Interreg
Danube Transnational Programme
ENERGY BARGE

ENERGY BARGE

Building a Green Energy and Logistics Belt

Project Code: DTP1-175-3.2

Deliverable 6.3.1

Recommendations for national/EU policy makers on biomass production for energetic use

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Content

I About the ENERGY BARGE project

The Danube region offers a great potential for green energy in the form of biomass. The main objective of ENERGY BARGE is to exploit this potential in a sustainable way, considering the Renewable Energy Directive 2009/28/EC, thereby increasing energy security and efficiency in the Danube countries. The project brings together key actors along the entire value chain, biomass companies and Danube ports as well as relevant public authorities and policy stakeholders. The project maps value chains and facilitate the market uptake of biomass, support better connected transport systems for green logistics and provide practical solutions and policy guidelines. The Agency for Renewable Resources (FNR) coordinates the project with its fourteen partners from Austria, Bulgaria, Croatia, Germany, Hungary, Slovakia and Romania.

Project coordinator

Agency for Renewable Resources		
Fachagentur Nachwachsende Rohstoffe e.V.	FNR	Germany

Project partners

BioCampus Straubing GmbH	BCG	Germany
Deggendorf Institute of Technology	DIT	Germany
Austrian Waterway Company	VIA	Austria
Port of Vienna	PoVi	Austria
Bioenergy2020+ GmbH	BE2020	Austria
International Centre of Applied Research and Sustainable Technology	ICARST	Slovakia
Slovak Shipping and Ports JSC	SPaP	Slovakia
National Agricultural Research and Innovation Center	NARIC	Hungary
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Technology Center Sofia Ltd.	TCS	Bulgaria
Romanian Association of Biomass and Biogas	ARBIO	Romania
Federation of owners of forests and grasslands in Romania	Nostra Silva	Romania

II About this document

This report corresponds to Deliverable 6.3.1 *Recommendations for national/EU policy makers on biomass production for energetic use* of the ENERGY BARGE project. It has been prepared by:

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1 Background

Deliverable "D 6.3.1 Recommendations for national/EU policy makers on biomass production for energetic use" is based on the Activity as described in the latest approved version of the Application Form of the project ENERGY BARGE (Project Code: DTP1-175-3.2).

- Activity 6.3 *Guidelines and recommendations on improving biomass production and logistics in the Danube region* (Lead: FNR)

The gained results of mapping the bioenergy sector (WP3), assessment of logistics requirements in WP4, pre-feasibility and case studies (WP5) as well as the analysis of regulatory gaps/barriers (WP6) were considered for the guidelines and recommendations in the frame of Activity 6.3. Different biomass feedstocks were taken into account, giving advice on which feedstocks should be prioritised.

A strategy based on Activities 6.1 and 6.2 will be developed in order to facilitate the transnational work of the relevant stakeholders, taking into account regional differences and how they can be overcome to improve energy security through biomass use and transport. The ENERGY BARGE strategy was presented in national workshops as well as the final conference and was integrated into the online and digital tools of the project. Recommendations and proposals for EU and national policy makers were elaborated, aiming to improve the current situation and to reduce identified barriers in order to facilitate the further development of a well-functioning biomass production and logistics network along the Danube.

2 Executive summary

Solutions on European level are required for a secure and reliable energy supply, competitiveness and climate protection in the frame of the energy transition to increase the shares of renewable energies. By adopting the 2030 climate and energy framework and the legislative packages to ensure that the Energy Union will be achieved, the European Union set the basis for the implementation of the energy transition. The European Union set the target to reduce the greenhouse gas emissions within the EU by 40% compared to the level of 1990. Further, the share of renewable energies in final energy consumption shall be increased to 32% by 2030 (BMWi, 2018).

The utilisation of biomass to generate energy plays a significant role in the European Union and is estimated to further increase by 2030. A frequently discussed topic in this context is the assurance of a sustainable supply of biomass resources. The European Commission indicated the need for an improved biomass policy in order to ensure a resource efficient utilisation of biomass and to contribute to the target to reduce the overall greenhouse gas emissions. Bogaert et al. (2017) transferred the general strategic objectives of the European Commission to the following specific operational objectives:

1. Ensure that the utilisation of bioenergy contributes to the mitigation of climate change;
2. Avoid direct and indirect land use change;
3. Minimise impact on biodiversity;
4. Prevent distortion of the biomass market;
5. Prevent trade barriers of biomass for energetic use.

The success of bioenergy highly depends on the availability of suitable biomasses in sufficient volumes and at competitive prices. The upgrading of residues, co-products and waste from agriculture to solid biofuels will be important in the upcoming years since it is seen to have a high potential for the future extension of the biomass base. A sustainable use of the biomass potentials requires the optimisation of processes as well as technologies and the integration of cascading utilisation paths and the development of an efficient bioeconomy. The establishment of sustainable supply and value chains and the cooperation of all actors along the value chain are of high importance (Biermayr et al., 2018).

The introduction of a carbon pricing system, which takes environmental externalities caused by fossil fuels into account, is to be considered. Carbon pricing would internalise these costs and make fossil fuels more expensive. This could partly compensate the higher capital requirements of bioenergy systems in comparison to fossil fuel systems. Such measures should also comprise a reduction of barriers in the taxation and broader regulatory systems. At present, the taxation and regulatory framework conditions are decreasing the competitiveness of renewable low carbon technologies (Agentur für Erneuerbare Energien, 2018; Lempe et al., 2018).

A crucial point that constitutes the basis for many of the business cases that were identified as good practice examples by the ENERGY BARGE project partners is a close cooperation of public and private actors from the biomass/bioenergy sector on regional and local level.

Lempe et al. (2018) also describe the importance of cities and local authorities to promote the utilisation of renewable energy sources in addition to incentives by national and regional governments. This is particularly important, since almost two thirds of the global energy demand is accounted for cities. The imposition of reliable policy and regulatory framework conditions for renewable energies on local level is of high relevance to gain the confidence of investors. This implies also to set up long-term policies from 10 to 15 years to stimulate investments in renewable energy plants (Lempe et al., 2018).

Furthermore, local and regional authorities should actively promote the benefits of bioenergy towards their citizens to improve the public acceptance and reduce potential reservations. Among other things, this comprises to point out to the social benefits that an increased utilisation of bioenergy could imply for a region, e.g. by increasing the degree of processing of biomass raw materials and thus create new jobs and keep a higher share of the added value in the region itself (Lempe et al., 2018). During several ENERGY BARGE workshops, concerns were expressed by external participants that it needs to be avoided to only transport raw materials to Western European countries, but rather to keep first processing steps in the respective countries. This would also increase the transport worthiness of the respective biomass products to consider inland waterway shipping as a competitive means of transport.

The establishment of regional clusters to promote networking activities among the relevant market actors proved to be an efficient measure, e.g. in case of the Croatian Vukovar-Srijem County Development Agency Ltd. HRAST or the German regional cluster Renewable Raw Materials. The establishment of a cluster, operating as a “one stop service centre”, provides the opportunity for companies to enhance their visibility for potential business partners and makes it more attractive for foreign and domestic investors to expand their businesses in the field of renewable raw materials in the region. Through an efficient marketing, regions can motivate further companies settling in the respective areas. Flagship projects can enhance the awareness of the selected regions and the entire Danube area.

