problem Framing Canvas discussions on the integration of transport systems confirmed that the biggest barriers to seamless European mobility are institutional fragmentation, inconsistent planning frameworks, and weak coordination across borders. Participants agreed that while infrastructure connections exist, the absence of aligned governance, tariff, and information systems prevents transport networks from functioning as one integrated European system. The exercise helped refine the challenge from a purely operational problem to a broader governance and coordination issue—highlighting that integration requires not only technical harmonization but also shared planning tools, financial mechanisms, and long-term cooperation between authorities, operators, and EU programs.

Prioritized Pains

- **Lack of cross-border coordination:** Neighboring regions rarely align timetables, fare structures, or planning processes.
- **Institutional silos:** Multiple operators and authorities act independently with no common governance or data-sharing tools.
- **Unequal investment priorities:** Major corridors receive funding while smaller regional and rural connections remain underdeveloped.
- **Ticketing and tariff incompatibility:** Passengers need multiple tickets or accounts to complete a single cross-border journey.
- **Limited interoperability:** Data and technical systems for operations, ticketing, and passenger information are not standardized.

Prioritized Gains

- **Seamless multimodal travel:** Harmonized timetables, integrated ticketing, and consistent passenger information across borders.
- **Shared planning and governance:** Common digital tools for regional coordination and infrastructure investment.
- **Balanced regional connectivity:** Improved access for smaller towns and border regions through integrated transport offers.
- **One-ticket simplicity:** Unified or interoperable fare systems enabling easy cross-border use.

Impact on the Use Case Development Phase

The prioritization of these pains and gains shaped a clear direction for the upcoming Use Case Development Phase. The next steps will focus on demonstrating how integrated governance, shared data infrastructures, and harmonized ticketing systems can foster cross-border mobility and economic cohesion across European regions. Specifically, the upcoming use cases will:

- Develop **joint tools** for timetable, tariff, and service coordination between neighboring regions.
- Explore **cross-border ticketing and payment pilots** to simplify travel for commuters and tourists.
- Test **data interoperability standards** for multimodal and transnational transport information.
- Promote **regional equity** by connecting cities and rural areas to European transport corridors.

These insights created a shared understanding that integration is both a technical and institutional task. Building seamless transport systems will require collaboration between operators, public authorities, and EU programs—ensuring that Europe's physical connectivity is matched by operational and digital continuity across its borders.

5. Use Case Development

The following section presents the results of the Use Case Development phase, which focused on translating the previously identified challenges into concrete and structured use case ideas. During the expert workshops, participants engaged in systematic, design-thinking-based sessions, supported and guided by the respective moderators.

The process followed a structured four-step methodology designed to move from problem understanding to initial idea generation:

- **VPC Customer Profile** – refining and validating customer needs, pains, and gains
- **Problem Definition** – aligning on a clear and shared problem statement
- **Value Proposition** – developing possible approaches and value-adding concepts
- **Crazy 6 Brainstorming** – generating and prioritizing creative use case ideas

Through this systematic approach, the expert groups transformed abstract challenges into tangible concept drafts. In total, at least twelve initial use case ideas were developed and documented across all expert areas. These ideas represent early conceptual directions that capture potential solutions, value propositions, and innovation opportunities for the European mobility and automation sectors. While still at an exploratory stage, the results form an essential foundation for the next project phase, where the concepts will be further refined, evaluated, and assessed for their implementation potential.

5.1 Electrification

The following section presents the thematic focus areas developed during the expert workshop held on 08 October 2025. During this session, two of the three originally defined thematic pillars were examined in greater depth:

- **EV Value Chain**
- **Charging Services**

The decision to focus on two areas was based on the expertise available during the session, enabling deeper discussion and more diverse perspectives. After the workshop, both groups' results were reviewed and aligned to ensure consistency. The consolidated insights presented here form the basis for the next project phases.

5.1.1 Focus Area: EV Value Chain

1. VPC Customer Profile

The Value Proposition Canvas exercise on the *EV Value Chain* focused on refining the group's understanding of the needs, constraints, and priorities of different stakeholders within Europe's evolving electric mobility landscape. Participants mapped the Jobs-to-be-Done, Pains, and Gains for actors such as OEMs, Tier-1 and Tier-2 suppliers, recycling companies, battery producers, technology providers, and SMEs entering the EV ecosystem.

Jobs-to-be-Done centered on the core industrial and strategic needs required to build a competitive European EV ecosystem. These included securing reliable and affordable supply chains, connecting cross-border supplier networks, accessing critical raw materials, and establishing robust recycling and second-life loops for batteries and components. Participants emphasized the need to scale EV platforms—from battery systems and electric powertrains to embedded software—while simultaneously automating and digitalizing production processes to maintain global competitiveness. Another key job identified was enabling SMEs to integrate into transnational production networks and future value chains.

Pains consistently addressed structural vulnerabilities and cost pressures across the European EV ecosystem. High energy prices, expensive logistics, and volatile material costs were cited as key risks that reduce Europe's attractiveness for large-scale EV and battery manufacturing. Participants highlighted a strong dependency on Asian suppliers—particularly for battery cells, precursors, electronics, and rare materials—combined with fragmented investment strategies and slow regulatory approval processes. SMEs reported major entry barriers due to certification requirements, financing limitations, and difficulties connecting to established supply chains. Regulatory complexity, reporting burdens, and unclear long-term policy signals were also named as inhibiting factors.

Gains focused on opportunities emerging from new industrial models, sustainability requirements, and cross-border collaboration. Participants described the potential for new high-skill jobs, SME participation in new component niches, and strengthened industrial clusters across Europe. Gains also included more stable, local, and lower-carbon production through advanced recycling technologies and energy-efficient manufacturing. The vision of a stronger "Made in Europe" position—supported by shared platforms, data-driven production, and improved circularity—was consistently emphasized.

Through the VPC, the group shifted from a narrow functional view ("how to reduce European import dependency") toward a broader strategic and human-centered understanding of cooperation ("how to make European collaboration the foundation of future EV competitiveness").

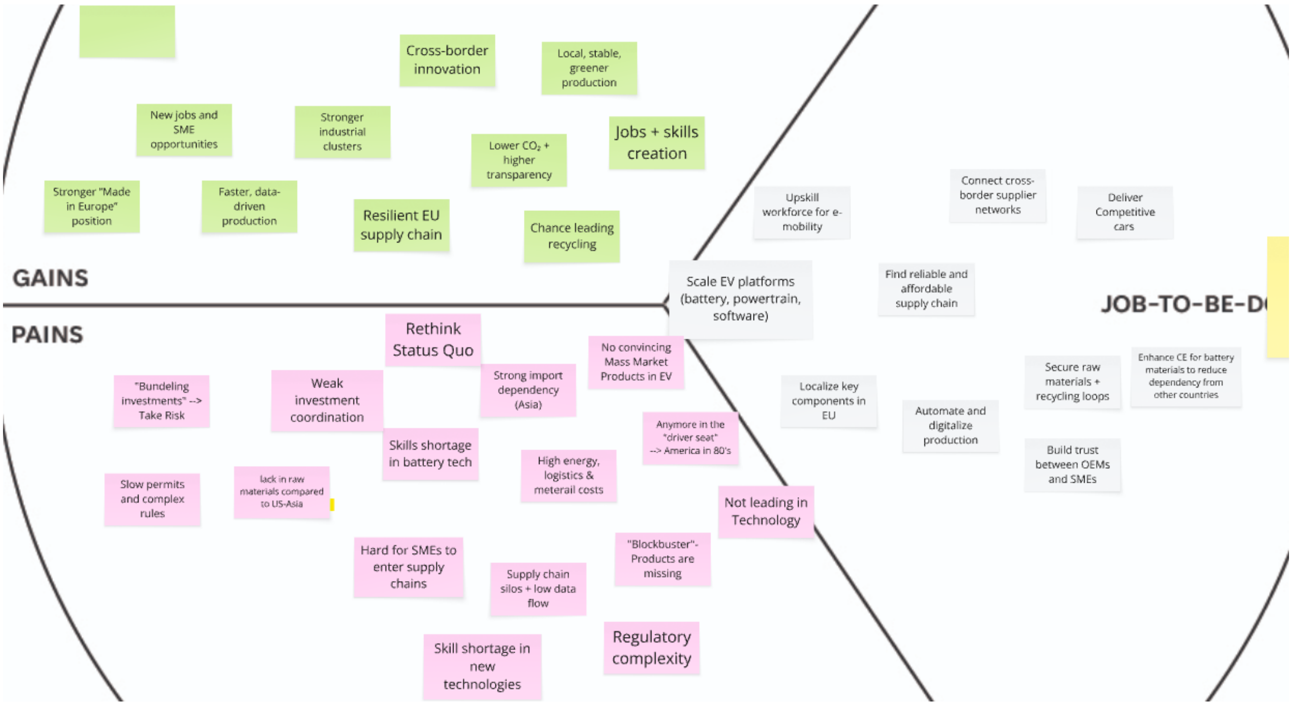


Figure 7: VPC Customer Profile – EV Value Chain

2. Problem Definition

Based on the collaborative discussion, participants formulated a shared problem statement that reflects both the industrial and circularity-related challenges:

Current recycling technologies cannot efficiently recover materials from existing ICE vehicles, while the rapid growth of EVs and battery production increases demand for critical raw materials. This reinforces Europe's dependency on finite and imported resources and creates a widening gap for circular, scalable recycling solutions. At the same time, recycled materials—often not matching the quality of virgin materials—are insufficiently integrated into vehicle and battery design processes. As a result, practical application remains limited, slowing progress toward true material circularity and a resilient, competitive European EV value chain.

This problem definition connects systemic obstacles (import dependency, limited recycling capacity, inconsistent standards) with practical industrial needs (scalable raw material access, design-for-circularity, cost efficiency). It lays the groundwork for solution-oriented, transnational collaboration across Europe's mobility and industrial ecosystem.

Problem Statement

Current recycling technologies cannot efficiently recover materials from existing ICE vehicles, while the rise of EVs and batteries increases demand for critical raw materials. This deepens dependency on finite resources and highlights a market gap for circular recycling solutions. Moreover, the use of recycled materials—often not matching virgin quality—is not yet integrated into the design and development process, limiting their practical application and slowing progress toward true material circularity.

Figure 8: *Problem Definition – EV Value Chain*

3. Value Proposition

Building on the jointly defined problem, participants developed a set of Pain Relievers, Gain Creators, and Products & Services to guide future European activities in EV value chain development. The group emphasized that Europe must maximize the value of its domestic resources, accelerate circularity, and strengthen industrial sovereignty to remain globally competitive. Central to this vision is a strong and integrated European battery and recycling ecosystem. Pain Relievers included accelerating the development of advanced recycling technologies—particularly for battery materials—to reduce external dependency and increase the availability of high-quality secondary materials. Participants stressed the importance of EU-wide platform collaboration among OEMs to pool investments, share standards, and build economies of scale in BEV development. Simplifying access to funding, reducing regulatory hurdles, and enabling SMEs to participate in innovation ecosystems were identified as essential actions. Transparent and predictable EU industrial policy was highlighted as a prerequisite for long-term investment planning. Gain Creators focused on strengthening Europe's industrial clusters, enabling new business models across the circular economy, and improving competitiveness through automation, digitalization, and shared infrastructure. Participants emphasized the potential for leveraging European technological strengths—such as precision engineering, robotics, and material science—to grow new markets. Developing a strong talent pipeline through university programs, vocational training, and STEM/MINT promotion was seen as essential to supporting the industrial transition. Products & Services envisioned by the group included large-scale demonstration plants for closed-loop recycling, digital platforms to connect cross-border supplier networks, European collaboration platforms for EV architecture and battery innovation, and standardization toolkits to integrate recycled materials directly into design processes. Participants also called for revisiting EU funding frameworks—particularly under FP10—to allow strategic support for production-oriented innovation where there is clear added European value.

4. Crazy 6 Brainstorming

The Value Proposition discussion formed the foundation for the Crazy 6 brainstorming exercise, in which participants generated six rapid ideas in six minutes, each addressing a core pain or gain previously identified. Ideas were then shared collectively, thematically grouped (e.g., circularity, supply chain resilience, SME integration), and assessed through a voting process to prioritize those with the greatest potential impact.

The strongest ideas included:

- **Creation of new European OEM players** through innovation-friendly frameworks enabling new entrants to challenge established models.
- **Large-scale European consortia** to pool investments, align standards, and scale up cross-border cooperation.
- **Full circular economy integration**, including the use of refined recycled materials in R&D and vehicle design processes.
- **Funding and demonstration support** for low-cost, ecologically optimized EVs inspired by concepts like Sono Motors—paired with European-scale production models.

Outcome

The VPC and Crazy 6 exercises collectively shaped a shared European vision for a competitive, circular, and collaborative EV value chain. The discussions highlighted that Europe's EV industry cannot rely on isolated national initiatives or small incremental improvements; instead, it requires strong transnational industrial cooperation, scalable recycling and reuse technologies, and the integration of circularity principles directly into design and manufacturing processes. Participants emphasized the importance of building a circular European resource loop for critical materials, strengthening cross-border industrial alliances, advancing digital and automated production capabilities, and establishing strategic investment frameworks that support long-term competitiveness. A skilled workforce—supported by targeted education and training initiatives—was identified as essential to enabling this transformation. These consolidated insights now guide the Use Case Development Phase, where key concepts such as advanced recycling infrastructures, cross-border supplier networks, and European collaboration platforms will be further refined and validated. Ultimately, the findings demonstrate how coordinated investment, innovation, and circularity can reinforce a globally competitive and resilient European EV ecosystem.

5.1.2 Focus Area: Charging Services

1. VPC Customer Profile

The VPC exercise on Charging Services was conducted to deepen the group's understanding of the needs, expectations, and operational realities faced by different user groups within Europe's increasingly complex EV charging landscape. Using the Value Proposition Canvas, participants mapped the Jobs-to-be-Done, Pains, and Gains for key stakeholders such as private EV drivers, cross-border travelers, fleet operators, mobility service providers, and charging point operators (CPOs).

Jobs-to-be-Done are centered on ensuring that charging infrastructure is easy to access, reliable, and scalable. Participants emphasized the need to build interoperable fast-charging networks that function consistently across borders, integrate renewable energy and storage systems to reduce operational costs, and standardize data flows, APIs, authentication, and payment procedures. For operators, key tasks included maintaining high uptime and energy efficiency, coordinating with grid operators, and ensuring transparent, predictable service quality. For users—jobs focused on finding available chargers quickly, initiating charging sessions without multiple apps or accounts, and understanding pricing clearly.

Pains highlighted the practical and structural barriers that hinder charging today. High and fluctuating energy prices increase operational costs and make charging more expensive for users. Roaming is still unreliable in several regions, making cross-border travel difficult. Slow and fragmented permitting processes delay the rollout of new infrastructure, while local resistance from residents or municipalities complicates site approval. Coverage remains uneven—dense in cities but insufficient in rural and peripheral regions—leading to range anxiety and inconsistent service availability. Additionally, the lack of standardized payment methods and authentication processes creates friction for both occasional users and fleets.

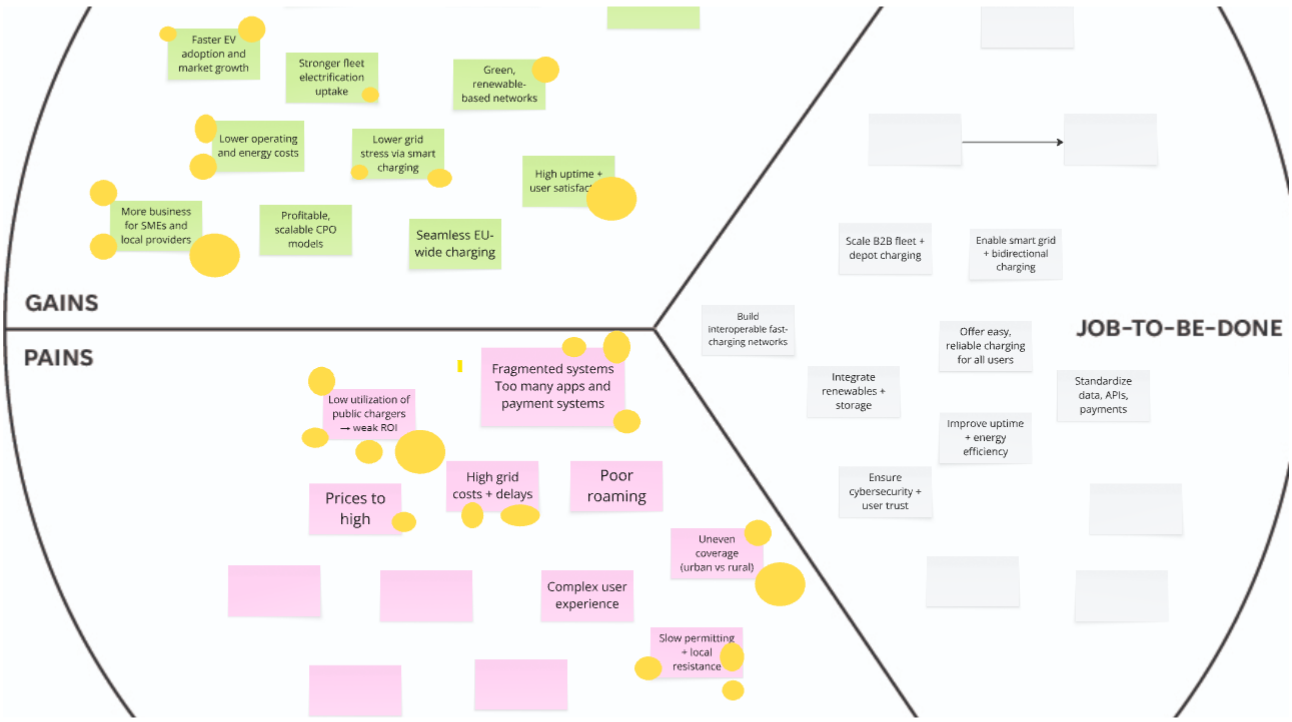


Figure 9: VPC Customer Profile – Charging Services

Gains reflected the strategic and economic opportunities that improved charging services could unlock. Participants identified strong potential for SMEs and local providers to contribute to network deployment, maintenance, and innovation. Scalable and profitable CPO business models would support long-term infrastructure growth and strengthen Europe's charging ecosystem. A seamless EU-wide charging experience could significantly improve fleet electrification, reduce operational complexity for companies, and accelerate overall EV adoption. Gains also included faster market growth for EVs, better load management through renewable integration, and greener, more resilient energy-based charging networks.

Through this analysis, the group shifted from a purely technical view ("how to increase EV charging availability") toward a more user-centered perspective ("what EV users need to feel confident, supported, and frictionlessly connected across Europe").

2. Problem Definition

From the collective discussion, two central problem statements were defined:

Drivers, fleet operators, and mobility providers face fragmented charging networks across Europe—with inconsistent pricing, payment systems, apps, and reliability. They need a unified, trustworthy charging experience that works seamlessly across borders and providers, supported by clear and consistent regulation. Charging stations are frequently blocked by non-EV vehicles, reducing availability and contributing to low utilization rates and weak ROI for charging infrastructure.

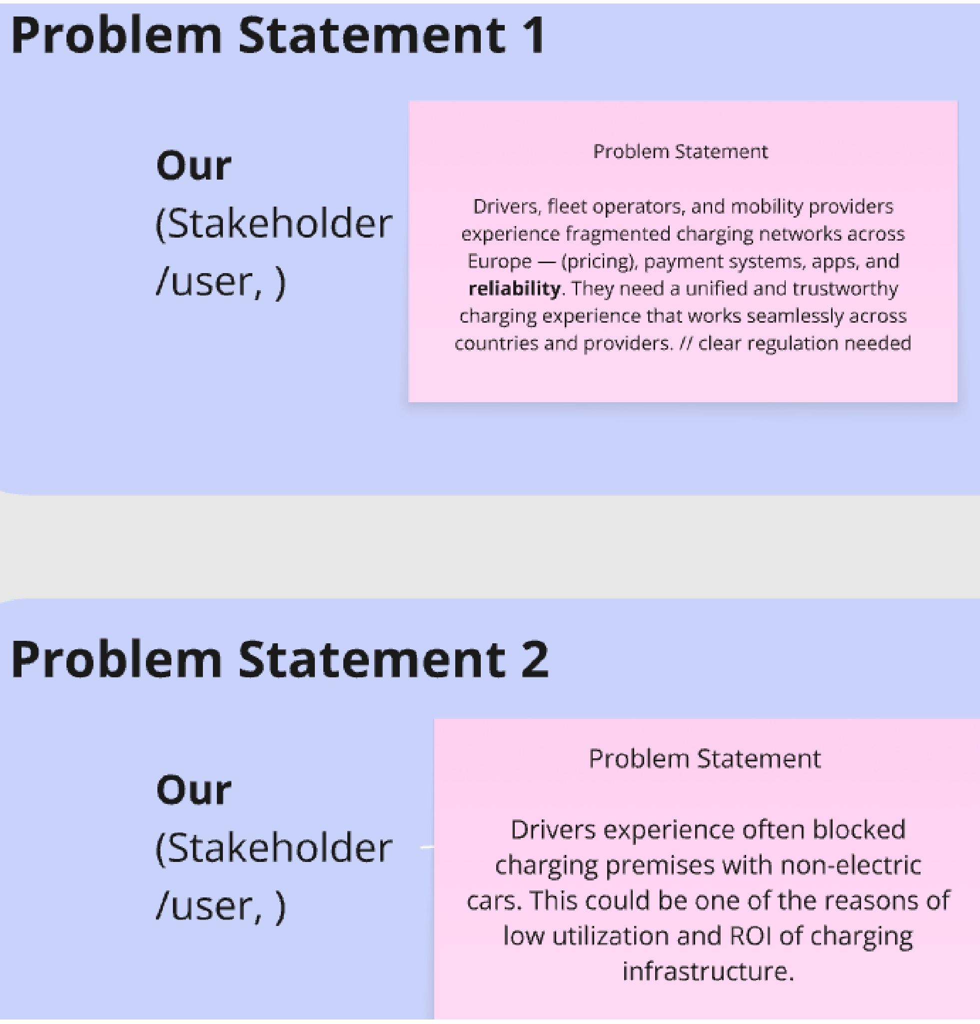


Figure 10: Problem Definition – Charging Services

3. Value Proposition

To enable seamless day-to-day EV charging, the group emphasized the need for simple, reliable payment options (e.g., credit cards, QR codes) supported by clear on-demand booking and reservation systems. Standardized data, APIs, authentication, and payment processes will increase interoperability and reduce complexity for users and operators. Integrating renewable energy and storage solutions, ensuring strong cybersecurity, and improving uptime are essential to building a dependable, efficient, and user-friendly charging network. These measures collectively support wider EV adoption, better infrastructure utilization, and a more resilient European charging ecosystem.

4. Crazy 6 Brainstorming

Building on the Value Proposition, participants developed and refined ideas during the Crazy 6 ideation exercise. Key concepts included:

- Standardized, cross-border roaming for all charging networks
- Shared cross-border information on charging availability, pricing, and methods
- Reducing the number of steps required to start a charging session (e.g., Plug & Charge)
- Incentive models such as "stamp cards" (e.g., every 11th charging session free for one hour) to increase utilization and customer loyalty

Outcome

Workshop participants identified a set of persistent challenges shaping today's European charging landscape, including fragmented networks, inconsistent payment and access systems, blocked charging points, high energy costs, slow permitting, uneven geographic coverage, and low infrastructure utilization. These barriers limit seamless cross-border travel, slow fleet electrification, and weaken the business case for charging operators. At the same time, the group highlighted strong opportunities: creating unified and interoperable EU-wide charging experiences, integrating renewables and storage, improving uptime and energy efficiency, and enabling scalable and profitable CPO business models. Standardizing data, APIs, and authentication was seen as essential to reducing complexity for users and operators alike. Collectively, these insights point toward a more coherent, accessible, and user-centric charging ecosystem—one that accelerates EV adoption, strengthens European competitiveness, and supports the transition to a greener and more resilient mobility system.

5.2 Automation

The following section presents the thematic focus areas developed during the expert workshop held on 29 September 2025. During this session, two out of the originally defined three thematic pillars were explored in greater depth. Specifically, these were:

- **Microbus/Shuttle & Fleet Operations in Public Transport**
- **Special Vehicles: Agriculture & Forestry Work Machines**

The decision to focus on two areas reflected the expertise available that day, allowing for deeper discussion and broader perspectives. After the workshop, both groups' results were reviewed and aligned to ensure consistency. The consolidated insights presented here form the basis for the next project steps.

5.2.1 Focus Area: Microbus/Shuttle & Fleet Operations in Public Transport

1. VPC Customer Profile

The exercise on Microbus/Shuttle aimed to refine the group's understanding of user needs, experiences, and expectations. Using the VPC, participants mapped out the Jobs-to-be-Done, Pains, and Gains for different users and operators.

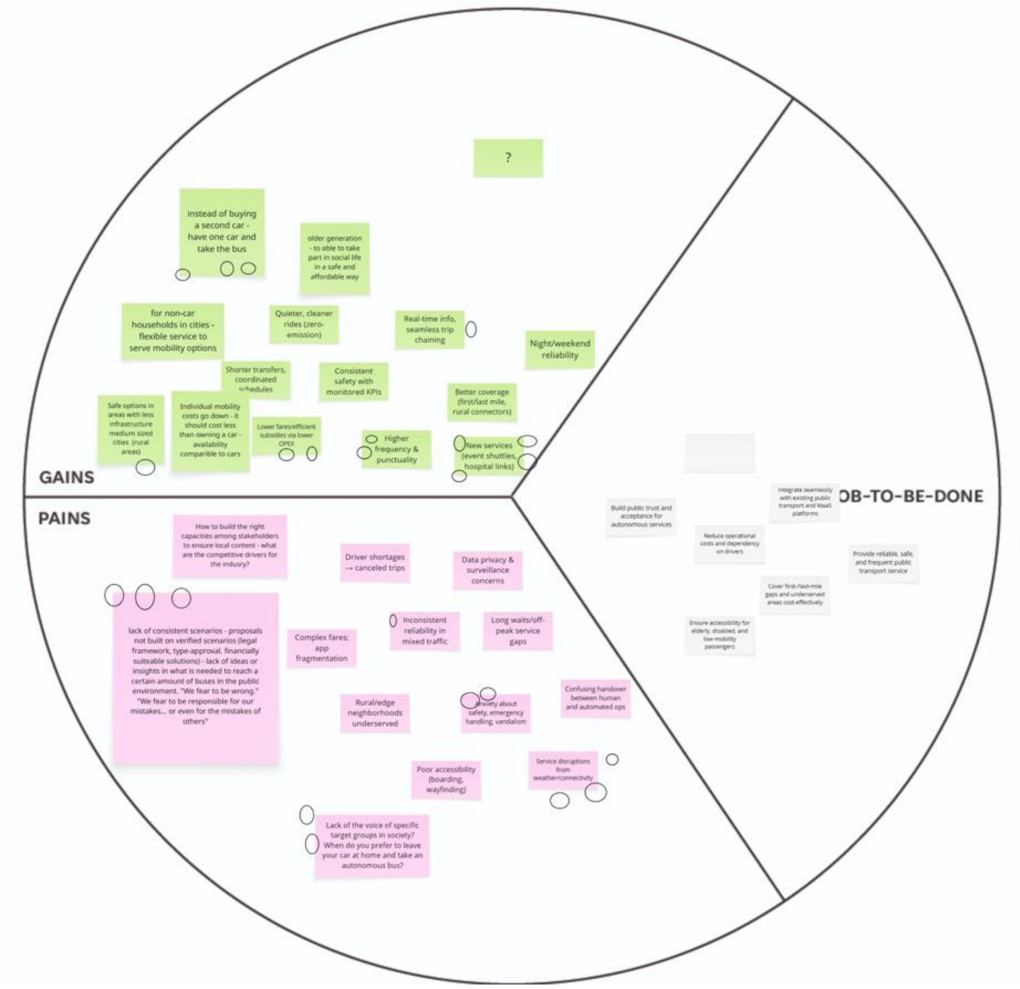


Figure 11: VPC Customer Profile – Microbus/Shuttle & Fleet Operations in Public Transport

Jobs-to-be-Done focused on the following: integration of autonomous shuttles/microbuses with existing public transportation and MaaS platforms, coverage of first-/last-mile gaps and underserves areas, reliable, safe and frequent public transportation and accessibility for low-mobility passengers on the user side; they simply want to get from A to B smoothly. On the other hand, the operators need to reduce operational costs and dependency on drivers, ensuring at the same time a reliable, cost-effective, safe and frequent public transport service, including in underserved areas. They further focus on trust/acceptance building for autonomous services.

Pains were related to the lack of consistent and verified scenarios, disruptions due to weather conditions or connectivity problems as well as anxiety about safety, emergency handling and vandalism.

Gains centered around simplicity and higher frequency. Users desire higher frequency and punctuality to avoid having to buy a second car, new services, such as event or hospital shuttles, and safer options in areas with less infrastructure.

Through the VPC, the group refined its understanding from a purely functional view ("how to make ticketing interoperable") to a **human-centered perspective** ("how to make mobility across Europe feel effortless and inclusive").

2. Problem Definition

Based on the group discussion, the following problem statements were defined:

Commuters and municipalities need a way to provide reliable, frequent, and safe mobility services because traditional fleets face driver shortages, high operational costs, and persistent gaps in first- and last-mile coverage, leaving many users underserved.

Public transport operators need a way to integrate autonomous shuttles seamlessly into existing networks because today's solutions remain isolated pilots with limited scalability, low utilization, and fragmented IT systems, which prevents efficiency gains and broader adoption.

3. Value Proposition

Participants emphasized that autonomous microbuses should be fully integrated into broader mobility strategies at national, regional, and urban levels rather than treated as isolated pilot projects. To move beyond experimentation, countries and cities need clearly defined operational scenarios that outline how financing, remote operations, insurance, data handling, vehicle approval processes, and stakeholder roles will work in practice. A crucial prerequisite for this is a coherent European and national legal framework that allows testing and homologation of autonomous vehicles on public roads; without such procedures, deployment will remain limited to private or otherwise supervised environments. Autonomous shuttle services are particularly suitable for locations where user behaviour is predictable and routes can be repeated reliably, for example in tourist destinations, industrial zones, campuses, airport areas, no-car zones, or event grounds. In such settings, services can be tailored to specific user groups with shared needs, ensuring regular usage, systematic feedback, and continuous optimisation. This targeted approach enables service models that are both practical and scalable. A coordinated operational framework is also essential. This includes reliable connectivity coverage, clear and predefined emergency and crisis protocols, efficient communication between operators and emergency responders, and the resilience to handle disruptions such as weather events, network overload, or cyberattacks. Only when these foundations are in place can autonomous mobility services operate safely and consistently. The value proposition that emerges from this approach addresses two main audiences. For public transport operators and mobility organisers, the goal is to offer cost-effective, homologated autonomous shuttles for small groups of passengers in supervised environments, where predictable travel patterns allow reliable operation. These offerings must be complemented by fleet-operation software capable of integrating traditional public transport modes with new autonomous solutions, including the necessary tools for smart fleet management, remote supervision, and appropriate charging infrastructure. For users, the value lies in accessing mobility services through intuitive, app-based digital channels at an affordable price, enabling them to travel from one point to another within an acceptable timeframe and with a comfortable, dependable experience that fills existing mobility gaps.

4. Crazy 6 Brainstorming

The joint Crazy 6 session generated several initial ideas for future mobility applications using autonomous shuttles. Key ideas included:

- Fleet monitoring and supervision tools, including remote parking functions for traditional buses
- Autonomous shuttles connecting park-and-ride facilities with city centers every 5–10 minutes
- Autonomous shuttle services in large holiday resorts, linking hotels to key attractions
- Shuttle routes between railway stations and major industrial parks
- Airport-based autonomous shuttles for internal mobility
- A European digital platform for registration, booking, and payment of mobility services

Outcome

In the Microbus/Shuttle & Fleet Operations focus area, experts agreed that large-scale deployment of autonomous shuttles depends on resolving homologation and regulatory procedures at European and national levels. Until these frameworks are standardized, autonomous shuttles will mainly be feasible in private or supervised environments through demonstration projects. A key open question is who will finance such pilots and how results can be transferred to public road operations. Participants also highlighted opportunities to apply autonomous technologies—such as remote supervision and automated depot parking—to conventional bus fleets. This could deliver immediate operational improvements while broader autonomous mobility ecosystems mature. Overall, autonomous microbuses present a promising solution for predictable, low-demand, or closed environments, if connectivity, emergency protocols, and stakeholder coordination are well established. This forms a foundation for future European use cases aimed at expanding flexible, inclusive, and digitally integrated public transport services.

5.2.2 Focus Area: Special Vehicles - Agricultural & Forestry Work Machine

1. VPC Customer Profile

The **Jobs-to-be-Done** in the area of agricultural and forestry machines revolve around enabling farmers and foresters to work more efficiently, safely, and sustainably under increasing pressure. They need to produce higher yields with fewer inputs, operate safely in remote, difficult, or hazardous environments, and automate repetitive or time-critical tasks to compensate for ongoing labour shortages. At the same time, they are expected to collect high-quality environmental, safety, and ESG data automatically and to use this information for smarter planning, continuous monitoring, and precise interventions where they are most needed. Ensuring reliable operations during critical seasonal windows, such as sowing and harvesting, also forms a core job they are trying to accomplish.

The **Pains** expressed by farmers and forestry operators relate largely to the practical and financial risks associated with adopting autonomous machinery. They struggle with high upfront investment costs and uncertainty about whether these technologies will deliver a reliable return. There is a strong fear of equipment failure at the worst possible moment, especially during peak seasons. Many rural and forest areas suffer from poor connectivity, making remote supervision difficult. Operators face long waiting times for spare parts, frequent sensor fouling from mud, dust, or rain, and the constant need to recalibrate equipment when moving between different terrains. Concerns about theft, vandalism, and the overall reliability of autonomous systems in harsh outdoor conditions further discourage adoption.

The **Gains** that users hope to achieve focus on boosting productivity and environmental sustainability. They look for machines that can operate continuously, even 24/7, and can take on a flexible range of tasks throughout the year. They value the possibility of precise, targeted interventions that reduce chemical and water usage, help meet environmental standards, and minimise soil damage. Reliable sensor systems offer the ability to detect plant stress, diseases, or forest damage early, improving long-term yields and resilience. Autonomous machines also support better traceability and compliance for certifications such as farm-to-fork requirements. Ultimately, operators want safer operations in remote or steep areas and improved access to locations that are difficult or unsafe for people or conventional equipment.

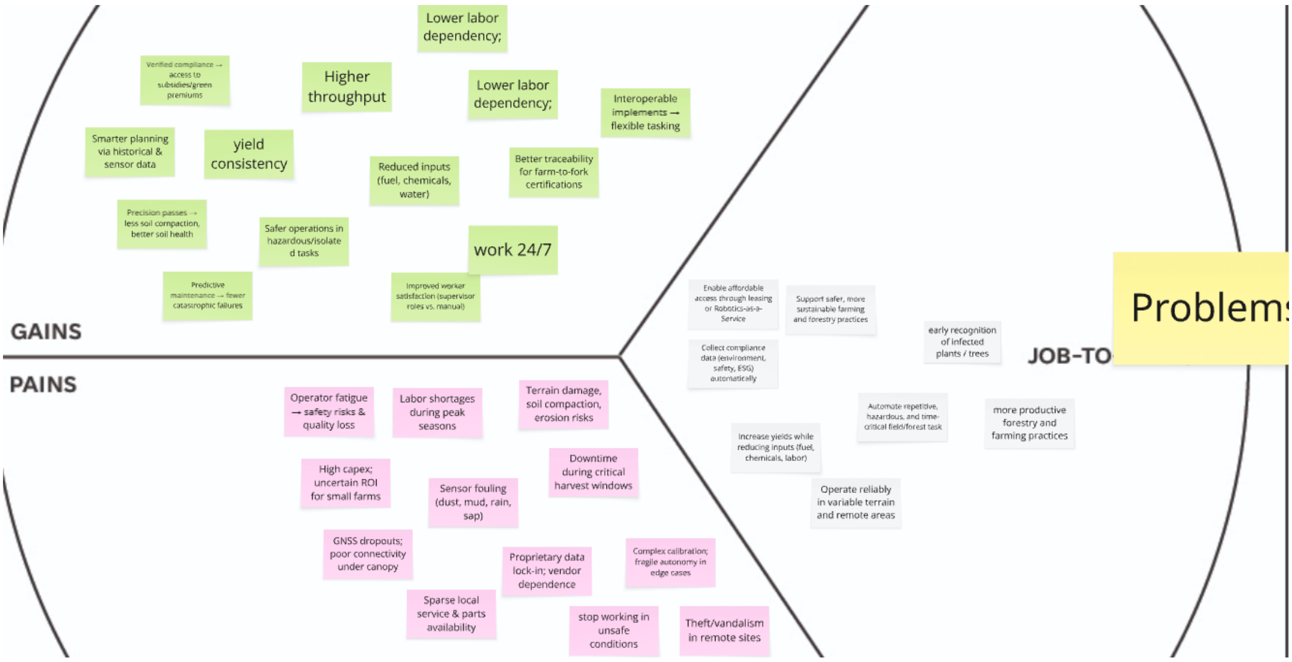


Figure 12: VPC Customer Profile – Special Vehicles - Agricultural & Forestry Work Machine

They also see significant value in technologies that increase safety and expand access to areas that are difficult or dangerous for humans or traditional equipment. Collectively, these insights shift the focus from a purely technical question — "how can machines automate field tasks?" — to a human- and value-centered one: "how can autonomous systems make agricultural and forestry operations safer, more resilient, and more sustainable?"

2. Problem Definition

The workshop identified two primary user groups, each with their own specific challenges:

Farmers need autonomous vehicles that support sustainable farming by helping them achieve higher yields with fewer inputs. These solutions must be capable of gathering high-quality data, performing robust analytics, and operating safely in difficult terrain. They also require features that protect valuable machinery, such as advanced sensor systems and integrated fleet-management tools.

