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DanuBioValNet

Cross-clustering partnership for boosting eco-innovation by developing a joint bio-based value-added network for the Danube Region

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WP3 **Value Chain Mapping**

Activity 3.4 **Roadmapping**

D 3.4.1 **Roadmap reports for all three VC**

Roadmap Report
Eco-Construction Value Chain

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For further information about the DanuBioValNet project, you will find a short description in the document. To learn more and to download additional resources please refer to the project website http://www.interreg-danube.eu/approved-projects/danubiovalnet.

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Introduction of the DanuBioValNet project

The DanuBioValNet project is a cross-clustering partnership for boosting eco-innovation by developing a joint bio-based value-added network for the Danube Region. DanuBioValNet stands for development of a joint bio-based industry cluster policy strategy, clusters connecting enterprises transnationally, new bio-based value chains in the Danube Region and eco-innovations for supporting regional development.

The DanuBioValNet project, launched in 2017 through a cross-regional partnership involving 17 partners from 10 Danube regions, will enhance transformation from a fossil-based economy towards an economy using renewable resources by creating bio-based value-added networks. The project will connect Danube actors in a bio-based industry to minimize greenhouse gases and to optimize biomass resource utilisation. These measures are intended to improve the sustainability and regional development through diversification of the local economy while positively affecting the workforce. The focus on emerging transnational cooperation of clusters should serve to foster the bio-economy and eco-innovations and should lead to a strengthening of the regional economies.

The development of new bio-based value chains from primary production to consumer markets needs to be done by connecting enterprises from different regions and industries. However, due to a missing holistic transnational approach, the Danube actors in the current bio-based industry still operate disconnected and cannot properly benefit from their potential. Therefore, the aim of this project is to develop new methods, strategies and tools to connect enterprises transnationally. Clusters represent groups of industries that are closely linked by common products, markets, technologies and interests. They are chosen to organize and carry forward the needed industry cooperation for the creation of new value chains. Properly performing clusters can help to upgrade industrial practices, generate new knowledge and contribute to regional policy-making.

The partners of the DanuBioValNet agreed that phytopharma, eco-construction and bio-plastic/advanced packing (bio-based packaging) have a high potential for improvement of their respective value chains and hemp is considered as a raw material suitable for all the three value chains. Project efforts are designed to allow partners to connect SMEs, farmers, universities, and research institutes within a value-added DanuBioValNet network. The partners intend to develop and implement a long-term, industry-driven roadmap for such collaboration along the entire value chain based on cluster partnerships for these processes. Focusing on the selected high potential sectors, and harnessing the nature of regional clusters within wider cross-regional selected value chains, DanuBioValNet will implement pilot actions, involving SMEs, universities, research institutions, policymakers, and civil society among others. The pilot actions serve as the prerequisite for creating a blueprint for cross-regional cooperation.

List of abbreviations

ASBN	Austrian Straw Bale Network
AT	Austria
CAGR	Compound Annual Growth Rate
ESBA	European Straw Building Association
EU	European Union
FSC	Forest Stewardship Council (Certificate)
GDP	Gross Domestic Product
GWP	Global Warming Potential
ha	Hectare
HTL	Technical school
kg	Kilogram
m	Meter
m^2	Square meter
m^3	Cubic meter
NACE	Statistical Classification of Economic Activities in the European Community
PEFC	Program for the Endorsement of Forest Certification Schemes
SME	Small- and Medium-Sized Enterprise
t	Tonne
VC	Value Chain
WS	Workshop

Glossary

Bioeconomy

Bioeconomy is the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products and bioenergy. Its sectors and industries have strong innovation potential due to their use of a wide range of sciences, enabling and industrial technologies, along with local and tacit knowledge. (Source: European Commission (2012). *Innovating for Sustainable Growth: A Bioeconomy for Europe,* p. 3)

Cluster

Clusters are geographic concentration of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also cooperate. (Source: M. Porter (1998). *On Competition, Updated and Expanded Edition*. Harvard Business Review Book, p. 213)

Cluster initiative

Cluster initiatives are organised effort to increase the growth and competitiveness of a cluster within a region, involving cluster firms, government and/or the research community. (Source: Ö. Sölvell, G. Lindqvist and Ch. Ketels (2003). *The Cluster Initiative Greenbook* , p. 9)

Cluster organisation

By a cluster organisation one should understand organised efforts to facilitate cluster development, which can take various forms, ranging from non-profit associations, through public agencies to companies. (Source: PricewaterhouseCoopers (2011). *Uncovering excellence in cluster management*, p. 6)

Cluster management can be defined as the organisation and coordination of the activities of a cluster in accordance with certain strategy, in order to achieve clearly defined objectives. (Source: PricewaterhouseCoopers (2011). *Uncovering excellence in cluster management*, p. 3)

Cluster Policy

Cluster policy is an expression of political commitment, composed of a set of specific government policy interventions that aim to strengthen existing clusters and/or facilitate the emergence of new ones. Cluster policy is to be seen as a framework policy that opens the way for the bottom-up dynamics seen in clusters and cluster initiatives. This differs from the approach taken by traditional industrial policies which try (and most often fail) to create or back winners. (Source: European Commission (2016). Smart Guide to Cluster Policy, *Guidebook Series: How to support SME Policy from Structural Funds,* p. 11).