The development of an economic profile of a region through the establishment of a cluster in the field of renewable energy could also be supported through the settlement of research and education entities or by enhancing the cooperation with these institutions. For example, in the region of Straubing in Germany, the involvement of research and education entities has been a driving factor for political actors to actively support the development of the bioenergy sector in the region. Furthermore, by integrating ports as biomass logistics hubs into the concept of a cluster, the Danube as a potential environmentally friendly transport axis could come to the fore and receive additional support from the political side.

Overall, success factors for functioning as a model region in the field of biomass utilisation and bioeconomy comprise a broad and continuous political support and funding on regional level. A strong actor base from the research and industrial sector, various sources of biomass feedstock supply, including versatile logistics options, enable the integration of biomass supply and bioenergy carrier production as well as a stringent development strategy.

3 Austria

3.1 Recommendations on particularly suitable biomass feedstocks

In Austria, the largest share of bioenergy is covered by firewood as well as wood chips, sawmill by-products and bark, which are mainly used in relevant wood processing industries, as well as in co-generation and district heating plants. The importance of pellets, which are mainly used in small-scale furnaces, is, however, small compared to this despite of a continuous increase in recent years (Biermayr et al., 2018).

There is a sufficient wood quantity in Austria and the resource potential is even increasing. However, sustainable forest management is not only ensured by the state in Austria. Responsibility for the condition of 80% of Austria‘s forests lies above all with the many private forest owners. A key factor for the success of all efforts to promote sustainability in forests is therefore the motivation of the forest owners (BMLFUW, 2015).

Other solid biofuels, e.g. household waste, sewage sludge, straw or other biogenic fuels cover a small share of bioenergy at present. The whole sector of solid biofuels made a total turnover of 1.606 billion Euros thus creating 18.967 jobs in Austria (Biermayr et al., 2018). The future development of bioenergy depends on the use of potentials. Estimates assume a bioenergy potential of around 95 PJ by 2030, with the supply of wood-based energy (forestry and short-rotation forestry) and other solid biogenic raw materials making up about 59.2 PJ (Austrian Biomass Association, 2015).

The success of bioenergy highly depends on the availability of suitable biomasses in sufficient volumes and at competitive prices. Therefore, measures to mobilise additional energy wood potentials are needed. The use of agricultural raw materials and residues for energy production is less promoted. The upgrading of residues, co-products and waste from agriculture to solid biofuels will be important in the upcoming years since it is seen as high potential for the future extension of the biomass base. The sustainable use of these biomass potentials requires the optimisation of processes as well as technologies and the integration of cascading utilisation paths as well as regional concepts. Furthermore, ecological boundaries should be considered. The establishment of sustainable supply and value chains and the cooperation of all actors along the value chain is of high importance (Biermayr et al., 2017). In addition to the traditional use of biomass in the heating sector, the importance of bioenergy as part of a sustainable energy system in combination with other renewables is increasing since biomass fuels are weather-independent energy suppliers. In this context, the co-production of electricity and/or material products such as biochar is of great interest in order to ensure the most efficient use of resources (Biermayr et al., 2018).

The regional supply chains with short transportation distances are well developed. However, sustainable and economic as well as ecological efficient long distance transport possibilities should be established. The use of Danube logistics could help to reduce emissions, to establish a low-carbon transport system and to improve the environmental performance along the entire

bioenergy value chain. Inland waterway transport is also a cost-efficient option for the transport of high volumes of goods and oversized cargo (high & heavy) on long distances.

Wood as a bulk cargo is considered transport intensive: the ratio of transport costs to the value of goods is very high compared to other goods. In particular, wood chips have a low bulk density and therefore high transport costs. An efficiently planned transport is thus of central importance. Since biomass in the form of sawdust or wood chips has a relatively low bulk density, it makes sense to compress them (pellets, briquettes) before transporting and thereby reducing the transport costs.

High transport costs constitute a major problem since prices for heating oil, gas and electricity remain at a low level. Furthermore, the energy use for heating is decreasing due to the trend to zero-energy buildings. Hence, in new buildings there is decreasing space for the heating technology and no need for a chimney. This affects the use of biomass small-scale combustion systems with the necessity for a chimney and the space requirements for storage and boiler negatively.

Research efforts are currently and in the next future focused on the extension of the power range, further reduction of emissions with increased focus on the reduction of particulate matter (PM) emissions and the reduction of NOx emissions. Further, the development of specific new sensors for improved combustion control, optimisation of systems and combined systems (e.g. combined with solar thermal systems), annual efficiency improvement and on the development of market-ready small-scale and micro CHP systems and the use of biomass as an energy carrier in industrial and commercial processes with high heat demand are of importance. In addition to the technological quality, a further reduction of capital costs is decisive for achieving success in international markets (Biermayr et al., 2018).

The most common subsidies for renewable energy in Austria are direct subsidies such as feed-in tariffs for green electricity and investment grants (mainly for small plants under 100 kW), as well as tax reductions and tax exemptions (e.g. for biofuels). The funding opportunities are easy to access; however, the funding volume decreased over the last several years. The sectors biomass boilers and stoves have a lasting downward tendency that reduced the sales figures in no time by half. The expiration of the feed-in tariffs in accordance with the Green Electricity Act without subsequent regulations leads to uncertainty among the plant operators. Most of the biomass CHP plants are not profitable without special feed-in tariffs due to the high biomass prices compared to the low electricity prices (Biermayr et al., 2017).

In Biermayr et al. (2018), national experts of the renewable energy sector have compiled challenges and recommendations of renewable technologies:

- Energy policy makers are confronted with the challenge of using the limited public subsidies for efficient and long-term effective instruments, which are incentive oriented. The economy also needs continuity and predictability more than great onetime effects. Innovative methods of optimally using the subsidies as for example weekly Internet auctions enable a good use of the private willingness to pay and improve the efficiency of the subsidies as for example free riders are reduced. On the contrary, long-term static

(excessive) subsidies are just as bad for the diffusion of technologies as stop-and-go subsidies.

- Furthermore, a budget neutral financing of incentive oriented energy policy through a CO_2-tax would mean double efficiency in reaching the desired outcome.
- Regularly updated technology roadmaps and long-term monitoring of actual developments are essential as a basis for the development of an efficient and effective energy policy.

In addition, future legislation and policies should support the following purposes (BMNT, 2019):

- Support research activities to increase yields in agriculture and forestry and to identify new raw materials from waste management;
- Reduce the soil sealing;
- Invent and improve new manufacturing processes in the industry to create new materials from waste and by-products;
- Increase public awareness for a more conscious and efficient use of raw materials;
- Increase in efficiency at all levels of the value chain, from raw material procurement through logistics and material use to energy recovery, as well as a rethinking of consumer behaviour towards a lifetime extension of products;
- Increase the use of residues, by-products, wastes and of new raw materials such as algae;
- Highlight the opportunities for replacing fossil resources with renewable, bio-based ones.

Furthermore, regularly updated technology roadmaps and long-term monitoring of actual developments are essential as a basis for the development of an efficient and effective energy policy.

3.2 Recommendations derived from the good practice examples

With a large-scale production business model, it is of high priority to choose a location that supports reliable feedstock supply as well as market access for products, being mainly characterised by favourable logistics – ideally trimodal sites. Expert discussions conducted in the frame of Work Package 4 of ENERGY BARGE showed that company and logistics locations in the vicinity of the Danube (at least one node of the transport route) are a prerequisite to facilitate a major modal shift towards Danube logistics in the bioenergy industry. Thus, the availability of different transport opportunities is a huge success factor for the total supply chain and the bioenergy business.

