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BIOEUPARKS

GUIDELINES

Steps in setting up wood biomass production chains in protected areas

Capacity building, capitalization of results and mainstreaming

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1 Introduction

The aim of the BIOEUPARKS project (Exploiting the potentialities of solid biomasses in EU Parks, IEE/12/994/SI2.645924) is to develop and propose a new approach to the promotion of new and renewable energies and their integration into the local environment and energy systems, as well as supporting the preparation of legislative measures.

More specifically, this project aims to contribute to the increase of local biomass supply from sustainably managed forests and from agricultural residues, and promote its most efficient use in heating and CHP installations.

Wood biomass is still an important fuel in many European countries. To support further development and the use of wood fuels also inside of national/regional or natural parks, step-by-step guidelines for the development of biomass production chains were developed. The main aim of this document is not to give the final decision and “to present the best option,” but rather to act as a guide through different options and to show what kind of data and information are needed before taking the final decision. Our overall goal is to show different options regarding development and local wood biomass production chains.

The different models propose to start with three key basic principles, which are strictly interconnected: sustainability, social acceptance, and economic growth.

To consider the parks as main actors in a biomass supply chain means to invest in a process based on the respect for nature, and the preservation of the ecosystem and biodiversity as starting points. At the same time, this choice implies a new way of looking at the role of parks; not only as a body in charge of managing natural and protected areas, but also a key actor with the ability to trigger a new way of local development matching nature conservation, and social and economic growth.

How does the project propose the parks manage this role? First of all, by choosing a specific supply chain model with identified and clear characteristics:

1. Short range. The distance from the location where biomass is harvested to the final user – in order both to minimize the impact on the environment and to ensure the quality of the biomass used for energy production.

2. Small scale and domestic plants. This means to promote local investment in local plants with under 1 MW of power, which can provide energy for a local district heating system or a biomass boiler installed in public buildings (parks and municipalities’ premises, schools, gyms or other leisure time facilities) or private houses. This is a key element for protecting both the ecosystem and the landscape.

3. Local engagement. The building of a biomass plant, particularly in an area of high natural value, represents a critical element. It can quickly cause a reaction from inhabitants concerned about the impact of the plant on air and soil pollution and landscape degradation.

The engagement of local inhabitants, economic actors, and policy makers in the process is the only way to achieve consensus. Local actors must be the first to be involved in the process, and raising their awareness about the opportunity that sustainable exploitation of solid biomass offers, and their agreeing with the sustainability criteria and the social-economic commitments that the supply chain represents, is of key importance.

Let us firstly look at sustainability in its wider sense: in terms of biomass use, sustainable forest management and sustainable biomass exploitation criteria must be followed; in terms of landscape, the value of natural heritage must be respected; in terms of social acceptance, the value of public overall health and wellbeing must be respected; and in terms of economic development, the requirements for natural protection must be taken into consideration.

In conclusion, the BIOEUPARKS project proposes and shows concrete alternative models on how European parks can become the leader in the process of local development where nature protection issues are perfectly matched with social values and economic growth.

2 Main steps in establishing a production chain

A supply chain is basically a sequence of organizations that are involved in different value performing processes that 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 a step-by-step implementation guide. The complexity is even higher when implementing biomass supply chains in protected areas.

Wood biomass production chains do not usually start from zero but are built from existing organisations or individuals, while only identified missing links have to be newly developed. The basic idea of the BIOEUPARKS project, within which these guidelines were produced, is to develop local biomass production chains inside the protected areas (in natural or regional parks) taking in consideration all existing limitations and local specialties.

Looking from this point of view, the main steps in establishing wood biomass production chains are:

1st step: Analysis of the present situation (market analysis) – this kind of analysis gives us an insight into biomass potentials, existing producers, and existing and potential users

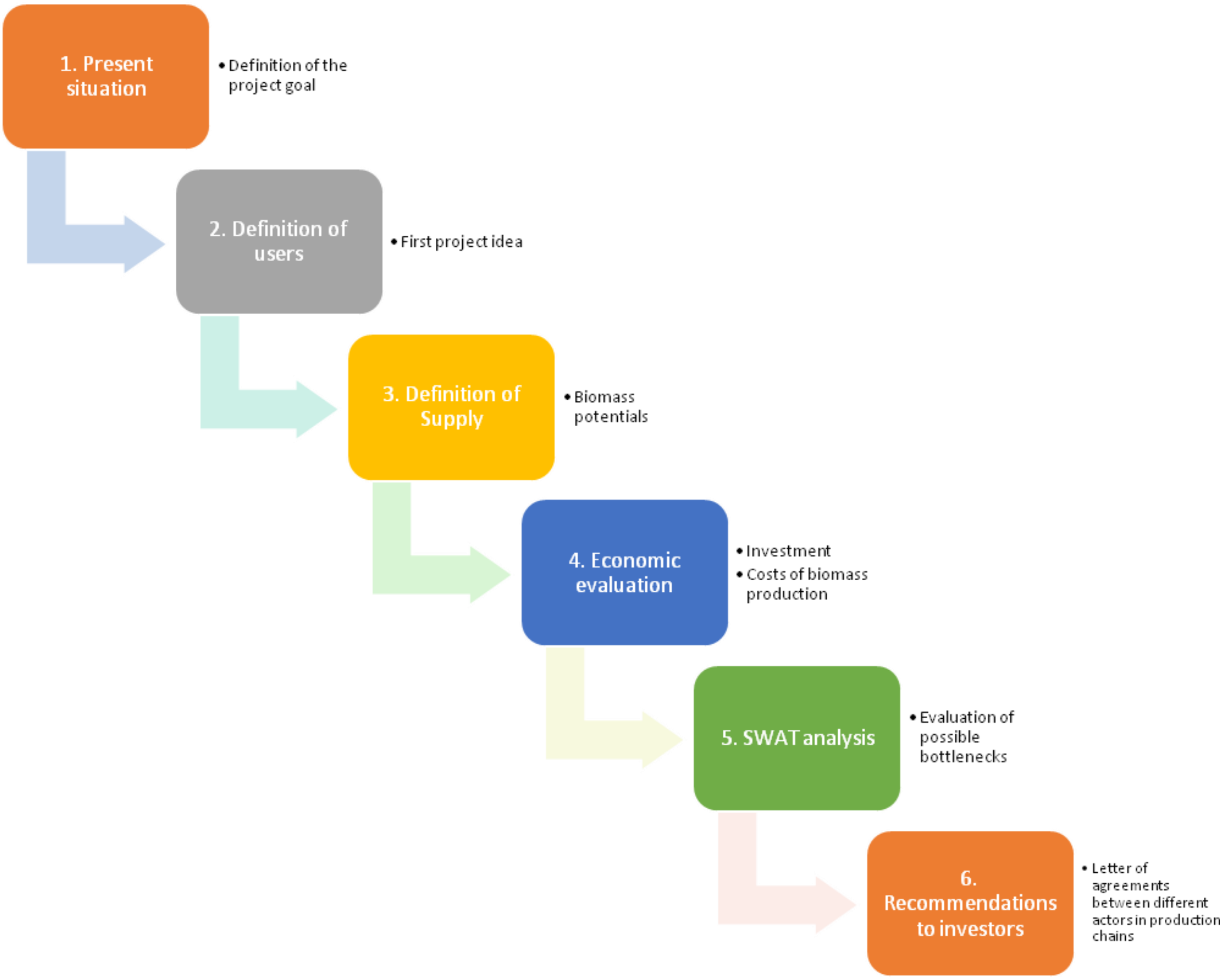
2nd step: Identification of end-users and the first project idea – analysis of end-users will provide the limits for biomass that needs to be produced and technical requirements

3rd step: Analysis of the biomass supply (theoretical and practical biomass potentials from different sources in the region and from protected areas – taking into account all limitations of protected areas)

4th step: Economical evaluation of a planned production chain

5th step: Evaluation of possible bottlenecks (weaknesses and strengths analysis)

6th step: Final recommendations for investors and Letters of Agreements between different actors in production chains



Picture 1 Steps in establishing biomass production chains

All these steps are presented in Chapters 3 to 6.

2.1 Analysis of the present situation

Prior to starting any project or new activity, a basic analysis of the market situation is necessary. This analysis can be done on different levels, depending on the scale of the project and the availability of existing data and financial resources.

A simple analysis of the present situation should be prepared using existing data (obtained from the relevant statistical office, public authority, park administration, public forest service and other publicly available data sets). Should the data not be available, some partial field data gatherings should be performed.

The analysis of the present situation should include the following Chapters:

A: Supply side

a) Biomass potentials – covering wood biomass from forests (incl. protected areas), wood biomass from other resources (agricultural land, wood processing industries), topics like forest ownership should not be excluded (see Chapter 3.1);

b) Wood biomass producers – a list of larger biomass producers should be prepared as these are possible wood biomass suppliers (see Chapter 3.3)

c) Short overview of the wood fuel market (how and where wood fuels are marketed, existing biomass trade centres, wood fuel prices) (see Chapter 3.3).

B: Demand side

d) Existing wood biomass users – the focus should be on larger biomass users (systems with an installed capacity of over 500 kWh).

C: Other issues

e) Existing environmental and other limitations (existing concessions for natural gas, limitations for the use of wood biomass due to air pollution...)

f) References (data sources)

2.2 Project goal

The most important question at the beginning of each project is the following: **"What is our goal, what do we want to achieve?"**

a) We would like to increase the use of wood biomass inside the park area. This goal can be achieved through the promotion of modern wood biomass boilers in households for heating houses/apartments with wood logs, wood chips or wood pellets. It can be achieved also through heating public and commercial buildings with wood biomass (by individual heating systems or if possible with district heating systems). The bottleneck is the amount of wood fuels (logs, wood chips or wood pellets) available from the sources inside the park area, therefore a detailed analysis of wood biomass potentials should be performed. Basic data collection on wood biomass potentials is presented in Chapter 3.1.

b) We would like to heat public buildings inside the park area with wood biomass, obtained through the maintenance of protected areas. An inventory of all public buildings in the park area should be prepared. The following data should be collected for each public building:

   a. Name/address

b. Current use of building
c. Year of construction
d. Total heating surface (m^2)
e. Existing heating system – type and age
f. Amount of fuel consumed in the last heating season
g. Energy efficiency measures performed during the last 10 years

An example of the questionnaire for collecting data is shown in the table below. Based on this data, a structured data set for public buildings can be created (also for future purposes).

Table 1 Questionnaire for data collection on public buildings in the park

Data needed	Building No. 1	Building No. 2
Type of building (school, kindergarten…) and its name (if applicable)		
Address		
Local community		
Year of construction		
Heating surface [m^2]		
Type of existing fuel		
Average annual amount of fuel (during the last 3 heating seasons)		
Use of energy in kWh/y		
Year of installation of existing boiler		
Energy efficient windows and doors (Yes/No)		
Insulation of walls (Yes/No)		
Roof insulation (Yes/No)		
Energy efficiency measures for whole building (Yes/No)		
Year of implementation of energy efficiency measures		

c) We would like to heat the settlements inside the park area (district heating system) with wood biomass supplied from within the park area. A list of settlements with maps and an overview of existing infrastructure should be prepared, public buildings should be marked and possible locations for a boiler house should be identified. A simple pre-feasibility study should be prepared. The data presented in Table 2 for buildings connected to the district heating system grid should be collected.

Picture 2 Map in pre-feasibility study – heating of a settlement

Table 2 Data collection on customers of the district heating system

First name and surname/company	Customer 1	Customer 2	Customer 3	Customer 4	Customer, etc.
Address	XXy				
Age of building	24				
Age of windows and doors (carpentry)	2				
Heated surface (m²)	240				
Number of occupants	4				
Daily internal temperature	20-22				
Existing energy source	Heating oil				
Age of heating system	20				
Power of boiler (kW)	25				
Annual energy source consumption	2.500 L				
Hot water (with or without boiler)	With existing b.				

This data presents the basis for the calculation of the installed capacity of the wood biomass boiler and the first estimation of wood biomass consumption per heating season. The practical calculation of wood biomass consumption is presented in Chapter 3.3.

d) We would like to heat the offices of the park administration with wood biomass and present the system as a good practice example in the park area. The offices can be in one or more buildings which are in one or more locations. As with all other projects, some basic data should also be gathered and the first decision regarding the heating system (micro district heating system of individual boiler houses) should be taken. The data presented in Table 3 for the buildings should be collected.

Table 3 Data collection on park administration buildings

	Building 1	Building 2	Building etc…
Address	XXX		
Age of building	24		
Age of windows and doors (carpentry)	2		
Heated surface (m²)	540		
Daily internal temperature	20-22		
Existing energy source	Heating oil		
Age of heating system	16		
Power of boiler (kW)	110		
Annual energy source consumption	5.500 L		
Hot water (with or without boiler)	With existing b.		

This data presents the basis for the calculation of wood biomass consumption. Following the simple calculation from Chapter 3.4, the installed capacity of a boiler can be calculated and the annual amount of wood biomass needed can be estimated. These estimations can be used for determining whether there is enough wood biomass available for the planned systems (matching supply and demand sides).

e) We would like to produce wood fuels and sell them to inhabitants inside the park area

The basic types of wood fuels that can be produced on the local level are the following (according to EN ISO 17225-1-7):

Firewood: Cut and split oven-ready fuelwood used in household wood burning appliances like stoves, fireplaces and central heating systems *(NOTE Firewood usually has a uniform length, typically in the range of 200 mm to 1000 mm).*

Wood chips: Chipped woody biomass in the form of pieces with a defined particle size produced by mechanical treatment with sharp tools such as knives. *(NOTE 1 Wood chips have a sub-rectangular shape with a length of 5 to 50 mm and a low thickness compared to other dimensions).*

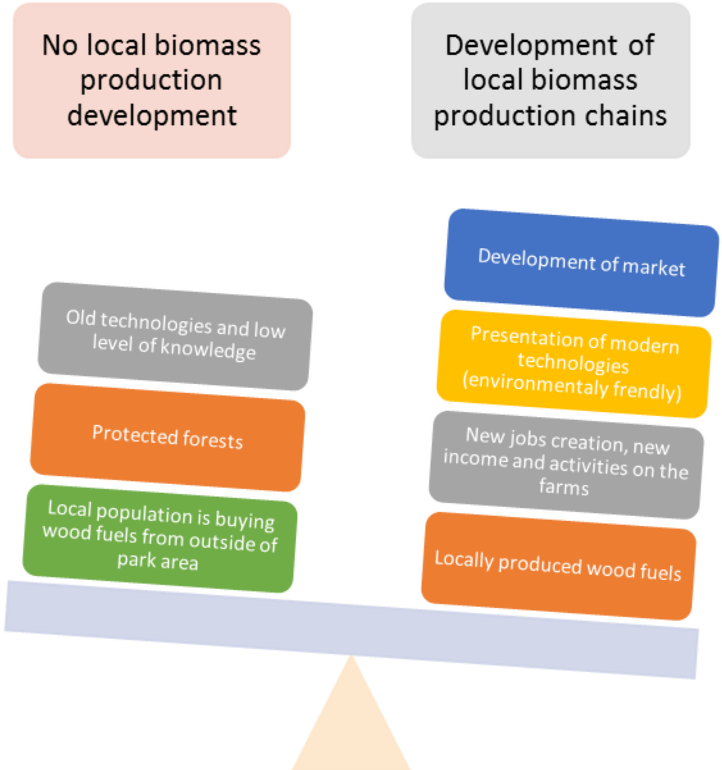
Wood pellets: Densified biofuel made from pulverised woody biomass with or without additives, usually in cylindrical form, of various lengths but typically 5 to 40 mm, with broken ends.

Wood briquettes: Densified biofuel made with or without additives in cubiform or cylindrical units, produced by compressing pulverised biomass.

The production technologies and characteristics of each type of wood fuel are presented in Chapters 3.1 and 3.2. For the purpose of an estimation of possible annual production of selected wood fuels, an estimation of available raw materials should be prepared (see Chapter 3.1). Prior to any decision making, market conditions also need to be analysed (an overview of the existing biomass producers – see Chapter 3.3).

f) We would like to give the local population the rights to produce wood fuels inside of the park area to heat their homes. This goal is not connected with any investment costs and as such doesn't need an investment plan. We need written rules and a written and signed agreement with the interested local population to prevent the degradation of ecosystems and non-professional exploitation of forests (causing damage to standing trees, erosion of soil, and damage to infrastructure, disturbing fragile / protected ecosystems,…). A proposal for a written agreement was prepared within the BIOEUPARK project and it is available on www.bioeuparks.eu. The preparation of a plan for forest operations is vital (e.g. for the next 5 years), and it should include marked areas of intervention, present all limitations (technologies that can be used, weather conditions in which harvesting can be done, part of the year when operations can be performed,…) and it should be a part of the written agreement.

Each of these goals include different steps and different project ideas, and that is why it is very important to discuss different options, analyse different approaches and determine the goals at the beginning of the planning processes.