Eco-innovation

Eco-innovation aiming at significant and demonstrable progress towards the goal of sustainable development. Eco-innovation projects will therefore aim to produce quality products with less environmental impact, whilst innovation can also include moving towards more environmentally friendly production processes and services. Ultimately, they will contribute towards the reduction of greenhouse gases or the more efficient use of various resources. (Source: European Commission (2015). Eco-innovation, When business meets the environment. *FAQ: What is Eco-Innovation?* Online).

Smart Specialisation Strategies – S3

Smart Specialisation is a strategic approach to economic development through targeted support for research and innovation. It involves a process of developing a vision, identifying the place-based areas of greatest strategic potential, developing multi-stakeholder governance mechanisms, setting strategic priorities and using smart policies to maximise the knowledge-based development potential of a region, regardless of whether

it is strong or weak, high-tech or low-tech. (Source: Foray (2015). *Smart Specialisation, Opportunities and Challenges for Regional Innovation Policy*, Routledge).

Value Chain

The value chain describes the full range of activities that firms and workers do to bring a product from its conception to its end use and beyond. A value chain refers to the full lifecycle of a product or process, including material sourcing, production, consumption and disposal/recycling processes. This also includes activities such as design, production, marketing, distribution and support to the final consumer. (Source: University of Cambridge (2017). *What is a value chain? Definitions and characteristics.* Online).

I. Background and relevance

Importance of the selected value chain

Economic importance. The forest-based sector in the EU represents about 7% of EU manufacturing GDP. In 2011, it had a combined production value of €460 billion, with a total added value of €135 billion on a turnover of €485 billion. Forest-based industries provide nearly 3.5 million jobs across over 400 000 companies, most are small and medium-sized or micro enterprises. Raw material used by the forest-based industries provides income to around 16 million forest owners in the EU.[1]
The EU forest-based industries consist of four major sectors: woodworking, furniture, pulp and paper, and printing.[2]

The EU woodworking industries include the production of sawn wood, wood-based panels, and wooden construction materials and products. About 70% of the wood in the EU is used in construction and furnishings.[3]

Ecological importance of wood. Wood has several quite obvious advantages. It offers a simple way to reduce the CO2 emissions that are the main cause of climate change, through the carbon sink effect of the forests; the carbon storage effect of wood products; and the substitution for carbon-intensive materials. Besides, wood construction consumes normally less energy than other types of construction. Wood is light and easy to put together on site, requiring little or no use of heavy-duty equipment. Foundations are minimized. Transport requires less energy. All these consume less energy than other materials and structural types.[4]

Importance of other renewable materials for Eco-Construction

Eco-Construction also focuses on other products like insulation materials made of renewable resources like fibres (hemp, flax, straw, etc.) or sheep wool. Also, innovative products like hemp concrete and wood plastic composite materials for terrace flooring and fixing systems are developed in order to provide new products for Eco-Construction.

Thermal insulation. Insulation materials could contribute significantly to improving the overall energy efficiency and sustainability of buildings, especially by reducing the energy losses through the building envelope (walls, roofs, floors, etc.). They can also be applied to reduce energy use in new buildings (near-zero-energy buildings) as well as in retrofitting/refurbishment (renovation) projects.

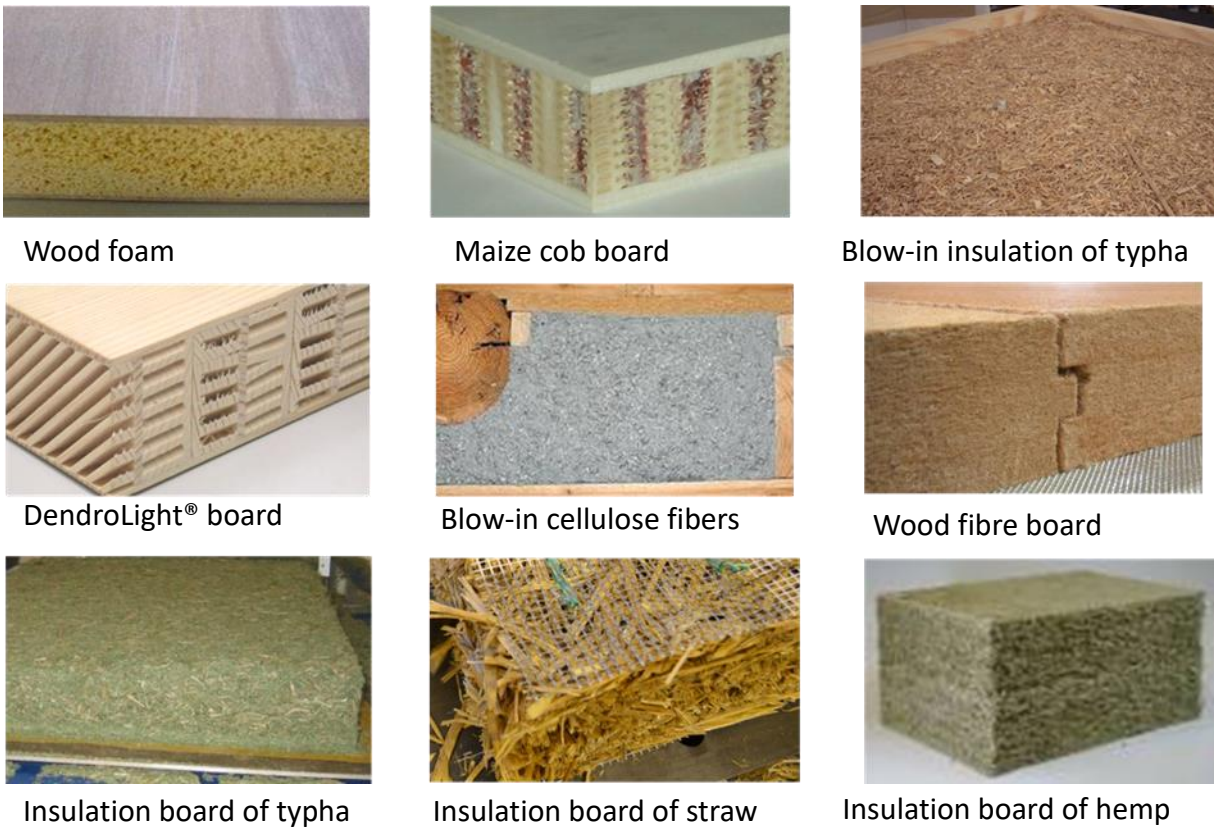
In the EU, the demand for thermal insulation materials is estimated to increase at 3.48 % annually (2015-2027 CAGR).[5] According to IAL Consultants, in 2014 the total European market for thermal insulation products was 7.4 million tonnes (corresponding to 234.6 million m^3) of approximate market value of EUR 11.5 billion.[6]