Efficient infra- and superstructure supporting the handling of biomass are important to convert Danube ports in logistics hubs for the bioenergy industry. In Austria, the "programme supporting the development of connecting railways and transfer terminals in intermodal transport 2018-2022" provides financial support for the development of transhipment facilities for combined transport in order to support the modal shift of freight from road to rail and water. Regarding inland waterway transport, the aid scheme co-finances investments in quay systems

(25% of eligible costs) and other measures such as for instance river engineering measures at the port location (25% of eligible costs).

The Austrian good practice example – AGRANA's bioethanol production facility – is located in Pischelsdorf. The site of the industrial estate in Pischelsdorf was selected in view of its location in the heart of the raw material production region, its excellent links to the Danube, roads and railway, as well as the ideal range of energy supply possibilities. From the perspective of AGRANA, the following criteria are important regarding the integration of Danube ports into multimodal logistics chains:

- A guaranteed minimum loading rate (performance of loading quantity per day) for biomass;
- Transparency in terms of loadings (first come – first serve);
- Product safety should be guaranteed;
- Possibility of intermediate storage at the port location;
- Ports should be able to load truck cargo quickly and efficiently (adequate weighing bridges, loading ramps, grids).

This particularly refers to loading points in Central and South-Eastern Europe where raw materials for the company's starch and bioethanol production are transhipped to inland vessels.

3.3 Recommendations on bioenergy logistics along the Danube

In the past years, the following raw materials and products relevant for the bioenergy sector have been transported, transhipped and stored along the Austrian Danube:

- wood-based raw materials
- starch-based raw materials
- sugar beets
- oil seeds
- primary and secondary residue material
- biodiesel
- vegetable oil
- pellets, briquettes, wood chips

These types of cargo are particularly suitable due to the fact that inland waterway transport is a cost-efficient option for the transport of large volumes of goods on long distances. Most of the time facilities for intermediate storage are available in the vicinity of transhipment sites or in inland ports (e.g. large open storage space for round wood, bulk storages, tanks for liquid fuels). These goods are often less sensitive in terms of the transport time and can easily be transhipped with conventional handling methods (with the exception of sugar beets and wooden pellets, which have to be treated with special care due to a higher risk of quality loss).

One of the most important tasks of the ENERGY BARGE project is to define under which circumstances inland navigation can play a more important role for the transport of raw materials, intermediates and end products related to the bioenergy and biomass industry. According to interviews carried out with key stakeholders from Austrian bioenergy companies the general logistics requirements of the bioenergy industry can be summarised as follows:

- reliable waterway infrastructure;
- efficient infra- and superstructure in the Danube ports (in terms of quantity and quality);
- time-efficient and flexible administrative processes;
- flexible logistics concepts integrating Danube logistics services.

The most effective way to increase the use of inland waterway transport in bioenergy supply chains is to ensure reliable waterway infrastructure along the whole Danube. Larger cargo volumes per vessel or convoy improve the relation between freight revenues and costs and thus the overall competitiveness of inland waterway transport. This implies that there is a direct relationship between fairway conditions, the load factor of vessels and ultimately the competitiveness of this mode of transport. In order to enable Danube navigation to make use of its key strengths, waterway maintenance and ensuring reliable fairway depths remains an indispensable task of all Danube countries.

viadonau – Austrian Waterway Company is continually striving to achieve a harmonised development of the Danube waterway and enhance the integration of the Danube Region into the policies of the European Union. To achieve this, the company maintains close contact with other waterway authorities, decision-makers and interest groups in the Danube riparian states. Since 2011, Austria and Romania have been working together as the coordinators for Priority Area 1a (inland waterways) as part of the Strategy of the European Union for the Danube Region. The heart of this strategy is an action plan (Fairway Rehabilitation and Maintenance Master Plan for the Danube and its navigable tributaries) whose objectives include the improvement of the Danube's waterway infrastructure and its navigable tributaries, along with integrated and coordinated international waterway management. On 3 December 2018, the Transport Ministers of the Danube riparian states reconfirmed their commitment to implement the Master Plan upon invitation of EU Transport Commissioner Violeta Bulc and based on the preparatory work of PA1a. It is essential that all relevant industries, which have a vital economic interest to use the Danube as a transport corridor, also support the implementation of this action plan.

From the point of view of the shipping industry, Danube ports and transhipment sites shall be equipped with efficient infra- and superstructure. A ports' infrastructure is formed by quay walls, rail tracks and roads as well as other paved surfaces while the superstructure is built on the infrastructure and includes e.g. cranes, warehouses and office buildings. In line with European policy guidelines and EU funding programmes, the Danube riparian states along the Middle and Lower Danube should provide a viable economic framework (including public funding) to ensure that their inland ports catch up with performance and service levels reached at the Upper Danube. The availability of adequate, cargo-specific handling and storage

equipment at a certain location is therefore – in combination with the overall service quality provided in ports (opening hours, flexibility, etc.) – a decisive factor concerning the question whether a modal shift towards inland waterway transport can be achieved or not. German and Austrian ports can serve as initiators for modernisation processes taking place in ports all along the Danube.

Long-winded and inflexible administrative processes and paperwork can be a significant competitive disadvantage for inland waterway transport on the Danube. The administrative processes that cause the biggest time losses and highest operational costs from the vessel operators' perspective are border controls and customs clearance at the EU's external borders (e.g. Serbia, Ukraine), bureaucratic processes in the Danube ports and administrative procedures related to navigation surveillance.

In order to solve some of the most pressing administrative barriers for Danube navigation and to support the modal shift more effectively, public authorities and the Danube logistics sector should enter a more intensive dialogue how administrative procedures can be implemented in a flexible and efficient way. A harmonisation of administrative procedures in all Danube countries should also be a mid-term objective in order to ensure seamless transport chains and a higher competiveness compared to road and rail transport.

A dedicated working group on "administrative processes" was initiated by Austria in the frame of Priority Area 1a "inland waterways" of the EU Strategy for the Danube region. Many bio-based raw materials from the agriculture and forest sector within the scope of ENERGY BARGE require phytosanitary controls, which often cause additional bureaucratic burdens during the controls at the EU's external borders. Therefore, it is important that ENERGY BARGE supports the activities of the working group by providing technical inputs from the bioenergy and biomass industry. As one important step, the Transport Ministers of the Danube riparian states welcomed the introduction of three standardised forms (DAVID forms) to be used for border controls along the whole waterway at the Danube Ministerial Meeting on 3 December 2018 in Brussels.

Cargo owners from the bioenergy industry are often bound to harvesting seasons and seasonal fluctuations of cargo volumes. This can lead to a situation where the availability of vessels is scarce during peak seasons. Therefore, ENERGY BARGE also analyses seasonal fluctuations and cargo-specific transport patterns (e.g. transport demand in certain months of the year) which can additionally support the optimal use of inland waterway transport on the Danube.

In the case of blockages of the Danube (e.g. due to ice or flooding) as well as during low water periods cargo owners expect logistics providers to have adequate back-up systems via road or railway networks in place to ensure a continuous supply. The analysis of good practice examples at the Port of Bamberg and Port of Aschaffenburg (D 4.1.1) also showed that sufficient storage space at the transhipment hubs can help to ensure more resilient transport chains via inland waterways and to avoid shortages in the supply chains.

ENERGY BARGE provides B2B platforms to facilitate discussions between suppliers of logistical services and their customers in order to develop more flexible logistics concepts along the Danube.