Foresters need intelligent systems to monitor the health and conditions of trees and larger forest environments. They require reliable technologies that can detect damage or disease early using image recognition and analytics, and can initiate appropriate actions. These solutions must operate with minimal environmental impact, reducing soil disturbance and ensuring that interventions are precise and justified.

3. Value Proposition

Discussions centered heavily on prevention, safety, and environmental protection. Autonomous vehicles can support more sustainable agricultural and forestry practices by enabling precise interventions and reducing reliance on fertilizers and pesticides. They were also seen as an essential tool for reaching remote or hazardous areas where traditional machinery or human labour cannot operate safely. Participants stressed the value of autonomous systems equipped with advanced sensing technologies to assess soil and plant conditions, detect diseases, and support early intervention. Such capabilities enable more targeted actions, reduce environmental impact, and support the transition toward sustainable, low-input farming and forestry. Additionally, autonomous machines can be deployed to evaluate whether certain areas are accessible for specific operations, or to reach locations where human access is limited due to terrain conditions or shortages of specialised personnel. The discussion outlined several promising product and service categories, including autonomous devices for accessibility assessment, autonomous machinery capable of operating independently in remote areas, and sensor-driven intervention systems capable of evaluating plant or tree condition and executing precise actions such as fertilising, pesticide application, or selective removal.

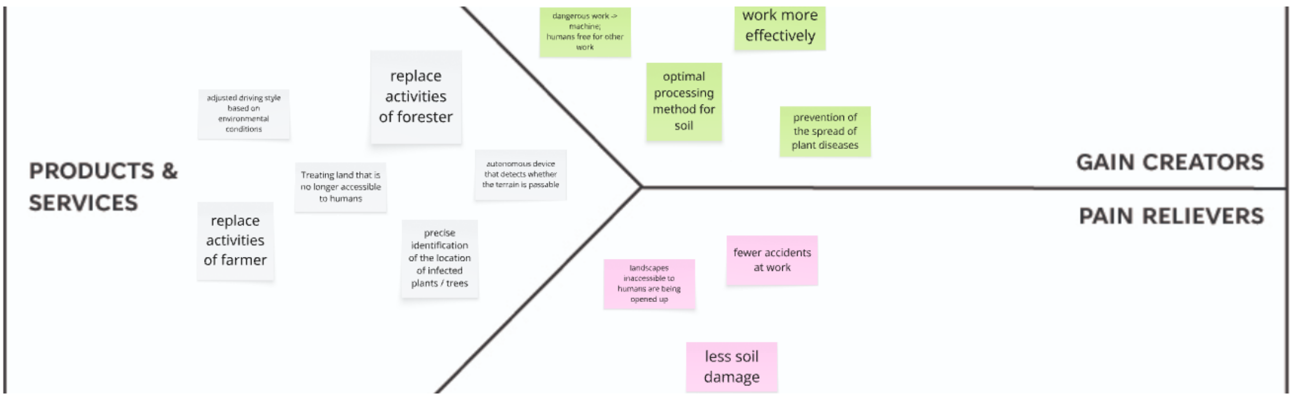


Figure 13: Value Proposition – Special Vehicles - Agricultural & Forestry Work Machine

4. Crazy 6 Brainstorming

During the brainstorming session the experts identified the following ideas:

- **Neural-network-based tree and plant health detection:** Autonomous systems use image recognition and machine-learning models to identify infected, damaged, or stressed trees and plants early, enabling timely interventions and reducing environmental impact.
- **Adaptation of pedestrian-recognition systems for natural environments:** Existing automotive detection technologies (used for identifying people or obstacles) are repurposed to recognise animals, humans, vegetation types, and environmental hazards in fields and forests.
- **Robotic gripper systems for agricultural and forestry operations:** Autonomous machines equipped with mechanical grippers can remove damaged trees, handle plants, collect samples, or perform selective interventions with minimal soil disturbance.
- **Autonomous sowing vehicles:** Self-driving field machines capable of performing sowing tasks independently, operating continuously and precisely even in remote or hard-to-reach areas.

Outcome

The discussion on agricultural and forestry work machines highlighted prevention and safety as central priorities. Participants emphasized the importance of reducing soil impact, protecting plants and trees, and enabling access to areas that are difficult or unsafe for people or conventional machinery. Autonomous technologies were viewed as a key enabler for improving operational resilience, reducing environmental pressure, and supporting more sustainable farming and forestry practices. The results point toward a future where autonomous systems complement traditional machinery, provide continuous data-driven insights, and enable safer, more precise, and more efficient operations across Europe’s agricultural and forestry landscapes.

5.3 Connectivity

The following section presents the thematic focus area *Connectivity*, refined during the expert workshops. Among the broader connectivity challenges identified earlier, experts agreed to focus on **V2X and V2V Connectivity**, as these technologies offer the strongest potential for cross-border impact and future mobility services. Through a design-thinking approach, the expert group narrowed the problem space, clarified key challenges, and shaped first ideas for transnational use cases.

5.3.1 Focus Area: V2X, V2V and Connectivity

1. VPC Customer Profile

The VPC exercise on **V2V, V2X and Connectivity** aimed to sharpen the group's understanding of user needs in an increasingly connected mobility ecosystem. Participants used the Value Proposition Canvas to map Jobs-to-be-Done, Pains, and Gains for cities, infrastructure operators, vehicle users, fleet operators, grid operators, and mobility service providers.

Jobs-to-be-Done focused on enabling seamless, reliable communication between vehicles, infrastructure, and road users across Europe. Key tasks included ensuring always-on connectivity for safety-critical information; supporting cooperative driving through V2V and V2I messaging; integrating traffic, parking, and charging data; and enabling cities to manage multimodal traffic flows more efficiently. For fleets, jobs centered on receiving real-time hazard information, optimizing routing, and ensuring compliance across borders. For grid operators and municipalities, tasks included balancing demand from high-power EV charging, planning construction or traffic management, and accessing accurate real-time data for decision-making.

Pains reflected deep fragmentation across the European connectivity landscape. As seen throughout the Problem Framing Canvas , users struggle with unreliable network coverage, inconsistent standards, regional protocol differences, and delayed or missing hazard notifications. Infrastructure remains uneven—cities differ in maturity, RSU equipment, and backend systems, causing dropouts and unpredictable service quality. Municipalities face overwhelming complexity when integrating charging, parking, V2X, and traffic data, while fleets encounter interoperability issues when crossing borders. Grid operators express concerns about bidirectional charging and grid stability. Certification differences, lack of harmonized cybersecurity rules, and high infrastructure costs further complicate deployment.

Gains centered around a future where V2X connectivity is harmonized, safe, and scalable across Europe. Participants described benefits such as real-time hazard alerts, optimized routing using SPaT/MAP data, smoother traffic flows, reduced congestion, enhanced safety, and fewer accidents. For municipalities, gains include improved planning and operational capacity, access to best practices, and simplified deployment. For fleets and drivers, gains include reliability, trust in warnings, fewer delays, and lower operational costs. For SMEs, a harmonized V2X ecosystem offers new business opportunities in analytics, integration, testing, and digital services.

Overall, the VPC exercise shifted the group's perspective from a purely technical question ("how do we deploy V2X infrastructure?") toward a user-centered ecosystem view ("how do we make connected mobility reliable, safe, and effortless for everyone across Europe?").

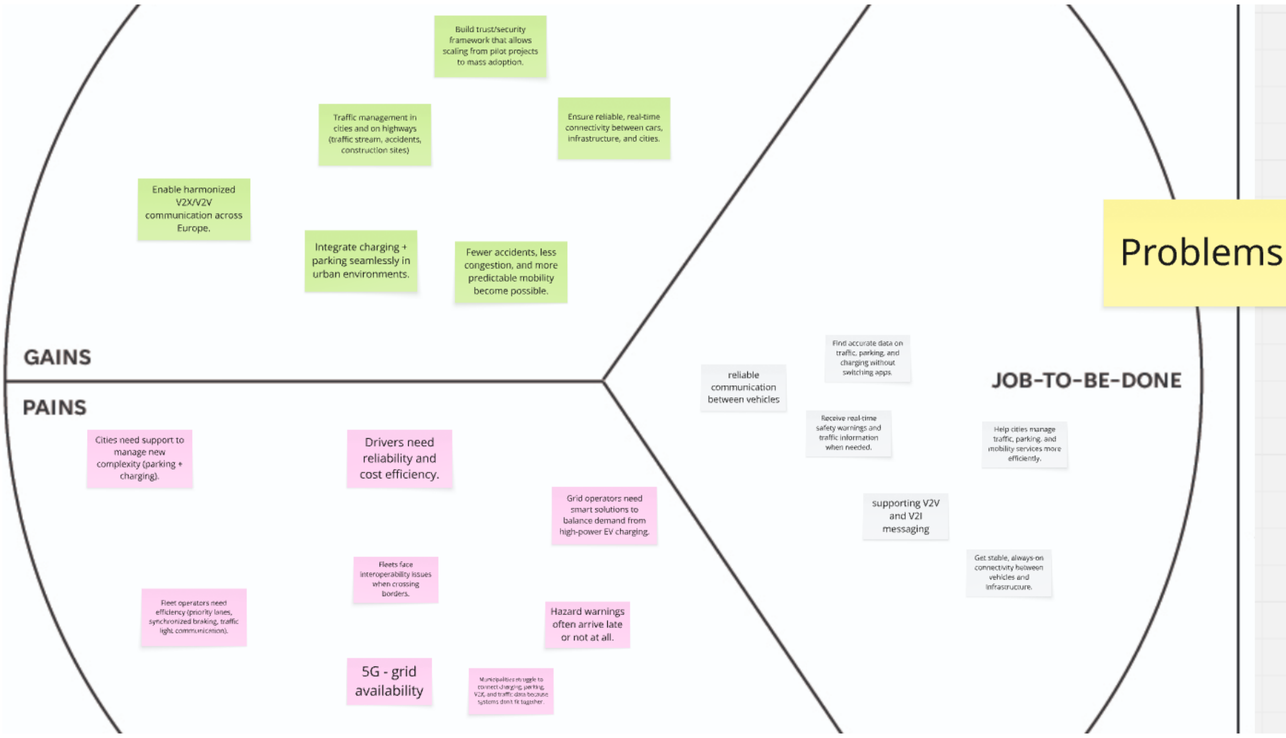


Figure 14: VPC Customer Profile – V2X, V2V and Connectivity

2. Problem Definition

Based on the Problem Framing Canvas , participants formulated two core problem statements that capture the systemic challenges of today's V2X landscape:

Drivers, fleets, and mobility operators struggle with unreliable and inconsistent vehicle connectivity. Network dropouts, missing standards across regions, and delayed or unclear hazard information make it difficult to ensure safety, efficiency, and trust in connected or autonomous functions. Without a stable and unified V2X communication layer, users cannot benefit from real-time warnings, cooperative driving, or efficient traffic management.

Today's V2X ecosystem is fragmented, costly to integrate, and hard to scale. Regions, infrastructure providers, and OEMs use different interfaces and requirements, creating complexity for fleets, cities, and technology partners. As long as interoperability and standardization remain incomplete, cross-border deployment remains slow, expensive, and unreliable.

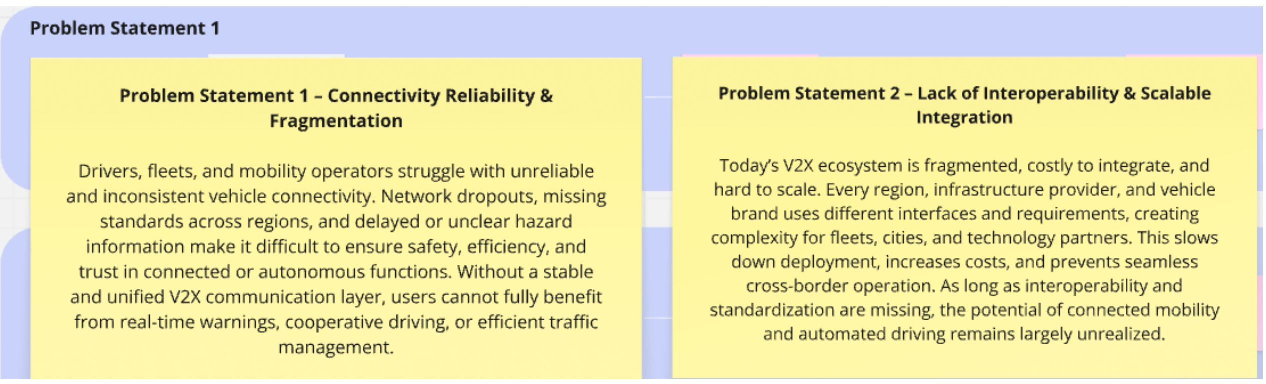


Figure 15: Problem Definition – V2X, V2V and Connectivity

3. Value Proposition

Building on the identified problems, participants developed a series of Pain Relievers, Gain Creators, and Products and Services for a future European V2X ecosystem. Pain Relievers focused on reducing complexity and fragmentation. Participants highlighted the need for standardized and pre-certified RSU hardware across all EU markets, unified APIs for cities and operators, shared data layers for hazards and traffic information, reliable multi-channel connectivity (5G, 6G, fallback systems), harmonized cybersecurity frameworks, and tools that simplify deployment and certification for municipalities. Gain Creators focused on enabling safer, more efficient, and more coordinated mobility. These included real-time hazard alerts, optimized routing based on V2X data, better construction and traffic management planning, and more predictable travel conditions. Gains also included improved service reliability for fleets and drivers, increased planning capacity for cities, and new market opportunities for SMEs. Products and Services envisioned by the group included a European V2X communication platform linking vehicles and infrastructure, a federated traffic signal data platform, a real-time hazard and traffic intelligence layer, fleet dashboards and analytics, RSU/OBU compatibility checking tools, and standardized toolkits for cities to deploy V2X systems more easily. Together these elements support a scalable, interoperable, and trustworthy European V2X ecosystem.

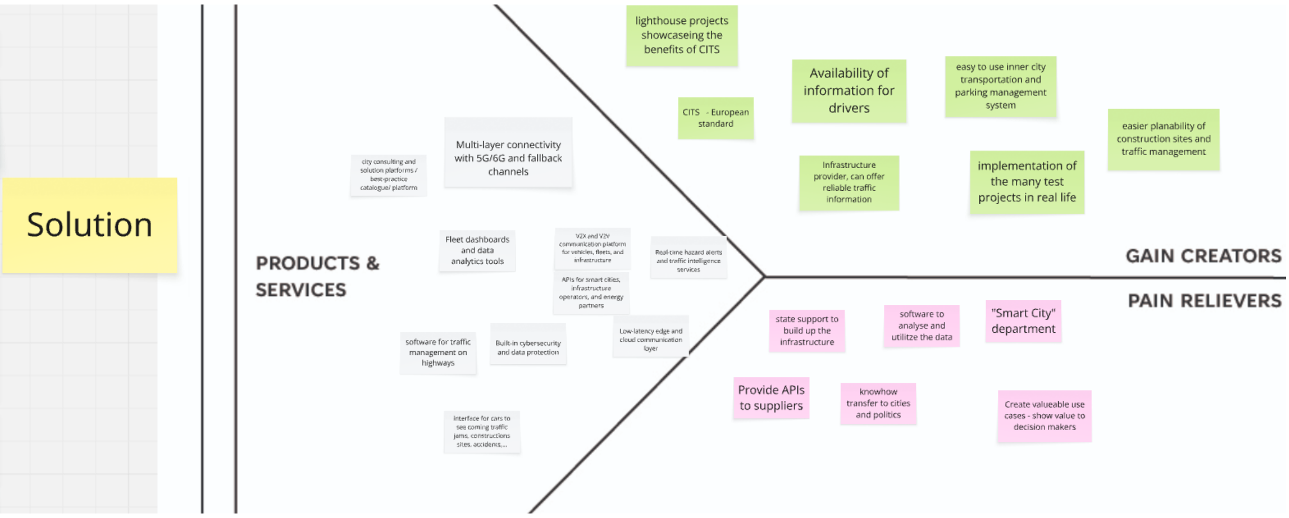


Figure 16: Value Proposition – V2X, V2V and Connectivity

4. Crazy 6 Brainstorming

The Crazy 6 session generated rapid, high-value ideas . Selected concepts included:

- Unified EU V2X Reference Standard: A cross-European technical baseline ensuring full interoperability for OEMs, cities, and infrastructure providers.
- Pre-Certified EU Roadside Unit Module: Standardized hardware + software approved for all EU markets to simplify deployment and reduce cost.
- Cross-Border Connected Mobility Corridor: A continuous V2X-enabled route across multiple countries for real-world latency, handover, and interoperability testing.
- EU Shared Real-Time Hazard Data Layer: A unified API where member states provide verified hazard, weather, and traffic data.

- Federated Traffic Signal Data Platform: EU-wide SPaT/MAP access ensuring all vehicles read signal phases consistently.
- Low-Cost V2X Deployment Kit for Municipalities: An EU-funded starter kit for smaller municipalities including RSUs, dashboards, connectors, and standard templates.
- Automated V2X Compatibility Checker: A digital tool allowing cities and providers to validate hardware, firmware, and data models against EU standards.
- In-Vehicle V2X Context Assistant: A module that translates V2X messages into understandable, actionable driver guidance.

Outcome

Across the V2V, V2X, and Connectivity topic, participants reached a shared understanding that Europe's current connectivity ecosystem is fragmented, inconsistent, and difficult to scale. Users—ranging from drivers to fleets and municipalities—face unreliable connectivity, heterogeneous protocols, and slow deployment processes, which undermine safety, efficiency, and user trust. Municipalities struggle with complexity and lack the technical capacity to deploy and manage V2X infrastructure, while OEMs and infrastructure providers face incompatible standards and costly certification procedures. At the same time, major opportunities arise from harmonizing V2X communication, enabling real-time hazard and traffic information, and establishing scalable cross-border mobility services. Participants identified a strong need for standardized RSUs, unified data governance frameworks, shared hazard layers, and interoperable communication protocols. They emphasized that integrated, secure, and trustworthy connectivity is essential for cooperative driving, automated mobility, and next-generation smart city services. The insights gained now provide a strategic foundation for the Use Case Development Phase, particularly in shaping cross-border V2X corridors, standardized deployment toolkits, and EU-level coordination mechanisms that can strengthen European competitiveness and unlock new transnational mobility value chains.

5.4 Platform Economy

The following section presents the thematic focus areas developed during the expert workshop held on 20 October 2025. During this session, two out of the originally defined three thematic pillars were explored in greater depth:

- **User-Centered Mobility Platforms**
- **Data-Driven and Emerging Mobility Solutions**

The decision to concentrate on only two areas was primarily driven by the limited availability of experts on that particular day, as well as a deliberate methodological choice: instead of forming three smaller groups with fewer voices per topic, the facilitators opted for two larger discussion groups. This allowed for richer dialogue, deeper insights, and a more diverse exchange of perspectives within each selected focus area.

Following the workshop, the outcomes from both groups were reviewed and harmonized to ensure consistency and coherence across the thematic inputs. The results presented here reflect this consolidated understanding and serve as a foundation for the subsequent phases of the project.

5.4.1 Focus Area: User-Centered Mobility Platforms

1. VPC Customer Profile

The exercise on *User-Centered Mobility Platforms* aimed to refine the group's understanding of user needs, experiences, and expectations in the context of Europe's fragmented mobility ecosystem. Using the Value Proposition Canvas (VPC), participants mapped out the Jobs-to-be-Done, Pains, and Gains for different user segments such as cross-border commuters, tourists, and residents in smaller cities.

Jobs-to-be-Done focused on everyday mobility needs: planning and booking multimodal journeys, managing tickets and payments digitally, and accessing reliable real-time information while crossing borders. Participants emphasized that users do not think in terms of modes or operators; they simply want to get from A to B smoothly.

Pains were consistently related to complexity and fragmentation. Travelers face multiple apps, disconnected ticketing systems, language barriers, unclear pricing, and low trust in data privacy. These difficulties are particularly acute for commuters and tourists moving between countries, who encounter what participants termed "digital borders" despite physically open transport networks.

Gains centered around simplicity, inclusiveness, and trust. Users desire a single, intuitive mobility interface that works seamlessly across borders and languages; transparent pricing; and reliable information in real time. Accessibility and usability for elderly and disabled users were also prioritized, reflecting Europe's social inclusivity goals.

Through the VPC, the group refined its understanding from a purely functional view ("how to make ticketing interoperable") to a **human-centered perspective** ("how to make mobility across Europe feel effortless and inclusive").

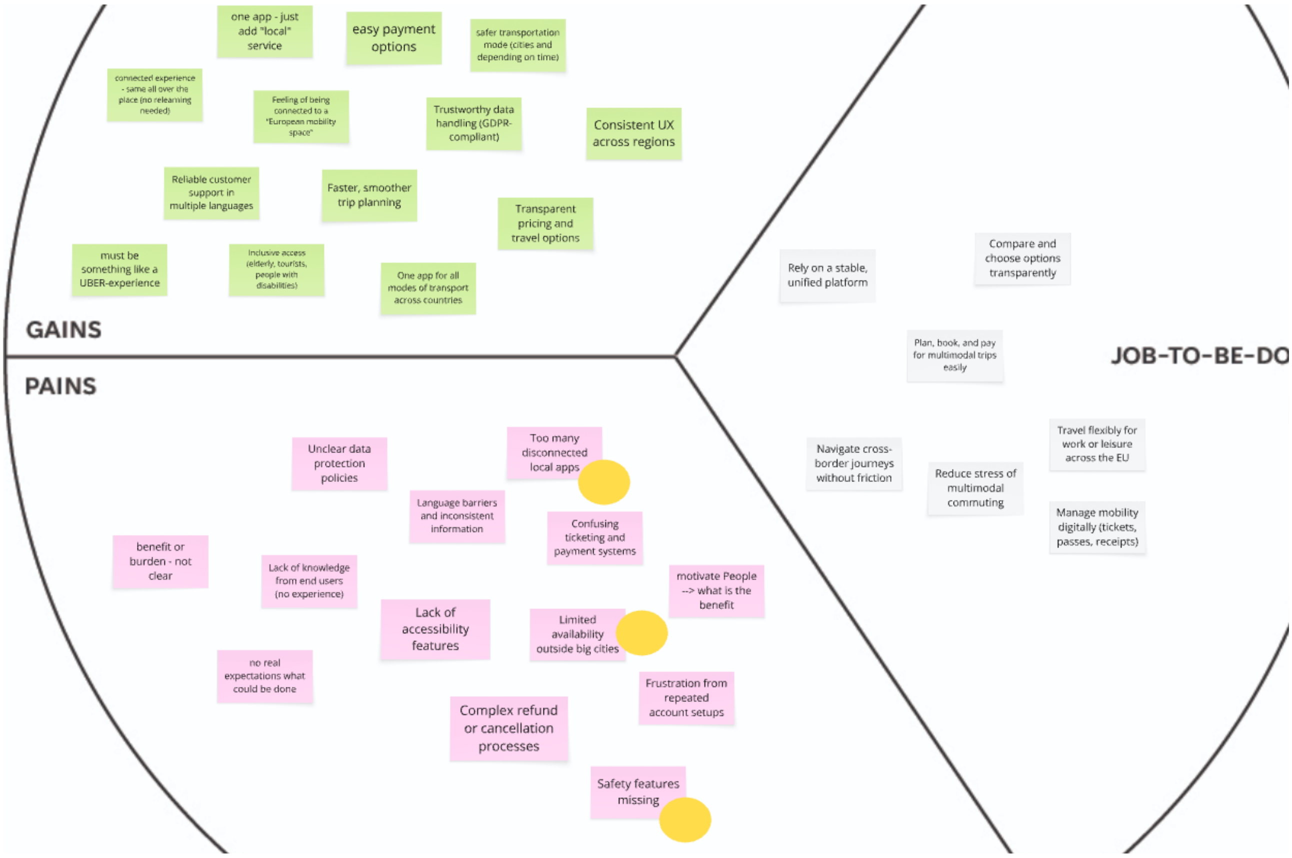


Figure 17: VPC Customer Profile – User-Centered Mobility Platforms

2. Problem Definition

The collaborative discussions led to the formulation of a shared problem statement that captured the user perspective in a clear, actionable way:

Across Europe, people struggle to access safe and reliable digital mobility services because existing platforms are fragmented, unevenly available outside major cities, and lack consistent safety and quality standards for cross-border use.

How might we create a unified, safe, and accessibility and user-centric European mobility experience that works seamlessly across regions and borders — not just in big cities?

This statement unified the group's understanding by combining both user frustration and systemic causes. It established a foundation for transnational ideation, highlighting that the problem is not about developing another app, but about enabling interoperability, accessibility, and trust across all European mobility services.

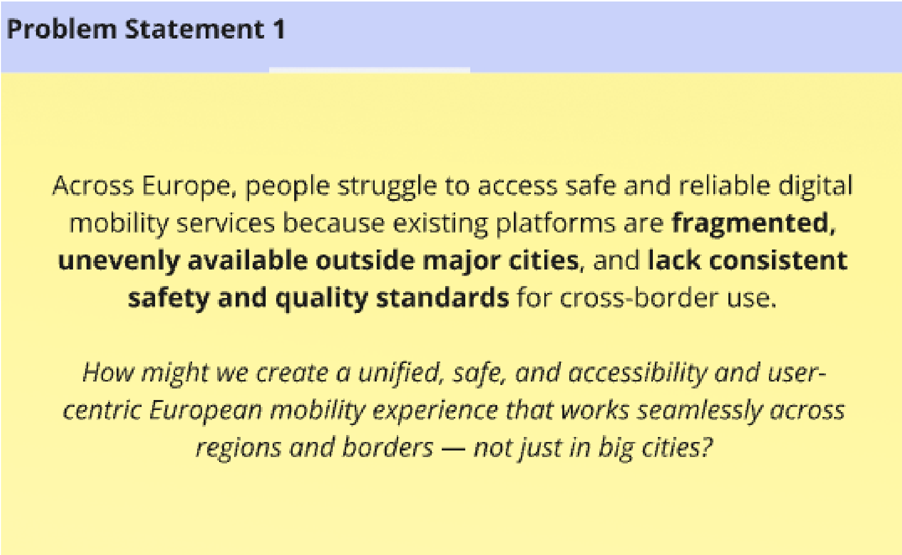


Figure 18: Problem Definition – User-Centered Mobility Platforms

3. Value Proposition

Building on the jointly defined problem, participants identified a series of Pain Relievers, Gain Creators, and Products and Services designed to address user needs and improve the overall experience of cross-border mobility in Europe. The group emphasized that the key to solving user frustrations lies in creating an environment where access to digital mobility services is unified, intuitive, and trustworthy. Among the proposed Pain Relievers were several concrete measures: the introduction of a unified European digital identity for mobility services, allowing users to log in and make payments through a single account; simplified ticketing and payment systems that are compatible across regions and operators; multilingual and inclusive design features to ensure accessibility for all user groups, including those with special needs; and transparent data management following GDPR-compliant standards to strengthen user trust. To enhance the overall travel experience, the group outlined several Gain Creators that would make European mobility more seamless and inclusive. These included multimodal integration—offering users “one journey, one app” across transport modes and borders—real-time cross-border travel information to improve reliability, and unified customer support and feedback mechanisms to provide consistent service quality across countries. Building on these insights, participants envisioned a number of potential Products and Services. These included the creation of an EU Mobility Account serving as a single access point for planning, booking, and paying for mobility across borders; a Cross-Border Ticket Wallet that consolidates multiple operators within one digital interface; and an Accessibility Mode Toolkit to help local and regional apps comply with EU accessibility standards. Together, these elements illustrate a coherent vision for a user-centered, interoperable European mobility ecosystem that reduces complexity, builds trust, and makes digital transport accessible to everyone.

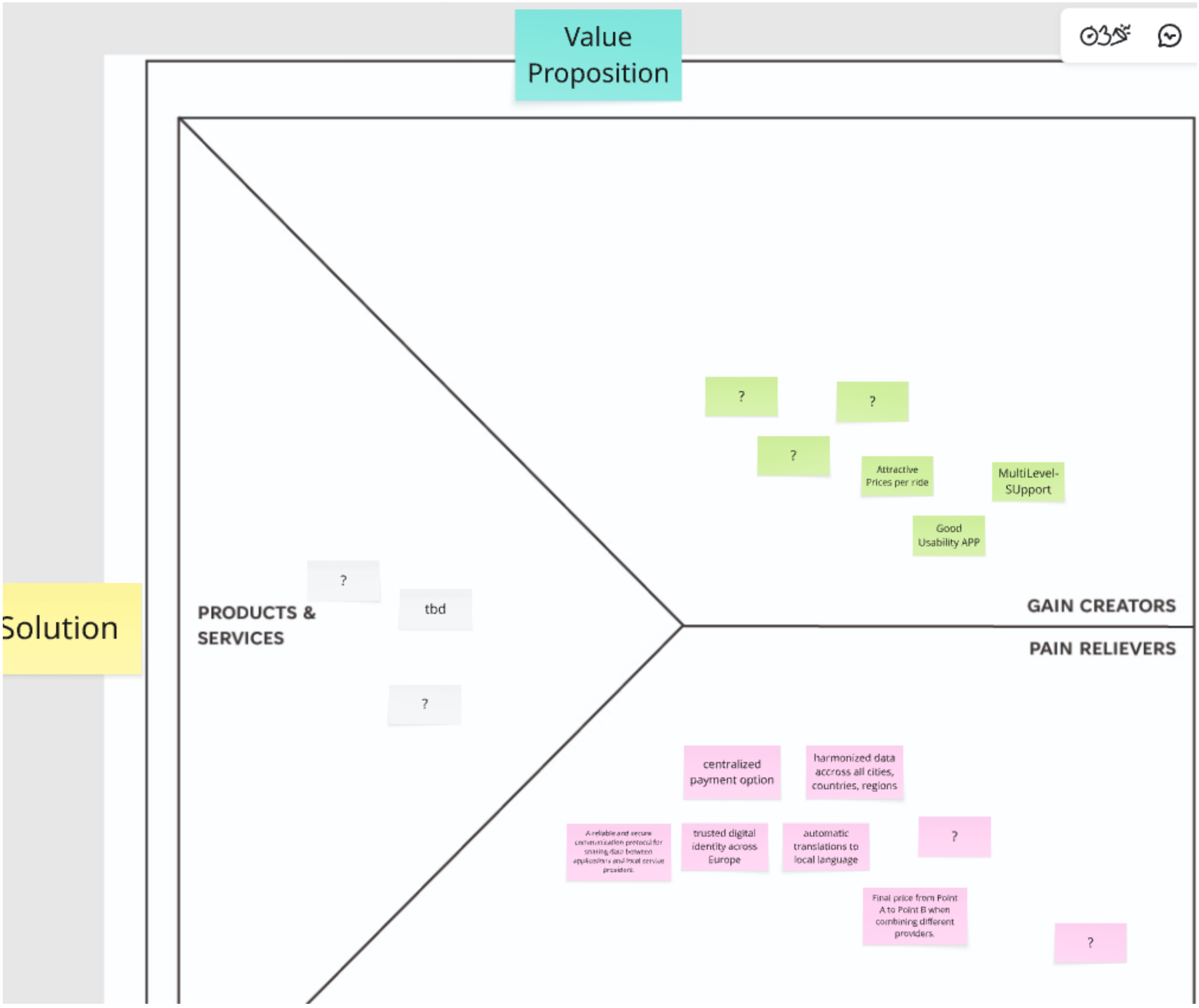


Figure 19: Value Proposition – User-Centered Mobility Platforms

4. Crazy 6 Brainstorming

To explore innovative approaches, participants conducted a Crazy 6 ideation session, generating six ideas in six minutes per person. Each idea addressed one key pain or gain identified earlier. The exercise encouraged fast, intuitive thinking and reduced the barrier to proposing unconventional concepts.

Ideas were then shared in plenary, clustered thematically (e.g. integration, accessibility, trust), and voted on using digital dots in Miro. The most promising ideas selected for deeper exploration included:

- One App for Europe – an interoperable mobility platform combining ticketing, planning, and payment.
- Cross-Border Ticket Wallet – integrating different national systems under one account
- European Accessibility Mode – a shared toolkit for inclusive mobility app design
- Unified Customer Support Hub – cross-border helpdesk to handle issues in multiple languages
- Safe Data & Trust Label – a European quality seal for mobility platforms ensuring transparency

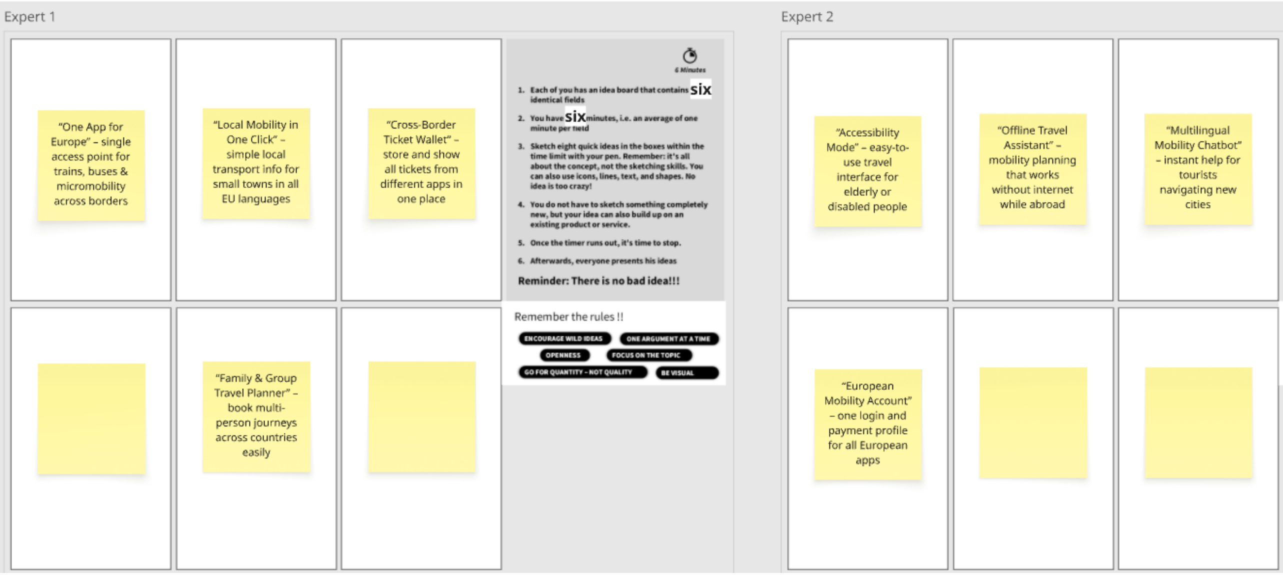


Figure 20: Excerpt from the Idea Generation Process for the Topic "User-Centered Mobility Platforms

Outcome

The Value Proposition Canvas and Crazy 6 exercises together helped articulate a shared European vision for truly user-centered mobility. Through these sessions, participants recognized that the future of digital transport in Europe lies not in replicating isolated national pilots, but in creating transnational, interoperable solutions that reflect the diversity of European users while ensuring a consistent and trusted experience across borders. A strong consensus emerged around the need to build user trust, inclusivity, and transparency into the very foundation of digital mobility platforms. This means designing systems that are simple to use, accessible to all citizens, and governed by clear and ethical data practices. These insights now form the strategic basis for the Use Case Development Phase, where selected concepts—such as the European Mobility Account and the Cross-Border Ticket Wallet—will be further refined and tested. The aim is to demonstrate how improved usability, accessibility, and interoperability can unlock new cross-border business models, strengthen European digital value chains, and ultimately contribute to a more connected, competitive, and citizen-focused mobility ecosystem.

5.4.2 Focus Area: Data-Driven and Emerging Mobility Solutions

1. VPC Customer Profile

The session on *Data-Driven and Emerging Mobility Solutions* focused on understanding how users, operators, and innovators experience the lack of interoperable data and regulatory coherence across Europe. Using the **Value Proposition Canvas**, participants explored the **Jobs-to-be-Done**, **Pains**, and **Gains** from both user and business perspectives.

Jobs-to-be-Done centered around access to real-time, reliable, and integrated mobility information—planning efficient journeys, ensuring service predictability, and benefiting from new AI- or automation-based solutions. For businesses, it included using data to optimize fleets, predict demand, and develop new value-added services.

Pains reflected widespread frustration with inconsistent and inaccessible data. Users struggle with unreliable or conflicting travel information, while SMEs and startups face closed data ecosystems and regulatory uncertainty. The lack of common technical standards and varying GDPR interpretations prevents scaling of successful pilots or cooperation between national systems.

Gains focused on the potential of data to enhance reliability, personalization, and transparency. Participants envisioned interoperable data spaces where public and private actors could safely exchange information, creating better user experiences and new business opportunities.

The VPC helped shift the group's view from isolated pilot thinking to a **systemic data ecosystem approach**—recognizing that shared standards, trust, and governance are prerequisites for European innovation.

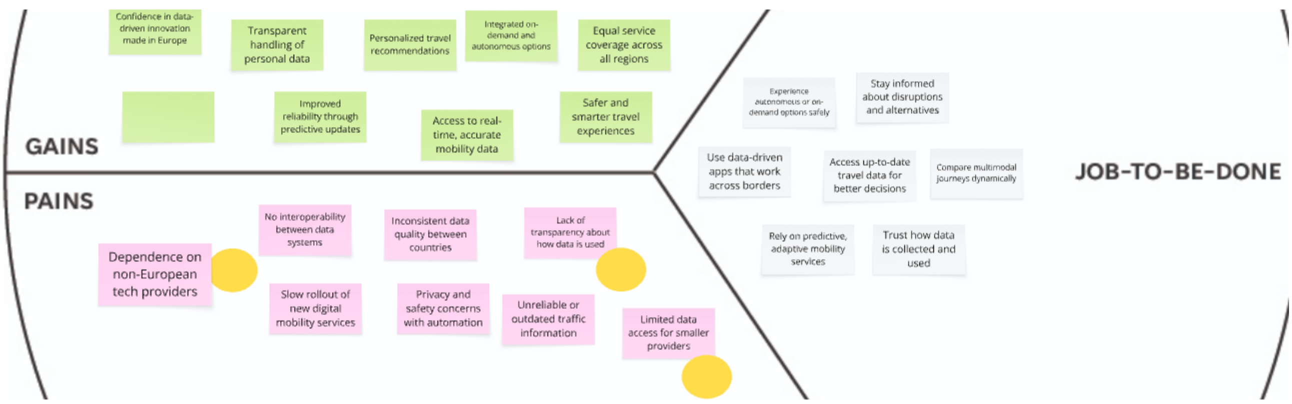


Figure 21: VPC Customer Profile- Data-Driven and Emerging Mobility Solutions

2. Problem Definition

Based on the insights, participants formulated a shared Problem Statement to guide further design work:

Our European mobility users and innovators need a way to access, share, and use reliable data across borders because current systems are fragmented, inconsistent, and governed by unclear or conflicting regulations, which prevent innovation and limit user trust.

