

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 Austria AGRANA Stärke GmbH - Bioethanol
production in Pischelsdorf**

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 /

Fachagentur Nachhaltende Rohstoffe e.V.	FNR	Germany
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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.

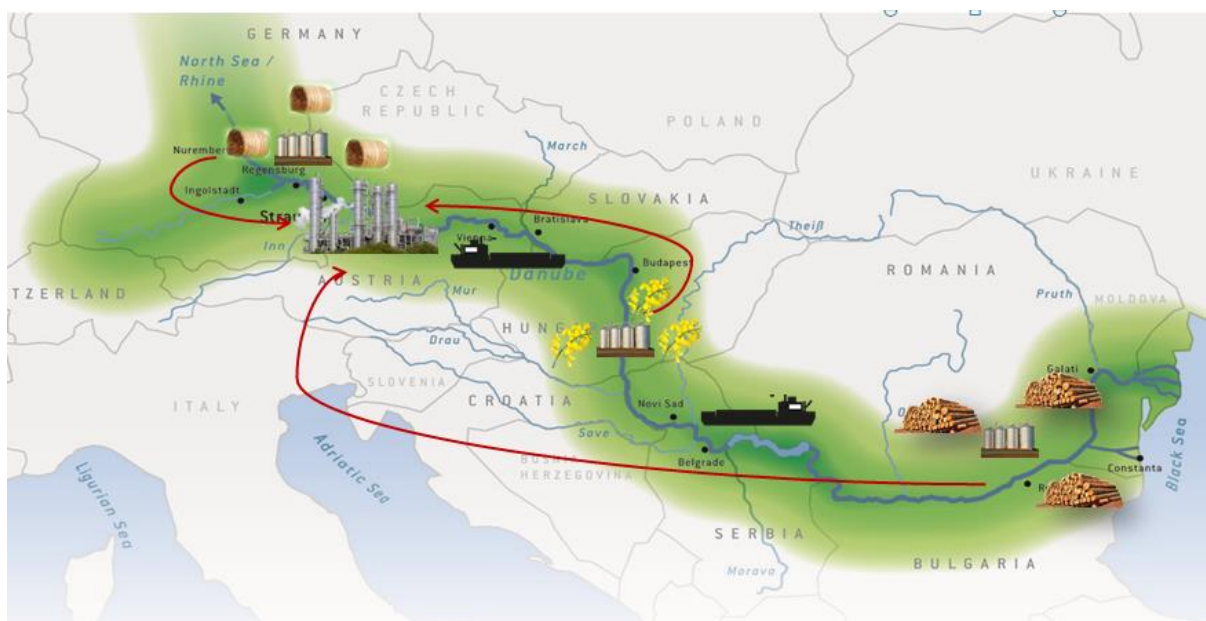


Figure 1: Green Energy and Chemistry Belt (Source: BioCampus Straubing GmbH, own visualization).

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 analyzing 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.

Case study AGRANA Stärke GmbH - Bioethanol production in Pischelsdorf, Austria

Executive summary

AGRANA is an internationally-oriented Austrian industrial company, which adds value to agricultural commodities to create industrial products for downstream industries (www.agrana.com). AGRANA represents top product quality, optimal services as well as innovative ideas and expertise in terms of product development – products and services appreciated by its customers around the world, whether global or regional players. AGRANA's three business segments, Sugar, Starch and Fruit, supply both local producers as well as international groups, particularly in the food industry.

In the sector "Sugar", AGRANA is a leading sugar supplier in Central, Eastern and South-Eastern Europe. In the division "Starch", AGRANA represents a major manufacturer of customer-specific starch products and **bioethanol** in Europe. In the sector "Fruit", AGRANA is a world market leader in the production of fruit preparations and top producer of fruit juice concentrates in Europe. The AGRANA plant in Pischelsdorf belongs to the Starch division and represents a Biorefinery. The Biorefinery commissioned in 2008 in Pischelsdorf represents AGRANA's most recent production site in Austria. An upstream wheat starch processing plant was added to the site in 2013. Top-quality foodstuffs and animal feeds, as well as products for technical industrial sectors, are produced at this bio-refinery, with almost zero waste. The Pischelsdorf facility annually processes more than 100,000 t of wheat starch, 23,500 t of wheat protein, **240,000 m³ of bioethanol**, 120,000 t of biogenic CO₂, 190,000 t of the protein-rich animal feed ActiProt® (DDGS - Distillers' Dried Grains with Solubles) and 55,000 t of bran. The close integration of the wheat starch plant and the existing bioethanol factory enable the cereals processed to be utilised particularly efficiently.

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. The site is logistically characterized as a trimodal site, utilizing rail, road and water for their inbound and outbound logistics.

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 Figure 2, 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).