Picture 3 Analyzation of different approaches

Table 4 Engagement of target groups and first steps to achieving specific goals

Specific goal	Target group	The most important first 3 steps
To increase the use of wood biomass inside the park area	Park authorities, households, local authorities, industries in the area, wood fuel producers, forest owners	1. Promotion of the idea among target groups 2. Organization of round tables 3. Technical and financial support
To heat public buildings inside the park area with wood biomass obtained through the maintenance of protected areas	Park authorities, local authorities, wood fuel producers, forest owners	1. Promotion of the idea among decision makers in local communities 2. Looking for possible investors 3. Organization of local supply chains
To heat the settlements inside the park area (district heating system) with wood biomass supplied from within the park area	Park authorities, households, local authorities, wood fuel producers, forest owners	1. Promotion of the idea among target groups 2. Looking for possible investors 3. Organization of local supply chains

To heat offices of the park administration with wood biomass and present the system as a good practice example in the park area	Park authorities, wood fuel producers, forest owners	1. Promotion of the idea among decision makers in the park 2. Looking for possible investors 3. Organization of local supply chains
To produce wood fuels and sell them to inhabitants inside the park area	Park authorities, households, wood fuel producers, forest owners	1. Promotion of the idea among households and wood fuel producers 2. Organization of local supply chains 3. Organization of local biomass trade centres
To give the local population the rights to produce wood fuels inside of the park area to heat their homes.	Park authorities, households	1. Promotion of the idea among households 2. Organization of round tables 3. Written agreement 4. Technical and financial support (for investing in modern boilers)

Picture 4 Delivery of wood chips to a storage house

3 Technical requirements for establishing a production chain

3.1 Wood biomass potential

The main sources of wood fuel are:

1. **Forests, plantations and other virgin wood**

Forests are the most important source of wood fuels in Southeast Europe. About half of the region's territory is covered by forests and this represents a significant source of wood fuel production. Wood has been used as a source of fuel for millennia and is still used in households around the world. Wood fuel is used mainly in rural areas and less so in urban areas.

Plantations are usually defined as short rotation energy plantations. They are generally established on agricultural land by regenerating new stems (shoots) from stumps or roots, harvested over a 1–5 year cycle. Fast-growing species like poplar, willow, black locust and eucalyptus are commonly used. Short rotation coppice, harvested over a 2–3 year cycle, is the most common across Europe (European model), with a planting density of between 5,000 and 16,000 plants per ha and a planting design of 0.5 x 3 m. The rotation cycle may vary from 1 to 3 years. A growing interest in coppice with a lower planting density (from 1,000 to 5,000 plants per ha and a planting design of 2 x 3 m) and rotation cycles up to 5–8 years (American model) have also been registered. The obtainable assortments in this case are firewood and wood chips.

Other virgin wood: Segregated wood from gardens, parks, roadside maintenance, vineyards, fruit orchards and driftwood from freshwater can also be considered under this category.

2. By-products and residues from the wood processing industry

This wood fuel can be chemically untreated wood residues (wood either with or without bark, or the bark itself) from primary wood processing (mainly sawmills) or chemically treated wood residues, fibres and wood constituents, but without heavy metals or halogenated organic compounds that are the result of treatment with wood preservatives or coating.

3. Used wood

This group includes post-consumer / post society wood waste, and natural or merely mechanically processed wood. It is important to understand that this kind of wood should not contain either any more heavy metals than virgin wood, or halogenated organic compounds that are the result of treatment with wood preservatives or coating.

In order to set up basic limits (operation scale) for the wood biomass projects, first estimations on wood biomass availability should be prepared. The main aim of this action is to determine the main sources and to estimate the theoretical wood biomass potentials.

The **theoretical market potential** is a maximum quantity of wood which could be sustainably cut down and offered on the market. The **actual market potential** is the actual average quantity of lower quality wood which was felled in the last five years and offered on the market. In this first stage, only theoretical potential is estimated.

For the collection of basic data on the park area and the theoretical potentials of wood biomass, the following questionnaire should be filled out.

Table 5 Table for data collection on wood biomass potentials

	General information about the target area
Topic	Geographic information about the park area: location and geographic context (altitude, geo-morphology, extension, etc.)
Description	Region, size of the park area... Surface: .... km²; Altitude: .... m.a.s.l. *(no more than 250 characters)*
Topic	Climatic conditions
Description	Short description of park area climate: Description of the heating season: Heating season start date: Heating season end date: Average winter temperature: Lowest winter temperature: *(no more than 400 characters)*
Topic	Land use information
Description	Structure of the land use in the park area: Forests: xx%, Agricultural land: xx% Building land: xx% Other: less than xx% Data source: Comments: *(no more than 250 characters)*
Topic	Population and socio-economic context (only most relevant information related to the forestry sector)
Description	Population: Density: people/km^2 Average age: Employed and self-employed: % Unemployed: % Agriculture: % farmers (share of population employed within the agricultural and forestry sectors) Forest ownership: % private forests Data source: Comments: *(no more than 250 characters)*

Topic	Protected area
Description	Data relevant for the exploitation of forests: NATURA2000: km^2 Protected forests: km^2 Comments: *(no more than 250 characters)*
	Information about forest stands in the target area
Topic	Forest cover (coniferous, broadleaved forest, other wooded land...)
Description	Forest area: ha (% of total park area) Broadleaves forests: % Coniferous forests: % Mixed forests: % Main tree species: Data source: Comments: *(no more than 250 characters)*
Topic	Growing stock (volume per hectare) and increment
Description	Broadleaves forests: m^3 Coniferous forests: m^3 Average increment: m^3/ha/year
Topic	Non-manageable forest area
Description	Area of non-managed forests: ha Main reason for non-management: *(no more than 250 characters)*
Topic	Accessibility of forests (forest roads) in the park area
Description	Total length of forest roads: km Average density: km/km2 Data source: Comments: *(no more than 250 characters)*

	Figures on wood production in the park area
Topic	Annual wood production
Description	Average annual harvesting: m^3 Structure of annual harvesting: Coniferous: ……% (% of total annual harvest) Logs: % Fuel wood: % Broadleaves: ……% (% of total annual harvest) Logs: % Fuel wood: % <u>Total amount of wood available for energy production</u> from the forests (estimation of theoretical potentials): ……………….. m^3
	Figures on wood biomass production for other resources
Topic	Wood processing industry
Description	Short description of wood industry in the area: No. of sawmills and their annual production No. of paper mills and wood boards producers and their annual production Other relevant information about the wood industry <u>Total amount of wood residues available for energy production</u> (estimation of theoretical potentials): ……………….. m^3 (or tons) *(no more than 500 characters)*
Topic	Other land use classes
Description	Biomass from vineyard and orchards: m^3 (or tons) Fuelwood from other land uses with trees: m^3 (or tons) Other relevant information about land use practices: <u>Total amount of wood biomass available for energy production</u> (estimation of theoretical potentials): ……………….. m^3 (or tons) *(no more than 500 characters)*
	CURRENT NATIONAL OR LOCAL POLICIES CONCERNING FORESTRY BIOMASS PRODUCTION
Topic	Information about regulation or funding in regards to forestry biomass production
Description	Short description of specific regulations that can foster or hinder wood biomass production in the park area: Available subsidies: *(no more than 750 characters)*

All gathered data should be used for the preparation of the summarizing table below, which serves as a basis for drafting further steps within the planning process.

Table 6 Summarising table for wood biomass potentials

Supply parameter	Estimation of theoretical potentials [1000 m^3]	Availability for new wood biomass projects (in %)[*1]
Biomass from forests and other forest lands		
Biomass from vineyards and orchards		
Sawdust and wood residues in wood-processing industry		
Fuelwood from other land uses with trees		

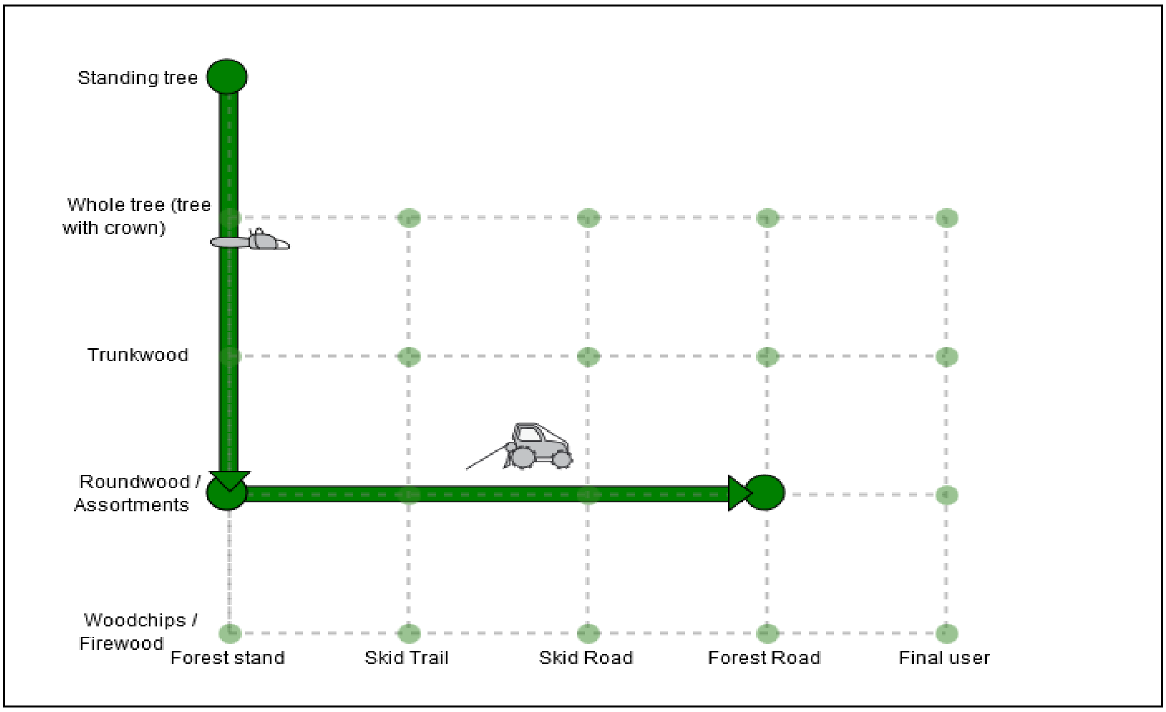
Remark: [*1] this percentage is only an estimation, for example it represents the percentage of wood biomass from forests that could be used in a new wood biomass system – the present use of wood biomass in households and other existing heating systems should be taken into consideration.

3.2 Wood biomass production technologies

Wood biomass production technologies vary along the value chain. These guidelines present the value chain of forest production as well as firewood and wood production value chains. The most attention is given to the wood chips production chain.

3.2.1 Forest production value chain

The most common system of wood production is a technology implemented in combination with traditional felling with a chainsaw and skidding with an adapted forest tractor. This process begins in a forest stand with felling. After felling, the tree is trimmed and cross-cut with a chainsaw with the power of 4 kW. Next follows the collecting and hauling of timber to the forest road with an adapted forestry tractor. An adapted forestry tractor is a tractor which has been completely upgraded for forestry use (safety frame), has a double drum built-in winch (5 tons), a radio-control unit, and forestry chains at least on its back rubber tires. A simplified illustration of this production chain is illustrated on Picture 5.



Picture 5 Production chain of timber felling and skidding; (source: Slovenian Forest Institute, 2015)

Picture 6 illustrates felling with a chainsaw, whereas Picture 7 shows skidding with an adapted forestry tractor.

Picture 6 Felling with a chainsaw

Picture 7 An adapted forestry tractor

Source: J. Klun

The total cost of this production chain is 45.2 EUR/h, whereas the direct material costs chain with the assumption of an average predicted efficiency in an eight-hour working day amounts to 15.3 EUR/m^3 (Table 7).

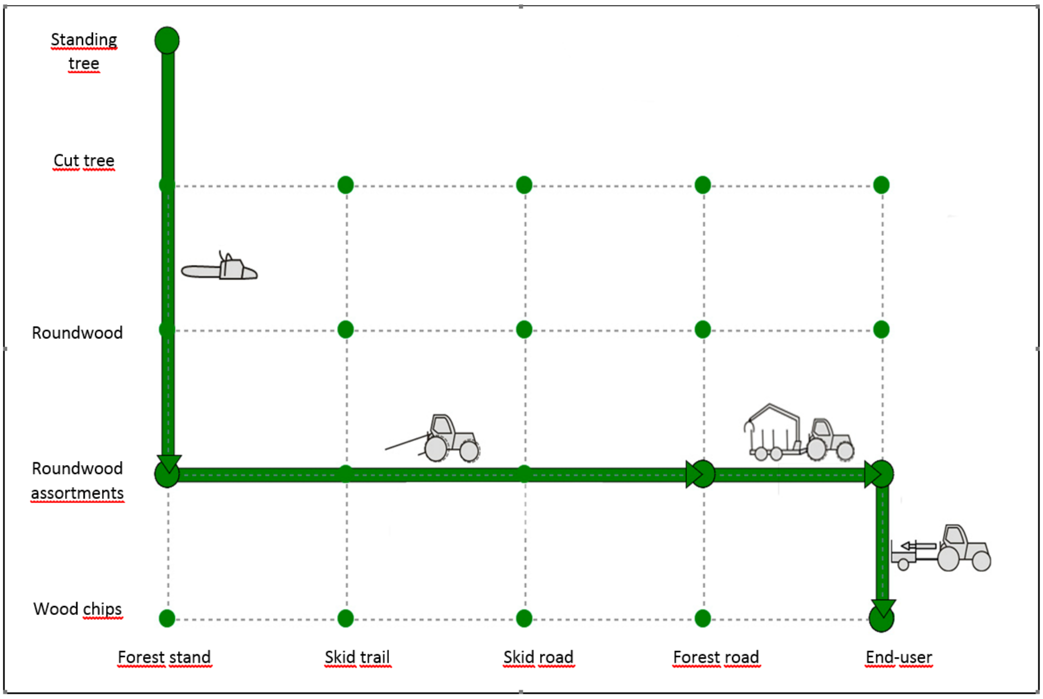
Table 7 Material costs and predicted efficiency of the timber felling and skidding production chain

Machine	Total cost (EUR/h)	Direct material costs (EUR/m³)	Predicted efficiency (m³/8h)	Comment
Chainsaw (4 kW)	4.0	2.1	15.0	Felling, delimbing
Forestry tractor	41.2	13.2	25.0	Skidding
Production chain costs	**45.2**	**15.3**		

Source: Slovenian Forestry Institute, 2015

3.2.2 Firewood production chain

The traditional production of firewood is the most widely used method for firewood production in households and agricultural holdings. As in forest production, the manufacturing process begins in a forest stand with felling, delimbing, and crosscutting with a chainsaw with the power of 4 kW. These operations are followed by collecting and hauling of timber to the forest road. This is done with an adapted forestry tractor which has been completely upgraded for forestry use (safety frame), has a double drum built-in winch (5 tons), a radio-control unit, and forestry chains on its tires. Roundwood assortments are transported from the forest road to the end-user by a forestry transport composition. This composition includes a three-axial truck for roundwood with a crane and trailer. Roundwood is cut into 1 m logs with a chainsaw with the power of 6 kW at the location of the end-user. Logs are then split into chunks (1 m firewood logs) with a hydraulic horizontal log splitter (up to 30 tons) on a standard tractor. The final step is the production of firewood (length of 33 cm), which is done with a standard tractor and a tractor driven circular saw (Picture 8).



Picture 8 Traditional firewood production chain; source: Slovenian Forest Institute, 2015

The pictures below show examples of a tractor driven circular saw and a hydraulic horizontal splitter.

Picture 9 Tractor driven circular saw Picture 10 Hydraulic horizontal splitter

Source: M. Dolenšek

Table 8 shows direct material costs of the production chain with the assumption of an average predicted efficiency in an eight-hour working day. The table shows that the total costs are 45.2 EUR/h, whereas direct material costs amount to 15.3 EUR/m^3.

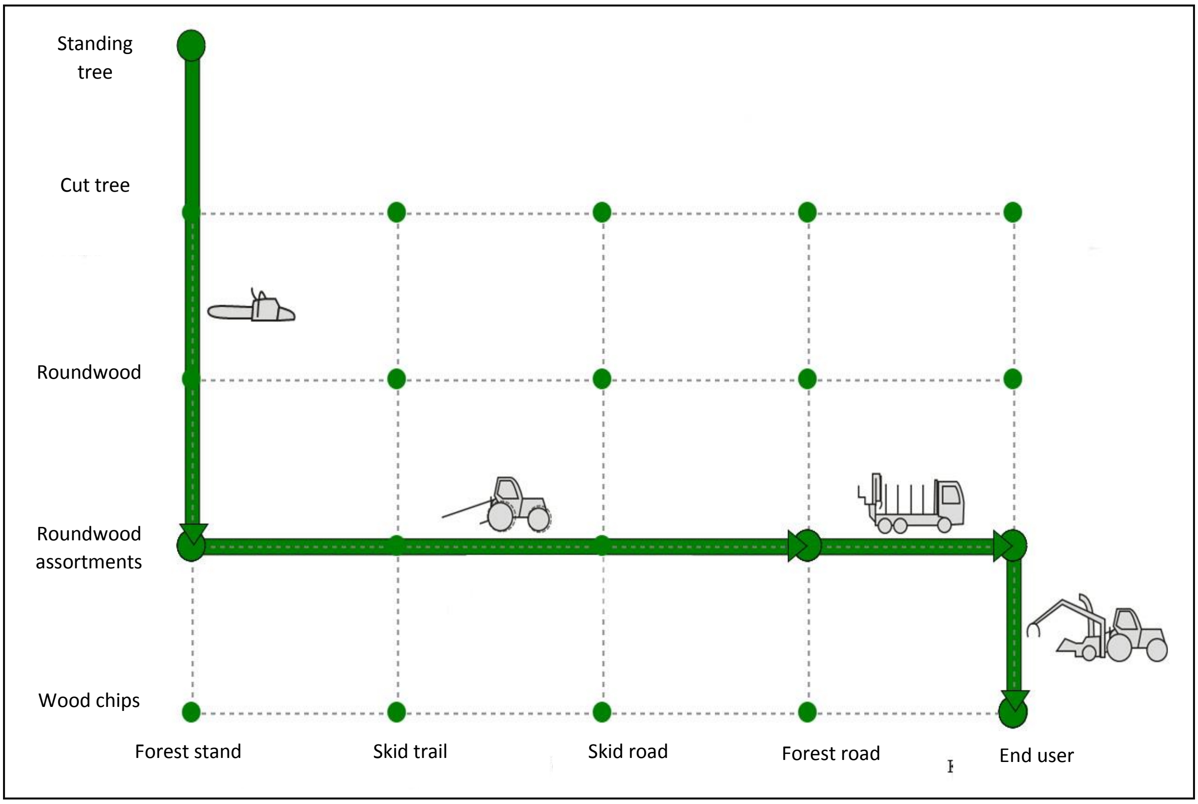
Table 8 Material costs and predicted efficiency of the traditional firewood production chain

Machine	Total cost (EUR/h)	Direct material costs (EUR/m^3)	Predicted efficiency (m^3/8h)	Comment
Chainsaw (4 kW)	4.0	2.1	15.0	Felling
Forestry tractor	41.2	13.2	25.0	Skidding
Forestry transport composition	44.4	5.1	70.0	Roundwood transport
Chainsaw (6 kW)	5.7	1.5	30.0	Cutting to 1 m
Standard tractor	25.8	12.9	16.0	Logs (1 m)
Splitter (30 t)	13.0	6.5	16.0	Logs (1 m)
Standard tractor	25.8	12.9	16.0	Firewood (33 cm)
Circular saw	7.5	2.5	24.0	Firewood (33 cm)
Production chain costs	**167.4**	**56.7**		

Source: Slovenian Forestry Institute, 2015

3.2.3 Traditional wood chips production chain

This chain provides the traditional way of timber harvesting. The chain starts in the forest stand with cutting, delimbing, and crosscutting with a chainsaw with the power of 4 kW. Timber is then collected and skidded to the forest road with an adapted forestry tractor with a light forestry safety frame, forest chains, and an electro-hydraulic single drum winch with a radio-control unit (6 tons). Roundwood (i.e. pulpwood and fuelwood) is transported from the forest road to the end-user by a forestry transport composition (a three-axle truck for roundwood with a crane and trailer). At the location of the end-user, wood chips are produced using a tractor PTO (Power Take Off) driven chipper with a loading device. This process is illustrated in Picture 11, whereas some of the machinery from this production chain is shown in Pictures 12 and 13.