This formulation captured both the user frustration and business constraint dimensions of the challenge. It framed the issue as a matter of trust, interoperability, and scalability, providing a unified direction for subsequent idea generation.

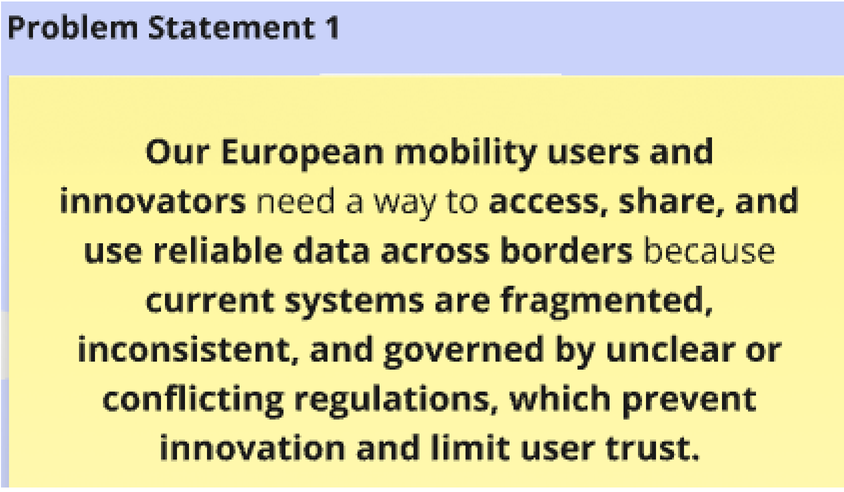


Figure 22: Problem Definition – Data-Driven and Emerging Mobility Solutions

3. Value Proposition

Participants then worked collaboratively to identify how specific Pain Relievers, Gain Creators, and Products and Services could address the needs of users and businesses within a future European data-driven mobility ecosystem. They emphasized that the first step toward overcoming fragmentation lies in establishing common EU-wide data formats and APIs for mobility and vehicle information, supported by clear governance models defining GDPR compliance and cross-border data use. Equally important are secure and transparent mechanisms for sharing sensitive operational data and creating collaborative frameworks that bring together public authorities and private innovators under shared standards. To generate additional user and business value, participants highlighted several key Gain Creators, including the development of trusted European mobility data spaces that enable open innovation while ensuring privacy, the use of AI and real-time analytics to deliver predictive and reliable services, improved access for SMEs to essential mobility datasets to foster fair competition, and cross-sector data integration connecting mobility with logistics and energy systems to create new value chains. Building on these insights, the group proposed concrete Products and Services that could operationalize these ideas: a European Mobility Data Hub for secure cross-border data exchange under common standards; an AI-based Travel Predictor to anticipate delays and optimize passenger journeys; a GDPR-Safe Data Broker model to facilitate anonymized and ethical data transactions; and a Data Trust Label designed to certify transparency and responsible data practices. Together, these elements form a coherent vision of how Europe can transform fragmented data landscapes into an interoperable, trustworthy, and innovation-friendly mobility ecosystem.

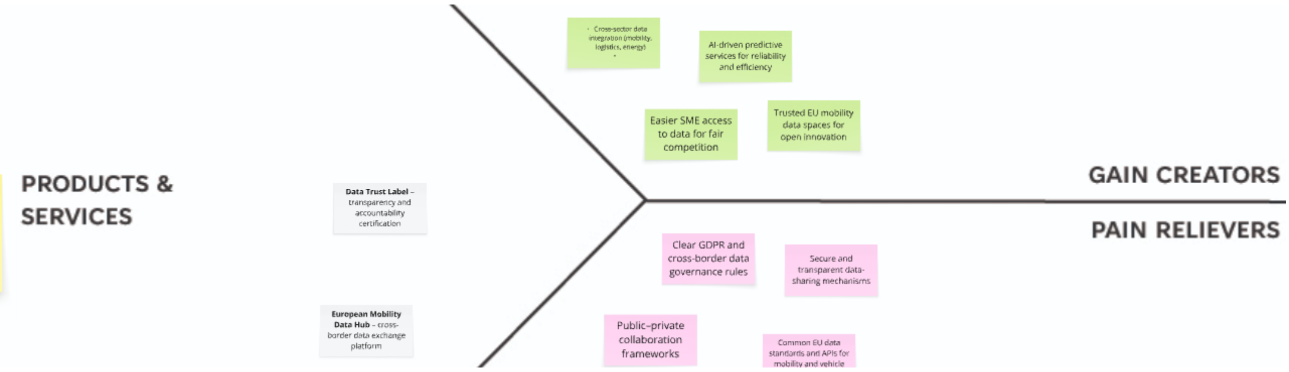


Figure 23: Value Proposition – Data-Driven and Emerging Mobility Solutions

4. Crazy 6 Brainstorming

During the Crazy 6 session, participants generated a broad range of creative concepts within a six-minute idea sprint. Each participant produced six quick ideas, which were then shared and clustered around key themes such as interoperability, trust, automation, and accessibility of innovation.

Ideas were prioritized through voting, leading to the selection of several promising directions:

- **EU Mobility Data Hub** – a federated platform for sharing real-time traffic and mobility data.
- **Data Trust Label** – a certification scheme for transparent and ethical data usage.
- **AI Travel Predictor** – predictive analytics for smarter travel decisions.
- **Regional Data Sandbox** – test environments enabling SMEs to build cross-border data services.
- **Autonomous Shuttle Corridor** – a coordinated European testbed linking cities under shared data rules.

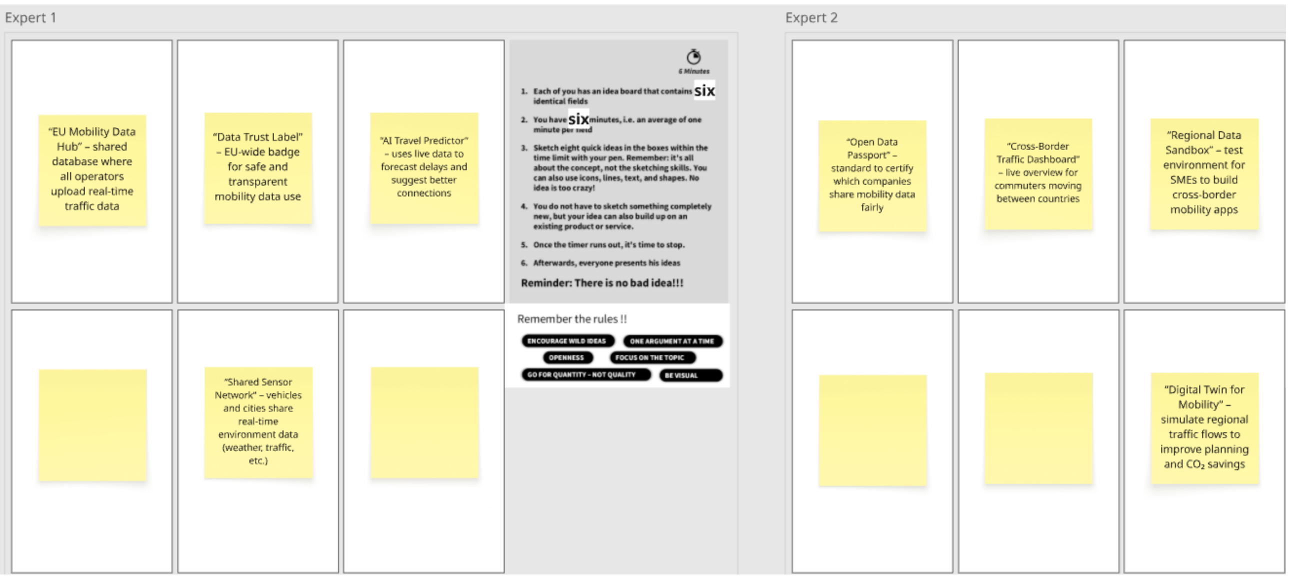


Figure 24: Excerpt from the Idea Generation Process for "Data-Driven and Emerging Mobility Solutions"

Outcome

The workshop concluded with a shared vision of data as a common European asset, emphasizing that mobility data should no longer be treated as a proprietary or purely national resource but as a foundation for collective innovation and competitiveness across Europe. Participants agreed that the ability to share, access, and use mobility data transparently and securely will be critical for developing new services, accelerating digital transformation, and ensuring that Europe maintains global leadership in sustainable, data-driven mobility. Building on this consensus, the group underlined that future use cases must demonstrate the tangible benefits of trustworthy data-sharing frameworks and open technical standards. These frameworks should not only foster innovation but also ensure that fairness, transparency, and privacy remain central to Europe's approach. The outcomes of this session provide clear direction for the upcoming Use Case Development Phase, which will concentrate on four core priorities: first, building interoperable data infrastructures that connect local and national systems across Member States; second, testing AI-based and predictive mobility services in real-world cross-border environments; third, defining governance models that balance innovation incentives with strict data protection and ethical standards; and fourth, demonstrating how European coordination can transform isolated pilot projects into scalable, interconnected ecosystems. In essence, the discussions reaffirmed that Europe's long-term leadership in digital mobility will depend on its capacity to create a connected, trusted, and data-driven ecosystem—one capable of transforming fragmented national initiatives into a cohesive European value network that benefits citizens, businesses, and the wider economy alike.

6. Use Case Evaluation

The following section summarizes the results of the Use Case Evaluation Phase, showing how early, often abstract ideas from previous workshops were developed into more concrete and structured concepts. The focus was to move from broad brainstorming toward a clearer definition of each idea's scope, value, and transnational relevance within the European mobility and automation landscape. The evaluation followed a three-step collaborative process.

First, experts prioritized the most promising ideas through a structured **Voting** round, selecting those with the strongest potential for cross-border value creation and scalability. The group then discussed and validated the top-ranked concepts to ensure a shared understanding. In the second step, the selected ideas were further elaborated by examining by so called **Transnational Use Case Canvas**- considering key conditions: Using six analytical domains—opportunity, technology, regulation, synergies, industry, and SMEs—participants identified relevant European challenges, digital enablers, regulatory considerations, regional complementarities, and SME roles. This ensured each idea was grounded in market needs and policy context. Finally, the refined ideas were translated into preliminary business models using **Business Model Canvas**. By working through all nine dimensions, participants defined core elements such as customer groups, value propositions, partnerships, and revenue structures. This helped sharpen the strategic direction of each use case and provided a consistent structure for comparing results. Overall, the process enabled a smooth transition from early ideation to clear, well-defined use case drafts, creating a common foundation for the next project phase, where feasibility and impact will be assessed in greater depth.

6.1 Electrification

During the Use Case Evaluation workshop, experts reviewed the list of use case ideas generated in the second workshop and ranked them according to their perceived usefulness. The evaluation resulted in the following scores:

- **Use Case Idea 1 - Circular Resource Loop for E-Mobility**
  A transnational system for collecting, recycling, and reusing critical materials from end-of-life electric vehicles to reduce Europe's dependency on imported raw materials. The goal is to build a closed-loop value chain that secures essential resources for battery and component production within Europe.
  Score: 6 points
- **Use Case Idea 2 - Improve User Experience When Charging**
  A tool or app supporting drivers, fleet operators, and mobility providers in navigating Europe's fragmented charging landscape. It aims to harmonize payment systems, apps, APIs, and reliability standards, enabling seamless, trustworthy charging across borders and providers.
  Score: 2 points
- **Use Case Idea 3 - Increase Public Charging Utilization & ROI**
  A system—such as a reservation or access-management solution—to improve usage of charging stations by reducing blocked or misused parking spaces, including at company premises, and addressing issues caused by non-electric vehicles occupying charging spots.
  Score: 1 point
- **Use Case Idea 4 - Lower Operation and Energy Costs**
  An integrated system combining on-site renewable energy, storage solutions, smart grid integration, and bidirectional charging to reduce the operational and energy costs of EV charging networks.
  Score: 2 points

Based on these results, the workshop continued with the three top-rated ideas: **Circular Resource Loop for E-Mobility**, **Improve UX When Charging**, and **Lower Operation and Energy Costs**.

Experts then explored each selected use case across six key framework domains: opportunity, technology enablers, regulatory factors, SME participation, cross-border synergies, and industry focus. This was followed by the development of a high-level Business Model Canvas for each idea, outlining essential elements from customer segments and value propositions to key partnerships, revenue considerations, and cost structures.

6.1.1 Use Case Idea: Circular Resource Loop for E-Mobility

Establish an EU-wide circular system that collects, recycles, and reuses critical materials from end-of-life electric vehicles, creating a resilient European value chain for battery production. The initiative strengthens Europe's strategic autonomy, reduces dependency on imported raw materials, and supports a sustainable and competitive e-mobility industry.

1 Transnational Use Case Canvas

The Circular Resource Loop for E-Mobility aims to build a coordinated European system that captures valuable materials from EV batteries and components at the end of their lifecycle. The opportunity lies in creating a closed-loop value chain that ensures long-term access to strategically important materials, addresses environmental challenges linked to battery waste, and supports Europe's position in the global e-mobility and battery markets. By integrating recycling, material recovery, and industrial reuse into a seamless cross-border system, the initiative directly contributes to EU climate, resource security, and industrial competitiveness goals.

Technology plays a central enabling role. Advanced robotics make battery disassembly safer and more efficient, while AI-supported material identification and sorting technologies improve the precision and economics of recovery processes. Secure data infrastructures — potentially including blockchain — ensure full material traceability across borders and provide trusted documentation for compliance with EU regulations. High-efficiency recycling technologies, such as hydrometallurgical and pyrometallurgical processes, allow Europe to recover critical materials like lithium, cobalt, and nickel at industrial scale, feeding them back into new battery manufacturing.

The regulatory foundation is anchored in the EU Battery Regulation (2023), which mandates recycled content, carbon footprint documentation, and lifecycle traceability. Additional frameworks, such as cross-border waste shipment rules and Extended Producer Responsibility, define how used batteries must be handled and who is accountable for collection and recycling. Harmonized certification standards for secondary raw materials are essential to ensure that recycled outputs can seamlessly enter manufacturing chains across Europe.

Cross-border synergies emerge through shared recycling capacity, coordinated logistics routes for handling end-of-life EVs, and joint research and innovation programs. Member States can pool infrastructure and expertise, reducing duplication and improving efficiency. A common traceability and reporting architecture supports interoperability between national systems and empowers authorities and private operators to collaborate on material tracking and compliance.

The industry perspective spans e-mobility, battery cell manufacturing, recycling industries, specialized logistics, and environmental services. OEMs, recyclers, raw-material processors, and public agencies form an interconnected ecosystem that relies on stable and predictable material flows. By structuring these interactions within a European circular system, the initiative helps secure supply chains and reduce industry exposure to geopolitical risks.

SMEs play a decisive role in enabling and scaling this concept. Many smaller firms specialize in robotics, diagnostics, niche recycling processes, data analytics, and reverse logistics. Their agility and technological specialization make them key suppliers of components, services, and innovations throughout the value chain. The shared European infrastructure lowers entry barriers, allowing SMEs to integrate into high-value industrial networks and contribute to Europe's circular economy transitions.

2 Business Model Canvas

Customer Segments: The Circular Resource Loop for E-Mobility targets a wide range of industrial and institutional actors. Core customer segments include OEMs that require reliable access to recycled materials and support in meeting EU Battery Regulation obligations, as well as battery manufacturers integrating certified secondary raw materials into new production cycles. Recycling companies and material processors depend on predictable material inflows, while logistics operators form an essential customer group through their role in collecting and transporting end-of-life vehicles and battery packs. Secondary segments include environmental authorities, certification bodies, financial institutions investing in sustainable value chains, and digital service providers using the system's traceability infrastructure.

Value Proposition: The system delivers an EU-wide closed-loop mechanism that ensures the efficient recovery, certification, and reintegration of critical battery materials. It reduces dependency on imported raw materials, strengthens industrial resilience, and lowers environmental impact through high-quality and energy-efficient recycling processes. The offering includes guaranteed access to certified secondary materials, full cross-border traceability, regulatory compliance support, and reduced strategic risks for European industries. For public actors, the system advances circular economy goals and reinforces European climate and resource security strategies.

Channels: Value is delivered through coordinated physical and digital channels. Physical channels include cross-border logistics networks and regional recycling hubs that manage incoming end-of-life EV batteries. Digital channels consist of EU-wide material traceability platforms, certification and reporting portals, collaborative industry platforms, and compliance dashboards. Additional channels include industry alliances, public-private innovation partnerships, procurement consortia, and joint research programs connecting companies, authorities, and research institutions across Europe.

Customer Relationships: Customer relationships are built on long-term cooperation due to the strategic importance of material supply and regulatory compliance. Multi-year service and supply agreements form the backbone of relationships between OEMs, recyclers, and battery producers. Public authorities engage through shared reporting systems, joint audits, and harmonized certification processes. Co-creation formats such as innovation clusters, research consortia, and pilot projects encourage continuous improvement, shared learning, and cross-border collaboration throughout the value chain.

Revenue Streams: Revenue is generated through several complementary streams. The most significant contribution comes from the resale of recovered materials such as lithium, cobalt, nickel, and manganese. Recycling service fees tied to Extended Producer Responsibility obligations create stable income, while logistics and collection services generate additional fees. Further revenue may come from licensing digital traceability systems, selling analytics and compliance tools, receiving EU co-funding for infrastructure development, and providing certification, laboratory testing, or environmental compliance services.

Key Resources: The system relies on a combination of physical infrastructure, digital platforms, and specialized expertise. Key resources include advanced recycling plants, automated dismantling lines, and accredited material laboratories. Digital resources such as secure and interoperable traceability platforms, data management systems, and standardized interfaces enable cross-border integration. Skilled personnel—including engineers, material scientists, data analysts, and regulatory specialists—are essential to ensure safe operations, high recovery rates, and compliance.

Key Activities: The main activities cover the entire circular material lifecycle. They include collecting and transporting end-of-life EVs and batteries, automated dismantling, AI-supported material identification and sorting, and applying hydrometallurgical or pyrometallurgical recycling processes. Certification of recovered materials and reintegration into production cycles are key operational tasks. Supporting activities involve regulatory reporting, cross-border coordination, R&D to improve recovery performance, technology upgrades, and continuous improvement of logistics and digital systems.

Key Partners: The initiative depends on an extensive European partnership network. OEMs and battery manufacturers act as key contributors and beneficiaries. Recycling firms, logistics providers, and material processors deliver operational execution. Certification bodies and regulatory authorities ensure quality, safety, and compliance. Research institutions and universities support innovation, while SMEs contribute robotics, diagnostics, software, niche recycling services, and flexible operational capacity. EU agencies and national ministries play a coordinating role, harmonizing frameworks and supporting cross-border alignment.

Cost Structure: The cost structure reflects the system's technological and cross-border complexity. Major cost factors include logistics for collecting and transporting end-of-life batteries, construction and operation of recycling and dismantling facilities, and investments in robotics, AI systems, and advanced recycling technologies. Digital platform development and maintenance for traceability and compliance create additional costs. Other significant expenses come from certification, regulatory reporting, workforce training, safety management, and ongoing R&D to enhance recovery efficiency and sustainability.

6.1.2 Use Case Idea: Improve UX when Charging

The idea aims to create a unified European charging experience by integrating access, payment, pricing transparency, and real-time reliability into one seamless solution. By resolving the fragmentation across charging networks, apps, and providers, the concept improves trust and convenience for EV users and supports cross-border travel without the need for numerous accounts, cards, or apps.

1 Transnational Use Case Canvas

The Improve UX When Charging use case seeks to harmonize Europe's highly fragmented charging landscape by delivering a cross-border application that consolidates access, payment, roaming, and real-time status information into a single, intuitive interface. The opportunity lies in eliminating uncertainty during charging, simplifying interactions for drivers and fleets, and building a more user-friendly, consistent charging experience across all Member States. By solving interoperability issues and reducing the complexity of multi-provider charging, the initiative directly supports the EU ambition to accelerate EV adoption and to strengthen consumer trust in public charging services.

Technology forms the backbone of this concept. API aggregation platforms gather data from heterogeneous Charge Point Operators, while unified payment and roaming interfaces enable billing transparency and seamless access across borders. Real-time reliability analytics provide accurate uptime indicators and status updates, and AI-driven recommendation engines suggest optimal charging points based on route, availability, and pricing. Together, these technologies allow the system to translate a fragmented ecosystem into a coherent user experience.

The regulatory environment provides substantial guidance. The Alternative Fuels Infrastructure Regulation (AFIR) defines minimum service standards, pricing transparency rules, and payment requirements for public chargers. EU-wide roaming and payment harmonization frameworks support interoperability between operators, while national consumer protection laws ensure fairness and transparency. GDPR governs secure and privacy-compliant handling of personal mobility and payment data. Compliance with these frameworks is central to ensuring the solution can operate across borders.

Regional synergies emerge through shared open data standards for charger location, pricing, and availability; multinational roaming agreements among Mobility Service Providers and Charge Point Operators; and coordinated efforts to support international fleet operations. A unified app for multi-country charging enhances cross-border mobility for citizens, goods, and services, and positions Europe as a leader in digital charging experiences.

The initiative spans several industries and value chains, including charging infrastructure operations, e-mobility platforms, digital payments, mapping and navigation services, and consumer mobility applications. Core actors include MSPs, CPOs, fleet operators, app developers, and European digital mobility bodies. The use case especially supports collaboration across digital mobility ecosystems and encourages innovation in user services, pricing models, and operational transparency.

SMEs play a central role as innovation drivers. They can develop the application, build the necessary APIs and data integration layers, and deliver specialized analytics, UX modules, or payment innovations. SMEs can also create value-added services such as smart reservations, loyalty programs, predictive recommendations, or white-label solutions for fleet operators or Charge Point Operators. Their agility and technical specialization make them key contributors to a seamless user experience.

2 Business Model Canvas

Customer Segments: The use case targets private EV drivers, professional fleets, mobility providers, and MSPs seeking a simplified and reliable charging interface. Drivers and prosumers benefit from transparency and ease of access; fleets require streamlined payments, reporting, and interoperability across regions; and mobility providers require integrated user solutions that reduce complexity and enhance customer satisfaction.

Value Proposition: The system offers a seamless, reliable charging experience across Europe by unifying access, payments, pricing transparency, charger availability, and real-time reliability information in a single interface. It reduces app fragmentation, improves trust in charging networks, and enables smooth cross-border travel for consumers and fleets.

Channels: Customers are reached primarily through mobile app stores, integrations into fleet management platforms, partnerships with MSPs and CPOs, automotive OEM in-car systems, and mapping or navigation platforms. Additional channels may include EU digital mobility portals, cross-industry partnerships, and B2B distribution through fleet service providers.

Customer Relationships: Relationships with individual drivers rely on intuitive self-service onboarding, in-app support, and transparent communication about pricing and charger status. Fleet customers are supported through dedicated service agreements, account management, and customizable dashboards for compliance, reporting, and cost control. MSPs and CPOs interact through APIs, technical partnerships, and data-sharing agreements.

Revenue Streams: Revenue is generated through subscription tiers for premium features, transaction fees on charging sessions, B2B integration services for fleets, API access and data services for mobility providers, white-label licensing for MSPs and CPOs, and potential EU support for interoperability functions.

Key Resources: The system relies on reliable API integrations with CPOs and MSPs, a secure payment engine, mapping and routing capabilities, user interface technologies, real-time analytics components, and a robust data infrastructure. Skilled personnel in software engineering, UX design, AI, and compliance are essential resources.

Key Activities: Core activities include aggregating and harmonizing charger data, processing and securing payments, monitoring real-time charger uptime and availability, generating route and recommendation insights, managing data compliance, and continuously improving the user interface. Additional activities include onboarding new partners, maintaining roaming agreements, and ensuring cross-border interoperability.

Key Partners: The ecosystem depends on collaboration with MSPs, CPOs, payment service providers, mapping and navigation platforms, automotive OEMs, fleet management companies, and national or EU-level digital mobility initiatives. SMEs and tech providers contribute specialized modules such as UX components, analytics engines, or payment innovations.

Cost Structure: Major cost components include API hosting and integration, payment processing fees, app development and maintenance, customer support, data infrastructure, cybersecurity, regulatory compliance, and ongoing R&D for AI-based recommendations and predictive insights. Additional costs arise from partnership management and interoperability testing across multiple Member States.

6.1.3 Use Case Idea: Lower Operation and Energy Costs

This idea focuses on reducing the operational and energy costs of EV charging networks by integrating on-site renewable energy, stationary storage, smart grid capabilities, and bidirectional charging. The goal is to create an intelligent, cost-efficient, and resilient charging infrastructure that supports sustainable business models across Europe while contributing to grid stability and energy system efficiency.

1 Transnational Use Case Canvas

The Lower Operation and Energy Costs use case aims to build an intelligent energy system that combines renewable generation, storage, and advanced load management to reduce the operating expenses of EV charging networks across Europe. The opportunity lies in lowering electricity procurement costs, reducing dependency on volatile energy markets, and improving the financial viability of charging infrastructure. By integrating local energy production with dynamic pricing and bidirectional charging capabilities, the initiative helps stabilize the grid, optimize peak loads, and support more sustainable and scalable charging operations across borders.

Technology enables the system's cost reduction potential. On-site solar or small-scale wind combined with stationary storage allows charging hubs to self-generate and store energy, reducing reliance on expensive grid electricity. Smart grid platforms and dynamic pricing systems help operators shift consumption to off-peak periods. Bidirectional charging capabilities (including V2G, V2B, and V2H) unlock the ability to feed energy back to the grid or local buildings, creating new revenue streams. AI-based load management systems forecast demand, balance loads, and ensure optimal charging and discharging behavior. Together, these technologies build a highly efficient and resilient operational model.

The regulatory environment is shaped by the EU Renewable Energy Directive, national incentive schemes for storage and bidirectional charging, and Member State-specific rules governing grid connection and energy feed-in. Energy pricing regulations and market access conditions vary across countries, making harmonization and interoperability essential for cross-border deployments. Aligning the solution with European energy market frameworks is crucial to unlocking economic potential and ensuring compliance.

Regional synergies arise from shared data infrastructures that support demand forecasting, grid management, and load balancing across borders. Joint procurement of storage systems and renewable components can reduce CAPEX and accelerate deployment. Harmonized V2G interoperability standards and common operational frameworks for charging hubs enable more efficient scaling across Member States. Cross-border energy collaboration also allows municipalities and operators to coordinate grid-friendly charging strategies.

The use case touches several industries and value chains, including energy production, renewable infrastructure, smart grid technologies, charging networks, and municipal planning. Key actors include CPOs seeking cost-efficient operations, DSOs responsible for grid stability, energy providers, storage manufacturers, and regulatory bodies. SMEs contribute significantly through installation services, IoT solutions, and energy management software, while municipalities and corporate fleets benefit from cost reductions and improved energy resilience.

SMEs act as essential innovation drivers in this ecosystem. They can install and maintain renewable systems or stationary storage, develop advanced smart energy management tools, and offer V2G integration solutions. Many SMEs provide local energy optimization services, consulting, or tailored digital tools that enhance performance and cost efficiency. Their flexibility and specialized capabilities make them indispensable partners for regional deployment and continuous innovation.

2 Business Model Canvas

Customer Segments: The primary customers include Charge Point Operators seeking lower OPEX, energy providers developing flexible energy services, corporate and municipal fleets requiring predictable and efficient charging costs, and municipalities aiming to stabilize local grid operations. Each segment engages through service contracts, energy-as-a-service models, or performance-based agreements supported by digital monitoring dashboards.

Value Proposition: The system delivers an intelligent energy solution that integrates renewables, storage, and bidirectional charging to significantly reduce operating and energy costs for EV charging networks. It enhances energy independence, improves grid stability, and enables scalable business models centered on cost efficiency and sustainability.

Channels: Customers are reached through energy-as-a-service platforms, OEM and integrator partnerships, renewable and storage installers, digital marketplaces, and municipal procurement channels. Additional channels include fleet management systems and partnerships with energy utilities.

Customer Relationships: Relationships are built around long-term service agreements, performance-based contracts, and continuous optimization supported by remote monitoring dashboards. For public authorities and fleets, partnerships often include co-investment models or shared operational responsibilities. Self-service portals and analytics dashboards provide transparency and performance insights.

Revenue Streams: Revenue is generated through energy savings achieved via optimized consumption, income from grid services enabled by V2G and storage participation in demand response markets, subscription fees for energy management software, and storage-as-a-service models. Additional streams may include renewable energy feed-in payments or shared savings agreements.

Key Resources: The system relies on energy management software, advanced AI algorithms for load forecasting, stationary storage systems, photovoltaic installations, smart grid interfaces, and real-time data infrastructures. Skilled personnel in energy engineering, software development, and grid integration form an essential resource base.

Key Activities: Core activities include load balancing, energy optimization, storage management, dynamic pricing integration, and participation in demand response markets. Additional activities involve integrating renewables, maintaining local generation assets, managing bidirectional charging operations, and ensuring regulatory compliance across borders.

Key Partners: Key partners include DSOs responsible for grid operations, renewable installers providing PV and small-wind systems, storage suppliers and integrators, energy utilities, technology providers for AI and smart grid platforms, and municipalities as local deployment partners. SMEs play a key role in installation, software development, and local service provision.

Cost Structure: The major cost components include CAPEX for installing PV and storage systems, investments in energy management and optimization software, interoperability and integration costs, maintenance of local energy assets, and ongoing costs for data infrastructure, cybersecurity, and technical support. Additional costs arise from regulatory compliance, grid connection fees, and continuous R&D to optimize charging and energy flows.

6.2 Automation

During the Use Case Evaluation, the experts reviewed the list of ideas generated in the earlier Use Case Development workshop and provided the following ranking based on their perceived usefulness:

- **Use Case Idea 1 - Autonomous transportation in tourist regions and for commuters**
  Transporting passengers between hotels, park-and-ride areas, railway stations, tourist destinations, or industrial parks.
  Score: 3 points
- **Use Case Idea 2 - Remote operation of buses**
  Fleet management systems enabling remote parking and maneuvering of conventional buses at depots.
  Score: 3 points
- **Use Case Idea 3 - Autonomous Agricultural Vehicles for Plant Health Monitoring and Intervention**
  Focus on safe operation in harsh environments. Includes adapting pedestrian-recognition systems and developing AI models (neural networks and data acquisition) for infection detection.
  Score: 1 point
- **Use Case Idea 4 - Autonomous buses at airports**
  Transporting passengers between terminals, gates, and aircraft stands.
  Score: 2 points
- **Use Case Idea 5 - Fleet monitoring and supervision (remote control)**
  Leveraging EU expertise from space and aviation sectors to build a strong business model for supervising fleets of automated vehicles.
  Score: 2 points

Based on the ranking results, the workshop proceeded with the two top-rated ideas: Use Case 1 and Use Case 2. Experts then provided input across the six-framework domain opportunity, technology enablers, regulatory factors, SME participation, cross-border synergies, and industry focus. This was followed by a high-level Business Model Canvas, covering elements from customer segments to cost structure. In addition, considering feedback from previous expert meetings, the topic of autonomous vehicles for detecting and removing infected plants and trees (forestry and agriculture) was also further elaborated.

6.2.1 Use Case Idea: Autonomous transportation in tourist regions and for commuters

This use case envisions autonomous transport services connecting key destinations in tourist regions—such as hotels, resorts, beaches, ski areas, or city centers—as well as routes linking park-and-ride hubs or railway stations with industrial parks. Ranked among the top ideas, it aims to reduce congestion, support sustainable mobility in high-demand areas, and offer a convenient mobility option for tourists and commuters, especially in regions struggling with driver shortages or seasonal peaks.

1 Transnational Use Case Canvas

The concept focuses on leveraging autonomous shuttles to connect high-traffic points in tourist regions and commuter corridors across Europe. The opportunity lies in enhancing mobility in areas with significant seasonal fluctuations, improving accessibility in protected or congested zones, and reducing environmental impact by lowering the number of circulating vehicles. Europe's diverse tourism landscape—spanning mountain areas, coastal regions, cultural heritage sites, and national parks—offers numerous environments where autonomous transport can operate as an attractive, low-emission, and high-convenience mobility option. Beyond tourism, the solution also supports commuters from rural areas and enables seamless integration with public transport systems. Additional opportunities include luggage transport for hikers or cyclists, making travel more comfortable and reducing the need for private vehicles.

Technology plays a central role in enabling this use case. IoT communication systems ensure reliable connectivity, while advanced perception and safety technologies maintain secure operation even in challenging environments such as mountain valleys or densely populated tourist zones. Modular vehicle production with 3D-printed components allows tailored vehicles for different tourist settings. Autonomous driving systems rely on robust battery solutions and must be aligned with charging infrastructure. Digital platforms connect services and users, and user-centered software provides real-time availability, booking, payment, and location-based services—enabling a “make-my-stay” experience that combines mobility with local recommendations and contextual information.

The regulatory environment is both a key enabler and a barrier. Safety regulations must be met without compromise, and pilot regions offer initial testing opportunities. However, several Member States still require a safety driver for autonomous vehicle trials, which limits scalability and increases operational cost. The long-term goal is to enable regular autonomous operations in defined zones such as tourism corridors, industrial parks, and low-speed areas. A harmonized regulatory framework is essential to create sustainable business opportunities for OEMs, operators, and technology suppliers across Europe.

SME participation is a critical part of the use case’s scalability and regional relevance. SMEs can integrate autonomous systems into existing infrastructure, conduct local testing, support maintenance services, and operate rental or monitoring solutions. Many SMEs specialize in hardware, perception technologies, digital interfaces, or remote monitoring services that can support safe and efficient operations. Their flexibility and proximity to local markets make them essential actors in deployment and operation.

Cross-border synergies arise naturally in Europe’s interconnected tourism regions. Mountain areas spanning Austria–Italy, Germany–Austria, and Poland–Czech Republic–Slovakia, or coastal regions along Croatia–Slovenia or Slovenia-Italy, offer shared mobility needs and opportunities for joint deployment. A common user interface for tourists reduces fragmentation—ensuring that visitors do not need multiple apps for different regions. Shared funding frameworks, PPP models, and cross-border pilot programs strengthen cooperation. Lessons learned from pre-existing European mobility initiatives (e.g., GIRAVOLTA) can accelerate implementation.

The industry focus spans producers of autonomous systems, public transport providers, technology companies, digital platform operators, and tourism agencies. Local governments play a key enabling role by providing suitable lanes, priority zones, or operational corridors for autonomous shuttles. Bus and mobility technology manufacturers contribute modular and environment-specific vehicle solutions, while digital service providers integrate user interfaces, booking tools, and real-time operational management.

2 Business Model Canvas

Customer Segments: Customer groups include tourists seeking convenient and comfortable mobility during their stay; commuters traveling between stations and industrial parks; local intermediaries such as tourism agencies; public transport companies integrating the service into existing networks; platform providers like Uber or Bolt; and employees in tourism regions who rely on flexible transport options. Municipalities and regional authorities also represent key institutional customers.

Value Proposition: The service offers affordable, safe, and reliable autonomous transportation tailored to tourist and commuter needs. It enables easy booking and payment, seamless luggage transport, and a combination of on-demand and scheduled operations. Wi-Fi and charging options enhance comfort on longer routes, while electric operation reduces pollution in sensitive tourism areas. The service can also enhance the overall travel experience through an integrated “make-my-stay” digital platform offering personalized recommendations, local events, and essential information. For B2B customers, the system provides enabling technologies, fleet solutions, and operational integration.

Channels: Customers are reached through public tenders, tourism demo days, mobility trade fairs, and pilot deployments in tourist regions. Additional channels include digital marketing campaigns, integrations with hospitality platforms, partnerships with public transport operators, and app-based distribution. Demonstrations and live showcases are essential to build trust, highlight safety and convenience, and educate public authorities on how to procure and deploy autonomous systems. Training campaigns also help communities and operators understand vehicle capabilities and limitations.

Customer Relationships: Relationships are maintained via intuitive booking tools, in-app communication channels, and continuous feedback through surveys. Fleet and public transport clients rely on long-term operational partnerships and service agreements. Experts emphasized the need for moving away from isolated company-level initiatives toward coordinated sector-wide efforts, where multiple operators align on standards, interoperability, and shared infrastructure.

Revenue Streams: Revenue can be generated through ticket sales, tourist packages, or general mobility fees included in regional tourist taxes. Pricing models can include per-ride fees (e.g., €2 per ride), daily or weekly passes, or integrated packages combining mobility with local services. Additional revenue may stem from B2B service agreements, fleet solutions for industrial parks, or data-driven services for tourism agencies.

Key Resources: Key resources include autonomous vehicle fleets, perception and safety systems, digital platforms, booking and payment tools, and strong operational frameworks. Technical resources also include testing sites, modular vehicle production capabilities, and robust connectivity infrastructure. A critical resource is an enabling regulatory environment that permits driverless operation, which is essential for a viable business model.

Key Activities: Essential activities include establishing communication standards for vehicle interoperability, conducting awareness campaigns and educational demonstrations, selecting 3–5 test areas for multi-player pilots, and deploying vehicles on public roads without safety drivers. Additional activities include maintenance, remote monitoring, platform development, and supporting regulatory alignment.

Key Partners: Partners include local governments providing dedicated lanes or operational zones, public transport providers integrating or co-operating the service, remote-control operators where legally required, tourism and industry park agencies, investors, local hotels and businesses, and technology suppliers. Collaboration with public and private stakeholders strengthens deployment success and cost efficiency.

Cost Structure: Major cost categories include vehicle production, maintenance, and charging; IT safety and cybersecurity systems; insurance for autonomous operation in defined environments; and the establishment and operation of a vehicle control center. Additional costs arise from software updates, connectivity infrastructure, staff training, and compliance efforts.