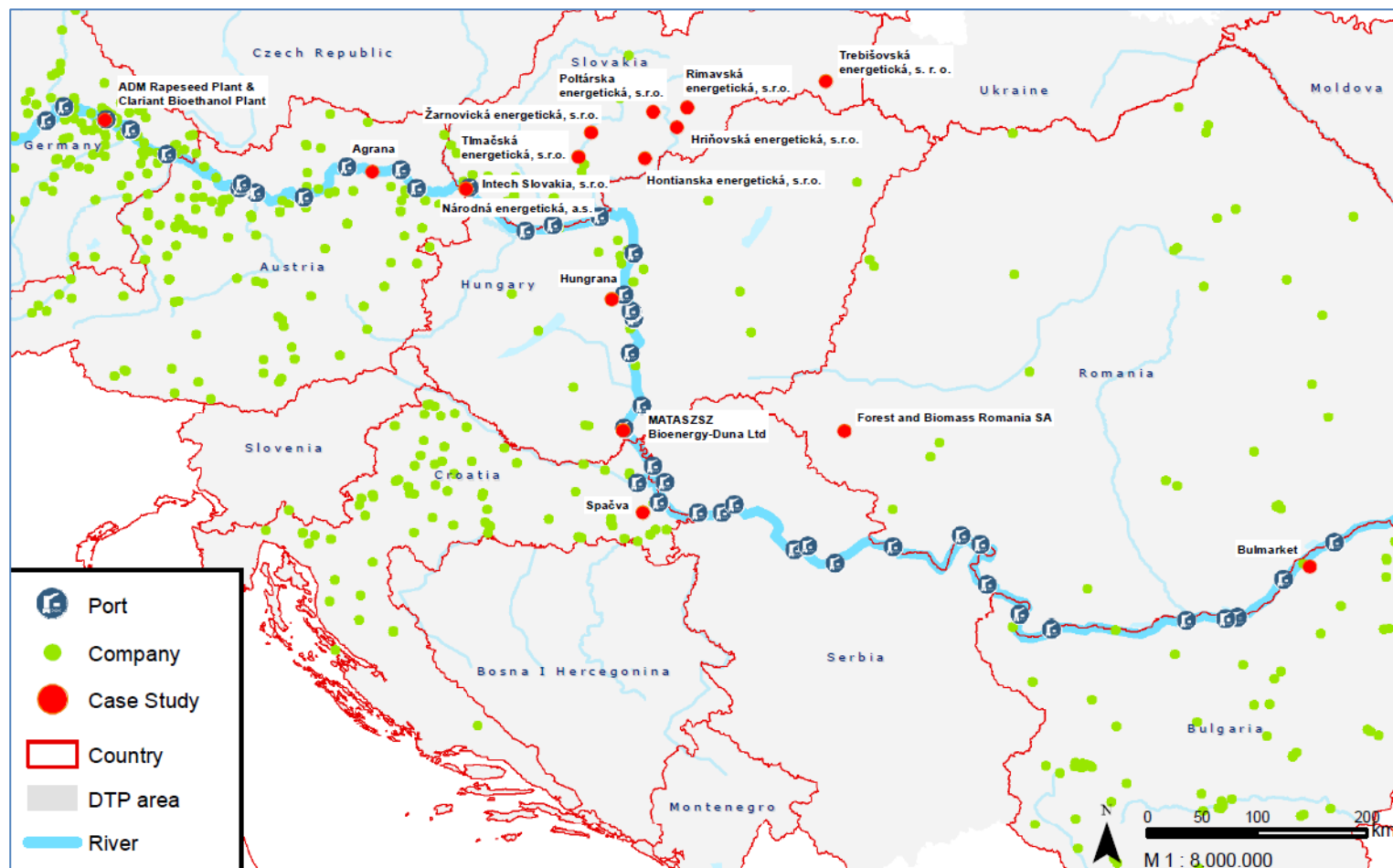


Figure 2: Overview of the location of the selected cases in the Danube region (DIT, 2018 source: open street map)

The case study was selected based on the provided criteria list and in coordination with the Austrian project partners (VIA, Port of Vienna and BE2020). In the following, a meeting with the Head of Raw material, Procurement and Logistics of the AGRANA Stärke GmbH took place on 12.03.2018 in Pischelsdorf. He agreed that we could present the AGRANA bioethanol production as Austrian Case study within the ENERGY BARGE project. Furthermore, the Head of Raw material, Procurement and Logistics of the AGRANA Stärke GmbH filled in part of the Case Study template and provided relevant information by E-Mail. In addition, already publicly available information is used for the case study description (see the annual report of the AGRANA group 2016/17 and the company's website <https://www.agrana.com/>). In the following, the Case Study was compiled by BE2020.

2. Case description

Address and contact of the bioethanol plant:

AGRANA Stärke GmbH - Pischelsdorf Plant
Industriegelände
3435 Pischelsdorf
+43 2277 90303-13112
+43 2277 90303-13133
info.starke@agrana.com

Geographic coordinates:
48.33663, 15.95529



Figure 3: Agrana Bioethanol plant.

Source:

<http://www.agrana.com/produkte/bioethanol/>

AGRANA is an internationally oriented Austrian company which adds value to agricultural commodities to produce a wide range of industrial products for the processing sector (**Fehler! Verweisquelle konnte nicht gefunden werden.** 3). With around 8,600 personnel based at 54 production facilities located around the world, AGRANA maintains a global presence and generates consolidated revenues of almost € 2.6 billion (Agrana Annual Report, 2017).