Renewable resources play still a minor role for building insulation so far; glass stone wool and plastic foams are the most required materials. According to experts, insulation materials from renewable raw materials have a market share of approx. 2-3%.

[1] EU DG Growth https://ec.europa.eu/growth/sectors/raw-materials/industries/forest-based_en (June 2018)
[2] EU DG Growth https://ec.europa.eu/growth/sectors/raw-materials/industries/forest-based_en (June 2018)
[3] EU DG Growth https://ec.europa.eu/growth/sectors/raw-materials/industries/forest-based/woodworking_en (June 2018)
[4] European Wood http://www.europeanwood.org.cn/en/why-wood (June 2018)
[5] Competitive landscape of the EU's insulation materials industry for energy-efficient buildings, JRC Technical Reports, European Union, 2018, p. 1 http://publications.jrc.ec.europa.eu/repository/bitstream/JRC108692/kjna28816enn_final.pdf
[6] IAL Consultants Press release July 2015, http://www.ialconsultants.com/uploads/CUBE_press_release/2015-07-15/EUThermal%20Ins%20press%20release%202015.pdf

There are several projects to develop new products out of renewable resources used for insulation purposes. For instance, in Austria one of the leading wood research institutes, "Wood K plus" also focuses on these new products and presented some of the findings in April 2018 in Linz at the event "Resource efficiency and circular economy in the timber construction sector". Some of the main products are shown in figure 1.[7]

Figure 1: "Wood K plus" Austria research focus on renewable insulation materials



Source: Presentation of bio-based insulation research topics at "Wood K plus": Resource efficiency and circular economy in the timber construction sector, Linz April 20 2018, with permission from Oliver Vay

Typha for insulation. The raw material typha is native to large parts of Eastern Europe (including Bulgaria) and sometimes forms huge populations (e.g. along the Danube river). They are highly productive (approx. 15 t/ha dry plant mass) in conventional agriculture when the water is highly contaminated with nutrients due to overfertilization and also contribute to water purification, erosion
reduction, flood protection and biotope formation.[8]

Since 2004, "Wood K plus" has tested and produced insulation boards made of typha. One of their mayor results shows that typha plates with termobonding are much easier to process than the blow-in insulation.[9]

[7] Presented by Wood K plus research institute, 20th April 2018
[8] Fraunhofer Institute for Construction Physics IBP, https://www.ibp.fraunhofer.de/de/Kompetenzen/hygrothermik/projekte/baustoff-aus-typha.html (August 2018)
[9] Thermobonding is a process for the thermal bonding of nonwovens. This considerably increases the bond strength and makes it possible to construct lighter nonwovens.

Hemp fibre for insulation. Hemp is one of the oldest domestic plants that can be effectively cultivated in the Danube valley countries. Traditionally grown for its fibres, seeds and psychoactive substances, it is now considered as an ideal crop for development of innovative biomaterials.[10]

Hemp can reach a height of up to four meters in three months, is very robust, undemanding and is regarded as a soil improver. It is particularly resistant due to its own bitter substances against pests. The use of pesticides or herbicides is therefore not necessary. The hemp fibre is extremely tear- and moisture resistant, it can weigh up to one third of its own weight of moisture and thus can be stored without thermal insulation. Thanks to the natural bitter substances hemp is also resistance to rot, vermin, rodents and mould. The insulation value of hemp is very good.[11]

The insulating material made of the hemp fibre is presented in table 1 for an Austrian; it has a potential in the local market.[12]

Table 1: Hemp as insulation material and potential for facade insulation in Austria

Yield of hemp per area in Lower Austria (mean value)	Density of an insulation board made of hemp fibre (example)	Yield of insulation volume	Area of façade insulation (assumption: 12 cm insulation thickness)
5 t/ha	100 kg/m^3	50 m^3/ha	417 m^2/ha

Source: Presentation of bio-based insulation research topics at "Wood K plus": Resource efficiency and circular economy in the timber construction sector, Linz April 20 2018

In Austria there are approx. 8 million m^2 insulated facade per year. The required acreage for Austria is approx. 20 000 ha for using this special product.