6.2.2 Use Case Idea: Remote operation of buses

The concept of remotely operating buses—primarily for maneuvering and parking within depots—was selected by the expert group because it offers immediate, practical innovation in existing fleets while avoiding the complex legal requirements associated with autonomous driving on public roads. The idea enables operators to modernize traditional buses with modular retrofit solutions, deploy automation in private or closed environments, and create efficiency gains without waiting for fully autonomous public-road approvals. As fleet operators in Europe face growing staff shortages, rising operating costs, and spatial constraints in depots, remote operation represents an attractive and scalable first step toward broader automation.

1 Transnational Use Case Canvas

The use case presents a strong opportunity at EU level to mitigate persistent labour shortages in the public transport sector by automating repetitive and time-consuming tasks such as depot parking, washing, charging, or repositioning. Automated or remote-controlled depot operations can significantly reduce operating costs, improve space utilization, and enhance the flexibility of preparing buses for daily service. Furthermore, depots provide safe, controlled environments that can serve as test beds for new technologies and functionalities that will later be used in public-road autonomous vehicles, such as advanced camera systems, predictive monitoring, communication between vehicle and control centers, and remote-intervention tools.

Technology forms a central pillar of this concept. Modular autonomous-driving components—including automated steering, perception sensors, and V2V/V2X communication—can be integrated into existing buses through retrofit kits. Control center solutions enable monitoring, guidance, and remote intervention using stable communication protocols, AI-assisted decision support, and real-time video feeds. Retrofitting technologies modernize traditional vehicles, while access-monitoring and safety systems manage restricted areas where autonomous or remotely operated buses move. The technological ecosystem thus enables a fast and cost-effective transition from manual depot operations to semi-autonomous or fully remote-managed processes.

The regulatory environment for this use case is extensive, as bus systems fall under EU vehicle approval, safety, and cybersecurity legislation. A wide range of regulations applies, including Regulation (EU) 2018/858, Regulation (EU) 2019/2144 on general safety and occupant protection, and multiple implementing and delegated regulations defining technical specifications for type approval, intelligent speed assistance, event data recording, lane-keeping systems, and software updates. Several UNECE regulations—such as UN R157, UN R155, and UN R156—govern automated lane keeping, cybersecurity, and software management. While remote operation in private depot environments may simplify compliance, alignment with national interpretations and the overarching EU regulatory framework remains crucial for safety, liability, and insurance. National regulations derived from EU directives add another layer of requirements for technical conformity and operational authorization.

Cross-border synergies are highly relevant, allowing operators to exchange knowledge, jointly develop pilot projects, and deploy interoperable solutions across different Member States. Experiences from projects such as VAMOS show that shared learning and coordinated testing accelerate technological maturity and reduce duplication. Harmonized solutions can support bus operators in different countries that share similar challenges in depot logistics, maintenance operations, and fleet modernization.

The use case spans several industry segments, including the public transport sector, operators of bus depots, manufacturers of modular autonomous driving systems, certified retrofitting companies, and suppliers of fleet management platforms. This ecosystem combines vehicle technology, software innovation, communication systems, and operational services. Integrating these components creates a comprehensive solution for automating depot operations and enabling remote fleet management.

SMEs act as vital innovation drivers. They are responsible for producing modular retrofit systems, designing control center technologies, developing fleet management platforms, and performing specialized bus retrofitting. Their agility, technical depth, and ability to adapt solutions to local depot environments make them strategic partners in the transition toward remote and automated depot operations.

2 Business Model Canvas

Customer Segments: The primary customer groups include public and private bus operators responsible for depot operations, owners of parking areas or large mobility hubs, and companies with large corporate bus or shuttle fleets that face spatial and efficiency challenges. Municipal transport authorities and integrated mobility operators also form part of the extended customer base.

Value Proposition: The solution offers automated parking, maneuvering, washing, and positioning of buses within depots, reducing labour costs and increasing operational efficiency. It enables simple retrofitting of traditional bus fleets and provides an autonomous fleet management solution that is easy to deploy and compliant with relevant standards. Insurance-ready frameworks ensure safety and reliability. A major value is the ability to integrate buses from different manufacturers into one unified system, creating a flexible and future-proof operational environment.

Channels: Customers are engaged through direct B2B communication, pilot and demonstration projects, industry fairs, technical workshops, and training programs. Feasibility studies and conceptual modelling of depot layouts help operators assess the applicability of the solution. Demonstrations in real depot environments are key to building trust and securing buy-in from operators and public authorities.

Customer Relationships: Relationships rely on long-term service agreements, technical support, and continuous operational collaboration. Operators depend on stable communication with technology providers for updates, maintenance, and system optimization. Training services and onboarding programs support operators as they integrate remote operation into their workflows. Transparency and reliability are central, especially due to safety considerations and the need for coordinated human–technology interaction.

Revenue Streams: Revenues arise through sales of modular hardware and software packages, retrofitting contracts, subscriptions or licensing fees for control center solutions, and service agreements for depot fleet management. Additional revenue is generated through maintenance contracts, monitoring services, and the provision of depot-management-as-a-service solutions that operators can outsource to providers.

Key Resources: Core resources include competencies in remote monitoring and intervention, modular autonomous driving kits for integration into existing buses, robust and high-bandwidth communication infrastructure between buses and the control center, and advanced fleet management software. Human expertise in system integration, safety validation, and real-time operations is also essential.

Key Activities: Key activities include developing and maintaining modular autonomous systems, retrofitting vehicles, installing communication systems, and operating or supporting control centers. Additional activities involve software development, pilot deployment, testing, and ensuring compliance with type-approval and cybersecurity requirements. Operators must also manage training, scenario testing, and continuous improvement based on operational data.

Key Partners: The solution depends on a wide network of partners, including public and private transport operators, depot owners, fleet management system suppliers, providers of modular autonomous vehicle technologies, control center systems vendors, and specialist retrofitting companies. Collaboration with certification bodies, insurers, and regulators is also necessary to ensure safe and compliant operation.

Cost Structure: Major cost categories include investment in modular autonomous driving systems, retrofitting of buses, development and operation of control center technologies, personnel costs for specialized staff, and R&D activities related to automation and remote operation. Additional costs arise from certification processes, insurance, compliance with evolving regulatory frameworks, and marketing and sales efforts undertaken by technology providers.

6.2.3 Use Case Idea: Autonomous Agricultural Vehicles for Plant Health Monitoring and Intervention

During the fourth expert meeting, this thematic field was less represented than in previous sessions. Nevertheless, the project partners emphasized the relevance of expert input and the significant cross-border opportunities in European farming and mountain regions. The idea proposes deploying autonomous vehicles equipped with AI-driven recognition and intervention systems to detect and remove infected plants and trees. It focuses on safe operation in harsh natural environments and adapts advanced perception technologies originally developed for pedestrian recognition. The use case addresses two critical challenges—plant disease management and persistent labor shortages—by enabling precision interventions, improving sustainability outcomes, and reducing reliance on manual field operations.

1 Transnational Use Case Canvas

Opportunity at EU level: European agriculture faces increasing pressure from climate volatility, rising disease risks, labour shortages, and ambitious sustainability requirements under the EU Green Deal and Farm-to-Fork Strategy. Early identification and removal of infected plants can prevent large-scale crop and forest losses while reducing pesticide dependency. Autonomous systems allow interventions in remote or steep terrain where labour is scarce or where manual removal is unsafe. This creates substantial potential for cross-border deployment in mountain regions and border-adjacent farming zones, supporting both climate adaptation and food security objectives.

Cross-border enabling technologies: The use case is technically enabled by several advanced systems. AI-based image recognition and neural networks trained on plant disease datasets allow vehicles to identify infections with high accuracy. Autonomous navigation systems support safe movement in uneven or forested terrain. Sensor fusion—combining visual, thermal, and environmental data—improves detection reliability. IoT connectivity ensures real-time data transmission for fleet monitoring and compliance reporting. Robotic grippers and intervention tools provide precise mechanical removal of infected plants or branches. Together, these technologies enable safe, autonomous operation in demanding agricultural and forestry environments.

Relevant EU regulations and standards: Deployment requires alignment with EU agricultural sustainability frameworks, including pesticide reduction targets and biodiversity strategies. Machinery safety regulations govern autonomous agricultural equipment, ensuring safe operation around workers and in shared environments. Data governance rules—such as those defined under EU agricultural data principles and the general GDPR framework—apply to imagery, mapping data, and operational logs. Cybersecurity and remote update obligations follow UNECE Regulations R155 and R156, ensuring secure and transparent operation of autonomous systems throughout their lifecycle.

Regional (cross-border) synergies: The use case benefits from shared disease-pattern datasets across border regions, enabling AI models to learn from geographically diverse examples. Joint R&D initiatives can accelerate model development and validation for different crops, climates, and terrain types. Interoperability standards allow different autonomous machines and sensors to work across Member States. Cross-border pilot areas—for example Austria-Italy, Germany-Poland, Poland-Czech Republic, or Poland-Slovakia—offer natural laboratories for testing in mountain and farming zones where diseases spread across borders and operational requirements are similar.

Addressed industries and value chains: The use case spans the agricultural and forestry sectors, robotics and automation technology providers, AI system developers, equipment manufacturers, and environmental monitoring companies. It supports a shift toward smart and sustainable farming, linking hardware innovation, data-driven management, and precision intervention technologies into a coherent value chain.

The role of SMEs as innovation drivers: SMEs play a central role in developing specialized AI algorithms, sensor modules, and robotic tools. They can provide retrofitting solutions for existing machinery, enabling farmers to adopt autonomous technology without purchasing entirely new vehicles. SMEs also deliver essential services such as calibration, maintenance, and local support—ensuring that autonomous systems are adapted to regional crops, climate conditions, and terrain. Their agility and proximity to end-users make them critical enablers of innovation diffusion in rural and cross-border regions.

2 Business Model Canvas

Customer Segments: Key customer segments include farmers, forestry companies, agricultural cooperatives, and equipment manufacturers seeking to modernize field operations. Public authorities responsible for sustainability enforcement, disease monitoring, and rural development also benefit from improved data, earlier intervention, and reduced pesticide dependency.

Value Proposition: The solution delivers automated detection and mechanical removal of infected plants and trees, reducing pesticide use and supporting sustainability compliance. It lowers labour dependency and improves operational safety by automating dangerous or hard-to-reach tasks. Real-time disease data enhances traceability and supports early-warning systems. For farmers and forestry operators, the solution increases yield protection while reducing manually intensive interventions.

Key Activities: Core activities include developing AI recognition models tailored to regional disease types, building robotic intervention systems, and deploying autonomous vehicles in pilot environments. Additional activities involve establishing data-sharing platforms for disease tracking, implementing compliance frameworks, and conducting training and awareness programs for farmers and forestry workers to ensure adoption.

Key Resources: Essential resources include autonomous vehicles capable of navigating rough terrain, AI algorithms trained on large agricultural datasets, multispectral sensor systems, robotic gripper and cutting tools, reliable connectivity infrastructure, and satellite or aerial imaging that enriches ground-level detection. Competencies in agricultural engineering, AI development, and robotics integration form an additional core resource base.

Key Partners: Partnerships include agricultural associations, innovation clusters, technology and robotics providers, research institutions, and companies across farming, forestry, and environmental monitoring. Local governments and cross-border authorities support pilot deployments and provide regulatory context. SMEs contribute software, sensor solutions, retrofitting services, and operational expertise.

Revenue Model / Sustainability: Revenue streams arise from the sale or leasing of autonomous intervention vehicles, subscription services for disease monitoring and analytics, cooperative purchasing and shared-service models for rural regions, and EU funding for sustainability and climate-adaptation projects. Additional revenue may come from maintenance contracts, retrofitting services, and platform-based data analytics subscriptions.

Cost Drivers: Major cost drivers include autonomous vehicle development, maintenance, and hardware upgrades; AI model training and continuous sensor calibration; connectivity and data infrastructure; and compliance costs related to cybersecurity, software updates, and agricultural safety regulations. Additional costs arise from field testing, demonstration projects, certification, and operator training.

6.3 Connectivity

During the Use Case Evaluation Workshop on connectivity-related innovation opportunities, experts reviewed the list of use case ideas developed in the previous session. Each idea was briefly discussed with regard to its practical relevance, feasibility, and potential for EU-wide impact. The ranking results were as follows:

- **Use Case Idea 1 – Pre-Certified EU Roadside Unit Module**
  A standardized, pre-certified hardware module enabling faster, harmonized deployment of roadside units (RSUs) across European regions, reducing certification effort and ensuring interoperability.
  Score: 2 points
- **Use Case Idea 2 - Low-Cost V2X Deployment Kit for Municipalities**
  An affordable, easy-to-install V2X starter package for cities and municipalities, enabling local authorities to deploy basic C-ITS services without high upfront investment or complex integration requirements.
  Score: 5 points
- **Use Case Idea 3 - Pan-European Safety Notification Service**
  A unified safety alert service distributing real-time hazard, accident, and road condition notifications across borders using standardized V2X communication protocols.
  Score: 2 points
- **Use Case Idea 4 - Automated V2X Compatibility Checker**
  A software tool that automatically verifies whether vehicles, roadside units, and digital infrastructure components comply with EU V2X communication and C-ITS interoperability standards.
  Score: 4 points
- **Use Case Idea 5 - EU V2X Deployment Playbook**A practical, step-by-step implementation guide for regional authorities and operators, offering best practices, templates, regulatory guidance, and technical specifications for harmonized V2X deployment across the EU.
  Score: 3 points

Based on this ranking, the workshop continued with the three highest-rated ideas: Low-Cost V2X Deployment Kit for Municipalities, Automated V2X Compatibility Checker, and the EU V2X Deployment Playbook. Experts then examined these selected use cases across the six framework domains—opportunity, technology enablers, regulatory factors, SME participation, cross-border synergies, and industry focus. This was followed by a high-level BMC exercise, defining customer segments, value propositions, key activities, partnerships, revenue considerations, and cost structures.

6.3.1 Use Case Idea: Low-Cost V2X Deployment Kit for Municipalities

This use case proposes an affordable, easy-to-deploy V2X starter package designed specifically for small and medium-sized municipalities that lack financial resources, technical expertise, or standardized tools to implement Connected Intelligent Transport Systems (C-ITS). The idea addresses a major structural barrier identified in the workshop: while V2X technology is mature, most municipalities cannot deploy it due to high CAPEX, integration complexity, and missing interoperability guidance. A modular, plug-and-play deployment kit enables cities to launch basic V2X services quickly, support safer mobility, and build a foundation for future expansions.

1 Transnational Use Case Canvas

Opportunity at EU level: Small and mid-sized municipalities across Europe struggle to access C-ITS technologies due to limited budgets, fragmented vendor ecosystems, and complex integration requirements. A low-cost V2X kit empowers them to adopt EU flagship technologies aligned with the ITS Directive, C-ROADS, and road-safety objectives. The solution supports harmonization across Member States, reduces entry barriers, and accelerates the creation of a unified European V2X landscape. It also enables equal access for rural, peripheral, and cross-border regions that currently lag behind major metropolitan areas.

Cross-border enabling technologies: The kit leverages standardized C-ITS communication protocols (ETSI ITS-G5, C-V2X PC5, LTE/5G), modular roadside units, pre-configured cloud backends, and auto-calibrating sensors. Edge computing enables low-latency services, while a unified onboarding interface allows municipalities to install and activate V2X components without expert intervention. Pre-certified hardware and API gateways support seamless integration with traffic-light systems, road-safety databases, public-transport information, and cross-border hubs.

Relevant EU regulations and standards: The kit aligns with the EU ITS Directive revision, C-ITS delegated acts, ETSI EN 302 665 stack, cybersecurity frameworks such as UNECE R155/R156, and national V2X deployment guidelines. Pre-certification reduces the regulatory burden for municipalities and ensures interoperability with cross-border corridors. GDPR-compliant data handling and secure credential management guarantee legal conformity for all digital components.

Regional (cross-border) synergies: The solution enables multi-country pilot regions to harmonize V2X deployments and share operational best practices. Border regions benefit from synchronized warnings (hazard, roadworks, weather) using identical, interoperable hardware. Joint procurement across municipalities greatly reduces costs and accelerates economies of scale. Shared data platforms create consistency between regions such as AT–DE, NL–BE, SK–CZ, or SI–HR.

Addressed industries and value chains: The use case connects roadside hardware suppliers, cloud service providers, telecom operators, traffic system integrators, and municipal mobility departments. It creates a new market segment around low-cost C-ITS integration and supports the emergence of European SMEs specializing in scalable deployment solutions.

The role of SMEs as innovation drivers: SMEs are central to the value proposition. They can develop modular hardware, provide installation services, create cloud dashboards, build integration tools, and deliver ongoing maintenance. Their specialization enables tailored solutions for diverse municipal environments—urban, rural, mountainous, and cross-border. SMEs also support training, procurement consulting, and adaptation to local regulations.

2 Business Model Canvas

Customer Segments: Primary customers include municipalities, regional road authorities, cross-border mobility clusters, public-transport operators, and small road operators responsible for local safety infrastructure. Secondary customers include telecoms, ITS integrators, and research pilots seeking standardized testbeds.

Value Proposition: The kit provides an affordable, pre-certified, plug-and-play V2X solution enabling municipalities to deploy C-ITS quickly and at low cost. It reduces complexity, minimizes need for specialized staff, supports EU interoperability, and creates immediate public-value services such as hazard warnings, signal-phase timing (SPaT), road-work alerts, and vulnerable-road-user protection. Its modular design allows municipalities to scale deployment over time.

Channels: Municipalities are reached through EU ITS associations, C-ROADS networks, national road-safety agencies, regional procurement platforms, mobility fairs, and vendor-neutral demonstration events.

Additional channels include public-private pilot programmes, online procurement toolkits, and direct B2G outreach.

Customer Relationships: The model relies on long-term service relationships (maintenance, updates, cloud operations), training programmes for municipal staff, and pilot-based engagement models. Self-service dashboards support simple setup and configuration, while dedicated support teams help municipalities expand the system over time.

Revenue Streams: Revenues come from hardware sales (RSUs, sensors), subscription-based cloud services, maintenance contracts, software-as-a-service dashboards, optional analytics modules, and consortium-based procurement packages. EU funding streams (CEF, regional grants, digitalisation budgets) can also subsidize deployment.

Key Resources: Key resources include certified RSUs, V2X communication modules, cloud-management platforms, cybersecurity toolkits, technical documentation, and a strong support ecosystem. Human resources include engineers, integrators, support teams, and regulatory experts.

Key Activities: Core activities include producing and configuring RSUs, ensuring interoperability certification, onboarding municipalities, running cloud infrastructure, providing training, and maintaining compliance with evolving EU standards. Pilot deployments and cross-border testing remain essential activities.

Key Partners: Partners include telecom operators, ITS integrators, national road agencies, EU C-ITS coordination groups, regional governments, SMEs providing hardware and software components, and universities conducting testing. Public-private partnerships play a crucial role in scaling.

Cost Structure: Major costs include hardware development, certification, software updates, cloud hosting, cybersecurity compliance, maintenance, on-site installation, and training. Additional costs arise from cross-border testing, logistics, and continuous alignment with EU standards.

6.3.2 Use Case Idea: Automated V2X Compatibility Checker

The Automated V2X Compatibility Checker introduces a tool that verifies whether vehicles, roadside units, and digital infrastructure across Europe comply with EU interoperability standards. During the workshop, experts highlighted a persistent fragmentation problem: cities, OEMs, telecom operators, and infrastructure providers all deploy V2X systems, but compatibility is often unclear, inconsistent, or dependent on vendor-specific documentation. A centralized, automated checker reduces uncertainty, lowers testing costs, and accelerates deployment — especially for cross-border corridors where interoperability is essential. This use case strengthens Europe's ability to scale V2X communication by ensuring that all system components communicate reliably.

1 Transnational Use Case Canvas

Opportunity at EU level: Europe is rapidly expanding C-ITS and V2X deployments, yet interoperability challenges slow down adoption. Municipalities, OEMs, and operators need a clear, standardized tool to confirm that hardware and software meet EU specifications. An automated compatibility checker helps harmonize deployment across Member States, reduces risk for public procurement, and creates trust in V2X investments. Cross-border regions in particular benefit from seamless compatibility, enabling uninterrupted hazard alerts, SPaT services, road-work warnings, and cooperative safety applications along international routes.

Cross-border enabling technologies: The tool relies on automated protocol verification, testing frameworks for ETSI ITS-G5 and C-V2X, cloud-based test suites, and digital certification repositories. It uses AI-driven log analysis to identify deviations from message standards and communication errors. Cybersecurity validation modules check certificate chains and credential handling. API-based integration allows OEMs, suppliers, and cities to upload logs or live data for automated assessment. Compatibility results are generated through a standardized scoring model that quantifies interoperability readiness across borders.

Relevant EU regulations and standards: The tool aligns with the ITS Directive, EU delegated acts on C-ITS, ETSI EN 302 665 and EN 302 637 standards, security credential management frameworks, and UNECE cybersecurity and software update regulations (UNECE R155/R156). It also integrates national certification guidelines where relevant. By referencing these frameworks, the tool acts as a compliance enabler — reducing administrative effort for municipalities and vendors and ensuring adherence to Europe-wide V2X interoperability requirements.

Regional (cross-border) synergies: A compatibility checker supports multinational corridors where vehicles must transition seamlessly from one Member State's infrastructure to another. Cross-border testbeds can use the same tool to benchmark new deployments, share test results, and align technical upgrades. Municipal clusters can jointly evaluate hardware from different suppliers, reducing procurement uncertainty and enabling coordinated deployments across borders such as AT–DE, NL–BE, or HR–SI.

Addressed industries and value chains: The use case connects automotive OEMs, roadside unit suppliers, C-ITS integrators, telecom operators, certification authorities, and cybersecurity providers. It supports the entire V2X value chain — from hardware production to traffic management and smart mobility services. The tool becomes a central element of Europe's digital mobility ecosystem.

The role of SMEs as innovation drivers: SMEs can lead development of testing modules, data analytics engines, cybersecurity checkers, and user-friendly dashboards. They can offer specialized compatibility services, consulting, and integration support. Because SMEs often supply niche V2X components, participation in this ecosystem ensures their products remain certified, competitive, and interoperable across Europe.

2 Business Model Canvas

Customer Segments: Primary customers include municipalities evaluating equipment for procurement; OEMs validating vehicle V2X stacks; roadside unit and sensor manufacturers; telecom operators deploying C-V2X; research centers operating testbeds; and national road agencies responsible for C-ITS certification. Secondary customers include software integrators, cybersecurity firms, and EU-funded pilot consortia.

Value Proposition: The tool delivers fast, automated validation of V2X compatibility with EU and ETSI standards. It reduces testing and certification costs, ensures cross-border interoperability, and increases confidence in deployment decisions. By providing transparent, repeatable test results, it supports procurement, benchmarking, and quality assurance across the mobility ecosystem.

Channels: The solution is distributed through digital platforms, EU mobility portals, ITS associations, national C-ITS competence centers, and direct B2B and B2G partnerships. Pilot programmes, interoperability events, and public demonstrations act as key channels for adoption. API-based integration supports vendor and OEM testing pipelines.

Customer Relationships: Long-term partnerships are built through continuous testing services, annual subscription packages, and recurring certification updates as standards evolve. Automated self-service portals allow customers to upload logs or test datasets. Dedicated customer support assists with interpretation of testing results and integration into procurement processes.

Revenue Streams: Revenue arises from subscription tiers (basic, advanced, premium), one-time compatibility assessments, certification support services, consultancy packages for procurement, and integration toolkits for OEMs. Additional revenue is possible through licensing the underlying test framework or partnering with EU-funded pilot corridors.

Key Resources: Core resources include testing algorithms, compatibility databases, cybersecurity validation modules, cloud infrastructure, and access to real-world V2X datasets. Human resources include V2X engineers, standards experts, data scientists, and cybersecurity specialists.

Key Activities: Primary activities include developing and updating compatibility modules, maintaining certification frameworks, running cloud-based test environments, onboarding customers, analyzing logs, and providing compliance reports. Additional activities include participating in EU interoperability events, updating test suites according to new ETSI releases, and coordinating with road authorities.

Key Partners: Partners include national road authorities, EU V2X coordination bodies, telecom operators, OEMs, roadside unit suppliers, cybersecurity agencies, and SMEs providing specialized testing modules. Universities and research institutions contribute to ongoing development and standardization alignment.

Cost Structure: Major cost drivers include cloud infrastructure, development of testing frameworks, standardization updates, cybersecurity compliance, personnel, customer support, and participation in cross-border testbeds. Additional costs relate to certification audits, documentation, and integration with EU digital infrastructure initiatives.

6.3.3 Use Case Idea: EU V2X Deployment Playbook

The EU V2X Deployment Playbook addresses one of the most persistent challenges identified by experts: municipalities, road operators, and smaller Member States lack clear, actionable guidance on how to implement V2X and C-ITS infrastructure safely, cost-effectively, and in line with evolving EU standards. While major European testbeds and large metropolitan regions have acquired substantial knowledge, this know-how rarely reaches smaller or rural areas. The Playbook aims to close this gap by providing a harmonized, practical implementation guide that covers planning, procurement, installation, testing, operations, cybersecurity, and maintenance. It acts as a blueprint for achieving interoperable, future-proof V2X deployments across Europe.

1 Transnational Use Case Canvas

Opportunity at EU level: Europe urgently needs a common reference model to accelerate V2X deployment. Municipalities and regional authorities often hesitate to invest because they lack clarity on standards, certification, procurement rules, and operational models. The Playbook directly supports the ITS Directive, Europe's Vision Zero safety ambitions, and climate-neutral mobility strategies. By simplifying deployment, it democratizes access to C-ITS technologies and supports coordinated rollouts across Member States. It is especially valuable for cross-border regions, where alignment on architecture, services, and cybersecurity is vital.

Cross-border enabling technologies: The Playbook integrates practical guidance on V2X communication technologies, including ETSI ITS-G5, C-V2X, and hybrid communication architectures. It provides templates for network design, cloud integration, RSU placement, message-set configurations, and test procedures. Cybersecurity best practices, credential management, maintenance workflows, and OTA update strategies are also included. Tools for digital twins, simulation models, and automated deployment checks help operators design and validate solutions before installation. These technologies ensure that deployments can scale across borders while remaining interoperable.

Relevant EU regulations and standards: The Playbook aligns with the ITS Directive revision, C-ITS delegated acts, ETSI standards, EU security credential management frameworks, GDPR, UNECE R155/R156, and national V2X guidelines. It includes model procurement documents, compliance checklists, and reference architectures that satisfy regulatory requirements. By offering step-by-step mapping of these standards into operational processes, the Playbook reduces legal uncertainty and provides a transparent foundation for V2X implementation.

Regional (cross-border) synergies: The Playbook supports joint deployments along European corridors, enabling shared learning across Member States. It encourages multi-country pilot clusters, coordinated procurement frameworks, and standardized operational procedures. Using a common playbook, regions such as DE–NL–BE, AT–DE, or HR–SI can align their deployments, minimize integration costs, and ensure seamless driver experience across borders. Cross-border knowledge transfer also strengthens emerging regions and scales best practices.

Addressed industries and value chains: The use case brings together road authorities, telecom operators, roadside equipment providers, OEMs, cloud service providers, cybersecurity specialists, research institutions, and mobility platform developers. It supports the entire value chain from planning and procurement to installation, testing, and continuous operation. The Playbook thus becomes a strategic backbone for all stakeholders participating in Europe's digital mobility ecosystem.

The role of SMEs as innovation drivers: SMEs contribute templates, integration modules, deployment tooling, consulting services, training programs, and technical documentation. They support local adaptation of the Playbook, ensuring it fits regional regulatory constraints, infrastructure maturity, and mobility patterns. SMEs also benefit significantly, as the Playbook lowers entry barriers and enables them to participate in procurement processes that previously favored large integrators.

2 Business Model Canvas

Customer Segments: The Playbook primarily serves municipalities, regional road authorities, national ITS competence centers, and cross-border mobility clusters. It also targets telecom operators, RSU vendors, integrators, C-ITS testbeds, and transport ministries. Secondary segments include consulting firms, training providers, and EU-funded pilot consortia.

Value Proposition: The Playbook provides a complete, practical, and interoperable roadmap for deploying V2X systems in compliance with EU standards. It reduces uncertainty, accelerates procurement, ensures interoperability, and supports long-term sustainability of digital mobility infrastructure. It empowers less-resourced regions to participate in Europe's mobility transformation and provides confidence through clear processes, checklists, templates, and validated architectures.

Channels: Distribution occurs through EU mobility portals, national ITS organizations, C-ROADS clusters, consortium workshops, road authority forums, training programs, and vendor-neutral demonstration events. Digital channels include downloadable toolkits, online configuration guides, webinars, and interactive models. EU-supported dissemination channels ensure broad adoption.

Customer Relationships: Relationships are built through continuous training, certification programs, helpdesk support, regular updates, and long-term capacity-building partnerships. The Playbook evolves with standards and includes update cycles, allowing authorities to stay aligned with EU regulations. Community-of-practice forums enable municipalities and suppliers to exchange knowledge.

Revenue Streams: Revenue can come from licensing enhanced versions of the Playbook (advanced modules), training and certification courses for municipal staff, consulting services, premium digital tools (e.g., simulators or procurement configurators), and EU funding for large-scale dissemination. Additional revenue arises through partnerships with integrators who use the Playbook as a framework for turnkey deployments.

Key Resources: Key resources include standardized templates, technical guidelines, compliance frameworks, training materials, simulation tools, data models, and cloud-based reference architectures. Human resources include mobility engineers, standards experts, training specialists, and regulatory consultants.

Key Activities: Core activities include developing and updating the Playbook, maintaining compliance with evolving ETSI standards, conducting training and certification, supporting municipalities in pilot deployments, managing digital platforms, and coordinating with European and national standardization bodies. Continuous evaluation and refinement based on real-world pilots are essential.

Key Partners: Partners include national road authorities, EU ITS coordination bodies, telecom operators, OEMs, research institutes, SMEs, and integrators. Alliances with cross-border corridor initiatives, universities, and cybersecurity agencies help maintain the Playbook's technical accuracy and regulatory alignment.

Cost Structure: Major cost components include research, standardization alignment, development of training materials, digital platform maintenance, regulatory updates, community management, and dissemination activities. Additional costs arise from expert consultations, pilot validation, and certification development.

6.4 Platform Economy

In this section, we describe how the use case ideas were reviewed, refined, and prioritized during the expert workshop. The session began with a structured assessment of five preliminary concepts developed in the previous Use Case Development Phase. Each idea was presented and briefly discussed in terms of its relevance, feasibility, and potential to generate cross-border value. The ranking results were as follows:

- **Use Case Idea 1 – European Mobility Data Hub**
  A shared, cross-border data infrastructure enabling unified access, integration, and exchange of mobility data across public and private actors.
  Score: 4 points
- **Use Case Idea 2 – Cross-Border Ticket Wallet**
  A digital wallet that consolidates tickets, payment methods, and mobility services across countries, enabling seamless, multimodal travel throughout Europe.
  Score: 8 points
- **Use Case Idea 3 – Accessibility Mode for All**
  A user-centric accessibility layer integrated into mobility apps and services, offering personalized routing, assistance features, and barrier-free travel information for passengers with special mobility needs.
  Score: 2 points
- **Use Case Idea 4 – AI-Based Travel Predictor**
  A machine-learning-based prediction engine for forecasting travel demand, congestion, and passenger flows across regions and transport modes.
  Score: 0 points
- **Use Case Idea 5 – Cross-Border Autonomous Shuttle Corridor**
  An autonomous transport corridor connecting key mobility hubs across borders, enabling automated shuttles between cities, transport nodes, and regional centers.
  Score: 3 points

Based on this ranking, the workshop proceeded with the three highest-rated concepts: Cross-Border Ticket Wallet, European Mobility Data Hub, and Accessibility Mode for All. During the next step, experts analyzed each selected use case across six framework domains: opportunity, technology enablers, regulatory factors, SME participation, cross-border synergies, and industry focus. This helped identify relevant European challenges, digital enablers, policy considerations, and roles for small and medium-sized enterprises. Finally, the refined ideas were translated into high-level business models using the Business Model Canvas. By working through all nine dimensions — from customer segments and value propositions to partnerships, revenue models, and cost structures — participants clarified the strategic direction and practical relevance of each concept.

6.4.1 Use Case Idea: Cross-Border Ticket Wallet

The Cross-Border Ticket Wallet envisions a unified digital solution that allows travelers to store, manage, and validate all mobility tickets—train, bus, tram, metro, ferry, micro-mobility, and regional passes—across multiple European countries in one secure wallet. The goal is to eliminate the fragmentation of Europe's ticketing landscape by offering a single, user-centric access point for multimodal, cross-border mobility. This initiative not only simplifies travel for tourists, commuters, and business travelers but also opens new cooperation opportunities for public transport operators, private mobility providers, and fintech companies across Europe. It directly supports EU ambitions for seamless multimodal mobility and reduces barriers that currently limit the use of sustainable transport options.

1 Transnational Use Case Canvas

The Cross-Border Ticket Wallet addresses one of the most persistent barriers in European mobility: inconsistent ticketing, payment, and validation systems across cities, regions, and Member States. **The opportunity** lies in enabling seamless multimodal journeys across borders by consolidating all mobility tickets into a single interoperable wallet. This would significantly reduce friction for travelers, increase public transport uptake, and create a more competitive and integrated European mobility ecosystem. The idea supports daily cross-border commuters, multimodal travelers, and tourists who currently struggle with incompatible apps, payment systems, languages, and regulations.

The **technology enablers** for this use case combine several cross-border digital building blocks. These include cloud-based wallet infrastructure, standardized ticketing APIs, QR/NFC validation technologies, secure authentication through European digital identity frameworks, and blockchain components for managing credit balances or verifying ticket integrity—elements explicitly noted by experts during the workshop. AI-based travel support can further enhance the service by offering smart routing, personalized recommendations, or dynamic ticket bundling.

The **regulatory dimension** is central, as the wallet operates across heterogeneous national systems. Relevant elements include EU interoperability guidelines for mobility and ticketing, GDPR compliance for data handling, national transport regulations, digital ticket validation standards, and cross-border consumer rights. Experts also highlighted complexities around taxation and the need for tariff and fare standardization, which require alignment between regional and national transport authorities.

Strong **cross-border synergies** emerge from shared ticketing standards, joint infrastructure for validation and settlement, and pooled technical expertise from multiple Member States. This synergy enables operators to expand into new markets with reduced integration costs and provides a foundation for coordinated European mobility services—an issue repeatedly emphasized in the integration (e.g., cross-border governance challenges and commuter needs) .

Across industries, this use case affects public transport, rail, bus, micro-mobility, payment services, and digital mobility platforms. It creates new links between traditional public operators and emerging digital service providers, reflecting experts' remarks on the role of payment providers, aggregators, and mobility technology vendors (page 34) .

SMEs play a central innovation role. Workshop notes underline the importance of SMEs as wallet developers, interface providers, data analytics specialists, module suppliers, and integration partners. Local development capacity and EU-hosted data solutions also provide SMEs with a competitive advantage by lowering entry barriers and enabling them to serve niche mobility markets that large players often overlook.

2 Business Model Canvas

Customer Segments include public transport operators, rail and bus companies, micro-mobility providers, payment service providers, travel platforms, mobility aggregators, and end users such as commuters, tourists, and business travelers. These groups all struggle with fragmented ticketing ecosystems.

Key Value Propositions revolve around delivering a seamless, unified ticketing experience across borders. This includes enabling multimodal travel with a single wallet, reducing administrative and technical barriers for transport operators, improving customer satisfaction, lowering complexity for travelers, and promoting sustainable public transport use. Importantly, the wallet reduces friction in multi-country journeys and provides trust through secure, interoperable digital identity and standardized validation processes.

Channels include app stores, integrations into existing mobility apps, B2B partnerships with public transport operators, travel platforms, and mobility aggregators, as well as demonstration projects and EU mobility portals. Additional channels include API-based embedding into national ticketing systems or operator-specific apps—mirroring the workshop instructions for cross-sector cooperation.

Customer Relationships are primarily digital and self-service, supplemented by user support through in-app helpdesks and multilingual assistance. For B2B partners, relationships are maintained through long-term integration agreements, technical support packages, onboarding processes, and interoperability compliance services.

Revenue Streams include subscription fees for operators, transaction fees for ticket processing, premium B2B API packages, co-financing via EU funding, service agreements with transport providers, and potential white-label licensing models for national or regional operators.

Key Resources encompass the wallet's cloud infrastructure, API libraries, authentication and encryption technologies, integration toolkits, partnerships with payment service providers, and the expertise of mobility tech developers. Knowledge assets such as tariff models, settlement rules, and data interoperability standards are also critical resources.

Key Activities involve integrating transport operators into the wallet ecosystem, maintaining secure and real-time validation infrastructure, ensuring regulatory compliance, managing settlement processes, and continuously improving the user experience. Activities also include testing in cross-border pilot regions, conducting stakeholder alignment workshops, and expanding the interoperability catalogue.

Key Partners include public transport authorities, local and national transport operators, payment providers, mobility aggregators, standardization bodies, SME tech firms, and EU agencies facilitating cross-border harmonization. These partnerships are required to achieve certification, interoperability, and regulatory alignment.

Cost Structure includes investments in software development, integration frameworks, cybersecurity, compliance, backend infrastructure, user support, partnership management, and marketing. Additional costs arise from maintaining API interoperability, covering settlement and reconciliation processes, and supporting pilots across multiple regions.

6.4.2 Use Case Idea: European Mobility Data Hub

The European Mobility Data Hub proposes a shared, pan-European platform that enables public and private mobility operators to exchange real-time transport, traffic, and usage data under unified EU standards. The idea responds to the fragmented mobility-data landscape across Member States, where operators, regions, and industries work with incompatible systems, separate datasets, and differing data governance rules. A common data infrastructure unlocks new cross-border services, supports seamless multimodal travel, and fosters innovation in logistics, tourism, public transport, and smart cities. By making high-quality mobility data accessible, interoperable, and secure, the initiative strengthens Europe's digital sovereignty and accelerates the transition toward integrated, efficient, and sustainable mobility.

