Sustainable Networks for the Energetic Use of Lignocellulosic Biomass in South East Europe

Work package	**WP4**
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1 Introduction

Beside water, wind and solar power, forest biomass is one of the most important sources of renewable energy in Central and South East Europe. Biomass constitutes a sector of the highest energy potentials. It covers more than half of the renewable energy sources for heat applications, and as heat covers more than half of the final energy consumption in Europe, biomass obviously is a key domain to meet the ambitious 2020 targets of the Renewable Energy Directive (2009/28/EC). A transnational approach with regard to overall and regional/national needs is required to tackle the challenges ahead. Experience shows that only organized private forest owners can bring appropriate amounts of forest raw materials on the market and guarantee the sustainable and nature - oriented forest management. However, there exists a tremendous number of small private forest owners who are neither organized, nor, consequently, interested for use of their resources. The forest and biomass sector has been tremendously affected by technological innovations, which have lessened the need for wood products. On the other hand, out-dated technologies with relatively low efficiency rate are still in use in almost all countries of the SEE - area. These old technologies prevent the actors to use their full biomass potential. Potential investors lack initiative, knowledge and support from external advisers for suitably high investments. Therefore, innovations are a must if forestry and wood processing industry are to become competitive and profitable on the global level. One of important barriers for increase bioenergy utilisation is the lack of knowledge by both consumers and producers of wood biomass fuels on a wide range of topics including technologies for production and utilisation, economic and financial aspects, legislative framework and environmental aspects.

With "Hands on guidelines on the improvement of biomass production chains (experiences, best practices, challenges and opportunities)" we would like to present simple methodology that would help biomass producers and all other stake holders along biomass production chains to evaluate selected actor in the chain (see the chapter 3 Model for assessment of Good Practice Examples). To help all who are interested in existing good practice examples in SEE region a list and detail description of good practice examples was prepared (all GPE are presented also in: Comparative matrix of good practice examples on www.foropa.eu). The methodology and GPE should be used in different countries with different natural, economical, technical and social conditions. To help readers and user of this methodology a list of transnational transferability indicators was developed. The main aim of this list is to check each selected GPE trough this indicators before using it in selected environment.

More informations about wood biomass production chains and other FOROPA results can be found on www.foropa.eu .

2 Introduction to "Supply Chain Operational Reference Processes" (SCORPs)

By supply chain we basically understand a sequence of organizations that are involved in different value performing processes that target to provide products or services for the customer. Accordingly, a biomass supply chain includes forest owners, forest entrepreneurs, transport enterprises, biomass traders, and – depending on the type of wood fuel – private or public customers. The increasing complexity of biomass supply chains demands for introducing systematic supply chain management into this sector.

For analysing processes within a supply chain specific tools are necessary, for example the SCOR® (Supply Chain Operations Reference) model. This model has been developed and endorsed by the Supply Chain Council, it can provide a process overview and is used for addressing, improving, and communicating supply chain management practices within the supply chain (source: supply-chain.org). However, to meet the special needs of FOROPA this method was adapted to specific requirements in forestry for analysing biomass supply chains in SEE and transnational **Biomass Supply Chain Operational Reference Processes (BioSCORPs)** were set up.

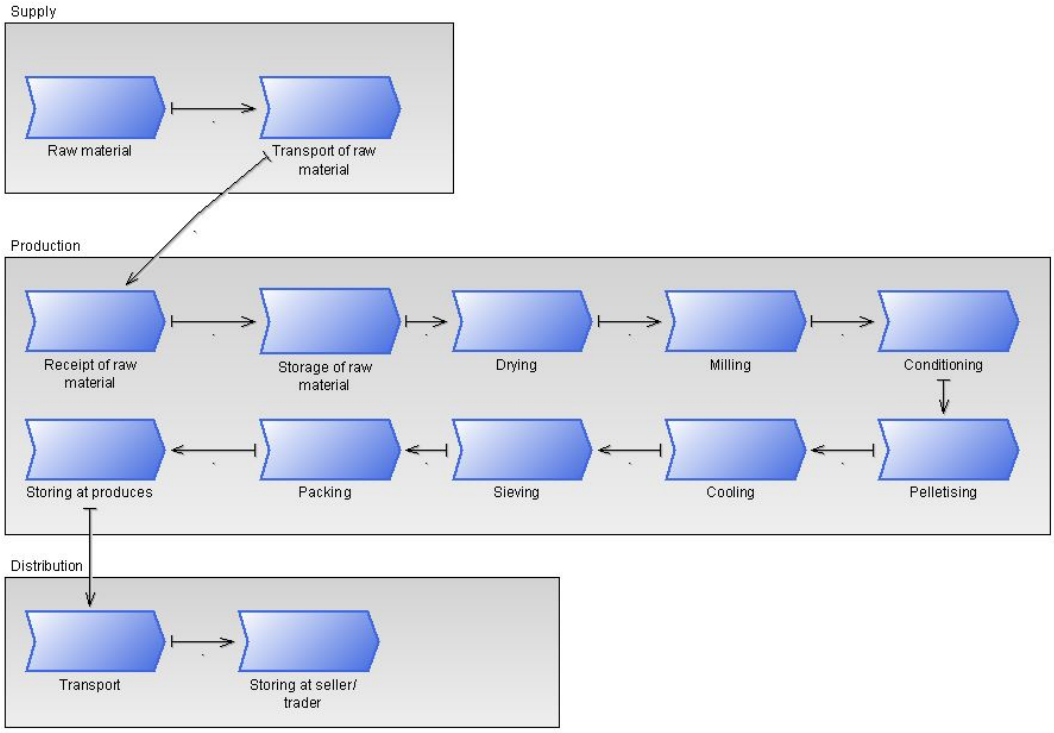


Figure 1: Example of supply chain for production of pellets

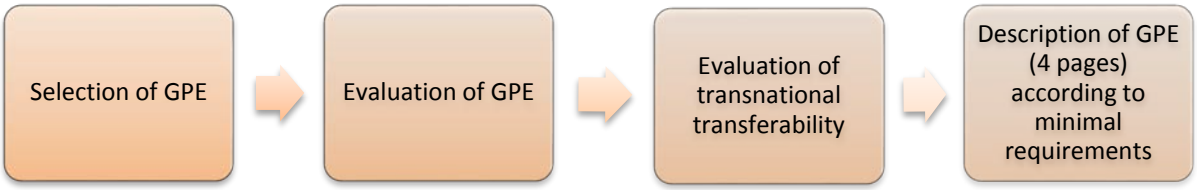
The innovation needs of enterprises and commercial end users were analysed in the woody biomass supply chain. Moreover, these talks aim at promoting and strengthening clusters and networks for an improved use of lignocellulosic biomass in the SEE area. Relevant existing national and regional entities were coordinated in order to encourage and foster innovation of all actors along the biomass supply chain and to spur the political support for an increased substitution of fossil fuels with bioenergy from the forest.

Transferability of BioSCORPs were demonstrated by a series of pilot applications within the SEE territory to push forward the ability of intermediaries and entrepreneurs to innovate their businesses and to boost the competitiveness of woody biomass on the European energy market. Therefore new and well adapted innovation instruments are now available facilitating the innovation process of the FOROPA partners and their clients.

The (theoretical) potential of biomass is high in all SEE countries (ref. also Joint-SWOT). FOROPA initiates activities which aim at improving the utilisation of this potential through differently structured Supply Chain Operational Reference Processes (SCORPs). Starting from the forest sector, the SCORPs address three main biomass sources according to the land tenure: (i) private forests, (ii) state forests, and (iii) short rotation plantations, thereby involving stakeholders representing different biomass sources, transport modes, distribution channels, treatments (depending on the type of wood fuel), heating technology, and end users (private household, district heating, industrial use, etc.).
Existing regional forest fuel supply chains were analysed and evaluated in detail. Firstly, the current state of specific supply chains in each country was documented by guided interviews. The interviews with key actors of regional supply chains (forest owners, freight carriers, logging companies, heating plant operators, biomass traders, etc.) were used to map highly detailed process landscapes. Based on that, supply chains were analysed and modelled using business process modelling notation 2.0 (BPMN 2.0). Moreover, reference processes have been identified and should be used for knowhow transfer within SEE. Business Process Modelling Notation (BPMN) is a graphical representation for specifying business processes in a model and aims to provide a standard notation readily understandable by all business stakeholders. The current version of BPMN is 2.0 and used by the FOROPA project partners to illustrate the BioSCORPs.

The use of advanced ICT technologies is a prerequisite to manage the distinct biomass SCORPs in a competitive way. Information and communication technologies will be adopted and concepts of direct use will be implemented. The communication flow and the organisational structure of the innovation-driven biomass networks in SEE will be further developed. ICT-based portals, platforms and services for specific exchange of knowledge and innovation transfer will be set up, and training and qualification measures will be developed and implemented.

3 Model for assessment of Good Practice Examples



3.1 Selection of SCORP or process for evaluation

In the first step each project partner had to capture status quo of regional biomass supply chains. These documents can be found on FOROPA website and can be helpful for understanding the variety of different social, environmental, economic and legislative needs found among different EU countries. Based on guided interviews, that involved all relevant actors of biomass supply chain, most relevant supply chains were defined and analysed. To identify good practice example (GPE) selected progressive processes within biomass supply chain or whole biomass supply chains were selected and evaluated according to captured information's.

3.2 Evaluation of Good Practice Examples

3.2.1 Introduction to evaluation methodology

The evaluation includes several different types of indicators; social, legal, technological, environmental and bonus indicators.

Before starting with evaluation, process evaluator has to consider that two excluding indicators were selected; if the answer to any of those two questions is negative (NO) the selected supply chain (SCORPs) or process cannot be a good practice example. If answer to both questions is positive (YES), then the evaluation process can be proceed.

All the indicators (excepting bonus indicators) have three possible answers (NO, PARTLY, YES). All of them are evaluated with different amount of points. Next to each indicator a short explanation (threshold) is given, explaining in which case "YES" or "PARTLY" can be selected. If the requirements for "PARTLY" are not met then "NO" should be selected.

At the end of evaluation process BONUS indicators are available. Bonus indicators have only two possible answers (YES or NO). Bonus indicators represent special advantages of selected SCORP or processes. Special attention has been given to description of bonus indicators in description of GPE (look for chapter "Description of good practice examples").

3.2.2 List of indicators with values

Table 1 Indicators for evaluation

Excluding indicators			
Does the company respect the relevant legal requirements / legislation?	No		Yes
Does the company respect the legal health and safety insurance duties and pension costs?	No		Yes
If both answers are YES then proceed with further evaluation!			
Social indicators			
Does the company employ local work forces (more than 75 % YES, from 50 to 75 % PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company invest in trainings and further education of employees (safety regulations, new technologies...) (at least one training in last 2 years YES, one training in last 3 years PARTLY)?	No (0)	Partly (1)	Yes (2)
Has the company skilled workers for each workplace/working process?	No (0)	Partly (1)	Yes (2)
Does the company employ young people (e.g. between 18 and 35)? (25 % or more YES, from 18 to 25 % PARTLY)	No (0)	Partly (1)	Yes (2)
Is the company involved in relevant local development/social projects? (at least one active involvement in last 2 years - YES, one active involvement in last 3 years - PARTLY)	No (0)	Partly (1)	Yes (2)
Does the company pay more than the legal minimum requirements to their workers (at least two bonus payments per year - YES, one bonus payment per year - PARTLY)?	No (0)	Partly (1)	Yes (2)
Legal indicators			
Has the company a system to track the origin of incoming material (all sources – YES, only for some – PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company have a system for identification of suppliers/buyers (for all timber – YES; only for domestic or only international timber - PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company respect legal deadline for payments (75% of payments are done significantly before the deadline - YES, all the payments are performed in legal deadline - PARTLY)?	No (0)	Partly (1)	Yes (2)

Technologic indicators			
Is the company using the relevant information and communication technologies (ICT) (ICT is used for management of all main processes – YES, ICT is used for management of selected processes – PARTLY)?	No (0)	Partly (1)	Yes (2)
Is a company following the development of relevant technology including ICT (at least once a year – YES, at least once in two years - PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company regularly search the possibilities to optimise the supply chain (implementation of at least one solution – YES, searching for solution - PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company have QA/QC system for monitoring of products quality (all products - YES)/ only selected products - PARTLY)?	No (0)	Partly (1)	Yes (2)

Economic indicators			
Does the company have contracts with their suppliers/costumers (at least 50% of annual turnover – YES, at least 25% of annual turnover – PARTLY)?	No (0)	Partly (1)	Yes (2)
Is the company investing in promotion of products and activities including social media (regional level – YES, local level – PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company regularly monitor costs in their production (for every process – YES, for selected processes - PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company have a system for cost optimization (for every process – YES, for selected processes - PARTLY)?	No (0)	Partly (1)	Yes (2)
Environmental indicators			
Is the company preferably selecting environmentally friendly technologies/materials/fuels (for every process – YES, for selected processes - PARTLY)?	No (0)	Partly (1)	Yes (2)
Does the company have relevant certificates (PEFC, FSC, labels…)(products are from 100% certified forests – YES, only selected products are from 100% certified forests - PARTLY)?	No (0)	Partly (1)	Yes (2)
Bonus indicators			
Is one company covering at least 3 processes?	No (0)	Yes (3)	
Has the company introduced at least one innovative solution in its processes in last 3 years?	No (0)	Yes (3)	
Is the company investing in research and development projects/activities?	No (0)	Yes (3)	
Does the company actively participate in stakeholder informal/formal networks?	No (0)	Yes (3)	
Does the company have any of the available ISO certification?	No (0)	Yes (3)	
Has the company invested more than 5% of the turnover in modern technologies in the last three years?	No (0)	Yes (3)	
Has the company invested more than 1% of the turnover in modern ICT technologies in the last three years?	No (0)	Yes (3)	
Has company carbon footprint for any product?	No (0)	Yes (3)	

3.2.3 Final evaluation of selected SCORP or a process for GPE

After evaluation of all indicators in above tables a sum of points should be calculated and table 2 should be field in.

Table 2 Sum of points per group of indicators.

Indicators	Max. number of points	Sum of points
Social indicators	12	
Legal indicators	6	
Technologic indicators	8	
Economic indicators	8	
Environmental indicators	4	
Bonus indicators	16	
Total sum	**54**	

The selected SCORP or process is a GPE, if sum of all points is 30 or higher and it has at least one bonus indicator.

3.2.4 Comparative matrix

As one of the results of FOROPA a comparative matrix for assessment of relevant actors, tools & formats for transferability of biomass SCORPS and network communications structures will be presented.

A matrix will be divided by country and biomass SCOPRs profiles. During project an online matrix was prepared and published on FOROPA website (www.foropa.eu), where each guest will found different "Good practice examples". Visitors will be able to actively determine whether selected "Good practice example" is suitable for its national or regional conditions.

Table 3: A comparative matrix

Country	Forest operations	Logistics/ distribution	Wood processing	Production of wood chips	Production of wood pellets	Production of energy	Stakeholder network
Austria		BTC Leoben I Pabst Gmbh		BTC Leoben II		DHP St. Lambrecht	FOA Styria proPellets Austria
Italy						DHP Ritten [*coming soon*] DHP Toblach [*coming soon*]	
Slovenia				Biofit d.o.o. Biomasa d.o.o.	EnergijaNarave d.o.o.		
Serbia			Moca Ltd. Jablanica		Bioenergy Point	Senjak	
Romania	Sc Neval Sc Fortuna		Sc Neval Sc Fortuna				Padurile Sincii
Slovakia				Lesy SR s.e. Banska Bystrica		Bučina Zvolen National Energy Co	
Greece					Agia Kyriaki Alfa Wood Nevrokopi	Alfa Wood Pindos	

3.3 Evaluation of transnational transferability

Transferability indicators are indicators that show if the selected GPE can be suitably transferred to another country. In the first phase those indicators were prepared on national level and later incorporated into joint transferability indicators. Generally, the method is the same as it was in case of evaluation of good practice examples with several indicators. If answer is negative (NO), then the good practice example cannot be transferred to national condition. If the answer is PARTLY this means that some minor modification should be implemented, whereas if the answer is positive (YES) than simple transfer of good practice example is possible.

3.3.1 Common transferability indicators

In cooperation with FOROPA partners a list of joint transferability indicators has been produced. This approach can be used in order to check possibilities for implementation of the good practice examples to other EU countries. Common transferability indicators are appropriate for good practice examples presented within FOROPA project or any other SCORPs, which were evaluated according to the evaluation methodology mentioned in subject "Evaluation of good practice examples".

Why we need this?

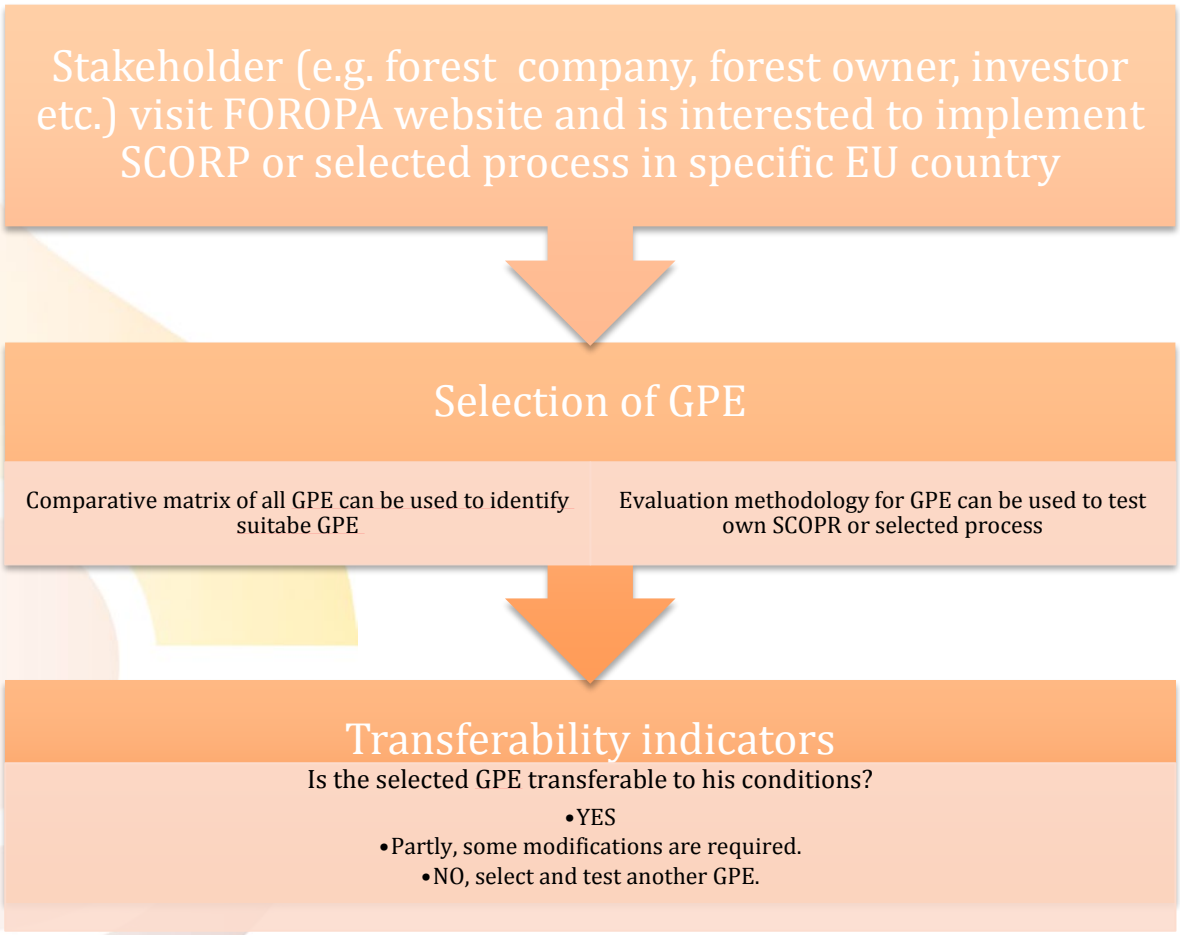


Table 4: Transferability indicators

Is selected GPE transferable to national forest management practice?	No	Partly	Yes	Ecological
Do the legal aspects of selected GPE comply with the general national legislation framework?	No	Partly	Yes	Legislation
Is selected GPE transferable to national/regional future development plans/strategies?	No	Partly	Yes	Policy
Can the selected GPE be transferred to the current national/regional market conditions (e.g. subsidies, financial framework, green electricity prices...)?	No	Partly	Yes	Economy
Can the selected GPE be implemented in economic effective way (e.g. taxes, labor cost, environmental taxes...)?	No	Partly	Yes	Economy
Is there available technology to transfer-implement the selected GPE (e.g. harvesting technology, chippers, trucks...)?	No	Partly	Yes	Technology
Are the social and cultural aspects of selected GPE transferable-implementable to national/regional conditions (e.g. adequate workforce, public perception, economic effectiveness, willingness to implement/cooperate in common projects, level of bureaucracy, level of trust etc.)?	No	Partly	Yes	Social

3.4 Description of Good Practice Examples which pass the evaluation process

After the evaluation process, all evaluated SCORPs or selected processes, that exceeded the proposed threshold for a good practice example (see subject "Evaluation of Good practice examples"), were described and published on the FOROPA website. Minimal requirement for description of good practice examples were set in order to be able to:

- to check the adequacy of selected good practice example according to the transferability indicators;
- compare good practice examples.

3.4.1 Minimal requirements for GPE

Minimum description content of description for each good practice example should contain:

1. General description of the selected process or SCORPs (company name, general description of company history, who is involved etc.)
2. Why this process or SCORP was selected – why this is a good practice example should be explained?
3. Who is involved and who are the stakeholders in this process or SCORP?
4. Technical description (description of machinery used etc.)

5. Economical information's – basic investment costs should be presented (at least: engineering study, equipment costs, installation cost), O&M annual costs, energy and financial benefits compared to a conventional option etc.)
6. Legal aspects - if applicable – what kind of legislation was considered when implementing this good practice example?
7. Environmental aspects (CO_2 savings, eco-efficient machinery etc.)
8. Socio-economic aspects (new activities on farms, job creation etc.)
9. Presentation of bonus indicators for selected GPE - If selected SCORP or process got some points for bonus indicators this should be described in a separete chapter.

For each good practice example some pictures should be selected and a national contact person should be mentioned.

4 Economical analysis of "GPE's"

4.1 Economic data of the production of premium wood chips at Biomass Trade Center Leoben

4.1.1 General

The Biomass Trade Center (BTC) Leoben in Styria/Austria buys energy wood in form of round wood and produces high-quality wood chips. The wood is usually harvested manually by motor saw and transported to the forest road by cable crane. Round wood is bought at the forest road by the BTC and transported to the center by round wood trucks where it is stored. After storage, round wood is chipped either directly into a transport vehicle or the storage bunker (see Figure 1).

