



DELIVERABLE D.T1.1.5 “ANALYSIS OF PAPER-PLASTIC VALUE CHAIN AND INNOVATION SYSTEM”

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FOREWORD- COUNTRY CONTEXT

The most powerful sectors of the Slovak economy belongs to the cellulose-paper industry. It consists of a total of 11 companies affiliated to the Union of the cellulose-based industries. This sector covers 100% of the production of paper and most of the production of goods in the entire industry. Pulp is produced at Mondi SCP, a. s., Ružomberok and in Bukóze Holding, a. s., Hencovce. The largest processors of recovered paper are Metsa Tissue Slovakia s. r. o. and SHP Harmanec, a. s.

Packaging producers have in comparison with the paper and cellulose producers more advantageous position, particularly in terms of energy consumption in production and lower costs of upgrading. In the Slovak Republic there are several manufacturers of packaging. The production of cardboard packaging from corrugated cardboard, which are used for transport and storage of various products, such as of Duropack Turpak Packaging, which is trying to benefit from the boom in the automotive and electrical industry and specializes in packaging for automotive components and large-TV screens. Grafobal in Skalica, on the other hand specialises in plain cardboard covers and mainly invests in graphic editing packages.

Cellulose-paper and packaging industry in Slovakia is responding to the increased demand for biodegradable and compostable packaging continues the trend of increasing production of paper the construction of two new production units for the manufacture of packaging materials, in the company Mondi SCP a.s. Ružomberok and Bukóza Holding a.s., Hencovce.

Biodegradable plastics are not manufactured by that time in Slovakia, some products in particular biodegradable bags for shopping are on the market, but are based on the import of materials (prevalent Mater-Bi, from Novamont, Italy).

For paper (cardboard) /bioplastics – this is a bioplastic composite material with traditional plastic benefits of processed papers, but free of conventional plastics. Of the characteristics can be picked up, that these products are 100% biodegradable, do not contain PE and other conventional plastics, are structurally rigid, heat weldable, water resistant and are well printable. In addition, they are a solid, flexible and have low weight. They can be supplied in roll form and find application in many applications such as packaging materials, food containers, cups, saucers, etc. The ideal way to disposal after use is composting.