Picture 11 Traditional wood chips production chain; source: Slovenian Forest Institute, 2015

Picture 12 Forestry transport composition Picture 13 PTO driven wood chipper
Source: J. Klun

Table 9 shows the direct material costs of the production chain (based on the assumption of an average predicted efficiency) in the eight-hour working day. The table shows that the total costs of this production chain are 198,6 €/h, at what direct material costs are 28,7 €/m^3.

Table 9 Material costs and predicted efficiency of the traditional wood chips production chain

Machine	Total cost (€/h)	Direct material costs (€/m^3)	Predicted efficiency (m^3/8h)	Comment
Chainsaw (4 kW)	4.0	2.1	15.0	Felling
Forestry tractor	29.9	7.5	32.0	Skidding
Single drum winch	5.5	2.5	18.0	Skidding
Forestry transport composition	44.4	5.1	70.0	Roundwood Transport
Standard tractor	40.7	4.1	80.0	Wood chips
PTO Wood chipper	74.1	7.4	80.0	Wood chips
Production chain costs	**198.6**	**28.7**		

Source: Slovenian Forestry Institute, 2015

3.2.3. Mechanized wood chips production chain

This production chain assumes the production of wood chips on a forest road or at a temporary storage location, and transports them over long distances to major customers (i.e. district heating systems). Felling begins in a forest stand and is then followed by delimbing, crosscutting, and collecting the timber with a wheeled harvester with the power of 140 kW. Timber is transported to the forest road by a forwarder with a load capacity of 12 tons. Wood chips are produced on the forest road using a wood chipper on a truck with a loading device. Wood chips are transported to the end-user by a truck with a segment moving floor (cargo floor) trailer for loose material. The pictures below show the machines that are used in this production chain.

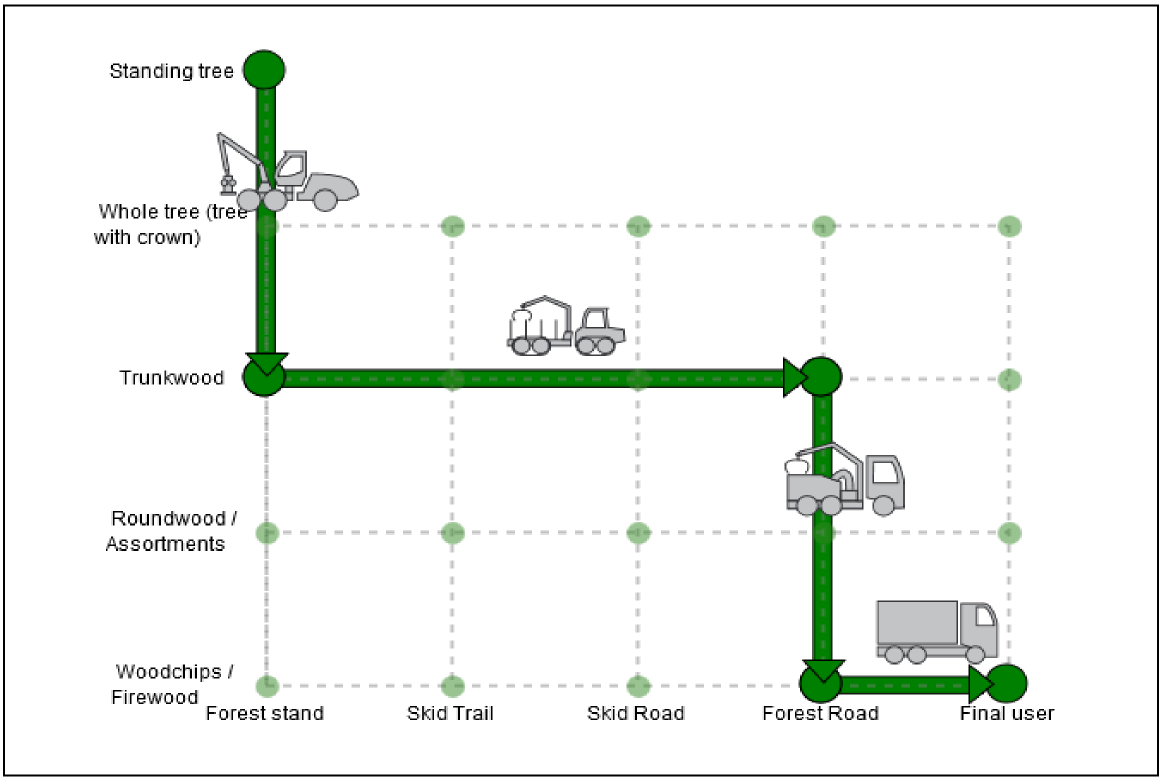
Picture 14 Harvester

Picture 15 Forwarder

Picture 16 Wood chipper on the truck

Picture 17 Truck with cargo floor trailer

Source: J. Klun



Picture 18 Mechanized wood chips production chains; Source: Slovenian Forestry Institute, 2015

The direct material costs of the production chain are shown in Table 10. The table shows that the total costs of this production chain are 595.4 EUR/h, whereas direct material costs amount to 44.5 EUR/m^3.

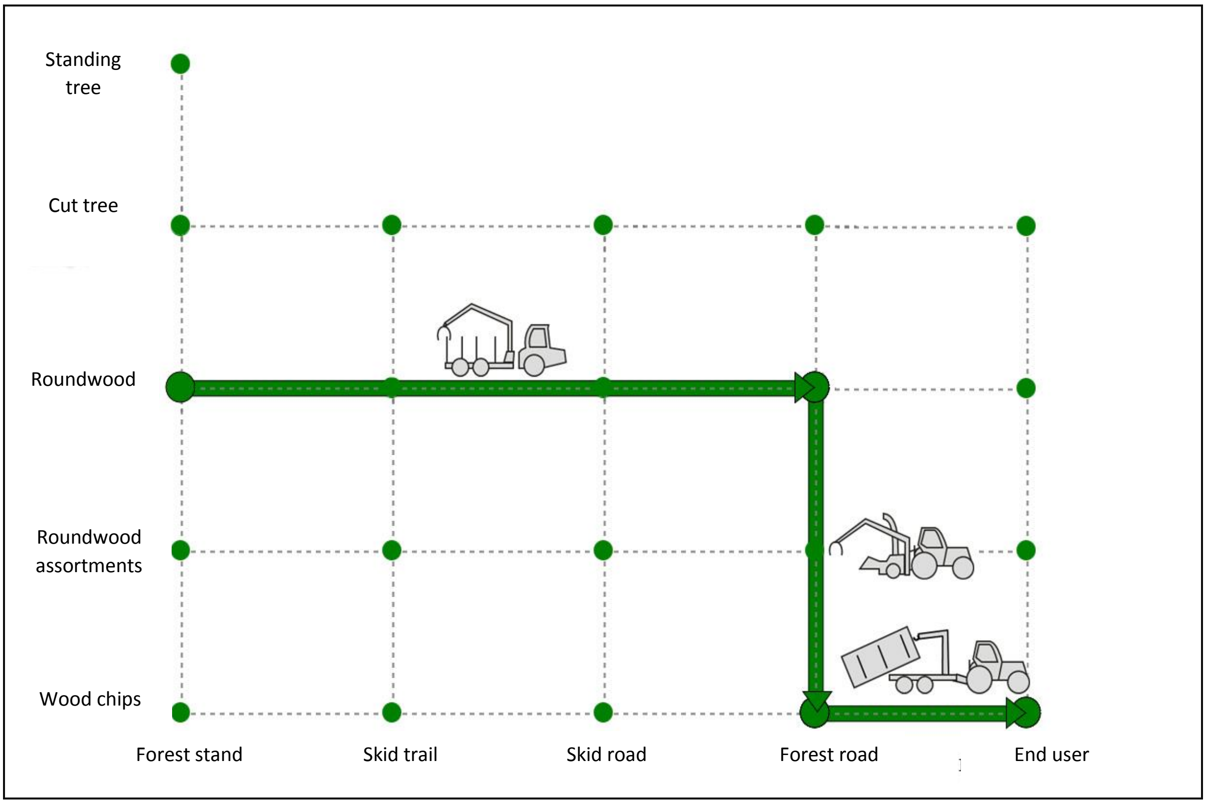
Table 10 Material costs and predicted efficiency of the mechanized wood chips production chain

Machine	Total cost (EUR/h)	Direct material costs (EUR/m^3)	Predicted efficiency (m^3/8h)	Comment
Harvester	115.0	13.1	70.0	Felling, collecting
Forwarder (12 t)	87.7	11.7	60.0	Extraction
Truck wood chipper	421.5	16.9	200.0	Chipping
Wood chips truck	86.3	15.3	45.0	Transport (30 km)
Production chain costs	**710.4**	**57.0**		

Source: Slovenian Forestry Institute, 2015

3.2.4. Green wood chips production chain

Green wood chips are produced from residues obtained during forest production (e.g. treetops, branches). This production chain illustrates the collection and harvesting of felling residues with a mini-forwarder (5 tons). Green wood chips are produced on the skid road using a standard tractor with a wood chipper and loading device. Green wood chips are transported to the end-user with a standard tractor with a container trailer (16 tons) and a lifting device.



Picture 19 Green wood chips production chain; Source: Slovenian Forestry Institute, 2015

Table 11 shows the direct material costs of the production chain on the assumption of an average predicted efficiency in an eight-hour working day.

Table 11 Material costs and predicted efficiency of the green wood chips production chain

Machine	Total cost (EUR/h)	Direct material costs (EUR/m^3)	Predicted efficiency (m^3/8h)	Comment
Mini-forwarder (5 t)	50.0	16.0	25.0	Collection of felling residues
Standard tractor	40.7	4.1	80.0	Chipping
Tractor wood chipper	74.1	7.4	80.0	Chipping
Standard tractor	40.7	13.0	25.0	Transport (10 km)
Container trailer	21.7	6.9	25.0	Transport (10 km)
Production chain costs	**227.2**	**47.4**		

Source: Slovenian Forestry Institute, 2015

As evident from the table above, the total costs of this production chain are 227.2 EUR/h, whereas the direct material costs amount to 47.4 EUR/m^3.

3.3 Wood fuel producers

The analysis of wood fuel producers in the park area and its surroundings should be an essential part of the analysis. The methodology for data collection should be adapted to time and resources available. Data on registered wood fuel producers should always be collected from the official register. Data can be collected from the European Business Register (hereinafter referred to as "EBR"). EBR is an information system through which Member States provide data and certain services from their national business registries. This growing network currently includes 24 European countries. The EBR information system provides fast and simple access to data and information regarding business entities based in EBR Member States, as well as to certain documents related to the business entities' operations (http://www.ajpes.si/registers/eebr_company_search/overview). Additional data sources are regional Chambers of Commerce (if they exist), Forest Services, local internet pages and advertisements in different media. A catalogue of wood fuel producers in 9 countries / regions (Slovenia, Croatia, Romania, Italy – Northern part, Austria – Styria, Germany – Bavaria, Spain, Ireland and Greece) was published within the framework of the BIOMASSTRADECENTRE II project and is still available on http://www.biomasstradecentre2.eu/wood-biomass-production/service-providers/.

Data can be collected with the form presented in the table below.

Table 12 Table for data collection on wood fuel producers – first stage

Company name	Address	Type of wood fuel produced	Company size	Comments
Xy 1		Wood logs Wood chips Wood pellets	Micro SME Large	In the park area In the surrounding area
Xy 2		Wood logs Wood chips Wood pellets	Micro SME Large	In the park area In the surrounding area
……		Wood logs Wood chips Wood pellets	Micro SME Large	In the park area In the surrounding area

The first stage of data collection can be done through desk research (the collecting of data from different resources). After the conclusion of the first stage, some more specific data should be collected and this has to be done through short phone interviews. The data, collected in this second stage, is more detailed (see table below).

Table 13 Table for data collection on wood fuel producers – second stage

Company name	Average annual production (tons*1)	Main source of wood biomass	Main existing buyers	Available wood biomass for new buyers (t)	Quality classes of wood fuel produced*2
Xy 1		Forests Wood industry Non-forest land Other	Households Existing biomass systems / Industry Export Other		
Xy 2					
……					

Remark: *1: Please specify whether fresh or dry tons are reported.
*2: In accordance with relevant ISO standards (ISO/DIS 17225 series (7 parts))

All gathered data should be used for the preparation of the summarizing table below, which serves as a basis for drafting further steps within the planning process.

Table 14 Summarising table for wood biomass producers

Type of wood fuel producers	Estimated No. of producers	Estimated annual production (t)	Available wood biomass for new buyers (t)
Wood log producers			
Wood chips producers			
Wood pellet producers			
Sum			

It is more important to gather data on wood chips and wood pellet producers in the selected area (the area of the park with a defined surrounding area) than to collect the number of wood log producers. It is very common that wood log producers are smaller by scale, are often not registered for the activity and it is consequently harder to locate them.

When buying or selling wood fuels, two main questions arise:

1. Units of measurements
2. Wood fuels quality – what are the quality classes

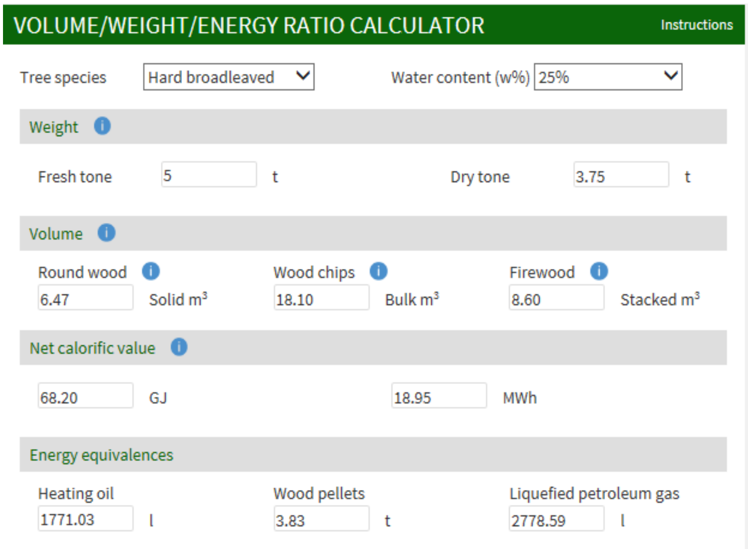
3.3.1 Units of measurement

The table below shows the units of measurement for volume and weight that are commonly used in the marketing of wood fuels.

Table 15 Units of measurement

Ton	Kilogram	Stacked cubic metre	Bulk cubic metre
t	kg	stacked m^3	bulk m^3
log woods chips pellets and briquettes		log woods	firewood chips

The Slovenian Forestry Institute developed a simple calculator (see picture below) that enables the calculation of different units of measurements: http://wcm.gozdis.si/Home/UnitsCalculator.



Picture 20 Volume/weight/energy ratio calculator

Table 16 Basic conversion factors for wood fuels

	Round wood	Logs		Wood chips	
		Stacked	Heaped	Fine	Coarse
	[m^3]	[stacked m^3]	[bulk m^3]	[bulk m^3]	[bulk m^3]
1 Roundwood	1	1.2	2	2.5	3
1 stacked m^3 logs	0.85	1	1.67	2	2.5
1 bulk m^3 logs	0.5	0.6	1	1.25	1.5
1 bulk m^3 wood chips, fine	0.4	0.5	0.8	1	1.2
1 bulk m^3 wood chips coarse	0.33	0.4	0.67	0.85	1

3.3.2 Quality of wood fuels

The quality of wood fuels has to match boiler requirements. Smaller boilers (with a capacity of under 200 kW) have higher quality requirements. The water content should be under 25%, the size of particles is strictly defined, and the percentage of fine dust particles should be lower. The requirements for the highest quality classes are presented in the table below.

