

THE HyEfRe NEWSLETTER

HYDROGEN INTEGRATION FOR EFFICIENT RENEWABLE ENERGY SYSTEMS



ABOUT THE PROJECT:

Sector-coupling is a promising approach to replace fossil fuels with renewables. However, this idea of “electrifying” the entire economy requires the rollout of new technologies and rules. **The HyEfRe project helps with this by establishing green hydrogen ecosystems in eight regions.** The partners foster an investment-friendly environment for renewable energy and green hydrogen technologies. They evaluate hydrogen potentials with a new model and develop and test a new tool to calculate ideal parameters for technical plants. Their action plan for policy actors will reduce regulatory barriers impeding a timely expansion of renewables and green hydrogen.

CONTENTS:

1. From regional data to hydrogen potential: Testing the Hydrogen Potential Model
2. From hydrogen potential to practical solutions: testing the HyEfRe Decision Support Tool

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From regional data to hydrogen potential: Testing the Hydrogen Potential Model

The transition towards climate-neutral energy systems requires more than ambitious targets. Regions and municipalities need practical tools that can help them understand where renewable energy and green hydrogen can realistically contribute to their future energy systems. Within the HyEfRe project, the Hydrogen Potential Model (HPM) was developed to address precisely this challenge.

The HPM is designed as a web-based decision-support tool that combines renewable energy generation, electricity demand and techno-economic parameters to estimate the potential for hydrogen production. By working with hourly energy data, the model can identify periods when renewable electricity exceeds local demand and assess how this surplus could be used for hydrogen production. The tool also provides indicators such as hydrogen production potential, electrolyser utilisation, Levelized Cost of Hydrogen (LCOH) and payback periods.

Between late 2025 and spring 2026, the model was tested in three very different Central European contexts: the Šaleška region in Slovenia, the Mazovia region in Poland and the City of Pécs in Hungary. The diversity of these locations was an important part of the pilot approach. The aim was not only to test whether the model works technically, but also to understand how data availability, local infrastructure, economic conditions, regulation and stakeholder capacity influence its practical use.

The Hydrogen Potential Model (HPM), a web-based decision-support tool, helps users estimate how much green hydrogen could be produced from renewable energy sources in a specific region and what infrastructure would be needed.



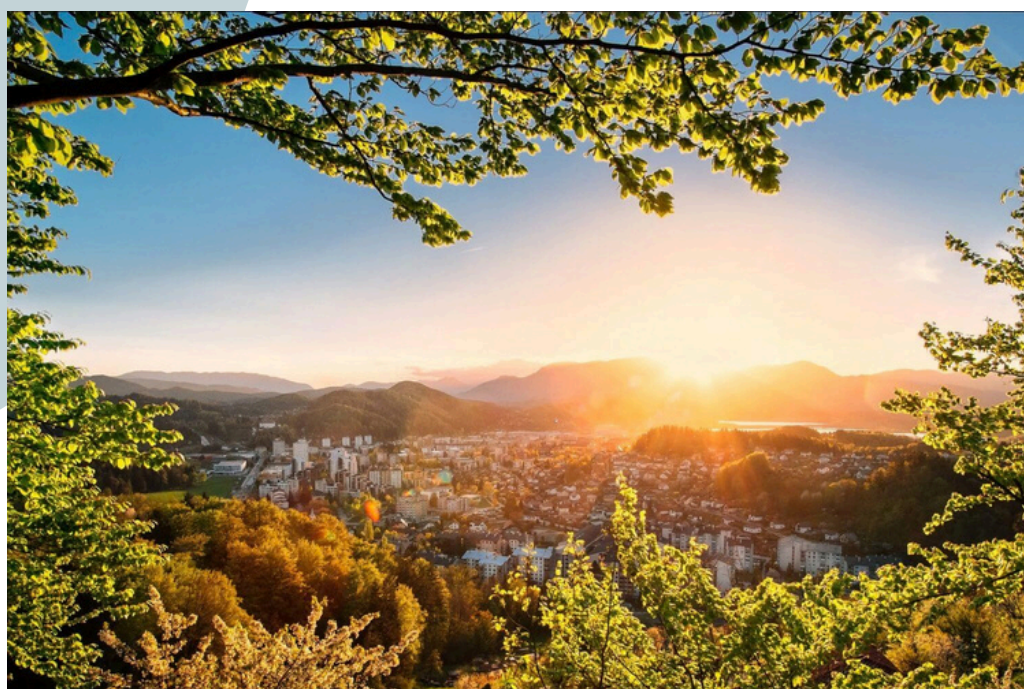
HyEfRe's pilots showed that hydrogen can be a mass-production opportunity in a former coal region like Slovenia's Šaleška Valley.