3.4 Overcoming barriers

In essence, the following recommendations can be derived from the results of the ENERGY BARGE project and the literature research:

- Soundly evaluate the effects of current policy changes on EU and national levels in the renewable energy sector on the demand for bioenergy, especially with regard to types of measures applied (e.g. incentives, quotas);
- Provide consistent frameworks for sustainability criteria of bioenergy and feedstock;
- Consider abolition of subsidies for non-renewable energy sources in order to support competitiveness of low-emission renewable energy technologies and subsequent willingness to invest;
- Support further development of low-emission technologies and their application, especially in Southern Danube countries with a currently high share of traditional wood burning in private households;
- Enhance development of infrastructure as well as improve the energy efficiency of existing systems;
- Increase the information basis and approval procedures for industrial applications/ commercial use of bioenergy;
- Set up a functioning transnational monitoring system for sustainable biomass feedstock availability;
- Support a high reliability and performance of infra- & superstructure (waterway and ports) as well as the elimination of administrative barriers for Danube logistics on transnational level;
- Locate new production and logistics sites directly along the Danube waterway to ensure an efficient access to inland waterway transport and sufficient cargo volumes to enable the use of vessels especially deployed for the bioenergy industry;
- Foster the development of flexible logistics concepts by creating sufficient/efficient logistics nodes to switch to the most suitable mode of transport (inland ports as biomass hubs).

4 Bulgaria

4.1 Recommendations on particularly suitable biomass feedstocks

Bulgaria has significant forest resources and a developed agricultural sector. Solid biomass is the most widely used source of renewable energy in the country. Firewood is the main type of biomass consumed in the country. There is also a trend towards improvement of waste management in order to use the waste for bioenergy production (Ministry of Energy, 2019). Furthermore, the production of electricity from biomass power plants is continuously rising, from 65 GWh in 2012 to 163 GWh in 2016 (Ministry of Energy, 2017).

As shown in the Bulgarian market study report (ENERGY BARGE D 3.1.1), the biomass feedstock with the highest potential for bioenergy purposes is wood (primary wood, forest residues, waste wood) and biomass from agriculture (primary products & residues), especially straw and oil seeds.

Wood biomass

At present, the most common used type of woody biomass in Bulgaria is wood for combustion, which is a major component of the country's energy balance as a source for heat production. However, inefficient stoves are widely used. The potential of woody biomass for energy production could reach about 5,500,000 tons in 2020 (Bulgarian Energy and Mining Forum, 2018).

Primary wood

The forest area in 2017 amounts to 4,243,835 ha, of which 3,092,262 ha (72.86%) are state forest territories. In comparison to 2016 the total forest area increased by 13,010 ha (Executive Forests Agency, 2018). According to the "National Action Plan for Energy from Forest Biomass 2018-2027", there is serious potential to increase the amount of wood for bioenergy up to 8.5-10 million m^3 of standing wood by 2020, which would represent up to 70-75% of the average annual forest growth in the country (Consortium "Focus Systems - Dan Tea", 2017). However, environmental activists fear, that this will result in significant destruction of forests (Greenpeace Bulgaria, 2018).

Waste wood (Forest residues, Industrial residues (e.g. from sawmills))

According to the "National Action Plan for Energy from Forest Biomass 2018-2027", the unused quantitative potential of waste wood amounts to 236,500 m^3. However, in recent years there is an obvious trend, showing that the collection of waste wood is decreasing. While in the period 1995-2005, the volume of branches that have been collected and utilised amounted to an average of 50,000 m^3, the quantity of the harvested wood decreased from 25,581 m^3 in 2012 to 10,803 m^3 in 2016 (Consortium "Focus Systems - Dan Tea", 2017). Waste wood from the woodworking and furniture industry is an interesting element of the total potential of woody biomass in the country but often difficult to evaluate. There are no up-to-date statistics or incomplete and inappropriate data for the exact determination of the potential of industrial wood waste.

Energy Crops

In addition, there is a strong potential for creating plantations with fast growing tree species, such as willows, poplars, paulownia and others for accelerated wood production (Consortium "Focus Systems - Dan Tea", 2017). The Forestry Act from 2011 also created certain incentives to promote these kinds of plantations (Ministry of Agriculture, Food and Forests, 2011).

Agricultural biomass

The climate and nature conditions in the North Central Region of Bulgaria determine it as a favorable farming region. The land is largely flat, safe for the southernmost areas towards the

Balkan mountain range. Crop cultivation has a leading position in the economy of the region. Over 58% of the cultivated lands (14% of the total for the country) are used for growing grain crops (wheat). Sunflowers are in second place, covering over 22% of the arable lands in the area. The North Central Region produces around 17% of all the sunflowers in the country. The last few years mark a clear trend in increasing sunflower production due to the higher demand on the domestic and foreign markets. The climate and other positive preconditions for agriculture determine a potential for use of wheat, sunflower, corn and other energy crops as renewable energy sources.

Recommendations

- Focused state policy for the production and consumption of energy from biomass through development of a specific strategy for the use of biomass for energy production. This should include the development and implementation of financial or tax mechanisms (tax reduction, public loans with advantageous interest rates, etc.) in order to encourage the production respectively consumption of energy from biomass. In charge: Ministry of Agriculture, Food and Forestry, Ministry of Energy, Ministry of Finance;
- Introduction of incentives (e.g. tax reduction for new installations) and modern green technologies (e.g. through information campaigns) in order to stimulate the transition from low effective to highly efficient heating installations in family and/or multifamily homes. In charge: Ministry of Agriculture, Food and Forestry, Ministry of Energy, Ministry of Finance;
- Enhancement of production of pellets, briquettes, etc. from solid biomass (wood, sunflower husk, etc.), ideally in the proximity of Danube ports in order to minimise road transport and to promote IWT;
- Simplification of procedures for creating plantations from fast growing species. In charge: Ministry of Agriculture, Food and Forestry;
- Introduction of regulations for mandatory use of energy-efficient systems and technologies. In charge: Ministry of Agriculture, Food and Forestry, Ministry of Energy;
- Development of an appropriate methodology to collect information about the availability of industrial wood waste. In charge: Ministry of Agriculture, Food and Forestry, Ministry of Environment and Water, State forestry enterprise, municipal and other owners of forests, forest industry;
- Necessity of significant investments in forest infrastructure, e.g. improvement of technological capabilities to collect forest residues. In charge: Ministry of Agriculture, Food and Forestry, Ministry of Environment and Water, State forestry enterprise, municipal and other owners of forests, forest industry;
- Creation of regional logistics centres to provide a better interconnection between producers and sellers and to optimise the transport of biomass. In charge: Ministry of Agriculture, Food and Forestry, municipalities, private investors.

4.2 Recommendations derived from the good practice examples

The good practice example (sunflower and rapeseed oil producer Olivia JSC, see ENERGY BARGE D 3.2.3) has shown that theoretically, the potential of biomass for energetic use (here: sunflower husk pellets) on domestic level is quite high, especially due to the rising fuel and heat prices. The monopolistic position of district heating companies is contributing to the circumstance that more and more households switch to biomass heating. Unfortunately, the highest share of biomass used in this trend is borne by regular firewood. Pellets, briquettes, wood chips and other processed wood fuels are not very popular (Bulgarian Ministry of Environment and Water, 2018).

However, inland waterways and railway distribution networks for grain are not very well developed at present. Although there are more than ten private railway operators registered in the country, specialised transports are carried out mainly by Bulgarian State Railways. This is related to the lack of specific wagons at private companies to transport grain.

