

ENERGY BARGE

Building a Green Energy and Logistics Belt

Project Code: DTP1-175-3.2

Deliverable 3.2.3

Regional case studies

for biomass and bioenergy production –

Case Study Slovakia:

INTECH Slovakia – Národná Energetická

29 June 2018

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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 facilitates the market uptake of biomass, supports better connected transport systems for green logistics and provides practical solutions and policy guidelines. The Agency for Renewable Resources (FNR) coordinates the ENERGY BARGE project consortium with fourteen partners from Austria, Bulgaria, Croatia, Germany, Hungary, Slovakia and Romania.

Project coordinator

Agency for Renewable Resources /

| | | |
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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 |
| MAHART-Freeport Co. Ltd. | MAHART | Hungary |
| International Centre for Sustainable Development of Energy, Water and Environment Systems | SDEWES Centre | Croatia |
| Public Institution Port Authority Vukovar | PoVu | Croatia |
| 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 “D.3.2.3. Regional case studies for biomass and bioenergy production” of the ENERGY BARGE project. It has been prepared by:

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Background

ENERGY BARGE aims at exploiting the Danube macroregion's bioenergy potential to increase energy security and diversification of energy sources by establishing secure, efficient and sustainable bioenergy supply chains along the river. To this end, a holistic view on the bioenergy market and underlying value and supply chains is needed. Given national and regional disparities in theoretical, geographical and market potential for bioenergy, deployment, public support, and also cooperation between private and public actors, it is necessary to identify levers for tapping potential and options for market actor cooperation, business development and market uptake.

A theoretical model designed to increase the market uptake of bio-based feedstock for both material and energetic (ideally cascading) use in the Danube region and thus to address the objectives also set out in the EU Strategy for the Danube Region (EUSDR) is a concept called "Green Energy and Chemistry Belt" (see Figure 1). It was developed by the BioCampus Straubing GmbH (Project Partner 1) and aims at using the Danube River as a natural biomass corridor and sustainable transport axis for biomass. The underlying principle follows the logic of "local harvesting – decentral processing into more transport-worthy states (e.g. oils, pellets, liquids) – central refinement or end use", so that added value creation can mainly stay in rural areas along the Danube. This concept forms the basic idea of the ENERGY BARGE project.

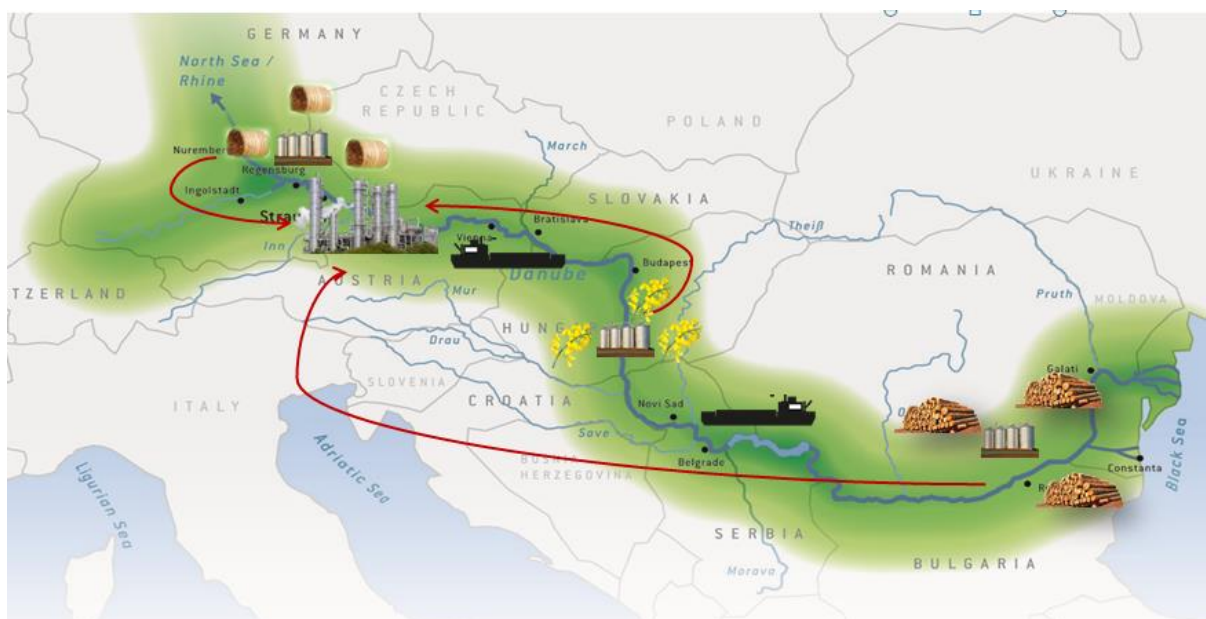


Figure 1: Green Energy and Chemistry Belt (Source: BioCampus Straubing GmbH, own visualization).

In order to reach the targets outlined above, Work Package 3 provides market-oriented mapping of the Danube region's value chains from biomass feedstock production and residues to energy generation from an integrated, transnational perspective, giving regional and transnational guidance for market development along the river (green bioenergy belt) and setting the stage for increased use of Danube logistics in the bioenergy sector. This will be achieved through a transnational market study compendium including biomass flows and sustainability aspects

(macro-perspective, Activity 3.1), business landscape mapping, case studies and identification of best practice locations for bioenergy value chain integration (micro-perspective, Activity 3.2).

Objective of the regional case studies

This deliverable “D 3.2.3 Regional case studies for biomass and bioenergy production” is based on the task as described in the latest approved version of the Application Form of the project ENERGY BARGE (Project Code: DTP1-175-3.2).

- *A3.2- Providing a systematic insight into the integrated bioenergy landscape along the Danube (lead: BCG)*

Activity 3.2 focusses on the biomass and bioenergy business sector, with the aim of mapping the state of the business landscape working along the bioenergy value and supply chain in the Danube region. This will mainly be achieved, in connection with a company inventory and a demand scenario analysis, via a set of regional case studies, focusing on exemplifying cases with already established (or currently being established) biomass and/or bioenergy markets/businesses, their future integration potential, and also covering their already existing as well as potential logistics connections with a focus on connections with nearby inland port terminals and inland waterway transport (IWT).

With D 3.2.3, the aim is to identify cases, i.e. specific real-life situations (businessdictionary, 2018), in each of the partner countries in which biomass production and/or utilisation in the bioenergy sector (as well as other utilisation sectors, e.g. chemical-material use) plays a dominant role in comparison to other cases. After identification via a standardized matrix, the objective is to coherently analyse these cases in case study reports. The focus here shall be on describing the status quo of these cases with respect to a set of characteristics and on subsequently analysing the success factors (enablers & inhibitors) influencing this status quo. In addition to this qualitative analysis, each case shall be accompanied by a GIS-based (geographical information system) map depicting land use, as well as options for regional supply and logistics chains (roads, ports, business partners). Through the direct contact to responsible managers and other important people in charge at the cases, the project can be further disseminated. Moreover, discussions and considerations about challenges and chances of the bioenergy sector in the Danube region are spurred, contacts made and options for future integration of inland waterways and ports can be presented and discussed.

In the following project steps, the aim is to use these case studies for Output 3.2 as a basis to identify good practice examples on how and in what ways biomass and bioenergy production and utilisation can be regionally and locally integrated, how supply chains can be improved or established and – ideally - how inland ports can contribute to this integration via their logistics services as biomass and bioenergy hubs.

Overall, project partners from six countries (Austria, Croatia, Germany, Hungary, Romania, Slovakia) compiled seven case studies. Each country's case study report is designed as additional information to the interactive ENERGY BARGE modal shift platform. In addition, a summarizing

synthesis report is made available in order to get an overview to the whole case study area and the sites chosen.