Hemp concrete. Hempcrete is a building material made of lime and hemp shives (a waste product from hemp fibre growing). The binder is either a pure lime (strongly hydraulic lime) or a formulated hempcrete binder made of lime mixed with a smaller proportion of pozzolans or Portland cement. It can be used for walls, floors and roof insulation. The material is breathable, absorbing and can emit moisture to regulate internal humidity and avoid trapped moisture and mold growth. It provides excellent acoustic and thermal insulation as well as thermal mass. It is also lightweight and thus reduces construction costs.[13]

Hempcrete is often used in restoration projects to upgrade the thermal performance of traditional and historic buildings. It is commonly applied to repair historic infill to panels in timber frame buildings or to replace inappropriate (non-breathable) infill materials where those were used in previous repairing.[14]

[10] Danubiovalnet Roadmap Report Hemp Value Chain, June 2018 (p5)
[11] Dämmstoffe richtig eingesetzt, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Österreichische Energieagentur – Austrian Energy Agency within the framework of the national biobased programme klimaaktiv nawaro markt (p. 32)
[12] Presented by Wood K plus research institute, 20th April 2018
[13] The Hempcrete Book - Designing and building with hemp-lime, By William Stanwix and Alex Sparrow
[14] Website UK Hempcrete, FAQ document, https://www.ukhempcrete.com/ (August 2018)

Figure 2: Hempcrete and its use in construction materials for walls


Source: *Website UK Hempcrete Ltd. with permission from Beca George*

Straw bale building. One special type of building is construction with straw. Straw has some significant advantages when used in construction:

- It is a by-product of the agricultural production
- It is a renewable material
- It can be used as thermal and (foot) sound insulation
- It can be used as load-bearing straw bales
- It is energy-efficient (minimum production energy)
- It contributes to a good indoor climate.

The moisture content, which is decisive for the quality during paving, is of great importance and must be less than 15 % to avoid the formation of mould. To use straw as a building material, loose straw is pressed into plates under the high pressure and heat. When filled in in wooden stand constructions straw is easy to use. Floor and roof parts can be prefabricated relatively easily. In the USA, however, straw is even used to erect exterior walls of buildings in load-bearing execution. Straw has a good insulating effect and is permeable to water vapour. [15]

There are interest groups for straw bale building both in Austria and in Europe. The objective of both organisations is to promote and develop the use of straw in buildings and to work together in projects, share results of researches and tests, building techniques and skills in special workshops to support and help self-builders, professionals, officials and architects.[16,17]

Figure 3: Wheat straw bales and their use for insulation materials in Austria, St. Pölten


Source: *Gemeinnützige Sanierungs-und Beschäftigungs GmbH with permission from Johann Lechner*

[15] Dämmstoffe richtig eingesetzt, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Österreichische Energieagentur – Austrian Energy Agency within the framework of the national biobased programme klimaaktiv nawaro markt (p44)
[16] ASBN – Austrian StrawBale Network, http://baubiologie.at/strohballenbau/ (August 2018)
[17] ESBA – European Straw Building Association, http://www.strawbuilding.eu/ (August 2018)

The construction of the office building in figure 3 is an innovation due to usage of only natural, renewable building materials. In addition, unemployed persons were recruited and qualified in the course of construction. Preferably regional companies were commissioned as well as socially and ecologically committed persons were invited for co-financing the project. These are important contributions environmental sustainability in the region as well as in job creation. The building contains offices and consultation rooms, seminar rooms and social rooms.[18]

Sheep wool insulation is suited for wooden construction. It can absorb up to one third of its own weight in moisture without significantly affecting the insulating effect. Sheep wool has very good thermal and sound insulation properties. There are evidences that sheep wool can neutralize not only humidity but also pollutants (such as formaldehyde) from the room air.[19]

Sheep wool insulating material has, compared to other natural fibres, a high flash point, it only ignites at 560°C. Flame retardants are therefore only required for very light products.[20]

Treeplast screw (new product for straw bale building). When building with straw bales, the problem of how to mount various components or structural elements to the wall has been encountered. Straw bales show an inhomogeneous, comparatively rough structure. Ordinary nails or screws, as used with other building materials, are not applicable.[21] For this purpose a new product was developed. Treeplast is originally made of wood chips (cellulose 30-50%), lignite, crushed corn (starch) and natural resins; today several recipes are used for dedicated applications.[22]

With the treeplast screw, anchorage points can be set in the straw bale and facades, but also objects such as boxes or shelves on straw bale walls can be fixed. At the same time, thermal bridges in the building envelope can be avoided. This is an essential requirement for achieving the passive house standards.[23]

Figure 4: The biopolymer screw has a hexagonal head, which can be fixed with the specially developed tool to the straw bale

Source: Treeplast-Strohschraube für wärmebrückenfreie Strohballenbauten, GrAT – Gruppe Angepasste Technologie, with permission of Sören Eikemeier