Table 17 Basic quality requirements for wood fuels

	Basic requirements (according to ISO standards)[*1]	Relevant standard
Wood logs	Class A1: Diameter and length should be stated, M20 or M25 (moisture below 25%), no visible decay, more than 90% of pieces should be split	EN ISO 17225-5:2014
Wood chips	Class A1 or A2: Particle size P16S or P31S, up to M35 (moisture below 35%), ash content less than 1.5%, fines fraction less than 15%	EN ISO 17225-4:2014
Wood pellets	Class A1: M10 (moisture below 10%), ash content less than 0.7%, mechanical durability more than 97.5%, bulk density more than 600 kg/m^3	EN ISO 17225-2:2014

Remark: [*1]The values in the table are only informative, for a more detailed quality check of wood fuels, the original ISO standards should be used.

The properties of wood fuels should be specified in the product declaration. It is important to emphasise that the whole responsibility for correct and accurate information is on the side of the producer/supplier.

For more detailed information about the issues regarding the quality of wood fuels, see two publications produced within the framework of the BIOMASSTRADECENTRE II project (literature is available on www.biomasstradecentre2.eu).

3.3.3 Buying wood chips

Wood chips are traded on the fuel market in bulk cubic metres or absolute dry mass (tons). One bulk cubic metre corresponds to 200–450 kg, depending on the respective wood type, size and water content. The net caloric value of one bulk cubic metre is between 630 kWh and 1,100 kWh, mostly depending on water content. For this reason, wood chips should be bought and sold based on their weight and water content.

For the delivery of wood chips, their quality should be defined before signing a contract with selected wood fuel producers. The main points that should be agreed upon in a wood chips delivery contract before delivery are the following:

- Wood chips quality:
    - Water content (M): From 25 to 35% (water content can be described as the ratio between water and total substance (fresh material) – fresh wood (after harvesting) has a water content between 60 and 65%.
    - Particle size class (P): For small and medium size boilers, the particle size class should be P16S or P31S, oversized particles can cause problems.
    - Contaminated wood chips: Produced from demolition wood or wood wastes (contaminated with plastics, paint,…) and should not be used.
- Estimated total annual amount of wood chips needed (the amount is estimated based on past heating seasons, and when dealing with a new heating season, the estimation from project documentation is used)
- Time of delivery (in case of school, the delivery should be carried out before or after classes.
- Person responsible for ordering and monitoring the delivery of wood chips at the side of the user and the producer.
- Price of wood chips: Wood chips are traded on the fuel market most commonly in bulk cubic metres or in absolute dry mass (tons). One bulk cubic metre

corresponds to 200–450 kg, depending on the respective wood type, size and water content. The net caloric value of one bulk cubic metre is between 630 kWh and 1,100 kWh, mostly depending on water content. For this reason wood chips should be bought and sold based on their weight and water content. However, it is usually very hard to weight and monitor the water content of every delivery, and that is why we recommend that the payments for wood chips be based on the actual heat they produce – the amount of heat produced is determined by a calorimeter (installed in the boiler house) on a monthly basis and the produced heat is paid for according to the agreed price (EUR/MWh).

3.3.4 Wood biomass trade centres

Biomass trade centres (BTC) are market spots where quality wood fuels (wood logs, chips and pellets) are sold in a transparent way all year round. The most important part of each BTC is a storage place which should be partly covered (for storing of final forms of wood fuels), but also large enough to store larger amounts of roundwood and other raw materials. It is important that it is located away from the settlements, as production of wood chips and logs is a noisy and dusty activity. A BTC should also have a weighting bridge for selling wood fuels by weight and it has to offer services (e.g. transport of wood fuels). It is important that in a BTC, only local wood fuel is sold and that it has a cohesive role in the local wood biomass production chains. It is recommended that BTCs should be established and managed by local forest owners. This type of local centre can also have an informational and educational role (an information point for those who would like to produce or use wood fuels).

3.3.5 Buying wood pellets

1. The colour of pellets does not determine their quality.
2. The only characteristic of pellets that can be determined by the buyer (without special measurement) is their mechanical durability; the fine dust on the bottom of a 15 kg sack shows the durability of pellets.
3. The label that confirms the certificate

(ENplus, DINplus) provides insurance that the quality of wood pellets is controlled by independent institutions. This means that there is a much higher probability that wood pellets will be of good quality (or at least of the quality indicated on the declaration).

4. At the moment there is no legislation about data that should be published on declarations and it is recommended to select pellets from producers that provide more data on their labels.
5. It is recommended to check the origin of pellets.
6. All wood pellets have nearly the same gross caloric value (regardless of tree species), and their net caloric value changes only depending on water content. This means that the tree species or share of bark factor has no significant influence on the energy content of pellets.
7. Bulk density of pellets is important only because of the volume that a 15 kg sack will take up. Lower bulk density means a larger volume of a 15 kg sack (sometimes a 15 kg sack can even weight less than 15 kg).
8. The quality of pellets should be adapted to the needs of the customer (and especially to the requirements of the customer's heating system).
9. The price of wood pellets shouldn't be the main selection criteria.
10. When buying pellets from new and untested producers, first a smaller amount of pellets should be bought and tested (only a few 15 kg sacks).
11. Wood pellets should be bought at the end of the heating season when the prices are lower.
12.

3.4 Estimation of wood fuel consumption

The needed amount of wood chips in a new boiler house can be calculated from data on past consumption of fossil fuels (in case of the replacement of an old boiler). In the following example, we will foresee the change from heating oil to wood chips.

a) *Calculation based on data on past consumption of light heating oil (the average from the past three years will be taken into consideration)*
   - Average annual amount of light heating oil: 23,530 l per year
   - Heating value (H_i) heating oil: 10 kWh per l
   - Efficiency of the boiler (ŋk): 85 percent

Annual heat production in kWh:

$$\textbf{Heat (kWh per year)} = \mathbf{23\,530\,l * 10\ \ per\ kWh\ per\ year}$$

b) *Calculation of the annual amount of wood chips*

- Needed amount of heat: 200,000 kWh/year
- Heating value (H_i) wood chips (M30 percent): 3.4 kWh per kg
- Efficiency of the boiler (ŋk): 80 percent

Estimation of the annual amount of wood chips:

$$wood\ \ chips\ \ (kg/year) = \frac{200\,000\ \ kWh/year}{3.4\ \ kWh/kg * 0{,}80} = 73.530kg\ \ (\approx 75t)$$

In case of wood chips with w = 35%, 75 tons is equivalent to 293 nm^3

c) *Rough estimation of the necessary installed capacity of the wood chip boiler (1,500 working hours per year)*

$$Q\ (kW) = \frac{200\,000\ kWh}{1\,500\ h} * \frac{1}{0.80} \approx 160\ kW$$

For the calculation of wood chip requirements in small-medium size plants, the following empiric formulas may be used:

Boiler capacity in **kW x 2.5** = wood chips requirement in **bulk m^3 per year**

If the plan is to build a new district heating system, data on past consumption in individual houses should be collected as shown in Table 1. The collected data can be used just as a first estimation. An expert should be consulted for the correct calculation of the installed capacity of the boiler and the dimensions of pipe lines.

4 Compliance with EU legislation and sustainability issues

In this part of the guidelines, we will endeavour to present the most important aspects that nature parks should take into account when they intend to implement biomass activities on their territory.

Under its energy policy, the EU has set itself a mandatory target of having 20% of its total energy consumption coming from renewable energy sources by 2020, which should increase the demand for forestry biomass (Directive 2009/28/EC). Additionally, approximately 37.5 million hectares of forest belong to the Natura 2000 network for nature protection, set up under the European Union's environment policy. The rational use of forests is one of the thematic priorities of the European Union's new Environment and Climate Action Programme (LIFE 2014–2020, Regulation (EU) No 1293/2013). The EU Biodiversity Strategy to 2020 (COM (2011) 0244) stipulates that sustainable forest management plans for publicly owned forests must be in place by 2020. Tailored sustainability policies: environmental, economic and social sustainability is a key condition for successful business development in the forestry biomass sector. But securing these objectives is a challenge for policy makers. Another important issue is carbon neutrality of forestry biomass as a fuel. Because of the many different ways that bioenergy can be produced, the energy efficiencies and climate (carbon) impacts of forestry biomass-based energy production may vary greatly.

4.1 National biomass sustainability criteria

In its 2010 Biomass Report, the Commission recommended sustainability criteria similar to those applying to biofuels and bioliquids, for biomass installations of a minimum 1 MW electric or thermal capacity. National authorities were also recommended to design national support schemes with the objective of stimulating higher efficiency of bioenergy plants. Furthermore, Member States were invited to keep records of the origin of primary biomass used in electricity and heating/cooling installations of 1 MW or above, in order to improve the biomass statistics and allow for a better monitoring of market trends. These recommendations were aimed at preventing both the risk of trade barriers stemming from the development of (potentially conflicting) national sustainability regulations and addressing potential sustainability issues. A review of Member States' implementation of the 2010 recommendations found that:

- While about half of the Member States have adopted regulations promoting higher efficiency of bioenergy production (i.e. efficient CHP), only few Member States (Belgium, Italy, UK) have adopted greenhouse gas (GHG) saving criteria for biomass used in electricity/heating, which appear broadly in line of the Commission recommendations.

- Other Member States (Belgium, Hungary, UK) have introduced specific sustainable forest management (SFM) criteria for forestry biomass and land criteria for agricultural biomass (UK). More recently, the Netherlands has announced plans to adopt by the end of 2014 a comprehensive set of sustainability criteria addressing, amongst others, impacts on forest carbon stocks and on indirect land use change (ILUC).

- A number of countries have introduced regulations aimed at addressing potential competition with existing biomass uses. In Belgium, for example, woody feedstocks suitable for the wood-processing industry are not eligible for the Flemish Green Power Certificates. Moreover, Poland has adopted a policy increasingly excluding the use of stem wood (with a diameter above a certain size) from being eligible for national financial incentives for renewables.

Table 18 Different energy specific sustainability criterias

Country	Status	Energy specific sustainability criteria
BE	Adopted in 2007	**Financial incentives linked to GHG savings, SFM requirements for forestry biomass**
HU	Adopted in 2010	**SFM requirements for forestry biomass**
IT	Adopted in 2012	**Minimum GHG saving threshold for forestry biomass**
UK	Adopted in 2013	**Minimum GHG saving threshold for solid and gaseous biomass, land use criteria for agricultural biomass, timber standard for woodfuel for heat and electricity**
NL	**Planned for end of 2014**	**GHG saving performance, forest carbon stock and ILUC impacts**

5 Main problems and barriers

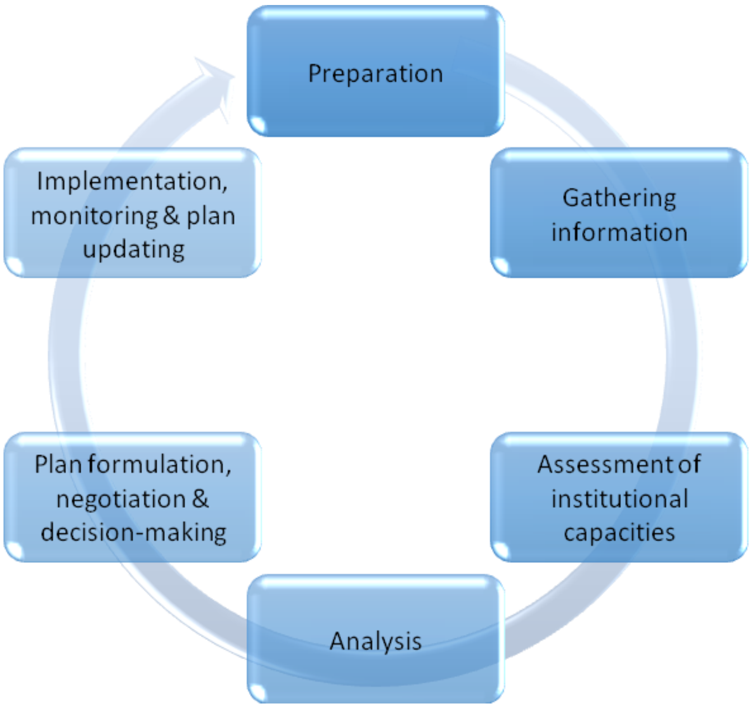
The main problems and barriers for further development of wood biomass production chains were identified as follows:

1. Forest conservation has higher priority than wood biomass production
2. Limitation regarding the forest operations has a negative influence on the costs of production
3. Capacities for planning new wood biomass supply chains in parks are often low (especially in small parks)
4. Limited financial resources for new investments in wood biomass heating systems
5. Low level of knowledge about wood biomass production chains among park administration
6. Cooperation and mutual trust between certain actors in local supply chains is relatively low, information exchange is limited
7. No coordinated planning over whole supply chains
8. Ownership of the forests in the park area is diverse
9. Structural and organisational disadvantages in small-scale forests
10. Wood utilization is usually of no (economic) interest for small-scale forest owners
11. Short-time decisions of forest owners depending on daily prices
12. Low timber mobilization and discontinuous wood supply in/from small-scale forests
13. Weather dependency of wood supply (accessibility of forest roads)
14. Financial indiscipline of wood traders
15. Park administrations are not active market players
16. Biomass from outside the park area can often be supplied at lower prices (often coming from abroad) and therefore it is difficult to convince the end-user to choose local biomass

6 Alternative solutions to identified problems and barriers

6.1 Forest conservation and limitations in the protected areas

Forest utilization in protected areas is often constrained by conservation principles and limitations they impose. Nevertheless, forest utilization in the protected areas is possible with respect to existing limitations. To avoid conflicts that can arise between various stakeholders and sectors operating in the protected areas, careful, integrated and participatory planning of wood mobilization is necessary. Steps of this process are shown on Picture 21.



Picture 21 Steps of integrated land use planning, Source: GIZ, 2012

As most of the protected areas already have management plans, it is possible that not all steps of integrated land use planning are necessary (i.e. steps *Gathering information* and *Analysis*). In any case, special attention must be given to existing limitations as they must be respected. For that purpose, it is advisable to conduct an environmental impact assessment of forestry operations. Step *Plan formulation, negotiation & decision-making* is of the highest importance as that is the only way to avoid or mitigate conflicts and to include all stakeholders in the planning process. This step usually consists of following sub-steps:

- Drafting forest utilization (documents and maps)
- Public presentation and discussion
- Negotiation

- Conflict management
- Voting
- Decision on the land use plan (GIZ, 2012).

The last step is *Implementation, monitoring & plan updating*. This step must not be skipped, as it serves to check whether all activities are running as planned, what arising problems maybe exist, and how forest utilization is influencing ecosystems and species in the protected area.

6.2 Ownership of forests in the park area

In many protected areas land is privately owned, whereas properties are often small and fragmented, and forest owners are not interested in forest utilization. The solution to this problem is the early inclusion of forest owners in planning in order to identify their needs and to motivate them for forest utilization. As utilization of small scale forests is not economically cost-effective, forest owners should act together. If united in some kind of organizational form (i.e. cluster, association, etc.), they will manage a larger forest area, so the problem of small scale forestry would be overcome. Additionally, they would be able to buy or rent machinery together, and act together in the market and have more competitive prices.

6.3 Implementation of modern technological solutions for production and use of wood fuels

Many protected areas have limited budgets, and forest owners and operators are usually not so keen in investing in new technologies due to their high prices. On the other hand, modern technologies are more productive, cost-effective and environmentally friendly, so they can help fulfil requirements of protection regimes. Local biomass chains in protected areas should work towards introducing modern technologies, where economic aspects will certainly have an important role in the decision. For that purpose, the Slovenian Forestry Institute has developed a free access online tool – WoodChainManager (http://wcm.gozdis.si/). It offers various interactive tools suitable for the organization and optimization of applications in forestry:

- Creation of interactive transparent descriptions of the forest-wood chain
- Creation of transparent cost calculations of forest machinery
- Determining norms of forestry production
- Converting between volume, weight and energy units

Modern biomass boilers have lower emissions and a higher efficiency, and they are therefore the most suitable choice in protected areas. Many countries are granting subsidies or favourable credits for this kind of investments, so additional help could also come from the state.

In many countries / regions, special frameworks are available to help forest owners or entrepreneurs with subsidies or credits to invest in modern machinery. These options should be analysed and presented to target groups in the park area to support investments in modern technologies.

6.4 Improving market conditions for wood fuel users and producers

Improving wood fuel market conditions requires a systematic approach and political commitments, so protected areas as such cannot really influence it significantly. If wood biomass chains are operating in the protected area, an agreement about supplying can be concluded between producers and the park administration. This way, the protected area would use endogenous biomass, and producers would have a market for their products. Also, if wood biomass is being supplied from a protected area, some kind of trademark or brand can be introduced as a way of certifying that wood was obtained in a sustainable way. It is recommendable for producers to assure and certify good quality of wood biomass fuels they produce. The promotion of locally produced wood biomass should be organised by park administration.

Very often, market conditions within the wood biomass production chain itself are weak. This can be overcome by building trust and good business relations between individual actors along the production chain. That is why all of the interested stakeholders should be brought together at the very beginning of the planning process.

6.5 Promotion and capacity building activities for different target groups

Various stakeholders have different knowledge and capacities with regards to wood biomass production. Therefore, it is necessary to bring all of their knowledge and capacities to a similar level. The optimal way to do this is to gather all relevant and interested stakeholders at the beginning of the planning process. All capacity building activities should be carefully planned and designed for specific target groups.