III Executive Summary

Based on selection criteria the INTECH SLOVAKIA - NÁRODNÁ ENERGETICKÁ has been conducted as a qualitative research in Slovakia. The case study represents group of companies, active in heating production as well as management of biomass feedstock supply and operations. Majority of installed heat production capacity is based on biomass feedstock, including wooden chips, pellets, as well as straw and hay, which makes the case study relevant for the project.

Company is operating heat production units in 8 different sites, located nationwide across Slovakia, mainly in the region of Mid to South Slovakia. Location of sites is directly related local to biomass feedstock availability as well as other socio-economic factors.

Company is, inter alia, involved not only in production of heat (operating boilers and production sites), but also (via company INTECH SLOVAKIA) on management and supply of biomass feedstock to both its own operational companies as well to external customers. Bioenergy market thus represents the main market and basis for the business model.

Successful operations of a business, based on bioenergy and biomass is possible mainly due to existing policy, regulation as well as relatively well implemented legislation, which stabilizes overall business. Correct regulation enables active involvement of most of relevant stakeholders, especially final customers (mainly municipalities), banks ready to finance well-structured projects as well as technology providers. Combination of the above mentioned factors and stakeholders' involvement enable sustainable and continuously development of the company.

Company is very sensitive on costs and tendency to use the cheapest biomass feedstock, such as waste wooden chips and residuals, is preferred. This is resulting into logistics applications, where road transportation, utilizing preferably own handling and transportation fleet is used.

The closes Danube port is located approx. 50 km from the closes operations and currently inland water transport is not used by the company. However, as overall operations and volumes of biomass feedstock are increasing, Company might potentially consider using water transport in future. Main factors for this decision however are (i) availability and price of local biomass feedstock, (ii) price of imported biomass potentially available, (iii) total volumes of biomass processed, and (iv) pricing of local transportation, where new technologies with lower operational costs might start to play significant role for final decision.

Lessons learned from the Slovak case study are mainly (i) proper implementation of EU supportive policy is a must for successful development of the biomass market, (ii) proper marketing and involvement of all types of stakeholders plays important role during implementation of business model, (iii) usage of Danube water way might be realistically considered in mid-term future, due to expected development of important decision making factors.

1 Case study methodology

Overall, six partner countries present case studies: Austria, Germany, Hungary (2 studies), Croatia, Slovakia, and Romania. Each country's case study report is designed as additional information to the interactive ENERGY BARGE platform. A summarizing case study report is made available in order to get an overview to the whole case study area and the sites chosen.

In the map below, an overview of the Danube region and all cases covered (red dots) is presented. The map is an extract from the ENERGY BARGE modal shift platform (www.energy-barge.eu) and also depicts an abstracted level of bioenergy company locations in the macro region (green dots).

The Slovakian case study on the INTECH SLOVAKIA - NÁRODNÁ ENERGETICKÁ has been conducted as a qualitative research in order to collect and evaluate available data and information about related companies and their involvement in biomass and bioenergy activities. Major parts of the information have been mainly collected from publicly available sources as well as a questionnaire form and interviews with the CEO of the Company, Mr. Ivan Ďudák.

The team has executed wide research of available data, using mainly internet resources, such as the web site of the company (narodnaenergeticka.sk, 2018, intechenergo.sk, 2018), databases of financial and corporate data of Slovak companies on FinStat (www.finstat.sk, 2018), the commercial register of Slovak Republic (www.orsr.sk), and the Statistics Office of Slovak Republic (www.statistics.sk).

Mr. Ďudák, CEO of Národná energetická, a.s. and a former CEO of Intech Slovakia, s.r.o., has been contacted at the beginning of the study in order to establish initial contact with the company. He represented the main contact during conduction of the case study.

Steps and communication executed during preparation of the case study is summarized in the following table:

Table 1: Methodological steps during Slovak case study

| Task / Activity | Date |
|--|----------------|
| Initial internet research for public sources and available data | March 2018 |
| Initial contact with Mr. Ďudák | 28 March 2018 |
| Preparation of initial questionnaire for the company | March 2018 |
| Questionnaire sent to the company | 29 March 2018 |
| Initial answers received | 12 April 2018 |
| Proceeding of answers and preparation for the personal interview | Week 2-3 April |
| Personal interview with Mr. Ďudák | 18 April 2018 |
| Site visit to Levice / Vrable site | 26 April 2018 |
| Final clarification call to confirm data collected | 30 April 2018 |

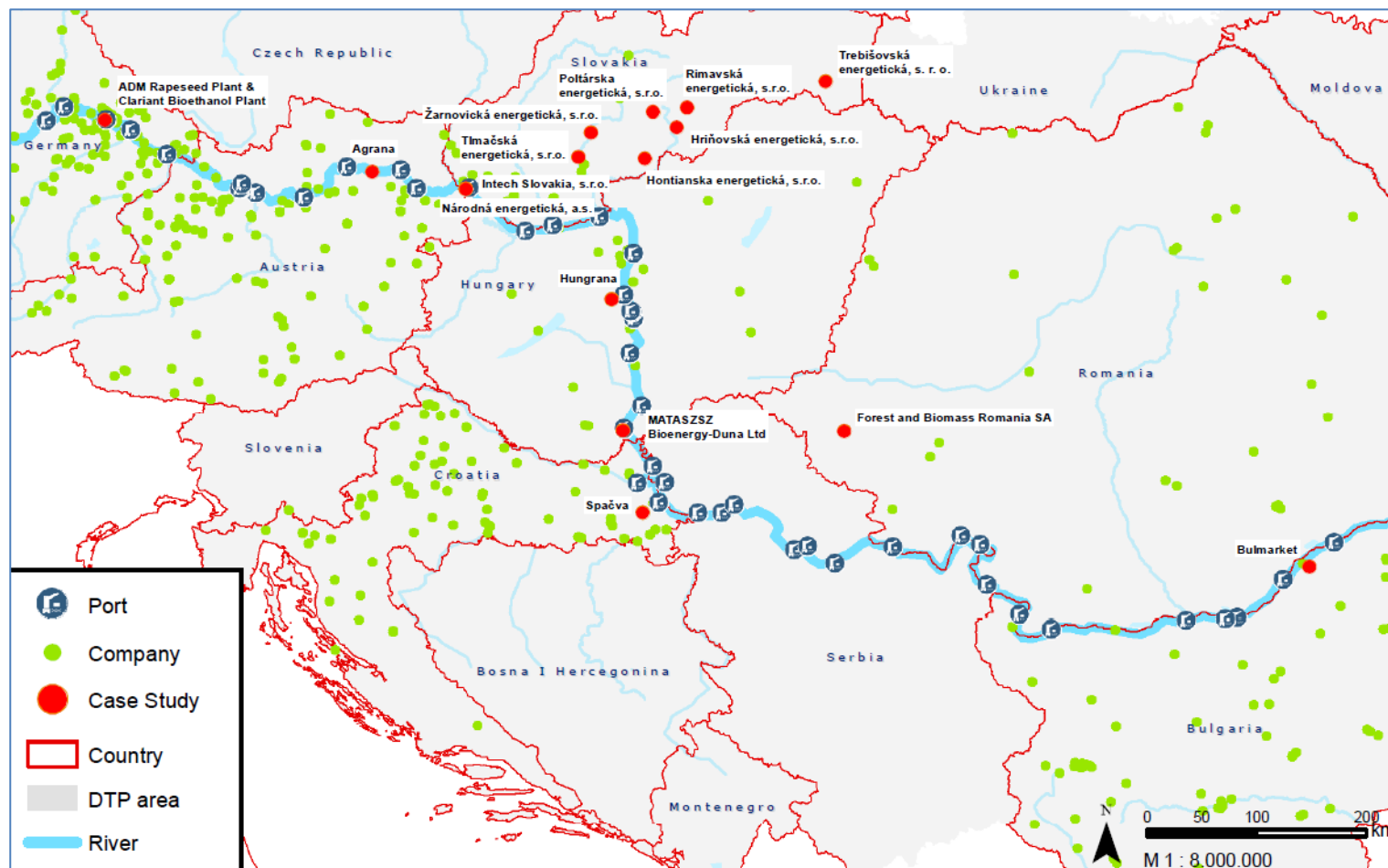


Figure 2: Overview of the location of the selected cases in the Danube region (DIT, 2018 source: open street map)

2 Case description

The case study Národná energetická, a.s. is a company type of study focused on (i) company Národná energetická, a.s., and (ii) company Intech Slovakia, s.r.o., both with registered seat at Vilova 2, 851 01 Bratislava, Slovakia.