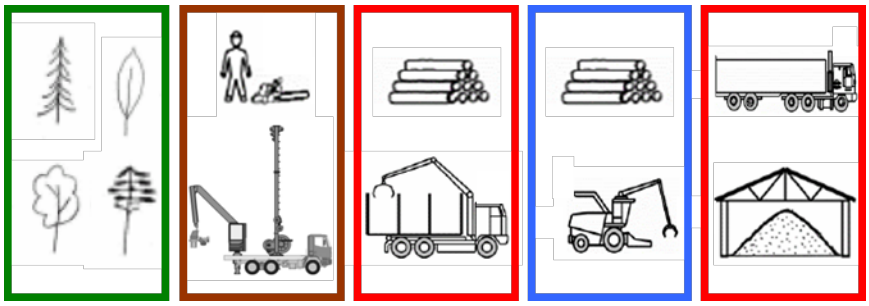


Figure 2: Process chain for the production of premium wood chips

4.1.2 Cost structure (excl. VAT)

Costs for feedstock procurement and storage	[€/solid m³ incl. bark]
Feedstock	Conifers (mainly spruce: Picea abies)
Feedstock costs at forest road	30 – 33
Transport forest road to BTC*	9 – 10
Costs at factory gate (BTC)	39 – 43
Storage	1,5 – 3
Manipulation	2

*Mode/s of transport: almost exclusively round wood truck with trailer are in use, load capacity is approx. 25 solid m³

Costs for chip production	[€/bulk m³]*
Chipping	2 – 3
Manipulation	0,5 – 1
Administration	1

*Pls. note €/bulk m³ as unit for the chip production

4.1.3 Conversion factor/s in use

Base unit	Converted Unit	Conversion rate
1 solid m³ incl. bark	Bulk m³	2,5

4.1.4 Summary

The BTC buys the round at the forest road for 30 to 33 € per solid m^3 (with bark) and organizes the transport. Costs at per solid m^3 delivered to BTC range between 39 and 43 €. Total costs for the production of one bulk m^3 wood chips range between 20 and 23,2 €. The conversion factor between solid and bulk m^3 for the produced grain size is 2,5 which means that 2,5 m^3 of wood chips can be produced from 1 m^3 of solid wood.
The main three cost drivers are feedstock (58%), transport to factory gate (18%), and chipping (11%) which add to 87% of the total production costs of premium wood chips. The share of each process/cost factor on the total average production costs of 21,6 € can be seen in Figure 3.

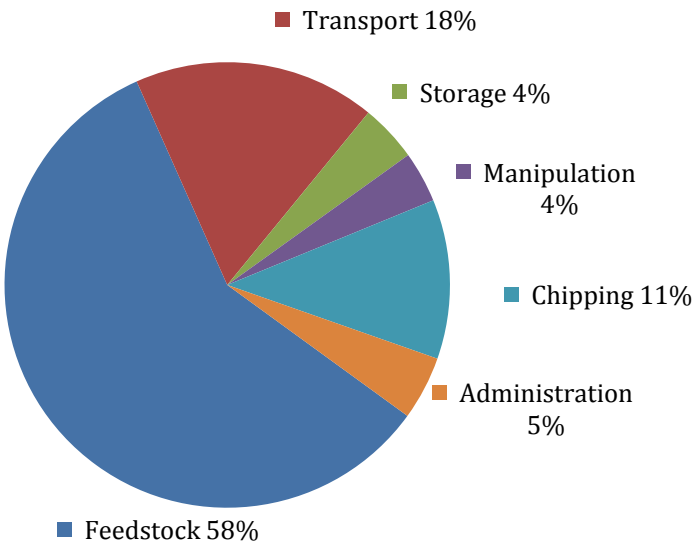


Figure 3: Share of each process on the total average costs of 21,6 € for the production of 1 bulk m^3 of wood chips

4.2 Economic data of the production of pellets in Western Macedonia

4.2.1 General

The company Alfa Wood Nevrokopi is located at the Greek Bulgarian border and is buying roundwood, both imported from Bulgaria as well as locally produced, to a share of approximately 50%. The Greek wood is harvested manually by motor saws and transported to the forest road by means of a mini skidder. From there it is transported to the factory by independent carriers and sold at the gate. The transportation distance of the raw material was in the past up to 70 km, but nowadays it reaches 150 km. The company is buying 45.000 tn of roundwood (including bark) and producing 20.000 tn of pellets. The occurring woody by-products (e.g. bark) are used for process heat and space heating.

4.2.2 Cost structure (excl. VAT)

Costs for feedstock procurement	tn	€
Feedstock cost at gate	45.000 tn (Conifers and Broadleaves), 35-60 €/tn	2.137.500

*Mode/s of transport: mainly trucks with/without trailer are in use

Costs for pellet production	€
Pelletizing	156.520
Administration	302.248

4.2.3 Summary

The company is buying roundwood both imported as well as locally produced. The wood is bought at the company's gate, which means that the company is not involved in harvesting and transportation of the raw material.
The company is buying 45.000 tn of roundwood (including bark) and is producing 20.000 tn of pellets. The occurring woody by-products (e.g. bark) are used for process heat and space heating.

The three main cost drivers are feedstock (82%), pelletizing (6%), and administration (12%). The share of each process/cost factor on the total average production costs of 129.8 € per tonne of pellets can be seen in Figure 3.

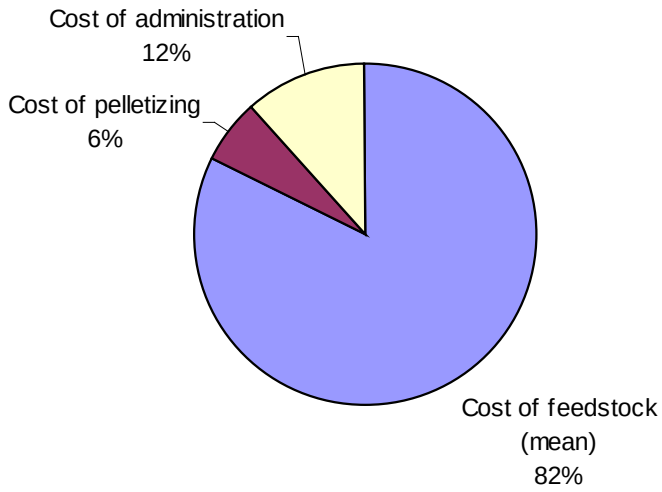


Figure 4: Share of each process on the total average costs of 129.8 € for the production of 1 tn of pellets.

4.3 Economic data of the production of firewood in Western Macedonia

4.3.1 General

Many wood trading companies are dealing with firewood in Western Macedonia. Some of them are buying wood either from the Agricultural and Forest Cooperatives which are active in each forest district or from private forest owners. The purchased wood is mainly beech and oak wood and pine in smaller quantities.
The wood is usually manually harvested by motor saw and transported to the forest road by means of a mini skidder (round wood) or mules (sawn fire logs of 1m length). The wood is bought at the forest road by the firewood trader and then transported to the company's facilities by trucks of 20tn capacity. After unloading at the company's premises, the roundwood is chopped into firelogs of 25 – 33 cm length and afterwards stored for natural drying for a period of min. 2-3 months.

4.3.2 Cost structure (excl. VAT)

Costs for feedstock procurement	[€/solid m³ incl. bark]	[€/tn]
Feedstock	Beech and Oak	Beech and Oak
Feedstock costs at forest road	58 – 67	70 - 80
Transport forest road to storage	14.1	11.8
Administration	1.1	0.9
Costs at gate	73 - 82	82.7 – 92.7

*Mode/s of transport: mainly trucks without trailer are in use, load capacity is max. 20tn – average distance covered is approx. 60km

Costs for firewood production	[€/solid m³]	[€/tn]
Chopping	5	4.2
Storing Including Natural Drying	2.3	1.9
Administration	0.6	0.5

4.3.3 Conversion factor/s in use

Base unit	Converted Unit	Conversion rate
1 tn	Solid m³	1.2
1 bulk m³	Solid m³	0.60

4.3.4 Summary

The wood trading company buys the sawn fire logs of 1m length at 58-67 € per solid m³ (70 – 80 €/tn). The company organizes the transport. The total cost for the production of firewood ranges between 94.3€ per tonne, excluding the distribution cost of the product (5.5€ per tn), a 10% profit margin and VAT (13%) of the sold product.

The three main cost drivers are feedstock (80%), transportation (13%), and chopping (4%) which add to 97% of the total production costs of firewood. The share of each process/cost factor on the total average production costs of 94.3 € per tonne of firewood can be seen in Figure 3.

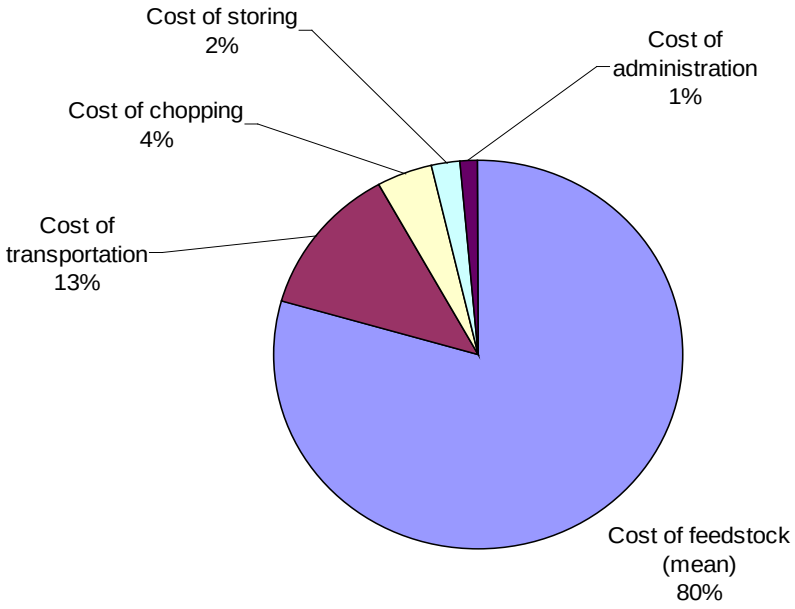


Figure 5: Share of each process on the total average costs of 94.3 € for the production of 1 tn of firewood.

Table 5 – Feedstock costs

Factor	*Amount EUR/m³ (solid)*	*Amount EUR/tn*
Cost of feedstock at forest road	**58 – 67**	**70 - 80**
Mean price	**62.5**	**75**

Table 6 – Cost factors for Transporting

Factor	*Amount EUR/m³ (solid)*	*Amount EUR/tn*
Administration	**1.1**	**0.9**
Direct labor costs	**8.8**	**7.3**
Direct material costs	**5.0**	**4.2**
Indirect cost related to transportation	**0.3**	**0.3**
Subtotal	**15.2**	**12.7**

Table 7 – Cost factors for Chopping

Factor	*Amount EUR/m³ (solid)*	*Amount EUR/tn*
Direct labor costs	**4.3**	**3.6**
Direct material costs	**0.4**	**0.3**
Indirect cost related to chopping	**0.3**	**0.3**
Administration	**0.2**	**0.2**
Subtotal	**5.2**	**4.3**

Table 8 – Cost factors for Storing Including Natural Drying

Factor	*Amount EUR/m³ (solid)*	*Amount EUR/tn*
Administration	**0.4**	**0.3**
Direct labor costs	**1.1**	**0.9**
Direct material costs	**1.2**	**1.0**
Subtotal	**2.7**	**2.3**

Table 9 – Cost factors for Distribution (not included)

Factor	*Amount EUR/m³ (solid)*	*Amount EUR/tn*
Cost to distribute product	**3.3 – 4.2**	**4.0 – 5.0**
Administration	**0.8**	**1.0**
Subtotal (mean value)	**4.6**	**5.5**

*Mode/s of distribution: mainly trucks without trailer are in use, load capacity is either 9tn or 3tn – average distance covered is approx. 20km

Table 10 – Total cost of production

	Amount EUR/m³ (solid)	*Amount EUR/tn*
Cost of feedstock (mean)	**62.5**	**75**
Cost of transportation	14.1	11.8
Cost of chopping	5	4.2
Cost of storing	2.3	1.9
Cost of administration	1.7	1.4
Total	**85.6**	**94.3**

5 Roadmap – Filing Innovation Gaps

5.1 Transnational Innovation Road Map and Research Agenda – Filling Innovation Gaps

Background – Innovation and Research in the primary forest fuel sector

FOROPA analysed the innovation needs of forest owners, enterprises and commercial end users in the forest fuel supply chain. However, there are some peculiarities of the primary forest fuel sector that influence innovation activities and research: (i) The forest - based sector (providing round wood and woody biomass) is a traditionally cost - based sector shaped by SMEs and small family - owned businesses; (ii) Long - term relations along the value chain dominate; (iii) The innovation behaviour is generally slow and concentrates mostly on the adaptation of proven practices and of copying of what others do; (iv) R&D spending and research - driven innovations are dramatically low in comparison to other industrial sectors. As innovation can only be gradually infused into the sector through a long bottom - up process or through a faster top - down procedure, intermediaries have been formed in the forest sector across Europe to overcome those structural deficits and play a vital role supporting innovation processes, RTD development and transnational cooperation and coordination activities.
In this sense, the FOROPA partners exploited the interregional nature of the project:
(i) to raise the awareness of the stakeholders along the biomass value chain on innovation and innovation processes, (ii) to facilitate the uptake and diffusion of new technologies and processes by entrepreneurs along the biomass supply chain, (iii) to transfer best practices and knowledge to less advanced partners and regions, and (iv) to enhance efficiency and performance of regional innovation providers.

Transnational Innovation Road Map and Research Agenda – Filling Innovation Gaps

The technology roadmap on bioenergy for heat and power (IEA 2012, p6) defines as one key action "support international collaboration on capacity building and technology transfer to promote the adoption of best practices in sustainable agriculture, forestry and bioenergy production." Therefore, FOROPA itself can be seen as measure related to this key action, surveying best practices in the forest fuel supply chain and specifying in detail the interregional process of adopting best practices. Additionally, a second key action, namely to "support the installation of more pilot and demonstration projects, including their complete supply chains (IEA 2012, p6) has been taken by FOROPA by promoting cross boarder implementations of pilot projects covering the whole forest fuel supply chain. Based on these pillars of the roadmap on bioenergy for heat and power (IEA 2012) it was possible for FOROPA to include both, practitioners and scientists view to identify the following, forest fuel supply chain specific innovation needs:

- **Introduce new and expand existing innovation networks in SEE**
    - Promote international R&D collaboration
    - Stimulate use of national competencies
    - Enhance adaption and implementation of best practices in the forest fuel supply chain
- **Improve process and customer orientation**
    - Use of online tools for selling forest fuel assortments (online information/ordering platform for biomass, Biomass trading Geo Portal)
    - Increase the use of ICT within all processes
    - Automatic round wood takeover at biomass trade centres
    - Enabling the possibility for customers to pick up firewood outside the opening hours of biomass trade centres or similar retailers
    - Introduce trademarks
    - Biomass trade centres: such facilities have been established for example in Styria, but are absent in most of the other region although there are many people using wood for residential heating
- **How to reduce the energy input in the supply chain?**
    - Reduction of energy input in processing biomass (e.g. chipping)
    - Increase tool life and extend periodicity of maintenance to reduce overall energy input over the life time
    - Apply economic methods to determine optimal processing with reduced energy input
    - Reduction of energy consumption in forest fuel logistics
- **How to store biofuels?**
    - Improving storage properties of slash
    - Improving properties of storage rooms for pellets at the consumer
    - Increase the knowledge of long-term storage of wood pellets. Europe needs to be independent of fossil fuels; however, fuels must be stored to bridge temporary shortages and as a strategic reserve
    - Study self-ignition of stored material.
- **How to improve material characteristics?**
    - Develop new methods for easily measuring quality characteristics
    - Drying of forest fuels
        - Technologies
        - Economic calculations
        - Incorporation is efficient supply chain

- Torrefaction
- Reduce contamination of forest fuel due to harvesting techniques
- Separation of undesired contaminations

- **How to improve forest fuel logistic concepts?**
  - Increase the use of the railway for forest fuel transport
  - Use inland water way for forest fuel transport if possible
  - Seek for multimodal solution for forest fuel transport
  - Increase the number and capability of biomass terminals
  - Balance intermediate storage against the connected extra costs
  - Optimize location and capacity of comminution
  - Develop methods to reduce empty drives (Special case: In order to reduce empty trips of round wood trucks which deliver wood to a sawmill with included pellet plant and delivering wood pellets to an intermediate storage, pellets in Big Bags shall be transported by the trucks on their way from the sawmill/pellet plant to the forest sites)
  - Develop new types of containers or adapt existing container types according to customer needs and feedstock properties
  - Increase the use of a system enabling delivery of wood chips (blow into storage) similar to pellets
  - Studying the interaction of different supply chains to each other
  - Creation of material flow analysis for biomass in the different regions

- **How to expand the resource basis for bioenergy generation?**
  - Market barriers should be eliminated by uniform quality standards and the increasing need for resources should be served by an extension of the usable feedstock
  - Energetic use of wood from slopes, meadows and less economically valuable forests
  - Harvesting and energetic utilization of non-woody biomass (e.g. reed, miscanthus, etc.)
  - Broadleaved wood utilization efficiency increase in some regions
  - Fundamental research in breeding and agriculture for energy plants
  - Establishment of short rotation plantation of fast growing trees on agricultural land
  - Afforestation of abandoned land (this is not primarily intended for biomass, but will definitely give some yields of biomass)
  - Fundamental research in breeding and agricultural technology (plantation, harvesting, etc.)

- Research in conflicts between natural conservation and biomass production on both, woodland and agricultural land.
- Research in CO_2-storage, and -emissions for different types of biomass
- Use of non-forest wood fuels, e.g. wood from tree pruning along roads or paths, from parks as well as from agricultural sites (fruit trees)
- Use of wood from removing trees from pasture land.
- Improve harvesting technology to provide additional assortments for energetic use (e.g. corncobs)
- Basic studies on material blends: e.g. logistics and storage; combustion characteristic, disposal of ash, emissions

- **How to deal with technical/ecological challenges?**
  - Utilization of biomass ashes
  - Slash utilization map for specific regions
  - Decision support system (DSS) for ecologically efficient supply chains utilizing logging residues
  - Study of nutrient cycles for (i) forest biomass, (ii) energy plants, and (iii) secondary feedstock
  - Development of recognized and practicable methods for the preparation of LCAs for the entire biomass supply chain

- **Cooperation**
  - Cooperation between forest owners for market development
  - Cooperation between different actors within the forest fuel supply chain
  - Cooperation between material and energetic use via joint procurement reducing procurement costs and increasing supply security for both uses
  - Cooperation between different organisations and countries in SEE for knowledge transfer
  - Development of usage concepts, operators and business models for diverse supply chains
  - Development of supply concepts for industrial applications, especially with regard to security of supply and risk management

- **Standardisation**
  - Improve standardisation in the field of bioenergy

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IEA (2012): Technology Roadmap. Bioenergy for Heat and Power. 68p.

6 Presentation of "Good practice examples"

6. 1. Quality management and quality assurance of wood chips at biomass trade center Leoben

Biomassehof LEOBEN

1. General

The biomass trade center Leoben is an association founded in 2009 that currently involves 300 members who cultivate a total forest area of 13 700 ha. The center buys energy wood directly from its members and produces premium wood chips suited for the use in small-scale heating systems in private households as well as fire wood. Premium wood chips are sold to private customers, small to medium-scale commercial end users as well as to medium and large-scale heating plants, whereas each group represents about one third of the customer segment (Metschina 2012).

Quality management plays an important role in the wood chip supply chain. Besides grain size and fines, water content is the most important parameter, directly influencing energy content and storage properties of the wood chips.

Quality management is carried out according to EN 15234-1 resp. 15234-4 and involves the following processes:

1. Storage of round wood
2. Chipping
3. Storage of wood chips
4. Selling of wood chips by weight and moisture content

The quality management enables the production of high-quality wood chips and guarantees a constantly high fuel quality with low moisture content to the customer. The right storage of round wood already leads to an increase in quality through natural drying, which provides an ideal basis for the production of premium wood chips. In addition, selling wood chips by water content and weight ensures a transparent and fair method of invoicing.

In the process chain of quality management, the manager and an employee of the biomass trade center, as well as a chipping company and a hauler (for round wood and /or wood chips) are involved.

2. Right storage of round wood

After round wood has been delivered and stored at the BTC, it is stored outside for 14 to 18 month. On one hand, the storage increases security of supply and provides a buffer function, while on the other hand the quality of the wood is increased through natural drying. The outside storage reduces the water content of the wood to 27 % or lower, which increases the heating value and therefore has a positive influence on efficiency of heating systems, which on the other hand reduces the amount of wood chips needed. In addition, this leads to a better utilization of the transport capacity of the transport vehicle and therefore reduces transport costs.

While storage also leads to some mass loss due to natural decomposition processes, the loss lies between 1-3 % of dry matter per year and is relatively low compared to storage of moist wood chips, which can lead to substantially larger mass and energy losses depending on storage conditions (Golser et al. 2005).

The storage of green wood chips can lead to additional problems such as mould growth, self-heating and even self-ignition due to micro-organic activities. The storage of wood chips takes up more space than round wood. Therefore, the storage of round wood provides the best alternative. Important factors for good drying results are the right location, which should be sunny and windy, as well as the right kind of storage, especially the required ground clearance and the right stacking of the logs (Kühmaier et al. 2007).

Roundwood is chipped after the right kind and duration of storage © WV Stmk

3. Chipping

The chipping process mainly influences grain size and fines of the produced wood chips. Especially in small-scale applications, a uniform grain size and a low content of fines are required to allow for an undisturbed operation of the heating system. The chipping is carried out by external companies at the storage area of the biomass trade center with large-scale mobile chippers which can produce wood chips in the required quality. If possible, round wood is chipped directly into a transport vehicle to avoid intermediate storage and handling. Since also a certain stock of wood chips is required and the chipper is usually chipping the whole day if on site, the chip depot is filled as well. In one day, up to 1000 bulk m^3 of wood chips can be produced. If the chipper is on site, usually two trucks are loaded directly and the chip storage depot is filled in one day.

4. Chip storage

After chipping, the produced chips are stored in a roofed depot, if the round wood was not directly chipped into a transport vehicle. The chips are so protected from weather conditions and re-moisturization, while the good ventilation leads to additional drying. Furthermore, security of supply, especially regarding short-term orders, is additionally increased. The storage depot can take up to 800 bulk m^3 of wood chips.

5. Selling of wood chips by weight and moisture content

Wood chips can either be traded by volume (bulk m^3) by weight (t), by energy content (kWh) or by weight and moisture content (t dry matter).

Charging by volume is the easiest way and works relatively accurate if wood chips are produced from only one tree species. If wood chips from different species are sold, this method gets problematic

as the energy content per volume can differ substantially between tree species. Depending on moisture content, wood species and grain size and the corresponding bulk density, Energy content and weight per volume unit can differ substantially. One bulk m^3 can weigh between 250 and 450 kg and contain between 630 and 1 100 kWh of energy. If traded by volume, coarse wood chips are more expensive than finer material because of the larger pore volume. If traded only by weight, wet wood chips are more expensive then dry ones because of the higher weight. Therefore, charging by weight with additional determination of the moisture content provides a much more transparent and fair method, because it is paid only for the dry matter of the wood resp. the contained energy (Wittkopf 2004; Loibneggar 2011).

The water content is the most important quality parameter regarding wood chips, as it is not only crucial for the energy content but also for the storage properties of the chips. Green wood chips contain more than 50 % of water and are not suited for the use in small scale heating systems or longer storage periods. If wood chips have to be stored for longer durations, the water content has to be less than 30 %. If charging by moisture content and weight, the exact determination of the contained water is crucial, as an error of 10 % of water content already leads to a miscalculation of 20 % of the selling price. The required accuracy can only be achieved by the complete

drying of a chip sample in a drying cabinet (Wittkopf 2004).
Determination of dry matter of a chip sample © WV Stmk

For the above reasons, wood chips are traded by weight with additional determination of the water content. For that matter, the empty transport vehicle is weighed on a calibrated weigh bridge, then the order amount of chips is loaded resp. chipped on the vehicle and it is weighed again before it leaves the biomass trade center. While the loaded vehicle is weighed, a chip sample is taken and dried to 0 % moisture in the drying cabinet. Afterwards, the dry matter of the sample is determined and the dry matter of the whole delivery is calculated, which provides the basis for invoicing with the customer.