1 Transnational Use Case Canvas

Opportunity at EU level: Europe lacks a unified mobility data ecosystem capable of supporting cross-border integration and large-scale innovation. The opportunity lies in building a single European data layer that connects national and regional systems, closes existing digital gaps, and enables coordinated mobility services across borders. The Hub allows Europe to streamline operations such as traffic management, freight logistics, multimodal travel planning, and tourism services. It supports EU priorities including the ITS Directive, the EU Data Strategy, and the digital single market, offering a foundation for new data-driven mobility value chains.

Cross-border enabling technologies: The platform builds on European data-space concepts such as Gaia-X and utilizes cloud-native architectures, standardized APIs, secure IoT sensor networks, and data pipelines capable of aggregating inputs from diverse regional systems. Edge computing and AI enable predictive analytics for traffic flows, demand forecasting, and real-time event management. Blockchain or distributed ledgers can ensure tamper-proof transactions, provenance, and data integrity. An interoperable architecture provides controlled access for multiple actors — municipalities, transport operators, logistics platforms, and digital service providers — enabling collaborative innovation across borders.

Relevant EU regulations and standards: The Hub aligns with the EU Data Act, the revised ITS Directive, GDPR, the Open Data Directive, and sectoral mobility-data regulations. It incorporates standardized metadata, security credential management, and transparent data-governance frameworks. By providing compliance-by-design tools, the Hub helps operators meet legal requirements for data access, privacy protection, consent management, and cross-border exchange. The regulatory foundation ensures trust, fairness, and legal clarity for all stakeholders.

Regional (cross-border) synergies: The Hub facilitates collaboration between cities, regions, and industries from multiple Member States. Municipalities and transport agencies contribute real-time traffic and public-transport data, while private mobility providers add usage patterns and service statistics. Shared cross-border data layers enable interoperability of travel apps, freight platforms, and safety systems. Regions can participate in joint R&D, reduce duplication of digital investments, and align their mobility strategies. The Hub strengthens transnational corridors and enhances the EU's capacity to deliver integrated mobility services across borders.

Addressed industries and value chains: The initiative touches a wide range of industries, including mobility and public transport, logistics and freight, ICT, infrastructure management, climate and environmental monitoring, and tourism. It supports multiple value chains — from traffic management and fleet operations to MaaS platforms, digital services, and policy intelligence. By providing a unified data foundation, it enables innovation across all these sectors and promotes a competitive European mobility ecosystem.

The role of SMEs as innovation drivers: SMEs are essential contributors to Hub's success. They can build data-analytics tools, visualization solutions, routing engines, simulation models, and user-centric applications on top of the platform. The open API ecosystem lowers entry barriers for SMEs, allowing them to join new European value chains without requiring large IT investments. SMEs benefit from access to high-quality data, interoperable systems, and cross-border markets — enabling them to scale digital services far beyond their local region.

2 Business Model Canvas

Customer Segments: The Mobility Data Hub serves public transport authorities, national and regional mobility agencies, municipal governments, logistics operators, transport service providers, digital mobility platforms, and software developers. Research institutions, start-ups, and SME technology firms also form significant user groups.

Value Proposition: The platform offers unified, high-quality, interoperable mobility data across Europe, enabling seamless integration of multimodal services, enhanced traffic-management capabilities, and innovation in logistics, tourism, and public transport. It ensures compliance with EU standards, supports cross-border interoperability, and provides a fair and transparent governance model. For private actors, it enables new products, optimized operations, and real-time insights.

Channels: Main channels include a digital EU data portal, standardized developer APIs, national mobility-data platforms, EU innovation networks, and collaborative research programmes. Conferences, hackathons, regional pilots, and digital-mobility associations further promote adoption. Public–private partnerships serve as important deployment channels.

Customer Relationships: Relationships are based on open-access principles, tiered data-service models, and long-term ecosystem participation. Public entities may access core datasets for free under open-data rules, while private actors can subscribe to premium services or analytics modules. Ongoing user support, community governance, and co-creation forums ensure continuous engagement.

Revenue Streams: Revenue sources include EU co-funding for platform development, subscription fees for premium analytics or commercial data access, licensing of advanced data-processing tools, public procurement contracts, and collaborations with private operators. Additional streams may emerge from industry-specific data services, integrated MaaS tools, and freight-logistics applications.

Key Resources: Fundamental resources include cloud infrastructure, data-lake architectures, secure APIs, governance frameworks, data-quality mechanisms, and analytics engines. Human resources encompass data engineers, mobility experts, cybersecurity specialists, data-science teams, and governance bodies. The ecosystem also relies on national mobility datasets, IoT sensor feeds, and cooperative data providers.

Key Activities: Core activities include data aggregation, cleaning, and normalization; maintaining cloud and edge infrastructures; ensuring compliance with EU standards; developing APIs; conducting stakeholder onboarding; and operating data-governance processes. Additional activities involve facilitating co-creation events, updating algorithms, and managing cross-border pilot deployments.

Key Partners: Key partners include EU institutions, national ministries, transport authorities, mobility operators, logistics companies, telecom providers, cloud and technology companies, research institutes, and SMEs. Standardization bodies, certification associations, and Gaia-X consortium actors ensure alignment with European technical frameworks.

Cost Structure: The main cost drivers include platform development and maintenance, cloud-computing resources, cybersecurity, governance and legal compliance, data-quality management, standardization processes, stakeholder coordination, and long-term operations. Additional costs include training, documentation, dissemination, and cross-border pilot support.

6.4.3 Use Case Idea: Cross-Border Autonomous Shuttle Corridor

This case proposes an EU pilot corridor connecting two or more neighboring cities with autonomous, electric shuttles operating under harmonized European standards. The initiative demonstrates how automation, electrification, and digital connectivity can jointly enable safe, efficient, and zero-emission mobility services that operate seamlessly across borders. By bridging regulatory, technological, and operational barriers between Member States, the corridor builds a new European value chain around autonomous vehicle technology, digital infrastructure, and integrated mobility services.

1 Transnational Use Case Canvas

Opportunity at EU level: The cross-border shuttle corridor showcases a flagship European approach to connected and automated mobility. It addresses key EU ambitions in climate neutrality, multimodal integration, and cross-border interoperability while offering direct benefits to regional connectivity, tourism, and labour mobility. The opportunity lies in demonstrating highly automated shuttle services that can replace low-frequency bus lines, support first-/last-mile connections, and relieve congested border crossings. The corridor also reduces the need for manual operation in areas facing driver shortages and provides a scalable blueprint for future, pan-European autonomous mobility networks.

Cross-border enabling technologies: The service is enabled by a suite of advanced technologies including autonomous driving systems, V2X communication for cooperative safety, 5G/edge infrastructure for low-latency control, and AI-powered navigation and perception. Cloud-based control centres provide remote supervision and safety fallback, while digital twins and simulation support planning, testing, and optimization. Harmonized interfaces ensure interoperability between shuttles, infrastructure, and cross-border traffic control systems, enabling continuous operation without interruptions at national borders.

Relevant EU regulations and standards: The corridor builds on the EU framework for automated vehicles, including EU type approval rules, coordinated safety validation, and harmonized operational permits for defined autonomous driving zones. UNECE regulations on cybersecurity (R155), software updates (R156), and Automated Lane Keeping Systems (UN R157) provide the regulatory backbone for safe system operation. Local and national authorities cooperate to establish special operational areas, mobility data-sharing protocols, and liability and insurance frameworks for cross-border deployment.

Regional (cross-border) synergies: The corridor is highly suited for regions where cities and economic areas are interconnected across borders — such as AT-DE, BE-NL, SI-HR, or FR-LU. Shared testing environments and joint R&D programmes enable countries to align deployment strategies and technological roadmaps. Cross-border collaboration strengthens Europe's leadership in autonomous mobility and encourages co-investment in digital infrastructure. The corridor becomes a flagship environment for validating EU-wide standards, enabling mobility solutions that function regardless of national boundaries.

Addressed industries and value chains: The initiative unites multiple industries including the automotive and shuttle manufacturing sector, ICT and 5G providers, mobility operators, cybersecurity companies, infrastructure developers, and digital platform providers. It supports a coordinated European value chain extending from vehicle production and sensor technologies to fleet operations, remote supervision, maintenance, and data services.

The role of SMEs as innovation drivers: SMEs contribute essential components such as sensor modules, communication equipment, cyber-security systems, perception tools, and remote operation interfaces. They also provide local deployment services, maintenance, mapping, and fleet operation support. Participation in cross-border pilots offers SMEs visibility and access to procurement markets that are typically dominated by large operators. Their flexibility, specialization, and regional presence make them indispensable actors in ensuring the corridor's technical robustness and scalability.

2 Business Model Canvas

Customer Segments: Key customers include city authorities and regional governments aiming to modernize public transport and strengthen cross-border connectivity. Private transport operators, industrial park managers, and mobility-as-a-service providers represent additional customers seeking innovative, automated shuttle solutions.

Value Proposition: The corridor offers a safe, automated, zero-emission shuttle service that demonstrates European technological leadership. It enables continuous mobility across borders, reduces operational costs, increases service frequency, and enhances user convenience in areas where conventional public transport is limited. The solution integrates automation, electrification, digital connectivity, and real-time data services into a single mobility offering.

Channels: Deployment relies on integration with local mobility platforms, MaaS applications, digital ticketing systems, EU-funded pilot initiatives, public tenders, and awareness campaigns. Demonstration events, cross-border mobility showcases, and industry fairs help build trust among citizens, regulators, and operators.

Customer Relationships: Relationships are structured through public-private partnerships, concession models, long-term operational contracts, and stakeholder alliances. Authorities and operators collaborate through shared governance structures, joint monitoring dashboards, and coordinated safety procedures.

Revenue Streams: Revenue sources include service contracts with municipalities, public funding through EU mobility and digitalization programmes, operational subsidies for pilot phases, data-sharing agreements, and commercial cooperation with tourism regions or industrial parks. Demonstration projects also attract investment in associated digital services and infrastructure.

Key Resources: Core resources include autonomous electric shuttles, 5G and edge infrastructure, V2X communication systems, remote-control centres, cybersecurity frameworks, AI navigation models, and digital mapping tools. Additional resources include skilled personnel for fleet operation, safety validation, and cross-border coordination.

Key Activities: The main activities include operating and maintaining shuttle fleets, ensuring continuous connectivity, optimizing routes through AI analytics, managing remote supervision, coordinating with local and cross-border authorities, and ensuring compliance with EU safety and cybersecurity rules. Pilot testing, system validation, and iterative updates remain critical throughout deployment.

Key Partners: Partners include local and regional governments, OEMs and shuttle manufacturers, telecom and 5G operators, cybersecurity providers, technology research centres, universities, and SMEs specializing in integration, mapping, and maintenance. Public transport operators and cross-border mobility alliances support alignment and adoption.

Cost Structure: The key cost elements involve vehicle deployment, charging infrastructure, digital infrastructure, safety validation, regulatory approvals, insurance, remote-control centre operations, and continuous connectivity and cybersecurity management. Additional costs arise from pilot testing, data management, user engagement, and long-term maintenance of vehicles and infrastructure.

7. Use Case Ideas Refinement

The following section presents the refined Use Case Ideas developed during the D2T expert workshops. Building upon the outcomes of section 6. Use Case Evaluation, this chapter describes each idea in greater depth and with a clearer structure. Whereas the earlier chapter provided a comparative, high-level overview, this section offers detailed, standalone descriptions of the use cases generated through the design thinking process.

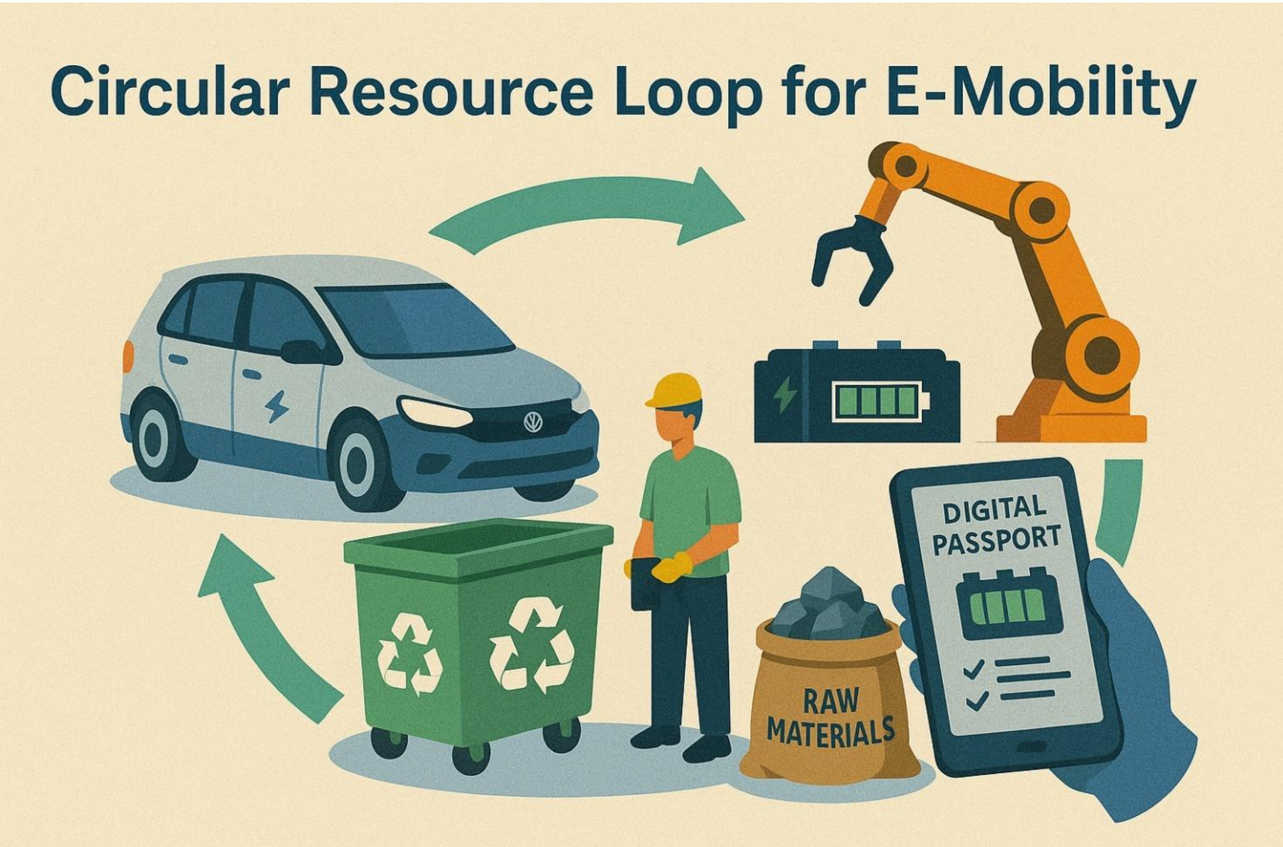
Each idea is documented according to a consistent template, outlining its background, core concept, and transnational relevance. This ensures comparability across all ideas and provides a solid foundation for further development. The descriptions draw directly on the insights gathered during the evaluation phase, where expert groups collaboratively shaped and refined the concepts. Additionally, for each use case a generative AI image was created to visually illustrate the concept in a schematic and intuitive way.

It should be noted that this section does not assess feasibility, implementation potential, or economic viability. Its purpose is solely to capture the ideas in their conceptual form. A more comprehensive evaluation — including analysis of practicality, scalability, and expected impact — will follow in Phase A3.3 as part of preparing selected use cases for potential implementation.

7.1 Use Case Idea 1: Circular Resource Loop for E-Mobility (Electrification)

1. Basic Information

Use Case Name: Circular Resource Loop for E-Mobility



Short Summary: The Circular Resource Loop for E-Mobility proposes an EU-wide circular system to collect, dismantle, recycle, and reuse critical materials from end-of-life EVs. By recovering lithium, cobalt, nickel, and other strategic resources, the initiative strengthens Europe's industrial resilience, reduces dependency on imported raw materials, and supports the competitiveness of the European battery and e-mobility sectors. The system integrates recycling technologies, material traceability, and coordinated logistics to build a closed-loop European value chain.

Main Objective: The main objective is to establish a harmonized European circular value chain that ensures long-term access to critical battery materials and supports compliance with EU sustainability requirements. The initiative aims to connect recycling facilities, logistics systems, OEMs, and material processors in a seamless cross-border framework that improves recovery rates, reduces environmental impact, and enables cost-efficient reuse of materials in new battery manufacturing.

2. Transnational Context

Opportunity: Europe's fast-growing EV market will generate millions of end-of-life batteries within the coming decade. Without a coordinated system, valuable materials risk being lost, exported, or processed inefficiently. The Circular Resource Loop creates a Europe-wide solution to reclaim these materials, making Europe more resilient against geopolitical supply risks and enabling strategic autonomy in battery production. It also supports environmental goals by reducing waste, minimizing mining activities, and enabling circular use of high-value metals.

Technology Dimension: The system integrates advanced technologies such as robotic battery disassembly, AI-supported material identification and sorting, and digital twins for process optimization. High-efficiency recycling methods — including hydrometallurgical and pyrometallurgical technologies — enable industrial-scale recovery of critical materials. A secure, EU-wide data infrastructure, potentially based on blockchain, ensures full traceability of materials throughout their lifecycle and guarantees compliance with regulatory standards. These technologies enable safe handling, high recovery quality, and cost-effective operations across borders.

Regulatory Dimension: The use case is closely aligned with the EU Battery Regulation (2023), which mandates recycled content, product passport traceability, and lifecycle reporting for EV batteries. Cross-border waste shipment regulations and Extended Producer Responsibility (EPR) define obligations for OEMs and recyclers. Harmonized certification standards for secondary raw materials ensure that recycled materials can enter European manufacturing chains without additional national barriers. The initiative provides a structured framework for compliance across different Member States.

Cross-Border Synergies: Cross-border coordination allows Member States to pool recycling capacities, share logistics infrastructure, and jointly invest in high-tech recovery facilities. Harmonized data systems enable seamless tracking of used batteries as they move across borders. Joint R&D programs support technology development and create interoperable standards across Europe. A shared ecosystem also improves efficiency by balancing regional material flows and allowing specialization in processing stages across the EU.

Industry Focus: The initiative spans the e-mobility, battery cell production, recycling, logistics, and environmental services industries. It strengthens the entire European battery value chain — from end-of-life collection and material processing to battery manufacturing and component production. The system provides stable supply streams for OEMs, recyclers, and material processors and reinforces Europe's competitiveness in the global battery market.

SME Participation: SMEs are vital enablers within the ecosystem. Many specialize in robotics, diagnostics, niche recycling processes, digital traceability tools, and reverse-logistics services. Their agility and ability to innovate allow them to fill critical gaps in automation, testing, data analysis, and specialized material recovery. The shared European infrastructure lowers entry barriers and enables SMEs to collaborate with OEMs and major recyclers, integrating into high-value industrial networks across Europe.

3. Concept Description

Detailed Description: The Circular Resource Loop for E-Mobility is a coordinated European platform and operational system that oversees the full lifecycle of EV batteries and components. It orchestrates the collection of end-of-life EVs, automated disassembly, material recovery, certification of secondary materials, and reintegration into battery production. A digital backbone ensures traceability, regulatory compliance, and efficient coordination between logistics operators, recyclers, OEMs, and material processors. The system provides both public-facing reporting (for regulatory oversight) and commercial services (for industry partners), enabling a balanced ecosystem for sustainability and competitiveness.

Transnational Added Value: The cross-border model allows Europe to operate as a unified industrial region rather than a patchwork of national recycling systems. Harmonized standards and shared infrastructure improve material recovery rates, reduce duplication of investments, and enable scaled industrial processes. The initiative also allows Member States to benchmark environmental performance, align policy frameworks, and coordinate long-term infrastructure planning. It provides a basis for EU-wide resource strategies and supports the European Green Deal and Circular Economy Action Plan.

Innovation Aspect:

- **Technological:** Next-generation recycling technologies, automated dismantling, AI-driven sorting, and blockchain-based traceability.
- **Organizational:** Cross-border coordination mechanisms and shared governance models.
- **Economic:** New material-recovery markets, service models for battery lifecycle management, and data-driven circular economy solutions.

Expected Results / Outputs:

- Functional prototypes of shared digital traceability and certification platforms.
- European governance model for battery lifecycle coordination.
- Pilot deployments of cross-border recycling and logistics chains.
- Standardized processes for collection, disassembly, and material reuse.
- Policy recommendations for scaling circular material systems across the EU.

4. Business Model Perspective

Customer Segments: OEMs; battery manufacturers; recycling firms; logistics and dismantling operators; material processors; environmental and regulatory bodies; certification authorities; and digital service providers using lifecycle data for compliance or analytics.

Value Proposition: An EU-wide closed-loop system that delivers secure access to high-quality recycled materials, reduces strategic dependence on third-country imports, ensures full traceability, and supports compliance with EU Battery Regulation requirements. It lowers environmental impacts through efficient recycling and enables cost-competitive, sustainable European battery manufacturing.

Key Activities: Collecting and transporting end-of-life EVs and batteries; automated dismantling; AI-based material analysis; industrial recycling; certification of recovered materials; reintegration into manufacturing; regulatory reporting; R&D; and managing the digital traceability platform.

Key Resources: Recycling and dismantling infrastructure; digital traceability systems; robotics and AI technologies; certified laboratories; logistics networks; material-flow data; regulatory expertise; and skilled engineering and scientific staff.

Key Partners: OEMs; battery manufacturers; recycling companies; logistics operators; certification bodies; national and EU regulators; research institutions; and SMEs providing robotics, data systems, diagnostics, and specialized recovery technologies.

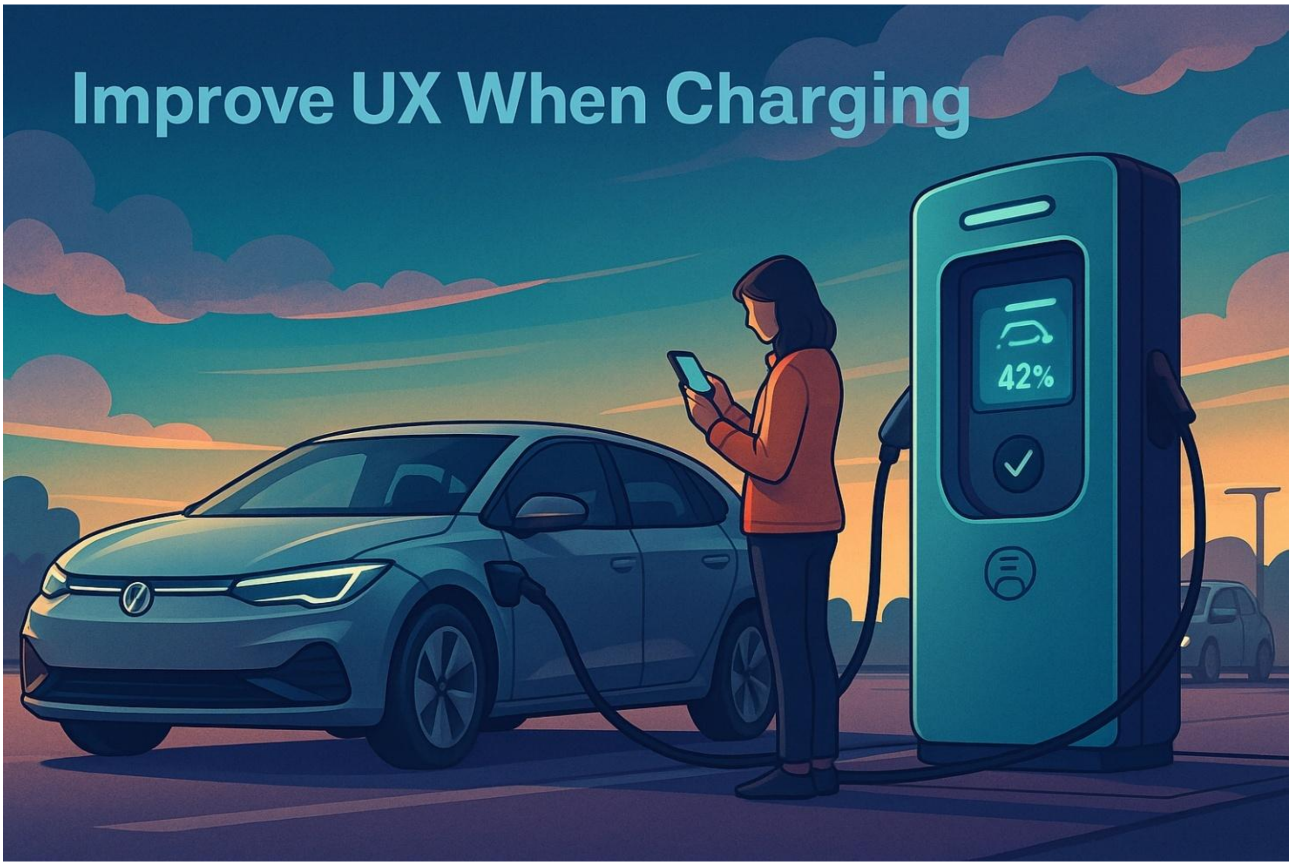
Revenue Model / Sustainability: Revenue streams include resale of recovered materials, recycling service fees under EPR, logistics fees, digital platform licensing, compliance and certification services, analytics tools, and EU co-funding for circular economy infrastructure. Long-term sustainability can be secured through industrial co-investment and cost-sharing across the value chain.

Cost Drivers: Major cost factors include logistics, plant construction and operation, advanced recycling technologies, robotics and AI systems, digital platform development, certification processes, regulatory reporting, safety management, workforce training, and continuous innovation.

7.2 Use Case Idea 2: Improve UX when Charging (Electrification)

1. Basic Information

Use Case Name: Improve User Experience (UX) When Charging



Short Summary: This use case proposes a unified European charging experience by integrating access, payment, pricing transparency, and real-time charger reliability into one seamless digital solution. The concept eliminates the fragmentation that currently forces EV users to rely on multiple apps, cards, and accounts across Europe. By consolidating data and services from different charging networks into a single interface, the initiative strengthens user trust, simplifies cross-border travel, and supports the uptake of electric mobility.

Main Objective: The primary objective is to create a consistent and frictionless charging experience throughout Europe by harmonizing access, payment, and information services across Charge Point Operators (CPOs) and Mobility Service Providers (MSPs). The initiative aims to reduce complexity for drivers and fleets, enhance transparency, and establish a unified digital layer that supports wider EV adoption as part of Europe's clean and connected mobility transition.

2. Transnational Context

Opportunity: Europe's charging ecosystem is fragmented — with multiple apps, cards, pricing models, and validation systems that vary across countries and providers. This creates uncertainty for drivers, especially during cross-border travel or long-distance trips, where payment methods may not work, charger availability is unclear, or roaming fees are unpredictable. Harmonizing the charging experience allows Europe to position itself as a leader in user-centric e-mobility, while supporting climate goals by removing barriers to EV usage.

Technology Dimension: The technology dimension of the use case is built on several complementary digital components that together enable a unified European charging experience. At its core, the system relies on API aggregation platforms that integrate data from different Charge Point Operators into one consistent interface. Standardized roaming and payment mechanisms support seamless billing and service access across borders, while real-time analytics provide accurate information on charger availability, reliability, and operational status. AI-driven routing functions enhance the user experience by recommending optimal charging stops based on factors such as route, pricing, and charger performance. These capabilities are supported by secure authentication and encryption methods that protect user identities, payment data, and all transactions within the system. Collectively, these technologies transform today's highly fragmented charging environment into a coherent, user-friendly digital ecosystem.

Regulatory Dimension: The use case aligns with the Alternative Fuels Infrastructure Regulation (AFIR), which defines minimum service quality, transparent pricing rules, and open access payment requirements. EU roaming and digital mobility interoperability guidelines support cross-network compatibility. GDPR ensures secure handling of personal and payment data. National consumer protection laws and energy market rules also guide pricing transparency and billing fairness.

Cross-Border Synergies: Cross-border interoperability is central to this use case. Shared open data standards for charger status, multinational roaming agreements, and coordinated payment solutions enable uninterrupted travel across Member States. The wallet-style interface supports European fleets operating internationally, tourism mobility, and cross-border logistics. Harmonization strengthens Europe's single market for EV charging services and enables consistent experiences regardless of the country.

Industry Focus: The initiative spans multiple industries: charging infrastructure operators, electric mobility service providers, digital payments, navigation and mapping providers, automotive OEMs, fleet operators, and MaaS platforms. It supports innovation in pricing models, user services, and integration with broader mobility ecosystems such as routing, parking, and smart energy systems.

SME Participation: SMEs play a central innovation role as developers of APIs, UX components, analytics modules, and payment services. They can offer value-added solutions such as loyalty programs, predictive charging insights, smart reservation features, and white-label versions for CPOs or fleets. Their technical agility and specialization are crucial to designing user-friendly interfaces and integrating complex data flows across borders.

3. Concept Description

Detailed Description: The Improve UX When Charging concept envisions a digital platform or application that consolidates Europe's charging infrastructure into a unified interface. Drivers and fleets can access all essential information — charger availability, uptime, pricing, plug type, accessibility, and roaming compatibility — in real time. The system integrates payment and roaming features that allow users to charge anywhere in Europe without switching between providers. Behind the scenes, API aggregation bridges disparate operator systems, ensures transparent settlement, and supports harmonized user experience across borders.

Transnational Added Value: The concept provides a uniform charging experience across Europe, supporting international mobility, tourism, and fleet operations. It addresses key user pain points and helps ensure that EV adoption grows evenly across Member States. A common charging interface also enables EU-wide policy benchmarking, strengthens infrastructure planning, and supports the scalability of public charging networks.

Innovation Aspect:

- **Technological:** Integration of AI, real-time analytics, and pan-European payment systems.
- **Organizational:** New collaboration frameworks between CPOs, MSPs, OEMs, and regulators.

- **Economic:** New service models (e.g., premium routing services, smart reservations) and opportunities for SMEs to deliver specialized digital mobility tools.

Expected Results / Outputs:

- A prototype cross-border charging interface with real-time status updates.
- Harmonized roaming and payment procedures across networks.
- Pilot deployment in selected cross-border regions.
- Documentation on interoperability standards, pricing transparency, and validation rules.
- Governance recommendations for long-term EU-wide rollout.

4. Business Model Perspective

Customer Segments: Electric vehicle drivers and prosumers, fleet operators, CPOs, MSPs, automotive OEMs, mapping platforms, MaaS providers, and cross-border mobility operators.

Value Proposition: A reliable and consistent charging experience across Europe — integrating access, payment, pricing transparency, and real-time insights. It reduces uncertainty, streamlines charging for fleets, eliminates the need for multiple apps or cards, and builds trust in Europe's public charging infrastructure.

Key Activities: Aggregating and harmonizing CPO data; processing secure payments; maintaining uptime and availability monitoring; generating AI-powered route recommendations; managing roaming agreements; ensuring compliance with AFIR and GDPR; onboarding partners; and supporting cross-border pilots.

Key Resources: API hubs, payment engines, routing and mapping technologies, real-time analytics engines, cloud infrastructure, cybersecurity layers, UX design expertise, and mobility-sector partnerships.

Key Partners: CPOs and MSPs, payment service providers, automotive OEMs, navigation platforms, telecom operators, digital mobility bodies, EU agencies, and SMEs building specialized modules.

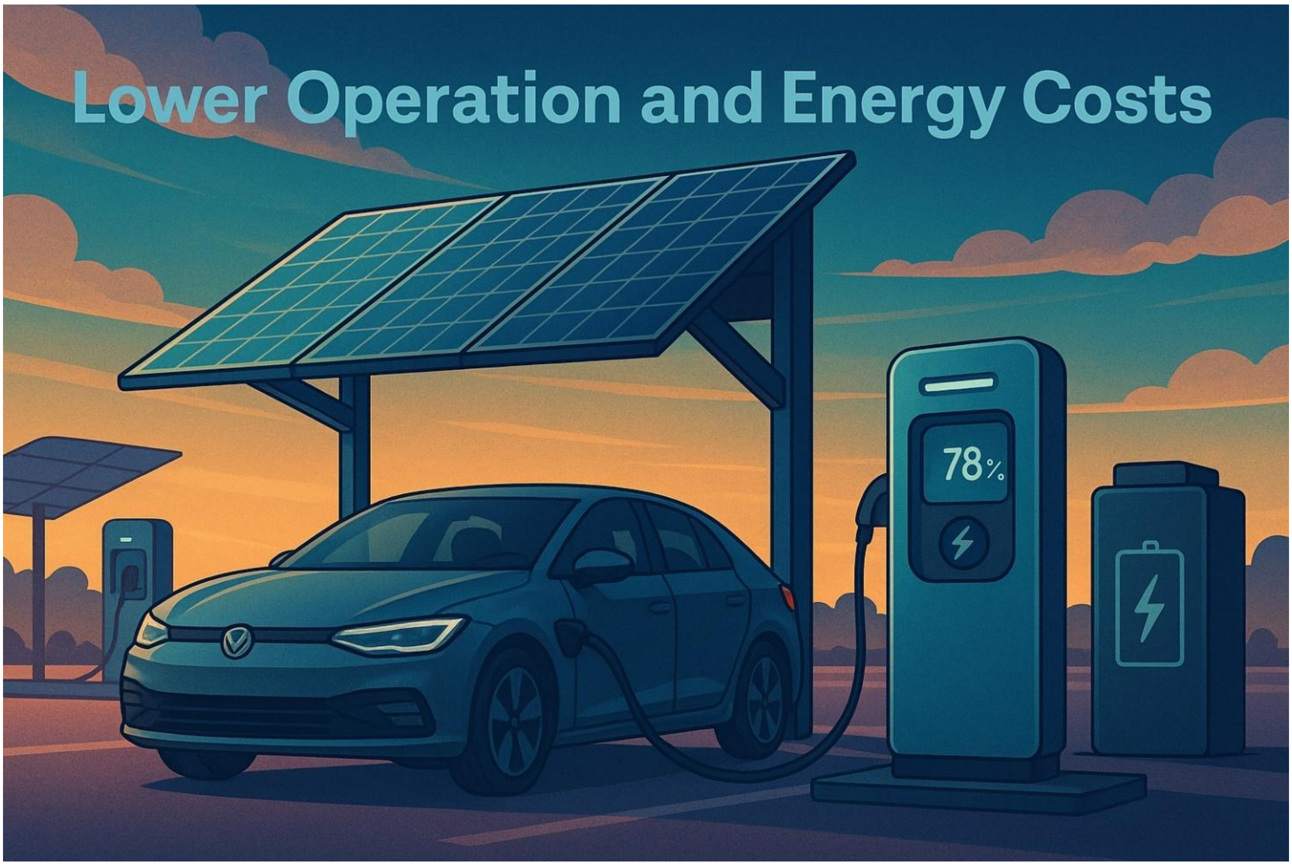
Revenue Model / Sustainability: Revenue streams include subscription fees for premium features, transaction-based charging fees, B2B integration services, white-label platform licensing, data and analytics packages, and EU co-funding for interoperability tools. Long-term sustainability may rely on hybrid financing from operators, fleets, and public mobility programs.

Cost Drivers: Major cost items include API integration, cloud hosting, payment processing fees, app development, cybersecurity measures, data infrastructure, regulatory compliance, customer support, interoperability testing, and ongoing R&D for predictive models and user experience enhancements.

7.3 Use Case Idea 3: Lower Operation and Energy Costs (Electrification)

1. Basic Information

Use Case Name: Lower Operation and Energy Costs for EV Charging Networks



Short Summary: This use case focuses on reducing the operational and energy costs of public and private EV charging networks by integrating on-site renewable energy generation, stationary storage systems, smart grid functions, and bidirectional charging capabilities. The concept creates an intelligent and resilient charging infrastructure that minimizes energy expenditures, supports sustainable business models, and contributes to grid stability across Europe. By combining local renewable production, advanced load management, and dynamic pricing, the initiative strengthens the economic viability of charging operators while advancing EU energy and mobility goals.

Main Objective: The primary objective is to develop a cost-efficient and energy-optimized charging ecosystem that leverages local generation, storage, and grid-interactive technologies to reduce OPEX for charging operators and fleets. The aim is to enhance energy independence, improve grid integration, and support scalable, future-proof charging networks across European regions. The use case also intends to improve overall system resilience and align charging operations with European energy transition policies.

2. Transnational Context

Opportunity: EV charging operators across Europe face rising energy prices, volatile electricity markets, and increasing demand for public charging. Many charging hubs remain dependent on expensive grid energy during peak periods. By integrating renewable energy sources, storage systems, and demand-side flexibility, operators can significantly reduce operational costs and stabilize long-term expenditures. The opportunity lies in building an intelligent, grid-friendly charging ecosystem that strengthens Europe's energy autonomy and supports the rapid expansion of EV infrastructure.

Technology Dimension: The concept relies on several interlinked technologies, including on-site renewable energy systems such as photovoltaic arrays or small-scale wind installations that generate local, low-cost electricity; stationary battery storage units that store excess energy and supply charging hubs during peak pricing periods; smart grid platforms that coordinate local generation, storage, and grid imports based on dynamic electricity tariffs; bidirectional charging technologies (V2G, V2B, and V2H) that allow electric vehicles to feed energy back to the grid or local buildings; and AI-driven load management systems capable of forecasting demand, scheduling charging intelligently, and optimizing charging and discharging cycles. Together, these technologies create a highly efficient, cost-optimized, and resilient operational environment for EV charging infrastructure.

Regulatory Dimension: The use case aligns with the Renewable Energy Directive (RED II and RED III), which supports the integration of local renewable energy and storage into European energy systems. National incentive schemes further encourage investments in renewable generation, stationary storage, and V2G capabilities. Grid connection rules, feed-in tariffs, and energy market participation requirements vary across Member States, making harmonization important for cross-border deployment. Compliance with energy market regulations, cybersecurity requirements, and local permitting processes is essential for implementation.

Cross-Border Synergies: Regional collaboration enables shared data infrastructures for demand forecasting, grid management, and load balancing. Joint procurement of storage systems and renewable components can reduce investment costs and speed up deployment across borders. Harmonized interoperability standards for V2G technologies and coordinated operational frameworks allow charging hubs to scale efficiently across Member States. Cross-border cooperation further supports municipalities and operators in developing grid-friendly charging strategies that reduce stress on local networks.