Although the port of Svishtov is closer to Polski Trambesh (45 km distance instead of 70 km to the port of Ruse), it is not preferred for IWT. This is related to the insufficient port infrastructure as well as to its private ownership, which makes the use of the port by other market actors sometimes difficult. Another reason for the inadequate use of the Danube is the fact that in a very long period of the year it does not allow navigation due to low water levels.

Recommendations

- As the prices of highly efficient heating installations are still very high, incentives to stimulate purchases of new and efficient heating installations are necessary to increase domestic demand;
- Information campaigns should inform potential users about the environmental impact and the reliability and efficiency of using biomass pellets. At present, despite the increased production of pellets, they are mainly exported and not utilised in Bulgaria;
- Improvement of port infrastructure in and its connection to the rail network is needed;
- Public or private initiative needed to better integrate Bulgarian Danube ports in the whole logistics chain;
- Transformation of ports into logistics hubs that offer a complex service for the reception, storage and transportation of biomass.

4.3 Recommendations on bioenergy logistics along the Danube

Inland waterways freight transport has a relatively high share in Bulgaria, according to data from Eurostat. In 2016, 27.2% (% of total tonne-kilometres) of inland freight was transported via the Danube (EU-28: 6.2%) (Eurostat, 2018).[1] The total cargo transport volume in 2015 was 6.38 million tons (1.70 million tons domestic, 1.34 million tons export, 1.66 million tons import

[1] The comparatively high share of IWT in Bulgaria is in part explained by the extensive traffic on the Danube and in part by the 'territorialisation' of the road data.

and 1.68 million tons transit transport) (Danube STREAM, 2016). The biggest share of cargo turnover of Bulgaria comes from the transport of agriculture and forestry products.

It turned out that sometimes it is not possible to use ports because the concessionaires use them for their own purposes, which leads to advantages for some companies compared to others.

Recommendations

- The Ministry of Transport should introduce specific rules for setting up ports and/or terminals specialised in specific cargos, ensuring access and transparency of the ports services for all companies to avoid competitive advantage and to allow the use of ports for all companies;
- The Executive Agency for Exploration and Maintenance of the Danube River has to ensure and guarantee minimum standards in fairway levels of 2.5 meters throughout the year.

4.4 Overcoming barriers

The Ministry of Energy has drafted an "Integrated Energy and Climate Plan for 2020-2030", in which the production and consumption of energy from renewable sources shall encourage the sustainable use of existing wood and agricultural resources and the development of new production systems in the forestry and agricultural sectors.

According to the Ministry of Energy, policies and measures to implement the national contribution to the binding 2030 target at EU level for renewable energy shall include:

- Legislative changes in administrative procedures related to the construction of power plants from renewable sources and biomass conversion plants in biofuels, solid, liquid and gaseous fuels from biomass;
- Requirements for the use of energy from renewable sources in the construction of new or overhaul of existing buildings, where this is technically and economically feasible. For these buildings at least 15% of the total heat and cooling energy needed for the building to be produced from renewable energy is provided by introducing:
    - district heating using biomass or geothermal energy;
    - individual biomass burning facilities with conversion efficiency of at least 85% for residential and commercial buildings and 70% for industrial buildings;
- The sustainable use of existing wood and agricultural resources and the development of new production systems in the forestry and agricultural sectors are promoted, provided that the sustainability criteria and the reduction of GHG emissions are reached;
- Replacement of solid fuel stoves and boilers (coal and briquettes) for heating with stoves and biomass boilers in the field of domestic heating – mandatory phase-out between 2020-2024 (Bulgarian Ministry of Energy, 2019).

Within the scope of ENERGY BARGE, the following recommendations can be derived:

- An absolute necessity is the maintenance and guarantee of a minimum fairway level of 2.5 meters throughout the year in order to use IWT for biomass. While endeavouring to improve the situation concerning river transportation in line with the aforementioned recommendations, alternative means of transportation should be considered to further optimise the logistic chains. This also takes into account the lack of predictability for the opportunities for using Danube navigation related to low water and the inability to provide a consistent depth of the fairway throughout most of the year.
- Initiate broad discussions with relevant stakeholders (central government, municipality, companies at regional level) to address the negative consequences of the high transportation costs. In particular, initiate broad discussions to address the issue of better equipping river ports, shifting the transport modes, and the high transhipment prices. At present, ports are not well connected to the country's core rail network and road transport is becoming more expensive with fuel prices rising and this reflects on the final price of the products. Currently, it is preferable to supply neighbouring countries using mainly road transportation.
- The transformation of Bulgarian Danube ports into logistics hubs that offer complex services for the reception, storage, and transportation of biomass should be targeted.
- Systematisation and up-to-date information on available resources, suitable for the production of bioenergy as well as its territorial distribution should be established. The information should be accessible for the public with a special focus on the interests of potential producers. In charge: Ministry of Agriculture, Food and Forests, National Statistical Institute;
- Opportunities for potential public-private partnership projects in the bioenergy-sector should be elaborated.
- Introducing binding regulations for new businesses/investments to use mandatory energy efficient systems and technologies with a minimum of environmental pollution.

5 Croatia

5.1 Recommendations on particularly suitable biomass feedstocks

Croatia, having a vast source of wood biomass, is not likely to promote any alternative biomass source for energy production. While there have been some efforts to use the remainders of olive oil production and several working examples of using straw for pellet production, they have all proven to be inadequate for large-scale production. In terms of production of biofuels as another energy source to be transported via inland waterway logistics, it has been prevented by the unfavourable regulatory framework. Without more stringent enforcement (or encouragement in terms of subsidies) of using domestically produced biofuels as a part of commercial products, this is not likely to change.

In the eastern part of the country, which would be the target area for feedstock or raw material transport on the Danube, there are several large bioenergy producers (e.g. Šišarka, Spačva), and also end users (e.g. BE-TO Osijek, Uni Viridas) using wood chips for energy production.

Recently, there have been some issues regarding the distribution of forest biomass due to the nationally owned company (Hrvatske šume d.o.o.) in charge of 80% of forest area in Croatia leaving the processors, who depend on the raw material inflow, in a difficult position. As stated in previous documents (Deliverables 6.2.1 and 3.2.1 of the ENERGY BARGE project) the raw material is hauled directly from the forests after public procurement or public auctions. In some cases, the contracts are made for the delivery of a guaranteed amount of material within a specific period. In such cases, there are processors with a lack of sufficient biomass feedstock. This leaves a huge potential to open the raw material market to imports though.

Overall, woody biomass remains the most important feedstock for both import and export, but given the fact that the production of biofuels is non-existent in Croatia, raw material can be exported for further processing (e.g. various oils). Expanding the cooperation between Croatia and the Danube area in terms of biofuel production can enhance research activities in the country to establish possible new approaches to biofuel production.

The regulatory framework supports the energetic use of biomass only through the means of subsidising the electric energy fed to the grid via a system of national quotas, which have been fulfilled years ago. Also a new decree on short rotation crops has been introduced, which seems not to be favouring small landowners and is mostly in control of the state owned forestry company.

5.2 Recommendations derived from the good practice examples

All interviewed parties have not made any investigations or research on the feasibility or the financial viability of handling both the raw materials and products by river transport. The vast majority of logistics is still carried out by road transports. After having presented the prices for IWT to Spačva d.d., which was chosen as the best practice example, a significant interest in the matter has been shown. For the wood processing company, the main issue regarding the water transport would be the transhipment and the fact that a significant portion of the process has to be handled by trucks, increasing the final price.