Šaleška: large-scale renewable energy as the key condition

The Šaleška pilot provided a particularly relevant example of how additional renewable generation can fundamentally change the hydrogen potential of a region. The region is undergoing a major energy and economic transition following decades of coal-based electricity production. The pilot therefore explored the potential of a proposed 130 MWp floating photovoltaic system on Družmirje Lake.

The modelling showed a clear difference between the current situation and a future system with large-scale floating PV. Under the baseline scenario, existing renewable generation provides only limited surplus electricity and hydrogen production remains very small, with long payback periods. The introduction of the 130 MWp floating PV system substantially increases the amount of renewable electricity available for electrolysis. Under higher hydrogen demand, the model estimated production in the range of several thousand tonnes per year, although seasonal differences remain significant.

The analysis also highlighted an important planning issue: solar generation alone cannot guarantee stable hydrogen production throughout the year. During summer, renewable electricity can exceed the requirements of the hydrogen system, while winter brings periods of insufficient solar generation. Complementary renewable sources, hydrogen storage or flexible demand would therefore be needed for a year-round hydrogen system.



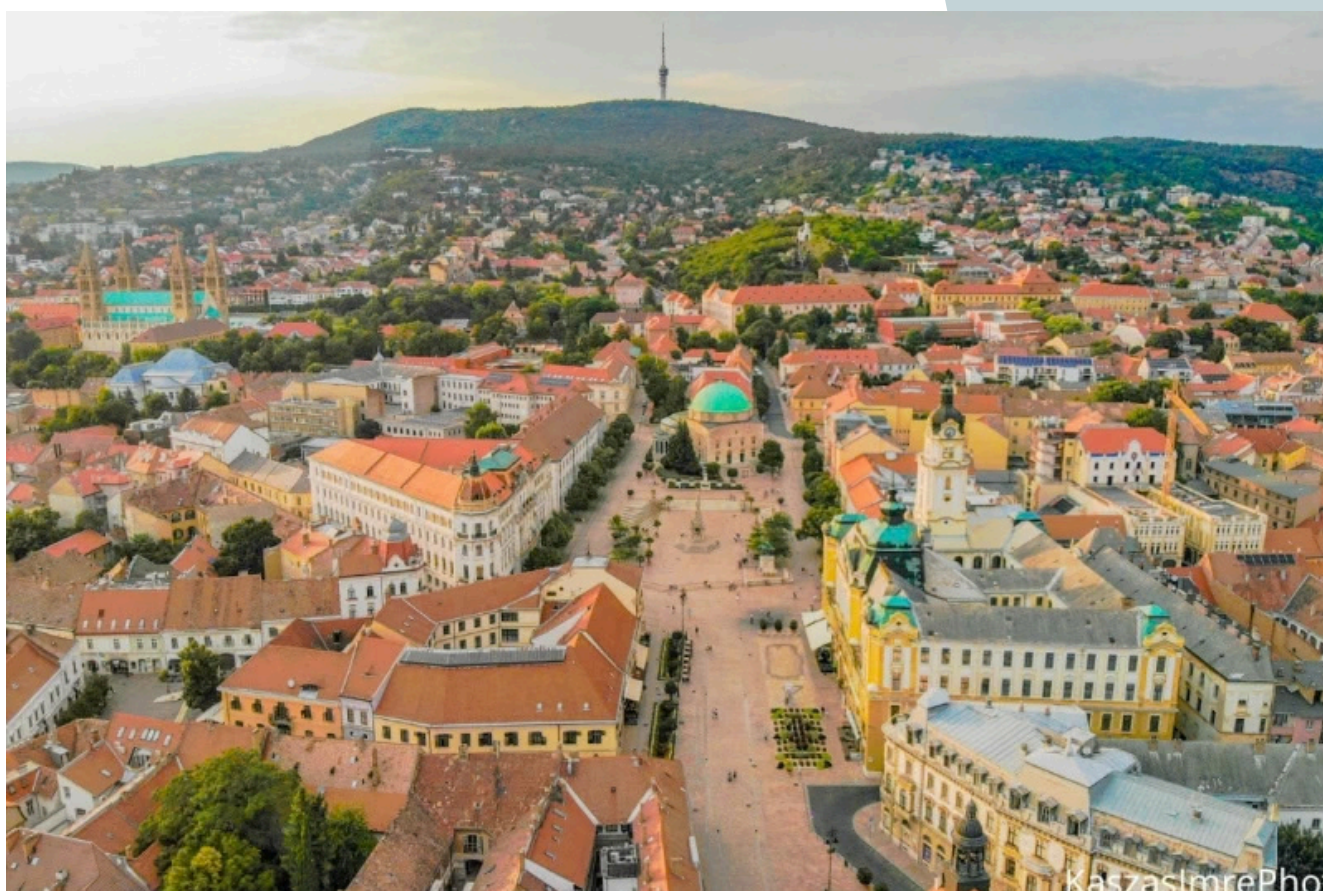
Šaleška valley (source: visitsaleska.si)