The company Narodna energeticka is operating as a holding company with shareholders position in eight operating companies, owning and providing services of industrial and municipal heating supply. Via its subsidiaries, the company is operating in the following towns of Slovakia, located mainly in Central-South and South-Eastern parts of Slovakia:

Table 2: Operating companies (narodnaenergeticka.sk, 2018)

| Subsidiary company | / Operational | Location of operations – Town | Total population (town) | Administrative region of Slovakia |
|-----------------------------------|---------------|-------------------------------|-------------------------|-----------------------------------|
| Trebišovská energetická, s. r. o. | | Trebišov | 24,401 | Košice |
| BYTENERG, spol. S r.o. | | Medzilaborce | 6,809 | Košice |
| Hriňovská energetická, s.r.o. | | Hriňová | 7,814 | Banská Bystrica |
| Rimavská energetická, s.r.o. | | Rimavská Sobota | 24,640 | Banská Bystrica |
| Hontianska energetická, s.r.o. | | Veľký Krtíš | 12,999 | Banská Bystrica |
| Poltárska energetická, s.r.o. | | Poltár | 5,826 | Banská Bystrica |
| Žarnovická energetická, s.r.o. | | Žarnovica | 6,490 | Banská Bystrica |
| Kysucká energetická, s.r.o. | | Kysucké Mesto | 15,699 | Žilina |
| Tlmačská energetická, s.r.o. | | Tlmače | 3,823 | Nitra |

Operational and business model of Narodna energeticka and its subsidiaries usually does not involve distribution of the heat to end customers, as heating pipes are usually owned by special municipality heating companies. Narodna energeticka is providing energy sources by a direct supply of heat to the heating distributor.

In addition to this, the company Intech Slovakia, s.r.o. as part of the same ownership and strategic group, focuses on utilization of biomass energy for heating and energy production. It operates over entire Slovakia and provides the following services:

- Supply of solid wooden biomass fuel sources to internal (Narodna energeticka) as well as external (both retail and industrial) customers (role of trader in classification of ENERGY BARGE project)
- Providing advisory services for potential investors and operators of energy sources, using biomass and other renewable energy sources
- Assisting and running operational contracts to help owners of energy sources to run and operate their facilities efficiently and effectively.

The mission of both companies is to provide the highest quality services related to the optimization of energy systems in order to achieve benefits for their customers in the fields of cost saving, operation reliability, and environment protection.

Narodna energeticka is operating (via its subsidiary companies) eight boiler plants running on renewable energy sources, namely woody and lignocellulosic biomass. The boilers are used for production of central heating for municipalities and industrial clients. Six boilers are running on wooden chips, 1 boiler on wood pellets and 1 on straw.

All bioenergy facilities are owned by private companies, the majority of which is owned and controlled by Narodna energeticka, i.e. all biomass facilities are privately owned. However, the operational segment is defined as mainly municipal heating.

All boilers are producing heat power for central heating systems. No electricity production or combined electricity / heating production are installed at the moment.

Biomass supply for these locations is usually arranged by central supply from Intech Slovakia company, which uses different sources of biomass suppliers. At the moment, logistics are arranged by road transport, as the easiest and most flexible kind of transport from the point of view of the company. However, company is aware of strategic importance of differentiation of sources of wooden biomass and might consider import of material using inland waterway transport ways.

Central actors and their roles

The following table describes actors and stakeholders, which have been identified as relevant for the case study. Below mentioned subjects are considered to be directly or indirectly influenced as well as influencing operations of companies, described in the case study. The list of stakeholders is based on internal analysis as well as interviews with the company.

Table 3: Central Actors and their roles – list of actors (based on company interviews and own analysis)

| Group | Actors | Role description |
|---------------|---|---|
| Public actors | <i>RONI / Regulatory Office for Network Industries (RONI, 2017)</i> | Executes overall regulations Provides business licensing for heating distribution and production (in case connected to municipal distribution grid). Sets pricing of renewal energy and controls correctness of price calculation and application by different companies. Set regulatory rules and execution deems. Plays role of arbitrage judge and decision maker in case of claims from customers. Crucial role for company business model and operations. |
| | Ministry of Economy of Slovak Republic | Preparing overall national energy strategy. Key partners for direct or indirect (via professional associations) negotiations regarding direct and indirect goals of subsidies (such as biomass boilers, price support policy, etc.). |
| | Municipality Administration / Local Government in related towns | Municipality administration and local government of particular towns where company is operating plays important role as it usually executes roles and tasks assigned to regional level by the central government (such as running of environmental offices responsible for control of emissions, issues construction permits necessary for any investments and connections to grid customers), represents |

| Group | Actors | Role description |
|-----------------------------------|--|--|
| | | key role for applying policy, related to municipality heating segment, including application and active utilization of renewable sources such as biomass. |
| | Slovak Innovation and Energy Agency | The Slovak Innovation and Energy Agency (SIEA) acts as the advisory body of the Ministry of Economy as well as to the Regulatory Office and is involved in creation of the legal framework and its harmonization with the EU energy legislation. The organisation now participates in policy development on a regional level, as well as providing advice on conditions that support the environmentally-responsible use of energy. It plays an important role in transformation of EU policy into Slovak regulations. |
| Private Actors / Companies | Slovak Association of Heat Producers | Professional corporate association, of which subsidiaries of Narodna energeticka are members. The association is representing heat producers and plays an important role in order to influence development of legislative and regulation framework for heat production in Slovakia. |
| | Narodna energeticka and its subsidiaries | Narodna energeticka, operates as the main holding company, which also executes certain trading roles within the company Each local/regional energy provider (i.e. owner / operator of particular boiler) is operating in the form of an individual company in order to separate accounting as well as meet better reporting and regulatory requirements. |
| | Intech Slovakia, s.r.o. | Company of the group – representing main supplier / trader of the biomass feedstock |
| | Key business partners – customers | Based on business and operational model of Narodna energeticka, key customers are usually represented by local distribution companies, which are operating heat distribution grids and delivering (selling) heat to final (residential or industrial) clients. In 3 cases customers are industrial clients, which are representing the main customers of the company. |
| | Key business partners – suppliers | Main suppliers are represented by companies supplying raw material (wooden pellets, chips, straw, etc.) and natural gas as main sources for energy production. Other crucial suppliers include vendors of technologies – i.e. boilers and related installations and operational devices. Service contractors, responsible for maintenance of boilers and related investments are usually directly connected to vendors of technology or might even be the same subject. They play a key role in order to keep existing technology operational. |
| | Banks and financial institutions | Availability of financial institutions (mainly banks) with necessary skills and ability to finance construction of boilers running on biomass (and other renewable energy sources) play key role for the company. Without funding institutes, the business model would not be feasible and achievable. Supporting factor in this respect is also exercised by EU policies transformed into applicable |

| Group | Actors | Role description |
|-----------------|---|--|
| R&D | Universities | legislation in Slovakia as well as currently very low interest rates applied for financing. |
| | Associations for development of biomass usage | Company is sporadically cooperating with R&D institutions, but not to an extent that it would like to. |
| | Private labs and R&D centers | Partial cooperation has been established on projects, where more efficient usage of biomass sources have been researched and investigated. |
| Logistic Actors | Road transport service providers | Company is directly cooperating with road transportation companies across Slovakia as well as particular regions of operations. |
| | Railway | At the moment company is not cooperating with any railway companies as location of its sites vs. volume and character of material needed is not suitable for this kind of transport (at current prices). |
| | Inland Water Transport | At the moment the company is not cooperating with any water transport provider as it is not using water transport for its purpose as of yet |
| | Local logistics and handling | Company is cooperating with local handling companies. Availability of their operations represent important factor for stable delivery of feedstock, in order to ensure continuous usage of heating. Logistics functions are partially delivered by the holding company itself. |

3 Socio-economic indicators

Slovakia is considered to be a stable economy, member of Euro Zone, with focus on industrial production and with an increasing role of the services sector. The role of agriculture and forest sectors on GDP formation remained stable over last 10 years or is slightly decreasing, respectively, mainly due to general increase of industrial production and services sectors.