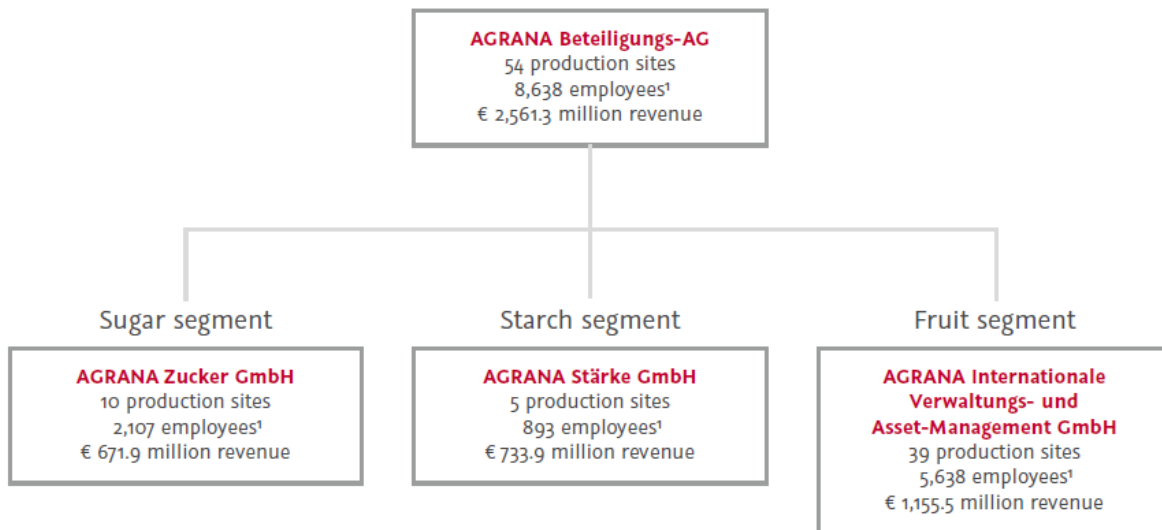


Figure 4: AGRANA Group business sectors
 Source: Agrana Annual Report, 2017

In its three business segments, Sugar, Starch and Fruit, AGRANA supplies local producers and large international players, particularly those in the food processing industry. In the Sugar segment, AGRANA supplies both industrial and end customers with sugar products under the Wiener Zucker brand.

Today, the group is:

- Leading supplier of sugar and isoglucose in Central, Eastern and South-Eastern Europe
- Major European manufacturer of custom starch products and bioethanol
- The world market leader in the Fruit segment for fruit preparations and the largest manufacturer of fruit juice concentrates in Europe

Business within the starch area concentrates on:

- Development of special starch products (potato starch, cornstarch, waxy maize-starch) by means of deriving starch physically and chemically for applications in various technical fields (paper, corrugated board, textiles, construction, ceramics, pharmaceuticals etc.)
- Practical technical investigations for widely different areas of technical applications
- Development of innovative starch products for the construction sector
- Bio-starches, AGRANA is the market leader in this area for applications e.g. in fruit preparations, mayonnaise, etc.
- In the area of **bio-ethanol production**: testing and development of wheat varieties that are richer in starch, for the production of bioethanol, and investigations to optimise the production process of bioethanol, in particular through speeding up fermentation, by

means of adding special additives (e.g. complex nitrogen sources such as PNC - Potato Nitrogen Concentrate)

Hence, the AGRANA plant in Pischelsdorf belongs to the Starch division and represents a biorefinery. The biorefinery commissioned in 2008 in Pischelsdorf represents AGRANA's most recent production site in Austria. An upstream wheat starch processing plant was added to the site in 2013. Top-quality foodstuffs and animal feeds, as well as products for technical industrial sectors, are produced at this bio-refinery, with almost zero waste. The Pischelsdorf facility annually processes more than 100,000 t of wheat starch, 23,500 t of wheat protein, **240,000 m³ of bioethanol**, 120,000 t of biogenic CO₂, 190,000 t of the protein-rich animal feed ActiProt® (DDGS - Distillers' Dried Grains with Solubles) and 55,000 t of bran. The close integration of the wheat starch plant and the existing bioethanol factory enable the cereals processed to be utilised particularly efficiency.

The total of around 240,000 m³ of bioethanol produced at AGRANA's facility in Pischelsdorf, Lower Austria are a quantity sufficient to cover all of Austria's domestic demand. AGRANA currently exports around half of the bioethanol produced in Lower Austria. In the last years, bioethanol was mainly exported from Austria to Germany and Slovakia. In total about 650,000 t per year Wheat, Corn, Triticale, Barley, Rye, Molasses, Starch Slurry (low grade) are used as raw material feedstock in the Bioethanol plant, resulting in the fact that the plant mainly processes first-generation biomass at the moment.

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.

Bioethanol is a fuel made from the fermentation of carbo-hydrate-rich biomass with an alcohol content of at least 99 percent by volume, making it practically water-free. In Europe, the most important raw materials used to produce bioethanol include any crops containing starch (wheat, corn) as well as concentrated sugar beet juice. In line with legal admixture obligations, five percent bioethanol by volume is currently mixed with petrol in Austria. Plus, it is used as a separate, environmentally friendly fuel known as SuperEthanol E85, which is a mixture of petrol and up to 85 percent of bioethanol. AGRANA produces bioethanol in Austria and - through its involvement with HUNGRANA Kft. - also in Hungary (AGRANA website, 2018).

In the last years AGRANA has been working intensively on the further integration of sustainability aspects in the operational business processes, and is a member of several sustainability-related initiatives (**Fehler! Verweisquelle konnte nicht gefunden werden.1**).