Thus, it would be beneficial to enter a bilateral discussion with the bioenergy stakeholders about their needs for overcoming the problems. Mainly, this would include enhancements to the port infrastructure to enable fast and simple material transports to the barges. Possibly, this could be solved by establishing storage facilities. In Croatia, there are no dedicated traders capable to take on the larger amounts of material and handle the transport both in and out of the country. A network of such traders (with their storage facilities located at or near the ports) would relieve the producers/processors from the task of feedstock handling at the ports, decreasing their overall effort and costs.

One of the strategic projects both on local and national level is the canal connecting the two navigable waterways in Croatia, the Sava and the Danube rivers (linking up in Serbia). The new canal, which would connect two rivers, should, according to the project, increase the availability of inland transport to central Croatia and would include building a new logistics centre in the vicinity of Vukovar port. However, the project has been rejected by the local authorities in the city of Vukovar fearing that it might negatively affect the port of Vukovar, drawing away some of the business, as well as having a negative effect on agricultural businesses in the vicinity. It is very unlikely that the idea might be realised in the near future.

5.3 Recommendations on bioenergy logistics along the Danube

As indicated in the previous chapters and according to the interviews held with experts in the frame of the ENERGY BARGE project, there is currently no regular transport of biomass via the Danube, which would include any stakeholders from Croatia. Any effort in this respect would be a huge step forward in expanding the supply of feedstock and products in the Danube area.

Organising an international B2B meeting with producers of final products and raw material on each end would be beneficial to make connections between bioenergy actors from the distances previously not being considered. Currently, in Croatia, the profitability limit using road transport of wood pellets is approximately 1,000 km. Joint efforts by the stakeholders to increase awareness of using bioenergy products in the region would draw the public attention to the issue and might provide some additional boost.

Producers currently using only road transport should be encouraged to shift to the alternative modes by providing support in terms of facilitating easier and administratively less demanding change of transport mode (transhipment road-river-road). Establishing the role of traders who would also be in charge of handling the multi-modal transport would be widely accepted.

5.4 Overcoming barriers

While there have been numerous mentions of the inclusion of biomass in several action plans at both regional and national levels, there have not yet been any real efforts made in order to promote a higher share of bioenergy in Croatia's overall energy supply. It would be advisable that a regional or local action plan is supervised by a higher authority to ensure that it is being implemented. In terms of energy production, the biggest issue seems to be that, at the national level the preferred producers' quotas have been fulfilled already a while ago, discouraging any new investments into establishing new facilities. Exacerbating this problem, only a small amount of these quotas have actually been met by the initially proposed projects, rendering large parts of the capacity supplied by the quotas unused. A time limit on an approved quota for a preferred producer to put the project into working state would be a step in the right direction. The applicants should also be required to propose a timeframe in which the project should be operational.

For extending the logistic part of the biomass transport, an initial incentive to promote a role of a classical trader, which would also act as a distribution centre, preferably near a river port, could also draw the producers to use river transport.

In terms of biofuels, the new act on biofuels for transport does not promote new ventures into first generation biofuels production, but is rather aimed at encouraging research and development efforts to explore new and advanced fuels.

Projects, which have been signed to receive a preferred producer status, should be urged by the managing authority (Croatian Energy Market Operator Ltd.) to increase their output. Thus, it would become more pressing to fulfil the quotas or have the unused quotas revoked (after a prescribed fixed deadline to start the electricity production) to the benefit of new projects with a limited time for finalisation.

There have been examples of smaller communities establishing district heating facilities in non-urban areas, but such have not been promoted on national level. These ventures, not only provided a more efficient way to provide heat energy to the community, but also to local biomass sources in a different way and to create additional jobs for the local population. Using the already established, successful projects as good practice examples, the experiences can be shared among other potential areas with additional support in terms of initial subsidies or favourable financial support and additional support in technical project preparation. In addition, support can be provided in terms of preparing projects on a transnational level, which would also enhance the visibility of the bioenergy potential and draw more interest from other local authorities.

6 Germany

6.1 Recommendations on particularly suitable biomass feedstocks

- In general, especially residue material is of relevance for bioenergy production in Germany in the near to mid-term future; the main types as identified in the market report for Germany in WP 3 (D 3.1.1) are: residual forest wood, grain straw, animal excrements and to a certain extent communal waste such as landscaping material, leaves/greenery;
- Especially dry bulk goods with suitable specific weight and uncomplicated characteristics regarding fragility and contamination are currently transported via IWT and should be prioritized for IWT → oil seeds and starch based materials for bioethanol and biodiesel production;
- In Germany, there are many highly skilled market actors along the bioenergy value chain;
- Several regions with high theoretic woody biomass potential for utilisation in the bioeconomy in Germany have access to IWT and ports, e.g. Lower Bavaria (via Danube), Franconia (via Main), (both soft wood) and the area north of Frankfurt/Hesse via the Main (hard wood);

- The port of Straubing has received several requests for supplying different lignocellulosic and woody residue materials in comparatively large quantities, e.g. hazelnut shells for energetic utilisation. Their transport worthiness has not been assessed up until now but since they originate in Turkey and other countries in this area, a transport via the Black Sea and Danube could theoretically be possible.

In general, biomass feedstock for energy production should be regionally available. Road transport over longer distances (>80 km) should be avoided. For longer distances, the transportability on the Danube should be assessed.

- Production or processing should contribute to regional value creation, e.g. via first conversion steps on decentral, regional level;
- Cascading use or cluster forms of regional supply chains should be assessed and supported;
- Research regarding sustainable biomass utilisation is still needed, e.g. mobilisation of forest residue material;
- Wood from privately owned forests is frequently hard to acquire because harvests from many smaller forest properties have to be bundled into marketable quantities;
- State-owned forests (Bayerische Staatsforsten) and certified forests (PEFC) impose far reaching limitations on whole-tree harvest, thus complicating procurement of suitable biomass for energetic use from forests (Weis et al., 2016; PEFC, 2014);
- Subsidies focus on consumer benefits as well as research and development.

6.2 Recommendations derived from the good practice examples

- Especially dry bulk goods with suitable specific weight and comparatively good characteristics regarding fragility and contamination are currently transported via IWT;
- Especially central production sites with economies of scale and large input quantities consider IWT as a logistics option for their processes;
- Decentral applications such as cogeneration units rarely use IWT; at the same time, biomass supply seems to be a challenge oftentimes;
- Ports can be suitable locations for biobased processing plants, e.g. for the processing of biomass into bioenergy carriers or other biobased products or intermediaries; therefore, active business development towards ports as bioenergy and bioeconomy hubs should be put in place and supported by public/political level;
- Ports can be suitable locations for the creation of production clusters and integrated supply chains, e.g. in the case of Aschaffenburg as was learnt from the site visit in WP 4. Through active business development from the port authority, based on one settling company in the port (pulp and paper), both a sawmill and a wood chips cogeneration unit were attracted to the port. IWT is used to transport the products from the pulp and paper company, feedstock delivery for the sawmill and residue material from the cogeneration plant.

Case of Straubing:

- Regarding infrastructure, the port of Straubing is running beyond its capacities on waterside handling. A substantial expansion of port capacities is to be considered, including a second basin, additional berths, and storage options for biobased materials (mainly wood). Cranes need to be modernised.
- The shipping/navigation conditions need to be improved ("bottlenecks" south of Straubing). German politics need to recognise the functioning of IWT systems and that a connection to the Rhine area is only functioning when the German/Bavarian stretch is reliable to a sensible extent.
- The good practice examples do not receive any kind of state aid for using IWT.
- The regulatory framework conditions in the region are not specifically supporting the production of biomass for energetic use in a different way than these energy forms are generally supported on federal German and Bavarian level. However, the region of Straubing was awarded the title of "bioenergy region" for two consecutive periods until 2015. The title was combined with a set of regionally led activities to increase the utilisation of bioenergy in public and private realms. The big companies producing bioenergy carriers have been and still are supported by the regional political actors in case they require political activities to the extent possible.