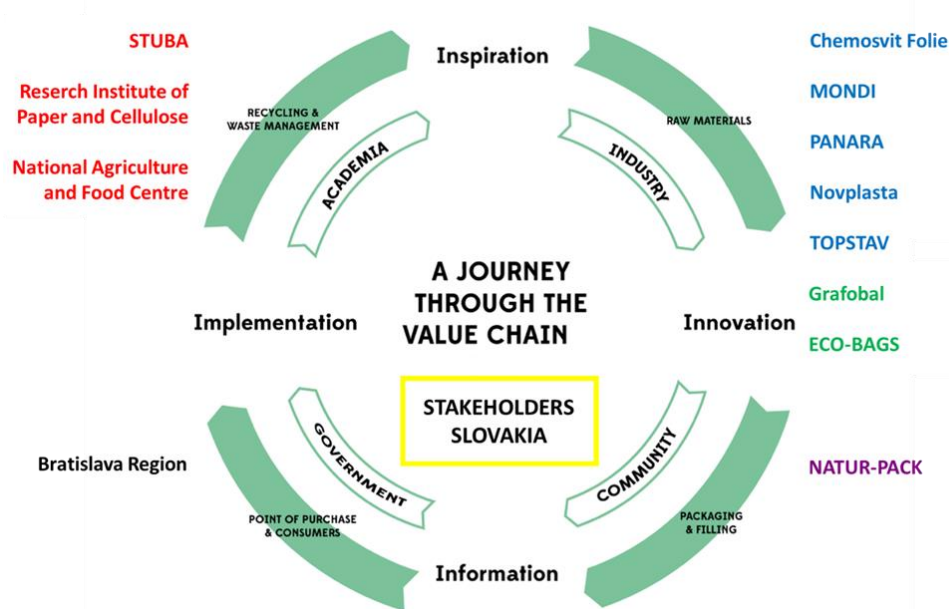
ANALYSIS OF THE VALUE CHAIN IN SLOVAKIA

Analysis of value chain in Slovakia in the field of composite materials, paper/biodegradable plastic is pursuing a strategy of creating conditions for the research and implementation of the research results in the industry with an efficient processing of both materials to sustainable organic products with added value is in line with the demand of the European markets. Another goal is to increase the rate of innovation to meet the increasing demands of customers on the Slovak plant on products capable for foreign and domestic market. Also progressively are welcomed the proposals of the production technology of biodegradable packaging biodegradable barrier paper-based packaging, packaging materials and intelligent biopolymers and their combination in order to achieve increased production and sale of products and the strengthening of the competitiveness of industrial enterprises in Slovakia

The strategy envisages a partial substitute for the use of biodegradable non-biodegradable plastic packaging, which are hazardous to the environment, the world's oceans, by new, biologically, degradable and compostable packaging. The consortium of the BIOCMPACK-CE project currently has 11 stakeholders, representing all the major value chain players: raw materials suppliers (MONDI, PANARA), packaging producer (GRAFOBAL, ECO-BAGS, CHEMOSVIT FOLIE, brand owners and retailers, producer responsibility organizations, as well as other technology suppliers and end users of the secondary raw materials.

In Slovakia basically the paper a strong commodity but in case of bioplastics a value chains is represented only by potential producers of raw materials which can be utilized at final packaging converters and users. Therefore, the specific data from paper/bioplastics are not up for grabs.

A journey of our stakeholders through the value chain



There are numerous approaches to increase the commercialization of bio-based materials in packaging. In general, the commercialization process could benefit from strong stakeholder involvement and the creation of partnerships and institutions to promote the research and institutional support necessary to enhance the state-of-the-art in bio-based packaging and overcome current barriers to implementation. Advancing commercialization can be done in a number of ways which can be used to promote the penetration of bio-based materials in packaging (originally in Slovak).

DESCRIPTION OF INVITED STAKEHOLDERS

Based on the previously prepared list of stakeholders in Slovakia that are invited to take part of the analysis in expert interviews, we selected our key-players to realized “case studies” in the value chain and innovation systems, which will be involved in project activities and engaged in the implementation process of business support service.

Grafobal, a.s., Skalica (Contact: Marián Kožíšek, gg@grafobalgroup.sk, + 421903703345)

Presented mission of the Company - Great packaging, just like tailor-made clothes, presents and highlights all the strong points of the contents while wonderfully masking those features intended only for the most experienced eyes. It appeals to the consumer, drawing their attention to the packaged product and makes purchasing it easier, with the promise of the expected value. Together with you we create creative packaging concepts that have been protecting, presenting and selling valuable content for more than 110 years. Our products are regularly awarded at prestigious international forums. We also have some of the highest awards for the best packaging in the world - the WorldStar Award for Packaging.

Our most important partner in the project with international exposure. STUBA has good references in the company through the common European projects.

CHEMOSVIT FOLIE, a.s., Svit (Contact: David Šarišský, sarisky.d@chemosvit.sk, +421 917914518)

CHEMOSVIT FOLIE, a.s. - its line of business involves the production, converting and sales of packaging material. It is among the biggest players in flexible packaging films converting in Central Europe. In 2013, its turnover reached over € 96 mil. Almost 50% of total production of Chemosvit consists of packaging materials produced by CHEMOSVIT FOLIE, intended, in particular, for the packaging of food products. Among them are big multinational producers of confectionery, biscuits and chips, and also hygiene products from the Czech Republic, Hungary, Poland, Germany, Benelux, the Ukraine, Russia, and other European states. It is necessary to mention the systematic, long-term building of the company internally, as well as in relation to external environment. CHEMOSVIT FOLIE is open to building common working teams with customers involving both the company and the customer staff, to accelerate and streamline inter-company business.

Our partner where STUBA realizes industrially trials in the production of biodegradable films.