The Šaleška pilot also demonstrated the importance of considering infrastructure beyond the model's direct calculations. Existing grid infrastructure, access to water from Družmirje Lake and the proximity of the district heating system could provide important advantages for future hydrogen development.

Mazovia and Pécs: different contexts, different hydrogen roles

The pilot in Mazovia demonstrated another important dimension of hydrogen planning. In a large metropolitan region such as Warsaw, limited space for renewable generation and high electricity demand mean that hydrogen may have a different role than in a region with large-scale renewable generation potential. The analysis therefore considered hydrogen in the context of flexibility, energy resilience and the integration of renewable electricity into a complex urban energy system.

Pécs provided yet another perspective, representing a medium-sized regional centre where renewable energy potential, infrastructure and future hydrogen demand need to be considered together. The pilot demonstrated that hydrogen opportunities cannot be assessed solely on the basis of renewable resources. Local demand, infrastructure, economic conditions and institutional capacity are equally important.



Pécs (source: parking-hungary.hu)

Data is often harder than modelling

One of the strongest lessons from the pilots was that preparing reliable data can require more time and effort than actually running the model. The HPM uses hourly data on electricity consumption and renewable generation, which means that data must be collected, cleaned, converted and validated before it can be used.

The pilots also showed the value of allowing synthetic renewable generation profiles where measured data is unavailable. At the same time, the results need to be interpreted carefully when they rely on assumptions or simulated data rather than operational measurements.

The pilot experience also identified several opportunities for further improvement. Users highlighted the need to modify and rerun existing scenarios more easily, to display input assumptions alongside results and to improve data preparation and validation. These improvements would make the tool more efficient for iterative planning and sensitivity analysis.

Supporting better decisions at an early stage

The overall pilot experience confirms the value of the HPM as an early-stage strategic planning tool. It enables regions to move beyond general discussions about hydrogen and examine concrete questions: How much renewable electricity is available? How much hydrogen could potentially be produced? Which assumptions have the greatest influence on costs? And what infrastructure or market conditions would be required?

At the same time, the pilots underline that the HPM should not replace detailed engineering studies, financial due diligence or regulatory assessment. Its greatest value lies in helping stakeholders identify opportunities, compare scenarios and understand the conditions under which hydrogen could become part of a future regional energy system.

For HyEfRe, the pilot testing therefore represents more than a technical validation exercise. It provides practical experience that can be used to improve the model and help Central European regions make better-informed decisions about their future hydrogen and renewable energy strategies.

From hydrogen potential to practical solutions: testing the HyEfRe Decision Support Tool

Identifying hydrogen potential is an important first step, but regional stakeholders also need to understand what a potential hydrogen system could look like in practice. How large should an electrolyser be? How much renewable energy would be required? What role could battery storage play? How would subsidies affect the economics? And can a hydrogen system meet the demand of local users?

The HyEfRe Decision Support Tool (DST) was developed to help answer these questions. During the pilot action, the tool was tested across three Central European regions - Landkreis Passau and Landshut in Germany, and Pécs in Hungary - using real locations, local data and different future scenarios. In total, the pilot testing covered 77 simulation scenarios across nine micro-locations.

The DST optimises integrated renewable energy and hydrogen systems, considering elements such as photovoltaic and wind generation, battery storage, electrolyzers, hydrogen storage, fuel cells, waste heat and grid connections. Scenarios were assessed for different time horizons and subsidy assumptions, providing stakeholders with a structured way to compare possible development pathways.