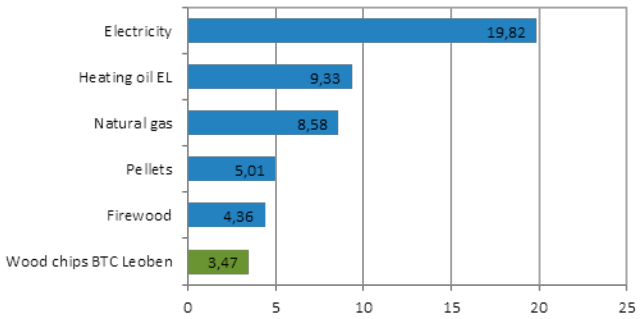
The loaded vehicle is weighed © LK Stmk

6. Technical data

Technical data	
Annual wood chip production	23.000 - 28 000 bulk m^3
Annual feedstock demand	10.000 - 12.000 solid m^3
Chip storage capacity	800 bulk m^3
Moisture content	23 - 27 %
Average grain size	30 mm
Bulk density	203 kg/m^3
Energy content	3,79 kWh/kg

7. Economic data

Economic data	
Total investment costs	130 000 €
Investment costs weigh bridge	30 000 €
Investment costs drying cabinet	5 000 €
Chipping costs	2 - 3 €/bulk m^3



Economic data	
Loading costs (wheel loader)	0,5 - 1 €/bulk m^3
Price of wood chips	125 €/t dry matter
Transport costs to customer	2 - 4 €/bulk m^3

Comparison of energy carriers in ct/kWh
Source: ÖBMV, proPellets Austria, Gaber; Status: August 2013

8. Environmental data

The delivery of wood chips to the customer is usually carried out regionally, within a supply radius of 30 km. Therefore, energy demand as well as emissions of CO2 and other pollutants accompanying with transport can be kept relatively low.

9. Socio-economic data

Currently, two persons are employed at biomass trade center Leoben: a manger for one day per week and an employee for two to three days per week, depending on die particular season and order situation.

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6. 2. Naturwärme St. Lambrecht: district heat from slash

Biomassehof NATURWÄRME ST. LAMBRECHT

1. General

Naturwärme St. Lambrecht is an agricultural community that operates a biomass heating plant with the corresponding district heating network since 1993. In its founding year, the community counted 15 members which were responsible for the fuel supply of the heating plant, which had an output power of 1 MW by then. The main plant (the community operates 4 plants with a total output power of over 6 MW by now) has a thermal output of 3,6 MW as of now and is still mainly supplied by its members with wood chips that are almost entirely made from slash – a byproduct of wood harvesting consisting of tree tops, branches and leafs/needles. The heating plant supplies a large part of the St. Lambrecht, a municipality with around 1 400 inhabitants in Styria, with district heat.

Currently, Naturwärme St. Lambrecht counts almost 100 customers, both private households and commercial customers. The community gains a few new customers every year.

Since 2011, Naturwärme St. Lambrecht also operates a biomass trade center and distributes premium wood chips and fire wood directly to end consumers, but to a lesser extent than the heat supply (Metschina 2012).

The regarded supply chain involves one community member (farmer/forest owner), a chipping company, a haulier and the manager as well as an office employee on the part of the heating plant.

2. Utilization of low-quality biomass – availability vs. economic feasibility

A major problem in the supply of slash is the low profit that can be achieved by utilizing this material. In addition, slash often "gets in the way" during the harvesting of timber which leads to higher manipulation and therefore increases costs. Therefore, the right organization of all processes around timber harvesting and the following logistics play a crucial part. Problems often arise if the processes harvesting, chipping and transport are organized by different people. Hence, it is important that it is made clear if slash shall be utilized before the harvesting even begins. This way, the logging company can cut the slash to the right length and concentrate it at the roadside so that the chipper can work at its full capacity. For efficiency reasons, the slash is ideally chipped directly into the transport vehicle to avoid an additional loading process and the corresponding machine to carry it out. Therefore, the transport has to be carried out without delay as well. Due to the relatively short transport distances of 20 km on average from forest to the plant, transport cost, which also play an important role in the supply chain of slash, are kept comparatively low.

The heat delivery community St. Lambrecht demonstrates how a regional concept for heat supply from low-quality biomass assortments that otherwise wouldn´t be used can work quite efficiently. Despite the common problems associated with the utilization of slash, the direct supply of district heat creates a relatively high added value that stays within the region.

3. Framework contract and individual delivery contracts

Every year, Naturwärme St. Lambrecht concludes framework contracts with its members. Every member is allowed resp. committed to deliver a certain contingent depending on in its community share. In the course of the framework contract, a price frame as well as the delivery contingent announced. The contingents are usually released quarterly to avoid an oversupply by the members. In addition to the framework contract, an individual contract is concluded for every single delivery.

4. Supply and delivery of slash

The wood chips from slash used in the heating plant are delivered almost exclusively by the community members and is bought only delivered free plant (supplier pays transport). Hence, the organization for the processes timber harvesting, chipping and transport lies within the responsibility of the supplier, who has to make sure that the supply runs without interruptions as his profit depends it.

If a member wants to deliver slash chips, it has to instruct the logging company to cut the slash to the right length and store in the right place (or the forest owner has to do it if he harvests the timber himself). In particular, it is important that the slash is not contaminated (with sand, stones etc.). In the next step, the slash piles are inspected by an employee of the heating plant and a delivery contract is conducted, which also includes a price frame depending on the quality of the slash,which allows the member to estimate the achievable benefit. Next, a chipping company is hired, which also inspects the slash and an appointment for chipping is made. In addition, a haulier has to be organized for the same date as well. The slash is then chipped directly into a truck, which drives directly to the heating plant afterwards.

Chipping of slash directly into the transport vehicle; in the left picture the slash concen © WV Steiermark

5. Acceptance of delivery at the heating plant

At the heating plant, the truck is weighed on a calibrated weigh bridge and a wood chip sample is taken for the determination of dry matter. After that, the wood chips are unloaded into a covered storage depot. The sample is dried to 0 % moisture content in a cabinet drier and so the energy content of the sample and furthermore of the whole delivery is determined, which provides the basis


for invoicing with the forest owner.
Unloading of wood chips at the plant and chip sample © WV Steiermark

6. Storage

Another problem connected with the use of wood chips from slash is its high water content and the accompanying poor storage property. Therefore, the wood chips are incinerated as soon as possible or, if that is not possible resp. a longer storage is planned, the chips are technically dried. Technical drying is especially important in the warmer seasons, when heating demand is low. For this purpose, the rejected heat from the plant is used.

7. Incineration and heat supply

The wood chips are taken from the storage depot via a wheel loader and loaded onto a walking floor, which feeds them directly into the incinerator. The produced heat is delivered to the consumers through the district heating network also operated by the heat delivery community.

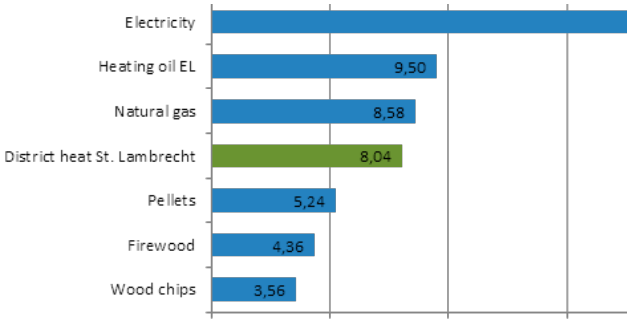
8. Technical data

Plant connection power	3,59 MW
Plant investment cost	872 0000 €
Operating hours	2 700 h/year
Fuel demand	17 000 bcm/year
Produced heat	9 700 MWh/year
Length of district heating network	8,1 km
Network investment cost	2 Mio €
Number of customers	95 (24 commercial, 71 private)

9. Economic data

Price per MWh	67 €
Connection costs	210 €/kW
Basic charge	18,42 €/kW/year
Heat meter charge	96 €/year
Total annual costs (20.000 kWh demand)	2 010 € (Incl. VAT.)

One MWh heat delivered to customer costs 67 € excluding VAT and basic charge up to a purchase quantity of 150 MWh per year. For higher demands, graded commercial tariffs exist. Compared to conventional energy carriers the sole heat price including VAT amounts to 8,04 ct/kWh which is slightly beneath the cost for natural gas (8,58 ct/kWh) and significantly lower than the price for heating oil (9,50 ct/kWh) (proPellets Austria 2013; status: August 2013). For a typical one family house with 13 kW connection power, investment costs amount to 3 280 €, the total annual cost at an annual heat demand of 20 000 kWh add up to about 2 010 € (including VAT).



Comparison of energy carriers in ct/kWh ÖBMV, Wallner; Status: August 2013 Source: proPellets Austria,

10. Environmental data

By using district heat from biomass, several negative environmental impacts can be minimized at once. On one hand, single heating systems with low efficiency and relatively high emissions are replaced by one efficient central heating plant with an efficient flue gas cleaning, which leads to a reduction of CO2-emissions. While even the use of district heat from fossil fuels is much more efficient than several small heating systems, emissions are further reduced by the use of biomass, which burns CO2-neutral. Furthermore, transport distances of the wood chips from forest to plant are relatively low at 20 km on average, which also leads to relatively low CO2-emissions. As the heat is delivered through the heating network, the fuel transport to the consumer by truck/car etc. , which is necessary for the supply of single biomass heating systems, is omitted, which saves additional emissions.

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6. 3. Marketing platform of forest owner association Styria

1. General

The collaborative marketing of wood from small-scale forest owners has a long tradition in Styria. In 1955, forest owners founded the first forest management community with support from the Chamber of Agriculture and Forestry in Hartberg/Eastern Styria in order to jointly market round wood. Throughout the years, similar forest management communities were established all over Styria. In 1990, the forest owner association Waldverband Steiermark[1] was founded as an umbrella organization for all regional communities. The main tasks of Waldverband Steiermark are the support of its members, support of the regional forest owner associations and lobbying.

In 2005, the Waldverband Steiermark GmbH was founded as a complementary legal entity to Waldverband Steiermark with focus on round wood marketing on behalf of the members of Waldverband Steiermark. The shareholders of Waldverband Steiermark GmbH are the 11 regional forest associations and Waldverband Steiermark. The business of Waldverband Steiermark GmbH. is directed by the manager, a directorate was installed as a controlling body, consisting of representatives from all regional forest associations and the Waldverband Steiermark as well. The business year of Waldverband Steiermark GmbH ranges from October 1st to September 30th of the following year.

2. Services of Waldverband Steiermark GmbH

The Waldverband Steiermark GmbH[2] regards itself as a timber marketing platform for the members of Waldverband Steiermark. Accordingly, the services offered by the Waldverband Steiermark GmbH are orientated towards:

- Timber marketing for members
- Selling timber on the stump/standing tree (organization, marketing and invoicing of wood harvesting)
- Forest management contract (a year-round management service for forest stands is offered to forest owners)
- Silviculture plan (offers a general overview of the current forest condition and its potential value creation)

3. Service focus of timber marketing by Waldverband Steiermark GmbH

The optimal timber marketing for its members is the main task of the Waldverband Steiermark GmbH. The main service features are:

- **Collateralized delivery:** Every wood delivery carried out by Waldverband Steiermark GmbH is 100 % collateralized for the forest owner, which is ensured through equity capital, bank guarantees and insurance.
- **Marketing of all assortments:** Due to its broad acceptance spectrum, Waldverband Steiermark GmbH is able to market all assortments in the best possible way. Ultimately, the price for the whole assortment is the crucial point for the member.
- **Transparent execution:** Transparency is an important principle for long-term cooperation and mutual trust. Therefore, Waldverband Steiermark GmbH provides an online platform for its members on which every step in the timber marketing is comprehensibly documented.
- **Average wood price:** Continuously, the sorting of the buyer is controlled and the current average price per solid m^3 wood is determined for each member that markets its wood through the Waldverband Steiermark GmbH.
- **Control measurements:** Waldverband Steiermark GmbH continuously conducts control measurements at buyers and sawmills for the members.
- **Qualification:** Already 2-5 days after the selling, the member is informed about quality and assortment of its timber. Therefore it is possible to promptly react to an incorrect production of assortments during wood harvesting.
- **Swift payment:** 5 days after the round wood acceptance at the industry, the payment to the member is commissioned.

4. Forest assistants

Trained forest personnel such as forest workers or forest wardens employed in Waldverband Steiermark are referred to as "forest assistants" ("Waldhelfer"). These assistants guarantee a direct contact between the member and the forest owner association on regional level.

Main tasks of forest assistants:

- Admittance of new members to Waldverband Steiermark GmbH
- Advising members regarding silviculture
- Marking of trees for wood harvesting
- Organization of logging companies for wood harvesting
- Monitoring of wood harvesting and sorting, securing a quality-oriented harvesting (remaining trees must not be damaged)
- Organization of round wood transport
- Monitoring of wood transport
- Organization of operating resources for members
- Organization of forest plants for members


Forest assistants are an important link to forest owners and service providers © WV Steiermark

1 Translation: Private Forest Owner Association Styria [Waldverband Steiermark] is a registered voluntary association under Austrian law)
2 Translation: Private Forest Owner Association Styria Ltd. Is a private limited company registered at the Austrian Commercial Register

5. Member platform

The member platform of Waldverband Steiermark www.holzabrechnung.at is an internet-based software tool. It provides the essential instrument for member administration of Waldverband Steiermark as well as for the billing of the marketed round wood through Waldverband Steiermark GmbH.

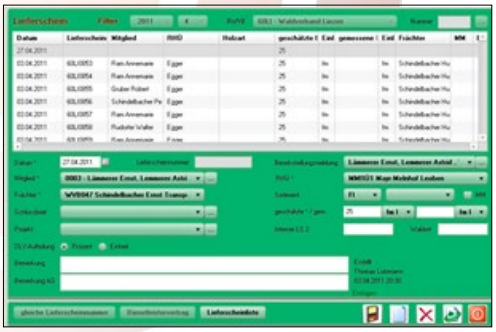
The entire administration of members is accomplished through the member platform. Regional forest associations capture their members through the platform. This data provides the basis for both the mailing of the member newspaper "Waldveband Aktuell" and the billing of the membership fee. The membership fees are paid to the regional forest associations whereas the regional associations pay a fixed amount per member to Waldverband Steiermark.

The platform also provides a number of instruments for the members:

- Announcement of the planned harvesting amount per year (these announcements provide the basis for the contracting with round wood buyers for Waldverband Steiermark GmbH.)
- Announcement on ready-to-transport wood (Basis for forest assistants for organization of wood transport)
- Electronic transfer of wood billing from Waldverband Steiermark GmbH to member
- Different possibilities for analysis of wood deliveries
  - Single stem protocol
  - Comparison of wood deliveries – also if delivered to different buyers
  - Capture of overall deliveries to Waldverband Steiermark GmbH
  - Summary of overall deliveries (according to EU-regulation regarding operators who place timber on the European market)

For Waldverband Steiermark GmbH the member platform provides the basis for billing:

- Overview of planned wood deliveries
- Overview of how much wood is currently on the way to buyers
- Creation of service contracts (if wood is bought on the stump/ as standing tree)
- Assigning wood deliveries to members
- Billing of wood deliveries
- Interface to automatic data transfer, to accounting and to domicile



Delivery note in member platform of Waldverband Steiermark © WV Steiermark

6. Technical data

Technical data	
Number of forest owners in Styria	42.000
Members of Waldverband Steiermark	13.000
Share of forest owners which are member in Waldverband Steiermark	31 %
Forest area in Styria	1,0 mio ha
Forest area owned by members	302.000 ha
Share of member area of total forest area in Styria	30 %
Annual wood harvesting in Styria	5,0 mio m^3
Annual marketed timber quantity by Waldverband Steiermark GmbH	1,0 mio m^3
Number of wood buyers of Waldverband Steiermark GmbH	60
Number of members who market timber through Waldverband Steiermark	6.700
Number of shareholders in Waldverband Steiermark GmbH	12
Founding year of Waldverband Steiermark GmbH	2005
Founding year of Waldverband Steiermark	1990
Founding year of first forest management community in Styria	1955

7. Economic data

Economic data	
Equity capital of Waldverband Steiermark GmbH	150.000 €
Annual turnover	70 mio €
Marketing fee per solid m^3 round wood	1,5 €
Costs for member support and organization of timber marketing by forest assistants and regional forest associations	1,0 € / m^3
Costs for billing and collateralization of wood deliveries	0,5 € / m^3
Total cost for marketing of round wood (including organization, billing and collateralization)	1,5 mio €
Average transport costs from forest site to buyer	10 € / m^3

For small buyers, wood is usually measured on site © WV Steiermark

8. Environmental data

A special task of Waldverband Steiermark GmbH consists in the supply of the regional wood industry (saw mills, paper and pulp mills, wooden board manufacturers and several biomass heating plants) in Styria. Despite round wood being also sold to bordering federal countries as well neighboring countries (mainly Germany for strategic business reasons) the average transport distance from forest site to buyer only amounts to 60 km. Round wood trucks usually consume 40 liters of diesel per 100 km. Considering an average load of 25 solid m^3 per truck and considering the empty trip back (which isn´t always the case due to availability of return freights) the transport of 1 solid m^3 takes up 1,9 liters of diesel. The total costs for the transport of 1 solid m^3 over a distance of 60 km amount to 10 € on average.

9. Socio-economic data

Waldverband Steiermark GmbH employs 6 full time and 2 part-time employees in the head office in Graz. In the regional forest associations, 5 part time employees are engaged in billing of round wood deliveries. Additionally, around 40 forest assistants work on commission basis as interface between Waldverband Steiermark and its members (usually on forest/agricultural sideline). For tasks such as member support, lobbying, event management and support of regional forest associations, 3 full time workers are employed at Waldverband Steiermark.

10. References

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zukunft innovation Steiermark 2007-2013
eer European Entrepreneurial Region 2013

6. 4. Direct pellet distribution of Johann Pabst Holzindustrie GmbH

PABST PELLETS

1. General

Johann Pabst Holzindustrie GmbH operates a sawmill, a planing mill, a profiled timber production, two laminated-wood plants as well as a pellet production plant in two different locations in Styria. The construction of the first pellet plant as well as the beginning of the pellet production took place in 2001.

By now, the Pabst Company has a production capacity of around 60 000 t of pellets per year in Zeltweg. The current production amounts to about 53 000 t of quality class A1 according to ENplus. Over 80 % of the feedstock for the pellet production, which consist of sawdust (80 %) and wood shavings (20 %) from spruce and, to some extent larch, comes as byproduct from the own plants. About 25 000 t of the produced pellets are sold directly in loose form to end consumers within a radius of 100 km by Pabst GmbH, 10 000 t are distributed via pellet traders and 18 000 t are exported. The direct pellet distribution is carried out through the company´s own truck fleet, which contains four pellet-silo-trucks. In addition, the direct distribution channel to the end consumer is also used by some in-between pellet traders.

On one hand, the transport distance and the corresponding costs and CO2-emissions are reduced through the direct distribution from plant to end consumer, while on the other hand, intermediate storage and handling are avoided, which minimizes abrasion and breakage of pellets as well as handling costs. The transport in specialized silo-trucks with on-board weighing system allows determining the exact amount of pellets unloaded at the customer. Furthermore, the pneumatic injection of pellets into the storage room adds to a careful and gentle storage of pellets.

In the Process of direct pellet distribution, usually the following people involved: a sales manager, an office employee, one person from the production (pellet loading), a truck driver and the customer.

2. Loading of pellets

Before pellets are loaded, the empty truck is weighed on a calibrated weigh bridge. After screening, the pellets are directly loaded from the storage silo into the silo truck. Afterwards, the truck is weighed again to determine the exact amount of pellets loaded.


Loading of pellets into the truck with foregoing screening © Pabst GmbH

3. Transport and unloading at the customer

After loading, the pellets are transported to the customer and are pneumatically inserted into the storage room through a hose. This procedure is very gentle and reduces dust formation, abrasion and pellet breakage. To allow for a dust-free blow in of pellets and to avoid overpressure in the storage room, a suction and screening device is necessary. By using a so-called dust bag, it is guaranteed that only a minimal amount of fines is blown into the customer´s storage room. If the storage room is full although the ordered quantity of pellets has not been blown in completely, excess pellets are discharged back into the truck. In contrast, the unloading stops automatically if the ordered amount of pellets is lower than the capacity of the storage room. The unloading process takes between 30 minutes and 1 hour, depending on the ordered quantity. The exact amount of the unloaded pellets, which is determined through the on-board weighing system, provides the basis for invoicing. A weigh note is printed out locally and a copy is handed to the customer. The original note is delivered to the office by the truck driver, where the invoice is created and sent to the customer (Pabst GmbH 2013; Obernberger and Thek 2009).

Unloading of pellets at the customer © Pabst GmbH

4. Technical data

Plant data	
Production capacity	60 000 t/year
Annual production	53 000 t
Number of pellet presses	3
Production output	12 t/h
Pellet quality	ENplus A1
Higher heating value of pellets	4,9 kWh/kg
Feedstock demand	371 000 bulk m^3 sawdust and wood shavings
Pellet storage capacity	7 000 t

Truck fleet data	
Number of silo trucks	4
Loading capacity	13 – 22 t
Number of axles	3 - 4
Equipment	On-board-weighing system, blow-in equipment
Delivery radius	100 km
Average transport distance	50 km
Investment costs	200 000 – 280 000 € per truck

5. Economic data

Depending on purchase quantity and transport distance, 1 t of pellets costs between 245 and 257 € delivered to customer including tax (July 2013). In addition, a delivery charge of 39 € is charged per shipment. The minimum purchase quantity is 3 t, the maximum quantity is 23 t (Pabst GmbH 2013). At an average energy content of 4,9 kWh per kg pellets, the energy price amounts to about 5,1 ct/kWh which leads to a certain price advantage in comparison to natural gas (8,58 ct/kWh) and heating oil (9,50 ct/kWh) (proPellets Austria, August 2013). The annual pellet demand for a single family home lies between 4 and 7 t. The total fuel cost including delivery amounts for about 1300 € for an average annual demand of 5 t.

Economic data	
Cost of pellets delivered	245 – 257 €/t
Delivery charge	39 €
Minimum purchase quantity	3 t
Maximum purchase per delivery	23 t
Annual demand for single family house	4 -7 t
Total fuel cost delivered (5 t annual demand)	1300 €

6. Environmental data

The energy demand for the production of 1 t of pellets amounts to 860 kWh on average in Austria, which equals around 17,5 % of the pellets´ energy content. During the production of 1 t of pellets, around 15 kg of CO2 are emitted, which is equivalent to 1 % of the CO2 contained in the fuel. This low value leads back to the fact that most of the thermal energy for feedstock drying stems from biomass heating plants owned by the sawmills and pellet plants and are operated with residues from the production process (proPellets Austria 2012; Moser 2009). The energy demand for the transport of 1 t of pellets to the end consumer over a distance of 100 km sums up to 50 kWh on average, which equals about 1 % of the energy contained in 1 t of pellets. The corresponding CO2-emissions amount to about 14 kg per t (Moser 2009). Since the average delivery distanced of Pabst GmbH is only about 50 km, it can be assumed that energy demand and CO2 emissions of pellet transportation are significantly lower. Over the whole supply chain, almost 97 % less CO2 is emitted, if wood pellets are used for heating purposes instead of heating oil.

7. Socio-economic data

In total, 15 people are employed in the production and distribution of wood pellets at the Pabst Company: 1 sales manager, 1 customer consultant, 2 office employees, 6 truck drivers as well as 5 persons working in the production process. Therefore, several jobs could be created in the region through the beginning of the pellet production and the development of an own distribution channel.