Table 1: Memberships in major sustainability-related initiatives. Source: AGRANA Group Annual Report 2016/17

Initiative	Member companies from AGRANA Group	Since	Initiative aim and other members
SEDEX	AGRANA Beteiligungs-AG	2009	Aim: Promote sustainable social and environmental practices along the value chain; Members: About 36,000 companies worldwide
ARGE Gentechnik frei (platform GMO-Free)	AGRANA Beteiligungs-AG	2010	Aim: Promote and safeguard Austrian GMO-free agriculture and food production; Members: Businesses along the whole food value chain, including many retailers
EcoVadis	AGRANA Zucker GmbH (Sugar segment); AGRANA Stärke GmbH (Starch segment) and fruit segment	2013	Aim: Supplier assessment on environmental and social criteria along the entire value chain; Members: about 120 large global companies
Initiative Donau Soja (Danube Soya Initiative)	AGRANA Stärke GmbH (Starch segment)	2013	Aim: Sustainable GMO-free soya production in the Danube region (focus on animal feed); Members: entire value chain, NGOs, etc.
Sustainability Agriculture Initiative (SAI)	AGRANA Beteiligungs-AG	2014	Aim: Develop guidelines for and implement sustainable agriculture practices; Members: Food and beverage industry
Bonsucro	AGRANA Zucker GmbH (Sugar segment)	2014	Aim: Improve the sustainability of sugar cane production and of sugar manufacturing from cane; Members: Producers, resellers, processors

3. Socio-economic indicators

Pischelsdorf is located in Tulln which is a district of the state of Lower Austria in Austria. Lower Austria has the largest area and the second largest population (after Vienna) of the nine federal provinces in Austria (1.62 million inhabitants). On the north, Lower Austria is bordered by the Czech Republic; on the east it is bordered by Slovakia where the river system of Thaya and March marks the frontier line. In the south, the foothills of the Eastern Alps form a natural boundary with Styria. In the south-east, Lower Austria borders Burgenland and this is where the province also has a share in the Pannonian Plateau, which then stretches a scant 4km away into Hungary.

The main economic sectors are the production of iron and metal goods, the chemical industry and oil processing. Mechanical engineering, agriculture and food industry are other important economic sectors. The economic strategy of the province of Lower Austria serves as a foundation for the activities and measures of the business areas of the Lower Austrian Ministry of Economic

Affairs. These include in particular: the Department of Economics, Tourism, and Technology of the Office of the Provincial Government of Lower Austria, the Business Agency of Lower Austria ecoplus Niederösterreichs Wirtschaftsagentur GmbH, Regional Innovations and Start-Up Centers of Lower Austria RIZ Regionale Innovationszentren Niederösterreich GmbH, the official tourism and marketing organisation of Lower Austria Niederösterreich Werbung GmbH, the financing pillar N.vest and its downstream subsidiaries NÖBEG, tecnet and accent (Government of Lower Austria, 2018).

The strategy also serves as a template for the numerous cooperative projects with intermediaries, for example the Technology and Innovation Partners (TIP) with the Chamber of Commerce of Lower Austria or the industrial policy action program with the Federation of Austrian Industry Lower Austria (Government of Lower Austria, 2018).

With 883,000 ha, more than a third of Lower Austria's area is used for agricultural production. With a forest share of 40%, Lower Austria is slightly below the federal average. The share of hardwood of 37% is significantly higher than in the rest of Austria (Austrian Biomass Association, 2017).

Lower Austria has the highest gross domestic energy consumption in Austria (about 350 PJ) and consumes about a quarter of the energy of the republic. Between 1988 and 2005, the gross domestic energy consumption of Lower Austria increased by 55% to 354 PJ. With the exception of one outlier in 2010 (375 PJ), a further increase in energy consumption has since been prevented. With a share of renewable energy sources of about 25% of gross domestic consumption, Lower Austria is below the national average of 30% and thus has the lowest value after Vienna. According to the EU Directive, the federal state achieves 32.5% of final energy consumption, almost equaling the Austrian average (Austrian Biomass Association, 2017).

The share of bioenergy among renewables is 61%, which is the third highest among all federal states. In absolute terms, this is the highest biomass use in Austria. While consumption of firewood has fallen by one-third over time, the use of other solid and liquid biofuels has multiplied (from 1.8 PJ to 40 PJ). The most important raw materials are wood chips and sawmill by-products with 40%, followed by firewood (23%), liquid biofuels (11%) and gaseous biogenes (9%) (Austrian Biomass Association, 2017).

The only bioethanol production plant of Austria, being the AGRANA plant discussed in this case study, is located in Pischelsdorf. From the annual production of 190,000 t, the domestic demand can be fully served: The share of biofuels in the transport sector of Lower Austria only amounts to 6.6% (Austrian Biomass Association, 2017).

Table 2: Key Figures Lower Austria *Source: Austrian Biomass Association, 2017*

General information	
Inhabitants	1,621,469
Area	19,186 km ²
Density	85 inhabitants/km ²
GDP/inhabitant	31,400 €
Farmland	883,526 ha
Forest	
Share of Forest Area	40%
Forest Area	767,450 ha
Coniferous	52.1%
Non-Coniferous	37.3%
Bushes and others	10.6%
Forest-growing stock	220 Mio. Stock cubic meters
Energy	
Gross domestic consumption	349.7 PJ
Dependence on imports	52.9%
Final energy consumption	232.8 PJ
Share of Renewables	32.5%
Bioenergy	
Gross domestic consumption	52.2 PJ
Biomass share of total gross domestic consumption	14.9%
Biomass share of renewable energy gross domestic consumption	60.9%

4. Biomass availability and utilization

At the wheat starch factory in Pischelsdorf in 2016/17, a net raw material volume of about 198,000 t of wheat was used in the production of wheat starch. In total about 650,000 t per year are processed in the Bioethanol plant. Wheat, Corn, Triticale, Barley, Rye, Molasses, Starch Slurry (low grade) are used as raw material. Given these numbers, solely regional sourcing and procurement is out of the question. Nearly 100% EU-Biomass is used, 30-35% of it originate in Austria, depending on markets and prices. Suppliers are located in Austria and in the neighbouring countries, often linked to the Danube region (from South Germany/Bavaria to Romania) and the biomass is also coming from CZ, SK and other European countries, depending on availabilities and prices. For the Bioethanol production as a priority low grade wheat (feed wheat) beside corn and other cereals is used.