All stakeholders that will operate in the protected area must possess knowledge about conservation principles and limitations in the area, as well as about consequences and possible negative impacts that forest utilization can have on the area. Administrators in the protected areas often lack capacities for planning new biomass supply chains, so capacity building activities for them should be directed towards this issue. Private forest owners are usually not aware of the benefits they could gain from wood utilization and joint initiatives, therefore work with them should include these aspects. Capacity building is also necessary for experts coming from different sectors. Although experts in their respective fields, they usually do not have an in-depth understanding of other fields, therefore mediation between different sectors could be necessary. Biomass producers should have enough knowledge about the biomass supply chain, the technologies they use and the modern technologies they can benefit from.

Promotional activities are also very important. They should be used to “spread the word” and to increase the level of knowledge the general public has about forest utilization activities in the protected areas. If the general public does not approve these activities, conflicts are possible to happen.

6.6 Land use, land use change and forestry accounting

Deforestation, forest degradation and a number of other practices can result in a significant loss of terrestrial carbon and/or significant changes in productivity (e.g. harvesting practices that result in excessive removal of litter or stumps from the forests). Emissions related to land use, land use change and forestry (LULUCF), are reported by all Annex 1 countries under the United Nations Framework Convention on Climate Change (UNFCCC), including EU Member States, Russia, Canada and the USA, but accounting methods as applied under the Kyoto Protocol need to be improved. International climate change negotiations are ongoing to decide accounting methods for LULUCF under a new international agreement. A UN programme for reducing emissions from deforestation and forest degradation in developing countries (REDD) is also being discussed under UNFCCC. LULUCF emissions can best be addressed through a general framework that accounts for both removals and emissions of all land uses (production of food, feed, and fibre, etc.). This would reward increasing carbon stocks, which are important to secure sufficient biomass resources over time. Proper global LULUCF accounting can make an important contribution in the context of the sustainable production of biomass.

6.7 Local emissions

Traditional uses of bioenergy (open stoves for heating and cooking) can affect the health of people, causing respiratory diseases. However, the impact assessment will not deal with these risks because local emissions are also regulated by other European legislation, such as Directive 2008/50/EC, which sets standards and target dates for reducing concentrations of fine particles, which together with coarser particles known as PM10, already subject to legislation, are among the more dangerous pollutants for human health. Local emissions from small-scale plants are regulated at national/regional level, and there are European standards developed by CEN (EN 303-5 for biomass boilers of below 50 kW, 50–150 kW and 150–300 kW output), setting emissions limits for carbon monoxide (CO), unburned hydrocarbons or organically bound carbon (OGC) and for particles. Labels have been developed in some Member States to certify low emissions, e.g. P-Mark (Sweden) and Swan Label (Nordic countries).

7 Recommendations for policies at national and regional levels

Lower risk of forest fire from removing branches and leaves on ground, improved GHG performance in energy, benefits for stabilization of forest stands and reduction of risk of insect infection, economic benefits like diversification of income possibilities for farmers, forest owners and rural areas as a whole. Positive impacts could arise from perennial grasses or short rotation coppicing grown on agricultural land, by increasing the soil carbon content as compared to annual agricultural crops (UN-Energy, 200712). Possible indirect impacts on land use are therefore considered to be lower than for biofuels and bioliquids and may well be positive. The Commission has been asked to prepare a report on the effects on indirect land use change of increasing the consumption of biofuels and bioliquids by 2010. The results of that work will give indications on whether or not the indirect land use change impacts of other commodities should be studied.

7.1 Possible areas of intervention

a) Visible demonstration projects

For countries that have seen no or very little market development， the starting point for market development can be well communicated demonstration projects. Public buildings have particular advantages in terms of communication and creating trust and credibility for the technology.

b) Procurement policies favouring modern biomass heating

Creating a market is the most important task at the beginning. Enterprises must have projects to start with. Procurement policies can be very supportive in this respect. Therefore it is important to involve the actors responsible for this aspect early on in the project.

c) Assessment of suitable market niches for pellet use

Prior to the identification of targeted national/regional policies it must be clear where particularly attractive opportunities for wood fuel use exist. Due to the profound differences in climatic conditions and heating habits these market niches can vary from member state to member state. Once they are identified, policies can focus their support measures on these promising segments.

d) Financial incentives

Financial incentives are indispensable for market start-ups. Financial incentives should reduce the high upfront investment costs significantly, they should be predictable (predictably declining is fine), they should be linked to quality criteria and include both monitoring and communication programmes.

e) Link existing subsidy schemes to RES use

In some member states, subsidy schemes may exist that just need slight modifications in order to promote the use of pellets. Schemes supporting the construction of, for example, social housing, could require renewable heating systems as a precondition for obtaining the subsidy.

f) Quality criteria for products and services

High quality products and services are a fundamental precondition for sustained market growth. The most effective way of enforcing adequate quality levels is to link quality requirements with financial incentives. This has been demonstrated in many successful cases of supporting policies.

g) Supply security and training programs

A dialogue with the pellet industry should be conducted on how security of supply can be guaranteed all the way from the producer to the end-user. Adequate training of professional installers also needs to be implemented and has been implemented in most countries with successful market development.

h) Monitoring programs for new installations

Close monitoring of realised projects in the use of pellets is of fundamental importance to identify quality issues and stimulate learning processes among the involved professionals right from the start. The later monitoring takes place, the greater the damage to the market caused by poor performing projects.

i) Communication campaigns

Once the appliance market and pellet supply is reasonably well established, communication programs are needed to create a general interest in the new technology. Such communication programs should be publicly financed as the involved companies are often too small to fund them. Also, public communication is more credible that company advertisements.

j) Regulatory policies

Regulations requiring a minimum amount of renewable heat for new buildings are mentioned in the draft European Directive on renewables and are considered an effective way to promote the transformation of the heat market. Particular attention needs to be given also to the issue of existing heating systems that are outdated and should be replaced. Regulations that speed up the phasing out of old heating systems could be one approach to address this issue.

k) Increased biomass production sometimes involves increased forest carbon stocks

There is also recognition that there exist some specific cases where forest management interventions to increase biomass production may involve increased forest carbon stocks. These include situations in which rotations applied to forest stands are extended as part of optimising biomass productivity, or the growing stock of existing degraded or relatively unproductive forests is enriched to enhance their productive potential. It is also possible to create new forest areas with the specific purpose of managing them for wood production, provided that forest carbon stocks on the land are increased as part of the conversion of non-forest land to forest stands, and that there are no associated detrimental indirect land-use changes.

l) Design a stress test for sustainability

Forestry biomass-based bioenergy production may result in significant environmental and economic sustainability gains for the EU. However, this is not guaranteed, and will not happen automatically. The market mechanism by itself will not guarantee that all environmental and economic objectives are met. Energy from forestry biomass is not a single entity, but hides a large variety of sources and qualities, conversion technologies, end products and markets. Some processes make economic and environmental sense, and others do not. Therefore, bioenergy-related policies should be designed in a way that enhances technological and economic efficiency, and environmental sustainability.

A *stress test* needs to be designed and implemented to guarantee that forestry biomass-based bioenergy production supported by subsidies or other policy means in the EU has an environmentally and economically sustainable basis. The stress test would determine the ability of a given forestry biomass-based bioenergy process to guarantee certain environmental and economic sustainability criteria.

The following stresses could be analyzed:

- What is the carbon balance of the process?
- What are the biodiversity impacts of the process?
- What are the potential trade-offs (opportunity costs) in terms of forgone alternative forest uses?
- What is the energy efficiency of the process?
- What is the socio-economic viability of the process (to what extent it needs policy support, and for how long?)

m) Focus on energy efficiency, minimizing emissions and promoting new businesses

The potential annual harvest of biomass from forests for energy in the EU is about 200 million m^3. There is also still plenty of potential and need to strengthen the utilization of industrial wood residues (e.g. sawdust and chips) and post-consumer wood (e.g. packaging materials, demolition wood, timber from building sites). It is estimated that EU would need around 40,000 person-years in labour input to mobilize the full potential of harvested forestry biomass for energy – eight-times the number of people who work in forest energy supply today. To meet this likely shortfall in labour, novel technologies are needed to improve efficiency in energy biomass harvesting, logging, processing and transport. Long lasting competitive advantages can only be reached by developing biomass production, harvesting technology and supply logistics to reduce the cost of biomass. It is also essential to improve the energy efficiency of the production processes. The product portfolio based on forestry biomass must be developed towards high value materials and fuels to enable a higher ability to pay for the feedstock. But to operate these more efficient technologies and processes, we need agents, enterprises and businesses willing to take over responsibility for sourcing materials, transporting and converting them into ready-for-use, and producing the products. Policies which create incentives to help facilitate economic, technological and environmental efficiency developments and business opportunities for the whole forestry biomass-based energy supply chain are needed.

8 Good practice examples – Presentation of existing production chains

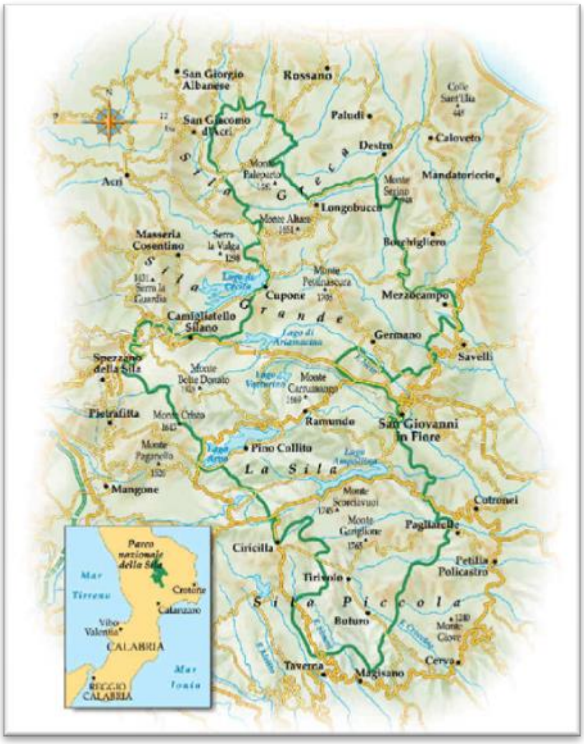
8.1 Sila National Park

8.1.1 Description of the park

- **Sila National Park:**
  - **Land Surface Area (ha):** 73,695.00
  - **Regions:** Calabria
  - **Provinces:** Catanzaro, Cosenza, Crotone
  - **Municipalities:** Acri, Albi, Aprigliano, Bocchigliero, Celico, Corigliano Calabro, Cotronei, Longobucco, Magisano, Mesoraca, Pedace, Petilia Policastro, Petronà, San Giovanni in Fiore, Savelli, Serra Pedace, Sersale, Spezzano della Sila, Spezzano Piccolo, Taverna, Zagarise
  - **Establishment Measures:** L 344 8/10/1997 - DPR 14/11/2002
  - **PA Official List:** EUAP0550
- **Park Authority:** Ente Parco Nazionale della Sila
- **Additional managed Protected Areas:**
  - State Reserve Coturelle – Piccione
  - State Reserve Gallopane
  - State Reserve Gariglione – Pisarello
  - State Reserve Golia Corvo
  - State Reserve I Giganti della Sila
  - State Reserve Macchia della Giumenta – San Salvatore
  - State Reserve Poverella Villaggio Mancuso
  - State Reserve Tasso – Camigliatello Silano
  - State Reserve Trenta Coste

The Sila National Park includes some of the most interesting areas in the Calabria Region. Its large forests are situated over the plateaux spreading from the Pollino Mountains to the Serre Mountains. There are many rural villages and a rich cultural and artistic heritage. The highest mountains are Botte Donato (1,928 m) in Sila Grande and Gariglione (1,764 m) in Sila Piccola; there are many torrential rivers and artificial lakes with several utilisations. The fauna, both permanent and migratory, is numerous and diverse.

8.1.1.1 History



Picture 22 Map of Sila National Park

Sila National Park was established on the basis of the Regional Decree 14. 11. 2002 (published in the Official Journal No. 63 – 17/03/2003), and at the same time, the Management Agency was also founded. It includes the territories that were formerly part of the "Historical" Calabria National Park (1968).

It protects areas of great environmental interest in Sila Piccola, Sila Grande and Sila Greca, with a total of 73,695 hectares, in

- 21 municipalities,
- 6 mountains communities
- 3 provinces of the Calabria region

8.1.1.2 Landscapes

The origin of the Sila plateau dates back to a geological age which is more ancient than the Apennine orogeny.

The **Silan landscape** is the result of the peculiar physical environment, varied and not so uneven, on which interacting systems such as a rich fauna, complex vegetation and a limited human presence are settled. There is a variety of landscapes, from mountains to hills and planes, the latter divided in alluvial plains, valleys and terraces.

Forest landscape, having a great biodiversity, is part of a woodland heritage with a considerable commission and ecosystem value, suitable for protection and preservation. There also exist marginal territories which are not involved in the modern development processes and where it is still possible to find places where resources and values have been preserved in their integrity. These same territories need to be optimally exploited by local communities in order to encourage their recovery, stability and permanence.

Agricultural landscape is more specifically the result of the interaction between man and environment; it is always a process of becoming as a consequence of changed social conditions, but also of the evolution of culture and improvement in agricultural techniques. This kind of landscape has been scarcely altered by the technological impact. Basically, it is still possible to describe Silan agriculture as conventional, as the natural balance, steadied through the course of time, has been maintained, and important genetic erosions or meaningful loss in species have been avoided.

The growing process involving human settlements in rural places has been controlled in most sites' parts. However, it is necessary to normalize possible excesses of human

intervention by limiting the tendency to soil transformation and exploitation, by preserving places with strong natural and environmental value, and by diversifying time-frames and methods of exploitation.
To sum up, it will be necessary to promote the integration of the development processes and the peculiarities these areas consist of, and to plan a scheme able to emphasize the Sila landscape resources.
Good results could be reached by putting into action suitable policies of territorial balance and social cohesion. This way, it could be possible for tourists to admire, even in the future, a landscape which would be for the most part still primitive, attractive and suggestive.

8.1.1.3 Forestry

The economic income of **wood**, which has been for centuries assured by the wood crop, has characterized life in the National Park. Locally used as the main building material for houses, the wood has been, and continues to be, the leading material in the carpentry sector and in the little semi-industrial and hand-crafted joinery handiworks.
The woody essences of **larch pine** and **chestnut-tree** are used mainly because of their characteristical endurance in regards to parasites and their durability in time; and in the field of ebony restoration, **beech**, **maple**, **oak** and even **strawberry-tree** and **heather** are used.

8.1.2 Description of the wood biomass potential in the park

8.1.2.1 Estimate of biomass that can potentially be available from the forests of Sila National Park

As already mentioned, about 80% of the Sila National Park area is covered with forests. More precisely, forests cover about 60,000 ha out of 73,000 ha. Except for integral and biogenetic reserves (property of the region) and areas owned by the municipalities, forests are privately owned. This is why private owners were invited to take part in the meetings held by the SNP to discuss the biomass supply plan.
In order to draw a realistic estimate of the amount of biomass produced in the park forests, some dendrometric data must be preliminarily gathered, particularly those concerning the existing types of forests. To do this, forest areas need to be divided into vegetation belts or biomes (Corsican pine, beech, downy oak, Turkey oak) and each of these into chronological classes.

At present, data gathered by the National Inventory of Forests and Forest Carbon Pools (INFC – Ministry for Agriculture and Forestry) are available.

It can be therefore supposed that the existing amount of wood in the forests of SNP, divided per land cover and use classes, corresponds to the figures reported in the table 18**.**

Table 19 Wood potentials in SNP

Classes of land cover and use	Area (hectares)	m³/ha	Tot. amount (m³)
Beech forests	13,214	350	4,624,900.00
Mixed forests with prevalence of beech	10,307	350	3,607,450.00
Corsican pine forests	27,595	322	8,885,590.00
Mixed forests with prevalence of Corsican pine	5,789	300	1,736,700.00
Deciduous oak forests	4,597	200	919,400.00
Chestnut-tree forests	3,29	150	49,350.00
Evergreen sclerophyllous forests	1,76	50	8,800.00
		Total	**19,832,190.00**

The total amount only represents the total biomass of the SNP, without distinction of assortment.

It must be considered that not all of the park forest area can be used, particularly areas located in Zone 1, that is, integral and biogenetic reserves where law prohibits any cut.

Furthermore, no forest can be entirely used for energy purpose, as all wood assortments have to be valorised. Thus, the amount of extracted biomass should be fixed in relation to annual tree growth rates, with no impact on existing stocks, that is, without reducing the existing amount of wood.

This is a sustainable use of forests and implies paying a strong attention to the environmental compatibility of the biomass supply chain.

8.1.2.2 Assessment of the actual available wood biomass from SNP forests

Out of total amounts of wood growth, the net amount of biomass that can be supplied to energy conversion plants is determined by the analysis of wood assortments and their use destination, ground slope degrees, other forestry programmes, mechanisation and, importantly, the authorisations annually issued by the Calabria region upon forest owners' requests.

Supposing that available conifer biomass is up to 25% of annual wood growth, available hardwood biomass is up to 10% of annual wood growth and available area is up to 13,000 ha of conifers and 9,000 ha of hardwood (Table 20).

Table 20 Potential extraction of biomass per year

Forest type	Area (ha)	Amount (m^3/ha)	Increment (m^3/ha)	Biomass per year (m^3/ha)	Potential extraction (m^3/year)
Pure and mixed Conifers	13,000	350	4	0.8	10,400
Pure and mixed Hardwoods	9,000	400	4.5	0.675	6,075
				TOTAL	**16,475**

Conifers

The forests of the Sila National Park that are potentially suitable to supply biomass occupy an area of about 28,000 ha, entirely in Zone C. More specifically, the area involved in the plan is up to **13,000 ha** conifers, which represents 50% of the SNP areas, almost exclusively composed by Corsican Pine *var Calabrica* or Corsican Pine mixed with beech.