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6. 5. ProPellets Austria: networking and cluster building, certification and public relations

pro»pellets Austria

1. General

proPellets Austria (PPA) is an association of the Austrian pellets industry. It was founded in 2005 and currently contains around 60 member organisations. Members of proPellets are primary pellet producers, pellet traders und manufacturers of pellet heating systems. Furthermore, companies which are otherwise active in the pellet industry, such as manufacturers of pellet plants and components, producers of accessories for heating systems and also consulting and research institutions, as well as companies that are otherwise involved in the industry, are members of proPellets Austria.

The aim of PPA is to make a contribution to the energy transition in heating by promoting the use of wood pellet heating systems. Wood pellets are a promising possibility to reduce dependency on fossil fuels and to make an important contribution to climate protection. Through its public relation activities, the association makes an important contribution to the penetration of the Austrian pellet market. Also, proPellets provides an important interface between different actors in the pellet supply chain through its networking activities– from pellet producers and traders to heating system manufacturers and end consumers – and therefore makes a positive contribution to the development of the Austrian pellet market.

By its function as market observer, the association contributes significantly to the market transparency in the Austrian pellet market. Furthermore, PPA offers a broad range of information and consulting services.The activities regarding the market introduction of the quality certificate ENplus lead to the certification of the majority of Austrian pellet producers as well as some traders. Therefore, a uniform pellet quality standard has established in Austria.

2. Tasks

The main task of the association is the spreading of pellet heating systems and PPA practices public relations and lobbying for this reason. Moreover, PPA contributes to the communication within the pellet industry and practices international networking. In addition, the association also acts as a market observer.

The main means of communication are the website www.propellets.at, the monthly newsletter, press releases, press conferences and publications in different specialized media. In addition, proPellets also makes use of social media.

3. Service for members

An important task of proPellets Austria is the permanent internal discussion and improvement of the interface between production, storage and transport and the requirements of heating systems. Differences in pellet quality often lead to problems with heating systems in the past.

The internal communication of the association takes place quarterly in the association forum, in which the members discuss interests of the industry and elaborate solutions for recent questions and problems.

As an interest group, PPA also stands up for favorable framework conditions for the pellet industry on a political level and informs stakeholders of the economic benefits of the transition from imported fossil fuels to domestic energy from renewable sources.

4. Service for end consumers

Since 2006, proPellets Austria is active as market observer and collects pellet prices on a monthly basis and calculates average prices for loose and bagged pellets for private and commercial customers and also for bagged pellets and publishes these data on the proPellets website. Based on the price data, a pellet price index is calculated and the pellet price is also compared to prices of other energy carriers. In addition, long-term and as seasonal price developments are published.

Besides price data, a broad range of information for end consumers can be found on the proPellets website, which reaches from general data about wood pellets to more specific information. For example, all pellet traders that are member of proPellets, sorted by region, can be found on the website as well as manufacturers of heating systems and the related accessories. All pellet producers, which are member of proPellets Austria, are listed as well.

In addition, a broad range of information about different consulting services as well as subsidies is provided on the homepage. In regard of subsidies, detailed information about the different situations on national and provincial levels can be found. Also, local subsidies on community level are mentioned, with reference to the relevant authorities.

Concerning consulting, all provincial helpdesks as well as all certified installers of biomass heating systems and specialized chimney sweepers are listed. Certified installers usually offer a broad advisory service, besides installation and maintenance of pellet heating systems. Also, the advisory service of pellet boiler manufacturers is mentioned on the website.

5. Certification

proPellets Austria is actively working on the market introduction of the pellet quality certificate ENplus, which is based on the standard EN 14961-2 and represents the first uniform quality standard for wood pellets within Europe. The standard specifies the three quality classes ENplus A1, ENplus A2 and EN-B and specifies values for different pellet properties such as size, density, water and ash content or fines and durability for each class. Class A1 stands for the highest pellet quality suitable for small-scale heating systems in private households while class B represents the first defined quality standard for pellets for industrial use.

Every pellet producer which is member of PPA, produces high-quality pellets according to EN 14961 2. Most producers are additionally

ENplus-Logo © DEPI

ENplus-Logo as sticker on a pellet heating system ©PPA; The sticker reads: "It is recommended to operate the heating system with ENplus-certified pellets"

certified according to ENplus themselves, which means that not only the produced pellets, but also the production process is subject to a standard. By the end of 2011, 72 % of the Austrian pellet production capacity was certified in accordance to ENplus (Rakos und Schlagitweit 2011).

Similar to pellet producers, all pellet traders who are member of proPellets are pledged to deliver only high-quality pellets according to EN 14961-2 to end customers. Analogical to pellet producers, pellet traders can be certified according to ENplus as well. Due to the fact that the quality of pellets which are produced according to the EN standard can suffer from inappropriate handling, only certified traders are allowed to sell Pellets with ENplus designation. Contrary to producers, only a few pellet traders are EN-plus certified to this date. By the end of 2011, traders representing 33 % of market share were certified.

ENplus-certified pellet trader © DEPI

If a customer buys pellets from an EN-plus certified trader, he has the guarantee that not only the product itself is in accordance with the standard, but also the whole production process, storage and delivery are carried out properly and the pellets are in the actual condition specified by the standard when they arrive at the customer.

6. International activities

PPA is also actively working together with pellet associations from other countries, the managing director of proPellets is also president of the European Pellet Council (EPC), which is the umbrella organization of European pellet association. The EPC is actively working on the spreading the ENplus quality certificate across Europe to create a uniform and universal European quality standard for wood pellets.

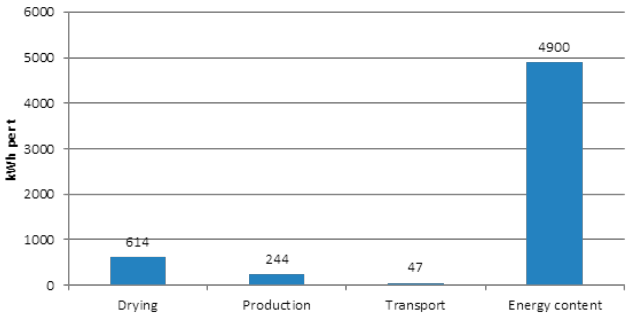
In addition to its membership in the EPC, proPellets Austria is also member in Renewable Energy Austria (EEÖ), the European Biomass Association (AEBIOM) and the World Biomass Association (WBA).

7. Economic data

The Austrian pellet industry achieved a turnover of almost 420 mio. € in 2012, weheras almost 200 mio. € were achieved by pellet producers and traders. In this year, 890 000 t of pellets were produced in 30 Austrian production plants. Also a lot of workplaces were created through the pellet sector: around 25 000 people are currently employed in the pellet industry.

8. Environmental data

In Austria, only around 30 kg of CO2 are emitted by the production and distribution of one t of pellets on average. This is due to the fact that the majority of the energy used for the production process originates from renewable sources. On the other hand, pellets only emit the amount of CO2 that the tree which they were made of, absorbed during its growth. In comparison to heating oil, the CO2-emission can be reduced by about 97 %. The primary energy



requirement for the production and distribution of pellets amounts to about 900 kWh per t, which equals 18,5 % of the energy content of 1 t of pellets.

Primary energy consumption of the supply and energy content in kWh per t of pellets Source: proPellets Austria

9. Socio-economic data

The Austrian pellet sector created a multitude of jobs. Currently, around 25 000 people are employed in the pellet industry.

10. References

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6. 6. Round wood takeover by weight and moisture content at biomass trade center

Biomassehof LEOBEN

1. General

The biomass trade center Leoben is an association founded in 2009 that currently involves 300 members who cultivate a total forest area of 13 700 ha. The center buys energy wood for the production of premium wood chips in the form of round wood, which is not suited for the use in sawmills, mainly from its members. The wood is bought at the forest road; the transport is organized and paid by the biomass trade center (Metschina 2012).

Green wood contains between 50 and 60 % of water. As the water content directly influences the weight of the wood, considerable price fluctuations may occur if it is traded only by weight. The easiest method is the acceptance by volume. Since the energy content, which is in no direct relation to the volume of the wood, is of major importance in the case of energy wood, the acceptance by volume is also not the ideal method. Also, the density of wood, which can differ substantially between different wood species as well as within in the same species, speaks against the trade by volume.

Therefore, round wood is accepted by weight, with additional determination of water content at biomass trade center Leoben. This procedure is the most precise method for round wood acceptance and enables a transparent and fair way of invoicing, as it is only paid for the sole wood mass and not for the contained water

In the process of round wood acceptance, the manager of the biomass trade center, a truck driver and, if required, an employee of the center for unloading of the wood, are involved.

2. Delivery and acceptance of round wood

The energy wood is delivered by a round wood truck which is weighed on a calibrated weigh bridge when it enters the biomass trade center. The wood is then unloaded at the storage area. When the empty truck leaves the center, it is weighed again to determine the dead weight of the truck which allows calculating the mass of the green wood in difference to the weight of the loaded truck.

Weighing of the truck and unloading of round wood

3. Sample taking

While the loaded truck is standing on the weigh bridge, an employee of the biomass trade center takes wood shaving samples from different logs of the delivery by cutting them with a motor saw. The sample is then weighed, dried to 0 % moisture content (absolutely dry) in a drying cabinet and then weighed again to determine the dry matter. From the weight of the green wood and the moisture content determined from the sample, the dry matter of the whole delivery is determined in $t_{dry\ matter}$, which provides the basis for invoicing with the supplier.

Sample taking and determination of dry matter © Waldverband Steiermark

4. Invoicing

Invoicing is carried out on the basis of the dry matter of the round wood determined before and is executed through a credit memo procedure. Data gained from weighing and the determination of

© Waldverband Steiermark

dry matter is captured by software and transmitted to accountancy. The calculated credit is then transferred directly to the supplier.

The charging by weight and moisture motivates the supplier to store the round wood adequately before he delivers it to keep moisture content low. This does not only lead to a higher price per m^3, but also has a positive effect on the utilization of the load volume of the truck and therefore reduces transport costs.

Depending on whether the supplier is a member of the biomass trade center or not, different invoicing conditions apply. Non-members only get a standard price per solid m^3 of wood while members get an additional bonus payment per m^3. The bonus payment does only apply to the delivery contingent of the member which depends on its association share. If a member delivers more than its contingent, it only gets paid the standard price for the additional amount.

5. Technical data

Round wood delivery distance	30 km
Round wood demand	10 000 -12 000 solid m^3/year
Storage capacity	18 000 solid m^3
Average round wood stock	6 000 – 10 000 solid m^3

6. Economic data

Total investment costs	130 000 €
Investment costs weigh bridge	30 000 €
Investment costs drying cabinet	5 000 €
Round wood costs	30 - 33 €/solid m^3 (at forest road)
Transport costs to BTC	9 - 10 €/solid m^3
Storage costs	1,5 - 3 €/solid m^3

Costs for wood harvesting amount to about 28 € per solid m^3, costs for transport to the forest road lie between 2 and 5 €, which causes total feedstock costs between 30 and 33 € per solid m^3 at the forest road. The round wood transport to the biomass trade center costs between 9 and 10 € per solid m^3. Storage cost for round wood are in the range between 1,50 and 3 €/m^3 (Gaber 2013). Total costs per solid m^3 of round wood amount between 40,50 and 46 € delivered to the biomass trade center, including storage.

Total investment costs for the biomass trade center added up to around 130 000 € in 2009 (Metschina 2012).

7. Environmental data

As the delivered round wood mainly originates from the region and the biomass trade center limits the maximum delivery distance to 30 km, long-distance transports are avoided. Therefore, energy demand, as well as emissions of CO2 and other pollutants interrelated with round wood transport are kept relatively low.

8. Socio-economic data

Currently, two persons are employed at biomass trade center Leoben: a manger for one day a week and an employee for two to three days per week, depending on the actual season and order situation.

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6. 7. LeobenFORTUNA S.R.L.

FORTUNA FOREST construiti natural, construiti cu lemn

1. General Description

S.C. PRODUCȚIE FORTUNA S.R.L. is a local company located in Covasna, Centru Region Romania, which was established back in 1994. Currently it operates on the Romanian forest biomass market. Initially, it started to operate in timber harvesting, and, after that it extended its activities in wood processing. All the harvested wood is procured locally and all the processed wood results from own harvesting operations. The company harvests, transports and processes about 10,000 m^3 yearly. Beside firewood and wood briquettes, it produces also woodchips. High quality wood is processed for furniture and constructions. Most of the firewood is sold on the local market while woodchips are used for own energetic consumption in heating the drying facilities and other administrative-productive spaces.

Fig. 1. Reduced quality timber used for wood chips production

2. A Good Practice Example

According to its activity domain, S.C. PRODUCȚIE FORTUNA S.R.L. is the workplace for a number of 50 highly trained employees which were locally recruited. The company assures periodical tranings for professional and work safety security. For this purpose, it signed a training contract with a specialized firm for work safety and security. The employed personnel is periodically extended, mostly by hiring young people (more than half of the emplyees are under 35). The company is involved in social and regional development projects, one of them reffering to investments in a touristic resort which was developed locally. Because it is involved in most of the processes for forest biomass production, it also offers reduced prices for firewood for local population by comparison with the currently practiced prices in region. Each process is accompanied by relevant ICT technologies, starting with cost monitoring and optimization and ending with wood and supplyers-customers tracking.

In order to optimise its own supply chain S.C. PRODUCȚIE FORTUNA S.R.L. invested great amounts for procuring state-of-art machines, equipments and technologies such as: lumber dryers, heating boilers (woodchips and sawdust), lumber processing machines, numerical control machines, solving this way integral use of harvested forest biomass.

Fig. 2. Facility for lumber processing

Further investments will target the aquisition of a high capacity chipper and a performat pelletizing line.

Fig. 3. Facility for wood chips production

3. Who Is Involved?

S.C. PRODUCȚIE FORTUNA S.R.L. complyies with the national legislation regarding timber harvesting, processing and selling. This means that it is an A.S.F.O.R. certified member. Wood to be harvested is buyied from local Forest Administration (Covasna), and the resulted firewood is sold on the local market. Other biomass products such as wood briquettes are sold on the Romanian market. The company's harvesting and processing activities are periodcally supervised by the Regional Forest Inspectorate and other relevant authorities according to the current legislation.

Fig. 4. Stacked wood assortments for production of fire wood

The company possesses all the certificates, authorizations and licences needed when dealing with timber harvesting, transport, processing and manufacturing.

4. Technology

Covering several processes, S.C. PRODUCȚIE FORTUNA S.R.L. owns machines and equipments for all the processes starting from timber harvesting and ending with wood processing. Also, most of the processes are assited by information and communication technology fact which is enabled by the work of a computer programmer which is employed by the company.

Harvesting

Timber harvesting is done using traditional harvesting systems such as associations between skidders and chainaws. Currently the company ows four new Romanian skidders and five chainsaws.

Transporting

All the harvested wood is trasported by the means of own equipment to the own processing plant. For this purpose the company invested in 2 modern truck-trains. Processed wood products are transported also to the customers by its own means, with a specialsed vehicle.

Fig. 5. Truck used for transportation of processed wood products

Fig. 6. Production facilities of wood products

Wood Processing

Firewood results only from the poor quality wood and from wood processing residues when the last ones are not converted in woodchips.

5. Investments and Logistics

Covering several processes, the company invested great amounts in technology and equipment. For timber harvesting, investments are:

- 4 skidders. . . . . 120000 euro;
- 10 chainsaws . . . . . .5600 euro.

Transport of harvested timber from forest to the processing plant is done using two MAN made trucks (investment of 300000 euro). Processed wood products are transported to the customers using a specialized truck (investment of 140000 euro).

Since the activity of S.C. PRODUCȚIE FORTUNA S.R.L. involves wood processing, important investment efforts were done in this direction:

- sawmill (including all the afferent constructions and assemblies) . . . . . 100000 euro;
- lumber drying facility . . . . . 100000 euro;
- multiblade cutting machine . . . . . 30000 euro;
- processing machine. . . . . 140000 euro;
- numerical control machine for wood processing. . . 40000 euro;
- welding press. . . . . 40000 euro;
- wood chipper. . . . . 40000 euro;
- briquetting machine . . . . . 15000 euro;
- thermic boiler (1200 kW, including the installation) . . . . . 100000 euro;
- all the constructions from the production platform (offices, production facilities etc.), including all the taxes and engineering studies . . . 400000 euro.

6. Prices and Quantities of Produced Firewood

All the biomass products processed by S.C. PRODUCȚIE FORTUNA S.R.L. are sold in Romania. Fire wood is sold to the local community while wood briquettes are sold to other Romanian customers. The average annual production of wood briquettes is of about 400 tons which are sold to an average price of 89 euro per ton. Firewood results form poor quality wood as well as from processing activities. The average annual produced quantity is about 1400 tons while the average selling price is of 17 euro per stere (about 24 euro per ton). These prices are considerably low by comparison with the price of firewood on the local market.

7. Environment Protection and Local Development

By integral use of harvested wood, which includes the utilization of wood processing residues, important CO2 and money savings are attained by S.C. PRODUCȚIE FORTUNA S.R.L.. Conventional solution

of heating using fossil fuels was replaced by a heating solution on sawdust and wood chips. This solution assures the energy needed for lumber drying and heating the production and administration facilities.

Starting with 2013 S.C. PRODUCȚIE FORTUNA S.R.L. will invest in a modern pelletizing line as well as in a high capacity wood chipper. This will result in extending the employed personnel.

Fig. 7. Storage area for lumber and raw resource timber

8. Formal and Informal Stakeholders Networks

S.C. PRODUCȚIE FORTUNA S.R.L. owns a membership in A.S.F.O.R. (Romanian Association of Timber Harvesting and Processing Companies). It collaborates mainliy with Covasna Regional Forest Administration from where it procures timber for harvesting and processing. Most of the firewood is sold locally.

9. Polyfunctionality - A Key for Success

The investments made in polyfunctional equipments enabled the production orientation to several biomass products. This assured the integral use of harvested wood as well as reduced prices for fire wood for local population.

6. 8. SC NEVAL SRL

1. General Description

S.C. NEVAL S.R.L. is a local company located in Zetea (Harghita County), Centru Region Romania, which was established back in 1994. It operated, initially, in road transport business and currently it operates on the Romanian forest biomass market: timber harvesting, timber transport, wood chips production, wood pellets and briquettes production. Its main wood supplier is the Zetea Forest Association and its main customers are:

- for firewood: Explosiv Group SRL, Lemnzet SRL, Petrowood SRL, Reisan SRL, Moretti Giuseppe (Italy);
- for wood chips: Urbana SA, Romchar SRL, Vlăhița Town Mairy, RFV Center of Regional Development SRL, B.H.L. Logistic SRL;
- for wood pellets and briquettes: Print Impex SRL, Waberers Romania SRL, H-Kandallo Kft (Hungary), Energy4You Kft (Hungary), Binder Josef GMBH (Austria), Interro Handels GMBH (Austria), Gentile SRL (Italy), Silvestri & Salvati SRL (Italy), Tosato Federico (Italy), Moretti Giuseppe (Italy), Tritec GMBH (Germany) etc.

Wood chips are produced from poorer quality wood resulted from harvesting operations, while wood pellets and briquettes are produced from sawdust and shavings resulted from wood processing industry (mostly from furniture industry) as well as from own wood processing activities. The energetic biomass products result from processing the wood harvested mainly from thinnings (diameters < 5cm) and pastural areas clearing.

2. S.C. NEVAL S.R.L. - a Good Practice Example

S.C. NEVAL S.R.L. employs highly trained personnel for all the processes from its supply chain. It is the workplace for 37 employees which are periodically trained in what concerns the work safety (company has a special employee for this activity) and operating new technologies and equipments (periodical trainings in the countries which supply equipments). Young people are employed periodically as the company extends its business domain. Also, the company is involved in social and regional development projects:

communal heating project from Zetea, biomass co-generation plants from Odorheiu Secuiesc and Miercurea Ciuc. Because the company covers most of the processes of biomass production, it can afford to provide reduced prices for the local fire wood consumers. Thus, the firewood is sold at prices with up to 50% smaller than those practiced in the region. Relevant ITC technologies are included in the majority of processes starting with cost monitoring and optimization, wood tracking and suppliers and customers tracking. The company is preoccupied by its supply chain optimization, fact which led SC NEVAL SRL on the innovation pathway starting from 2006. Today, the company is pursuing the improvement of a energy input for a pelletizing line. All the equipment and logistics for timber harvesting, transport and quality monitoring systems for intermediary an final products have been improved in the last period (acquisition of state-of-art technologies and equipments for timber harvesting and transport etc.). Initially, the company invested in promotion activities, which has been abandoned lately due to the increased demand of products. Currently, the promotion of forest biomass as an alternative to fossil energy is one of the main preoccupations of SC NEVAL SRL. It should be mentioned that the company made all the arrangements for ISO certification on the whole supply chain, the receipt of certification being only a matter of time.

3. Actors Involved in the Supply Chain

The required biomass raw resources are procured from local forests, ones of the main actors in the supply chain being Zetea-Liban Private Forest District, as well as the forest owners associations from the area. Wood chips are selled mainly to the local consumer facilities, while the wood pellets and briquettes are selled both, to the local and European markets. By comparison, the fire wood is sold locally where it covers the energetic needs of the local population: individual households, schools, local administration, private business etc. SC NEVAL SRL is a member of ASFOR. It is also the subject of periodical controls regarding the harvesting, transport and processing of wood, according to the current legislation. These controls are performed by Regional Forest Inspectorate.

4. Technology

Timber Harvesting

Timber harvesting is done mainly by the inclusion of fully mechanized equipment. Substantial investments were made for this process:

- harvester Silvatec (Danish made)..... 50000 euro;
- feller-buncher Silvatec (Danish made)..... 50000 euro;
- forwarder Timberjack (John Deere)..... 45000 euro;
- farming tractor adapted for forest operations (U 651) .....5000 euro;
- chainsaw .....400 euro;
- wood chipper (Mortbarc)..... 25000 euro;
- mobile wood chipper Silvatec (Danish made)..... 150000 euro;

Wood Transporting

Wood transportation is assured by several equipments which were acquired in order to provide the means for logs and wood chips transportation. SC NEVAL SRL has invested also in equipments required in logging infrastructure development. The following equipments have been procured:

- 4 container trucks for transportation of biomass products or biomass related raw ressources (MAN, DAF, Mercedes and VOLVO)..... 100000 euro;
- 20 containers (35-40 cubic meters capacity)..... 80000 euro;
- 1 crane truck train (MAN)..... 30000 euro;
- 1 buldo-excavator FITALIS ..... 20000 euro;
- 2 excavators (ATLAS, LIEBHER) ..... 30000 euro;

Wood Processing

Wood processing represents one of the main activities of SC NEVAL SRL. Several investments were made in order to convert the raw material into biomass products:

- repairing and maintenance workshop for forest equipments including the building for offices ..... 50000 euro;
- production plant for pellets and briquettes (building and accessories) ..... 60000 euro;
- industrial platform (concrete platform, storage areas, loading platform) ..... 10000 euro;
- wood pelletizing line..... 37000 euro;
- wood briquetting line..... 50000 euro;
- wood sawdust dryier..... 35000 euro;
- wood pellets and briquettes packing line..... 15000 euro;

5. Practiced Prices for Biomass Products

SC NEVAL SRL practices the following prices for biomass and biomass related products:

- wood chips: .....12 euro/ cubic meter;
- raw biomass:.....10 euro/ cubic meter;
- shavings produced pellets: ..... 190 euro/ ton;
- sawdust produced pellets:.....170 euro/ton;
- industrial pellets (produced from wood processing residues):.....150 euro/ton;
- wood briquettes:.....100 euro/ton + packing costs;

6. Legislation

SC NEVAL SRL has the necessary authorisations according to activity nomenclature from Romania (CAEN): 4941 for road transportation, 1629 for pellets and briquettes production and 0220 for timber harvesting. It possesses also certificates and authorizations from the following regulatory institutions: Environment Protection Agency (Environment Authorization), Commision for Certification

of Economic Operators in Timber Harvesting Activity (Certificate of Attestation/Reattestation), National Authority for Regulation of Public Utility Communitary Services (License).