Sustainability activities around the procurement of raw materials directly from agricultural producers have long been integral to AGRANA's business operations. In order to work on and document sustainability aspects in the agricultural supply chain regardless of the procurement model in an even more structured way, AGRANA has since July 2014 been an active member of the Sustainable Agriculture Initiative (SAI) Platform (a food initiative founded in 2002) and, with its Sugar, Starch and Fruit segments, participates in all working groups and committees relevant to its raw materials. THE SAI gives processors of agricultural raw materials like AGRANA several

helpful tools particularly for the evaluation and documentation of conformity with good environmental and social practices in the agricultural supply chain and for comparing the value of different documentation types and international certifications.

In addition to bioethanol, high-quality protein-rich animal feed are produced each year and marketed under the name ActiProt® (based on DDGS). This certified GMO-free animal feed, as well as the other by-products produced in Pischelsdorf, help to make the production of bioethanol commercially viable, with the quantities produced replacing up to one third of Austria's soya imports from countries that can no longer guarantee GMO-free produce. ActiProt, produced primarily from wheat and corn, is a by-product from AGRANA's bioethanol production. In a downstream process, the solid waste of the bioethanol production, called stillage, is dried, before being mixed, dried and pellitised together with liquid waste that has been boiled down to a syrup-like consistency. AGRANA's number one premise is the fact that ActiProt is completely GMO-free.

From the end of 2013, also wheat starch and wheat gluten for the food and animal feed industry are produced in a wheat starch plant at the Pischelsdorf site. The close integration of the wheat starch plant and the existing bioethanol facility allows the cereals to be processed in a particularly efficient manner. The raw materials otherwise left over as by-products of the manufacture of wheat starch and gluten will be used in the manufacture of bioethanol and to produce the premium-grade, GMO-free, protein-rich animal feed ActiProt.

Even the biogenic CO₂ stored in the plants prior to their processing and released in the course of the production of bioethanol will, in future, be collected and used by the industrial gas company AIR LIQUIDE. Around 100,000 t of CO₂ will be made available for industrial applications such as the production of carbonised beverages. The result is not only complete material utilisation but also a considerable saving in terms of fossil-based CO₂ emissions. Moreover, it is opening up new markets providing additional revenue streams and helping to diversify the portfolio, all adding to increased viability.

5. Bioenergy production and utilization

AGRANA's essential core competency- the large-scale processing of agricultural raw materials into industrial products- is also the basis for the bioethanol business. Out of the biomass round about 240,000 m³ Ethanol, up to 190,000 t DDGS (Distillers' Dried Grains with Solubles) and 120,000 t of CO₂ are produced annually. Due to the location of the facility, finished goods and co-products can be distributed by the means of trucks, waggon and vessels European-wide. AGRANA's clients are located in Europe who mainly use bioethanol for blending gasoline. CO₂, which is a co-product of the production process, is liquefied in a linked CO₂ facility and is used in the beverage industry. DDGS as an important co-product is used as a middle protein in the feeding industry and is also distributed all over Europe.

The total of around 240,000 m³ of bioethanol produced at AGRANA's facility in Pischelsdorf, Lower Austria are a quantity sufficient to cover all of Austria's domestic demand. AGRANA currently exports around half of the bioethanol produced in Lower Austria, thereby giving away

Project co-funded by European Union funds (ERDF)

the potential CO₂ savings Austria could fully make use of itself, rather than having to purchase expensive emission rights on the global market. The introduction of E10 in Austria would not require additional production capacity or land for cultivating crops – exports of bioethanol would simply be lower.

Bioethanol is a fuel made from the fermentation of carbo-hydrate-rich biomass with an alcohol content of at least 99 percent by volume, making it practically water-free. In Europe, the most important raw materials used to produce bioethanol include any crops containing starch (wheat, corn) as well as concentrated sugar beet juice. In line with legal admixture obligations, five percent bioethanol by volume is currently mixed with petrol in Austria. Plus, it is used as a separate, environmentally friendly fuel known as SuperEthanol E85, which is a mixture of petrol and up to 85 percent of bioethanol. Its use as a petrol substitute in more or less undiluted form (so called high blends) requires modifications to engines. For low blends (such as E10), engine modification is not needed.

The total bioethanol production from 2006 to 2016 in Austria is depicted in Figure 4.