Research Institute of Paper and Cellulose (Contact: Štefan Boháček, bohacek@vupc.sk, +421911728601)

The Pulp and Paper Research Institute, Bratislava was established with the main target to promote the development of the pulp and paper industry. The Institute has participated in both preparation and implementation of development actions of the Czech and Slovak pulp and paper industry. It has directed towards technological research and development and industrial application, on technical assistance to pulp and paper mills and converting plants, on enhancing the skill of the papermakers and on retrieval and dissemination of professional and economical information. The instrumental outfit and the pilot plant equipment of the Institute are of high level.

Our research partner in national projects with a good general cooperation and personal interconnection. In 2018 we prepared the state project oriented to composite materials based on paper and biodegradable plastics.

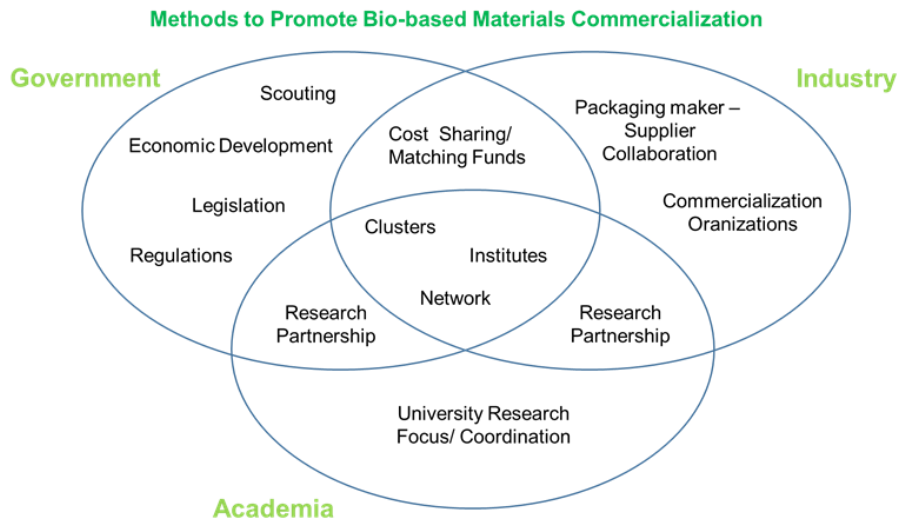
PANARA a.s. (Contact: Miroslav Galamboš, mgatac@mail.t-com.sk, +421911113434)

Since 2006 the company entered into bioplastics area with the goal to develop biodegradable- bio based blends for different types of plastic processing. Strong partnership with Slovak university of technology escalated into common excellent and unique Centre called CEPOMA (Center for Applied Research of environmentally friendly polymeric materials) which is technological and technical base for research and development activities connected with new biodegradable and bio based blends. The main goal is to introduce to the worldwide market a new generation of sustainable bioplastic material based on PHA and PLA polymers that could be utilized for production of final plastics products (such as films for agriculture use, packaging material, 3D prints etc.).

The Company where STUBA realized the CEPOMA Center as the Department of STUBA.

Methods for bio-based materials commercialization

There are numerous approaches to increase the commercialization of bio-based materials in packaging through the value chain as we see nowadays in Slovakia. In general, the commercialization process could benefit from strong stakeholder involvement and the creation of partnerships and institutions to promote the research and institutional support necessary to enhance the state-of-the-art in bio-based packaging and overcome current barriers to implementation. Advancing commercialization can be done in a number of ways. The strategy is based on communication and cooperation with a broad scale of partners as it is noted in the next picture.



The fact must be emphasized that these schematic methods listed above do not represent independent pathways to commercialization. Instead, these initiatives demonstrate collaborative ways to enhance the commercialization environment for bio-based packaging.