7. Environment Protection

All the energy requirements for sawdust drying (pelletizing and briquetting technological lines) are covered only by the utilization of wood residues and poor quality wood which cannot be used for other purposes. No fossil fuel is required for processing activities.

8. Socio-Economic Aspects

SC NEVAL SRL has contracts with companies which are investing in co-generation projects from Miercurea Ciuc and Odorheiul Secuiesc. These investments may generate 150-200 employment opportunities, in all the supply chain, starting from timber harvesting and ending with energy production.

9. Pathway Form Forest to Energy

State-of-Art Mechanization and Automation

SC NEVAL SRL deals with several processes which are specific to the energy production from woody biomass. The increased level of mechanization in timber harvesting, as well as many authomatization facilities in pellet and briquettes production led to substantial improvements in all the supply chain. All the activities are supported by higly trained profesional staff as well as by ICT technologies (wood tracking, suppliers and buiers tracking, selling, invoicing and accounting etc.).

Innovation and Optimization

Improvements and optimizations were and are ones of the main preoccupations of SC NEVAL SRL. Currently, the company tries to energetically improve a pelletizing line which will be installed in the current year. The energy requirements will be considerably smaller (with about 50%) fact which will lead to substantial CO2 savings. The new system will use solar energy for sawdust drying, reducing the amount of needed energy with up to 50 Kwh for pelletizing-briquetting lines.

New Investments

SC NEVAL SRL has invested in a project related to North-West Regional Development Agency, supported by the Sectorial Operational Programme - „Increasing the Economical Competitiveness" for acquisition of a wood chipper. The total investment amount was of 250000 euro.

6. 9. PĂDURILE ŞINCII R.A.

1. General Description

In conditions of Romania, firewood represents a widespread resource for energetic use, especially in rural areas where the main customers are the individual households. This is also the case of comunities located aroud the forest administrated by R.P.L. F.D. Pădurile Şincii R.A.. Provisioning track of the firewood is quite simple, because in most cases, after the planning and harvesting activities the firewood is provided at the roadside. F.D. Pădurile Şincii R.A. is located in Brasov County, Central Region, Romania and it was founded in 2004 and starting from 2010 it was transformed in local public administration.

Fig. 1. Staff of Private Forest District Pădurile Şincii

Presently, it administrates a total forest area of 19521.21 hectares belonging to communes (Părău, Şinca şi Şinca Nouă), composesorate (Silva-Grid, Mira-Perşani, Cucutiş-Vlad, Ţaga-Şinca, Râureana-Râuşor, Frăţia Dealul Strâmbii-Toderiţa, Dabiju-Comăna de Sus) as well as to other owners (churches, schools, physical persons, societati comerciale). It has a number of 84 employees, collaborates with 40 harvesting companies and provides firewood for a population of abut 7000 persons (2000 households). The average annual production of firewood is about 13370 steres.

2. A Good Practice Example

According to its activity domain, and relative to the supply chain for firewwod provisioning for local population, F.D. Pădurile Şincii R.A., through its quailified personnel, participates in all the provisioning related processes starting with planning and ending with firewood selling to local population. Active involvement in local and regional development is the latest preoccupations of the forest district's personnel. Beside the employment for own people, substantial, contibuting to the wellbeing of local population is proved by substantial price reduction for firewood (about 30% cheaper firewood for local population). Developing and rehabilitating the forest transportation infrastructure is assured by its own accessibility fund, and, recently, it participated in a local infrastructure project targeting the rehabilitaton of a road. All the component processes in the firewood provisioning-production are managed using relevant ICT (all the administrated area has an updated GIS, wood selling and control is done using SUMAL – a nationalwide imlemented software, harvesting companies are selected based on bonity criteria – Contractor Register and it posesses an updated accounting balance by using the accounting software ContNet).

The developed forest infrastructure projects contributed to the reduction of wood logging distances, assuring this way reduced costs for wood harvesting.

F.D. Pădurile Şincii R.A. invests in promotion of its own activities, services and products. For this purpose it uses its own website as well as announcements in local and regional media (newspapers and journals).

All the products (especially firewood) are realized using national standards, all the contrctate activities or services are done based on contracts and all the payments to and from the contrctants are done before the legal deadline. Cost monitoring for all the processes in which it participates are done through internal audit which is mandatory and which provides the basis for cost optimization of specific processes.

Starting from 2010, an area of 14875.26 hectares was certified using the FSC system, fact which imposed the use of adequate ecological sound wood harvesting technologies. All the wood provided from this area is FSC certified, and the distinction between certified and uncertified wood is made by F.D. Pădurile Şincii R.A.

In order to improve its own supply chain for firewood procurement, F.D. Pădurile Şincii R.A. targets the construction of 1 to 3 storage and processing areas for wood.

3. Who Is Involved?

When delivering firewood to local population, several stakeholders are involved within the supply chain. Planning activities are done by F.D. Pădurile Şincii R.A. personnel based on forest management plans. Wood harvesting is done either by F.D. Pădurile Şincii R.A. or harvesting companies.

Activities control for F.D. Pădurile Şincii R.A. as well as for harvesting companies is done by the Regional Forest Inspectorate on a legal basis (Law 46/2008 – Forest Code, Law 171/2010 and Order 996/2008). Firewood is sold at roadside from where the individual householders may choose to made the transport by their own or they may contract transport services.

4. Technology

Covering several processes, F.D. Pădurile Şincii R.A. has invested in technologies for each process: planning, accounting-administrative, harvesting etc.

Planning

Planning activities are done using the state-of-art technologies. A comprehensive GIS system was implemented for all the administrated area and it was supported by WWF Romania. For administration purposes there is used SUMAL software which enables the

work in several processes: evidence keeping for planning and selling activities, harvesting situation on harvesting cutblocks, management activities, evidence of contractors etc. Field activities related to planning are supported by specific software (Fond+Transfer) which is installed on PDA's and is available for all personnel in charge with field planning.

Wood selling is organised in auctions and information regarding the available wood is disseminated using several channels: own website, local and regional media, by phone etc.

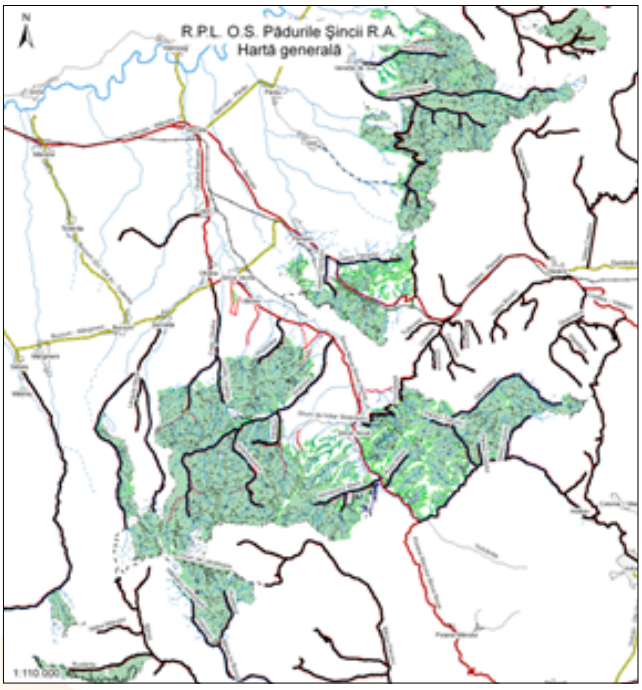


Fig. 2. A multifunctional GIS enables the efficient planning of forest resources

Harvesting and Processing

Despite the fact that F.D. Pădurile Şincii R.A. does not possess the latest wood harvesting technologies, it made substantial investments for this process. Curently, forest equipments comprise the following: 4 skidders, 8 chainsaws and a firewood splitter Posch.

Fig. 3. Low investments for own timber harvesting – a farm tractor adapted for forest operations

5. Investments and Logistics

According to the national legislation, for a sustainable management, all the forests must have a forest management plan. F.D. Pădurile Şincii R.A. invested about 33000 euro for contracting engineering services for forest management plans realization (this investment is done each 10 years). GIS investment which was supported by WWF Romania was about 3000 euro. Accounting and perssonel software was purchased for about 700 euro. Own website realization costs were of 100 euro.

A total amount of about 4000 euro is invested per yer for promotion activities. Also, for work safety and health, F.D. Pădurile Şincii R.A. purchased in period 2012-2013 protection equipment for employees as a result of an ivestment of about 8000 euro.

Skidders were purchased as used machines for an amount of 22000 euro, chainsaws were purchased new at an amount of 4000 euro while the firewood splitter costs were of 4000 euro. Additional forest equipment was purchased as follows:

- winch for skidding .....2900 euro;
- independent winch .....2450 euro;
- snow blade and a small excavator.....5770 euro.

6. Forest Regeneration, Nurseries and Other Activities

Natural regeneration of the harvested forests is assured in a minimum proportion of 72%. However, in case of resinous species and clearcuts or substitution cuts, young trees are provided by own nurseries. For this purpose, F.D. Pădurile Şincii R.A. has established 6 nurseries for own use as well as 7 special cultures for Christmas trees. The last ones serve in order to reduce the pressure on natural forests during winter.

7. Prices and Quantities of Produced Firewood

F.D. Pădurile Şincii R.A. sells differentiately firewood, with an active involvement in wellbeing of local community. The amounts of firewood sold in 2012 were as following:

- harvesting-processing companies (10.0% from available amount) ..... 1341 steres;
- individual households (external communities - (1.6% from available amount).....220 steres;
- local community (88.4% from available amount) ..... 11809 steres.

The average firewood prices, including VAT were the following (sold at the roadside):

- harvesting-processing companies ..... 14.9 euro/ stere;
- individual households (external communities).....17.8 euro/stere;
- local community.....11.1 euro/stere.

8. Environment Protection and Local Development

F.D. Pădurile Şincii R.A. produces and sells about 13000 steres of firewood per year. In average, a stere of wood (beech) is the equivalent of 200 m^3 of methane gas. In Romania, this quantity of gas is sold for aproximately 60 euro. Due to the fact that the wood is CO2 neutral, and the prices for wood-equivalents are very low, important economies are attined both in capital and CO2 savings, making F.D. Pădurile Şincii R.A. one of the most important contributors in assuring environmental protection in region.

9. Formal Informal Stakeholder Networks

F.D. Pădurile Şincii R.A. is a full member of the Romanian Forest Adminstrators Association and is certified by A.S.F.O.R. (Romanian Association of Timber Harvesting and Processing Companies).

10. A Successfull Business

Beside its forest administration oriented business, F.D. Pădurile Şincii R.A., covers most of the supply chain processes, which assures the competitiveness of fire wood products prices to the final (local) customer. The substantially reduced prices for fire wood are enabled by relatively reduced investments in equipments, as well as by the development of transport infrastructure.

6. 10. Heating Plant in Belgrade - Senjak

ЈАВНО КОМУНАЛНО ПРЕДУЗЕЋЕ БЕОГРАДСКЕ ЕЛЕКТРАНЕ

1. General description of selected process or SCORPS

Belgrade plants are engaged in the production and distribution of energy for heating and domestic hot water delivery, the transformation of electricity for EDB / EMS, construction and maintenance of heating and gas installations, the implementation of heating system programmes (connection conditions, approval of projects and construction works and approval of objects in the system), providing information about the failures and planned outages. For thermal energy the following are used: natural gas about 85.6 %; heavy fuel oil - crude oil ca. 13.5 %; coal ca. 0.4 %; fuel oil ca. 0.13 %; biomass - pellets 0.24 %. The heating plant in the Belgrade Senjak neighbourhood uses pellets as a supplement for energy production. During an average winter, the heating plants use approximately 2,000 tons of pellets for residential heating.

2. Why this process or SCORP was selected

This company has been selected as a best practice example because it does not use only fossil fuels for the production of thermal and electric energy, and it has already begun using pellets and briquettes for energy production, i.e. they are added as a supplement in the production of energy to reduce greenhouse gas emissions.

3. Who is involved in this process or SCORP?

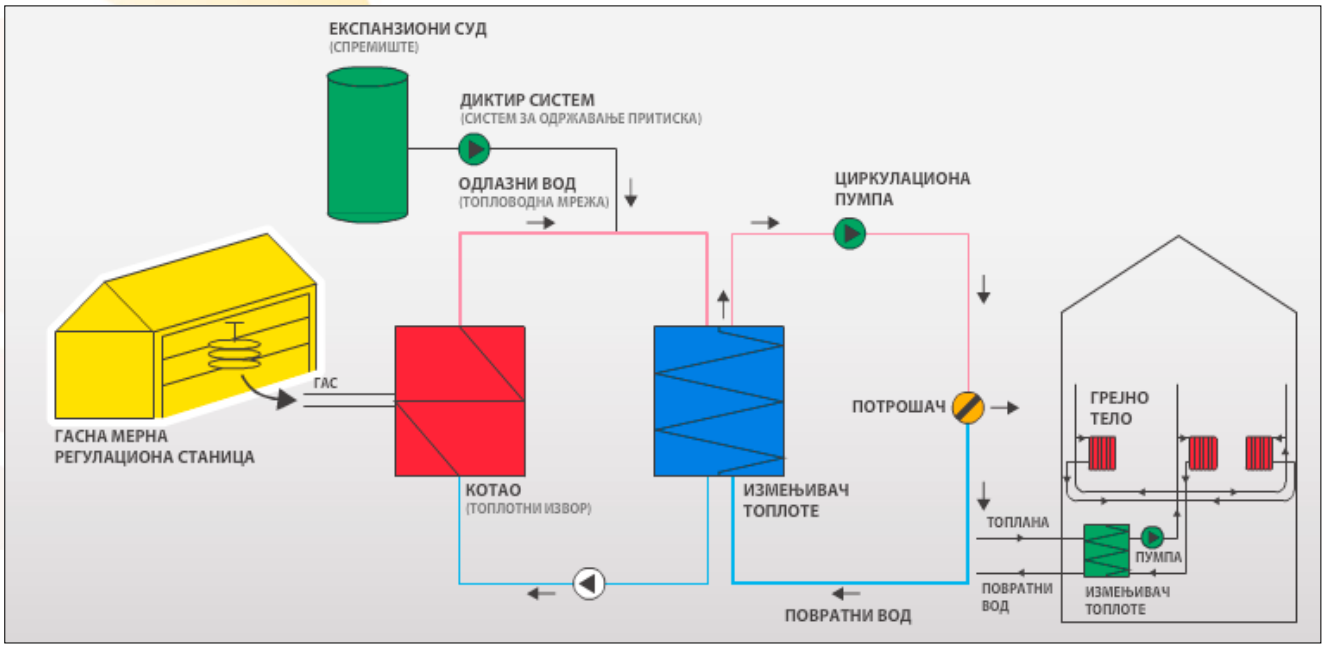
This process includes all employees working in the Heating Plant, as well as pellet distributors. It is important to note that in this case the distributor is Bioenergy Point, that we find interesting, because it is located in the Timok region.

4. Technical description

The district heating system consists of a heat source (boiler) within which the heat exchanger is heated (water, steam, etc.). The heat exchanger is then lead through a distribution network (pipelines) to a heat transmitting station (substation) and from it to the heating bodies (radiator, underfloor heating pipes, air heater, etc..) located on the premises. In this way, the heat from the heat exchanger is directly transferred to the air on the premises that are heated. The total nominal installed capacity is 2,832MW + 36MW (economizers in heating plants "New Belgrade", "Konjarnik", "Vozdovac", "Cerak" and "Danube"). The average annual heat production is about 3,500,704 MWh.

5. Legal aspects

The use of biomass and wood pellets is not yet regulated by law in Serbia.



6. Economic information

Total revenues in 2012 amounted to 221,341,766.00 €, while total expenditure amounted to 215,372,748.00 €. Profit before tax amounted to 5,969,018.00 €. Net profit after tax amounted to 3,201,538.00 €. These economic indicators apply to the entire District Heating Company, and as an example of good practice only one part of the company is considered.

7. Environmental aspects

The state-of-the-art system for monitoring emissions of air pollutants from boilers was put into operation in the heating plant "Danube", and by the end of 2013, the PUC "Belgrade Power Plants" will introduce such systems on ten more heat sources of a capacity exceeding 100 MW.

8. Socio-economic aspects

At the end of 2012, there were 2,267 employees in Belgrade power plants. Compared to year 2002, the company's number of employees decreased by as many as 535, or 20 %, while in the same period consumption (consumers - heating surface areas) increased by ca. 27%, or by more than 4,427,017 m^2 (conditional) office and residential space. Job optimization and increase in consumption are issues that are constantly worked on.

6. 11. Bioenergy Point Ltd.

BIOENERGYPOINT

1. General description of selected process or SCORPS

Bioenergy Point, a business company founded in 2007, is registered for business operations in the area of renewable energy sources. As a leader on the Serbian market, the company started the production of wood pellets in its newly built production plant in Boljevac, Eastern Serbia, in October 2008. The production plant's capacity is 35,000 tons per year. In present conditions, the company works round the clock, i.e. follows a 24/7 work schedule with 100% sales of its products, mainly to foreign markets. The most significant market is Italy. In addition, it exports to Greece, Albania and Macedonia. The company emphasizes the growth of domestic demand for pellets. Except for Belgrade power plants, which represent the rare few plants in Serbia that use pellets, the company is anticipating new domestic clients in this sector.

2. Why this process or SCORP was selected

This company has been selected as a best practice example because it is the biggest producer of pellets (its annual pellet production is bigger than the production of all other pellet manufacturers together), and, additionally, it is located in the Timok region, the area that was selected for analysis in this project.

3. Who is involved in this process or SCORP?

This process includes all employees who work in Bioenergy Point and SE "Srbijašume", auto transport operators, shippers, and pellet customers.

4. Technical description

Wood pellet are produced by grinding, drying, additional chopping and pressing the raw material (sawdust, wood chips, etc.). Since they are made of 100% wood, our pellets are denser and heavier, which results in slower and more uniform combustion, and this makes them highly efficient fuel. Production is carried out under controlled conditions in accordance with the DIN 51731 standard: diameter 6 mm, length up to 30 mm, humidity below 10% and density above 1.12 kg/dm3. One of the main advantages of the pellets is that the ash produced by burning is about 1%, and the energy value is more than 18 MJ per kilogram. The pellets are used in stoves and heating boilers, in houses and apartments, as well as for large consumers. The new equipment installed in the production plant was obtained in the Netherlands (CPM – presses), Germany (BRUKS-Kloeckner – chipper), Croatia (Seting – drying plants) and Slovenia (Robotika – packing machines).

5. Economic information

Total revenues in 2012 amounted to 5,217,528.00 €, while total expenditure amounted to 4,790,771.00 €. Profit before tax amounted to 43,958.00 €. Net profit after tax amounted to 39,865.00 €.

6. Environmental aspects

CO2 emissions per household which is heated by fuel oil, coal or gas is 2500 - 5000kg for the season, and the emission of gases obtained by burning wood pellets is 0.03 kg/kWh and so insignificant and harmless that it does not even require a chimney but a hole in the wall through which a drain is derived.

7. Legal aspects

The use of biomass and wood pellets is not yet regulated by law in Serbia.

8. Socio-economic aspects

There are about 55 employees in total, 9 of them with university degrees, 3-4 with college degrees and about 40 workers with either secondary education or being low-skilled. In 2013, about 45.000 tons of wood pellets are planned to be produced, and in the coming years the construction of a new factory with new job openings is planned.

Србијашуме

6. 12. Moca Ltd. Jablanica

MOCA Jablanica SRBIJA

1. General description of selected process or SCORPS

The company was founded in 1920, and with time, from a carpenter's workshop it has turned into a wood processing plant. During this time period, four generations of family Petronijević worked on the creation and enhancement of their family business. In 1991 it became a company, and today it has an advanced and stable production of elements obtained by processing beech. This concept has proved to be successful, and now the entire production is based on exports to Europe, Asia and Africa, according to the orders of known customers.

2. Why this process or SCORP was selected

This company has been selected as a best practice example because it has fully completed its production. That is to say that pellets and briquettes are made from the residues that remain in the production of raw, dry and planed elements. And the residue that cannot be used for the production of pellets and briquettes is used for energy in the kiln. Each year, about 1,200 t of pellets are produced from the production residues.

3. Who is involved in this process or SCORP?

This process includes all employees who work in Moca Ltd. Jablanica, as well as a number of transport companies and SE "Srbijašume" that supplies the raw material.

4. Technical description

The core activity of the company Moca Ltd. is the production of raw, dry and planed elements. The company has two manufacturing plants. The first hall is meant for primary wood processing, while in the second hall the final processing of pre-manufactured elements is performed, as well as the production of pellets and briquettes from wood waste. The production is automated, and the machines in the production plant are modern and computer-controlled.

5. Economic information

Total revenues in 2012 amounted to 1,110,686.00 €, while the total expenses amounted to 1,065,915.00 €. Profit before tax amounted to 44,771.00 €. Net profit after tax amounted to 41,076.00 €.

6. Legal aspects

The use of biomass and wood pellets is not yet regulated by law in Serbia.

7. Environmental aspects

Moca Ltd. is a company that cares about the environment, and that is in every way committed to reducing CO2 emissions. Due to the usage of electricity, there is no CO2, only when drying wood, wood waste that can not be pelleted and briquetted is used and its CO2 emissions are very small, negligible, so to say.

8. Socio-economic aspects

At the end of 2012, there were 60 employees in Moca Ltd.. At the beginning of 2013, capacity building occurred and new staff were hired , so now the company has 70 employees. This company is trying to keep up with the times, and not so long ago it invested in the construction of a new wood drying kiln.

Србијашуме

6. 13. Forest of the Slovak Republic s.e. Banská Bystrica

LESY SR š.p. Banská Bystrica

1. General description

BIOMASS, a specialized enterprise for production of wood chips is a part of the state enterprise Forests of the Slovak Republic, s.e. Banská Bystrica. The enterprise produce wood chips from the crown parts from mature and pre-mature cuttings, whole trees from cleaning and waste wood material from assortment production in forests depots. Annual production of wood chips ranges from 130 to 180 thousand tons. Enterprise Forests of the Slovak Republic manages the total forest area of 900 thousand ha and annual production of timber thicker than 7 cm without bark ranges from 4 to 5 million m^3.

A Good Practice Example was identified as part of the supply chain including wood chips production planning in the large company managing forest, preparation of the biomass for wood chipping in forest depots, organisation of wood chips production and the wood chipping and organisation of the subsequent storage and transfer to the end user. The end users are also heating plants in Zvolen and Martin with an annual fuel consumption of 90 and 50 thousand tons.

The mentioned parts of the supply chain can be transferable and implemented by large forest owners, willing to produce wood chips using their own capacities or as part of their services.

Figure 1: Forest biomass

2. Description of activity in biomass supply chain

The entire supply chain has the following structure:

1. Negotiation with end users on wood chips supply – provided by a specialized enterprise, subject to the contracts is generally supply for the next calendar year.
2. Conclusion of contracts for the wood chips supply with end users - based on documentation of the specialized enterprise, contracts are concluded by the management (headquarters) with a legal entity. In case of sudden changes (dropout of the wood chips demand) chips will be delivered to other customers based on short-term contracts.