Industry Focus: This use case brings together the energy sector, charging infrastructure operators, renewable system providers, smart grid technology developers, and local governments. It also involves Distribution System Operators (DSOs), who benefit from improved grid stability. Storage manufacturers, energy service providers, and municipal planning units play a key role. SMEs contribute to IoT integration, installation services, and advanced energy management tools.

SME Participation: SMEs serve as major innovation drivers by installing and maintaining local renewable systems, deploying stationary storage, developing energy optimization software, and integrating V2G solutions. Many SMEs offer specialized consulting and digital tools that tailor energy optimization strategies to local conditions. Their flexibility makes them essential partners for scaling the concept across diverse European regions.

3. Concept Description

Detailed Description: The Lower Operation and Energy Costs use case envisions an intelligent charging ecosystem where EV charging hubs operate with a combination of local renewable energy, storage solutions, smart grid features, and bidirectional charging. Charging sites equipped with solar panels, stationary batteries, and advanced load management systems can produce and store energy locally, thereby reducing reliance on grid electricity. Smart grid integration allows operators to shift charging loads to low-cost hours using dynamic pricing signals. Bidirectional charging lets EVs supply energy back to the grid or local buildings, unlocking new flexibility and revenue options. A real-time energy management system orchestrates generation, storage, grid imports, and EV charging to optimize costs, support grid stability, and increase operational resilience.

Transnational Added Value: The concept provides a scalable framework that can be replicated across Europe, regardless of regional differences in grid capacity or energy markets. It supports cross-border energy planning, harmonization of V2G standards, shared procurement strategies, and coordinated grid-friendly charging policies. A common approach helps operators reduce costs, improves energy security, and strengthens Europe’s position in clean mobility and renewable energy integration.

Innovation Aspect:

- Technological: Combining renewables, storage, smart grid tech, and bidirectional charging into a unified operational model.
- Organizational: New partnership models between CPOs, DSOs, municipalities, and energy providers.
- Economic: New business models based on dynamic pricing, grid services, and energy-as-a-service solutions that significantly reduce operational costs.

Expected Results / Outputs:

- Pilot deployments of renewable-powered charging hubs.
- Standardized operational frameworks for V2G and smart energy systems.
- A prototype AI-enabled energy management platform.
- Recommendations for European-scale deployment and regulatory harmonization.

4. Business Model Perspective

Customer Segments: Charge Point Operators seeking lower operational costs, energy providers offering flexible services, municipal and corporate fleets requiring predictable charging expenses, and municipalities aiming to improve local grid stability. These segments typically engage through performance-based contracts, energy-as-a-service models, or long-term operational agreements supported by digital monitoring.

Value Proposition: The use case offers an intelligent, integrated energy solution that significantly reduces electricity and operating costs for charging infrastructure. It increases energy independence through local renewable production, enhances grid stability through flexibility services, and enables scalable business models based on cost efficiency and sustainability. Operators benefit from lower OPEX, fleets from predictable and optimized energy costs, and municipalities from improved local energy resilience.

Key Activities: Key activities include managing local renewable energy production, maintaining stationary storage, operating AI-based load management tools, integrating dynamic pricing models, participating in demand-response programs, and coordinating bidirectional charging operations. Additional tasks include regulatory compliance, cross-border interoperability management, and optimization of charging behavior.

Key Resources: Essential resources include energy management platforms, AI forecasting algorithms, stationary storage systems, photovoltaic installations, smart grid communication interfaces, real-time data infrastructures, and skilled personnel specializing in energy engineering and grid integration.

Key Partners: Partners include DSOs managing local grid operations, renewable energy installers, storage suppliers, energy utilities, smart grid technology providers, and municipalities facilitating local deployment. SMEs are vital contributors as installers, software developers, and providers of specialized energy optimization tools.

Revenue Model / Sustainability: Revenue is generated through reduced energy costs, earnings from grid services such as demand response enabled via V2G and storage, subscription fees for energy management software, and storage-as-a-service arrangements. Additional income may come from renewable energy feed-in tariffs or shared savings agreements. Long-term sustainability can be ensured through hybrid financing models involving operators, fleets, utilities, and public-sector programs.

Cost Drivers: Major cost drivers include capital expenditure for photovoltaic systems and stationary storage, investments in energy management software and interoperability tools, maintenance of energy assets, data infrastructure and cybersecurity, technical support, regulatory compliance costs, and continuous R&D to improve load forecasting and system optimization.

7.4 Use Case Idea 4: Autonomous Transportation for Tourists and Commuters (Automation)

1. Basic Information

Use Case Name: Autonomous Transportation for Tourists and Commuters

Short Summary: This use case focuses on deploying autonomous shuttles and minibuses to connect key destinations in tourist regions—such as hotels, resorts, beaches, ski areas, and city centres—as well as commuter routes linking park-and-ride facilities or railway stations with industrial and business parks. The services aim to provide safe, affordable, and flexible mobility in areas that face seasonal congestion, driver shortages, or limited public transport options. By offering convenient, electric, automated transport, the concept reduces emissions and congestion while enhancing the overall travel experience for tourists and commuters.

Main Objective: The main objective is to address limited and often inefficient mobility options in tourist regions and rural commuter corridors by introducing scalable, autonomous transport solutions. The use case targets improved accessibility, reduced operational costs, and sustainable transport aligned with EU climate, road safety, and digitalisation goals. It aims to create a replicable model for autonomous shuttle services that can be deployed across diverse European regions and cross-border areas.

2. Transnational Context

Opportunity: Many European tourist destinations and rural regions face recurring mobility challenges: seasonal peaks in visitor numbers, congestion in sensitive areas, a lack of drivers for conventional public transport, and fragmented or infrequent services. Autonomous shuttles can provide reliable and flexible connections between hotels, attractions, mobility hubs, and industrial parks. They can reduce the number of private vehicles entering protected or congested zones, lower pollution in world heritage sites and national parks, and improve access for commuters travelling from rural areas to employment centres. Additional opportunities include luggage transport for hikers and cyclists, helping to make low-carbon travel more attractive and convenient.

Technology Dimension: The use case builds on a combination of autonomous driving technologies, digital platforms, and connectivity solutions that together enable safe and user-friendly operations in complex environments. Autonomous driving systems with advanced perception and safety functions allow shuttles to navigate mountain valleys, dense tourist zones, and low-speed urban streets. IoT-based communication and V2X connectivity ensure that vehicles remain in constant contact with control centres and other infrastructure, enabling remote supervision, fleet coordination, and real-time status monitoring. Modular vehicle production, including the use of 3D-printed components, makes it possible to tailor shuttle designs to local terrain and seasonal needs. Robust battery systems and appropriate charging infrastructure support continuous operation, including in areas with limited existing grid capacity. User-centric digital platforms integrate booking, payment, route information, and luggage services, while "make-my-stay" features provide local recommendations, event information, and context-aware travel support. Together, these technologies turn autonomous shuttles into a coherent, digitally supported mobility service rather than a standalone vehicle product.

Regulatory Dimension: The regulatory framework for this use case includes EU type-approval regulations for automated driving systems, UNECE rules on cybersecurity and software updates, and national laws governing the testing and operation of autonomous vehicles. In many Member States, current rules still require a safety driver for pilots on public roads, which increases cost and limits scalability. Pilot regions can serve as controlled environments to demonstrate safety and collect evidence for more permissive frameworks. A long-term goal is a harmonised regulatory environment that enables regular driverless operation in defined zones such as tourist corridors, industrial parks, and low-speed city areas. Consistent rules on liability, insurance, and operational safety across Member States are essential to developing sustainable business models.

Cross-Border Synergies: Tourist and commuter flows often cross national borders, particularly in mountain and coastal regions such as AT-IT, DE-AT, PL-CZ-SK, HR-SI, or SI-IT. Autonomous shuttle services can provide seamless cross-border connections, especially where public transport or taxi services are limited. A common user interface for tourists and commuters helps avoid "one app per region" fragmentation and supports integrated travel experiences. Cross-border pilot projects, shared funding frameworks, and PPP models can reduce deployment risk and spread best practices. Lessons from existing European mobility initiatives (e.g. prior automated shuttle projects) can be transferred to new regions to shorten learning curves.

Industry Focus: The use case sits at the intersection of several sectors: tourism, public transport, automotive and shuttle manufacturing, ICT and digital platforms, and local and regional government. Public transport providers and local authorities are key enablers, providing access to lanes, stops, and operational zones. Technology companies and OEMs supply autonomous systems, vehicles, and digital backends. Tourism agencies, hotels, and industrial parks help integrate services into local mobility and visitor offerings.

SME Participation: SMEs are crucial for localisation and scaling. They can act as technology providers (e.g. IoT, monitoring, cybersecurity), service operators (maintenance, rental, fleet management), and UX innovators (apps, booking tools, customer interfaces). SMEs can also support local testing, data services, and remote monitoring. Their proximity to regional markets allows them to tailor solutions to specific tourist regions or commuter corridors, making the service more adaptable and context-sensitive.

3. Concept Description

Detailed Description: Autonomous shuttles operate along predefined corridors in tourist regions and commuter routes, providing either scheduled services, on-demand trips, or a mix of both. Typical use cases include hotel-ski area-city centre connections, beach-resort shuttles, or links between train stations and industrial zones. Users access the service through a unified digital platform—often integrated into a "Make

My Stay" app—that handles booking, payment, route selection, and luggage handling. Vehicles are connected to a central control centre that supervises operations, intervenes remotely when needed, and monitors safety and performance KPIs. Pilot projects in mountain, coastal, and heritage regions test how services can function under real conditions and evaluate user acceptance. Over time, the system can be extended with additional routes, more vehicles, and deeper integration into public transport networks.

Transnational Added Value: Because tourism and commuter movements frequently cross borders, a harmonised service design avoids fragmented solutions and supports a consistent travel experience. Shared technical standards, interoperable booking platforms, and coordinated pilot schemes reduce integration costs and enable economies of scale. Cross-border cooperation supports joint marketing of regions as "autonomous-mobility ready" destinations and helps create a recognisable European profile for innovative and sustainable tourism and mobility services.

Innovation Aspect: The use case goes beyond simply replacing a driver with an automated system. It combines autonomous transport with digital tourism and commuter services, creating a more holistic mobility experience. Innovations include integrated luggage transport for hikers and cyclists, contextual "make-my-stay" content in the app, and flexible service configurations that respond to seasonal peaks. From a systems perspective, the solution experiments with shared corridors for multiple operators, common user interfaces, and multi-actor business models that combine public, private, and tourism stakeholders.

Expected Results / Outputs: Expected outputs include operational autonomous shuttle services in selected tourist regions and commuter corridors, interoperable booking and payment platforms, tested and documented pilot projects in different European environments, and cooperation models between public authorities, OEMs, operators, and SMEs. Lessons learned from these pilots provide input for regulatory evolution, standardisation activities, and scaling strategies.

4. Business Model Perspective

Customer Segments: Customer segments include tourists seeking comfortable and convenient mobility during their stay; commuters travelling between stations and industrial or business parks; tourism agencies and hotel clusters that wish to offer attractive mobility services to their guests; public transport companies integrating autonomous shuttles into their networks; platform providers such as Uber or Bolt; and employees in tourism regions who need flexible transport solutions. Municipalities and regional authorities are key institutional customers and enablers.

Value Proposition: For end users, the service offers affordable, safe, and reliable autonomous transportation tailored to tourist and commuter needs. It enables simple booking and payment, "seamless, no-effort" luggage transport, and a mix of on-demand and scheduled options. Comfort features such as Wi-Fi and device charging on board make longer rides more attractive. The use of electric vehicles reduces noise and emissions in sensitive areas, contributing to environmental protection and tourism quality. For B2B and public-sector customers, the system provides enabling technologies, visible innovation, and new levers to manage congestion and accessibility.

Key Activities: Key activities include developing and implementing communication protocols and interoperability standards, selecting and preparing pilot regions, deploying and operating vehicle fleets, and carrying out awareness and demonstration campaigns to build public trust. Establishing remote supervision and control centres is a central operational task, alongside maintenance, data collection, platform development, and support for regulatory alignment and approvals.

Key Resources: Core resources are autonomous vehicle fleets, perception and safety systems, IoT and connectivity infrastructure, the digital booking and payment platform, charging and parking facilities, and regulatory approvals for pilot and regular operations. Additional resources include control centre infrastructure, test sites, and skilled personnel for operations, maintenance, and remote monitoring.

Key Partners: Key partners include local and regional governments, public transport providers, technology and system suppliers, tourism agencies, industry park operators, remote-control service providers (where required by law), investors, hotels, and local businesses. Collaboration with research institutions and innovation projects supports testing and evaluation. Coordinated efforts among multiple operators help avoid fragmented solutions and support sector-wide scaling.

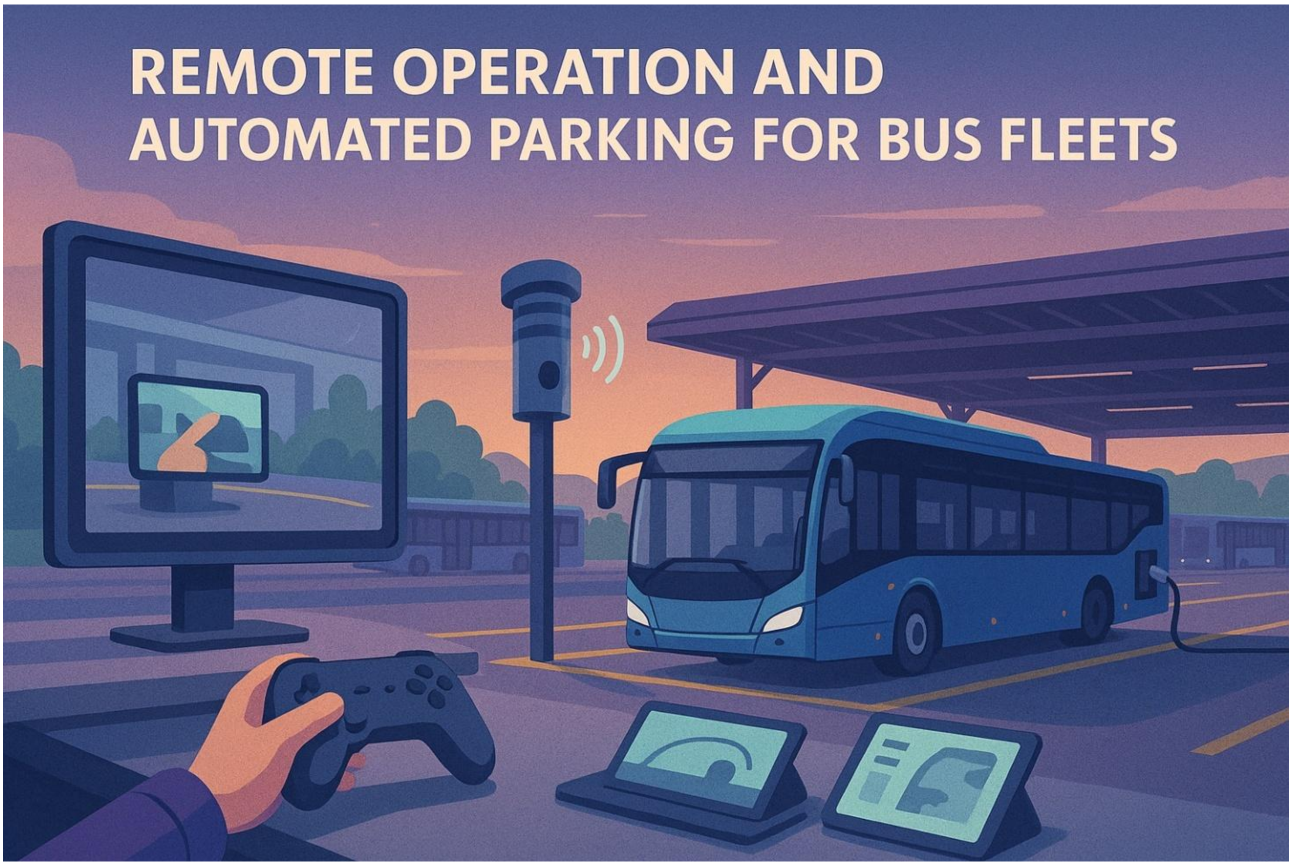
Revenue Model / Sustainability: Revenue streams include ticket sales (per ride or via day/weekly passes), tourism packages that bundle mobility with accommodation or experiences, and integration with regional tourist taxes or mobility fees. Additional revenue can be generated through B2B contracts with industrial parks, service contracts with public transport operators or municipalities, and data-based services for tourism agencies. Public–Private Partnership models and EU funding can support initial investment and long-term scaling, particularly in cross-border regions.

Cost Drivers: Major cost drivers are vehicle production or procurement, fleet maintenance and charging, IT and platform development, cybersecurity and data protection, insurance for autonomous operations, and staffing and operation of control centres. Further costs arise from connectivity infrastructure, software updates, staff training, regulatory compliance, pilot preparation, and ongoing marketing or demonstration activities needed to promote user acceptance and stakeholder engagement.

7.5 Use Case Idea 5: Remote Operation and Automated Parking for Bus Fleets (Automation)

1. Basic Information

Use Case Name: Remote Operation and Automated Parking for Bus Fleets



Short Summary: This use case focuses on implementing remote operation technologies and fleet management systems in existing bus fleets to enable automated maneuvering and parking within depots and other private or closed areas. Rather than targeting full autonomous driving on public roads, it offers an immediate and practical innovation path by retrofitting traditional buses and automating repetitive depot tasks such as parking, washing, charging, and repositioning. The concept reduces operational costs, optimizes limited depot space, and creates safe testbeds for future autonomous functions.

Main Objective: The main objective is to address driver shortages and inefficiencies in depot operations by introducing remote-controlled and semi-autonomous functionalities that can be deployed. The transformation targets cost reduction, improved flexibility in fleet preparation, more efficient use of depot space, and preparation for integrating higher levels of automation in future public-road operations.

2. Transnational Context

Opportunity: Public transport operators across Europe face rising labour costs, staff shortages, and space constraints in depots and logistic hubs. Bus parking, washing, and repositioning are repetitive, time-consuming tasks that often require drivers to perform non-revenue movements. Remote operation and automated parking can significantly streamline these processes, reduce dependency on scarce driving staff, and free up personnel for higher-value activities. Depots are also ideal environments for safe experimentation with advanced automation technologies, as they are controlled, well-instrumented, and shielded from mixed traffic.

Technology Dimension: The use case builds on a modular technological ecosystem that can be integrated into existing buses and depot infrastructure. Retrofittable autonomous-driving components provide automated steering, acceleration, and braking, while perception sensors and cameras enable safe maneuvering in confined depot environments. V2V and V2X communication interfaces connect vehicles with each other and with the depot infrastructure, allowing coordinated movements and collision avoidance. A robust control centre solution forms the operational backbone: it aggregates real-time data, processes video and telemetry streams, and allows trained operators to monitor vehicles and intervene remotely when necessary. AI-based fleet management software supports automated decision-making for parking allocation, routing within the depot, and scheduling of washing or charging processes. Access-control and safety systems ensure that only authorized personnel enter autonomous zones, while cybersecurity and software-update frameworks protect communication links and vehicle functions. Together, these technologies enable a fast and cost-effective transition from fully manual depot operations to semi-automated or remote-managed processes.

Regulatory Dimension: The regulatory context spans EU vehicle type-approval rules, general safety and cybersecurity legislation, and national regulations governing remote-controlled operations. Regulations such as (EU) 2018/858 and (EU) 2019/2144, along with implementing and delegated acts, define requirements for vehicle safety, intelligent speed assistance, lane-keeping, event data recording, and software updates. UNECE Regulations R157, R155, and R156 govern automated lane-keeping functions, cybersecurity management, and software-update processes. Although operations confined to private depot areas may face fewer legal constraints than fully autonomous public-road driving, alignment with national interpretations, insurance requirements, and occupational safety rules remains essential. GDPR obligations apply to operational and monitoring data, especially when video feeds and driver-related information are processed.

Cross-Border Synergies: Cross-border synergies arise from joint pilot projects and knowledge exchange among operators in different Member States. Shared testing environments and coordinated projects—such as those inspired by initiatives like VAMOS—help standardize retrofit architectures, communication protocols, and control-centre concepts. Harmonized approaches enable technology providers to scale solutions for multiple markets and reduce duplication of effort. European-level coordination also supports a gradual path from depot automation to more advanced automation in public-road contexts.

Industry Focus: The use case involves public and private bus operators, depot owners, manufacturers of modular autonomous driving systems, certified retrofitting companies, suppliers of fleet management platforms, and control-centre technology providers. It sits at the intersection of public transport operations, vehicle technology, industrial automation, and ICT services.

SME Participation: SMEs play a key role as producers of modular retrofit systems, developers of fleet management and control-centre solutions, providers of communication and safety systems, and operators of specialized retrofitting services. Their agility and ability to customize solutions to local depot layouts and operational practices make them strategic partners for deploying and scaling remote operation in diverse European contexts.

3. Concept Description

Detailed Description: In this use case, traditional buses are upgraded with modular systems that enable remote steering, automated maneuvering, and parking within depots. When buses return from their routes, drivers can hand over control to a remote operation system or, in some scenarios, need not enter the depot at all. A central control centre, staffed by trained operators, oversees the fleet using secure communication channels and real-time video and sensor feeds. Operators command or approve vehicle movements such as queuing for washing, positioning at charging points, or parking in tight bays. AI-based fleet management software optimizes the sequence of these movements, improving depot throughput and space utilization. The depot thus becomes a semi-automated environment, with clear access controls, geo-fenced paths, and monitoring systems that safeguard both vehicles and staff.

Transnational Added Value: Standardised retrofit kits, control-centre concepts, and communication protocols allow the solution to be rolled out across different countries and operators with limited customization. Shared pilot results and harmonized technical documentation reduce the risk and cost of adoption for new operators. By establishing a common European reference model for remote depot operations, the use case supports coordinated fleet modernization and helps build an automation-ready public transport sector.

Innovation Aspect: The use case is innovative in that it introduces meaningful automation in a realistic, near-term setting without requiring fully autonomous driving on public roads. It creates a bridge between conventional bus operations and future, higher-level automation by using modular retrofitting and control-centre-based remote operation. The depot becomes a real-world laboratory for validating advanced sensor systems, communication architectures, remote intervention strategies, and human-machine interfaces that will later be essential for autonomous buses in mixed traffic.

Expected Results / Outputs: Expected outputs include market-ready retrofit kits for existing bus fleets, operational prototypes of depot control centres, interoperability guidelines and reference architectures, and pilot implementations in multiple European depots. The pilots generate evidence on safety, cost savings, space optimization, and staff acceptance, feeding into future standardisation and regulatory evolution.

4. Business Model Perspective

Customer Segments: Primary customer segments are public and private bus operators responsible for depot operations, owners of large bus depots and parking facilities, and companies operating extensive corporate shuttle or staff bus fleets. Municipal transport authorities and integrated mobility operators form an extended customer base, particularly where they manage or co-own depots.

Value Proposition: The solution provides automated parking, maneuvering, washing, and positioning of buses within depots, reducing labour costs, improving operational efficiency, and optimizing scarce space. It enables straightforward retrofitting of traditional bus fleets and delivers a unified fleet management solution capable of handling vehicles from different manufacturers within a single system. The use case also offers a safe, controlled environment to test and validate technologies that will later support public-road automation, thereby future-proofing investments.

Key Activities: Key activities include developing and maintaining modular autonomous-driving and remote-operation systems, retrofitting buses with these components, deploying and operating control centres, and installing communication infrastructure in depots. Other crucial activities are software development, integration with existing fleet management tools, pilot implementation and scaling, operator training, and ensuring continuous regulatory and cybersecurity compliance.

Key Resources: Core resources are the modular retrofit kits, remote-operation and fleet management software, robust communication networks between buses and control centers, depot sensor and monitoring systems, and the physical infrastructure of depots themselves. Human resources include system integration experts, control centre operators, safety and cybersecurity specialists, and trainers for depot staff.

Key Partners: Key partners include public and private transport operators, depot owners, suppliers of modular autonomous driving technologies, control-centre solution providers, fleet management platform vendors, and specialist retrofitting companies. Collaboration with certification bodies, insurers, and regulators is required to establish safe operational frameworks. Research institutions and pilot projects support testing, evaluation, and refinement of the solution.

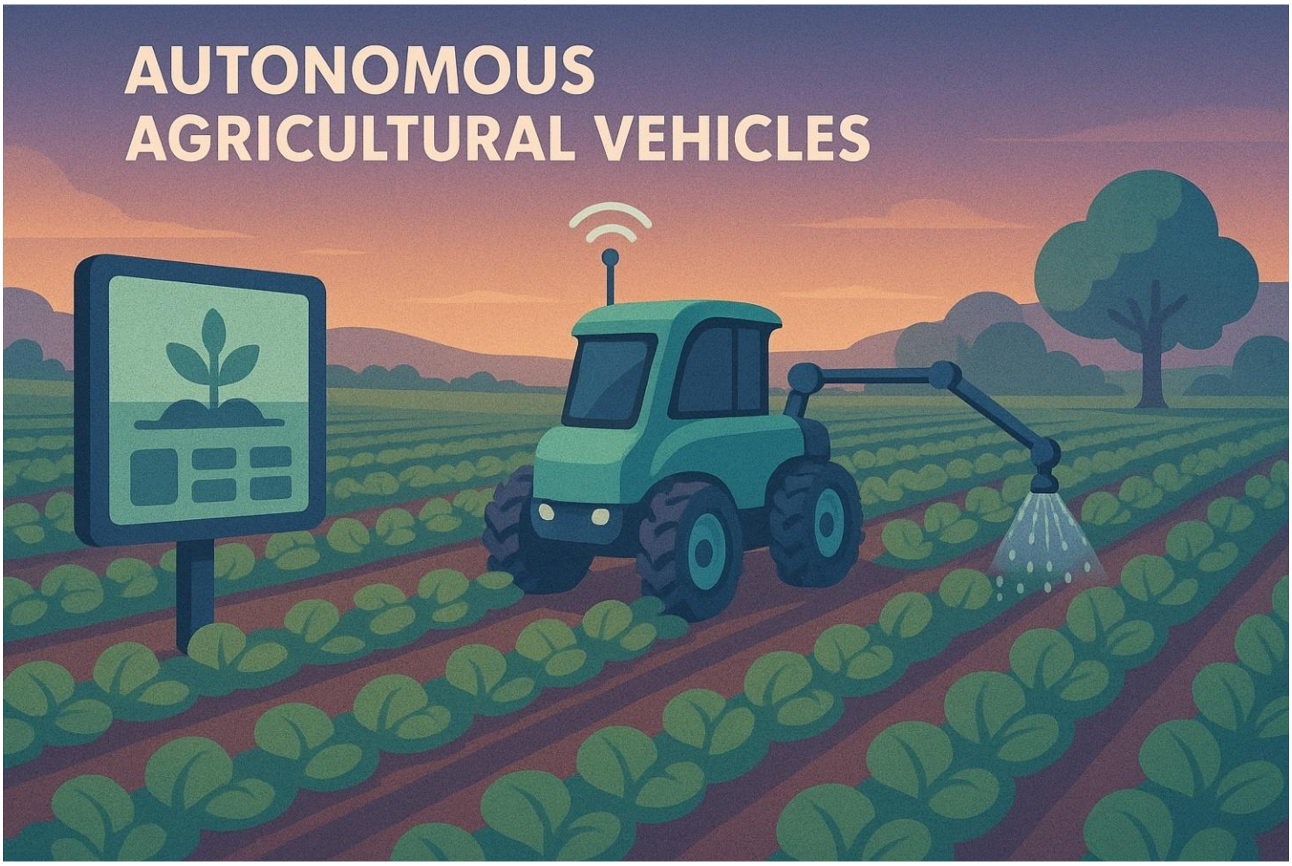
Revenue Model / Sustainability: Revenue streams arise from the sale or leasing of retrofit kits, licensing or subscription fees for control-centre and fleet management software, retrofit and installation services, and long-term maintenance and support contracts. Additional income can come from depot-management-as-a-service offerings, where technology providers operate depot automation on behalf of transport operators, and from public-private funding schemes that support innovation pilots and scaling.

Cost Drivers: Major cost drivers include the development and production of modular autonomous driving systems, retrofitting existing buses, building and operating control centres, and investing in communication and sensor infrastructure within depots. Ongoing costs stem from software development and updates, cybersecurity measures, certification and insurance, staff for remote operations and support, and sales, demonstration, and training activities aimed at operators and authorities.

7.6 Use Case Idea 6: Autonomous Agricultural Vehicles for Plant Health Monitoring and Intervention (Automation)

1. Basic Information

Use Case Name: Autonomous Agricultural Vehicles for Plant Health Monitoring and Intervention



Short Summary: This use case introduces autonomous agricultural and forestry vehicles equipped with advanced AI-driven recognition systems capable of identifying, removing, or treating infected plants and trees. Designed for operation in harsh environments, the vehicles rely on perception technologies originally developed for pedestrian recognition, adapted to agricultural disease detection. The concept addresses the dual challenges of rising plant disease risks and labour shortages in farming and forestry by enabling precise, efficient, and fully automated intervention.

Main Objective: The objective is to support European agriculture and forestry in managing plant diseases more effectively while reducing pesticide use, improving sustainability outcomes, and mitigating workforce shortages. Autonomous intervention vehicles provide a scalable solution that increases yield protection, enhances operational safety, and supports EU climate and biodiversity objectives.

2. Transnational Context

Opportunity: European agriculture faces rising stress from climate change, evolving plant disease patterns, and persistent labour shortages. Early detection and intervention are essential to prevent large-scale crop and forest losses, especially in mountain regions and border-adjacent farming zones where diseases spread across national boundaries. Autonomous systems enable continuous monitoring, reduce pesticide dependency, and support the EU Green Deal and Farm-to-Fork Strategy. They also offer safe alternatives for intervention in rugged terrain where manual labour is unavailable or hazardous.

Technology Dimension: The use case relies on an integrated technological ecosystem adapted to agricultural realities. AI-based image recognition and neural networks trained on diverse plant disease datasets allow vehicles to detect infections with high precision, even in varying light or weather conditions. Autonomous navigation systems support safe mobility across uneven fields, dense forests, or steep mountain paths. Sensor fusion combines visual, thermal, and environmental inputs to enhance detection reliability and reduce false positives. IoT connectivity links each vehicle to monitoring platforms, enabling real-time fleet supervision, data transmission, and compliance documentation. Robotic arms, grippers, and cutting tools provide precise mechanical intervention, enabling removal or treatment of infected vegetation. Together, these technologies create a resilient system capable of operating autonomously in demanding agricultural environments.

Regulatory Dimension: The deployment of autonomous agricultural machinery must align with EU sustainability goals, pesticide reduction strategies, and agricultural data governance principles. Machinery safety regulations ensure that autonomous vehicles can operate near workers or within shared environments. EU frameworks governing agricultural data sharing, combined with GDPR requirements, apply to imagery, mapping, and intervention logs. Cybersecurity and remote-update responsibilities are guided by UNECE Regulations R155 and R156, ensuring that autonomous systems remain secure, up-to-date, and traceable throughout their lifecycle.

Cross-Border Synergies: Agricultural diseases do not respect borders, making shared data and coordinated intervention essential. Cross-border regions—such as Austria-Italy, Germany-Poland, Poland-Czech Republic, or Poland-Slovakia—provide natural testbeds for joint AI model development and operational pilots. Shared datasets enhance AI accuracy, while interoperability standards ensure that autonomous machines from different manufacturers can operate across Member States. Cross-border pilot sites create opportunities for harmonized deployment strategies and shared investments in agricultural resilience.

Industry Focus: The use case connects the agriculture and forestry sectors with robotics manufacturers, AI developers, environmental monitoring providers, and agricultural machinery companies. It supports the transition to precision farming and sustainable land management by integrating digital technology, manipulation robotics, and advanced sensing systems into existing agricultural operations.

SME Participation: SMEs play a central innovation role by developing disease-recognition algorithms, designing sensor modules, and creating robotic intervention systems. Many SMEs specialize in retrofitting existing machinery, enabling farmers to adopt autonomous systems without purchasing entirely new vehicles. They also provide calibration services, maintenance, and region-specific customization. Their proximity to local markets and operational agility make SMEs indispensable enablers of adoption in rural and cross-border regions.

3. Concept Description

Detailed Description: Autonomous vehicles equipped with multispectral cameras, environmental sensors, and specialized AI models patrol fields and forests to identify early signs of plant infections. When infections are detected, onboard robotic tools remove or treat the affected plants with high accuracy. The intervention process is fully automated, allowing operations in remote, steep, or forested terrain where human intervention is difficult or unsafe. All collected data is fed into analytical systems that support early-warning mechanisms, compliance reporting, and long-term health monitoring of agricultural landscapes. The system is designed to operate reliably under harsh environmental conditions such as mud, dust, rain, and temperature fluctuations.

Transnational Added Value: Because plant disease patterns often cross national borders, a harmonized detection and intervention system improves regional resilience and reduces the likelihood of cross-border outbreaks. Shared AI models trained on multicountry datasets greatly enhance recognition accuracy, while cross-border deployment frameworks reduce duplication and accelerate the spread of best practices across Europe.

Innovation Aspect: The use case innovatively adapts perception technologies from autonomous driving—especially pedestrian recognition—for agricultural disease identification. It combines autonomous mobility, AI-driven diagnosis, robotic manipulation, and sustainable agricultural practices in a single system. By merging plant diagnostics with automated intervention, the use case offers a fundamentally new approach to plant health management.

Expected Results / Outputs: Expected outputs include prototype autonomous agricultural vehicles, validated AI disease-detection models, cross-border disease-data platforms, and operational cooperation models involving farmers, forestry operators, SMEs, and authorities. Pilot deployments will generate evidence for scaling, regulatory adaptation, and long-term integration into European farming systems.

4. Business Model Perspective

Customer Segments: Target customers include farmers, forestry companies, and agricultural cooperatives seeking more efficient disease control; equipment manufacturers integrating autonomous functions; and public authorities responsible for sustainability enforcement, disease monitoring, and rural development programs.

Value Proposition: The solution provides automated detection and removal of infected plants and trees, reducing reliance on pesticides and improving compliance with sustainability standards. It lowers labour dependency and enhances safety by automating interventions in challenging terrain. The generated data supports traceability and regional disease monitoring, contributing to overall resilience and yield protection.

Key Activities: Key activities involve developing AI-based recognition models, building robotic intervention systems, integrating autonomous mobility capabilities, and deploying pilot projects across different terrains. Additional activities include operating disease-data platforms, supporting regulatory compliance, and conducting training and awareness programs for farmers and forestry workers.

Key Resources: Core resources include autonomous vehicles capable of rugged operation, AI algorithms trained on extensive agricultural datasets, sensor arrays combining visual and environmental data, robotic gripper and cutting tools, IoT connectivity systems, and access to satellite or aerial imagery. Expertise in agriculture, AI engineering, and field robotics is critical.

Key Partners: Essential partners include agricultural associations, technology clusters, robotics and AI providers, research institutions, farmers, forestry companies, SMEs offering retrofitting and operational services, and local or regional governments supporting pilot deployments. Cross-border authorities facilitate shared data, testing, and regulatory alignment.

Revenue Model / Sustainability: Revenue streams include the sale or leasing of autonomous intervention vehicles, subscription fees for disease monitoring and analytics services, cooperative purchasing models for rural regions, retrofitting services, maintenance contracts, and EU funding for sustainability or climate-adaptation initiatives. Additional revenue can arise from data-driven advisory services.

Cost Drivers: Cost drivers include autonomous vehicle development and hardware upgrades, AI model training and continuous sensor calibration, connectivity and data infrastructure, compliance with cybersecurity and safety regulations, field testing and demonstration activities, certification procedures, and training for end-users.

7.7 Use Case Idea 7: Low-Cost V2X Deployment Kit for Municipalities (Connectitivty)

1. Basic Information

Use Case Name: Low-Cost V2X Deployment Kit for Municipalities

Short Summary: This use case proposes an affordable, easy-to-deploy V2X starter package designed for small and medium-sized municipalities that lack the budget, technical expertise, or standardized tools required to implement Connected Intelligent Transport Systems (C-ITS). The concept addresses a structural barrier observed across Europe: although V2X technology is mature, most municipalities cannot deploy it due to high CAPEX, fragmented vendor ecosystems, and complex interoperability requirements. A modular, plug-and-play deployment kit enables municipalities to launch basic V2X services quickly, improve local road safety, and establish a scalable pathway for future expansions aligned with European mobility and digitalization objectives.

Main Objective: The primary objective is to democratize access to V2X technologies by providing municipalities with a low-cost, pre-certified, and interoperable deployment toolkit. The solution is designed to reduce implementation complexity, support EU-wide standardization efforts, accelerate local C-ITS adoption, and build a robust foundation for future cross-border, cooperative mobility services. It aims to empower municipalities—including rural, remote, and cross-border regions—to participate in Europe's transition toward connected and automated mobility.

2. Transnational Context

Opportunity: Across Europe, many smaller municipalities lack the financial and technical capacity to introduce V2X solutions, even though such systems can significantly improve traffic safety, operational efficiency, and digital mobility services. A low-cost deployment kit opens access to EU flagship technologies aligned with the ITS Directive, C-ROADS recommendations, and the Digital Decade objectives. By reducing entry barriers, the use case enables widespread adoption beyond major metropolitan areas and helps harmonize V2X deployment across Member States. It also supports cross-border regions that require coordinated C-ITS capabilities for traffic safety and information exchange.

Technology Dimension: The concept is enabled by standardized C-ITS communication technologies and modular system components, including V2X communication protocols such as ETSI ITS-G5, C-V2X PC5, and LTE/5G for cooperative safety messaging; low-cost modular roadside units equipped with pre-configured firmware and auto-calibrating sensors; pre-integrated cloud backends for device management, service activation, and data exchange; edge computing functions that enable low-latency applications such as hazard warnings and SPaT messages; and API gateways with pre-certified interfaces that allow seamless integration with traffic lights, public transport data feeds, and regional C-ITS hubs. These technologies provide a plug-and-play deployment experience with minimal need for specialized expertise.