6.3 Recommendations on bioenergy logistics along the Danube

- Improve the level of trust on the side of cargo owners and forwarding companies (general statement) in reliability of IWT generally and the Eastern countries in particular (task for IWT sector and responsible associations etc.).
- Provide business case calculations integrating environmental aspects and economies of scale, e.g. 1,000 t → 1 vessel or 40 trucks (24 t-standard), (task for IWT sector and responsible associations etc.).
- Provide practical information and translation of different understandings regarding measures, weight, and other cargo specific characteristics in order to improve a common understanding.
- Analyse the current regulatory framework for liquid cargo transport and options for handling in order to extend suitable infrastructure.
- Improve a regular exchange between cargo owners and customers in the biomass/bioenergy sectors and the IWT sector (task for associations of both sectors).
- Detailed analysis of IWT performance and assessment of IWT in comparison to other transport regarding subsidies and other forms of state aid (incentives to use certain transport modes).
- Educate port operators about the potentials of the biobased economy and the Danube region in this context so that the IWT sector can directly address these market actors with their offers and also actively offer business development for settlement of new biobased investments in Danube ports.

- Successful settlement activities in the field of bioenergy in one region can create "pull effect" for further settlings.
- Generally, the IWT sector seems to be most prone to the risks that the climate change effects. Long dry periods and low water levels pose a higher risk in comparison to other transport modes, which have a much higher contributing impact to these effects than IWT. In order to keep IWT competitive, resilience strategies and risk management tools for IWT users have to be developed ideally on EU level.

6.4 Overcoming barriers

- Increased research on sustainable options for biomass utilisation is still needed. This also includes the communication of potential of biomass for energetic and chemical-material purposes to the general public.
- The bioeconomy is a highly promising cross-cutting emerging sector for the development of the Danube macro-region.
- Analyse and realise options to improve infrastructure of IWT to ensure quality levels expected by cargo owners and customers.
- On German/Bavarian level: stronger appreciation of concerns regarding exploitation of biomass potentials without added value creation, especially in south-eastern countries.
- Improve level of trust on the side of cargo owner companies of biomass with respect to reliability of IWT generally and the eastern countries in particular (the interviews in WP 4 showed that several bioenergy companies once used IWT but made negative experiences with border crossings, tedious paper work, unexpectedly long waiting times in ports and corruption).
- Especially for eastern European countries, it is required to further analyse feedstock and cargo flows (e.g. import and export of wood pellets).
- In-depth analysis of modes used for biomass import and export and subsequent calculation of modal shift potentials.
- Assessment of the potential role of IWT and the Danube region for the provision of biobased feedstock and products for the European bioeconomy on a large-scale.

7 Hungary

7.1 Recommendations on particularly suitable biomass feedstocks

The original EU target has set a 13% share of renewable energy of the total energy consumption for Hungary by 2020. The Hungarian government voluntarily raised this value to 14.65 % in the Renewable Energy Utilization Action Plan. The share of renewable energy in total gross final energy consumption was 14.5% in 2015 while this figure was only 9.6% in 2014. Thus, Hungary has surpassed the mandatory goal for almost three years and is moving rapidly towards fulfilling its voluntary commitment. At the same time, it covers less favourable indicators by the fact that

solid biomass (including firewood) is the main source of bioenergy, while biofuels provide the other major source. The substantial change was caused by the different calculation method of the residential solid biomass use. Based on the data of the Hungarian Energy and Public Utility Regulatory Authority (2017), the value of the produced energy from renewable energy sources and wastes has increased more than 2.5 times between 2000 – 2015 (from 35.1 PJ to 92.8 PJ). From biomass and municipal waste 65.1 PJ, from biofuels 15.8 PJ and from biogas production 3.5 PJ energy was produced. In 2015, biomass contributed with 61% (52% solid biomass, 9% biogas) for the amount of electricity produced from renewable energy sources (3,215 GWh) (Hungarian Energy and Public Utility Regulatory Authority, 2017).

The utilisation of the domestic wood supply is low and lags behind the opportunities and long-term market needs. For energetic purposes, another 1.1 million m^3 of logging residue (branches, twigs, bark, chippings from cutting, trunks, etc.) could be potentially mobilised (Popp et al., 2018). A smaller portion of the logging residue is collected by the local population as firewood, but the majority is currently left in the forest. The additional demand for wood for energy generation may encourage forest managers to collect logging residue more effectively, but there are technical and economic limits to this as well. Firewood, unlike other types of biomass, already has a mature market. Therefore, the power plants' increasing demand has a great effect on the existing demand-supply relationship.

4-4.5 million tonnes of straw originate from the production of cereals annually. Of this, about 2.4-2.8 million tonnes could be used for energetic purposes in a sustainable way. In addition, 8-10 million tonnes of maize stover accrue annually. From this amount about 2.5-3.0 million tonnes of maize stover could be utilised as biomass feedstock for energy production. In addition, a significant amount of sunflower stems and oilseed rape straw is produced, which amounts to about 150-200 thousand tonnes of biomass per year from vineyards and further 400-500 thousand tonnes of per year from orchards (Agriforvalor project website, 2016).

Domestic biofuel production plants are roughly meeting the targets set earlier with their current production capacities. In the case of biodiesel production, the aim is to increase raw material processing. Bioethanol and its co-products are made from maize; approx. 2.0 million tonnes are processed per year. Ethanol produced in Hungary is sold in nearly 30 countries around the world. At the end of 2017, a new bioethanol production facility was installed in the country, which will increase the annual quantity of processed maize by 500,000 tonnes. Besides the main products, DDGS (Distillers Dried Grains with Solubles), CGF (Corn Gluten Feed), and some other by-products have a significant added value compared to their use as natural fodder. Presently, there is only one bio-diesel factory with 150,000 tonnes of production capacity per year. The main raw materials are fresh vegetable oil (rape, sunflower) and used cooking oil (the basis of IPPC Permit) (Popp et al., 2018).

7.2 Recommendations derived from the good practice examples

The Port of Komárom should be developed to serve as a supporting partner of Rossi Biofuel by building closed storage and drying facilities. The Freeport of Budapest should contact FŐTÁV

Zrt. (District Heating Co. of the Capital) about the company's new biomass-based heating plant: the southern plant (located close to the planned new district heating grid of Galvani Bridge) could be set up within (or close to) the port area. The second Hungarian case study (Deliverable 3.2.3) shows that the Hungrana company already uses IWT especially for feed and food products as well as raw materials.

Presently, Mohács (Bioenergy-Duna Ltd.) is the only operating district heating service provider using biomass where biomass transportation by inland waterways can be taken into account, since the town of Mohács is located on the banks of the Danube. Transportation on the Danube has big potential for the future because it connects renewable energy use with a more environmentally friendly way of transportation. Another advantage of the city's location is that it is located at the border of Hungary to Croatia and Serbia. This could become an advantage for future raw material imports.

Regarding the production of biomass for energetic use, Danube ports close to major energy biomass markets have the potential to serve as energy biomass hubs. To use this potential it would be required to offer storage capacities with value adding processing and services like drying, transfer to big bags, organising road and rail transfer, management of energy biomass supply for consumers and the implementation of quality control systems.