Industrial production is contributing to 30% of GDP formation while agriculture and forest sector is contributing by 3.4%. Narodna energeticka is operating mainly in the administrative regions of Banska Bystrica, Nitra and Kosice, whereas Banska Bystrica and Nitra represents regions with the largest share of agriculture and forest sectors on GDP formation in Slovakia.

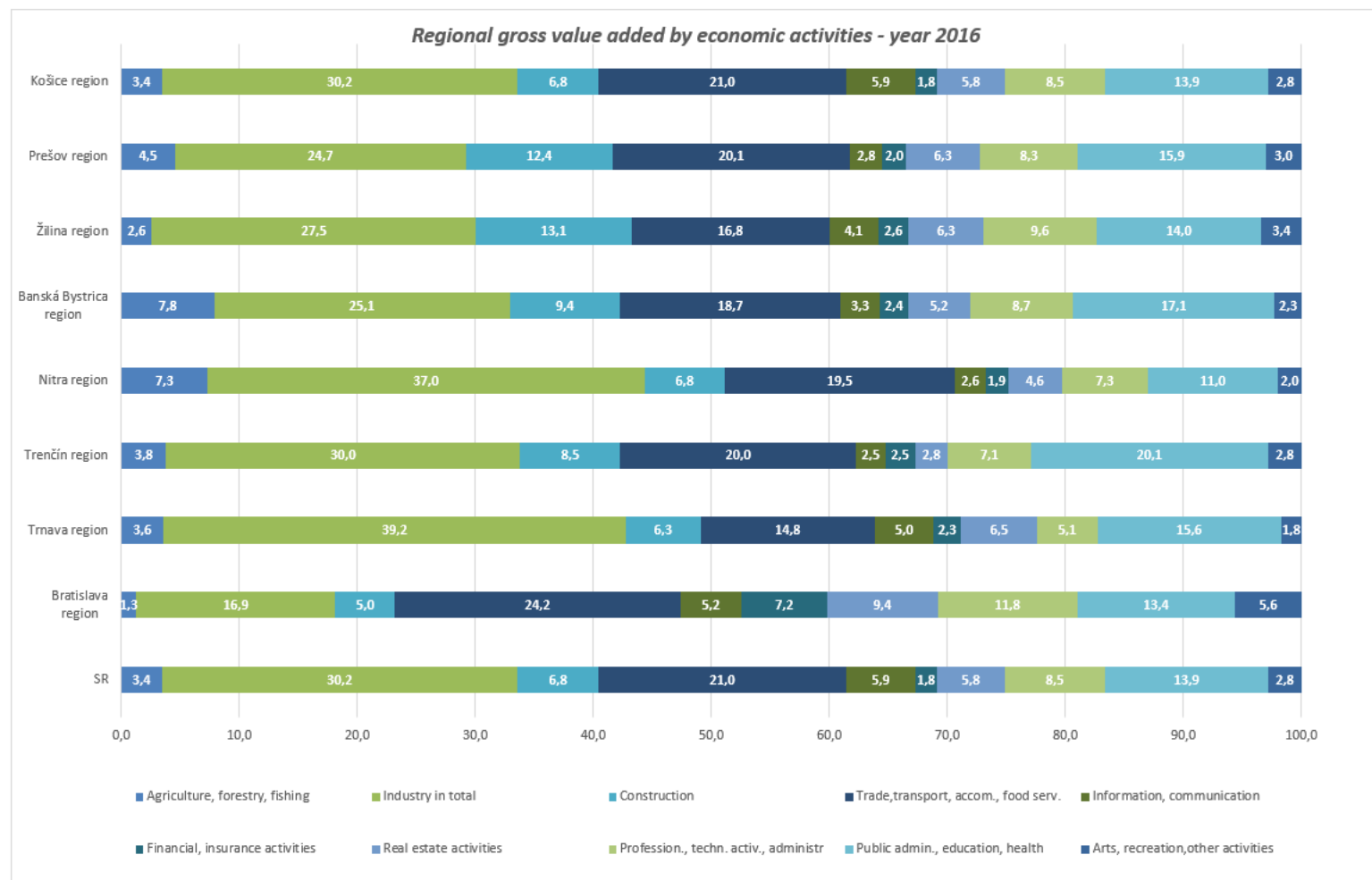


Figure 3: Regional gross value added by economic activities 2016 (StatDat, 2018)

GDP of 2017 by industry at constant prices calculated by chaining volumes to the reference year 2010

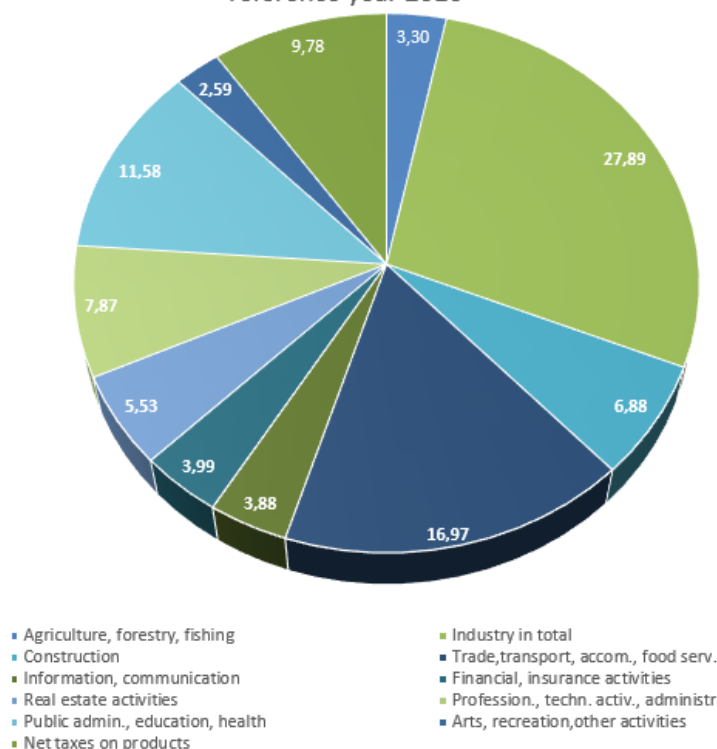


Figure 4: GDP of 2017 by industry at constant prices (StatDat, 2018)

Overall social-economic characteristics of Slovakia and its administrative regions are described in the following table. The case study company is operating in regions with the higher than average unemployment, relatively low population density (below Slovak average) and with relatively low GDP per capita (mainly Banska Bystrica region).