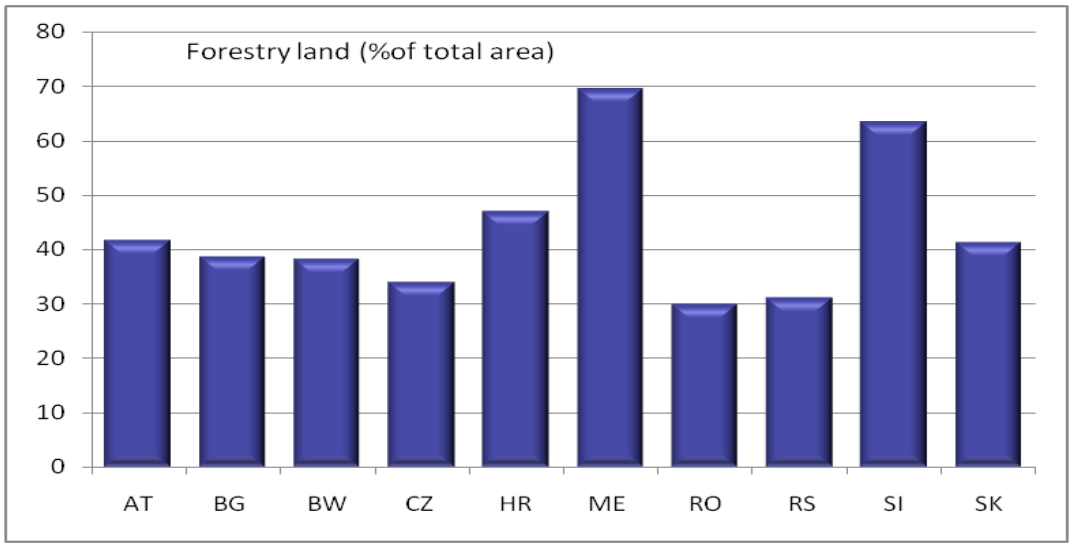
[18] Gemeinnützige Sanierungs-und Beschäftigungs GmbH, https://www.gesa-noe.at/ueber-gesa/haus-des-lernens/ (August 2018)
[19] Isolena Sheepwool Austria, https://www.isolena.at/der-daemmstoff/im-ueberblick (August 2018)
[20] Dämmstoffe richtig eingesetzt, Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Österreichische Energieagentur – Austrian Energy Agency within the framework of the national biobased programme klimaaktiv nawaro markt (p40/41)
[21] Treeplast Screw – a device for mounting various items to straw bale constructions, The Journal of Sustainable Product Design, January 2004, Volume 4, Issue 1–4, pp 33–41
[22] Website Treeplast, http://www.treeplast.com/ (August 2018)
[23] Treeplast-Strohschraube für wärmebrückenfreie Strohballenbauten, GrAT – Gruppe Angepasste Technologie

Relevance of the value chain

The Eco-Construction value chain was chosen because of the strong competencies of partners and wood clusters in the Danube region.

Forests and other wooded areas occupy 38.2 % of the total area of 10 Danube countries/regions that participate in the DanuBioValNet Project. The total surface area of these countries/regions is 775,956 km², and the forest area is close to 300,000 km.[24] In the following figure the area of forested land as a percentage of total surface is given.

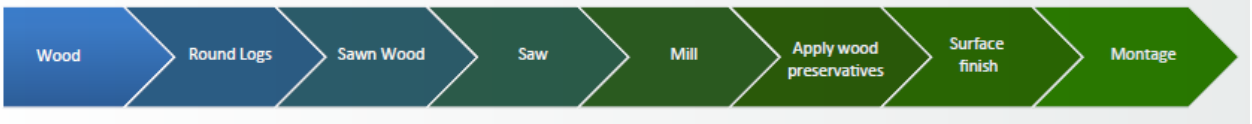
Figure 5: DanuBioValNet countries; Area of forested land as a percentage of total surface area



Source: The biobased status in the Danube Region, Country Synthesis Report, June 2017

The value chain of Eco-Construction was defined by the consortium and consists of the following parts:

Figure 6: Value Chain for Eco-Construction

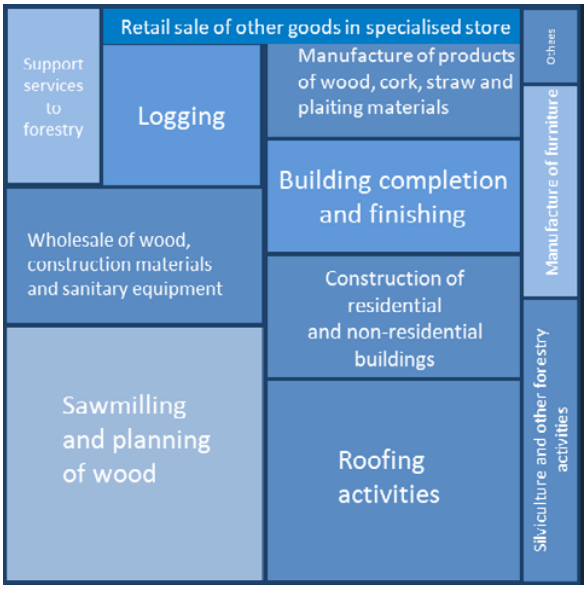


Source: Cluster Mapping Synthesis Report, Eco-Construction, 2017

The Eco-Construction industry composition illustrated in Figure 6 is based on the intensive work of the project partners and related cluster managers and is based on more than 350 companies and their related NACE classifications identified. The size of the different boxes (NACE classifications) is proportional to the number of enterprises. As Figure 6 illustrates, the biggest share of enterprises (about 21 %) operate in the sector "Sawmilling and planning of wood" (NACE Code C16.10).[25]

[24] The biobased status in the Danube Region http://www.interreg-danube.eu/uploads/media/approved_project_public/0001/13/13342f880ccf7f7472fae03879951066f678062f.pdf
[25] Cluster Mapping Synthesis Report Eco-Construction, http://www.interreg-danube.eu/uploads/media/approved_project_public/0001/14/87179323f80944f83b444418cb1c645fd7a17389.pdf

Figure 7: Eco-Construction industry composition based on NACE industry classification 2008



Source: Cluster Mapping Synthesis Report, Eco-Construction, 2017

During the value chain mapping activity and survey several issues were addressed:[26]

Source material. It came out from the survey that the key requirement when purchasing wood raw material is quality. The respondents are neither afraid of a lack of source material nor see big obstacles to obtain more material in the future as well.