Present day scenario

Based on data analysis concerning land cover in SNP, it can be argued that the production of biomass for energy purposes is based on conifer forests.

The availability decreases again due to a lack of forest management plans, and is currently up to around **5,200 tons/year.**

Hardwood

Regarding hardwood, 12,000 ha of the SNP area, also included in Zone C, will be involved. More specifically, hardwood forests can be identified in **9,000 ha** of beech forests and beech forests mixed with other hardwoods. Most of these SNP forests are not included in any Forest Management Plan; their exploitation is therefore the owner's decision (either private or public) – the felling permission needs to be approved by the Calabria region.

Present scenario

From the analysis of data concerning land cover in SNP, it can be argued that the production of biomass for energy purposes is based on hardwood forests. The availability decreases again due to a lack of forest management plans, and is currently up to around **3,035 tons/year**.

8.1.3 Description of production chain

The analysis of the production chain is made through the administration of specific questionnaires during specific meetings, where forestry companies describe their machinery and working procedures – it can be concluded that harvesting operations depend on local orography and technical capacities of harvesters (that is, forestry machines and the equipment they use).

The following procedure is used by most of the forestry companies operating in the SNP territory:

Preparatory phase:

Preparation implies wearing personal protective equipment (chainsaw trousers, chainsaw, steel-toe boots, helmet, gloves and ear defenders). Forestry operations can be generally synthesized as follows.

Felling

Felling consists of cutting the tree at the bottom. This operation is generally carried out with chainsaws and other tools used to determine the felling direction, such as wedges, felling levers, tackles, etc. The operator first makes an undercut and then the felling cut.

Processing

It includes delimbing, cross cutting, and debarking where necessary. Delimbing and cross cutting are carried out with the chainsaw and manual tools such as bush knives and adzes. This operation can be carried out either at the felling point or the landing area, after extracting whole or delimbed trees.

Bunching and extraction

The cross-cut wood or the long stems are first moved from the felling point to the strip road, along which they are later brought to the landing. The landing is an area dedicated to the gathering of wood and it is accessible by roads suitable for heavy vehicles. The most common extraction systems involve the use of tractors equipped with a winch or, in inaccessible areas, draught animals. If the conditions of the striproads and orography permit, forwarder forestry tractors are used.

Chipping

This operation involves reducing different types and forms of wood to small-sized pieces (chips), through mechanic cutting. In the use of biomass for energy purpose, chipping can be carried out in the forest, and this shows some advantages compared to traditional bunching techniques:

- It allows for the use of all wood biomass available, including branchwood, which is a dangerous fire fuel (in traditional bunching it is usually left on the forest ground);
- It allows for partial or complete elimination of small-sized assortments’ bunching, saving workforce and improving ergonomics.

Chipping at the felling site is only possible in plains (inclination of up to 20%) and areas that are less uneven. When working conditions are not favourable (higher inclinations or areas that are too uneven), it is necessary to extract the whole tree up to the area where chipping will take place, through the so called “whole-tree” technique.

Pelletisation

Wood chips and sawdust obtained from first wood processing will be transformed into pellets which will then be supplied to SNP heating systems. The material supplied will have to comply with UNI standards.

- Lower calorific value > 16.5 MJ/kg,
- Moisture content < 10%,
- Ashes < 0.7%
- Diameter 5-6 mm.

Each supply must be accompanied by an ENPLUS-A1 certification.

Picture 23 Transportation of logs

8.1.3.1 Forestry legislation and sustainable forest management criteria

Forest cuts in the park area are subject to three main regulations:

- **Calabria Region's Forestry Law (L.R: No.45 2012) "Management, protection and valorisation of the regional forestry heritage"**
  Laying down general rules and guidelines to improve sustainable forest management designed to preserve the territory and fight against climate change. This law aims at strengthening the forestry supply chain starting from the production level in a way that ensures, in the long term, the multi-functionality and diversity of forest resources. This law also determines which forestry interventions can be realised.

- **General Provisions and Forest Police Provision (GPFP), laying down technical and administrative rules for the use of forests**
  These provisions state that, in order to obtain cut authorisations, public and private forest owners have to present a project drafted by a qualified expert. The following rules apply:

Table 21 Technical and administrative rules for the use of forests

Method of woodland management	Operational provisions
Coppice	Depending on species, the chosen forestry practices have to comply with technical guidelines included in the chapter “Sustainable forest management” of the Regional Forestry Plan. The selection of seedlings has to be made according to criteria from Art. 43 (Coppice of two rotations system) and Art. 44 (Coppice with standards).
High forest	The planned felling quantity is determined according to Section IV of the chapter “Sustainable forest management”. The management system has to involve, depending on the forest population and temperament of species, a selective regeneration cut “for small or very small groups” not larger than 200 square meters. Thinnings in natural formations have to consist of a selection of interventions “from below, of low or moderate degree” in relation to population structure, temperament of species and plant health conditions.

- **SNP management plan**

Table 22 Art. 23 – Interventions in forests and tree cuts

Zone A (integral natural reserve)	**Any silvicultural intervention is forbidden**
Zones B (oriented general reserve), C (protected areas for traditional uses) and D (areas of economic promotion)	Silvicultural interventions (forest utilisations, thinnings, prunings, plant health cuts, etc.) must be authorised by the park following explicit request.
Zone B	In Corsican pine, beech, oaks and other high forests, forestry utilisations are allowed (based on selection cuts) with an utilisation rate of 1.5%.
Zones C and D	Thinnings can be made in accordance with GPFPs.

8.1.3.2 Quality control

Together with the application of the above-mentioned regulations, the SNP will verify the origin of wood material through the so-called track and trace system. The supplier will have to submit documents allowing the traceability of the supply, more specifically:

- Cut authorisation issued by the Calabria region identifying the cutting area;
- Wood purchase contract;

- Short report by the works director including a specification of processing phases, origin of wood and other information requested by the track and trace system, described in the LSCP (Localized Supply Chain Plan);
- Declaration certifying that pelletisation has been carried out within the SNP area or in the territory of a municipality included in the SNP, in case the supplier used a third pelletisation facility;

The SNP will supervise and control the supply chain and may ask any accredited laboratory to carry out analyses of the material supplied in order to verify the compliance with required standards. Furthermore, forestry processing phases and pelletisation will be submitted to on-the-spot-checks. Audit reports will be countersigned by the supplier.

8.1.3.3 Social and economic aspects

The creation of this supply chain aims at fostering the valorisation of local productions and at favouring the development of local communities.

In this perspective, the participation of local actors in the supply chain is particularly important as it may allow the use of silviculture products locally rather than selling them to thermal power stations located outside the SNP area.

Another crucial aspect, discussed during the project's "specific meetings", is the opportunity for companies to optimise the use of wood feedstock for productions with the highest added value, including the re-use of waste for energy purposes.

8.1.4 Description of producers, suppliers of wood biomass

Most of the forestry companies existing in the SNP area have been invited to take part at round tables and specific meetings.
The choice of actors to be involved has been made taking into account the capacity to create the supply chain and to maintain it in the future.
In particular, target forestry companies would have the following characteristics:

- Without regard to juridical status, target companies need to rely on a team of qualified workers and a number of forestry machines suitable for the creation of a short supply chain.
- Moreover, the company has to be included in the regional register of forestry companies with specific reference to forestry works, environment restoration, biomass chipping, reforestation, restoration of degraded forests, and wood transportation.

8.1.5 Description of the end-user

The analysis of biomass flows currently produced within the SNP area shows that the destination of wood biomass are thermal power stations in Crotone and Cosenza provinces. Thus, the final user is GSE (national manager of energy services). As a consequence, all the energy produced from SNP biomass enters the national system with no direct advantage for the local territory.

This project proposes a new approach to solid biomass valorization, based on social and environmental sustainability, and directed to promote the utilization of biomass inside the harvesting area. On the one hand, this would reduce transportation costs, and on the other hand, ensure the supply to small and very small-scale local stations.

In order to favour this process, the park played the role of the final user of biomass during the first year of the supply chain activity, and has issued a call for tenders to purchase pellets form local suppliers, as is further described in the next paragraph.

The biomass purchased will be destined for 8 heating systems in buildings managed by the park that have been converted from diesel and log fuels to pellets; their technical specifications are shown in table 23.

Table 23 Technical specifications of heating sytems

N	Structure	Municipality	Prv	fuel	brand	KW	Final users
1	SNP headquarters	Lorica	Cs	pellets	Pasqualicchio	208	Staff and Visitors
2	Cupone Segheria – Museum	Spezzano Sila	Cs	pellets	Pasqualicchio	208	Visitors
3	Cupone study centre	Spezzano Sila	Cs	pellets	Pasqualicchio	77	Visitors
4	Longobucco Museum	Longobucco	Cs	pellets	Pasqualicchio	92	Visitors
5	Lorica-Mellaro	Lorica	Cs	pellets	Pasqualicchio	114	Visitors
6	CTA-Cava di Melis	Longobucco	Cz	pellets	Palazzetti	15	Staff CFS
7	CTA-Carbonello	Taverna	Cz	pellets	Palazzetti	15	Staff CFS
8	CTA-Cupone	Spezzano Sila	Cs	pellets	Palazzetti	15	Staff CFS

During the second year of the project, the number of final users will be extended by inviting public bodies and private operators to take part in the supply chain and sign the framework agreement with the park and local biomass producers.

One of the plants involved in the project is the central plant of Longobucco. In its case, hot water will be produced downstream through a cogenerator fed with syngas from the gasification plant. A district heating system will be created in order to distribute it.

The following buildings will be supplied with thermal energy:

1) "Former Convent of Reformed Friars" – via Roma, seat of the SNP museum; rated thermal input of 108 kW;

2) "Santa Croce" school – via Matinata, rated thermal input of 72 kW

8.1.6 Setting up the production chain

The process of building the supply chain started with the involvement of territorial stakeholders to analyse the present-day biomass market situation and the feasibility of a short supply chain based on environmental, social and economic sustainability.

During numerous public meetings and roundtables, it was established that biomass produced in the park area is entirely absorbed by thermal power plants of Crotone and Cosenza provinces.

The park has therefore started a process to elaborate and share with stakeholders a different approach to forest resource management, whose pillars are the short supply chain, environmental and social sustainability, and the promotion of local scale energy districts.

The aim was to re-direct a part of the biomass stored by local producers to supply small stations inside the park area. Such an approach raised the interest of biomass producers but had to deal with the problem of finding local plants fit for biomass combustion.

Thus, the park elaborated a two-step strategy: during the first step, the park itself would play the role of the final biomass user. Consequently, the park issued a public call for tenders for the supply of pellets to 8 stations that had been recently converted from diesel and lpg thanks to national funding. The contract fixes the price at 4.2 EUR/15 kg bag, which will be paid by all public and private actors interested in participating in the supply chain.

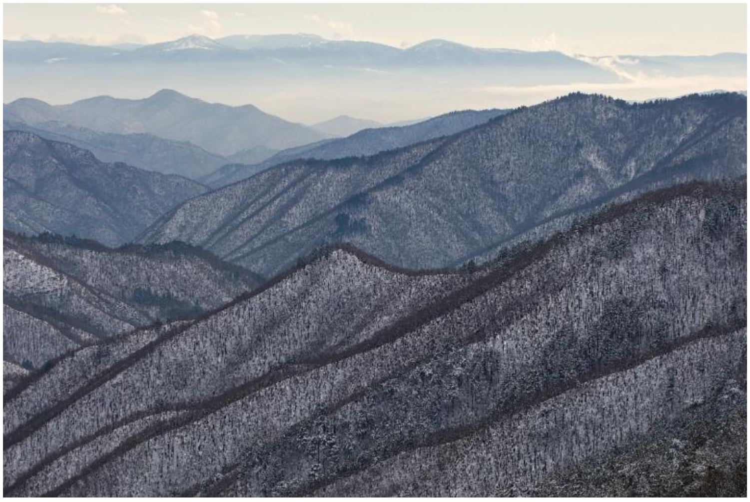
The second step is based on the involvement of public bodies and economic actors (including hotels, restaurants, farms) in the SNP area in order to start a process of conversion of thermal power plants, including domestic ones – also emphasizing incentive measures existing in national and regional programs – and finally take part in the supply chain.

8.2 Rodopi National Park

8.2.1 Description of the park

The RNP covers a very wide mountainous area in North Greece of 173,150 ha. The northern park boundaries coincide with the Greek – Bulgarian borders; they start from the region of Kato Neurokopi at Drama and they end at the region of Dimario at Xanthi. The southern boundaries consist of the north-east slopes of the Falakro Mountain and follow the course of Nestos River. Four middle-sized towns with a population higher than 40.000 inhabitants and several smaller towns are inside the 50 km buffer zone of the project.

The RNP area was established by Law 3044/2002 and designated as a National Park by the Joint Ministerial Decision 40379/01-10-2009 (GG 445/D/02-10-2009). Administratively the RNP belongs to the Region of East Macedonia and Thrace; it is included in the Regional Units of Drama and Xanthi and the Municipalities of Kato Neurokopi, Drama, Paranesti, Miki and Xanthi. The Forest Agencies which are involved in the management of the forests within the RNP are the Forest Offices of Xanthi, Drama, Stavroupoli and Kato Neurokopi.



The RNP area is protected by multiple protection regimes at national, European and global levels. In particular: seven (7) areas of the RNP have been integrated into the Natura 2000 network according to the Habitats Directive 92/43/EEC and the 2009/147/EC (two (2) SPA and five (5) SCI), 2 areas have been characterized as Preserved Natural Monuments, seven (7) areas as Wildlife Reserves according to the Greek law and three (3) regions have been characterized by the European Council as Biogenetic Reserves. The great majority of the park area (almost 92%) is characterized as a “sustainable usage and development zone”, where biomass production is permitted after elaboration of management plans authorized by the local forest offices.

8.2.2 Description of wood biomass potentials in the park

The area of Rodopi National Park incorporates the most wood productive forests of Greece, managed within the scope of decadal forest management plans. The biomass production potential of the RNP area is considered high.

The great majority (97.24%) of the park area is covered by forests and woodlands, while only 2.15% consists of agricultural lands. All forest and wood lands are owned by the Greek state.

The Forest Service is responsible for their management and supervision. Wood production is regulated through the elaboration of forest management plans, valid for 10-year periods, which take into account all forest services in order to secure the forest ecosystem sustainability.

The high proportion of forest and woodland cover types also explain the great significance of wood as a biomass source in relation to residues derived from agricultural activities in the RNP area.

Detailed production data for the RNP is difficult to be provided because of the mismatching boundaries of the RNP and the local Forest Offices. Table 1 below gives an approximation of wood production in m^3 within the RNP derived for Forest Offices of Drama and Nevrokopi.

Table 24 Wood production (m^3) in the RNP area (year 2013)

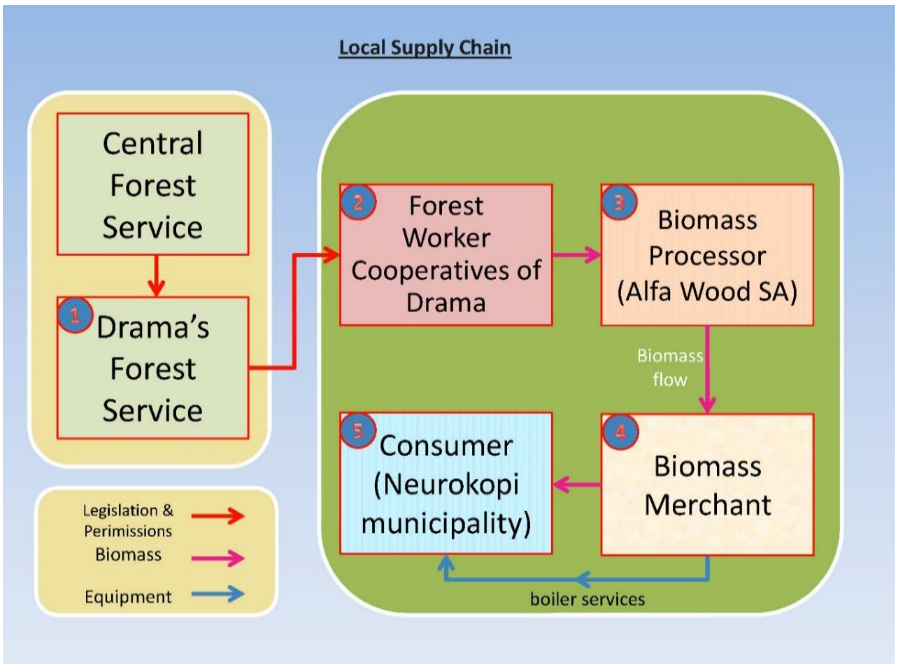
	Roundwood	Industrial	Firewood	Total
Nevrokopi	11,983	0	21,871	33,854
Drama	54,480	4,376	31,794	90,650
Total	**66,463**	**4,376**	**53,665**	**124,504**

8.2.3 Description of the production chain

The existing forest production exploitation schemes are used to develop the supply side of the local pilot chain. The LSCP includes only thermal energy production from firewood and/or pellets.

The LSC follows the contemporary work flow applied in wood production and trading, since wood is the basic biomass source in RNP. The operating LSC includes a Local Authority (Municipality of Neyrokopi) as an end-user. The Local Authority is supplied with biomass from a biomass provider (merchant) on a long term basis. The merchant acquires the biomass (pellets) from the processor (private company). The processor is provided with raw material (wood) from the FWC (forest harvester) under the supervision of the Forest Service (forest owner).

The following chart shows the main actors and interconnections of the LSC in the area of Rodopi National Park.