Regulatory Dimension: The solution aligns with the EU ITS Directive, the incoming C-ITS delegated acts, ETSI EN 302 665 standards, and national guidelines for V2X deployment. Pre-certified hardware reduces administrative burdens and ensures interoperability with road corridors and C-ROADS implementations. The solution incorporates GDPR-compliant data handling, secure credential management, and adherence to cybersecurity and software update requirements as defined in UNECE R155 and R156. This regulatory alignment ensures that municipalities can deploy systems with confidence and long-term legal certainty.

Cross-Border Synergies: The use case enables cross-border regions to coordinate roadside infrastructure and share consistent safety messages, such as hazard warnings, roadwork alerts, and weather notifications. Multi-country pilot deployments benefit from harmonized hardware and software modules, consistent data interfaces, and aligned operational procedures. Shared procurement processes—especially through regional alliances—help reduce unit costs and support economies of scale. Joint platforms allow regions such as AT–DE, NL–BE, SK–CZ, or SI–HR to exchange V2X data seamlessly.

Industry Focus: The initiative supports multiple industries including roadside equipment manufacturers, cloud service providers, telecom operators, ITS integrators, and municipal mobility departments. It fosters a new European market segment for low-cost, scalable C-ITS deployments and strengthens EU capabilities in cooperative mobility technologies.

SME Participation: SMEs play a critical role as developers of modular roadside hardware, installers, cloud dashboard providers, and integration specialists. Their adaptability and domain expertise allow them to tailor V2X solutions to local urban, rural, or cross-border settings. SMEs also contribute to training, procurement support, regulatory adaptation, and long-term maintenance—making them indispensable partners in local deployment.

3. Concept Description

Detailed Description: The Low-Cost V2X Deployment Kit for Municipalities is envisioned as a modular, plug-and-play package that allows municipalities to introduce C-ITS services rapidly and affordably. The kit includes pre-certified roadside units, a secure cloud backend, configuration dashboards, and integration interfaces that eliminate the need for specialized engineering knowledge. Upon installation, municipalities can activate core V2X services such as hazard warnings, signal-phase-and-timing messages, roadwork notifications, and vulnerable-road-user protection. The system is designed to scale over time, enabling municipalities to gradually expand into more advanced applications such as traffic prioritization, cooperative perception, or integration with automated mobility pilots.

Transnational Added Value: The kit supports a standardized European approach to V2X deployment, reducing fragmentation and ensuring that even small municipalities can participate in cross-border C-ITS ecosystems. Harmonized hardware and software components ensure consistency across Member States, making it easier to deploy services in cross-border regions and integrate with national or European mobility platforms. The approach strengthens Europe's ability to build a unified, cooperative mobility environment.

Innovation Aspect:

- Technological integration of low-cost, pre-certified, plug-and-play C-ITS components.
- Organizational simplification of procurement, installation, and activation processes for municipalities.
- Economic transformation by creating an accessible procurement model that lowers barriers to entry and stimulates new market segments for SMEs.

Expected Results / Outputs:

- A ready-to-deploy V2X kit with standardized interfaces and cloud dashboards.
- Pilot deployments in diverse municipal environments across Europe.
- Best-practice guidelines for low-cost V2X rollout, maintenance, and scaling.
- Harmonized operational frameworks supporting cross-border deployment.
- Evidence of safety, efficiency, and digitalization benefits in municipalities.

4. Business Model Perspective

Customer Segments: The primary customers are municipalities, regional road authorities, cross-border mobility clusters, public transport operators, and local road operators responsible for safety infrastructure. Secondary customers include telecom operators, ITS integrators, and research pilots seeking standardized testbeds.

Value Proposition: The kit provides an affordable, pre-certified, plug-and-play V2X solution that reduces complexity, minimizes the need for specialized staff, and supports EU interoperability from day one. It enables municipalities to deploy essential C-ITS services quickly, improves road safety and traffic awareness, and offers a scalable foundation for long-term digital mobility transformation.

Key Activities: Core activities include manufacturing and configuring roadside units, ensuring interoperability certification, onboarding municipalities, operating the cloud backend, providing training, and conducting pilot deployments. Continuous updates, maintenance, and alignment with evolving EU standards are part of the ongoing activity profile.

Key Resources: Key resources include certified RSUs and sensors, V2X communication modules, cloud management platforms, cybersecurity and credential-management tools, documentation libraries, and skilled personnel such as engineers, integrators, and regulatory experts.

Key Partners: Partners include telecom operators, ITS integrators, national road authorities, EU C-ITS coordination bodies, regional governments, SMEs providing hardware and software components, and universities conducting testing and evaluation. Public-private partnerships are essential for adoption and scaling.

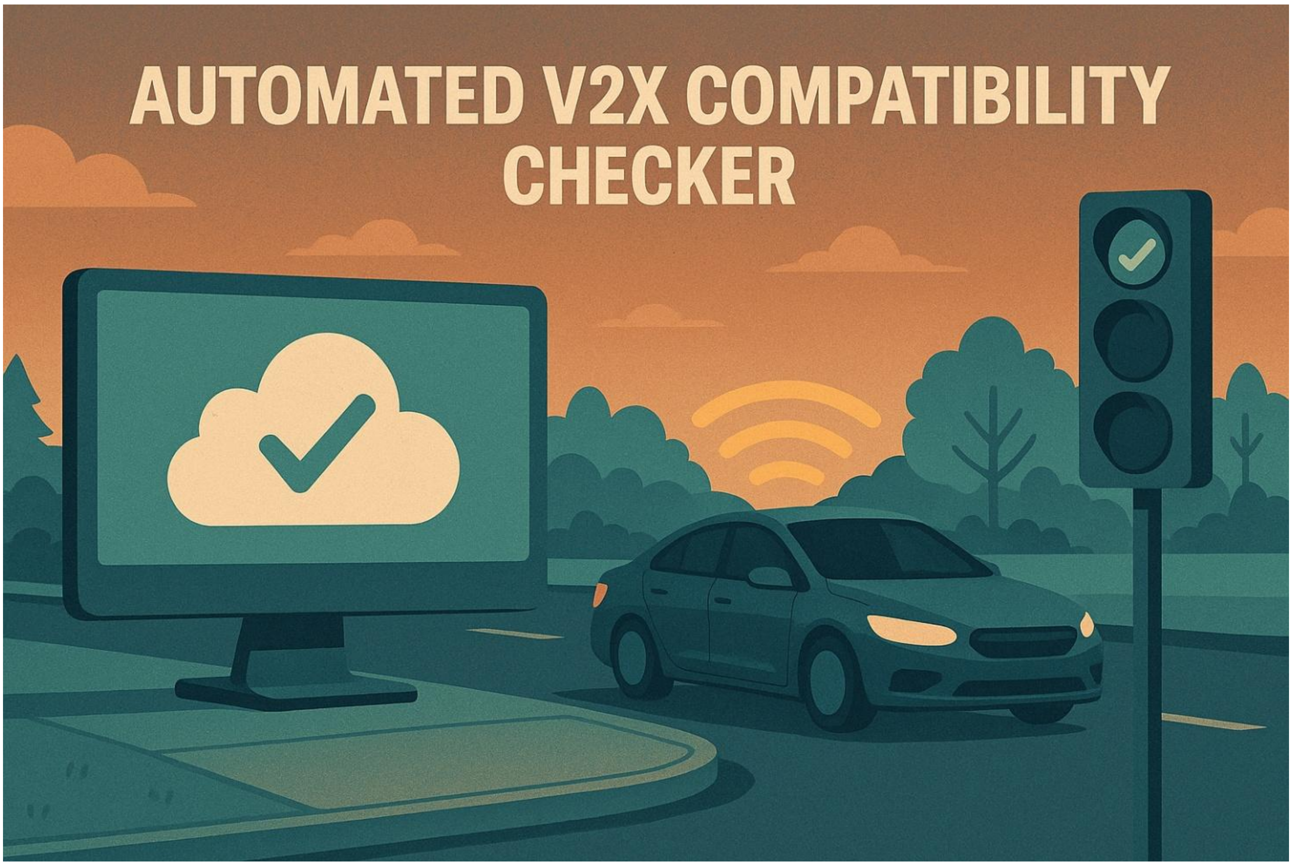
Revenue Model / Sustainability: Revenue streams are generated through hardware sales, subscription-based cloud services, software-as-a-service dashboards, maintenance contracts, analytics add-ons, and consortium procurement models. Municipalities may access EU funding sources such as CEF, Digital Europe, and regional mobility grants to support deployment.

Cost Drivers: Major cost components include hardware development and certification, cloud hosting and maintenance, software updates, cybersecurity compliance, installation and training, cross-border testing, and ongoing harmonization with EU technical standards.

7.8 Use Case Idea 8: Automated V2X Compatibility Checker (Connectitivty)

1. Basic Information

Use Case Name: Automated V2X Compatibility Checker



Short Summary: This use case introduces an automated tool that verifies whether vehicles, roadside units, and digital infrastructure comply with European V2X interoperability standards. Despite growing investments in connected mobility, municipalities, OEMs, telecom operators, and infrastructure providers often struggle to confirm compatibility due to inconsistent implementations and vendor-specific documentation. A centralized checker reduces uncertainty, lowers testing costs, and ensures that V2X components communicate reliably across Europe. The tool strengthens the foundation for large-scale, cross-border deployment of cooperative mobility services.

Main Objective: The primary objective is to provide an automated, standardized system that enables public authorities, manufacturers, and mobility operators to validate V2X interoperability quickly and reliably. By creating a uniform testing framework aligned with EU and ETSI standards, the use case supports harmonized deployment across Member States, accelerates procurement decision-making, and improves trust in V2X investments—particularly in cross-border corridors where seamless communication is essential.

2. Transnational Context

Opportunity: Europe is rapidly scaling C-ITS and V2X systems, yet persistent interoperability issues continue to slow down deployment. Municipalities lack practical ways to confirm that roadside equipment meets EU specifications, and OEMs face significant costs to validate compliance. An automated compatibility checker addresses this gap by providing a transparent, consistent method to assess whether vehicles, RSUs, and telecom infrastructure can communicate according to established European standards. Cross-border regions stand to benefit significantly from uninterrupted hazard warnings, SPaT services, roadwork alerts, and cooperative safety applications. The tool thus supports harmonization, reduces risk in public procurement, and strengthens cross-border mobility ecosystems.

Technology Dimension: The solution relies on a combination of automated protocol verification, cloud-based test environments, and machine-driven analysis to evaluate whether V2X components meet required standards. Testing frameworks for ETSI ITS-G5 and C-V2X enable the system to simulate communication scenarios and identify non-compliant behavior. The platform analyzes message logs using AI-assisted pattern recognition to detect deviations from standardized message sets or inconsistencies in timing, encoding, or communication performance. Cybersecurity validation modules assess certificate chains, credential management processes, and adherence to update protocols. A cloud-based repository of certification references ensures that the tool reflects the latest versions of EU and ETSI specifications. Through API-based integration, manufacturers, suppliers, and public authorities can upload logs, live data streams, or software builds for automated assessment. The system generates compatibility scores that quantify technical readiness across different suppliers, infrastructures, and national contexts, offering a unified, comparable view of interoperability performance across Europe.

Regulatory Dimension: The tool aligns with the ITS Directive, the forthcoming C-ITS delegated acts, ETSI EN 302 665, ETSI EN 302 637, and the broader European interoperability stack. It also integrates cybersecurity and software update requirements defined under UNECE R155 and R156. The automated approach reduces administrative burdens for municipalities and vendors by offering a standardized reference system for compliance. National certification guidelines can be incorporated through modular profiles, ensuring compatibility with country-specific mandates. GDPR-compliant data handling ensures that uploaded logs and system information remain secure and privacy-protected.

Cross-Border Synergies: The compatibility checker supports cross-border testing environments where vehicles transition across national infrastructures. By using the same tool and methodologies, regions can benchmark deployments, coordinate hardware procurement, and align their technical roadmaps. Municipal clusters can jointly evaluate systems from different suppliers, compare results, and reduce procurement risk through shared assessments. This harmonized framework strengthens interoperability along key corridors such as AT–DE, NL–BE, HR–SI, and enables more consistent upgrades across the EU.

Industry Focus: The use case spans the entire V2X value chain, including automotive OEMs, roadside unit manufacturers, telecom and C-V2X operators, traffic system integrators, certification authorities, and cybersecurity service providers. It becomes a central digital asset within Europe's connected mobility ecosystem, supporting both public and private deployments.

SME Participation: SMEs play a crucial role in developing specialized testing modules, analytics engines, user-friendly dashboards, and AI-driven evaluation tools. They can provide compatibility-as-a-service offerings, consulting, and integration support for municipalities or OEMs. For SMEs developing V2X components, the tool ensures that their products remain competitive, certified, and interoperable in a fast-evolving European market.

3. Concept Description

Detailed Description: The Automated V2X Compatibility Checker is designed as a cloud-based platform that evaluates the compliance of V2X devices and software with European standards. Through automated testing protocols, the system analyzes communication logs, system configurations, and message patterns to determine whether components behave according to ETSI and EU specifications. The tool supports both pre-deployment certification and continuous operational verification. It provides manufacturers and municipalities with structured reports that highlight compatibility issues, security concerns, or deviations from expected behavior. By standardizing assessment, the tool accelerates V2X rollout, ensures interoperability between suppliers, and strengthens Europe's digital mobility backbone.

Transnational Added Value: The checker creates a unified interoperability layer that applies consistently across borders. Rather than relying on national testing regimes or vendor-specific documentation, stakeholders gain access to a single European reference tool. This facilitates coordinated deployment along international routes, supports EU-wide safety applications, and ensures that local investments remain compatible with future European mobility strategies. It also enhances trust between Member States by providing transparent, comparable test outcomes.

Innovation Aspect:

- Technological innovation through automated test suites, AI-assisted log analysis, and integrated cybersecurity checks.
- Organizational innovation by establishing shared certification processes across municipalities, operators, and OEMs.
- Economic innovation by reducing the cost of interoperability testing and supporting efficient, large-scale procurement.

Expected Results / Outputs:

- A standardized compatibility-testing platform with automated assessment modules.
- Cross-border pilot testing in major European corridors.
- Interoperability scorecards and benchmarking tools.
- Policy recommendations for integrated EU-wide certification frameworks.

4. Business Model Perspective

Customer Segments: Primary customers include municipalities validating roadside equipment, OEMs verifying vehicle V2X stacks, RSU and sensor manufacturers, telecom operators deploying C-V2X infrastructure, research centers operating cross-border testbeds, and national road agencies overseeing certification processes. Secondary users include IT integrators, cybersecurity firms, and EU-funded pilot consortia.

Value Proposition: The tool offers fast, automated, and standardized validation of V2X compatibility with EU and ETSI standards. It reduces certification and testing costs, minimizes deployment risks, and ensures seamless cross-border interoperability. By providing transparent, repeatable results, it supports procurement decisions, quality assurance, and coordinated corridor deployment.

Key Activities: Key activities include developing and updating compatibility modules, maintaining certification databases, running cloud testing environments, onboarding customers, analyzing communication logs, issuing interoperability reports, and aligning the system with new ETSI releases. Participation in EU interoperability events and coordinating with road authorities are essential ongoing activities.

Key Resources: Resources include testing algorithms, compatibility databases, cybersecurity validation modules, cloud infrastructure, real-world V2X datasets, and expert personnel such as V2X engineers, standards specialists, and cybersecurity analysts.

Key Partners: Partners include national road authorities, EU coordination bodies for C-ITS, telecom operators, OEMs, roadside unit manufacturers, cybersecurity agencies, SMEs contributing specialized testing components, and universities or research centers supporting standardization and validation work.

Revenue Model / Sustainability: Revenue derives from subscription packages (basic to premium), on-demand compatibility assessments, certification services, OEM integration toolkits, consultancy packages for procurement, and licensing of test frameworks. Additional funding can come from EU pilot corridors and digital infrastructure initiatives.

Cost Drivers: Major cost factors include cloud hosting, development of testing modules, updates aligned with ETSI specifications, cybersecurity compliance, expert personnel, documentation, customer support, and participation in cross-border testbeds.

7.9 Use Case Idea 9: EU V2X Deployment Playbook (Connectitivty)

1. Basic Information

Use Case Name: EU V2X Deployment Playbook

Short Summary: The EU V2X Deployment Playbook addresses a major barrier identified by experts: many municipalities, road operators, and smaller Member States lack clear, actionable guidance on how to deploy V2X and C-ITS infrastructure safely, cost-effectively, and in compliance with EU standards. While leading testbeds and large metropolitan regions have developed considerable know-how, this knowledge does not systematically reach less-resourced regions. The Playbook fills this gap by offering a harmonized, practical implementation guide covering planning, procurement, installation, testing, cybersecurity, and operations. It functions as a blueprint for achieving interoperable, future-proof V2X deployments across Europe.

Main Objective: The primary objective is to create a comprehensive, easy-to-use, and standardized reference model that enables municipalities and road authorities—regardless of size or technical capacity—to deploy V2X systems confidently. It simplifies complex regulatory, technical, and operational requirements and provides a structured pathway for achieving interoperability across Member States. By doing so, the Playbook accelerates Europe's digital mobility transition and supports coordinated, cross-border V2X deployment.

2. Transnational Context

Opportunity: Europe urgently requires a common reference framework to support widespread V2X deployment. Smaller municipalities and regional authorities often hesitate to invest because they lack clarity on standards, certification processes, procurement strategies, operational models, and legal requirements. The Playbook eliminates uncertainty by translating EU mobility and C-ITS policy goals into actionable steps, supporting Vision Zero road-safety objectives and Europe's climate-neutral mobility strategy. It democratizes access to advanced digital mobility systems and helps ensure that cross-border regions can align their deployments and operate seamlessly.

Technology Dimension: The Playbook builds on the full suite of V2X communication and C-ITS technologies and translates complex technical requirements into practical design and deployment guidance. It explains how municipalities can implement ETSI ITS-G5, C-V2X, or hybrid communication architectures and provides structured recommendations for network planning, cloud integration, roadside unit placement, and message-set configurations. It incorporates detailed procedures for installation, commissioning, and operational testing, including how to verify message correctness, communication reliability, and cybersecurity compliance. The guidance also covers credential management, maintenance routines, over-the-air update strategies, and long-term lifecycle planning. Tools such as digital twins, simulation environments, and automated deployment checks help municipalities validate configurations before installation, reduce risk, and ensure that deployed systems remain interoperable across borders. By packaging these technologies into clear, practical steps, the Playbook bridges the gap between high-level standards and on-the-ground implementation.

Regulatory Dimension: The Playbook fully aligns with the ITS Directive, C-ITS delegated acts, ETSI standards, and national V2X deployment guidelines. It incorporates requirements from EU cybersecurity credential management frameworks and UNECE regulations on cyber security and software updates (UNECE R155/R156). It provides procurement templates, compliance checklists, and reference architectures that reflect European regulatory expectations. By mapping these regulations into operational procedures, the Playbook reduces legal uncertainty, supports consistent implementation, and promotes adherence to EU-wide interoperability requirements.

Cross-Border Synergies: The Playbook supports coordinated deployment across border regions, enabling harmonized service architectures and shared operational practices. It facilitates multi-country pilot clusters, joint procurement across regions, and the alignment of technical upgrades. When multiple Member States implement the same guidelines, international routes—such as DE-NL-BE or AT-DE or HR-SI—can offer seamless, consistent V2X services. The Playbook therefore helps synchronize technical decisions, reduce integration costs, and provide drivers with a seamless experience regardless of national borders. It also enables knowledge exchange between advanced testbeds and emerging regions.

Industry Focus: The use case spans a broad ecosystem: road authorities, telecom operators, roadside equipment providers, OEMs, cloud and data service providers, cybersecurity specialists, research institutions, and mobility-platform developers. The Playbook becomes a strategic framework supporting the entire value chain—from planning and procurement to installation, testing, operations, and maintenance. It strengthens Europe's digital mobility ecosystem by ensuring that all actors have access to validated, interoperable implementation pathways.

SME Participation: SMEs play a crucial role by contributing templates, deployment modules, integration tools, consulting services, training programs, and technical documentation. Their flexibility allows them to tailor the Playbook to local conditions, regulatory constraints, and infrastructure maturity levels. SMEs also benefit from reduced entry barriers, as the Playbook provides clear procedures that enable them to participate competitively in procurement processes historically dominated by large integrators.

3. Concept Description

Detailed Description: The EU V2X Deployment Playbook is envisioned as a comprehensive, modular, and continuously updated implementation guide for municipalities and road authorities. It offers standardized architectural blueprints, procurement templates, technical instructions, simulation models, testing procedures, and cybersecurity guidelines. The Playbook is designed to accommodate varying levels of local capacity: small towns can rely on simplified procedures and turnkey deployment models, while larger regions can use advanced templates for complex architectures. The Playbook supports the full deployment lifecycle—from initial planning and stakeholder coordination to installation, testing, operation, maintenance, and system evolution.

Transnational Added Value: The Playbook ensures that deployments across Europe adhere to shared principles and interoperable standards, reducing fragmentation and ensuring seamless cross-border mobility services. By providing a unified reference model, it strengthens Europe's collective capacity to scale V2X technologies while enabling consistency between Member States. This transnational approach supports joint infrastructure planning, shared procurement frameworks, coordinated rollouts, and the exchange of operational best practices.

Innovation Aspect:

- Technological innovation through the integration of digital twins, automated deployment checks, and structured testing workflows.
- Organizational innovation by creating a shared European implementation method that municipalities and suppliers can follow uniformly.
- Economic innovation by reducing the cost and complexity of V2X deployment and enabling a competitive ecosystem involving SMEs, integrators, and equipment suppliers.

Expected Results / Outputs:

- A standardized, practical V2X implementation playbook for municipalities and road operators.
- Reference architectures, procurement templates, and compliance checklists aligned with EU standards.
- Cross-border pilot clusters and shared learning environments.
- Regularly updated guidance reflecting evolving standards and technologies.
- A sustainable knowledge base supporting long-term European C-ITS deployment.

4. Business Model Perspective

Customer Segments: Core customers include municipalities, regional road authorities, national ITS competence centers, and cross-border mobility clusters. Additional customer groups include telecom operators, roadside equipment manufacturers, integrators, transport ministries, training providers, and EU-funded pilot consortia.

Value Proposition: The Playbook provides a complete, practical, and interoperable roadmap for implementing V2X systems in line with EU standards. It reduces uncertainty, accelerates procurement, ensures technical and regulatory compliance, and builds long-term operational sustainability. It empowers less-resourced regions by making state-of-the-art digital mobility technologies accessible and understandable.

Key Activities: Key activities include maintaining the Playbook, updating content based on evolving ETSI standards, developing training and certification materials, supporting pilot deployments, coordinating with national and European standardization bodies, and managing the digital platform that hosts the Playbook. Continuous refinement based on real-world feedback is essential.

Key Resources: Resources include standardized templates, reference architectures, compliance frameworks, simulation tools, procurement libraries, training materials, cloud-based distribution platforms, and subject-matter experts skilled in mobility engineering, cybersecurity, and regulatory interpretation.

Key Partners: Partners include national road authorities, EU C-ITS coordination bodies, telecom operators, OEMs, research institutions, SMEs, cybersecurity agencies, and cross-border corridor initiatives. Collaboration with universities and innovation clusters ensures ongoing validation and improvement.

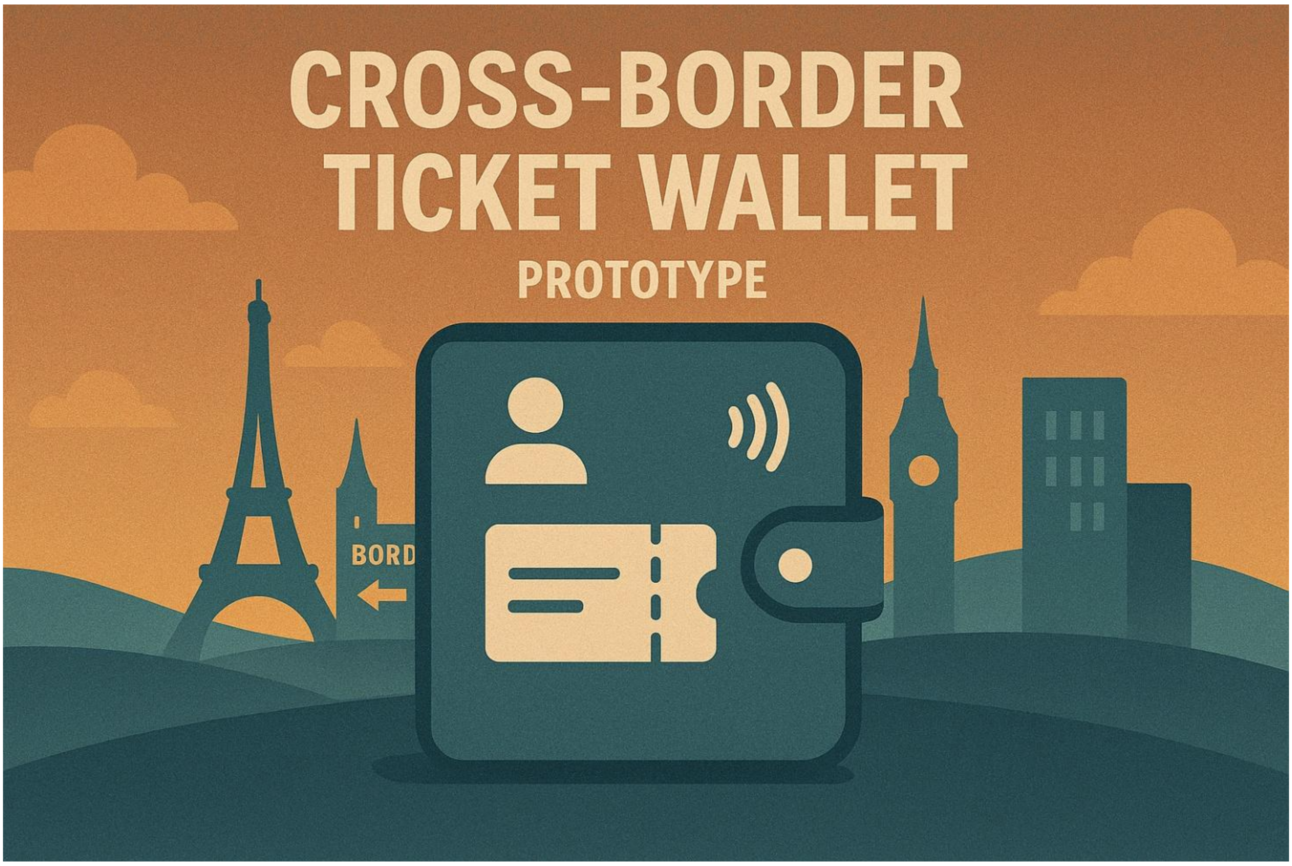
Revenue Model / Sustainability: Revenue streams include licensing enhanced or premium modules, training and certification fees, consulting services, digital toolkits (such as simulators or procurement configurators), and public-sector funding for dissemination. Integrators may also generate revenue by using the Playbook as a turnkey deployment framework.

Cost Drivers: Major costs include research and standardization alignment, development of training and simulation tools, ongoing updates to documentation, digital platform maintenance, expert support, pilot validation, and dissemination activities across Member States.

7.10 Use Case Idea 10: Cross-Border Ticket Wallet (Platform Economy)

1. Basic Information

Use Case Name: Cross-Border Ticket Wallet



Short Summary: The Cross-Border Ticket Wallet proposes a unified digital solution that allows travelers to store, manage, and validate mobility tickets across multiple European countries — including train, bus, tram, metro, ferry, and micro-mobility services. By consolidating fragmented regional ticketing systems into one secure wallet, the solution removes barriers to cross-border travel and enhances user experience. It directly supports multimodal, sustainable mobility by simplifying access to public transport and enabling frictionless travel across different national transport ecosystems.

Main Objective: The main objective is to overcome the fragmentation of Europe's ticketing landscape by establishing a standardized, interoperable, and user-centric digital wallet. The initiative aims to enable seamless cross-border ticketing, streamline validation and payment processes, and promote wider adoption of public transport and shared mobility services. At the same time, it fosters collaboration among transport authorities, operators, mobility platforms, and SMEs to build a harmonized European ticketing framework.

2. Transnational Context

Opportunity: Europe's transport systems remain siloed, with cities, regions, and Member States relying on incompatible ticketing formats, payment systems, and apps. This fragmentation creates barriers for cross-border commuters, multimodal travelers, and tourists. The Cross-Border Ticket Wallet addresses this challenge by offering a coherent digital layer for ticket storage, verification, and settlement across countries. It enables interoperable mobility services, increases public transport uptake, and supports EU goals for connected, accessible, and climate-friendly mobility.

Technology Dimension: The wallet relies on cloud-based digital infrastructure, standardized ticketing APIs, QR/NFC-based validation, and secure authentication through European Digital Identity frameworks (eIDAS2.0). Blockchain components can be used for verifying ticket integrity or managing credit balances. AI-based travel assistance provides smart routing, personalized offers, and dynamic ticket bundling. Real-time data exchange between operators and wallet providers enables accurate pricing, availability updates, and smooth interoperability across borders.

Regulatory Dimension: The use case aligns with EU principles for interoperability and fair access in digital mobility services. Relevant frameworks include GDPR for data protection, EU mobility and ticketing interoperability guidelines, eIDAS for digital identity, consumer rights for cross-border digital services, and national public transport regulations. The wallet provides tools for transparent consent management and ensures compliance with tax rules, fare structures, and potential settlement requirements between operators.

Cross-Border Synergies: The wallet creates strong cross-border synergies by linking ticketing systems between Member States and enabling multimodal travel across borders. Shared standards and validation rules allow operators to integrate more easily and expand services to neighboring regions. Joint ticketing pilots, shared infrastructure, and harmonized fare structures foster collaboration between public authorities, operators, and digital mobility providers. The wallet also supports coordinated R&D and innovation projects focusing on multimodal mobility.

Industry Focus: This use case spans several industries: public transport, rail, bus and coach services, micro-mobility, fintech and payments, digital mobility platforms, and tourism. It enables new cross-border mobility offerings, supports MaaS (Mobility-as-a-Service) ecosystems, and provides a foundation for interoperable, standardized European ticketing services.

SME Participation:SMEs play a central role as app developers, integration partners, analytics providers, UX specialists, and wallet infrastructure vendors. Open APIs and interoperable standards reduce entry barriers, allowing SMEs to innovate and provide tailored solutions. SMEs benefit from access to harmonized ticketing data, enabling them to develop specialized mobility services, payment tools, or regional extensions that complement the core wallet.

3. Concept Description

Detailed Description: The Cross-Border Ticket Wallet is a digital platform that aggregates tickets from multiple mobility providers into one secure wallet accessible via smartphone. Travelers can purchase, store, validate, and combine tickets from different operators and across borders. The platform uses standardized APIs to integrate national and regional systems and applies a multi-layered access model to support both public and commercial tickets. It also manages settlement between operators, ensuring a coherent backend for ticket distribution and validation. The wallet may integrate a recommendation engine that suggests optimal routes or ticket bundles to users.

Transnational Added Value: The added value lies in harmonizing diverse ticketing ecosystems into a single, cross-border solution. Travelers benefit from seamless access to mobility services regardless of regional boundaries. Operators gain access to wider customer groups, easier onboarding to international markets, and reduced technical and administrative complexity. The wallet supports multimodal travel planning, cross-border commuting, and tourism while enabling European-level policy benchmarking and collaborative transport strategies.

Innovation Aspect: The use case introduces innovation at multiple levels:

- **Technological:** Integration of distributed ticketing, European identity frameworks, AI-based routing, and smart contracts for settlement.

- **Organizational:** New collaboration models between transport authorities, operators, fintechs, and MaaS platforms.
- **Economic:** Opening new markets for cross-border mobility and enabling novel pricing models, combined tickets, and service bundles.

Expected Results / Outputs:

- A functional prototype of a cross-border ticketing wallet with standardized interfaces.
- Harmonized validation and settlement rules between operators and regions.
- Pilot deployments in selected cross-border corridors.
- Governance and compliance guidelines for data-sharing and ticket integration.
- A roadmap for scaling the wallet to additional Member States, operators, and modes.

4. Business Model Perspective

Customer Segments: Public transport authorities, rail and bus operators, micro-mobility providers, MaaS platforms, payment service providers, cross-border commuters, tourists, business travelers, and digital mobility app developers.

Value Proposition: A single, interoperable ticket wallet enabling seamless travel across European cities and borders. It removes complexity for users, reduces operational costs for providers, improves accessibility of sustainable mobility options, and creates a transparent framework for ticket validation, payment, and settlement.

Key Activities: Integrating operators into the wallet ecosystem; maintaining secure validation and settlement systems; ensuring regulatory compliance; managing user authentication; updating APIs; conducting cross-border pilot tests; and supporting operators through documentation and onboarding.

Key Resources: Cloud infrastructure, standardized APIs, authentication and encryption technologies, real-time validation systems, regulatory compliance frameworks, partnerships with operators, and mobility datasets.

Key Partners: Public transport authorities, national transport ministries, payment providers, ticketing system vendors, mobility platforms, fintechs, standardization bodies, SME tech firms, and EU agencies supporting mobility interoperability.

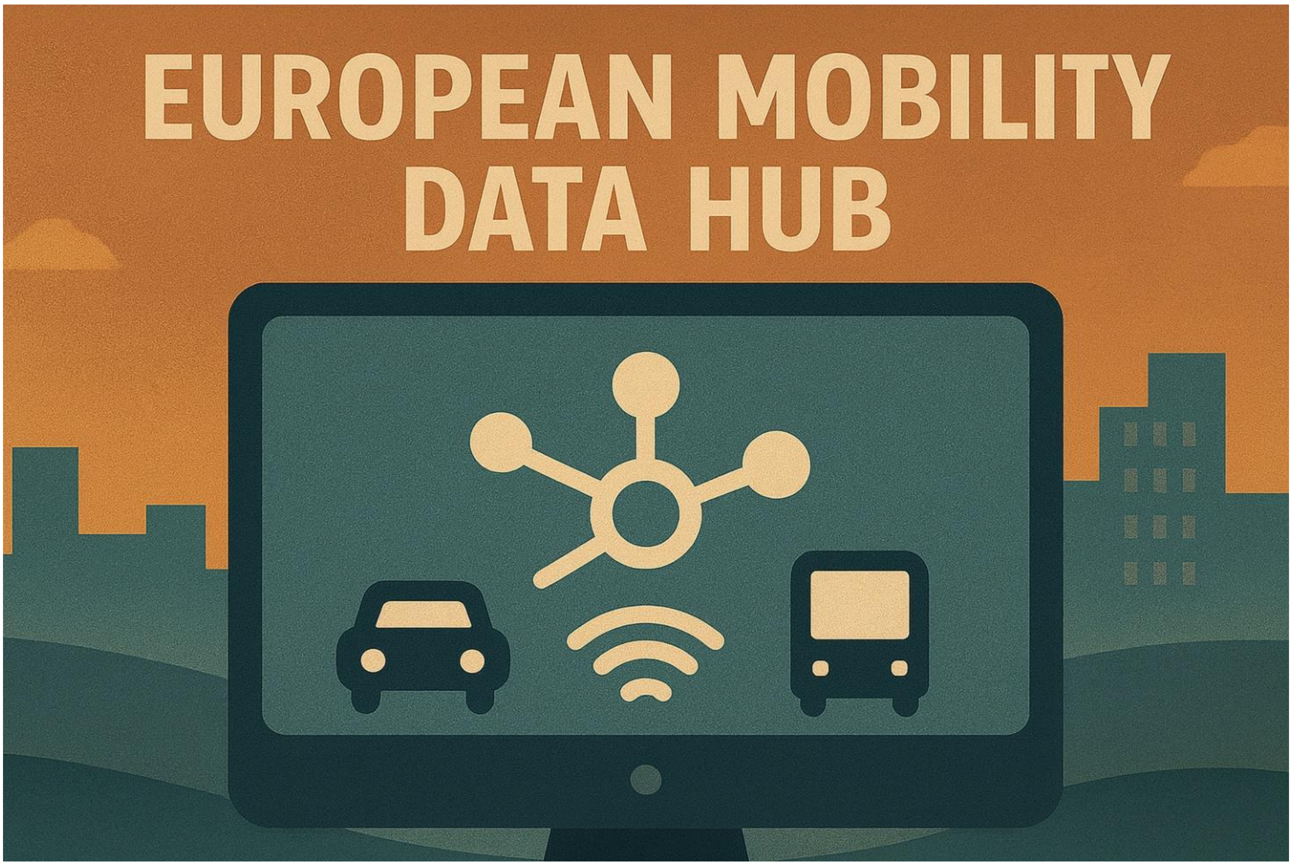
Revenue Model / Sustainability: Possible revenue streams include operator subscription fees, transaction fees, licensing for premium features, revenue-sharing agreements, public procurement contracts, and EU funding for cross-border digital mobility. Long-term sustainability could be secured through shared cost models between Member States and mobility operators.

Cost Drivers: Software development, integration and interoperability testing, cybersecurity, settlement infrastructure, data storage, customer support, regulatory compliance, and cross-border pilot operations.

7.11 Use Case Idea 11: European Mobility Data Hub (Platform Economy)

1. Basic Information

Use Case Name: European Mobility Data Hub



Short Summary: The European Mobility Data Hub proposes the creation of a shared European platform where public and private mobility operators exchange real-time traffic, transport, and usage data under unified EU standards. The hub acts as a transnational digital infrastructure enabling new cross-border services and business models in logistics, tourism, and smart city development. It strengthens Europe's mobility ecosystem by improving data accessibility, interoperability, and innovation capacity.

Main Objective: The main objective is to overcome the current fragmentation of mobility data across national and regional systems by establishing a unified European data framework. The hub aims to provide a seamless, interoperable, and secure data environment that supports innovative, data-driven mobility solutions across borders — fostering collaboration among public authorities, transport providers, ICT companies, and SMEs.

2. Transnational Context

Opportunity: Across Europe, mobility and transport systems generate large amounts of data — yet most of this information remains isolated within local or national systems. This fragmentation limits innovation, especially in cross-border mobility, logistics, and multimodal transport services. The European Mobility Data Hub addresses this challenge by creating a single European framework for mobility data sharing, allowing stakeholders from different countries to collaborate, innovate, and build new value chains around data-based services.