7.3 Recommendations on bioenergy logistics along the Danube

Ports close to major consumers or potential markets could serve as logistic hubs of energy biomass supply by organising and managing biomass supply, transport to end-users, and providing quality control services to satisfy end-user requirements. Major investments in solid biomass-based energy production can change raw material market conditions considerably as well. Presently, there are only a few biomass-based thermal power plants in the direct vicinity of the Danube. For energy biomass suppliers transport costs are a key factor in competitiveness where waterway transport could have a major positive effect if prices can be kept low. Solid biomass stocks can be stored in ports close to end-users in order to secure a consistent supply. Ports have to play an active role in the logistic chain by optimising shipment costs and provision of buffer storage facilities to ensure flexibility and security of supply during critical seasons (winter months). A system providing data on empty vessel capacities for solid biomass suppliers could facilitate better utilisation of waterway capacities for energy biomass transport.

The Hungarian Danube section is not navigable throughout the whole year. According to interviews that were conducted in the frame of the ENERGY BARGE project; the Danube in the Hungarian section is only navigable for appr. 200 days. Complex dredging operations need to be completed along the Hungarian section. To increase the number of days for river navigation, the basin needs to reach a depth of 2.5 meters. This would also allow vessels and barges to load more cargo and thus making IWT more efficient. Overall, this measure would attract more clients facilitating a modal shift from road transport to waterway transport.

7.4 Overcoming barriers

For energy biomass suppliers, transport cost is a key factor of competitiveness where waterway transport could have a major positive effect if prices can be kept low. The development of storage (buffer) capacities in ports for solid biomass with a general optimisation of the transport costs could increase the competitiveness of this mode of transport.

Key improvements to strengthen the role of waterway shipping with regard to energy biomass (including bio-fuel raw materials, and other seasonal products) comprise the improvement of the navigability of the Hungarian section of the Danube, as well as developing port capacities in the vicinity of major wood production areas. This includes the installation of wood processing capacities (especially on the Danube section above Budapest). In addition, information services on waterway transport costs and special offers for energy biomass suppliers and subsidised investment programmes could generate an increase in the role of the Danube in the field of energy production from renewable sources.

8 Slovakia

8.1 Recommendations on particularly suitable biomass feedstocks

The total forest coverage makes up more than 40% of the territory of Slovakia. Of this forest area, out of which only 55 to 60% are being managed. Currently, there is a significant problem in forestry, causing the die-off of old spruce plantations (StatOffice SR, 2018).

From this point of view, considering direct incineration of biomass in special up-to-date facilities, the majority of the installed heat production capacity is based on biomass feedstock, represented mainly by wood chips, pellets, as well as straw and hay. The supportive program of the Slovak Government for the utilisation of biomass from agriculture and forestry includes incentives for the utilisation of biomass from agriculture for heat production with the goal to avoid using energy from non-renewable sources for heat production (rokovania.sk, 2004).

In order to improve the utilisation of biomass for energetic purposes, the following recommendations can be derived:

Long-term and more stable rules for RES. The most important problem appears to be a lack of cogeneration power plants for the production of heat and electricity, with a year-round consumption of wood chips, especially concerning the summer consumption. Therefore, the government officially implemented a program to promote biomass (wood chips) as a major component / source for the production of green energy. The program's intention is to contribute to the government's goals to increase the share of renewable energy.

Proper and standardized wood processing. Well-timed chipping of residue coniferous biomass is necessary for the hygiene of the forest. Improper steps during the woodcutting and further

processing as well as the current structure of Slovak forests is increasing the danger of spreading infestations, pests and vermin. The introduction of national standards and norms should increase the overall quality of forests as well as particular products.

Stricter controls of used types of biomass for energetic purposes. There are significant claims from environmentalists in Slovakia, arguing that not only residue and lower quality wood, but also wood of higher quality is used for the production of wood chips and pellets (TREND, 2018). The result is inefficient timber harvest as residual wood is not fully processed and remains are left in the forest, as well as unsustainable cutting volumes, resulting in a slowly declining forest area in Slovakia. In the future, it will be prohibited to produce wood chips from high quality wood (ENERGIEPORTAL, 2019; TREND, 2018).

8.2 Recommendations derived from the good practice examples

Narodna Energeticka, a Slovak company that was identified as a good practice example in the frame of Deliverable D 3.2.3, is operating several heat production units of small and medium size nationwide across Slovakia. The respective locations of the sites are directly related to the local biomass feedstock availability. However, operations of all subsidiaries are centrally managed and controlled.

The company is involved not only in the generation of heat by operating boilers and production sites, but also on management and supply of biomass feedstock to its own operational companies as well as to external customers. The bioenergy market thus represents the main market and basis for the business model.

Based on the investigated example of Narodna Energeticka, the following recommendations can be derived:

Proper coordination of company's strategy in line with existing government and EU support programs. Effective utilisation of biomass for energetic purposes can be achieved only by significant investments. Those are affordable only by using long-term financing, linked to guaranteed sales at guaranteed prices.

Supporting action – Consider support, either direct through launching of national calls for projects or indirect, e.g. via tax allowances.

Strict evaluation of biomass quality from different suppliers. Real energy efficiency of biomass commodity plays significant role in overall efficiency. As biomass commodity represents as much as 70-80% of overall variable costs of operations, a real energy conversion rate plays significant role.

Economically meaningful energy production in Narodna Energeticka consists of using the cheapest biomass feedstock, such as wood chips and other feedstock generated from residue materials. This results in logistics solutions where road transportation is used. Narodna Energeticka was identified as a good practice example according to the following facts:

- Optimal attitude towards management of all subsidiary companies;
- Investment in production sites to secure most effective performance considering both technical and economical parameters;
- Optimization of biomass sources concerning both effectivity and price, mainly by a combination of wood chips and straw;
- Concern towards permanent development of all factors related to the increase of effectivity of energy production from biomass (demonstrated recently by establishing an experimental field for cultivation of fast growing plants as a source of biomass for energy production).

8.3 Recommendations on bioenergy logistics along the Danube

Concerning Slovakia, generally it is believed that the most effective way to utilise biomass for energetic purposes consists in domestic sources supplying the energy to local customers. Several small companies are operating this way, utilising biomass from adjacent regions. To start the production of energy from biomass on a substantially larger scale, the requirements would differ substantially for the current situation:

- Ensure appropriate biomass quantities to operate the energetic plants;
- Find and support agricultural entrepreneurs to initiate the production of energy crops, e.g. fast growing trees;
- Estimate the economic conditions if transports over long distances would be required, determining the lowest economically feasible amounts
- Initiate the reconstruction of Slovak ports to be able to handle large amounts of biomass;
- Support of technical facilities in ports that are required to handle large volumes of biomass of varying characteristics.

The idea of a central biomass storage / warehouse / logistics centre is being discussed by several business partners from both the energy as well as the logistics sector. Due to the relatively high availability of local wood resources, importing higher volumes of biomass via IWT has not been considered more deeply yet.

8.4 Overcoming barriers

The main concern should be devoted to the design of a complete energetic chain – starting with biomass, through its processing, until heat production intended for final consumption. The authorities should inspect all activities and support the missing elements in the energetic chain. Main concerns must be devoted to the optimisation and an increased efficiency of the processes. All subsidies must be well designed, clearly defined at each stage (eligibility of supported subjects, economically sound support, clearly defined and verifiable goals), secured by legal instruments to achieve the declared outcomes, including long-term sustainability.

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