According to our recommendations, the provider should have the obligation to supply the Local Authority with biomass derived from the RNP area and/or to provide a biomass boiler for heating. The provider should also undertake the service and the maintenance of the boiler (e.g. refuelling procedures). In case the provider offers the boiler at no cost (or lower than the current market cost), the Local Authority undertakes the obligation to buy biomass for a certain time period from the specific provider according to the terms and provisions described in a contract. There is also an ongoing suggestion to the Central Forest Agency to reduce the fees connected with wood exploitation from FWC and imposed by the Forest Service.

8.2.4 Description of producers, suppliers of wood biomass

The public Forest Service as the owner and responsible for the management of the forests and local Forest Workers Cooperatives are involved in the harvesting procedures of the forestry biomass.

The Forest Workers Cooperatives (FWC) are legal entities commissioned to operate in state forests providing logging services. The main legislation documents that rule their operation are:

- Law 86/1969 “Forest Code”
- Presidential Decree 126/1986 “Procedures for granting the operating, maintenance and improvement of forests belonging to the State and legal persons of the public sector in forest cooperatives”.

The above institutional framework makes the Forest Workers Cooperatives the only player in harvesting operations and therefore their participation in biomass production process in the LSC is mandatory. In the RNP area, there are 72 Forest Workers Cooperatives comprising

463 members. These numbers reveal a great fragmentation and a small average size of individual memberships.

The Forest Workers Cooperatives share the prescribed volume for harvesting wood in accordance with annual or biennial programs, compiled by each Prefectural Directorate. Each FWC is installed in one or more forest stands inside the harvesting area by the Forest Service. With the signing of the relevant contract, the cooperatives provide a guarantee deposit equal to 5% of the value of the prescribed harvested wood volume. 12% of the revenues derived from wood products sale are transferred to the Forest Service and to the Green Fund and an administrative fee of 5% is transferred to the municipality where the harvesting takes place. At present and within the frame of the implementation of Local Supply Chain, 21 contracts have been signed between Forest Service & Forest Workers Cooperatives/MoU actors. Dates of MoU signing are from 4/4/2014 to 30/6/2014.

The Forest Service defines on site, during the installation procedure, the harvesting borders for each Cooperative, and marks the trees for logging. Cooperatives are obliged to accomplish the logging and move the logs outside the harvesting area within a certain time period.

The logs are cleared from branches and formed into timber products, which are transported and temporarily left collateral to forest roads or in a log yard. Fine wood residues remain in the stands. Machinery skidding is used for technical wood, but fire-wood is transposed from the stand by pack animals (mules). The wood logs are separated into product categories, compiled and counted on the road (or log yard) by the Forest Service in order to charge the State fees. After that, each Cooperative is free to sell the harvested products to wood traders, wood sawmill companies, pellet manufacturers, etc.

Forest Workers Cooperatives operate under a special and protective institutional framework, which suppresses competition and may distort the timber market and consequently the biomass supply. The great number of FWC and their small number of members limit their potentials in wood harvesting operations and deter large scale investments both in harvesting and aftermath wood processing.

After the logging operations and the approval of the Forest Service, the wood products are sold at the road (or log yard) by the Forest Workers Cooperatives to the wood market (wood traders, wood sawmill companies, pellet manufacturers, etc.). The transportation of wood logs is done by trucks and the transport cost is charged to the purchaser.

Presently and within the frame of the implementation of Local Supply Chain, 6 contracts have been signed between Forest Cooperatives & Private companies (ALFA Wood)/MoU actors. Dates of contract signing are from 10/7/2014 to 26/9/2014.

Storage is also the responsibility of the purchaser. The major private companies, active in the area of RNP (wood processors, traders and pellet producers), have their own depositories (open air and/or covered) to secure the appropriate storage of raw material and final products.

Wood processing and trading professions are exercised freely, from individuals or legal entities in Greece. Even the Forest Workers Cooperatives could exercise wood processing and trading without restrictions, a case which is actually very rare. Relatively recent regulations have been issued to protect consumers in the transactions with wood trades:

1. Guide for firewood transport which is actual a technical description for biomass storage and trade published by the Ministry of Development and edited by CRES (Centre for Renewable Energy Sources)
2. Solid biomass fuels for non-industrial use – Requirements and Test Methods Ministerial Decision 198/2013 (GG 2499/B/04-10-2013), Ministry of Finance

In the area of the Rodopi National Park, there are currently two (2) major wood processing and trading companies and several minor ones. All are active in firewood trading and would participate in the LSC as well. There are also two high capacity pellet producing facilities. One of them is established in the vicinity of the park borders and participates in the LSC.

Biomass import in Greece is free and wood traders can import biomass from neighbouring countries – and they actually do. Since RNP is located at the Greek – Bulgarian borders, importing is easy and cheap and could deter exploitation of local biomass. The VAT legislation and import regulations among EU countries create disadvantages to the local biomass production inside the RNP. Greek pellets production is charged with a 23% VAT, while the same product imported from Bulgaria is charged with a 0% VAT. Moreover, the VAT on fossil fuels (oil, natural gas) and renewable fuels with a low thermal efficiency (firewood for stoves and fireplaces) is 13%, ten points lower than that of pellets.

8.2.5 Description of end-users

Local municipal authorities are and will continue to be the major biomass consumers, involved as end-users by installing biomass burners in order to heat municipal buildings. DUTH and RNP teams believe that local municipalities are the most appropriate bodies to promote the efficient use of biomass coming from sustainably managed local forests through examples of installations that can be demonstrated as good practices.

Since no biomass power plant is installed in the area of RNP, the final consumer of the LSC will be the households which use firewood and pellets for heating. Population dynamics and energy needs in the reference area of the Rodopi National Park determine the overall demand of the local biomass supply chain. The thermal energy demands of the communities inside the RNP according to the database of the Ministry of Environment, Energy and Climate Change, are: per capita 10,782 MJ which means 0.257 toe or 2,995 KWh per capita per year.

Comparing the energy demands of the RNP communities with the estimated wood production of the park, it can be concluded that the park has the potential to cover these demands by almost 4 times. An increase in the firewood production by 30% (rational estimation according to the local forest offices data) would cover the energy demands by almost 6 times.

8.2.6 Setting up the production chain

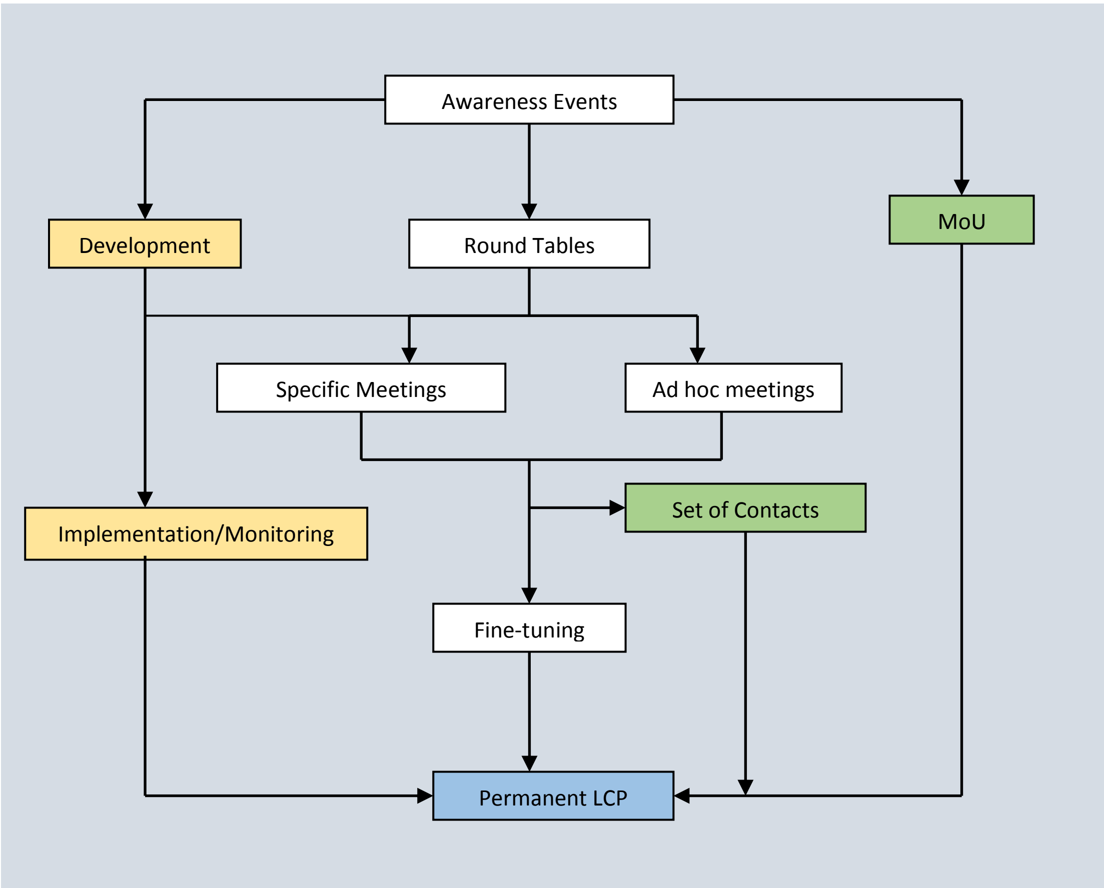
DUTH and RNP teams have contacted – during the organized awareness events and round tables – the local municipalities, which account as big energy consumers (city halls, schools, administration buildings, etc.), and succeeded in an agreement to install biomass burners in municipality buildings of Nevrokopi. Other municipalities, realizing the benefits, also expressed their willingness to proceed with similar installations and they are seeking financial means.

At present there are six (6) biomass facilities operating within the frame of the LSC – in the municipality of Nevrokopi, using pellet fuels, with a total installed capacity > 1 MW and an average efficiency of 90%. In the next heating season (2015-16), three (3) new burners are planned to be operative in public buildings of the municipalities of Paranesti & Myki, using pellet fuels and with a similar burning capacity and efficiency. Local municipal authorities installing new technology burners with efficient conversion and minimal GHG emissions at municipality buildings are seen as the vehicle to promote biomass for energy use within the RNP area. The Municipality of Nevrokopi is expected to be a good practice example – six pellet burners have already been installed there in six municipal buildings, and the use of pellets as a thermal source is expected to expand to another building as well in the near future. Other municipalities in the park are also searching for financial means to install similar heating facilities.

During the awareness event of the project, DUTH and RNP teams emphasized the disadvantages of the mainstream use of biomass in traditional stoves and fireplaces, and pointed out the economic and environmental benefits of new technological solutions in the use of biomass for heating. Efficient conversion and minimal GHG emissions would also be the target in the installations at municipality buildings.

Round table discussions during the awareness phase of the project revealed the need for a forest management scheme reform towards biomass production for energy, and also a reform of the FWC organization to allow the creation of schemes with a bigger capacity and to permit large scale viable investments.

Flow chart of the procedures for setting up the LSC.

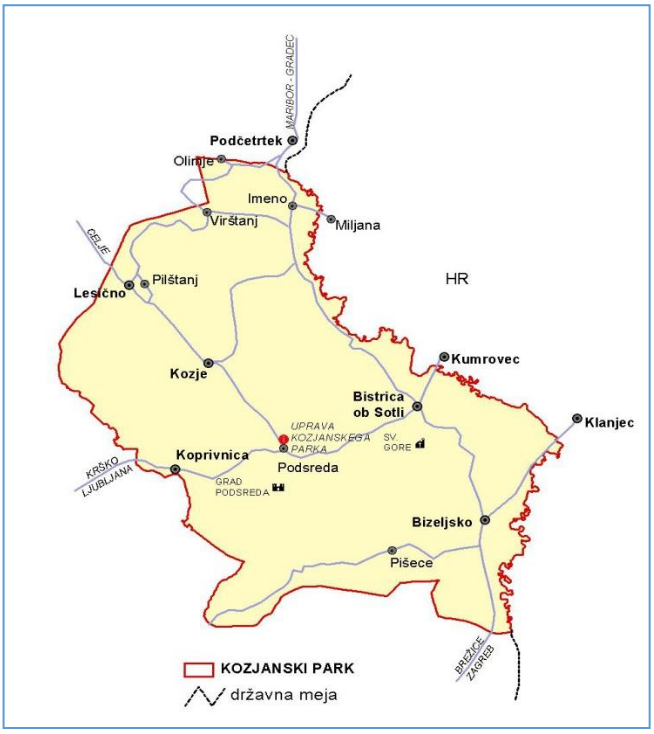


The awareness events and round tables showed that local actors in Rodopi National Park had not fully appreciated the advantages of using local biomass as an energy source. DUTH and RNP awareness raising activities have brought together suppliers and consumers and have contributed to decisions towards the efficient use of local biomass for heating.

Specific and ad hoc meetings revealed the need for the adjustment of the LSC and showed the way for tuning towards the direction of finding solutions for specific problems, such as refuelling needs (pellet refilling), acquiring burner facilities (financing with leasing solution), to reduce the fees in the cluster exploitation from FWC, etc.

The future activities of the project are targeted towards two directions. Firstly, the implementation and monitoring of the pilot LSC; the data related to the first heating season has to be collected, analyzed and evaluated by the Greek teams. Secondly, the promotion and implementation of this operating scheme in other possible end-users within the RNP area; the partners will undertake dissemination initiatives, organizing face-to-face meetings with other local stakeholders, emphasizing the advantages of the use of local biomass and providing support to the involved stakeholders.

8.3 Kozjanski Park



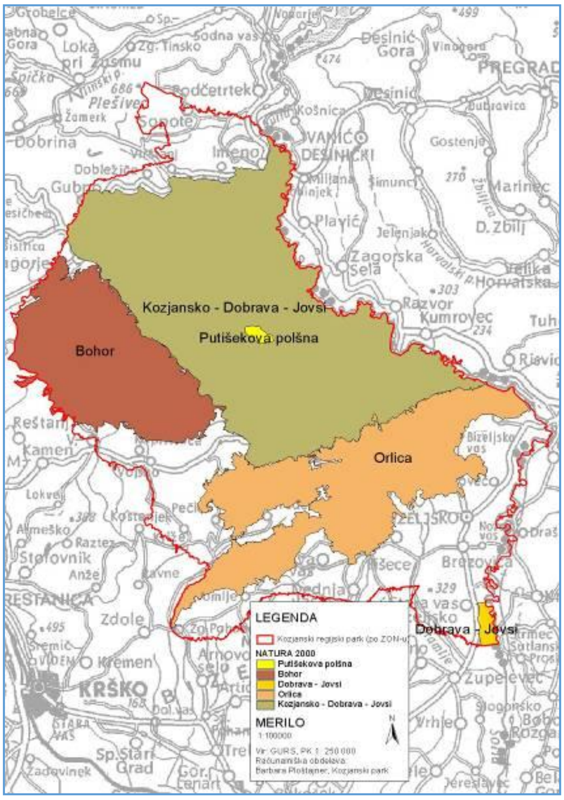
8.3.1 Description of the park

Located in the Eastern part of Slovenia, Kozjanski Park is one of the oldest and largest nature reserves in Slovenia. Stretching over 206 square kilometres, it has the status of a regional park, and is a mosaic comprised of the sub-Alpine Posavsko Hills, wine-bearing slopes, and plains along the Sotla River. It is a beautiful expanse of pristine nature with a rich cultural heritage.

The manager of the protected area is the Public Institution of Kozjanski Park.

The beech forest on Orlica Mountain, the grassy slopes of Vetrniki and Oslica, the old orchards scattered across the hillsides, the wetlands along the Sotla Rivers as well as the gorges and ravines, are home to a multitude of plants and animal species, some of which are rare or endangered. The isolated karst area adds a special quality to the region of Kozjansko, surprising visitors with sinkholes, dry dolines and river springs, karst caves and chasms. The well–preserved countryside reflects hundreds of years of human activity: mighty castles, ancient cathedrals and pilgrimage sites, medieval markets, and characteristic local homesteads with perfectly tilled fields.

The high rate of biodiversity ranks Kozjanski Park among the most important nature reserves in Slovenia and Europe, and most of the park (69%) is protected as a special NATURA 2000 reserve.



Picture 24 Natura 2000 within Kozjanski Regional Park

The remoteness of the Kozjansko region has created a uniquely harmonious coexistence between people and nature as well as between tradition and progress, both essential for modern sustainable development. The hiking trails, cycling routes, wine routes and many local events presenting our traditional and modern products, tie together the region's natural beauty, cultural landmarks and people.

The protected area of the park, with a wide area of influence, has the status of a biosphere reserve within the Man and Biosphere (MAB) project under the auspices of UNESCO.

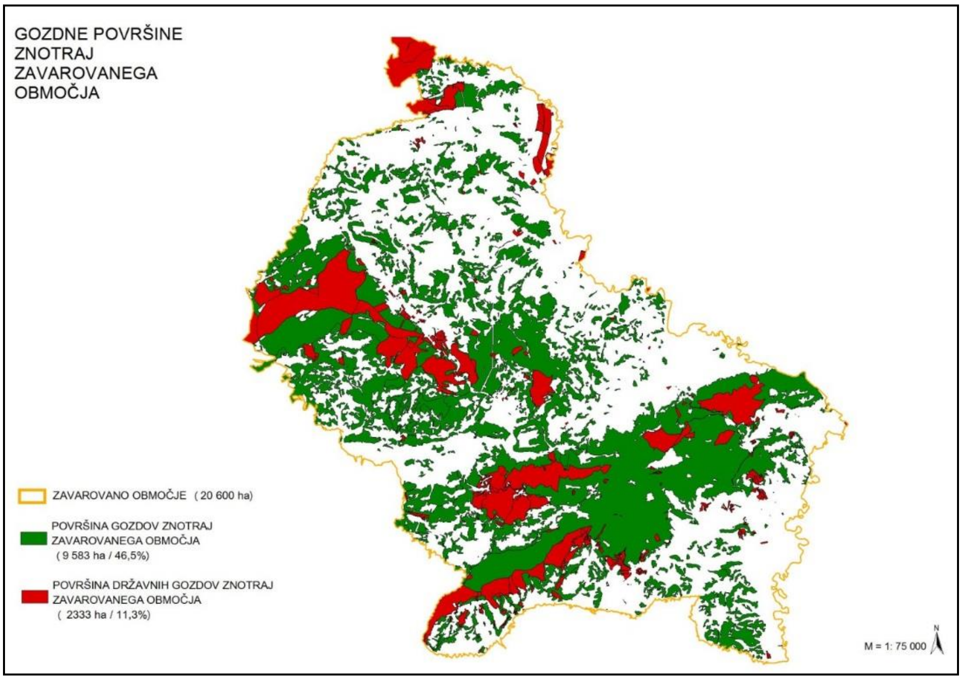
Picture 25 The position of the protected area within Slovenia

8.3.2 Description of Wood Biomass Potentials in the Park

An overview of the possible sources of wood biomass within the protected area.