Technology Dimension: The hub relies on a combination of emerging digital technologies. These include cloud-based infrastructures and European Data Spaces (e.g. Gaia-X) for secure data storage and exchange; standardized APIs and IoT sensor networks for real-time data collection; and artificial intelligence for analytics and forecasting (e.g. traffic flow optimization, demand prediction). Blockchain and smart contracts may be used to ensure transparent, traceable, and trusted data transactions between participants.

Regulatory Dimension: The use case is designed in full alignment with EU policies and data regulations. It directly supports the *EU Data Act*, the *Intelligent Transport Systems (ITS) Directive*, and the *General Data Protection Regulation (GDPR)*. By following these frameworks, the hub ensures compliant and fair data use while promoting interoperability through open standards. The initiative also contributes to the broader EU strategy for *Common European Mobility Data Spaces* — one of the key enablers of the European Green Deal and the Digital Europe Programme.

Cross-Border Synergies: The European Mobility Data Hub leverages synergies between Member States by linking diverse mobility ecosystems. It allows operators from different regions — public transport providers, road authorities, and private logistics firms — to exchange and utilize data in real time. Through this, cross-border transport planning, multimodal journey optimization, and logistics coordination become significantly more efficient. Moreover, it creates opportunities for joint R&D projects, shared innovation pilots, and common digital standards across Europe. The platform also encourages collaboration among universities, data providers, and industrial clusters that specialize in transport technologies and digital transformation.

Industry Focus: The use case is positioned at the intersection of several industries: mobility, logistics, ICT, tourism, and smart cities. It supports the digital transformation of Europe's transport systems, enabling the development of new services such as predictive maintenance, smart parking, dynamic routing, and cross-border multimodal ticketing. The initiative also strengthens the competitiveness of the European data economy by creating a strategic asset: shared, high-quality mobility data.

SME Participation: Small and medium-sized enterprises (SMEs) are at the core of this use case. The data hub provides them with access to harmonized and high-quality datasets that would otherwise be unavailable or costly to obtain. This allows SMEs to design innovative, data-based applications such as route optimization tools, traffic analytics dashboards, or sustainability reporting services. Furthermore, open APIs and modular governance structures lower market entry barriers for smaller companies, enabling them to collaborate with larger players and public institutions. SMEs thus act both as innovators and beneficiaries, using the platform to expand their reach across European markets.

3. Concept Description

Detailed Description: The European Mobility Data Hub is envisioned as a transnational digital platform connecting public authorities, mobility providers, and technology companies. It collects, aggregates, and distributes data from various national sources in real time — including traffic volumes, public transport timetables, vehicle flows, energy usage, and environmental indicators. The hub offers standardized interfaces that allow participants to upload, access, and process data under defined access rules. Users can build applications directly on top of the shared data infrastructure or combine datasets to develop cross-sectoral services. By offering both open-access layers (for public data) and restricted commercial layers (for private data), the platform enables a balanced ecosystem for innovation and business development.

Transnational Added Value: The added value of the European approach lies in creating interoperability between previously fragmented systems. Instead of multiple national solutions, the hub introduces a shared standard across borders, making European mobility data truly accessible. This harmonization allows for EU-wide services such as cross-border traffic management, multimodal journey planning, and integrated logistics solutions. The transnational framework also facilitates policy benchmarking and the development of coordinated transport strategies among Member States.

Innovation Aspect:

- **Technological:** Integrating AI, IoT, and blockchain in a unified European data ecosystem.
- **Organizational:** Establishing new forms of collaboration between public and private actors.
- **Economic:** Enabling data-driven business models and new market entries for SMEs. The hub contributes to the creation of a European data economy, where information becomes an accessible and valuable resource for innovation and sustainability.

Expected Results / Outputs:

- A prototype of the European mobility data platform, including shared standards and interfaces.
- A governance model defining roles, rights, and responsibilities of participants.
- Pilot applications demonstrating cross-border data use (e.g. route planning, logistics optimization).
- Recommendations for policy alignment and the replication of the hub concept in other regions or sectors.

4. Business Model Perspective

Customer Segments: The platform serves a wide range of stakeholders, including public transport authorities, logistics companies, city administrations, infrastructure operators, and private app developers. Academic and research institutions may also use the hub for analysis and innovation studies.

Value Proposition: The European Mobility Data Hub provides a single, standardized point of access for mobility data across Europe. It eliminates data silos and creates transparency in how information is shared and monetized. Stakeholders benefit from improved operational efficiency, better decision-making, and access to new markets through cross-border collaboration.

Key Activities: The main activities include data collection, harmonization, and validation; operation of the digital infrastructure; ensuring compliance with legal frameworks; and supporting application development through APIs and developer tools.

Key Resources: Essential resources include the IT infrastructure (servers, APIs, storage), a robust governance and security framework, and partnerships with data owners and public authorities.

Key Partners: Key partners encompass EU institutions (e.g. DG MOVE, DG CONNECT), national and regional transport ministries, ICT providers, telecom companies, universities, and SMEs offering analytics or application services.

Revenue Model / Sustainability: The hub's operation could be financed through a hybrid model combining EU program funding (e.g. CEF, Horizon Europe) with revenue from premium services, analytics tools, or subscriptions. Over time, cost sharing among Member States or sector-specific partnerships may ensure long-term sustainability.

Cost Drivers: The primary cost factors are platform development and maintenance, data storage, compliance and security measures, and continuous standardization and partner coordination activities.

7.12 Use Case Idea 12: Cross-Border Autonomous Shuttle Corridor (Platform Economy)

1. Basic Information

Use Case Name: Cross-Border Autonomous Shuttle Corridor

Short Summary: The Cross-Border Autonomous Shuttle Corridor proposes an EU pilot connecting two or more neighboring cities through autonomous, electric shuttle services operating under harmonized European standards. The corridor demonstrates how automation, electrification, and digital connectivity can be combined to provide safe, efficient, and zero-emission transport across borders. It aims to reduce regulatory and technological fragmentation, strengthen European leadership in automated mobility, and establish a new transnational value chain around autonomous vehicle systems, digital infrastructure, and mobility services.

Main Objective: The main objective is to create a scalable and interoperable blueprint for cross-border automated mobility. The corridor seeks to validate autonomous shuttle operations under real-world conditions, harmonize regulations and permits across Member States, and demonstrate how autonomous transport can strengthen labor mobility, improve regional connectivity, and reduce congestion. The initiative also aims to accelerate deployment of automated mobility solutions by fostering collaboration among cities, OEMs, telecom providers, research institutions, and SMEs.

2. Transnational Context

Opportunity: Across Europe, cross-border regions face persistent mobility challenges: fragmented public transport networks, congested border crossings, labor shortages, and limited first-/last-mile options. Autonomous shuttles offer an opportunity to modernize and decarbonize regional mobility by providing reliable, frequent, and low-cost transport services. The corridor supports EU goals in connected and automated mobility (CAM), climate neutrality, and multimodal integration while offering a highly visible demonstration of European technological leadership. It also serves as a test environment for emerging standards and creates the foundation for future pan-European autonomous transport corridors.

Technology Dimension: The corridor is enabled by a combination of cutting-edge technologies: autonomous driving systems, V2X communication for cooperative safety, 5G/edge infrastructure for low-latency control, and AI-driven perception and navigation. Cloud-based control centers ensure remote supervision and safety fallback, while digital twins support planning, validation, and optimization. Harmonized data interfaces enable continuous operation across national borders, ensuring that shuttles interact seamlessly with traffic control systems, digital infrastructure, and local MaaS platforms.

Regulatory Dimension: The use case aligns with EU type-approval frameworks for automated vehicles, the ITS Directive, and cybersecurity and software-update regulations (UNECE R155/R156). Automated Lane Keeping System standards (UN R157) support operational safety. Cross-border deployment requires cooperation between national authorities on safety validation, operational permits, data governance, and liability frameworks. Local regulations are adapted to define geofenced autonomous driving zones and procedures for integrating autonomous vehicles into multimodal public transport networks.

Cross-Border Synergies: The corridor strengthens collaboration between neighboring Member States by sharing testing environments, harmonizing operational procedures, co-investing in digital infrastructure, and aligning mobility strategies. It supports natural cross-border regions—AT–DE, BE–NL, FR–LU, SI–HR—where cities and labor markets are tightly interconnected. Joint R&D programs and pilot sites encourage technology exchange, accelerate standardization, and build a shared European competency base for autonomous mobility.

Industry Focus: The use case spans several industry domains: autonomous vehicle manufacturing, ICT and 5G networks, cybersecurity, public transport operations, mapping and simulation technologies, and digital mobility platforms. It creates a coordinated European value chain from vehicle production and sensor integration to fleet operations, remote supervision, infrastructure development, and data services.

SME Participation: SMEs play a key innovation role by supplying specialized components such as sensors, communication modules, cybersecurity systems, perception software, and fleet-management tools. They support deployment through mapping, maintenance, local testing, and integration services. Cross-border pilots give SMEs access to new markets and procurement opportunities, allowing them to scale their technologies and contribute to Europe's autonomous mobility ecosystem.

3. Concept Description

Detailed Description: The Cross-Border Autonomous Shuttle Corridor is a demonstration environment where electric autonomous shuttles operate between multiple cities across national borders. The concept includes the deployment of autonomous vehicles, roadside V2X units, digital twins, 5G/edge networks, remote-control centers, and harmonized operating procedures. The corridor provides frequent, low-emission transport on routes with limited public transport options, supports first-/last-mile mobility, and offers a safe and efficient alternative to congested border crossings. Data from the corridor flows into shared platforms, enabling route optimization, fleet management, incident response, and multimodal integration with regional mobility services.

Transnational Added Value: Instead of isolated national pilots, the corridor creates a unified testing and deployment environment that reflects real European mobility conditions. It ensures that autonomous shuttles remain interoperable across borders and provides insights for EU-wide regulatory alignment. The shared infrastructure supports EU-wide services such as cross-border mobility planning, real-time passenger information, and coordinated public transport operations. The corridor helps Member States benchmark policy approaches and identify common investment needs.

Innovation Aspect:

- **Technological:** Integration of autonomous driving, 5G, V2X, AI navigation, and digital twins in a cross-border environment.
- **Organizational:** New cross-border governance structures, joint permitting processes, and remote-operation models.
- **Economic:** Development of a European market for automated shuttle services, digital infrastructure, and mobility-as-a-service applications.

Expected Results / Outputs:

- A fully operational cross-border autonomous shuttle pilot with harmonized standards.
- Technical documentation, operating procedures, and safety validation frameworks.
- Insights for EU-level regulation of automated mobility.
- Scalable deployment concepts for additional corridors.
- Evaluation results informing future CEF and Digital Europe investments.

4. Business Model Perspective

Customer Segments: City authorities, regional governments, public transport operators, industrial parks, mobility-as-a-service providers, telecom operators, infrastructure agencies, and cross-border mobility alliances.

Value Proposition: A safe, automated, zero-emission mobility service that operates across borders and fills mobility gaps in underserved regions. It reduces labor dependency, increases service frequency, and improves user convenience. The corridor demonstrates European technological leadership and provides a blueprint for large-scale autonomous mobility deployments.

Key Activities: Operating and maintaining autonomous shuttle fleets; ensuring connectivity; managing remote-control centers; coordinating with local and national authorities; performing safety validation; optimizing routes using AI; conducting pilot tests; and updating digital and physical infrastructure.

Key Resources: Autonomous electric shuttles; V2X communication equipment; 5G/edge networks; digital twins; cybersecurity frameworks; mapping tools; remote-control centers; and specialized technical staff.

Key Partners: Municipalities; regional governments; OEMs; telecom and 5G providers; research institutions; cybersecurity experts; SMEs; public transport operators; and EU mobility agencies.

Revenue Model / Sustainability: Revenues can derive from public service contracts, EU funding (CEF, Horizon Europe, Digital Europe), partnerships with industry parks, mobility service integrations, and potential long-term concession models. Demonstration phases may rely on a mixed public–private funding structure.

Cost Drivers: Vehicle deployment and maintenance; digital and telecom infrastructure; remote supervision; cybersecurity; regulatory approvals; technical integration; insurance; workforce training; and ongoing operational costs including connectivity, data services, and updates.

8. Conclusion

Deliverable D3.2.1 provides a clear and structured foundation for the upcoming exploitation and implementation work in A3.3. Through a fast but systematic co-creation process, the consortium succeeded in turning broad transformation topics into **twelve initial use case approaches**, each offering a concrete starting point for further development, piloting, and transnational coordination.

The development process combined expert input, regional knowledge, and structured **Design Thinking** approach to quickly generate usable results despite time constraints and the complexity of the topics. By involving practitioners from industry, SMEs, research, and regional agencies, the process ensured that the ideas are not abstract visions, but **realistic starting points** aligned with market needs, technological feasibility, and Central Europe's industrial capabilities.

The **twelve use case ideas** now provide **initial strategic directions** and **problem-solution outlines**, including first thoughts on beneficiaries, value creation, and cross-border collaboration potential. They serve as intermediate step between the foresight scenarios developed in A1.2 and the exploitation logic in A3.3, ensuring that the next project phase can focus on prioritisation, investment logic, partnership models, and policy alignment rather than starting from scratch.

Each use case now contains a first actionable outline to guide the work in A3.3:

1. **Circular Resource Loop for E-Mobility:** Basic workflow for collecting, dismantling, and tracing battery materials.
2. **Improve UX When Charging**: First concept for a unified cross-border charging interface and roaming layer.
3. **Lower Operation and Energy Costs:** Modular setup combining renewables, storage, and smart energy management.
4. **Autonomous Transportation for Tourists and Commuters:** Initial idea for automated shuttle services in regional mobility.
5. **Remote Operation & Automated Parking for Bus Fleets:** Basic model for depot automation and remote maneuvering.
6. **Autonomous Agricultural Vehicles:** Initial outline for plant monitoring and intervention via automated field robots.
7. **Low-Cost V2X Deployment Kit:** Affordable municipal RSU starter package with simple installation logic.
8. **Automated V2X Compatibility Checker:** First concept for a digital service validating interoperability between systems.
9. **EU V2X Deployment Playbook:** Structured guideline for harmonised standards, rollout, and procurement.
10. **Cross-Border Ticket Wallet:** Initial model for integrating European ticketing systems into one digital wallet.
11. **European Mobility Data Hub:** Simple governance and data exchange concept for cross-border mobility data.
12. **Cross-Border Autonomous Shuttle Corridor:** Early outline for a coordinated test and deployment corridor.

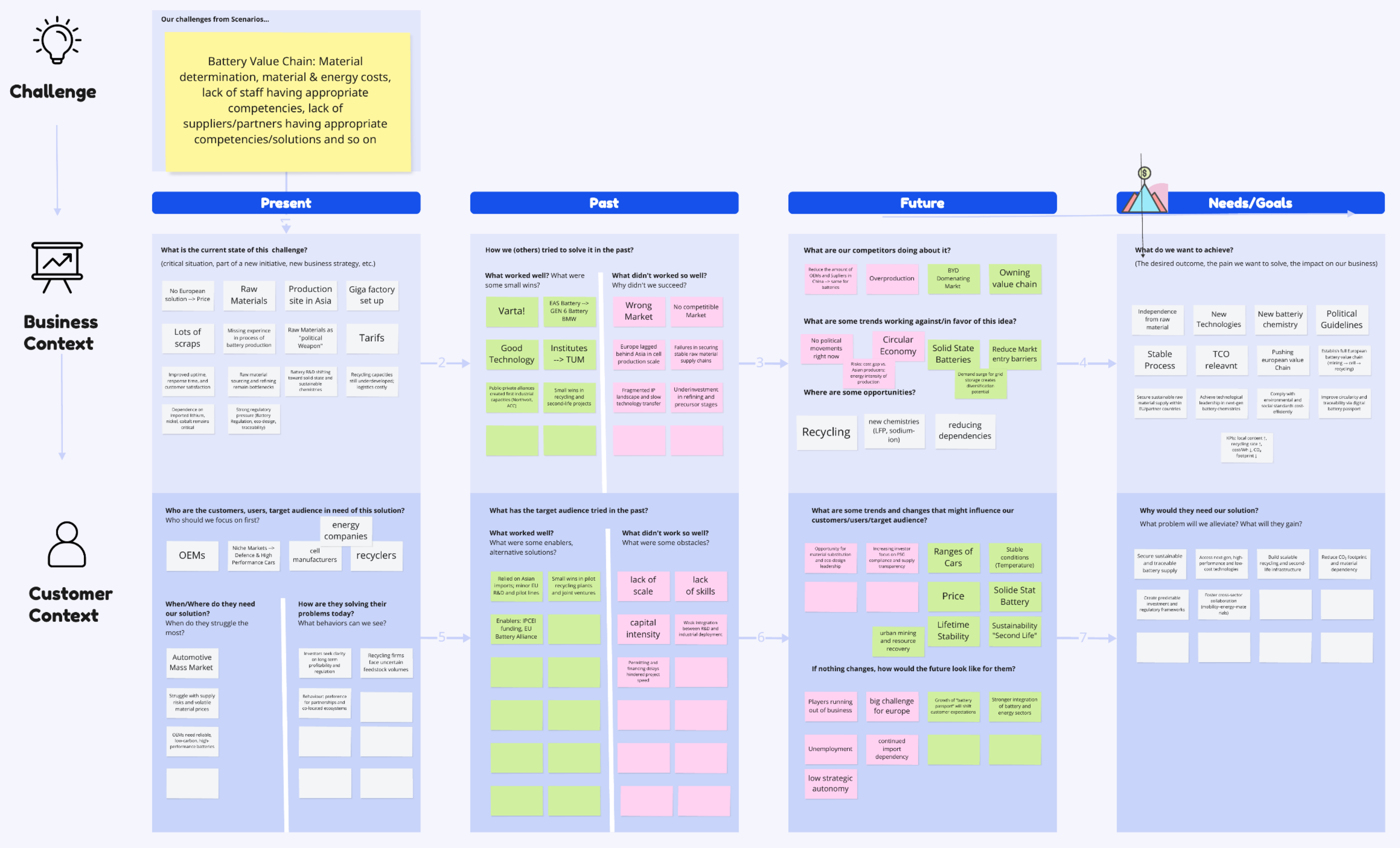
These initial approaches are **not final business models**, but they give A3.3 everything needed to move forward with prioritisation, feasibility studies, pilot design, and transnational exploitation activities.

Overall, D3.2.1 delivers a set of **clear, ready-to-use innovation starting points**. The process transformed expert knowledge, regional insights, and complex thematic areas into **twelve actionable use case approaches** that now serve as the operational basis for A3.3. The results are practical, aligned with real needs, and structured so the consortium can directly continue with evaluation, pilot design, partnership building, and policy alignment in the next phase.

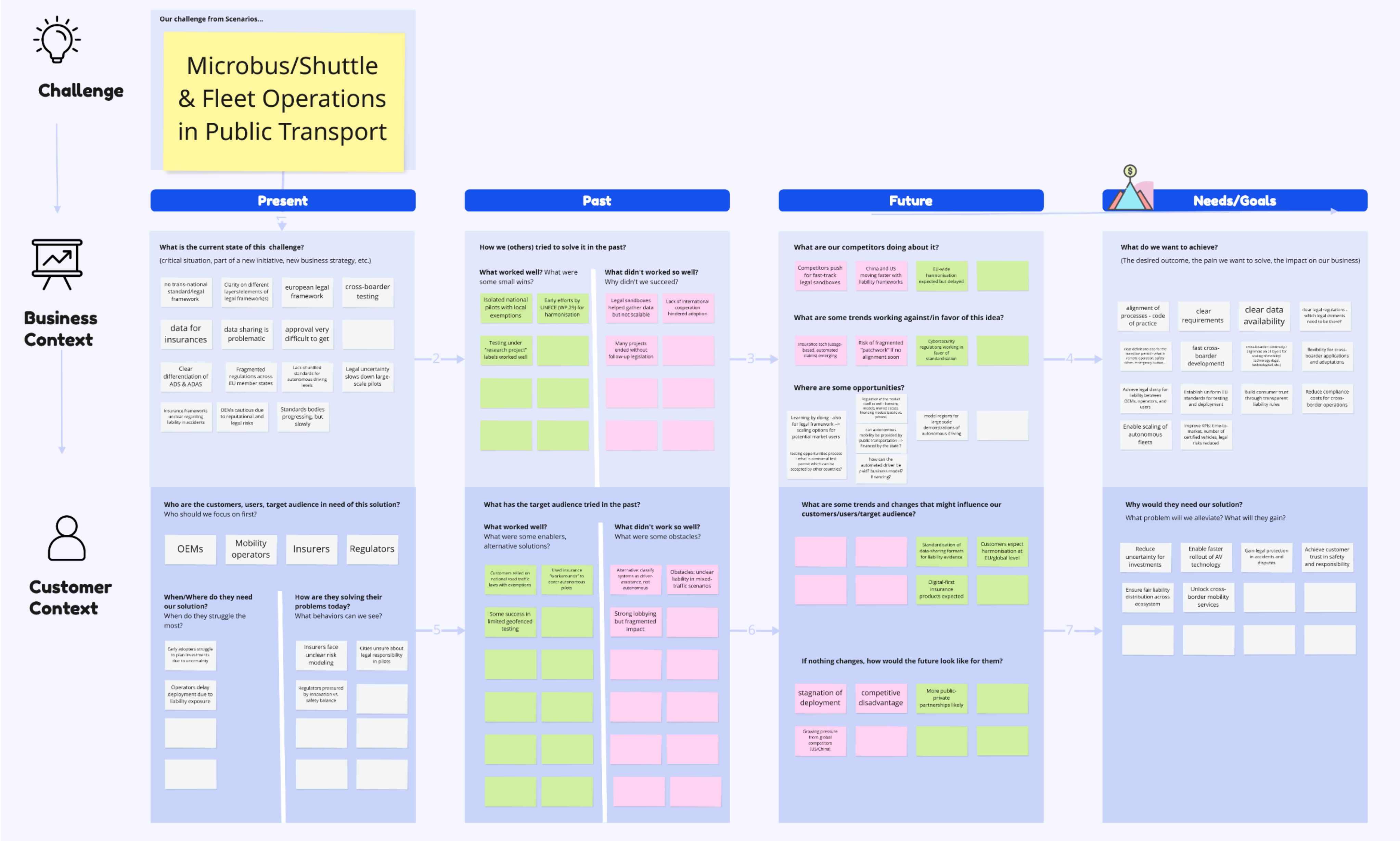
Appendix

Appendix 1: Problem Defining Canvas - EV Value Chain

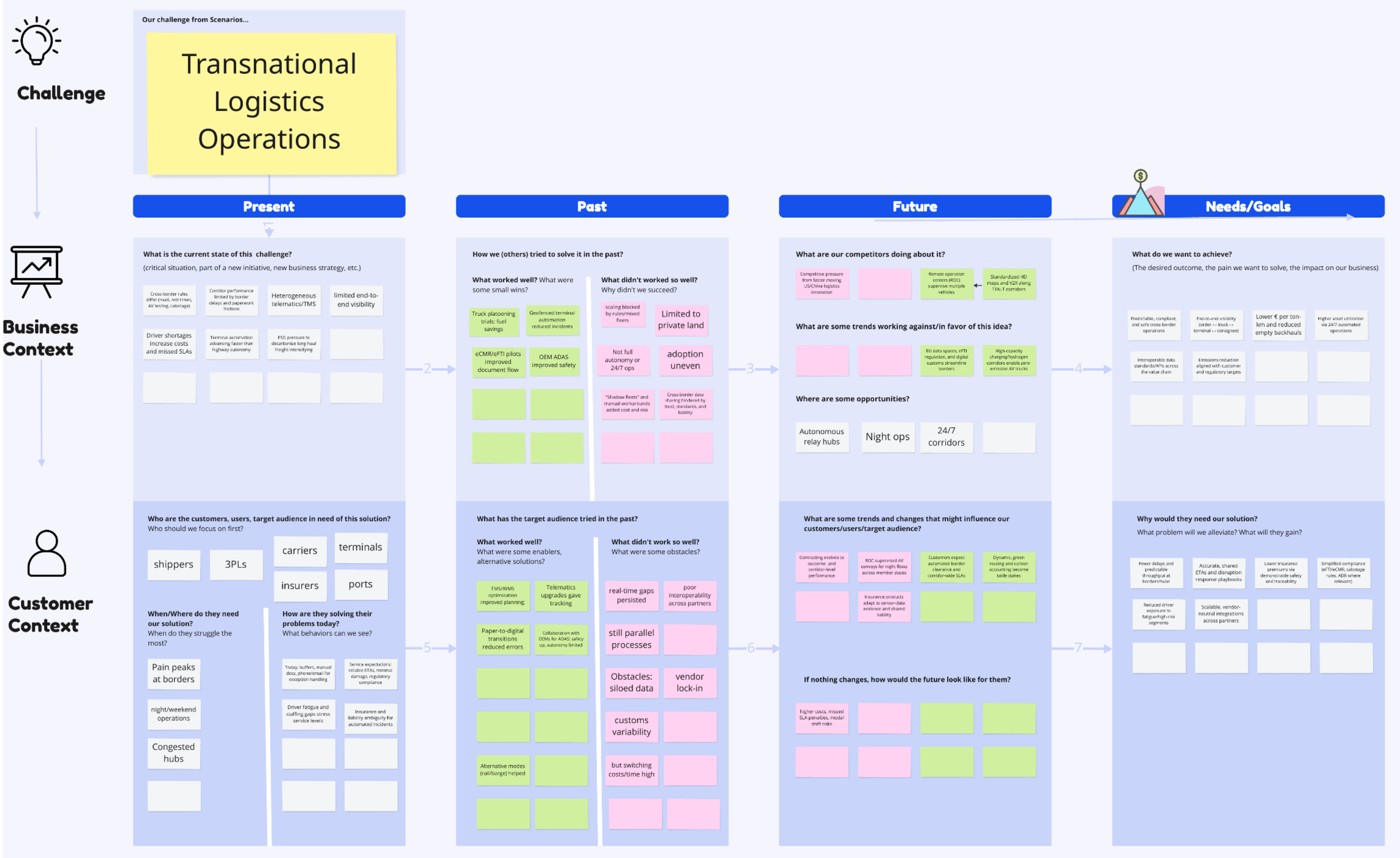
Appendix 2: Problem Defining Canvas - Charging Services



Appendix 3: Problem Defining Canvas – Battery Value Chain

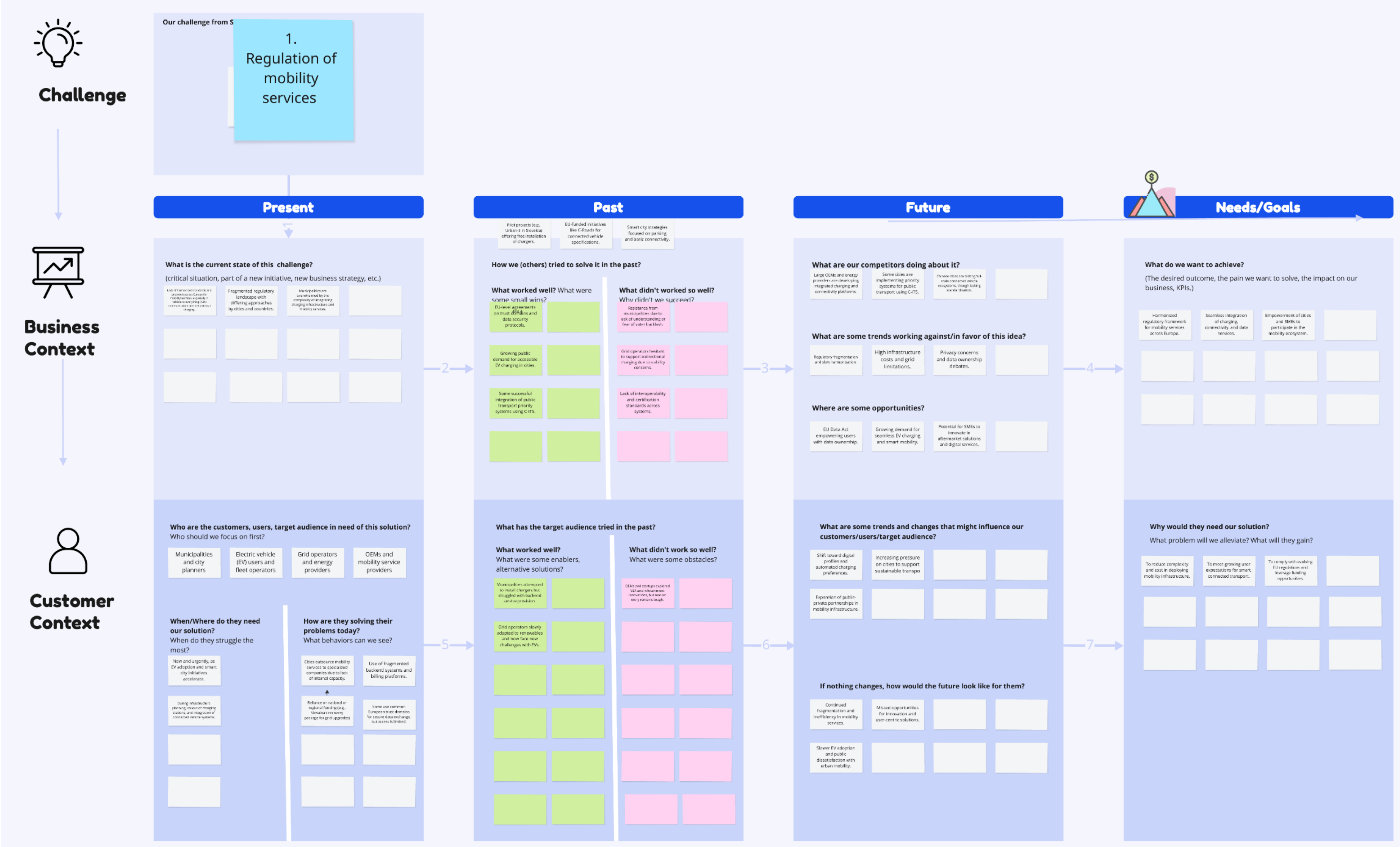


Appendix 4: Problem Defining Canvas - Microbus/Shuttle & Fleet Operations in Public Transport



Appendix 5: Problem Defining Canvas – Transnational Logistics Operation

Appendix 6: Problem Defining Canvas – Special Vehicles

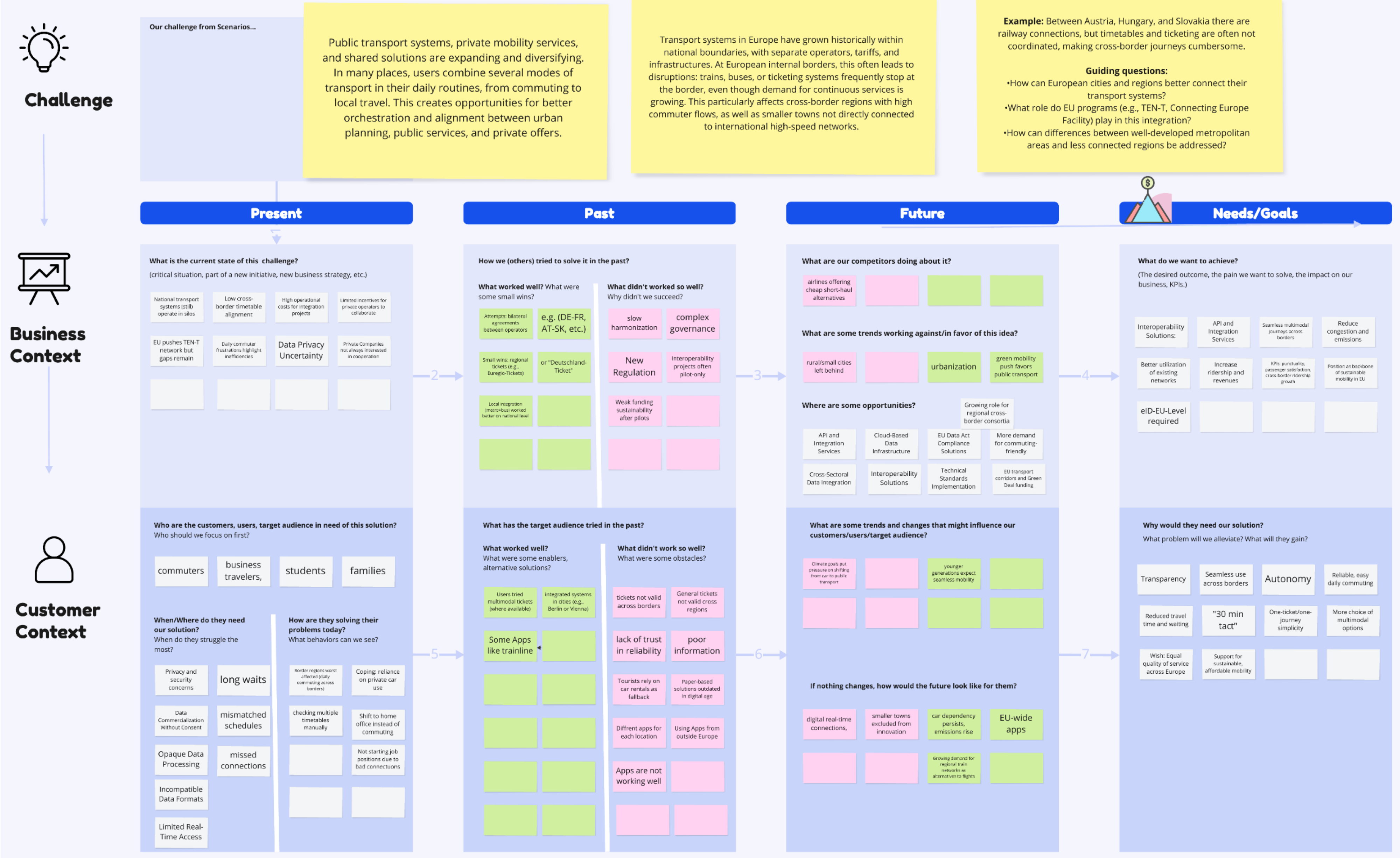


Appendix 7: Problem Defining Canvas – Regulation of Mobility Services

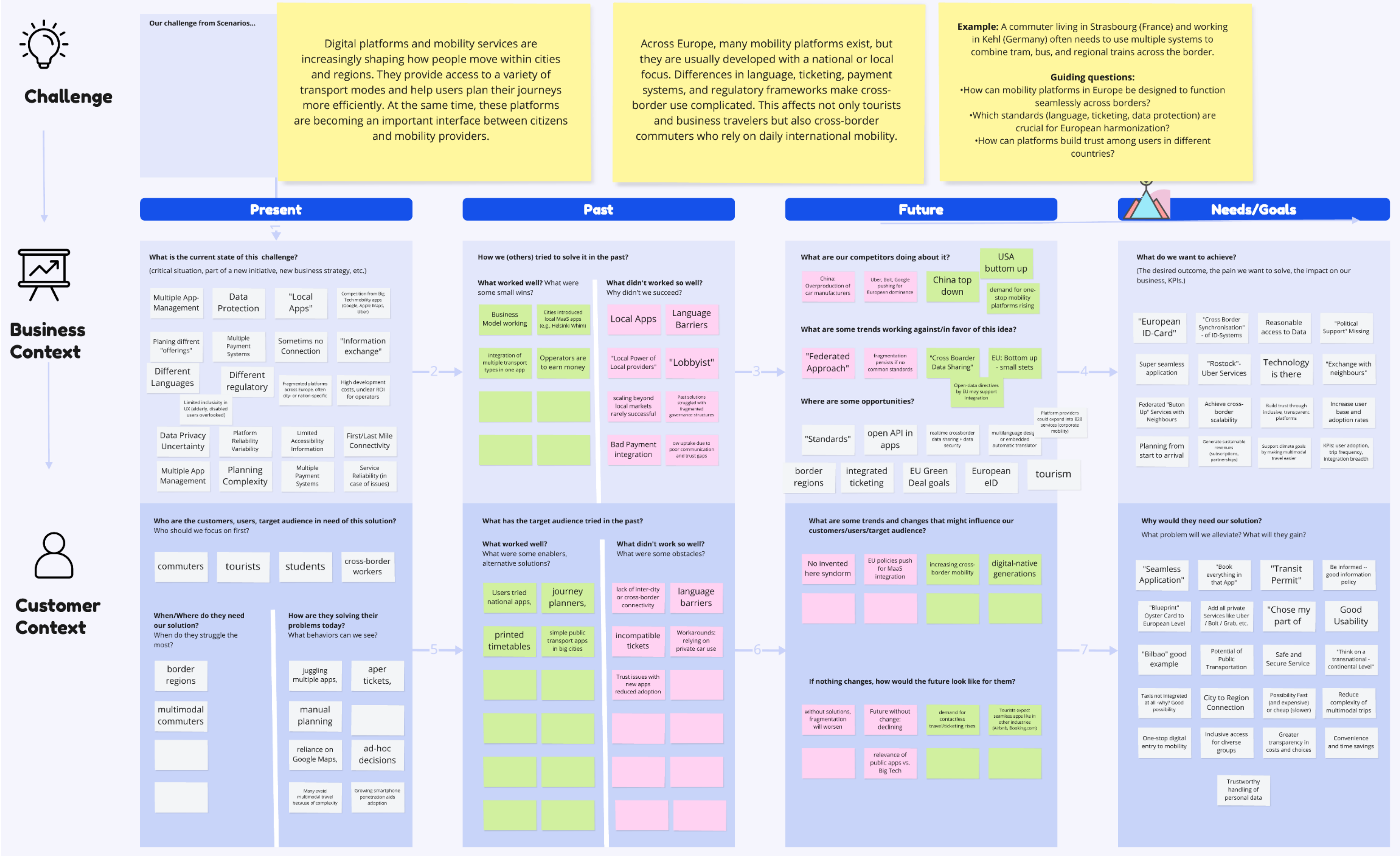
Appendix 8: Problem Defining Canvas – Infotainment and digital Services

Appendix 9: Problem Defining Canvas – V2X, V2V and Connectivity

Appendix 10: Problem Defining Canvas – User-Centered Mobility Platforms



Appendix 11: Problem Defining Canvas – Data-Driven and Emerging Mobility Solutions



Appendix 12: Problem Defining Canvas – Integration of Transport Systems