PULP AND PAPER INDUSTRY AND PAPER CONVERTING SECTOR

South Africa-based Mondi Group <http://www.mondigroup.com/> says it is evaluating new paper and board production investments, including the possible expansion of its Ruzomberok mill in Slovakia. Mondi SCP in Ružomberok is one of Mondi’s largest plants and is the biggest integrated mill producing paper and pulp in the Slovak Republic, with a production capacity of 560,000 tonnes of uncoated fine paper, 66,000 tonnes of packaging paper and 100,000 tonnes of market pulp. A consistent and focused long term strategy has positioned Mondi as a leading packaging and paper group, with a strong platform for responsible growth. In an early November news release Mondi says it considering expanding its packaging paper production capacity “through the installation of a 300,000 metric tons per year containerboard machine to produce a new product, kraft top white, as well as de-bottlenecking of the pulp mill.”

The critical success of the paper industry is the voluntary involvement of almost the whole of the value chain to enhance environmental performance, recycling and recyclability. Measurable, scientifically based evaluation design recyclability have developed and agreed with all participants in the value chain. It is an approach based on the waste hierarchy, responsibility and effective use of resources.

The paper industry to be able to push the boundaries even further, they will need to override certain policies. First of all, the collection of waste: organic fibers, which includes paper, are vulnerable to contamination, especially if the paper does not collect separately from other waste materials. It is therefore essential, in order to comply with the obligation to collect paper and some other material separately.

Currently for plastics that will degrade in a biologically active environment, and/or for plastics, which are derived from renewable raw materials, is not the usual pretty fair concept of bioplastics. Many of them are declared as biodegradable, but in fact there it is only their disintegration, bringing even more strain on the environment (e.g. oxo-plastics, oxo-bioplastics). Other bioplastics are biologically degradable in the environment, but need optimal conditions, the most common conditions of industrial composting and so these materials do not address that part of the problem of plastic waste, which is found outside of the regulated waste and ends up in rivers and oceans, whether on the landfill (managed, also unmanaged). Another inherent negative applications of bioplastics is generally their adverse interaction with synthetic plastics for recycling. Due to a lack of legislation and logistics, as well as due to insufficient differentiation between conventional synthetic plastics and bioplastics, it leads to contamination of waste plastic to be recycled, the recycling is in many cases impossible.

From the perspective of a complete solution to the problems with plastic and plastic waste in connection with the protection of the environment is a forward-looking and sustainable real alternative in the production and the use of biodegradable plastics made from renewable sources of raw materials, to be able to degrade as well under conditions of controlled composting, as well as in the wild (land, water, sea water). It is necessary to note, however, that in the context of the real ratio produced by the synthetic plastics and bioplastics (approximately 2-4% of the total production of plastics are bioplastics), fast solid replacement of synthetic plastics by bioplastics is not possible for the following reasons:

- the proportion of the total production of plastic products is too small and therefore also their separation on a massive scale is costly and inefficient,
- bioplastics which are not separated present the risk of deterioration of the plastics recycling, -
- major part of bioplastics is not able to decay outside the industrial controlled conditions, which does not solve the problem of the presence of plastic waste in the wild nature

It is therefore necessary in the early stages of the search for such a solution for applications that will not be fully ecological products interact with the recycling of synthetic plastics. Within the meaning of the cited the European strategy for plastics is a progressive and sustained solution to the use of plastic products on the basis of innovative materials in the framework of „a closed loop“, in communities, or in organizations, where it is easily manageable handling of bioplastics products. Such "closed loop" application can be, for example, hotels, hospitals, schools, office buildings, companies, etc. Compost piles are a part of the closed-loop, able to ensure degradation of such plastics such together with kitchen waste, thereby ensuring the ultimate disposal of plastics and compost or biomass as an output is obtained which can be returned to agriculture.

Although the bioplastics industry is globally growing about 20% per year, the global market of plastics that are biobased, biodegradable, or both is still in its infancy and occupies less than 1.00% of the overall plastics market, meaning a vast market potential. Due to limited mechanical properties and processing properties the biodegradable and 100% bio-based plastics are currently used in very limited amounts. Bioplastics (material inputs for the manufacture of bioplastových products) available on the European market for closed loop solutions are utilizable products based on renewable resources produced from PLA (polylactic acid). E.g. NaturePlast, Ingeo, CorbionPurac.