Figure 2: Unloading of forest biomass in end consumer storage

3. Development of plans to produce wood chips - production planning for the next calendar year is provided by specialized enterprise in partnership with 20 forest enterprises of the company managing forests. Plan for wood chips production is being elaborated on the basis of annual felling plans and production conditions (type of felling, timber quality, terrain condition, transport distance, etc...) Plan for wood chips production is confirmed by the management (headquarters). Because of the large proportion of calamity felling, wood chips production plan is being updated.
4. Production of wood chips – wood chips production is carried out according to the updated plan for production and concluded annual or short-term contracts. Production is provided by the specialized enterprise and is carried out depending on the weather conditions throughout the year.
5. Storage of wood chips in buffer stocks – Due to year-round production of wood chips and seasonal changes in consumption, it is necessary to store part of the whole production in the buffer stores. These are created on land owned by the state enterprise or on leased land.
6. Transportation of wood chips to end users or to buffer stores – Wood chips transport is organized by a specialized enterprise and provided by private transport services based on short-term contracts.

As Good Practice Example have been identified processes in the supply chain mentioned in paragraphs 3, 4 and 5.

Figure 3: Chipping of forest biomass

3. Technical characteristics

We mention only the technical characteristics of part of the supply chain identified as a GPE.

Information and communication technologies are widely used for elaboration of wood chips production plans, as for example wood raw material growing stock database, its generic and qualitative structure, relevant data of actual forest management plans and selected information on production conditions. The possibilities of wood chips production in terms of its quantity, location and time schedule are optimized depending on the demand options specified in the concluded or upcoming contracts.

Preparation of raw materials for wood chips production is organized mainly by enterprises managing forests as part of harvesting – production processes organized by private companies. Parts of tree biomass suitable for wood chips production is concentrated in forest depots on the edge of harvesting areas. The condition is sufficient biomass accumulation and spatial possibilities needed for chipping and loading transports. Coordination of work, chipping and transport to buffer stores or stores of end users is organized with helps if relevant information and communication technology.

Wood chips are produced by 8 wood chipping machines of Swedish origin on German tractors completed by company Doppstadt with an annual capacity of 15 to 20 thousand tons. Wood chipping machines are property of enterprise Forests of the Slovak Republic, s.e., Banská Bystrica.

4. Economic characteristic

Direct costs on timber felling including cuttings and concentration in timber depots range from 11 to 18 EUR per m^3, depending on production conditions. These costs are offset by sales of round wood assortments and pulpwood. An ideal share for chipping is 80 to 85 % of raw material, which can be used to make other assortments and 10 to 15 % is the share of pulpwood. Raw material for chipping is sold only by enterprises managing forests for a specialized enterprise BIOMASS for the price of 9 – 11 EUR/t. The cost of chipping ranges from 12 to 15 EUR/t. Cost for wood chips storage in the buffer store are 2 to 4 EUR/t. Costs for transportation to end-user store differ depending on the distance 7 to 14 EUR/t. Overhead expenses are from 8 to 10 EUR/t. The total production cost in different conditions range from 38 to 54 EUR/t.

5. Other characteristics

Investment costs for the purchase of 1 wood chipping machine are approximately 400 thousand EUR. Annual revenue from the sale of wood chips is 6.5 million EUR.

Producer of wood chips has to respect legal requirements and the legislation valid in the field of forestry, nature conservation, work safety and transport. There is no violation of law in the praxis.

Annual production of 130 000 tons of wood chips replaces 34.6 million m^3 of natural gas or 87.1 thousand tons of brown coal resulting in savings of CO2 emissions and other greenhouse gases (CH4). Other environmental benefits are increasing hygiene in forest stands (reproduction of harmful insects) and reducing the risk of fires.

Specialized enterprise employs 55 workers. Other private companies providing services (transport, storage, preparation of the raw material, service) for specialized enterprise has created another 250 permanent jobs. Other jobs are created by end users.

6. 14. Bučina Zvolen

bučina®

1. General description

The company owns the technology for combined heat and power production, consisting of back-pressure steam turbines of 5 MW and 2 steam boilers with a diagonal movable water-cooled grate with an installed capacity of 24 MW. Electricity is supplied to the public network and heat to wood-processing company Kronospan. Annual fuel consumption in the form of wood chips is from 50 to 60 thousand tons.

For the purpose of fuel supply, another subsidiary company was founded cooperating with producers of wood biomass and transport companies.

As GPE was identified supply chain including contacting and selection of fuel wood biomass suppliers, managing the collection and transport of fuel, its storage, dimensional treatment by crushing process and subsequent transport of fuel into boilers. Suppliers of wood biomass are wood-processing enterprises selling their waste materials, owners of forest and non-forest land and companies carrying out harvesting and wood-chipping.

The above-mentioned parts of the supply chain can be transferable and implemented by industry enterprises owning boiler plants or wood biomass power plants, in particular, the wood-processing industry enterprises with lack of their own resources of fuel wood biomass.

Figure 1: Controll system of power plant Bučina

2. Description of activity in biomass supply chain

The entire supply chain has the following structure:

1. Identification and negotiation with the potential suppliers of fuel wood biomass. Provided by a subsidiary company based on a planned annual consumption of fuel in the company Bučina.
2. Concluding contracts on biomass supplies with suppliers and transport companies. Provided by a subsidiary company that concludes mainly annual contracts with stable biomass suppliers and short-term contracts according to the actual supply need.

Figure 2: Woody residues from wood procesing industry

3. Organization of the concentration and transport of biomass from suppliers. Provided by a subsidiary company based on a time schedule of fuel consumption, possibilities of suppliers, climate conditions and possibilities of transport companies.
4. Storage and treatment of the fuel in the store of the heating plant. Provided by the company Bučina Zvolen using its own technology.

3. Technical characteristic

Information and communication technologies are fully used in managing the system of energy production and supply. Since the energy is expected to be produced the entire year, fuel consumption is relatively high in the individual months. Construction of the boiler allows using fuels with lower quality (moisture, heat value).

Information and communication technologies are also used to identify the potential suppliers of wood biomass. Due to incomplete databases, personal contacts and past experience is dominant.

The determining criteria for selection of suppliers are stability of supply, quality and price of biomass and transport costs.

Organization of the biomass accumulation and its transport is based on direct contacts with suppliers and transport companies. Approximately 70 % of supply consists of waste material generated by the wood-processing industry and municipal wood waste. The rest consists of biomass from forest and non-forest land, which is generally purchased based on short-term contracts.

Fuel is transported to heating plant by trucks of private companies. Storage capacity is approx. 7,000 tons, what creates the 6-week fuel reserves. Biomass that has been transported is then sorted out by front loaders according to its quality. Biomass with lower moisture content is stored in covered part of the store. Dimensionally different biomass is crushed using Klöckner technology consisting of 2 crushers.

Fuel is transported to the boilers by system of conveyors from movable platform using front loaders or system of conveyors directly from crusher.

4. Economic characteristic

Direct costs on purchase of wood waste material from wood-processing industry and municipal waste range from 15 to 25 EUR/t. The subsequent crushing ranges from 8 to 11 EUR/t. Transport costs of waste wood material depend on the transport distance and ranges from 4 to 12 EUR/t. Overhead expenses are 6-7 EUR/t. The total production cost of 1 ton of fuel is 33-55 EUR.

Purchase price of fuel wood chips ranges from 42 to 48 EUR/t including transport costs to heating plant. The average annual costs of fuel are 2 million EUR in all-year operation and profits from energy sale are 5.5 million EUR. Estimated return on investment is 8 years.

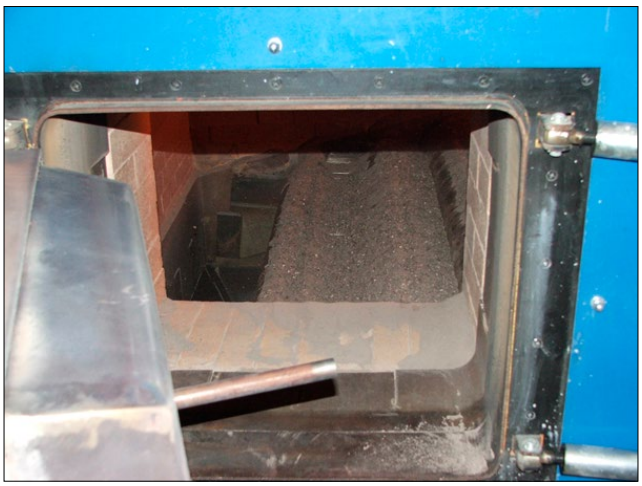


Figure 3: Biomass boiler in power plant Bučina

5. Other characteristic

All companies have to respect law on energy, renewable energy resources, air protection, nature conservation, waste, work safety and transport in the process of biomass energy production and other activities in the supply chain.

An annual consumption of 55 000 tons of wood chips can replace 14.6 million m^3 of natural gas or 36.9 thousand tons of brown coal, and make savings of CO2 emissions and other greenhouse gases (CH4).

Another economic contribution rests in environmental use of municipal wood waste and waste from wood-processing industry (for example, decreasing dust).

Company Bučina employs 45 people in cooperation with its subsidiary company providing supply of biomass. Private companies providing services (transport, biomass accumulation) employ 75 workers.

6. 15. National Energy company, Ltd. Bratislava

Národná energetická spoločnosť

1. General description

National Energy Company covers 6 subsidiary companies that operate 8 boiler plants for wood biomass in the cities: Hriňová, Hnúšťa, Žarnovica, Tlmače, Poltár, Veľký Krtíš, Revúca and Trebišov. The boiler plants are equipped with boilers using wood biomass in the form of wood chips and sawdust and boilers using natural gas. Gas boilers are used as power-reserve and, if necessary, they cover peak consumption of heat. Boilers for wood biomass cover 85 to 95% of the total heat consumption. Boiler plants supply with heat and hot water urban and municipal sphere. Supply of wood fuels is provided by company Intech, which includes Biomass division. The annual consumption of wood fuels is currently 50,000 tons.

Identified GPE is supply chain that includes contacting and selecting owners of fuel wood biomass in forestry and agriculture, harvesting, production and transport of wood chips to stores of boiler plants.

The above-mentioned example is transferable and implementable in companies producing energy from wood biomass for use in household and municipal sphere, industry and also in the plants.

Figure 1: Boiler house in Žarnovica

2. Description of activity in biomass supply chain

The entire supply chain has the following structure:

1. Identification and negotiation with owners of fuel wood biomass. Provided by company Intech – Biomass division based on a planned annual consumption of fuel in different boiler plants. Suppliers are exclusively forest land owners and owners of agricultural land overgrown by forest tree species.
2. Concluding contracts on wood biomass sale. Provided by company Intech – Biomass division purchasing standing timber from forest and non-forest land. The contracts are short-term.
3. Timber felling and wood chips production. Provided by company Intech – Biomass division.
4. Wood chips transportation into stores of boiler plants. Provided by company Intech – Biomass division by its own transport facilities.

Figure 2: Biomass storage of end user in boiler house.

3. Technical characteristic

Information and communication technology is used to contact wood biomass owners and manage production process and fuel supply. Concluding contracts is facilitated by personal contacts using current experience.

Since boiler plants are supplying mainly heat for households and objects, fuel consumption is concentrated into the heating season from October to April. It places an increased demand on the supply arrangements. That's the reason, why the fuel stores in boiler plants carry 2-3 month supply and use also buffer stores on leased property.

Boiler construction allows the use of lower quality fuels (moisture content, heat value).

The company employs workers for timber felling and skidding into forest depots. They use chainsaws and special tractors, skidding all parts of trees, including crown.

The company owns 3 wood-chipping machines – brands Kesla and Bieber with a total annual capacity of 50,000 tons, producing wood chips in forest depots.

Wood chips is transported by own transport facilities with a container structure and trailers. The capacity of each vehicle is 60 to 70 m3 of the wood chips.

Fuel is transported into the boiler through movable platforms and conveyer system. The movable platform is filled by front loader.

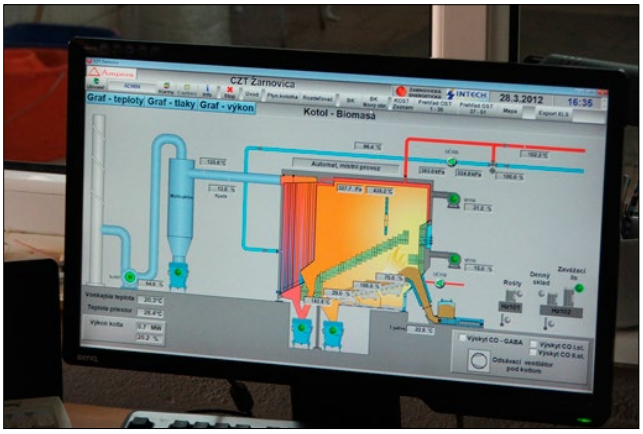


Figure 3: Controll system of boiler house in Žarnovica

4. Economic characteristic

Direct costs on the purchase of standing trees range between 3 and 8 EUR/t. The cost of felling and concentrating are from 5 to 13 EUR/t. Wood chips production costs are 10 to 13 EUR/t. Transport costs depends on the distance and range from 6 to 14 EUR/t. Overhead expenses are 6-7 EUR/t. The total production costs of 1 ton of fuel are 30-55 EUR/t.

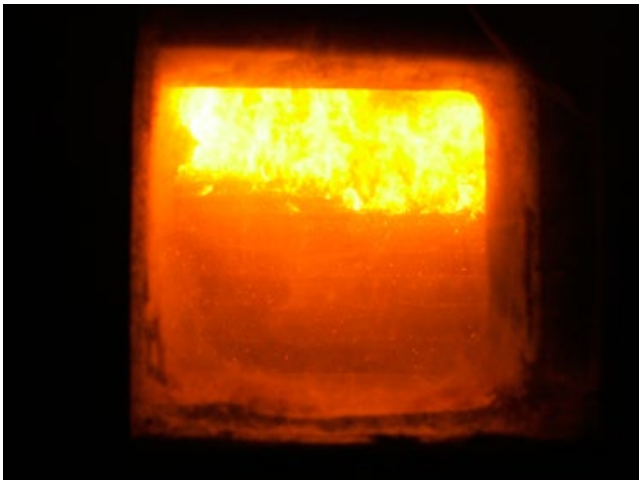
Subsidiary companies pay the price for delivered chips depending on the amount of produced heat in the output of the boiler (EUR. kWh-1). This method allows to evaluate the quality of supply fuel. Higher quality of fuel – heat value implies higher price.

5. Other characteristic

Laws of energy, renewable energy resources, air protection, nature conservation, waste, work safety and transport have to be respected in the field of biomass energy production and activities in the supply chain.

Heat producers have to respect also decree of the Office for Regulation of Network Industries on calculating the price of supplied heat, where the rate of profit is limited.

Annual consumption of 50,000 tons of wood chips replaces 13.3 million m3 of natural gas or 33.5 thousand tons of brown coal, what saves CO2 emissions and other greenhouse gases (CH4).



Company Intech – Biomass division employ in the described supply chain 27 people. Subsidiary companies operate biomass boiler plants and employ 85 people.

6. 16. Biofit d.o.o.

B/I/O/F/I/T

1. General

BIOFIT d.o.o. is a family business engaged in production of woodchips of varying quality, suitable for heating of individual houses, for use in large energy systems and for the needs of nurseries. Woodchips are made of poor quality wood that is, as a rule, unsuitable for industrial processing (branches, lesser quality roundwood, residues from wood processing industry …). The firm's emergence dates back to 2005, while under the name of BIOFIT d.o.o. it has been functioning since 2007. The key point of development at which a decision was made by the family to engage in woodchip production professionally was the decline of other agricultural activities and eventual search for new sources of income on the farm.

The decision was additionally spurred by the installation of woodchip boiler on the farm and first experience with woodchip buyers. The family members gained knowledge on woodchip production by visiting fairs and demonstrations of good practice cases in Slovenia and abroad, by consulting experts, through its own experience and cooperation with machinery manufacturers. For the needs of implementing these activities, they equipped themselves in the last few years with the necessary machinery also with the aid of RDP funds. Today, their machinery fleet enables them to carry out operations »from forest to end-user«. They function primarily in the Gorenjska region, but carry out major jobs in other parts of Slovenia as well.

2. Description of the activities

The firm derives from the family farm. Through the increased woodchip production, the firm BIOFIT d.o.o. was founded in 2007. The increased demand for their services and woodchips led them to expand the firm in the field of technology as well as in the field of employment.

Today, the firm carries out the following activities:

- Integrated maintenance of the environment and forest felling areas
- Woodchip production
- Sale and purchase of wood biomass
- Woodchip transport and marketing

Within the framework of wood biomass purchasing, the firm maintains forest edges as well as felling areas by removing wood residues and pastures by removing shrub layer from them. Apart from it, the firm carries out the service of landscaping around various facilities and in parks. For woodchip production, two chipping machines are used. Woodchip grinding can be carried out only as a service, though woodchips can be purchased as well. For woodchip haulage to end-users or warehouses, several funds of transport adapted according to transport possibilities and biomass quantity are used. Concerning the input raw material on the market, the firm offers woodchips of different quality classes – from »green woodchips« made from felling residues to higher quality woodchips made of roundwood and rest wood from wood processing industry.

The majority of woodchips are transported from production sites directly to end-users. This holds good particularly for green woodchips, which are marketed in Austria. These woodchips are made from felling residues and usually with higher water content. Apart from green woodchips, the firm is also marketing woodchips, which are in terms of water content and other criteria suitable for use in smaller household boilers and somewhat larger boilers of bigger individual users, such as schools or old people's homes, as well as for remote wood biomass heating systems. Woodchip quality is also conditioned by their suitable storage. For this purpose, the firm allocated part of its land along the farm, where wood for the production of woodchips and woodchips themselves are stored and protected against precipitation with tilts. Top quality woodchips that meet the requirements of smaller boilers are stored on the renovated premises of the former stable.

Some 40,000 stacked m3 of woodchips are thus offered annually on the market, but this quantity is expected to be doubled with the purchase of a new SILVATOR chipping machine.

3. Technology – machinery fleet

Optimization of production and selection of suitable machinery is a must for the production's competitiveness. The firm is therefore equipped for the implementation of separate jobs along the entire chain from the forest to the boiler house. Given that they are specialized for woodchip production, the felling and skidding of roundwood does not present a significant share of their activities and do not intend to develop in this particular direction. They enter the production chain after the completion of felling in the forest and hauling of roundwood. The machinery fleet began to get its contour some years ago with the purchase of Starchl MK 50 chipping

machine, by which they entered the woodchip market. In further text, the firm's extent of current machinery fleet, by which it covers the woodchip chain from the forest to end-users, is presented.

Maintenance of the surroundings of felling areas and pastures is carried out with:

- Two YC mini excavators, which are equipped with rubber caterpillars and special revolvable tongs for the gathering of felling residues. The excavators are intended for the concentration of felling residues in heaps. They were purchased in 2010/12.
- Novotny LVS 5000 semi-trailer forwarder. It is intended for the extraction of branches to the locality where woodchip production is carried out. The loading space capacity is 12 m^3. This machine ranks among the smaller semi-trailer forwarders and is the only of this type in Slovenia. It was purchased in 2012.
- AHWI forestry mulcher on Fendt tractor, 220 KW. It is used for the maintenance of pastures and forest edges as well as of localities where woodchip production has taken place. This is a renewed mulcher, bought in 2011, while the tractor was purchased in 2006.

Woodchip production is carried out with two chipping machines:

- Starchl MK 86, mounted on a tandem chassis and powered via tractor drive with Palfinger forestry crane. Dimension of its inlet aperture is 86 x 60 cm, while its chipping capacity ranges from 15 to 80 stacked m^3/h. The chipper is driven by Fendt tractor. Today, after the purchase of Silvator, it is used on hard to access terrains, for minor concentrations of wood biomass, and when the Silvator is in use elsewhere. It was purchased in 2007 with the aid given within the framework of RDP funds to the amount of 50% of the investment.
- Silvator 2000, manufactured by Albach, is a self-driven four-axle chipping machine with the chipping capacity between 150 and 330 stacked m^3/h. It is driven by a Mercedes 450 KW eight-cylinder engine. Registered as a working machine, it reaches up to 40 km/h. It is equipped with Epsilon Tip S110F crane with the maximum height range of 10.10 metres. This crane is usually intended for semi-trailer forwarders. The chipping machine is distinguished by its air conditioned lift cabin, which is ergonomically designed and equipped with a rotating seat with command levers. The chipping machine was purchased in 2012 with the aid of RDP funds to the amount of 20%.

Woodchips are transported by:

- Schwarzmüller moving floor trailer with a capacity of up to 90 m^3 on MB Actros truck. With it, longer-distance transportation is carried out, most often for delivery of »green woodchips«. The second-hand trailer and truck were purchased in 2007.
- Hüffermann containers and container trailers on Volvo truck and Krampe tractor container trailer. The firm owns nine containers with capacities ranging from 27 to 38 m^3. Container transport is carried out when no access with truck trailer is possible and in the event of minor deliveries. The second hand truck and truck container trailer were purchased in 2011. For the truck trailer and containers, the firm was approved grants from RDP funds (also in 2011) to the amount of 50%.
- Fliegl ASW 160 tractor trailer with thrust wall (30 m^3 volume) and Deutz Fahr 122 KW tractor. They are used for short-distance deliveries or when no truck access is possible. The trailer was purchased in 2010, the tractor in 2011.

Chain links	Working operations	Machine in use	Total investment amount (EUR)
Maintenance of felling areas, environment and pastures	Gathering harvesting residues	2* X YUCHAI YC35-8 excavator	147,000
	Maintenance of pastures and woodchip production sites	AHWI forestry mulcher	
	export of felling residues	Novotny LVS 5000 semi-trailer forwarder	
Woodchip production	Minor working sites, hard of access sites	Starchl 86 MK chipping machine	726,000
	chipper drive	Fendt *1	
	primary chipper	Silvator 2000 chipping machine	
Woodchip transport	Transport with moving floor trailer	MB Actros truck Schwarzmüller truck semi-trailer	307,000
	Container transport	Volvo truck and Hüffermann trailer	307,000
	Export of woodchips to woodchips yard or end buyer	KRAMPE tractor container trailer	
	Concentration of woodchips	nine containers	
	Short-distance delivery of woodchip	FLIEGL ASW 160 tractor trailer	
	Delivery of woodchip, loading of trailers	Deutz Fahr	

*1 Fendt tractor is also used to drive the mulcher, but the investment was taken into consideration in the »woodchip production« operation, where it drives the Starchl 86 MK chipping machine.

In optimal conditions, such a quantity of felling residues can be transported daily from the forest or pasture to the grinding site that 70 - 100 stacked m3 of woodchips can be made from them. Currently, the greater part of woodchip production is performed with the Silvator chipping machine. Optimal daily production of woodchips is currently about 500 stacked m3. The quantity of daily production is subject to the raw material input at a single site and continual export of woodchips. In favourable conditions, even more than 1,000 stacked m3 of woodchips can be produced per day.

4. Investments

The firm BIOFIT d.o.o. has been able to invest in its machinery fleet with the aid of bank loans and RDP funds. In the table from previous page the firm's machinery fleet and some data on investments made in the last few years are presented.

In the 2006-2012 period, the total investment in the machinery fleet amounted to 1,180,000 EUR. The greatest financial burden was the purchase of SILVATOR chipping machine, which exceeded 500,000 EUR.

5. Service market and marketing

The firm's target activity is woodchip marketing and implementation of services in the chain from the wood biomass site of origin to the final user. The machinery fleet enables them to maintain the surroundings of various facilities, parks and felling areas, to produce woodchips at different sites and to transport woodchips over longer distances as well as locally. Although the firm's target is the region in which it operates, it carries out its service all over Slovenia.