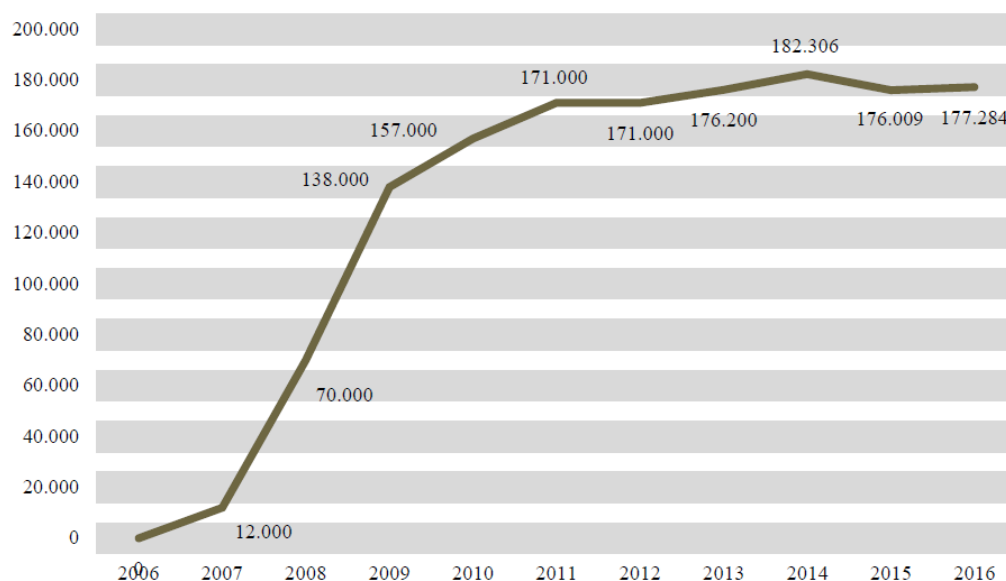


Figure 5: Bioethanol production in Austria [in t].
 Source: BMNT, 2017

Producing bioethanol at the HUNGRANA plant in Szabadegyháza|HU

HUNGRANA Kft. in Szabadegyháza, in which **AGRANA has a 50 percent stake**, produces isoglucose and bioethanol in a combined starch processing plant with a nominal capacity of up to 187,000 m³ per year. Corn, corn gluten and live-stock feed are by-products of the process to produce isoglucose and bioethanol. Corn is the only raw material used by HUNGRANA. The bioethanol produced at the HUNGRANA plant is also used in line with the EU directive on the substitution of petrol (see also Case Study Hungary 2 of the ENERGY BARGE project).

6. Infrastructure, logistics & integration of supply chain and logistics

AGRANA strives to make transport as sustainable as infrastructure and economics will allow. The value chains of the AGRANA group and the main actors along the chains are shown in **Fehler! Verweisquelle konnte nicht gefunden werden**.⁵ In the Starch segment, which includes the bioethanol production, AGRANA processes and refines raw materials grown by contract farmers or purchased in the open market via agri-traders.

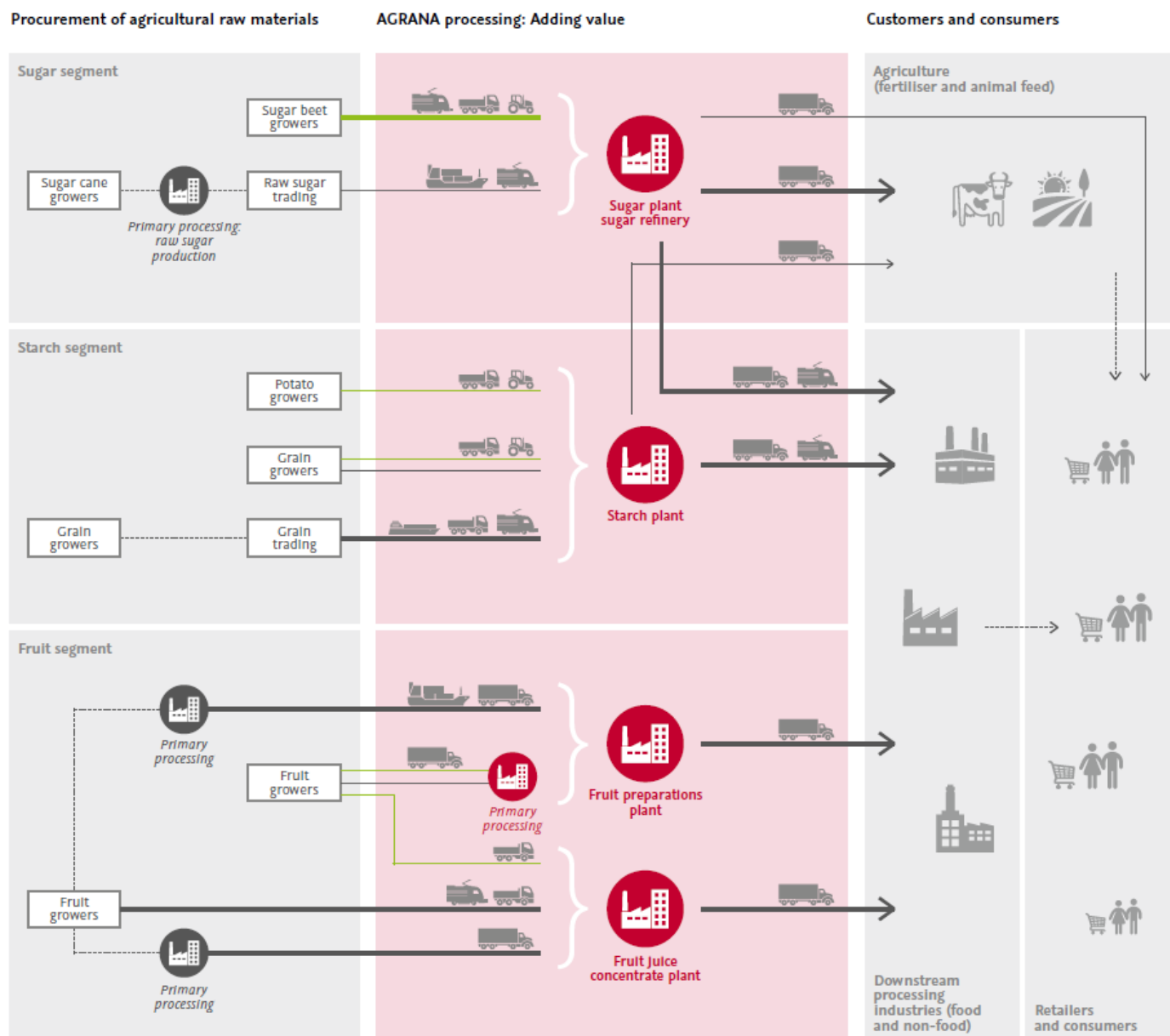


Figure 6: Simplified AGRANA value chain.
 Source: AGRANA Group Annual Report 2016/17

The site of the industrial estate in Pischelsdorf was selected as a production site for the starch business sector 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.