In Slovakia, the company PANARA s.r.o. will realize in 2018 the construction of production units of these materials in the SR with an initial capacity of 1.2 kt/year and after running the production unit plans to expand production capacity to a minimum of 40 kt/year. We are interested in work and in the development of new types of composite materials, paper-bioplastic.

Slovakia - Plastics Total Market Share

	2015	2016	2017 (Estimated)	2018 (Estimated)
Total Market Size	6,058,549	6,577,207	6,700,000	6,250,000
Total Local Production	5,284,985	5,598,000	5,600,000	5,500,000
Total Exports	2,352,263	2,385,808	2,400,000	2,500,000
Total Imports	3,125,827	3,365,015	3,500,000	3,250,000
Imports from the U.S.	9,808	9,789	10,000	11,000
Exchange Rate: 1 USD	0.837	0.91	0.903	0.940

USD thousands (total market size = (total local production + imports) - exports)

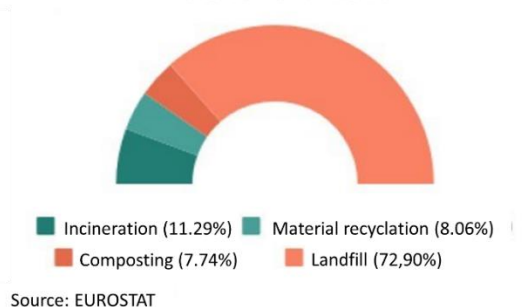
COMPOSTING SECTOR

Separate bio-waste composting allows for a closed-loop recycling and for shifting towards a sustainable material management. Centralized composting, however, presumes significant investments for the composting plants and for bio-waste collection and transportation, in particular if considering the seasonal peaks, and thus the higher frequency of collection intervals, of garden waste. Last but not least, odour emissions from the bio-waste collection bins may contribute to developing a rather negative attitude towards bio-waste. An option of both environmental and economical soundness is offered by the bio-waste garden composting. Its main advantages are presented in the table below, as counterparts to the requirements of a sustainable bio-waste management:

Ministry analysts calculated that Slovakia has the capacity to process bio-waste in a volume of 915 thousand tones. In the year 2016 only 357 thousand tones were processed. The current capacity is thus used only on 39 percent. In the year 2020 will, however, need the capacity of Slovakia to 1.292 million tones. Today's capacity will need to raise about 41 percent. The calculations are based on the data in the waste management plan for the period 2016-2020.

In the year 2015 in the EU Member States 17% of municipal waste were composted, in Slovakia it was only around 10%. On the higher end, in composting are in the long term our neighbors from Austria, who compost more than 30% of municipal waste.

Disposal of municipal waste in Slovakia in 2015



LEGISLATION CONTEXT

Slovakia as the EU member country implemented all EU legislative as it was summarized in the sent draft.

The strategic EU document issued by the European Commission on 16.1.2018 under the heading "A European Strategy for Plastics in and Circular Economy" clearly declares the need for solutions to the problems of plastic waste, and in particular the achievement of the 100% recycling of all packaging of plastic materials by the year 2030. At the same time, however, it raises the problem of plastics with a short life cycle, which is heavily incorporated into the recycling cycle and it is believed that continued to remain a part of the municipal waste with all the negative environmental impacts. A European strategy for plastics, viewed it as a challenge to ensure that even in these types of plastics environmental destruction. In line with this objective, the EC in its strategy document clearly declares support for solutions aimed at long-term sustainable way of dealing with plastic waste, which is based on the production and applications of plastics on the basis of biologically degradable materials, preferably from renewable raw materials, which addresses the fundamental problems in relation to plastics and the environment.

INNOVATION SYSTEM

In Slovakia the paper/bioplastic packaging products are inappreciable at the market. It is anticipated that new types of composite materials – are particularly in the packaging paper bioplastic for food. It is therefore necessary to take into account certain specific features which have such applications from composite material-bioplastic. In addition to environmental acceptability, are a barrier to gases (CO₂, O₂), water vapor barrier for aroma, their antimicrobial function, but also with mechanical, optical, and thermal characteristics.