As far as the source of wood biomass is concerned, the firm's customers are forestry companies, pasture commons and big forest owners. The most important wood biomass consumers are systems for the coproduction of electric power and heat from wood biomass in the neighbouring Austria, where mostly »green woodchips« are marketed, major individual and remote wood biomass heating systems in Slovenia, and larger local nurseries and household.

In order to optimize the entire production process as well as to reduce costs and environmental pressures, the firm strives at the regional wood biomass production and supply.

6. Goals and vision of the firm

The firm's increased scope of business, from the implementation of services and production of woodchips some years ago to partaking in the chain from forest to end-user, contributed to an increased workload and creation of new jobs in the region.

Today, the firm is distinguished by a young and reliable ten-member team. BIOFIT's associates are also independent entrepreneurs and individuals, who carry out their work within the framework of complementary activities on the farm.

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6. 17. Biomasa d.o.o.

BIOMASA froling

1. About the company

Biomasa d.o.o. is an ambitious, pervasive and innovative company based at Luče (Upper Savinja Valley), covering a wide range of activities from the field of wood bioenergy: from wood biomass production, remote heating system planning, heating systems assembly and servicing to wood energy contracting.

It all started in 1998, when Rok Suhadolnik founded the firm Biomasa Rok Suhadolnik s.p. at Luče and became general importer of biomass boilers, manufactured by the Austrian company Fröling, for the region of Slovenia and SE Europe. In a very short time, the company assumed the leading role in the sphere of biomass in Slovenia and has so far successfully set up more than 2,500 wood biomass systems for the heating of residential buildings, larger business, production and public facilities as well as industrial boilers for high power systems and remote heating systems. In 2005, the firm changed its name to Biomasa d.o.o. Apart from representing Fröling, the producer of biomass heating technology, and planning remote heating systems, the company is engaged in heating systems servicing, production and supply of wood fuels and energy contracting.

The key turning point in the company's development was its focusing on planning and production of remote micro heating systems, by which it became the actual instigator of this activity in Slovenia and this part of Europe.

By providing work for about 20 people, the firm is an important employer in its local environment. The team of workers is young and well qualified: more than 75% of the employees are from 18 to 35 years old, the majority of them with education levels V to VII. In the ensuing years, the company intends to employ additional staff.

Organisational arrangement of the company:

The company administration and business premises are based at the address Krnica 52, 3334 Luče, while part of its business premises, warehouse and biomass logistics centre, which works within the firm's framework, are located in the Industrial Zone Nazarje. In 2005, Rok Suhadolnik (Director of Biomasa d.o.o.) also founded EKOEN d.o.o., a firm for the production and distribution of eco energy, within which five remote biomass heating systems were built (with the aid of GEF project) at Luče, Solčava, Podrožnik in Mozirje and in Primary Schools Mozirje, and Postojna.

2. Description of activity

The company is equipped for the implementation of very diverse and specific tasks through the entire chain, from trees to boilers, however the major part embraces planning and setting up of individual and remote heating systems. The following activities are carried out:

- Mechanized logging in forests;
- Production and supply of wood fuels;
- Assembly and servicing of heating systems, installation of wood biomass boilers (including industrial boilers);
- Planning of remote systems with different power capacity boilers;
- Wood energy contracting (within the framework of EKOEN d.o.o.).

Mechanized logging and skidding represent a very small proportion of the company's activities, since the major part of raw materials is purchased from various suppliers, particularly sawmills. At the moment, the production of wood fuels embraces only about 20% of the entire business. Mainly fuels with characteristics as prescribed by Fröling are produced, while green woodchips cover only about 3% of the firm's entire wood biomass production. 30% of the activities are covered by the planning and assembly of remote systems of different sizes. In the past few years, the company set up 30 large remote heating systems throughout Slovenia. About 50% of the activities are covered by sale and servicing of log, pellet or woodchip heating systems (individual or industrial).

3. Technology and machine equipment

As the selection of suitable machinery is of high importance for the competitiveness of production, only some of the firm's most important machines and appliances (technologies) are listed below:

Logging in forests

The companies logging Menzi Muck A91 4x4 Plus with stepper chassis and articulate steering that enables a tight turning radius was purchased in 2009. It is suitable for terrains of up to 45°, and is also equipped with a winch that enables it to climb and descend on very steep terrains. Its Woody 50 harvesting head is suitable for felling and processing of both coniferous and deciduous trees.

Grinding of woodchips

For woodchip production, the following three stamping machines are used: BBT1500, Eschelböck Biber 92, and Eschelböck Biber 82.

Bentele BBT 1500 is built on the standard three-axle trailer and equipped with its own 1,000 HP Caterpillar motor. It produces woodchips of G40 to G100 size-class with 500 stacked m^3/h capacity and is suitable for log dimensions from 75 cm (for harder wood) to 110 cm (for softer wood).

Eschelböck Biber 92 is driven by Fendt 936 265 kW tractor. Cutting width is 122 cm, while maximum possible stem thickness is 75 cm. It is suitable for fine woodchips production of size G30 and coarse woodchips of sizes G50 to G100. The machine's capacity is 90 stacked m^3/h.

Eschelböck Biber 82 is driven by Class Xerion 3800 275 kW tractor. The inlet opening dimensions are 55 x 98 cm, and it can cut stems that do not exceed the thickness of 55 cm. The capacity of this machine is 80 stacked m^3/h.

Transport

For the transport of woodchips, external contractors possessing trucks and trailers with movable floor are hired. The company has alos its own Fliegl push-off trailer with the volume of 40 m^3, which is equipped with woodchip blower that reduces emissions of fine particles into the air in the phase of unloading, and a Fliegl push-off trailer with the volume of 50 m^3.

Biomass logistics centre (BLTC) at Nazarje

From 2008, a BLTC within the framework of Biomasa d.o.o. has also been functioning in the Savinja Valley. It is located in the Nazarje Industrial Zone, where the company has a 13,000 m2 large place for storing raw materials and some 1.000 m2 large covered warehouse for woodchips. This is one of the largest centres of this kind in Slovenia, as they produce from 60,000 to 70,000 loose m^3 woodchips per year. Just recently, the firm invested in appliances for coproduction of heat and electrical energy, which at this moment provides them with 100 kW electricity and 210 kW of heat. The capacities, however, will be doubled with additional two appliances in 2014. In 2013, they developed and constructed two drying houses for woodchips with the capacity of 1,000 kg/h, which exploit energy from the cogeneration process.

4. Investments and fundraising

The company has been very successful in fundraising from various projects. For most of the above mentioned machines and facilities, they acquired funds particularly from the rural development project (PRP), the only exceptions being the two Fliegl trailers, Class Xerion tractor and Eschlboeck Biber 82 and Biber 92 stamping machines, which were financed solely with their own resources.

As already mentioned, the company EKOEN d.o.o. invested, in construction of remote heating systems with the objective to engage in wood energy contracting.

Apart from it, the company aids its customers in the acquisition of subsidies for the purchase of new Fröling boilers and in investments in remote control heating systems.

5. Productivity

They make from 100 to 800 loose m^3 woodchips per day. Their daily production usually depends on raw material availability, weather conditions, type of terrain, and unpredictable failures in their mechanical equipment. The annual woodchip production is to be further increased by additional 50,000 to 60,000 loose m^3. In 2014, production of pellets is to be embarked upon as well.

Continuous quality of their products and services is provided by their own quality assurance and quality control system.

Chain links	Working operations	Machines and facilities in use	Year of investment	Project and share of cofinancing	Total investment (EUR)
Felling	Logging; production of assortments	Menzi Muck A91 with Woody 50 harvesting head	2009	PRP Operation 122 , 50 %	330,000
Woodchip production	Primary wood chipper	BBT 1500	2009	PRP- Operation 123, 50 %	950,000
	Production of woodchips in the field	Fendt 936 + Eschelböck Biber 92	2009/2010	PRP Operation 122 30 %	
		Xerion + Eschelböck Biber 82	2012	Own resources	
Woodchip drying	Drying of woodchips	Drying house with energy station	2013	Small business OL, 5 %	1,200,000
	Production of wood fuels	Drying-production line for wood fuels	2013/2014	PRP Operation 123, 45 %	
Woodchip transport	Delivery of woodchips	Two Fliegl push-off trailers with blower	2006/2013	Own resources	150,000

Table: Production chain links of the Biomasa d.o.o. company and its investments in machinery and facilities.

6. Market and raw material origin

Their raw material usually originates from the Savinja Valley and the regions of Koroška and Dolenjska. Raw material suppliers are mainly cooperatives, wood purchasers and local sawmills. Wood fuels are made largely from spruce wood (sawmill residues, pulpwood, small size or low quality log-wood) and are sold only in Slovenia, while heating systems are supplied and installed all over the western Balkans.

The most important woodchip buyers are especially remote heating system owners, the company Petrol, the company Eko toplota energetika d.o.o. (Kelag Wärme GmbH) from Gornji Grad, firms that require woodchips as a technological fuel or for heating purposes (e.g. IGM Zagorje), and individual households heated by woodchips.

7. The companies objectives

The companies short-term objectives are to introduce, in 2014, the production of large quantities of technically dry woodchips and pellets – wood fuels (considering that they have already invested in a new wood fuel production line). Acquisition of ISO 9002 quality certificate is also under way, which speaks that the companiy has a well-established internal quality control. An important objective is also to cover as many of their own energy demands as possible with the electric and heat energy co-production system located in BLTC Nazarje. In the sphere of all activities, they are striving to function as environmentally friendly as possible.

8. Conclusions

Biomasa d.o.o. is a good practice example, given that it has developed into one of the most salient companies in wood biomass field in the last few years. The firm is successful both in the sphere of wood fuel production as well as in the sphere of planning and installing different heating systems. It is an important employer at the local level, with a large share of young people employed. The workers are motivated and suitably paid for their work.

The firm is innovative and follows modern technologies. It has also been successful in the introduction of new concepts, such as the biomass logistics centre and energy contracting. Its workers are encouraged to participate at courses covering the spheres of new technologies and modernization of the existing ones.

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6. 18. Energija narave d.o.o.

energija narave
d.o.o., Družba za upravljanje z obnovljivimi viri energije

1. General

The company Energija narave d.o.o. was founded in 2009 in the Gorenja vas – Poljane Municipality for the specific project of energy contracting, i.e. wood biomass district heating (WBDH) for the need of GC Todraž. In the very same year, the project of a public-private partnership in the energy source replacement (switch to renewable energy resources) was embarked upon in GC Todraž. The investment was successfully implemented in 2010, when wood biomass heating was introduced in December as well. The old extra light heating oil boiler with a power rating of 1,900 kW was replaced wood chips boilers with a total nominal power of 1,000 kW. Despite the reduced capacities of the new modern boiler, it became clear as early as after the first heating season that GC Todraž would not come to life in full. This means that the envisaged heating requirements were completely overrated. The wood biomass boiler room was thus underutilised, but just when the investment began to seem unpromising, the success story has only just begun.

The company Energija narave d.o.o. opted for a new project: production of pellets, with which energy surplus was to be utilized. During the preparation of project documentation, several variants were studied, including those by which the investment costs would indeed be raised to millions of euros, but then the investment would enable them a co-production of heat, electric power and pellets. The technological model for the co-production of pellets was selected rationally, but still in such a manner that would enable them to raise the model to a higher standard, i.e. co-production of electric power. For the selected production chain, the company currently uses 80 % of all produced heat, while the remaining 20 % is used for the needs of energy contracting in the area of GE Todraž.

The company currently employs three people in the production and sales sectors. Apart from that, the production is regularly visited by the company's director who invested much of his spare time in the pellet mill. With regard to the positive response on the market, new jobs are also created by the company. All workers have been selected from the local community, providing them with suitable professional qualifications.

2. Description of the company's activities

The process line consists of several steps adapted to the type of input raw material. Pre-grinding or raw material and sieving is necessary during the first phase with regard to the type of input of raw material and its granulation, which then proceeds to the rough grinding process and on into the storage container, from which raw material is transferred into drying room. From here, raw material travels to the dry raw material storage container, and eventually to the fine grinding mill. The finely ground raw material is then supplied via dry raw material storage container to the press. The produced pellets are then sent to the cooling procedure and via sieve to the pellets storage container, where they are ready for packing and further handling.

3. Technology and productivity

Drying

When deciding on which technology to use, the company dedicated most of its attention to the selection of a suitable raw material drying room, with which the energy surplus of the existing WBDH system would be used. When fully operational (7,000 hrs per year), the boiler room can produce around 5.3 GWh of heat envisaged to dry the raw material, or about 10 % less if losses in the network are taken into consideration. After surveying several different possibilities, the investment in raw material belt drying system turned out to be the best variant among them all. Saw dust is shifted via storage

container and transporter to the rough mill and further on to the belt, where it is left to dry. The dried out material is dosed into fine mill via transporter and then through dry raw material storage container to the press. With the power input of 1,150 kW, the capacity reaches 1.5 tons of dried raw material per hour.

Conditioning

Prior to the pressing (pelleting) procedure, the well dried raw material is to be exposed to water vapour for 10 to 20 minutes in order to enable the raw material to be evenly moistened and a liquid layer of particles created on the surface. This procedure is called conditioning and is highly significant if top quality of the end product – pellets – is to be achieved. Another method of conditioning is the application of biological additives which, however, is not favoured by the company Energija narave d.o.o.

Pressing

Grinding, drying and conditioning procedures are followed by pressing of the input raw material into the end product – pellets. A constant raw material supply and homogenously ground raw material with a constant water content between 8 % and 13 % is a predisposition for a successful pressing of the pellets. The company Energija narave d.o.o. opted for Italian press manufactured by ZEPPI with the capacity of 1,000 kg/h. The effects of the press depend on several factors, while the planned annual production oscillates around 5,000 tons. Daily effects are influenced particularly by the functioning of the press itself; after six months of functioning, 95% capacity of the entire mill is achieved.

Cooling of the pellets

The last but no less important procedure prior to packing of the pellets is their cooling. Drying, conditioning and frictional forces during pressing cause the material to heat up. The temperature of produced pellets thus varies between 80 and 90 °C. Through cooling, the mechanical strength is increased and water content reduced, which means that cooling prior to storing is essential. In the refrigerator, the pellets are cooled with the aid of ventilation.

4. Investment

The investment in pellets production, which includes the system of grinding and drying of raw material, the pellet-making machine, sieving and cooling systems as well as transport and packing systems amounts to 591,100 EUR. The financing model envisages 60 % of own funds and 40 % of loans raised. With the reached 20 % rate of yield, the expected return on the investment is 7 years.

Planning	33,400 EUR
Construction works	45,000 EUR
Heating system	35,000 EUR
Drying room	307,700 EUR
Pellet mill	260,000 EUR
Storage place	30,000 EUR

Table: Investment breakdown

When WBDH Todraž was founded, the entire required documentation for the acquisition of incentives from the Ministry of Economy's Cohesion Fund was prepared and submitted. On the basis of this documentation, the company also acquired incentives for the construction of wood biomass boiler room. Apart from it, the company has signed a contract for heat supply to the RWBH Todraž.

5. Market and raw material hinterlands

The company Energija narave d.o.o. endeavours to produce and supply high quality pellets. These are made of different wood residues (saw dust, woodchips, side trimmings, offcuts, bark, slabs …) of spruce wood (80 %) and deciduous tree wood (20 %). Despite the fact that the production is carried out in one of the most forested areas in Slovenia, where forest cover exceeds 70 % of the area, data on wood potentials in its surroundings had been gathered prior to the project implementation. It was established that at least 26,000 tons of wood biomass was located within a radius of 30 km (most of it within 20 km). The established quantities suffice for the envisaged production. But as the company wanted to play it safe, it signed contracts with five major and a few minor constant suppliers, with which it agreed on regular supply during the cycles stipulated in advance. This means that the company has secured permanently quantities of the needed raw material, which is kept in a roofed depot with a capacity of 5,000 stacked m^3. The price of wood biomass as the input raw material greatly depends on transportation costs.

6. The company's goals and vision

As the company has been dedicating most of its attention lately to the quality of its products, it wishes to introduce a system for a constant control and, in turn, to provide for a constantly high quality of its pellets. As it aims high, it seeks to introduce a system in the shortest possible time that will satisfy the requirement for the acquisition of ENplus quality certificate, which is based on the European EN 14961-2 standard.

Apart from providing for the highest quality of its pellets, reduction of costs is one of the major factors in the development and upgrading of the company's production. Together with a permanent supervision of separate production elements, the company has introduced a number of innovations and thus increased the production capacities or provided for a lesser wear of materials, which on the long run brings lower costs and better utilisation of not only raw materials but production line as well.

With continued successful functioning, the company is also striving for economic growth and opening of new jobs on the account of increased production that would be possible, according to the company's director, only with a high investment in the ORC system for the cogeneration of electric energy. The company has all the resources to upgrade the existing system into a system of cogeneration, except that it should initially be stabilized after the investment cycle into the pellet mill, or should get an external partner to implement the necessary upgrading.

In fact, the company has already acceded to its upgrading through its distribution service. This concerns primarily distribution of loose goods in specially adapted containers with the system that enables loose goods to be blown into storage facilities. With this system, the company wishes to gain advantage with the customers who have boiler rooms and storage containers adapted to this mode of fuel supply.

7. Conclusions

The company Energija narave d.o.o. is certainly a good practice case, given that it was a successful tender and, later on, a successful investor in the wood biomass district heating system. After the initial failure, the company did not give up, but successfully exploited the available capacities by developing a pellet production plant. At the same time, it invested much time and money in the preparation of the project itself. In the very first year it thus endured the trial period, successfully started the production and presented its products on the market.

The company's employees are innovative people who constantly search for bottlenecks with their continuous control of the production chain and have successfully introduced a number of solutions. They are especially proud of their improved cutter knives in the cutting mill. With a minor modification, the knives are usable more than twice, due to which the grinding costs have been significantly reduced.

In cooperation with various research and energy institutes, such as the Slovenian Forestry Institute and TeTol, they aim even higher by producing top quality products and confirming this by appropriate European certificates. With their case they are also partaking in the preparation of MSc thesis.

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6. 19. Agricultural and Forest Cooperative Agia Kyriaki

1. General description of selected process or SCORPS

The Agricultural and Forest Cooperative of Agia Kyriaki has its headquarters in Velvento and operates in wooded areas of the regional entity of Kozani. Its active members are 9, who are also the shareholders of the cooperative. Its loggers have excellent experience in harvesting operations, processing of wood products, logistics and trade of wood logs and firewood.

The main activities of the forest cooperative are:

- Forest harvesting operations
- Transportation of wood logs
- Wood logs processing for firewood production
- Logistics and trade of firewood
- Production and trade of other wood products (other services)

2. Why this process or SCORP was selected

The deep economic crisis Greece faces as the recession enters its fourth year, as well as the new fuel taxes introduced by the government, have caused a sharp increase in the price of heating fuel. This steep increase in heating costs has led many Greeks to switch from heating oil to wood-burning. As a result, the old wood-burning stoves and fireplaces have seen a revival, creating a lucrative market for legal importers and salesmen of firewood.

The main objective of the forest cooperative is the quality and reliability of wood trade in order to increase quantities sold in local market through a permanent network of costumers. The forest cooperative sells wood, especially firewood, in low and stable prices, improving the competition in the retail wood market. The cooperative monitors the technology development in the wood sector and tries to update its equipment and machinery.

3. Who is involved in this process or SCORP?

- 9 active members of the forest cooperative (loggers)
- 2 accountants working for the forest cooperative

4. Technical description

The mechanical equipment of the cooperative is:

- Chainsaws for felling and delimping of trees.
- 2 Tractors for skidding of wood logs (mules are also used for skidding).
- Wood splitters and saws for the configuration of the wood logs.
- Trucks for firewood transportation and delivery to costumers.
- 1 lorry crane.
- 1 bus for the transportation of personnel (loggers).

5. Economical information's

The Agricultural and Forest Cooperative of Agia Kyriaki is a trade union own funded. It has annual contracts with the local forest agency and regularly monitors costs in its production, in order to reduce its indirect and direct costs. Their insurance contributions accounts to 25 % of their annual income.

Their equipment costs are:

- 180.000 € for a lorry crane
- 100.000 € per tractor
- 45.000 € for a wood splitter
- 100.000 € per truck
- 15.000 € for a mini bus
- 3.500 € for saws

6. Legal aspects

The 1975 Constitution, Laws 86/1969, 998/1979 and 1650/1986 constitute the basic legal framework of the country for the protection and management of forest and other wooded land. Forest and other wooded land are protected by articles 24 and 117 of the Constitution.

Law 86/1969 codified almost all the laws that had been issued since 1928 and had been amended and completed by Law 4173/1929. This law constitutes the Forest Code of the country and regulates matters concerning the protection, management, real property rights on forest land, taxation, exploitation of state and privately-owned

forests, forest improvement works etc. This code continues up to now to constitute the basic body of forestry legislation, although a lot of its provisions were amended and substituted by other laws such as Laws 886/1971, 996/1971, 248/1976 and 998/1979.

Law 998/1979 "On the protection of the country's forest and other wooded land" determines the specific protection measures for maintaining, developing and improving forest and other forest land of the country. This in turn aims at maintaining and improving the whole natural environment by direct reference to the legal status governing their ownership and use.

Law 1650/1986 "On the Protection of the Environment" includes a specific chapter "On the Protection of Nature and Landscape» which proposes new categories of protected areas and introduces changes in the administration and management of protected areas. The above-mentioned laws for protecting and managing forests were supplemented by Presidential decrees and Ministerial decisions.

The Presidential Decree of 19-11-1928 "On Forest management, felling regulations, Forest taxation and rent, disposal of products, resin collection and resin cultivation etc", regulates legislatively sustainable forest management. With this decree, incorporated into the Forest Code, the principle of sustainability is adopted in its simple form, i.e. sustained yield. However, the management of Greek forests based on sustained yield started after the Ministry of Agriculture issue Circular No 120094/499/1937.

7. Environmental aspects (CO2 savings, …)

Wood absorbs as much carbon when it is growing as is released when it is burnt. Provided that the wood is harvested sustainably, so at least as much is grown back as is cut, wood is assumed to be a carbon-neutral energy source.

No allowance is made for the carbon cost of cutting and transporting the wood from the forest to costumer within the short distances of the regional entity (up to 50km). It is assumed that the carbon cost of felling and haulage is de minimis.

8. Socio-economic aspects (new activities on farms, job creation…)

In the last 2 years no new personnel has been hired by the Agricultural and Forest Cooperative of Agia Kyriaki.

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Chemical Process and Energy Resources Institute

6. 20. Alfa Wood Nevrokopi

1. General description of selected process or SCORPS

Alfa Wood Nevrokopi is the largest pellet manufacturer in Greece and one of the largest in the Balkans. It is producing pellets in considerable amounts for domestic consumption and for some industrial applications.

The major raw material for pellet production is round wood either coming from local producers or imported from the neighbouring countries (mainly Bulgaria, at a share of 40-50%).

In Greece, wood residues are used unprocessed, as they leave the industrial operation. These materials are often used in boilers directly by the producing company or by companies near the production site. Often these wood residues are disposed of for free to companies which have the possibility of thermal exploitation (such as Alfa Wood Nevrokopi). The residues are mainly comprised of bark and sawdust or shavings, which cannot be utilized in the production process of the pellets, due to the high ash content.

2. Why this process or SCORP was selected

The reasons are as follows:

- Existence of unit of environmental management and energetic use of woody byproducts
- Reduction of production costs
- Reduction of drying costs
- Recycling of waste
- Use of biomass for energy generation
- System of electrical monitoring of energy control

3. Who is involved in this process or SCORP?

- transportation company
- wood processing company

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4. Technical description

ALFA WOOD Nevrokopi

ALFA WOOD Nevrokopi officially starts the production of pellets in 2009.