The industrial estate Pischelsdorf provides three locomotives on the factory railway network of more than 20 km which move 70,000 wagons per year with a total volume of 1,700,000 t. On the waterside transshipment area with a total length of 649 m, the vessel loads and discharges are carried out (Donau Chemie, 2018).

For supplying the biorefinery in Pischelsdorf and delivering goods, railway, vessels and trucks are used, making it a trimodal production site. For the discharging of the biomass and loading of co-products a discharging tower is in operation.

Regarding the bioethanol plant in the industry estate Pischelsdorf, three ways of transportation are possible: **railway, vessels and trucks**.

Railway, vessels and trucks are used for biomass and DDGS transport (dry bulk); railway and trucks for the transport of bioethanol (liquid bulk). Since the location has not the status of a harbour, bioethanol cannot be transported on vessels for the time being.

Depending on markets, prices and the necessity of using all three types of transport modes, the quantities of incoming and outgoing goods between the transport types can vary. Regarding the past years the range of cargos transported by vessels was 20% - 40%, by railway 5% - 20% and by trucks 50% - 75%.

Depending on the market situation and availabilities of storage facilities alongside the supply chain (farmer, warehouse, silos at the loadings stations, etc.), number of actors along these chains as well as transport modes used can vary. To give some examples:

- Biomass producer → trader with warehouse/silo | truck | → processing unit
|truck/railway/vessel| → client |truck/railway/vessels|
- Biomass producer with warehouse/silo → trader → processing unit |truck/railway/vessel|
→ client |truck/railway/vessels|
- Biomass producer → trader with warehouse/silo | truck | → warehouse |railway| →
processing unit |truck/railway/vessel| → client |truck/railway/vessels|

Overall, thus, the AGRANA plant in Pischelsdorf serves as one of the view examples along the Danube where a centralized large-scale production site of bioenergy carriers operates, utilizing all standard types of transport modes, including inland waterway systems. Moreover, especially regarding inbound logistics, the waterway plays a decisive role, given the fact that around 70% of the raw material processed is being imported from outside Austria, making the waterway an attractive carrier. This is especially true as grains, as dry bulk, have favorable characteristics for transport on water and make up one of the top cargo types transported on the Danube (European Commission, 2017).

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 case
- 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](#))