Table 4: GDP per capita of the region - year 2016 (StatDat, 2018)

| Region | GDP per capita (EUR) | GDP per capita (PPP) | % of Slovakia *100% = Slovakia in total | Number | Density (person per square metre) | Registered rate of unemployment (%) |
|-----------------|----------------------|----------------------|---|------------------|-----------------------------------|-------------------------------------|
| Bratislava | 35,790 | 53,692 | 239.51 | 650,838 | 314.90 | 3.05 |
| Trnava | 16,298 | 24,450 | 109.07 | 562,372 | 135.49 | 2.60 |
| Nitra | 12,924 | 19,388 | 86.49 | 678,692 | 107.15 | 4.05 |
| Žilina | 12,889 | 19,336 | 86.25 | 691,023 | 101.48 | 4.70 |
| Trenčín | 12,803 | 19,207 | 85.68 | 587,364 | 130.63 | 3.53 |
| Košice | 11,754 | 17,633 | 78.66 | 799,217 | 118.24 | 9.94 |
| Banská Bystrica | 10,917 | 16,378 | 73.06 | 649,788 | 68.82 | 8.67 |
| Prešov | 9,070 | 13,606 | 60.70 | 823,826 | 91.73 | 9.68 |
| Slovakia | 14,943 | 22,418 | 100 | 5,443,120 | 110.93 | 5.94 |

Implication of social and economic factors on case study is that the company is operating in regions where the usage of biomass energy might be considered as the most suitable due to availability of local sources and potentially good perception of people of biomass raw material (based on high share of agriculture sector).

The regions covered by the case study can be considered among the less wealthy compared to average of Slovakia (based on GDP per capita indicator). However this comparison is significantly biased by the significant impact of the wealthy Bratislava region on total average in Slovakia.

Slovakia still remains a very attractive country for local as well as foreign investment, mainly due to the following reasons (SARIO, 2017):

- Country offers very adaptable, educated and cost-effective workforce. Slight barrier represents ability of workforce to move more often in order to get a better job, but this factor has significantly improved over the past 10 years. Based on studies, in general candidates are willing to relocate or commute daily in the radius of 60–80 km.
- Workforce, mainly with higher education, has usually very good multilingual skills
- Very high share of workforce with university education – as much as 35 universities providing qualified pool of labour force. On the other hand, there is increasing problem to get a properly qualified non-university educated but skilful workforce, mainly technicians and production workers. This is due to high concentration of automotive industry in Slovakia with demand for workforce concentrated on particular professions
- Overall infrastructure is in general well developed, including utilities (electricity, water, sewage, natural gas) as well as central heating grids in towns. Road infrastructure is in general well spread; however regions and locations operated by the company are having partial problems with missing finalization of motorways (especially Mid-Southern and Eastern parts of Slovakia).

4 Biomass availability and utilization

Narodna energeticka is operating in the sector of heat production, focused on both industrial as well as residential customers. The overall heating industry in Slovakia is using different sources of fuel, including biomass. The indicative overall consumption and usage of different fuels for heat production is described in the following table:

Table 5: Type of fuels used for heat production in Slovakia (RONI, 2017)

| Year | Natural gas (GWh) | Biomass (th.t) | Coal (th.t) | bio-gas (GWh) | Total heat production (Gwh) |
|-------------|-------------------|----------------|-------------|---------------|-----------------------------|
| 2012 | 9,919 | 1,705 | 738 | 0 | 15,734 |
| 2013 | 9,136 | 1,998 | 676 | 80 | 15,041 |
| 2014 | 9,146 | 1,699 | 608 | 177 | 13,140 |
| 2015 | 9,053 | 1,729 | 578 | 323 | 14,023 |
| 2016 | 8,658 | 1,121 | 571 | 564 | 14,600 |

In general, biomass feedstock for energy usage is widely available in Slovakia. The production of wooden chips and pellets is generally widespread and necessary equipment for production of wooden chips and pellets is getting available by many forest owners and producers. There is a long term discussion about the quality of Slovak forests, growing and planning strategy, as several windstorms have caused significant damage in the past 10 years. This causes relatively high availability of fall wood, which represents the main source for production of wooden chips and pellets. On top of that, part of agriculture producers are investing in production of quickly growing trees, so-called short rotation coppice, which is harvested especially for bioenergy production.

The State enterprise Forests of the Slovak Republic remains the largest forest owner and operator in Slovakia. It is also the largest producers of biomass feedstock (from dendro-mass) in Slovakia, with an annual production of around 610,000 t (EKS Invest, 2014)

Availability of biomass feedstock depends on the particular location / region of operations. The case study company is operating its biomass boilers mainly in areas close to forest resources, which is reaching 40% in Slovakia. Forest owners/operators (mainly State Forests company, Church forests and local associations of forest owners) represent key partners for the company, in order to ensure stable and long-term satisfactory supply of suitable biomass feedstock.

Overall consumption of biomass fuel used by the company represents approx. 59,000 t/a in all boilers, of which only 6,000 t are made up of straw. As much as 70% of biomass consumed is represented by wooden chips and low cost wooden residual materials, suitable for bioenergy production. The company pays close attention to use only chemically non-treated biomass material, which represents no potential damage to environment. The remainder of the biomass feedstock is represented by pellets.

5 Bioenergy production and utilization

The company is actively running its business model based on the production and utilization of bioenergy. Bioenergy production itself represents the main source of energy production for the company and is the main goal of its mission and business model. The business model of the company is based on the following application steps:

1. Identification of suitable existing energy production facility, based on traditional fuel sources;
2. Evaluation of possibilities to acquire the facility and rebuild it into more efficient one, with a primary goal to use bioenergy feedstock
3. Including other relevant parties (municipalities, owner / operator of heating grid distribution network, final customers such as associations of flat owners, etc), in order to build a functional operational model
4. Identification of additional improvements for stakeholders, such as investments and improvements of distribution network, in order to increase overall efficiency and utilization of energy (i.e. by decreasing of leaks)

5. Identification of possible financing sources, including banks, public sources (municipalities) as well as funds (EU, Norwegian, etc.)
6. Analysis and selection of best technology solution, including type of biomass fuel available

The Company owns and operates the following bioenergy production facilities with the following capacities:

Table 6: Bioenergy production units

| Subsidiary / Focus | Installed capacity / Annual heat production from biomass | Main biomass fuel used | Approximate annual fuel usage |
|---|---|---------------------------------------|--------------------------------------|
| Hriňovská energetická, s.r.o. / municipal heating | VESKO B - 2MW / 45-50 TJ | Wooden chips | 6,500 t |
| Rimavská energetická, s.r.o. / central industrial heating and partially residential | VESKO B - 3MW / 76 TJ | Wooden chips, residuals | 8,000 t |
| Hontianska energetická, s.r.o. / municipal heating | VESKO B - 4MW / 80 TJ | Wooden chips, | 8,500 t |
| Poltárska energetická, s.r.o. / municipal heating | VESKO B - 2MW / 35 TJ | Wooden chips | 5,000 t |
| Žarnovická energetická, s.r.o. / municipal heating | VESKO B - 2MW / 36 TJ | Wooden chips, pellets | 6,000 t |
| Tlmačská energetická, s.r.o. / municipal heating | VESKO B - 2MW / TJ | Wooden chips, pellets | 6,000 t |
| Trebišovská energetická, s. r. o. | VESKO S - 2x4MW | Combined wooden chips, pellets, straw | 6,100 t straw, 8,000 t wooden chips |
| Kysucká energetická, s.r.o. | 135 TJ (of which approx. 60% produced from biomass) | Wooden chips | n.a. |

As much as 90% of the installed capacity of bioenergy sources is operating on dendro-mass – i.e. wooden chips and pellets. The Company is using mainly local and regional sources. Approximately 10% of the installed capacity (1 boiler in Trebisov) is using an agriculture residue biomass – mainly straw. This is based on overall availability of local sources in respective regions, where the company is operating.