Quality and labour force. Quality standards are very important in the region. PEFC and FSC are common certificates. Regarding the labour force of the eco-construction industry, the lack of qualified workforce is seen as the main problem. The respondents consider the low motivation of young people to work in the industry as a really big limitation.

Future perspectives. The industry and its customers are still more price-oriented and do not think so much about the environmental impacts. The main driver in construction is still energy efficiency but the concept of resource efficiency is catching up.

Main gaps. Currently, the respondents report that their clients do not focus on eco-construction products, but are only interested in the certification and price. The „eco"-impact is not as important to them as the awareness campaigns.

Missing links. The main missing link identified within the survey is the lack of institutionalised cooperation with R&D centres; the cooperation is mainly with individual experts, rather than with organisations.

Policy-related obstacles. According to the interviewed companies, some financial incentives or other support measures have to be developed on both levels – national and European. The role of the state should be more proactive and some incentives and measures for better support of Eco-Construction should be introduced.

[26] Synthesis Value Chain Mapping Report Eco-Construction, http://www.interreg-danube.eu/uploads/media/approved_project_public/0001/14/d5355b4cfda6852167fe58e74e7d19e9c3893588.pdf

II. Results of the Roadmapping Workshop

Objective of the Workshop

The objective of the Eco-Construction Roadmapping Workshop was to bring together companies and market experts, wood cluster managers, R&D and academia from the Danube Region countries to discuss the future goals, trends and market opportunities related to the development of the Eco-Construction business. Discussions addressed the gaps in the Eco-Construction mainly concerning R&D activities as well as qualification and incentives for companies.

Approach and methodology

The Eco-Construction Roadmapping Workshop was prepared according to the Roadmapping Workshop Methodology distributed by Anteja (ECG) and took place in Linz, Austria, on 20 April 2018.

The participants were chosen in advance according to the required composition of the group (cluster managers both from Austria and Danube countries, academia, R&D institute, companies). The participants received the agenda, invitation and background document in advance to prepare for the workshop.

A key note speaker invited from Brussels gave an overview on trends and strategies on the EU level. The second key note addressed the Interreg project "Forest-based Cross-sectoral Value Chains Fostering Innovation and Competitiveness in the Danube Region" (FORESDA). Afterwards, a company from Vienna presented to the audience its building systems.

Then the group divided into two breakout sessions addressing the topics gaps in providing services and incentives and gaps in providing well trained workforce. Each session started with a short overview from Austria (Wood Cluster Styria Ltd. and University of Architecture Linz) to get into the discussion.

Participants

The workshop was attended by 19 persons, coming from Austria, Slovenia, Romania, Croatia and Serbia. It was a good mix of (wood) cluster managers, academia, R&D institutes, cluster organisations and one company.

Structure of participants	Clusters, cluster managers	SMEs	Research and academia	Public Body (BSO)	Policy Makers	Cluster Association	Total
Number of participants	9	1	3	1	3	2	19

Results of the Workshop

The workshop results consider missing links and existing gaps in the related VC, trends and upcoming developments with regard to technology and application, markets, socio-economic factors and policy or business environment, and VC specifics.

In the context of the event, the topic "Gaps in providing well-trained workforce" was dealt with in one of the breakout session, which started with a short overview by Veronika Müller who is leading the university course in timber construction culture at the Linz University of the Arts.

The major problem defined by the group is the lack of skilled workforce. There is also a lack of motivation among young people to work in the wood industry, mainly due to its poor public image. Examples of the poor image are low wages, few perspectives and a low social status of craftsmen. A

lack of communication between business and education is the major obstacle in the industry, as well as a lack of connection between architects and technicians. It was also noted that in the regions with a highly developed industry, young people are keen to work in this sector.

Solutions at regional and macro-regional level. The training plays an important role at the regional level. For example, external teachers could teach new technologies. Another possibility could be a parallel education (Lehre mit Matura) or a dual education already at high-school level. Practical training (learning by doing) and implementation of technical schools (HTL) could also be important. A further solution could be better cooperation between craftsmen and architects.

At the macro-regional level, it is important to hold events that bring economics and research/education together. It is important to integrate digitization into the training timetable. In addition, study tours and mentoring programs could be helpful. Examples of macro-regional measures are "Werkraum Bregenzerwald".

Since its establishment in 1999, the Werkraum Bregenzerwald, organised as an association, has been providing a platform for innovative craftsmanship in Vorarlberg. It currently comprises 85 innovative firms, mainly involved in wood processing, such as carpenters, but there is also a handful of locksmiths, stonemasons, bricklayers, fitters, electricians, painters, upholsterers, textile processors and cobblers through to the exotic such as coppers and wood carvers.[27]

Another wood construction competition is Défi Bois wood challenge, at the University of Liège in Belgium. It aims at challenging future engineering students, thus enabling them to test and put into practice their theoretical knowledge (from the design of the work to its realisation, passing through the crucial phases of calculations and modelling).[28]

The second breakout session of the workshop dealt with the topic "Regulations and incentives affecting market development". A short input was given by Erhard Pretterhofer on how to position Styria as the number 1 high-tech wood region by 2025 by offering a wide range of services through the cluster.

One of the main gaps identified is the problem of different regulations in different regions concerning wood construction. This makes it difficult for companies to adapt. Another issue is that according to the public opinion, construction with wood is not easy. The reason is that there is a lack of knowledge about wood construction. In general, some traditional architects are not aware of the high-tech possibilities of construction with wood, especially with multi-storey buildings.