The output will be the innovation processes in manufacturing technologies, to ensure more efficient production, reduce production costs, increase the added value of products, increase the competitiveness of enterprises in the Slovak Republic to identify and eliminate bottlenecks, manufacturing technologies, to increase the market share of our business but also reduce the negative impacts of production on the environment.

Other outputs will be innovated products and entire product lines in the field of composites, new products on the basis of barrier packaging materials and products with the barriers created by the a paper substrate with lower cost, lower weight, ease of recyclability, biological degradability and compostability in comparison to the present. Another outcome will be the innovative technology of production of intelligent packaging paper-based materials in combination with bioplastics and printed electronics products with lower production costs, with the lower price, lighter weight, easy recyclability and biodegradability in comparison with the current situation.

Optimizing for the Packaging Value Chain

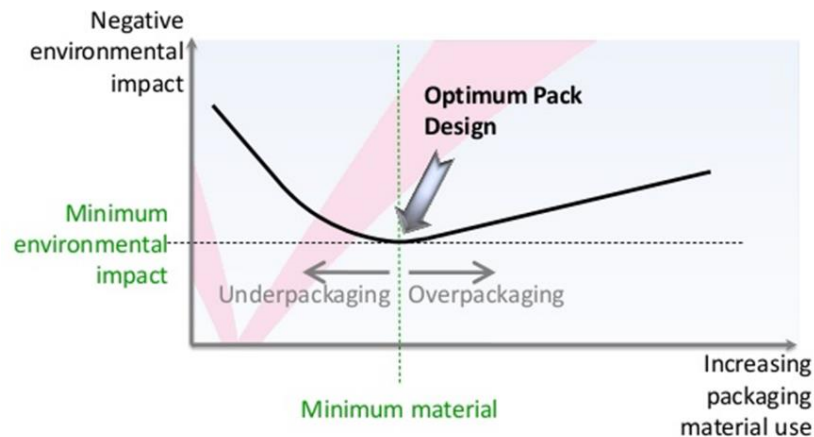


Diagram courtesy of Innventia AB

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CONCLUSIONS

In Slovakia the share of bioplastics in packaging can be step by step changed mainly due to the progressive implementation of current legislation.

Production of biodegradable plastics based on renewable resources is the only prospective, clinching and environmental global solution to problems with plastic waste. Terms of bioplastics, which are built on the basis of renewable raw materials and at the same time are biodegradable.

Despite the environmental benefits (whether partial or total) bioplastics, these materials are not massively expanded in the current industrial practice. Low competitiveness in the following classes of bioplastics in comparison with conventional plastics has the following causes:

Despite the environmental benefits (whether partial or total) of bioplastics, these materials are not massively expanded in the current industrial practice. Low competitiveness in the following classes of bioplastics in comparison with conventional plastics has the following causes:

- I. bioplastics have a significantly higher price than the synthetic plastics, which is given in particular their low production capacities
- II. bioplastics are often worse processing but also mechanical properties when compared to synthetic plastic
- III. bioplastics currently present on the market degrade only under conditions of industrial composting what creates the need for their separate collection and such plastics do not solve the problem of plastic waste with no controlled evasion into the nature
- IV. bioplastics, which are not separated get into the recycling stream, deteriorate by their rheological parameters recycled synthetic plastics, making material recycling of plastic waste difficult.

To increase the potential for the application of environmentally friendly plastics is therefore necessary to:

- deal with ecological plastic materials based on biodegradable plastics from renewable resources
- to design-renewable plastics based on renewable resources, so that they can be processed on conventional processing equipment for synthetic plastics
- to solve biodegradable plastics based on renewable resources to meet basic physical-mechanical characteristics comparable with synthetic plastics

- to solve biodegradable plastics based on renewable resources, to be degradable not only in industrial compost, but also in domestic compost in the soil and in the aquatic environment, in particular in sea water
- to deal with the development of biodegradable plastics based on renewable resources on acceptable price levels
- to deal with logistics in the production of plastics and its handling, and in particular the clear labeling of the various classes of bioplastics, their separate collection and controlled disposal by environmentally acceptable methods (e.g. composting)