Annual consumption of biomass feedstock as declared by the Company represents 6,000 t of straw and 50,000 t of wooden chips and pellets. The Company is able to sustainably grow, by very precise application of its business model, by gradual investments into reconstruction and installation of new biomass energy sources.

The progress and growth of the company is demonstrated in the following charts:

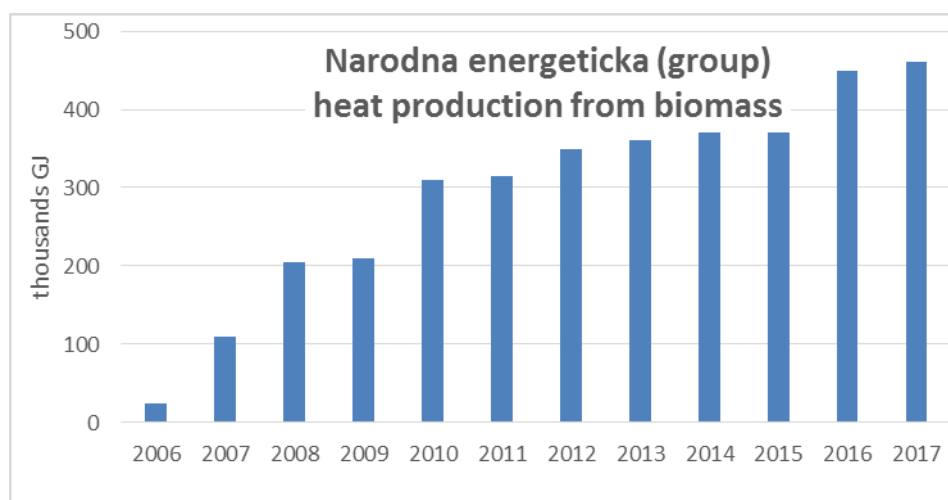


Figure 5: Heat production from biomass Narodna energeticka (narodnaenergeticka.sk, 2018)

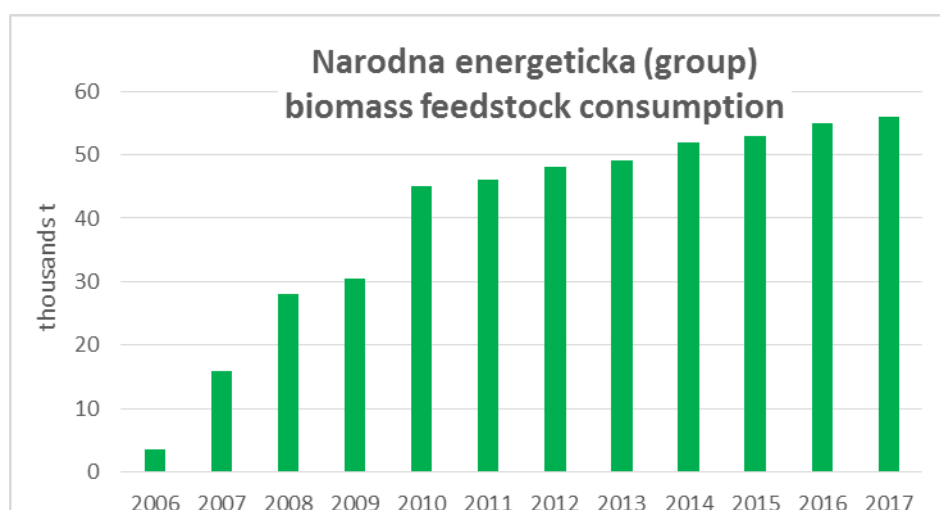


Figure 6: Biomass feedstock consumption Narodna energeticka (narodnaenergeticka.sk, 2018)

6 Infrastructure, logistics & integration of supply chain and logistics

In general, the road infrastructure is well developed in Slovakia with 18,000 km of road infrastructure as of 2017. The average density of road infrastructure is 0.368 km / km² of motorways represent 0.016 km/km². Density of road infrastructure measured per inhabitant is 3.32 km per 1,000 inhabitants of which motorways represent 0.141 km per 1,000 inhabitants.

Railroad infrastructure in Slovakia is represented by 3,657 km of railroads, which is in average 7.5 km per 100 km. This represents European average and in general main areas are usually very well accessible by railroads.

All locations, operated by the company are fully accessible by road transport and partially accessible by railroads. None of the location is situated near inland water transport corridors, or

Project co-funded by European Union funds (ERDF)

close to respective ports. The closest Danube port is located in Komarno and is approximately 60 km from the nearest operations of the company in Tlmače.

The following map shows distance of all company operations from Komarno port on Danube.

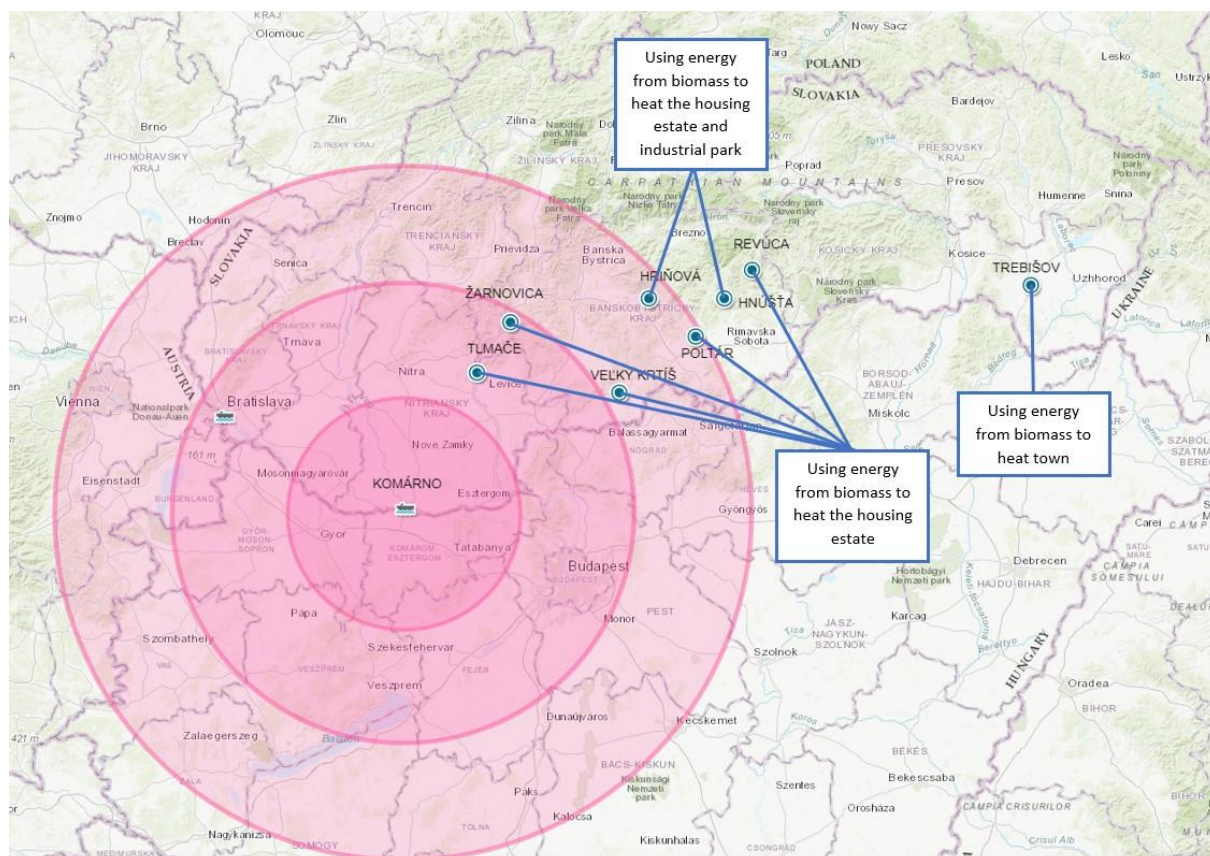


Figure 7: Application locations and distance to port of Komarno (own visualization)

Logistics organisation and infrastructure of the Narodna energeticka is based on the following structure and logic. The Company is fully cooperating with its “sister” company Intech Slovakia, s.r.o., which is responsible for the supply of biomass, including partial production, preparation, handling, warehousing for each site of the Company. Intech Slovakia is very active in the field of bioenergy, where responsible for supply of VESKO boilers (boilers running on biomass – dendro-mass as well as straw and hay) in Slovakia. Part of its investment contract there is usually also operating contract for supply of biomass feedstock, in order to ensure proper operations of boilers. Delivery of biomass feedstock on site of operations is usually part of contractual obligations of the company.