Another topic addressed was the missing approach to consider wood with regard to the global warming potential (GWP). The carbon storage of wooden products is quite significant. In general, it was stated that SME's are too small to have a real influence on the market. There is also a different situation concerning end markets in the Danube countries. Incentives to push the market could be set on regional as well as macro-regional levels.

On regional level there could be better support for SMEs for innovation (e.g. through adequate funding). Also, the possibility to offer study trips was discussed. This service is already provided by some wood clusters. The companies can also participate in R&D projects initiated by cluster organisations.

Healthy environment and increased visibility of wood for young people. There could be an initiative to build more kindergartens and public buildings like schools. This could easily be promoted through regional authorities. In Austria, for example, there are some reference buildings with sheep wool insulation materials in wood construction in order to ensure a healthy room climate inside the building, as earlier mentioned in the section for insulation materials.

[27] Website Werkraum Bregenzerwald, http://en.werkraum.at/ (August 2018)
[28] Website Université de Liège, https://www.enseignement.uliege.be/cms/c_9738610/fr/challenge-bois-2018-3-equipes-de-l-uliege-au-sommet (August 2018)

Figure 8: Montessori kinder garden Mondsee, Upper Austria

Source: Isolena Wolle Sheep wool insulation with permission from Patricia Mader

Another issue was the topic of establishing and using the methods of life-cycle cost calculation taking into consideration the process starting form planning until end-of-life options for wooden materials in construction. Wood has some considerable advantages, as mentioned before. It can be used in new buildings as well as attachments and extension of existing buildings. Wood is particularly suitable for prefabrication and that makes it easy to work with and cuts the costs. Also, wood is relatively unproblematic in disposal as it can easily be dismantled at the end of the buildings lifecycle. Individual components can be recycled and used in new applications such as high-quality wood for surfaces and furniture (preserving the "old" appearance of the material) as well as particle boards. Therefore, in general there are no costs for landfilling of waste materials. For life-cycle cost calculation there are different methods and it already plays a role in large construction projects.

There is also an option to increase the share of wooden buildings in cities to raise awareness and overcome obstacles in people's minds. In Austria, there are some projects on hybrid construction with the possibility to build 24-floor buildings using concrete and wood. In general, the regulations could be adapted to build in urban areas wooden buildings of up to 6 floors.

For example, in the newly developed area "Seestadt Aspern" in Vienna there is a project to build a 84 m high skyscraper in hybrid-construction on roughly 4.000 m^2 plot area. Extended on 24 floors there are planned commercial spaces for restaurants, beauty, wellness and business entrepreneurs as well as a hotel and serviced apartments.[29]

[29] Website HoHo Vienna, http://www.hoho-wien.at/Company/Medien (August 2018)

Figure 9: HoHo Vienna Seestadt Aspern – Wooden Hybrid Skyscraper up to 24 floors

Photocredit: Rendering Rüdiger Lainer u Partner Architekten ZT GmbH; Cetus Baudevelopment GmbH
Source: Kerbler Holding GmbH, with permission from Romana Hoffmann

One incentive on regional as well as macro-regional level could be the establishment of a "lobby organisation" for wood, like Pro Holz Austria (Pro Wood Austria), which is a marketing institution of the Austrian forestry and wood industry. The aim is to communicate the ecological, economic and structural advantages of wood as a building material and to set impulses, so as its use increases.[30] It was mentioned that several Danube countries had already tried to copy the Austrian model.

It was also discussed to organise a roadshow for Eco-Construction like presented on platform www.wooddays.eu. This roadshow focuses on exchange, know-how transfer and networking. Various formats from expert dialogue to architecture congress offer a unique, international dialogue platform. In all cities where the WOODDAYS roadshow is present, an intensive ten-day exchange on the possibilities of wood as a building material in the urban area takes place.[31]

On macro-regional level, it could be important to unify regulations concerning wood construction. For example, in Austria there are nine different building codes since the building industry is subject to state legislation. The Austrian Institute for Construction Technology (OIB) issued guidelines in order to harmonise the construction engineering regulations in Austria. The federal states may declare OIB Guidelines as binding in their building codes, which is already the case in all federal states.[32]

Table 2: OIB Guidelines

Guideline	Title
OIB Guideline 1	Mechanical resistance and stability
OIB Guideline 2	Safety in case of fire
OIB Guideline 2.1	Safety in case of fire in operational structures
OIB Guideline 2.2	Safety in case of fire in garages, roofed parking spaces and multi-storey car parks
OIB Guideline 2.3	Safety in case of fire in buildings with a fire escape level in excess of 22 m

[30] Website Pro Holz Austria, http://www.proholz.at/ueber-proholz/ (August 2018)
[31] Website Wooddays, http://www.wooddays.eu/en/wooddays/ (August 2018)
[32] OIB Guidelines https://www.oib.or.at/en/oib-guidelines (August 2018)

Guideline	Title
OIB Guideline 3	Hygiene, health and preservation of the environment
OIB Guideline 4	Safety in use and accessibility
OIB Guideline 5	Protection against noise
OIB Guideline 6	Energy saving and heat insulation

Source: Austrian Institute for Construction Engineering (OIB)

The guidelines also standardise the energy performance certificate for buildings in a legal standard. For Eco- and Wood-Construction, especially the guidelines 2 and 6 are relevant, mainly regarding fire-protection and sound insulation.