Energetic use of biomass

- Nominal output: 8tn/hr pellets (300 days/year)
- Input: 20tn/hr of biomass (for pellets production and heat generation)
- Biomass utilization (bark, sawdust etc.): 4tn/hr for drying and space heating (winter)

Installation

- The installation is designed for the production of 2.000.000 kcal/hr in an ORC (Organic Rankin Cycle boiler with output temperature of 275 oC and mean humidity of fuel equal to 35% as received, for heating purposes of the factory)
- A boiler of 7.5 MWth is used
- Raw material used: bark, sawdust, shavings etc. from the adjacent wood processing factories
- No quality control is being performed on the wood residues/ raw material

5. Economical information's

For the thermal exploitation of wood residues the company invested € 3 Mio.

6. Environmental aspects (CO2 savings, …)

4tn/hr of biomass (bark, sawdust, etc.) is used for drying of pellet's raw material and space heating (winter)

7. Socio-economic aspects

Thirty- five job opportunities have been created during the last years in ALFA WOOD Nevrokopi, which has contributed to the local economic development despite the Greek financial crisis.

6. 21. Alfa Wood PindosAlfa Wood Pindos

ALFA WOOD φυσική δύναμη

1. General description of selected process or SCORPS

ALFA WOOD PINDOS is located in the Community of Mavranei, 7 km from the city of Grevena, in a privately owned site covering 107.000 m^2. On these grounds, there is a 26.054.89 m^2 building which houses the administration offices and the company's production facilities.

The major suppliers of Alfa Wood are wholesalers trading forest timber and the local Rural Forest Cooperatives, which both transport products to the premises of the plant.

The round wood that is delivered by trucks to the company should have a size of 2 m length and 50 cm diameter. The round wood is stored at the yard of the plant. The logs are cut to a more manageable length (if over 2 m of length or over 50 cm of diameter), debarked and then sent to the chippers. If necessary, the round wood is washed to remove dirt and other debris. Wood chips of a size of 4x4 cm are produced. The produced wood chips designed for the production process are stored in a silo and the wood waste (bark etc.) for thermal utilization in another.

The general steps used to produce MDF (Middle Density Fiber board) include mechanical pulping of wood chips to fibers (refining), drying and blending the fibers, in order to transform the material to mat MDF. Then the material is hot pressed, cooled, trimmed, sanded and prepared for shipping.

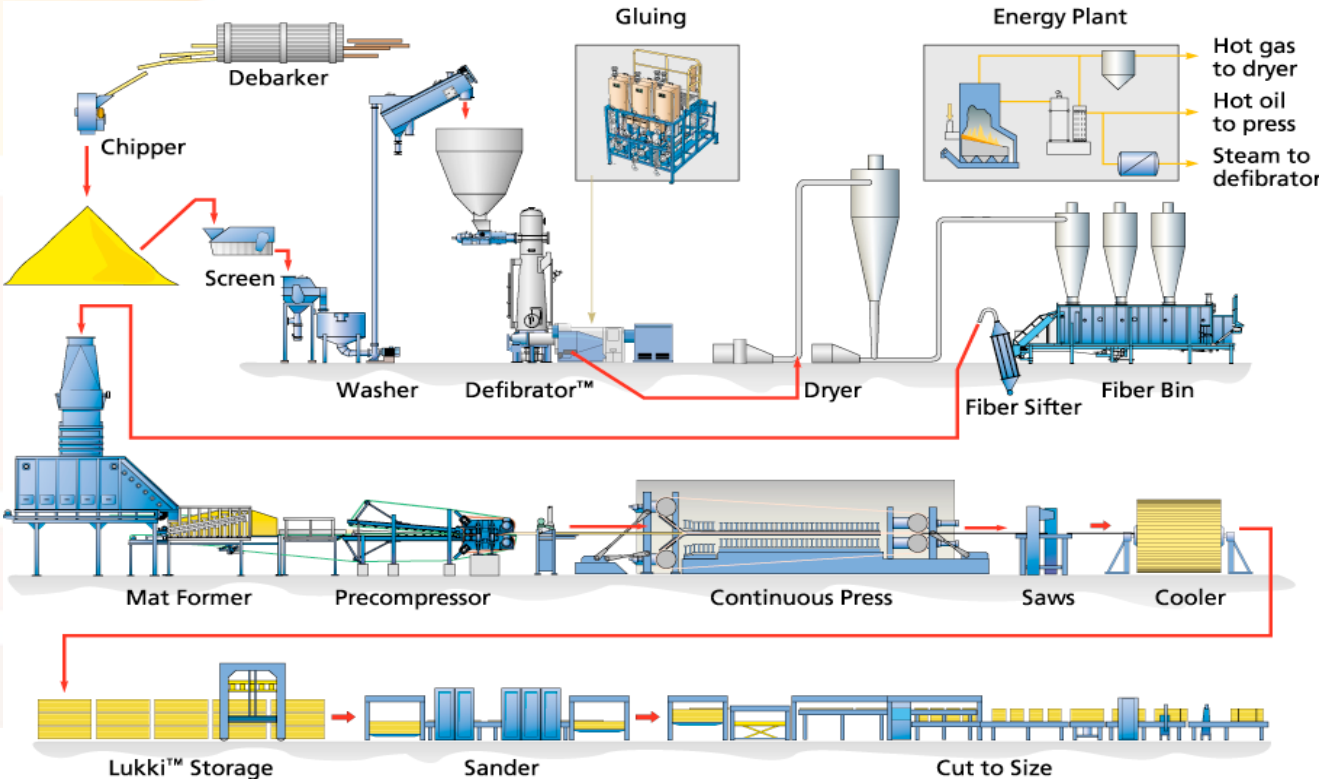
2. Why this process or SCORP was selected

The reasons are as follows:

- Existence of unit of environmental management and energetic use of woody byproducts
- Reduction of production costs
- Reduction of drying costs
- Recycling of waste
- Use of biomass for heat and energy generation
- System of electrical monitoring of energy control

3. Who is involved in this process or SCORP?

- transportation company
- wood processing company



4. Technical description

ALFA WOOD PINDOS S.A. – General overview

ALFA WOOD PINDOS officially starts the production of MDF (Middle Density Fiber board) and veneered MDF in April 2006.

Today, it produces 6 groups of products:

- MDF (raw)
- Veneered MDF
- Sanded MDF
- Laminate flooring (clipped)
- Lacquered MDF
- Melamine

After having invested in the increase of productivity, an investment that was completed by the beginning of 2009, the unit is able to produce 120.000 m^3 of raw MDF per year. With full modernization and the addition of 4 new production lines, the quantity of raw MDF produced, can be used to the production of:

- Veneered MDF
- Sanded MDF
- Lacquered MDF
- Clicked Laminate Floor

Energetic use of biomass

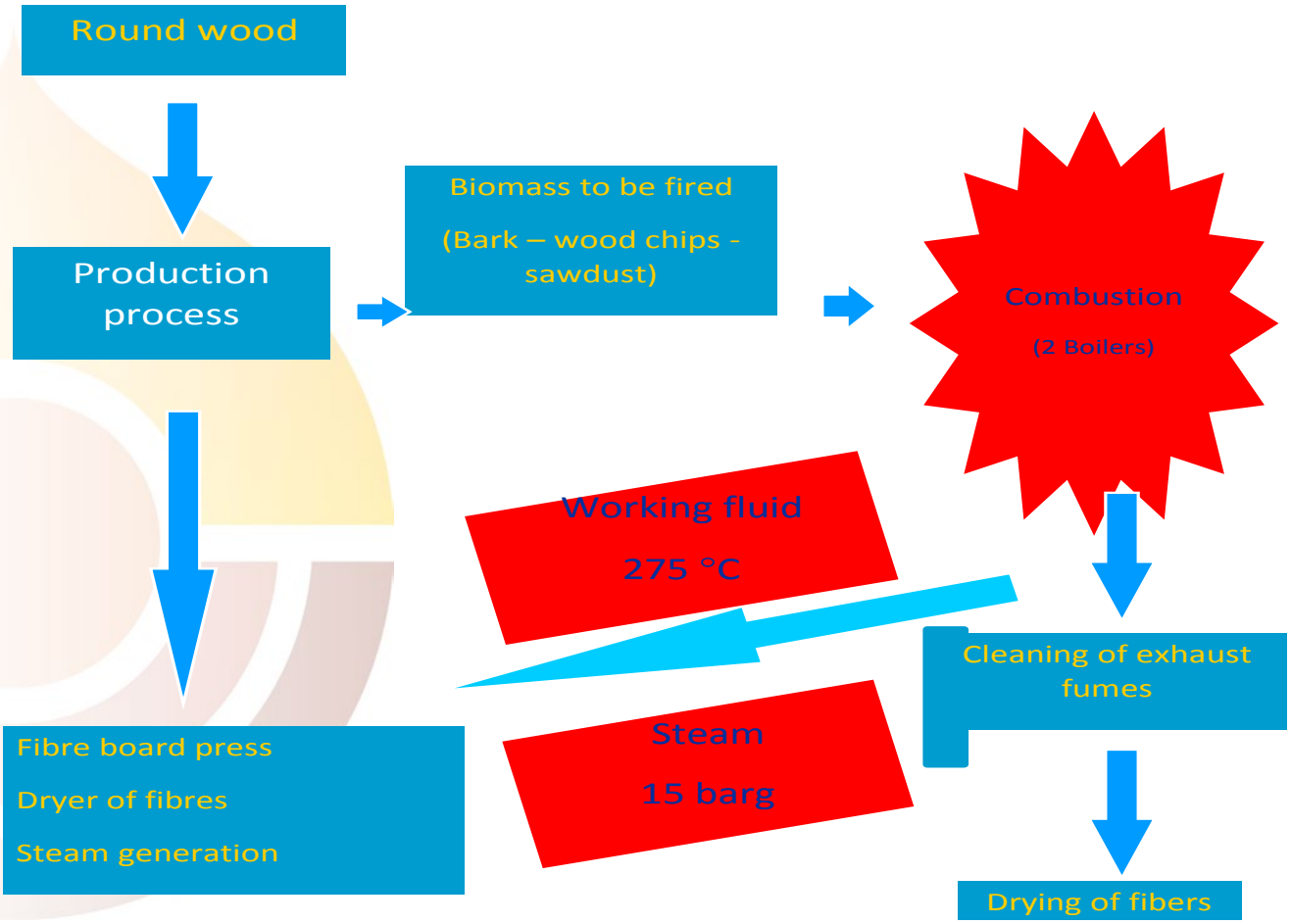
- The factory is processing 150.000 tn of round wood annually for its MDF production.
- 15.000 tn of waste/byproducts are produced and combusted which equals to 4.500 tonnes of petrol.

Installation for heat generation

- The installation is designed for the production of 11.500.000 kcal/hr in an ORC (Organic Rankin Cycle) boiler with output temperature of 275 oC and a mean humidity of the fuel equal to 35% as received.
- The fuel is bark and wood chips (up to 50cm of length).
- 2 boilers of 7,5 MWth & 8,7 MWth.
- 1 heat exchanger (working fluid – steam), steam generation 12 tn/hr, at 16 bar pressure.
- Economizer (exhaust fumes).
- 60.000 m^3/hr of exhaust fumes at a temperature of 245 oC is going through a series of fabric filters (bag houses) to the drying of the fibers.
- Total yield of installation: ~ 95%.

5. Economical information's

Maintenance: 4 hr/week
Investment cost: 2300 €/kWel
Maintenance cost: 0.007 €/kWel



6. Environmental aspects

4.500 tonnes of petrol are saved which equals to 14.170.500 kg CO2 (petrol 3149 kg CO2e per tonne).

7. Socio-economic aspects

In the last 2 years no new vacancies were created.

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6. 22. Biomass - District heating project Sarnthein

Unsere Energie

TiS innovation park

1. The Idea

The Sarnthein Biomass District Heating Plant arose from the idea that one should be able to make better and increased use of the local renewable resources of wood energy. Entry into energy production seemed to be a sensible way forward for rural enterprises to increase the added value of forestry operations through the on-going management and ministration of local forests.

Timber from the forest which is unsuitable for sawing has hitherto had no commercial use, so the installation of the heating plant was designed to increase the importance of this material as the last link in the forestry timber value-added chain.

Implementation Timetable:

- 1998: Foundation of the district heating plant Sarnthein association
- 2001: Start of construction of the boiler house and the storage area
- 2002: Connection of Sarnthein and beginning of operation of the heating plant
- 2006: Expansion of the heating network to Nordheim
- 2013: Expansion of the heating network to Astfeld

A management board, which was set up in 2009 on the basis of equal representation, oversees the work of the cooperative, which means that the timber suppliers as well as the energy customers are represented on the board and take joint decisions on matters such as the price of wood or heat. Altogether 263 heat transfer stations for approximately 790 units (houses, firms, public buildings and so on) had been installed and were operational by spring 2013.

2. The Technology

The Sarnthein Biomass District Heating Plant is located at the upper end of the industrial zone north of Sarnthein. This situation places it right at the centre of the service area between the main location of Sarnthein to the south and Nordheim and Astfeld to the north. The position is equally convenient in terms of access routes for delivering the fuel, avoiding the need for streams of vehicles to pass through the built-up areas.

The building consists of two structures: the boiler house with dimensions of 27.8 m x 15.3 m, and the adjoining fuel store measuring 45.0 m x 25.3 m. Part of the boiler house is used by the administration offices of the operating cooperative. The following facilities are housed in the boiler house: the biomass boiler plant, the oil-fired standby boiler, the flue gas treatment system and condenser, the district heating water installation with pumping system and expansion vessel, the automated feeder, the automated ash removal system and the emergency power unit. A 100,000 litre buffer store tank is available to cover peak demand as well as for providing

environmentally friendly operation in transitional periods. Currently, 53% of the buildings in Sarnthein and Nordheim are heated by the district heating plant.

3. The Heating Network

The district heating network is laid out as a radial dual-pipe system with flow and return. The pipe system consists of a friction-lock network system of factory-made pre-insulated pipework. The pipes are formed of a steel medium pipe with a polyethylene casing pipe and a heat-resistant insulator. They are buried in a sand bed at an average depth of 0.9 m. The pipes are equipped with signal wires for surveillance and locating leaks, and the signal wires can detect leakages not just in the medium pipe, but also in the casing as a result of water ingress from outside and thus indicate problems with the insulation and a potential danger of corrosion. The route of the district heating pipe system mostly follows publicly owned roads and paths.

4. The District Heating Substation

Connecting the heating circuit to the consumers' buildings takes place indirectly via district heating compact substations. Hydraulic separation into a primary circuit (i.e. the district heating network) and secondary networks (i.e. the central heating systems of the individual buildings) allows for adaptation to the different operating conditions in the heating systems of the consumers, and is also necessitated by technical and safety considerations. The following controls are available on the section of the primary network which enters the building:

- A blocking valve each for feeding and return flow
- Manometer
- Thermometer
- Dirt trap
- Combivalve for the adjustment of differential pressure and mass
- Heat counter
- control and feedback control systems

This provision allows the setting of an individual weekly heating programme and a timed programme for domestic hot water heating.

5. Our Raw Material (100% Sarntal)

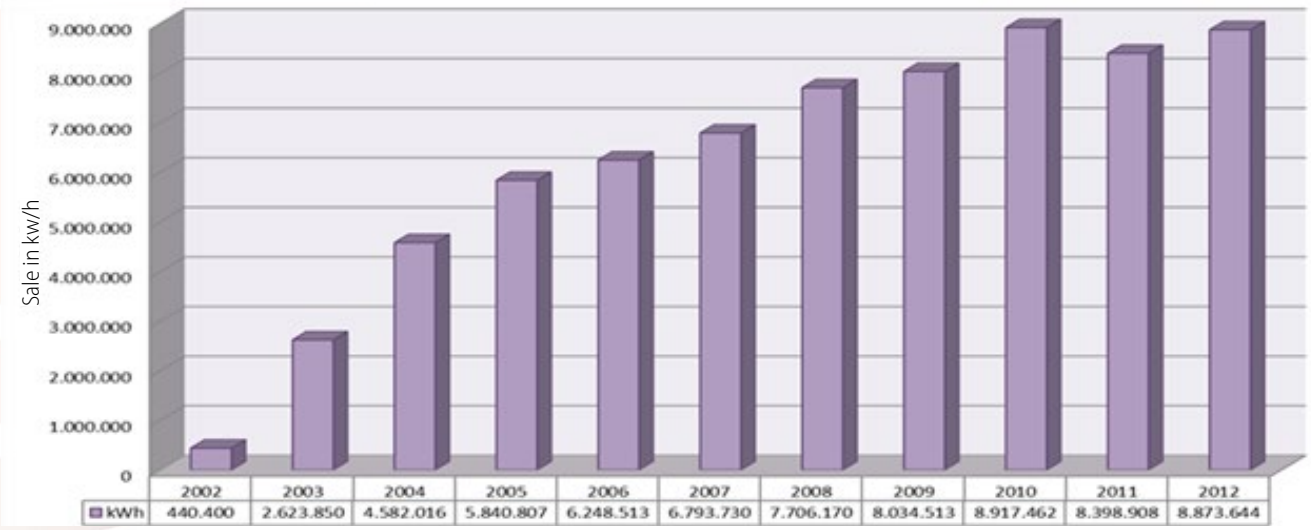
- Overall area of the valley of Sarntal ..... 30.250 ha
- Forest area ..... 13.000 ha
- Amount of forest owners ..... ca. 700
- Total reserves ..... 3,2 Mio scm
- Annual increment ..... 51.000 sfm/year
- Annual allowable cut ..... 45.000 sfm

The Sarnthein District Heating Plant exclusively uses biomass from the surrounding sustainably managed forests of the Sarntal. Approximately 36,000 cubic meters of standing wood are made available for felling each year, of which an average of approximately 30,000 cubic meters per year have been used over the past few years. Therefore, it can be argued fairly that the forest of Sarntal is managed sustainably.

The economically useable energy wood potential of timber from the Sarntal Forest represents around 18,500 cubic metres of standing wood per year (current consumption of timber in the Sarnthein District Heating Plant is 6,800 solid cubic metres, corresponding to around 17,000 cubic metres of loosely poured woodchips). Sustainable exploitation of the forests is guaranteed by the internationally recognised PEFC-Certification of all forest owners. This heating plant Sarntal is thus one of the few district heating plants in South Tyrol which are exclusively powered by local biomass.

6. Ecological advantages for the valley

By spring 2013, 317 buildings, including 45 businesses and 17 public buildings, had been connected to the Sarnthein District Heating Plant to the 12.7 km long pipe network. The network includes the townships of Sarnthein and Nordheim with the current extension to Astfeld.



Increasing sale of the heat in past years

The total quantity of heating oil replaced by wood in 2012 came to 1.15 million litres. As wood is a carbon-neutral energy source – when burnt it releases the same amount of CO2 it has absorbed whilst it has grown – around 3,400 tonnes of CO2 emissions could be saved in 2012. Thus the plant is making a significant contribution to the reduction of greenhouse gases.

Before the Sarnthein Plant started operations, all buildings in the area had stand-alone heating systems. On cold winter days at times of temperature inversion a blue pollution cloud would often form over Sarnthein. Several individual boilers have been replaced by the implementation of a central controlled furnace. This has led to a significant reduction in the emission of airborne pollutions and in turn to an improvement of the air quality.

6. 23. Bioenergy district heating plant Ritten

bioenergie Fernheizwerk Ritten
TIS innovation park

1. History

In 2006, a study for the future energy supply on the Ritten was made. The study concluded that the implementation of a district heating plant would only be expected for factions Klobenstein and Upper Bolzano, with the heating system in the Handwerkerzone Klobenstein. Even in 2006 a working group was established, which initiated the realization of the project.

In July 2007, the "Bioenergy Fernheizwerk Ritten cooperative" was founded. 2007 also a form for the connections and the connection fees was drafted - The aim was to reach a minimum height of approximately 9,000 kW within February 2008. In spring 2008 they started to bid for the work. It was decided to design the system not only in the production of thermal energy, but also to install an ORC module to generate electricity.

On 21 June 2008, the foundation stone for the construction of the center took place. In December 2008, the trial run has already been taken. The work on the pipeline network, especially concerning the main lines, was completed in 2008.

By the End of 2010 was also started with the construction of the first wood chip drying silo in South Tyrol. This was completed in the spring of 2011, and so the first wood chips could be dried in April 2011.

2. Technical data

Description	Data
Raw material consumption	approx. 62.000 loose cubic meter per year
Storage capacity of round wood	approx. 6.000 solid cubic meter
Storage capacity of wood chips	approx. 12.000 loose cubic meter
Nominal firing power	5,4 MW
ORC, thermal power	4.200 KW
ORC, electrical power	990 KW
Length of the district heating network	approx. 23.000 m

3. The raw material

The development in the last four years shows that more and more wood is supplied by local forest owners. The delivered biomass comes mainly from local forests, but also from other areas or cultures such as parks, river embankments, pasture or alp clearings, alleys, orchards, etc., so that deliveries could be progressively scaled back from the sawmills. The percentage of wood supplied by the major suppliers of wood (sawmills) is 30.60. From small wood suppliers (forest owners, members and non-members) 69,40% of all wood is delivered in the form of wood chips and logs.

4. The delivery

The delivery of the wood can be in the form of wood chips or logs. During the construction of the district heating plant a truck scale has already been installed for weight measuring. Initially, the moisture was measured by a probe that has been inserted into the unloaded wood chips pile. Since this system was, however, very inaccurate, it was decided to transfer to another, more accurate and reliable moisture meter (humimeter). The device has a 12 liter container, which is filled with wood chips. The moisture is then determined in the meter. The duration is including sampling, preparation of the measuring device and measuring about 5 minutes.

(Foto: www.humimeter.com)

5. The billing

The rates are defined in advance by the cooperative. The calculation of the price is due to the weight and the water content. The measured values are transmitted via a software system to headquarters, from where the credit amount is determined. Depending on whether the supplier is a member or non-member will be charged different amounts. Members receive a higher amount per solid cubic meter. In addition, there is a delivery quota which defines the max. possible quantity supplied by each member based on the forest area owned, which is charged at member prices. Currently, this amount is 20 SCM / ha of woodland. Further deliveries are charged at a lower price. Last but not least the payment is done.

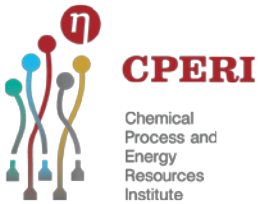
6. Wood chips dryer

By the end of 2010, the construction of the first wood chip drying system in district heating plants in South Tyrol began by the facility managers. Since no standard product could be delivered for the needed requirements, it was self-made. The dryer consists of two covered silo, which are equipped with a fine-mesh grid. Below the silos there are two fans that blow the excess process heat from electricity production up to the silos. By means of flaps, there is the possibility to regulate the quantity of heat flowing through electronically. The wood chips dryer was completed and put into operation in April 2011. The wood chips dryer brings immense benefits. Contribution of the current production residual heat can be used and must not be wasted. In addition, the district heating plant stores and burns mainly dry wood chips, which leads to considerable savings in aspects of mass loss (storage) and calorific value.

7. Economical data

Description	Data
Amount of employees	3,4
Investment main building	approx. 7,5 Mio Euro
Investment in network	approx. 10,0 Mio Euro
Average heat price	0,115 €/kWh
Amount of heat consumers	274
Amount of sold heat	approx. 11,0 Mio kWh

(Fotos: DHP Ritten)



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