Intech Slovakia is having its own logistics and handling capacities. Biomass is being purchased and supplied from the following suppliers.

Table 7: Suppliers of the case company and materials used

| <i>Supplier</i> | <i>Material used</i> |
|---|--|
| Local wood processing companies such as local furniture producers, sawmills and wood material producers | Residual and waste wood cuttings, sawdust |
| State Enterprise Forests of Slovak Republic | Cuttings and wood waste from harvest manipulation, crust, cuttings, sawdust, residual and low quality wood |
| Private forests and associations of forest owners (so called "urbars") | Lops and cuttings from logging |
| Administrators of rivers and waters of Slovakia (usually state companies or municipalities) | Waste wood from cleaning |

The suppliers above represent the most efficient sources of biomass feedstock for the company. Local accessibility and local presence close to operational sites (bioenergy production sites) plays a key role due to transportation costs.

Intech Slovakia is currently able to arrange and handle 60,000 t of biomass feedstock from dendro-mass per annum and additional 6,000 t from agriculture biomass in the form of straw and hay.

In order to arrange logistics needs the following equipment is used:

- Tractor LVS 511
- Forest tractor LKT
- Chipper
- Woodcutter
- Truck MAN 4
- Cargo Trailer HUFFERMANN 3x
- Cargo Trailer Scharmuller
- Loader Bobacat
- Loader Hyundai

Logistics operations are monitored and managed by information system, partially developed in-house, which is monitoring activities of different equipment (trucks, processors, etc.), status of feedstock capacities on different operational sites and planning further operations in order to ensure streamlined and smooth supply of biomass.

100% of biomass logistics is facilitated by road transport. Except of straw, which is packed and transported as breakbulk cargo in straw packages, other types of biomass feedstock the company is using is transported in the form of dry bulk cargo.

Based on regional sites and based on current availability of dendro-biomass feedstock, supply is based usually on local sources and due to transportation costs. However, the major part of suppliers and supply sites is located in Mid-Slovakia region (area of Zvolen), where the sources of

biomass are generally available at affordable prices. This supply region can serve as much as 6 sites of Narodna energeticka with transport radius maximum 50 km (average of 35 km).

Supply of straw and hay for Trebisov site is managed solely locally due to transport constraints of the material. Utilization of Danube port (especially the closest port in Komarno) has been discussed with the Company during the study. So far, the Company did not consider the usage of inland water transport and import of wooden biomass for its purpose, as at the moment Slovakia has enough of locally available biomass feedstock.

However the following factors might increase considerations of the usage of Danube transportation as potential source of biomass feedstock:

Table 8: Potential reasons for consideration of Danube transport for the case

| Factor | Role |
|--|---|
| Availability of biomass feedstock in Slovakia | Dendro-mass feedstock is currently widely available in Slovakia as high availability of fallen wood. However, this might not be the case in few years as regulation in this respect is increasing (mainly logging of fallen wood in national parks) and availability might decrease. |
| Increasing demand for biomass | Growing usage of bioenergy boilers and installations increase demand for biomass. Company is willing to continue in this business and supplying more customers might require getting access to external sources of biomass (potential imports). |
| Biomass import and pricing | Real availability of biomass to be imported into Slovakia will play key role in all considerations. In case of long term available biomass feedstock supply with stable (or at least predictable) contract, might increase an attitude of the Company to develop and build local warehousing capacities in a suitable location close to the port and one of existing sites (i.e. Tlmače), which might serve as a central distribution warehouse also for other production sites and other external customers. |
| Increase usage of alternative transportation – utilization of LPG or CNG trucks or eventually electro-mobile -trucks | Quick development of technologies that can serve as alternatives for traditional fossil fuels might significantly decrease prices of local road transportation. This would stimulate usage of central distribution and increase potential of usage of inland waterway logistic concept. |

7 GIS map

For the case study, a map visualizing geographical conditions and context based on a geo-information system (GIS) was designed. It is a set of aspects defining the case and its surrounding area with a particular focus on the proximity to the Danube and relevant ports. For the case, a catchment area with a radius of 50 km has been defined in order to allow for theoretically economically viable pre- and post-haulage logistics. Within this area, also the companies along the biomass and bioenergy value chain as well as the port locations as identified in the course of the ENERGY BARGE project are depicted via icons.

The following information is provided on the map:

- Location of the cases (head quarter and plants)
- Land cover categories on NUTS 3 level (CORINE land cover data, Eurostat, 2012)
- Land use data on NUTS 2 level for selected biomass feedstock (Eurostat, 2017)
- Market actors in the biomass and bioenergy sector in the region ([ENERGY BARGE D3.2.1 Transnational inventory of biomass and bioenergy companies in the Danube corridor](#))
- Danube port locations with equipment for biomass handling ([ENERGY BARGE D4.1.3 Analysis of logistics requirements for the bioenergy industry](#))