Implementation of pilot projects was also stressed during the event. This could be done in cooperation with renowned architects to highlight the design aspect of Eco-Construction. Austrian company Wiehag is quite active in the industrial construction and has several impressive reference buildings in Austria as well as in other countries.

As a regional example for Upper Austria, there can be mentioned the Customer Information Centre and Event Forum "Haus des Brotes II" ("House of Bread II) in Asten, close to Linz, which was designed by the architects COOP HIMMELB(L)AU and executed by Wiehag Timber Construction. It looks quite unusual: a box shaped plinth building with a foyer and event rooms plus the "Wunderkammer des Brotes", a two-storey freeform exhibition area floating on the top. Chosen materials were concrete for the facade and a cross laminated timber structure (CLT) for the exhibition area clad with stainless steel shingles. [33]

Figure 10: House of Bread in Upper Austria – Customer Information Center and Event Forum

Photocredit: Pillhofer. Source: Wiehag Timber Construction, with permission from S. Mühlbacher

Finally, there is a need for unified funding schemes for Eco-Construction. This might also address the end-consumer, as, for example, in Austria there are very different housing subsidies in the federal states. These subsidies could be tied to ecological standards using renewable materials like wood and wooden insulation products.

[33] Wiehag project house of bread Austria, http://en.timberconstruction.wiehag.com/Wiehag-Timber-Construction2/References/House-of-bread (August 2018)

III. Recommendations and inputs for WP4, WP5 and WP6

Joint Bio-Based Industry Cluster Policy Strategy

The main recommendations from the Roadmapping Eco-Construction workshop that can serve as inputs for the Strategy can be summarized as follows:

- To enhance the cooperation between science and business; there could be a funding call on qualification measures like tailor-made training offers for additional qualification of researchers and innovation managers
- Besides the issue of energy efficiency, there should be an indicator for material efficiency/renewable materials, probably connected to housing subsidies or other incentives
- Developing measures to better inform the consumers by involvement of regional energy consultants in order to attract interest in Eco-Construction
- Better integration of Eco-Construction parameters into a building certificate. This is already the case in Austria for several federal states.

Open Space Innovation Arenas and new Cluster Management Services

The workshop findings highlighted the need for raising awareness in Eco-Construction. The wood and construction clusters can actively contribute by displaying regional best-practice buildings, and by offering study tours for architects and other experts.

Also important is the participation of SMEs in R&D projects via the furniture and wood clusters (e.g. robotics in wood construction) in order to be on the forefront of innovation and competitiveness.

The third aspect could be the internationalisation of companies and related services offered by cluster organisations. This could be interesting in establishing cooperation with regard to marketing of new products. The openness of the companies in the Danube region to cooperation with foreign partners depends on current demand and distance (they prefer to cooperate with neighbouring countries).[34]

Pilot Actions

The successful implementation of Eco-Construction within a region requires the will to work together along the whole value chain. Not only the wood processing industry is involved, also architects and craftsmen need to collaborate. Besides, policy makers play a crucial role in facilitating the realisation of Eco-Construction projects by improving the framework conditions. According to WP 6, Pilot actions should have a transnational focus and could address the following topics:

- Implementation of Open Space Innovation Arenas (OSIA) by bringing together different actors from the Eco-Construction industry with designers and architects as well as producers of renewable insulation materials (e.g. hemp) in order to talk about new business models in Eco-Construction.

- Establishing a programme for international study tours for policy makers and other experts in order to get to know best practice examples both in actual wood construction and regional support programmes, as well as the political framework in implementing resource-efficient Eco-Construction.

[34] Synthesis Value Chain Mapping Report Eco-Construction, http://www.interreg-danube.eu/uploads/media/approved_project_public/0001/14/d5355b4cfda6852167fe58e74e7d19e9c3893588.pdf

Vorarlberg in Austria could be a good example for the leading region for Eco-Construction as it is widely adopted and supported by local authorities. The Energy institute of Vorarlberg offers a wide range of topics for excursions, such as energy plus houses, passive houses, wooden buildings, clay construction, straw buildings, single-family or multi-family houses, communal buildings, company buildings. Although the federal state of Vorarlberg is not part of the Danube region and original programme area of the Interreg Danubiovalnet project it has a leading position in Austria concerning wood construction and the cooperation of timber construction companies, carpenters, architects and planners.[35, 36]

In Upper Austria there could be a possibility to organise a study tour in combination with the Upper Austrian Timber Construction Award in 2019. The aim of the award is to support special achievements in the timber construction in Upper Austria in order to provide incentives for a new timber architecture and also to promote the increased use of wood as a raw material. Submission for the Upper Austrian Timber Construction Award runs from November 2018 to January 2019. The award ceremony is expected to take place in April/May 2019. The initiators of the award are the State of Upper Austria and the Furniture and Timber Construction Cluster together with Pro Holz Upper Austria, the Upper Austrian Wood Construction Guild and the Upper Austrian Timber Industry Group.[37,38]

[35] Website of Energy Institute Vorarlberg, https://www.energieinstitut.at/fachexkursionen/ (August 2018)
[36] Website of Vorarlberger Holzbaukunst, http://www.holzbaukunst.at/ (August 2018)
[37] Website of Furniture and timber construction cluster Upper Austria, https://www.m-h-c.at/mhc-leuchtturmprojekte/ooe-holzbaupreis/ (August 2018)
[38] Website of the Upper Austrian Timber Construction Award http://www.holzbaupreis-ooe.at/ (August 2018)