Three regions, three different hydrogen realities

In Landkreis Passau, hydrogen development is closely connected to mobility. The region already has an active hydrogen mobility ecosystem and a fleet of hydrogen trucks, while planned infrastructure along the TEN-T corridor provides an additional driver for hydrogen deployment.

The pilot showed how strongly system economics depend on the combination of renewable generation, hydrogen demand and financial support. At Vilshofen, for example, the modelling showed that increasing renewable generation through the integration of wind power could significantly increase hydrogen production. In the long-term 2050 scenarios, the system could reach several thousand tonnes of hydrogen production per year, while all hydrogen remained 100% renewable.

The Passau pilot also highlighted the importance of using hydrogen alongside other products and energy streams. At Bad Griesbach, for example, oxygen from electrolysis could provide an additional source of revenue. Waste heat and other forms of sector coupling can similarly influence the overall value of an integrated energy system.



Passau (source: expedia.com)

Pécs: when hydrogen is not automatically the optimal solution

The Pécs pilot demonstrated an equally important lesson: a hydrogen system is not necessarily the best use of available renewable electricity in every location.

At the wastewater treatment plant, the DST consistently selected photovoltaic generation combined with battery storage rather than hydrogen production. The electrolyser remained inactive because there was no sufficient external hydrogen demand and grid-export restrictions limited alternative uses of surplus renewable electricity.

This result illustrates the value of a decision-support tool. Rather than assuming that hydrogen should be deployed, the DST can compare different technologies and identify when another solution may currently provide greater system value.

At the same time, the pilot identified barriers to future hydrogen deployment, including the need for external hydrogen demand and restrictions affecting the use of local software in some organisations.

Landshut: different business models require different solutions

Landshut provided an opportunity to test the DST across three very different applications: hydrogen for logistics trucks, industrial hydrogen demand and hydrogen production linked to the gas grid.

The results demonstrated that hydrogen demand is one of the most important factors determining whether an electrolyser becomes economically relevant. At the Reproduction Technologies site, the tool was able to meet hydrogen demand in most scenarios, with the economics improving significantly under higher hydrogen prices and subsidy conditions.

The Gas Grid/Isarkanal case demonstrated both the potential and the current limitations of the tool. The site has access to a 5 MW hydropower resource, providing a strong renewable electricity base. However, the DST repeatedly selected an electrolyser of only around 1.2 MW, despite the much larger available hydropower capacity. This revealed a sizing limitation that needs to be addressed before the model can fully represent this type of application.

The pilot also identified issues in the component cost database. Some equipment costs differed substantially from market values, while LCOH results were not available for the gas-grid injection scenarios. These findings provide concrete priorities for future tool development.



Landshut (source: expedia.com)

Subsidies make a measurable difference

One of the clearest findings across the three regions was the impact of financial support. Comparing scenarios with 0% and 50% capital expenditure support consistently showed substantial improvements in project economics. Across the pilot regions, subsidy assumptions reduced payback periods and improved internal rates of return.

This comparison is particularly useful for public authorities and project developers because it demonstrates how policy instruments can influence the feasibility of renewable hydrogen investments. The DST therefore provides not only technical information but also a way to explore the relationship between technology choices and financial conditions.

What the pilots taught us

The pilot testing confirmed that the DST can support early-stage planning of integrated renewable energy and hydrogen systems. It performed particularly well for PV and battery systems, renewable hydrogen production in Passau and industrial hydrogen demand scenarios in Landshut.

At the same time, the testing identified several improvements needed before the tool can be used confidently by non-expert stakeholders. These include correcting component cost data, improving electrolyser sizing, adding missing outputs for some applications, improving fuel-cell modelling and making the software easier to access and understand.

Perhaps the most important lesson is that hydrogen projects need a clear demand anchor. Where there is a defined hydrogen customer, mobility application, industrial process or other source of demand, hydrogen can become an important component of an integrated renewable energy system. Where such demand is absent, the model may identify batteries or direct electricity use as more appropriate solutions.

The 77 pilot scenarios therefore provide more than a test of software functionality. They demonstrate how digital decision-support tools can help regions compare technologies, explore future scenarios and identify the conditions needed for successful hydrogen deployment. The experience gained through the HyEfRe pilots will feed directly into further improvements of the DST and support its future application across Central Europe.

Hydrogen Potential Model is fully integrated within the HyEfRe Decision Support Tool. Tools are available [here](#).

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