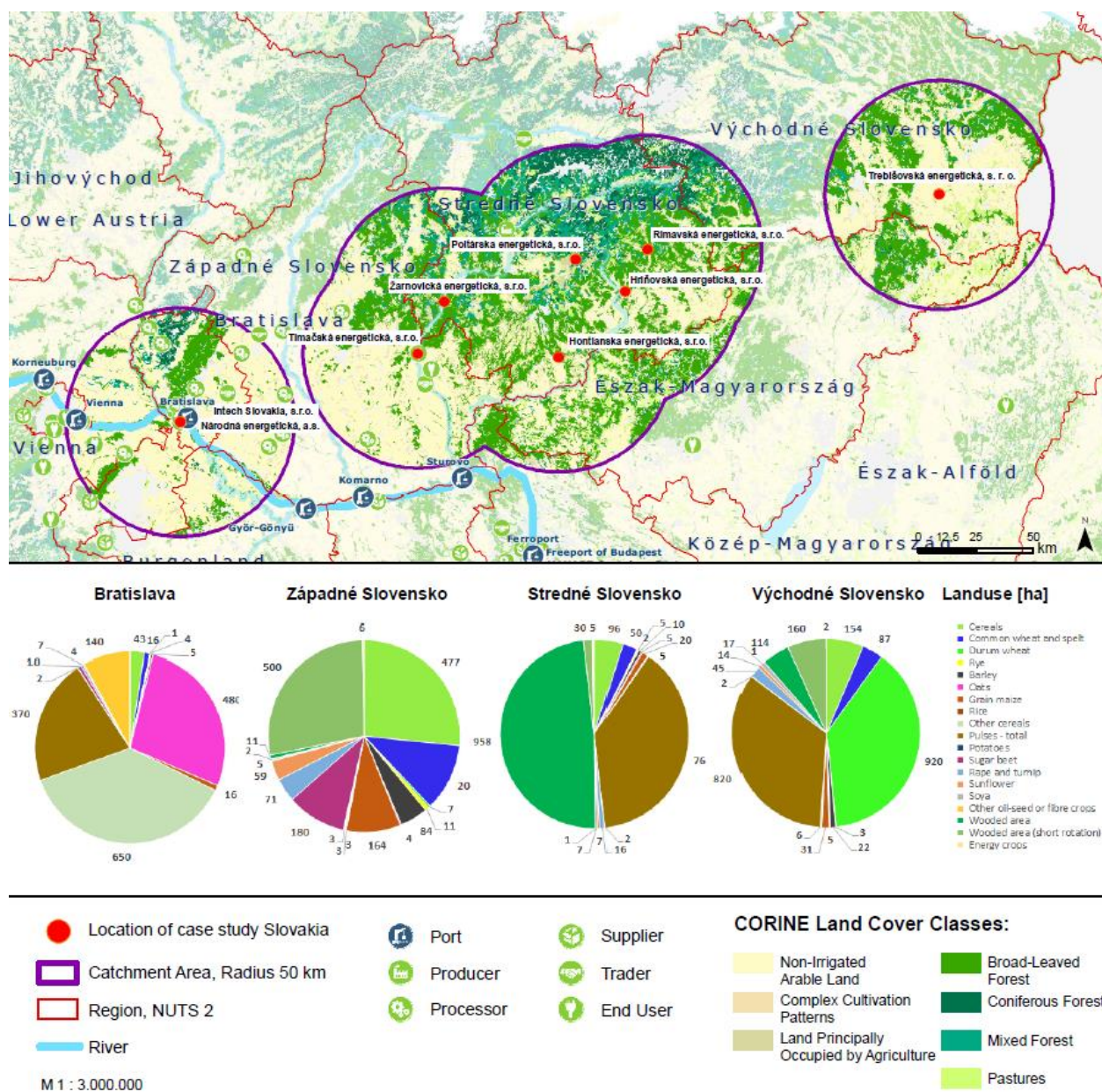


Figure 8: GIS analysis of the case locations (visualization: DIT for ENERGY BARGE project; sources: ENERGY BARGE, 2017/2018; EUROSTAT land use data, 2017; CORINE landcover data, EUROSTAT, 2012).

8 Analysis of success factors & lessons to be learnt: enablers and barriers

Table 9: Success factors cases Slovakia

| | Enablers | Barriers | Lessons learnt |
|---|--|---|--|
| Biomass availability | Biomass is currently available mainly from local / regional sources. Using own production of biomass is being considered and gradually increasing. | Logistics and handling remains a partial barrier for larger utilization. Availability in certain regions and larger towns might also represent a barrier for energy usage. | Difficult to transfer, as biomass availability is depending mainly on local factors. |
| Biomass utilization/va lorization | Residue material is used | | Utilization of residue material shall be considered as primary option for bioenergy generation wherever possible |
| Bioenergy production / utilization | Share of bioenergy production is growing in Slovakia, caused by success factors such as proper policy implementation, resulting in attractiveness to private capital and increased availability of financing. Consequently these factors make also technology more available and technology vendors more attractive in Slovakia. | Price sensitivity of customers (mainly investors) and relatively high investment costs for central heating solutions represents barriers for wider application of bioenergy production. Local monopoly of existing solutions and utilization of fossil fuels are also real barriers for particular cases. | Bioenergy utilization in Slovakia is still limited by price sensitivity of potential investors; These factors are highly dependent on particular local situation, so might be considered as difficult to transfer. |
| Existence of a strategy or concept | Privately structured business model, supported by proper application of EU strategy and legislation framework, as well as public funds, allows long-term sustainable growth and development. | Investments in heating production are quite high and require very educated and focused investors and banks. Despite well-defined regulation framework, technology reliability might still represent a barrier for larger development. | Private investment structures with a stringent business model can be successful in the framework of existing political strategies. Clearly transferable on EU level, following respective policies. Know-how and best cases transfer between different countries is highly desired and relatively easy to apply. |

| | | | |
|---------------------------------------|--|---|---|
| Role of stakeholders | Public and municipal administration plays important role in successful development of company business model. | Level of accessibility and biased view of certain stakeholders might cause further development of biomass utilization in certain regions. | Proper and transparent communication with relevant, mainly public, stakeholders is thus extremely important and crucial for the success of the company. Transfer of know how regarding transparent communication is possible. |
| Role of socio-economic factors | Socio-economic factors, mainly in less wealthy regions are playing important role, as bioenergy solutions are (in heat segment) resulting into one of the less expensive consumer prices. In regions, price more sensitive / less reach, biomass solutions might be preferred. On the other hand, more wealthy regions might start to pay more attention to overall environmental factors and "natural" character of heating solutions, which might again lead to bioenergy as a preferred solution. | Production of biomass and consequent logistics, warehousing and handling requires availability of relatively less expensive workforce. Slovakia is starting to have problems with availability of proper workforce in certain regions, which might end-up as a barrier for morewider implementation of biomass solutions. | Socio-economic factors are considered to be strictly regional / local. Thus only know-how and learning from other cases can be efficiently transferred to other regions. |

| | | | |
|----------------------------------|--|---|---|
| Integration of supply chains | Slovakia case study represents a typical example of positive enabler of integration of supply chain. Integration of different local bioenergy producers (boilers), effectively operated by an integrated holding company increases overall efficiency of operations and improve know-how transfer and positive effects from economy of scale. | Too much integration of biomass producers and supply chain might result into local monopolies / oligopolies in production, with negative effect on pricing. Real long-term availability of biomass at stable pricing remains thus always among key success factors of any biomass projects, mainly those based on agriculture biomass feedstock. | Key findings can and shall be transferred also to other countries with potential impact on regulation policies. |
| Role of logistics infrastructure | As in many other sectors, logistics infrastructure plays significant role in business decisions and success of project implementations. Biomass is still considered to be more local / regional product with certain limits for longer transport. Road network remains the key. However, availability of railways and water transportation might play more significant role in future in case if larger volumes of biomass are processed / utilized. | Only significant underdevelopment of road network might represent potential important barriers from logistics point of view. Biomass handling requires also proper warehousing facilities, as availability of biomass is more seasonal and storage plays important role in proper overall distribution. Availability (in terms of technology and price) of special equipment suitable for biomass handling might also represent certain barriers. | |

9 Recommendations & suggestions for future development

Building a sustainable usage of biomass feedstock for energy production represents the main mission of Narodna energeticka. The Company is so far succeeding to build its portfolio of operations in various regions of Slovakia.

In this respect, the following recommendations and the considerations for the company's future successful development are formulated:

- 1) Increasing even more centralized management and logistics organisation of feedstock in order to reach even higher efficiency of biomass utilization, i.e. by building / utilizing optimally located warehousing capacities to handle biomass feedstock logistics.
- 2) Keep strong existing effort of marketing biomass usage and educate existing and potential stakeholders and customers about experience with operations. Stress factors, generally considered as negative and biased by customers and offer reliable solutions, ideally by presenting functioning examples.
- 3) Consider usage of alternative fuels for internal fleet of transport vehicles in order to use existing biomass sources more (i.e. bio-gas) and decrease transportation costs.
Start broader strategic discussions with potential partners, including banks, funds, public administration (municipalities) and focus on development of case for potential usage of inland water transport terminal for biomass usage.
- 4) The three most valuable lessons learnt from the case are:
 - a. A proper biomass utilization, using its main unique "selling" points, such as relatively high efficiency of heat production, low final price of heat, environmentally friendly approach and close regional approach, can serve as a long-term sustainable business model
 - b. Proper regulation and legislation framework represents key success factors for wider spread of biomass utilization for energy, especially heat production.
 - c. Combination of several local / regional applications can build a big enough operations in order to utilize economy of scale effects, such as central group purchasing process (better prices of feedstock can be handled), know-how transfer from operations in order to increase operational efficiency and overall professional management based on rational business principles.

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