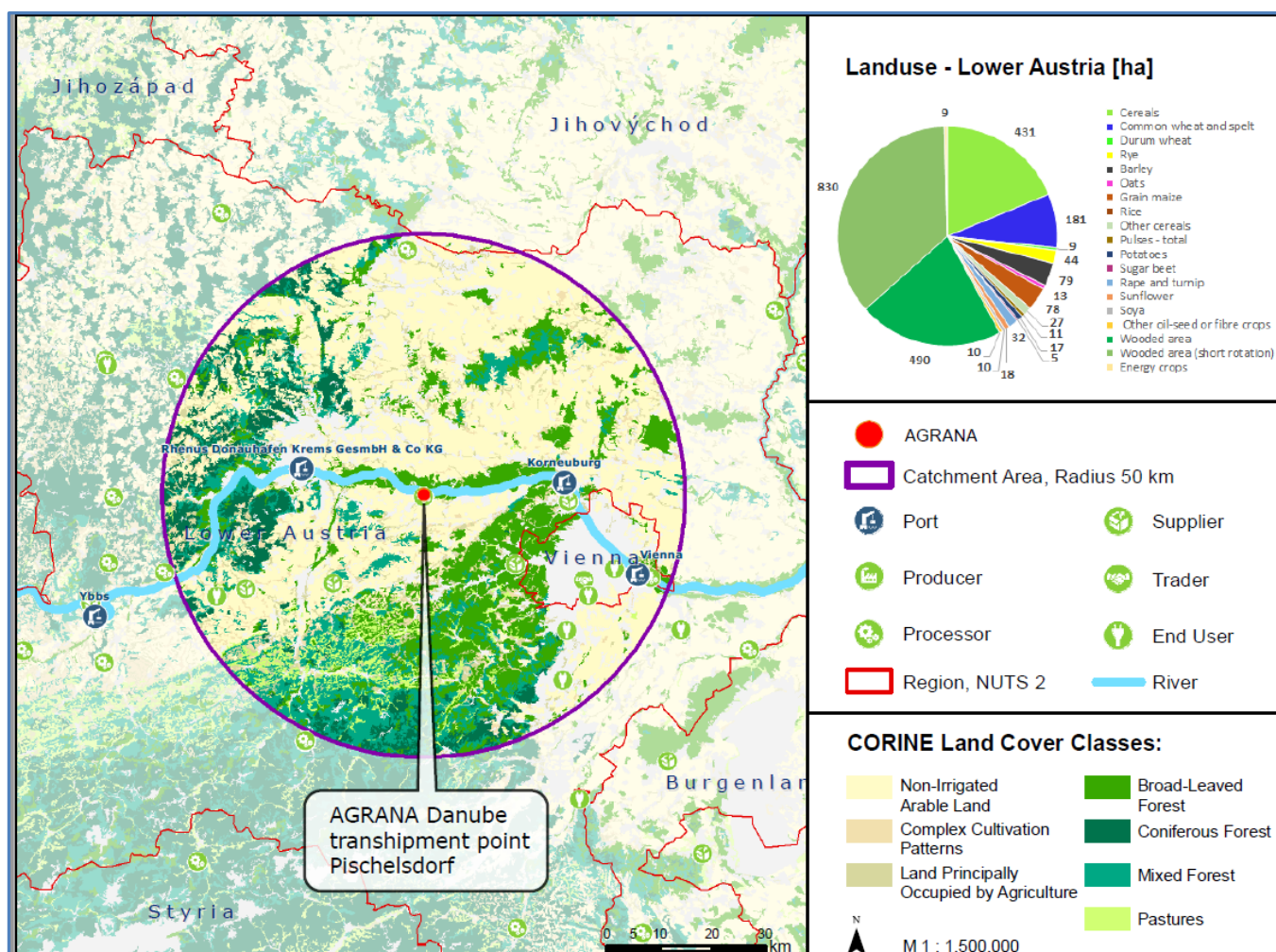


Figure 7: GIS map of the case location (visualisation: DIT for ENERGY BARGE project; sources: ENERGY BARGE, 2017/2018; EUROSTAT land use data, 2017; CORINE landcover data, EUROSTAT, 2012).

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

Table 3: Success factors of the Austrian case

	Enablers	Barriers	Learning and degree of transferability
Biomass availability	Long-term relationships/contracts with suppliers; market power as a major player on the market	Markets (commodity prices risks, volatility)	As a large-scale processor and thus large-scale buyer of feedstock, AGRANA can act differently in feedstock procurement as many other small-scale actors in the bioenergy market, however, the situation is comparable to most other actors active in the transport biofuel sector.
Biomass utilization/processing	AGRANA controls and manages the product value chain from the purchase of agricultural raw materials to the production of the resulting intermediate goods for industrial customers (and end products for consumers in the case of the sugar segment)	politics, markets, legislative framework (sustainability standards)	n/a

Bioenergy production / utilisation	The bioethanol production at the AGRANA plant is supported by the integration of the process and the economic viability of the process's co-products	politics, markets, laws (volatility of bioethanol market);	Only with a high degree of integration of the production process (biorefinery concept) and high-value co-products, this centralized concept of bioethanol production is economically viable. The business model is relying on export of products, since the domestic market is fully saturated and political framework conditions will likely not change in the near future in favour of increased domestic demand.
Existence of a strategy or concept	<i>AGRANA Group corporate management strategy:</i> AGRANA utilises the Groups's strategic know-how across segment boundaries. As a global market actor, AGRANA is not depending on any kind of regional strategy.	<i>n/a</i>	Comprehensive corporate strategies for market development, sustainability monitoring, and research and innovation are a necessity for globally acting companies like AGRANA. However, most actors in the bioenergy sectors are not large corporations and thus this success factor cannot be transferred easily to other cases.

Stakeholders	Being a global player with market power, AGRANA engages in activities to support sustainability of their processes also in public, they do so e.g. via the Sustainable Agriculture Initiative Platform	Different points of view, public relevance of „Plate vs. Tank“ discussion in the media and environmental NGOs	The engagement in platforms with the participation of NGOs furthering the sustainability of processes and standards or helping communicate the characteristics of the processes a company uses to contribute to the bioenergy market can be a favourable tool for stakeholder communication. Transferability is high as there are a number of such initiatives and organisations along the biomass and bioenergy chains, regionally, nationally and on EU level.
Socio-economic factors	Jobs, Suppliers, Logistics, Clients		
Integration of supply chain	Location at industry estate Pischelsdorf provides synergies of different industries & transport ways are used	Large-scale production as business model does not allow regional procurement solely	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 characterized by favourable logistics – ideally trimodal sites, such as available in Pischelsdorf. Also, regional feedstock supply is not of primary importance, high dependence on imports of feedstock and export of products.
Role of logistics infrastructure	Very important (supply chain), huge quantities are moved (incoming and outgoing). Readiness, quickness, reliability, communication, partnership are success factors.		

9. Recommendations & suggestions for future development

A main success factor is that AGRANA utilises the Groups's strategic know-how across segment boundaries. This is especially true for agricultural grower contract management and raw material procurement, the knowledge of customer requirements and markets, the opportunities for the development of inter-segment products, and synergies in logistics, purchasing, sales and finance. Such a strategy is only possible for big corporate players such as AGRANA.

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. The availability of different transport opportunities is a huge success factor for the total supply chain and the bioethanol business.

What is important regarding the integration of Danube ports?:

- To guarantee a certain loading rate (performance of loading quantity per day) for the biomass
- Transparency (first come - first serve) in terms of loadings
- To guarantee product safety (in terms of vermins, bugs, rattles, using grids to sieve biomass in case of loading truck cargos into vessels...)
- The port has a possibility for a intermediate storage
- The port is also able to load truck cargos quick and efficient (adequate weighing bridges, loading ramps, grids...)

The three most valuable "lessons learnt" regarding biomass supply:

- Be aware of product safety (vermins etc.)
- Use grids when loading truck cargos (protection against concrete, stones, steel/iron...)
- Transparency (first come – first serve) not always known (notice of readiness)

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