Table 25 Overview of the possible sources of wood biomass within the protected area.

Land Use	Area (ha)	%
Forest	9,580	47
Meadows	5,640	28
Cropland	2,130	10
Vineyard	1,080	5
Orchard	460	2
Other land	1,710	8
Kozjanski Regional Park - together	**20,600**	**100**



Picture 26 Wood surfaces within the protected area

8.3.3 Description of the production Chain

8.3.3.1 Potentials of wood biomass

During the first phase of the project, and in cooperation with the Slovenian Forest Service, the Agricultural Advisory Service and the Forestry Institute, we prepared an overview of the potential sources of biomass and established a value chain of wood and other agricultural residues as well as the use of biomass in the protected areas.

Table 26 Sources of Biomass

Forests	Around 40% of the planned cut
Waste from Wood Processing	40–60%
Waste from Agricultural Land	up to 3m^3/ha/year
Wood Residue on Farms	1 to 3m^3/year
Overgrowing Land	up to 1m^3/ha/year
Riparian areas overgrown with trees and bushes and scrapped wood products	up to 3m^3/ha/year

Table 27 The Potential of Biomass from Different Areas within the Protected Area

Use	m^3/year
Forests	16,000 m^3
Agricultural Land (vineyards, orchards)	3,000–6,500 m^3
Overgrown Lands	300–600 m^3
The Potential of Riparian Areas	100–200 m^3

Table 28 Main Indicators of Forest Funds

Area of forests	Conifers / deciduous (%)	Private / State (%)	Growing Stock (m^3/ha)	Increment (m^3/ha/year)
9,583 ha	8/92	73/27	285	8.2

The natural preservation of forests is a guarantee to ensure the sustainability of returns.

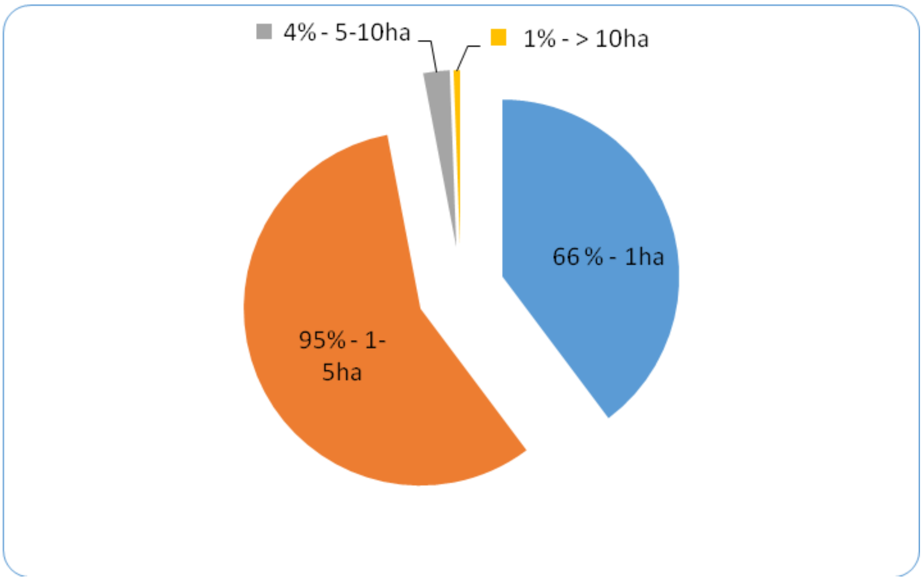
The Maximum Allowable Falling – Realization

A 10-year increment totals at 865,000 m^3, of which the maximum possible falling of the increment is 77% and the allowable falling of growing stock is 21%. The realization of the allowable falling in 2008–2012 was 100–106% in state forests and 30–53% in private forests. In the past five years, the average annual falling amounted to 36,000 m^3.

Ownership Structure of Forests

Forests are divided among approximately 8000 owners. The size of an average private estate is 1.5 ha.

- 66% of owners own a property of 1 ha, which comprises 15% of the surface area
- 95% of owners own a property of 1–5 ha, which comprises 60% of the surface area
- 4% of owners own a property larger than 5–10 ha, which comprises 20% of the surface area
- 1% of owners own a property larger than 10 ha, which comprises 20% of the surface area. 1% of forest owners attend annual education courses at the Slovenia Forest Service.
- 15% of forest owners are annually advised by the Slovenia Forest Service with the issuance of orders.



Picture 27 Structure of private forest estate

Skidding Conditions

99% of skidding is performed using a tractor. The average skidding distance is 344 m.

200 m	200–400 m	400–600 m	600–800 m
25%	51%	17%	7%

The Issue of the Withdrawal of Biomass from the Forest:

- It is unacceptable to take shrubs narrower than 5 cm.
- It is unacceptable to crush entire trees.
- Skidding method and technology of preparing wood chips is not acceptable with tree stumps.

Table 29 Basis for Calculation of wood biomass potentials

Development Phase / diameter of trees	%
Young trees (less than 10 cm)	100
Pulpwood (10–30 cm)	75
Stand of mature trees (over 30 cm)	45
Regeneration forest	40
Coppice and fern areas	85
Scrubs	100

Factor gross / net is 0.90 due to the use of branches (diameter of between 5 and 8 cm). The actual gross planned cut is considered according to the development stages. Closed surfaces are distributed evenly throughout the development phases.

Table 30 The potential of forests

	Potential of Biomass (m^3)	Share of the Maximum Possible Harvest (%)
Gross planned felling	66,500	100
Suitable	30,000	44
Accessible	26,000	40
Viable	23,000	35
Suitable realization	16,000	24

Table 31 The Potential of Farmland

	Area	Annual Potential
Vineyards	1,082	1–2 m^3/ha
Orchards	456	2–3 m^3/ha
Meadows / pasture	5,641	0.2–0.5 m^3/ha

3,000 to 6,500 m^3 of wood biomass could be obtained from farmland on an annual basis.

The Potential of Farms in the Park Area

The 700 farms in the protected area annually generate from 700 to 1,400 m^3 of wood residue. About 80 forest owners possess more than 10 ha.

The Potential of the Primary Processing of Wood

assortment	board	beams	other
% waste	45	30	60

Sawmills and the further processing of timber in the protected area annually provide from 1,000 to 2,000 m^3 of wood residue.

The Potential of Land Abandonment

From the 574 ha of abandoned land available, we could annually obtain from 300 to 600 m^3 of wood biomass. It would be prudent to take advantage of 75% of these quantities.

The Potential of Riparian Areas

From the 61 ha of land along rivers and streams, which is overgrown with trees, we could annually obtain 100 to 200 m^3 of wood biomass.

Total Current Potential of Biomass in the Protected Area

The full potential of biomass, according to the data collected, is 40,000 m^3 or almost 30,000 tons. Between 27,000 and 34,000 m^3 or between 20,000 and 25,000 tons of biomass would be appropriate for permanent use.

8.3.3.2 Key Challenges in the Field of Using Wood Biomass

1. Ensuring the efficiency of biomass energy utilization (the energy rehabilitation of buildings).
2. Increasing the efficiency of furnaces.
3. Heating in combination with other renewable energy sources.
4. Cogeneration of heat and electricity.
5. Ensuring the security of the supply.
6. Increasing demand with the construction of district heating systems.

Key Challenges in the Forestry Sector

1. Joining forest owners to create a form of joint management and performance in the market.
2. Reducing the fragmentation of forest properties.
3. Increasing the openness of forests with forest roads.
4. Phasing in efficient and environmentally acceptable technologies for harvesting and storage.

8.3.4 Description of producers, suppliers of wood biomass

The provider of biomass in the protected area is a farmer who has registered a complementary activity on the farm, which means that the production of biomass functions as an additional form of income. During the 2014/2015 heating season, farmers provided a full supply of wood biomass for the district heating in Kozje. A sufficient amount of woody biomass is obtained from farmers who also own forest lands. All the necessary equipment is their own.

In addition to the district heating in Kozje, the biomass is also used for heating of some individual households in the protected area. The quantity of the forest that covers this area is small, however a lot of households are still heated using conventional firewood. Given the high price of fuel oil, biomass heating in individual households is expected to increase in the next ten years. We also expect that the number of producers and suppliers of biomass will increase in the coming years.

8.3.5 Description of end-users

The end-users of district heating in Kozje are:

- the health centre
- the elementary school and kindergarten
- an apartment building (6 apartments)
- three multi-apartment buildings (15 apartments)
- five individual houses

Table 32 The technical characteristics of the district heating system in Kozje

Technical features:	
Boiler output	1.5 MW
Buffer storage tank	50,000 l or 1 day autonomy
Wood chip storage capacity	500 m^3
District heating network	1.5 km
Annual thermal production	2,000 MW/year

The next two tables show different biomass boilers.

Table 33 Small Biomass Boilers before 2008:

Location	Municipality	Fuel Type	Start of the System	Installed Power (kW)
Lesično	Kozje	Wood pellets	2006	20
Polje ob Sotli	Podčetrtek	Logs	2005	18
Bračna vas at Bizeljsko	Brežice	Logs	2003	32
Bizeljska cesta (Bizeljsko)	Brežice	Logs	2004	40
Brezovica na Bizeljskem	Brežice	Logs	2007	25
Brezovica na Bizeljskem	Brežice	Logs	2007	25

Table 34 Biomass Boilers – Pellets

Location	Municipality	Fuel Type	Start of the System
Trška cesta 15,	Podčetrtek	pellets	2011
Imenska Gorca 9	Podčetrtek	pellets	2012
Imeno 12a	Podčetrtek	pellets	2012
Buče 47	Kozje	pellets	2012
Brezovec pri Polju 11	Podčetrtek	pellets	2012
Ješovec 39	Kozje	pellets	2012
Kozje 29	Kozje	pellets	2012
Reštanj 32	Krško	pellets	2011
Zagaj 3	Bistrica ob Sotli	pellets	2012
Vojsko 14a	Kozje	pellets	2012
Stara vas 55	Brežice	pellets	2012

8.3.6 Setting up the production chain

The production chain was divided into three phases.

Phase 1: The organization of an informative event

- We organized two events for the general public.
- We invited farmers, forest owners, municipal officials, the Agricultural Advisory Service, the Slovenian Forest Service, and students of nature conservation.
- We presented them with the project objectives, stocks of wood biomass in the protected area, and an example of the production chain. The meeting was also attended by the then potential investor of the district heating who presented the advantages of such a system to the participants.

Phase 2: The organization of round table discussions

- We organized four round table discussions.
- The first round table was devoted to forest owners, producers of biomass, the district heating investor and the Slovenian Forest Service. The potential district heating investor wanted to know the chances of obtaining biomass within the protected area for his needs, and was especially interested in the final price.
- For the second round table, we invited representatives of the Slovenian Forest Service, namely the Brežice area unit and Celje area unit, who are responsible for forest management within the protected area. We wanted to learn more about the interest of forest owners in the production and sale of wood biomass, and the chances to establish an Association of Forest Owners within the protected area.
- The third round table was devoted to the presentation of the Association of Slovenian Forest Owners and a presentation of good practice within the framework of the association.
- At the fourth round table, the representatives of various associations as well as certain protected areas were acquainted with the meaning and operation of the wood biomass production chain in the country.

Phase 3: The organization of individual meetings

- Given the fact that the topic is the exploitation of wood biomass in the protected area, it is important to consider the aspect of sustainable use in exploitation. We carried out the arrangements on how to sustainably exploit biomass with the individual professional institutions operating within the protected area.
- All of our findings will be further shared with other protected areas.

8.4 Danube-Ipoly National Park

8.4.1 Description of the park

Following several years of well-established professional preparation, the ninth national park of Hungary, the Danube-Ipoly National Park was established on 60,314 ha on 28 November, 1997.

The Danube-Ipoly National Park is probably the most diverse of all national parks in Hungary. In its unique diversity it combines four regions of Hungary, the Pilis-Visegrád Mountain , the Börzsöny Mountain, the Ipoly Valley as well as a part of the Great Hungarian Plain along the Danube, to a harmonic unit.

The national park is destined for preserving the natural values of these mountain-land forests of specific beauty and habitats along the rivers.

The Danube-Ipoly National Park is located in the central region of Hungary, north of Budapest, and is connected in several places to the Slovakian border. Some parts of the national park are located in the direct vicinity of the capital. This means that the area is densely populated and there is a strong need for recreational use and other land use by local inhabitants.

The nature conservation manager of the national park and other protected areas in mid-Hungary is the Danube-Ipoly National Park Directorate (DINPD) The 1,354,742 ha administrative area of the DINPD includes 267,566 ha of nature conservation sites of community importance (Natura 2000 sites) and areas of different national protection level: the Danube-Ipoly National Park itself, 8 Protected Landscape Areas and 35 Nature Conservation Areas and ex-lege sites. The overall size of the areas of national importance is 135,000 ha including a Biosphere Reserve, an European Diploma site and several Ramsar Sites and Forest Reserves of great significance.

The main duties of the Directorate are defined by law. The DINPD:

- Manages the administration of priority natural values and areas within its administrative area and provides priority and secondary data collection. It also operates the monitoring and information system related to its scope of duties and cooperates with other information and controlling systems;

- Maintains and operates the conservation demonstration establishments and educational, documentary and tourist establishments, participates in nature conservational researches， and educational and documentary activities;

- Executes tasks of trusteeship related to the estates under its trusteeship;

- Manages the nature conservation of priority and high priority areas and nature values, of Natura 2000 sites, and areas and values belonging to international conservation agreements;

- Manages the preparatory tasks of regional forest and wildlife management belonging to the scope of the Ministry for Agriculture;

- Manages duties related to the designation of priority, high priority and Natura 2000 areas;

- Prepares the conservation management plans of protected areas and Natura 2000 sites;

- Manages the ranger service of the Directorate.

The ownership of the protected areas is very diverse: state owned and private owned areas are under the nature conservation control of the DINPD, such as areas owned by local municipalities or publicly owned companies. Also, the management of the areas is very diverse, both public and private managers are present in the administrative area of the park directorate.

The overall size of the areas directly managed by the DINPD itself is 15,000 ha including 2,500 ha of the forest/woody area.

Forest management tasks are carried out by three big state owned forestry companies in most parts of the forest areas: Pilisi Parkerdő Zrt., Ipolyerdő Zrt. and NEFAG Zrt.

8.4.2 Description of wood biomass potentials in the park

The total size of the areas managed by the DINPD itself is 15,000 ha: 2,700 ha of it is forest, and the remaining part is mainly grassland area. The main goal of DINPD management is nature conservation. Forestry management – with the aim to produce wood – is implemented in only half of the self-managed forest areas. Even at these sites, a relatively high amount of biomass is left in the forest as dead wood for nature conservation goals. A relatively high amount of biomass also comes from nature conservation management of the grasslands: apart from hay production, the removal of shrubs produces material, suitable for woodchip production.

The planned size of the project area is 3,840 ha – partly woody and partly grassland areas. In regards to the total size of the management area, the necessary area could be selected from that and the planned volume of biomass could be produced. However, if the invasive removal is successfully, the biomass can be harvested only once from an area. Long-term biofuel availability can be achieved by moving to another nearby area from year to year. In regards to the total size of the area, "infected" by invasive species, and the failures in final removal, the availability is ensured for at least ten years, and later forestry production areas can take over the role of the nature conservation areas. In some areas, small scale forestry management is carried out producing firewood without endangering nature conservation goals and keeping the continuous forest cover.

Considering the main task of the national park directorate, i.e. nature conservation, while setting up biomass supply chains for energetic use, priority was given to biomass obtained from nature conservation management and the areas of self-management. The original estimations regarding the amount of available biomass form such areas selected for the BioEUParks project showed that annually 1,220 tons of firewood and 2,717 tons of shrub are available from invasive removal in the selected grassland sites (2,387 ha), and 1,146 tons of BM is available from the selected forest areas (1,453 ha).

A more detailed calculation of the available biomass was based upon the final selection of the production sites (see description of the supply chains), mapping of invasive species and methodology based on site measurements.

Although the sustainably available amount of biomass in the DINPD managed areas is at least 10,000 tons/year, another BM producer, Pilisi Parkerdő Zrt. (Pilisi Parkerdő Forestry Ltd.), was involved in the project.

Pilisi Parkerdő Zrt. manages forests covering 57,000 ha in Pest County and Komárom-Esztergom County, sustainably producing 196,000 m^3 of wood annually, where 144,000 m^3 of it originates from protected areas of 42,000 ha. 33,000 m^3 of the annual production is industrial wood, 145,000 m^3 firewood, 14,000 m^3 narrow firewood and 4,000 m^3 woodchips.

Three basic types of woody BM are harvested in the management area of the Pilisi Parkerdő Zrt.:

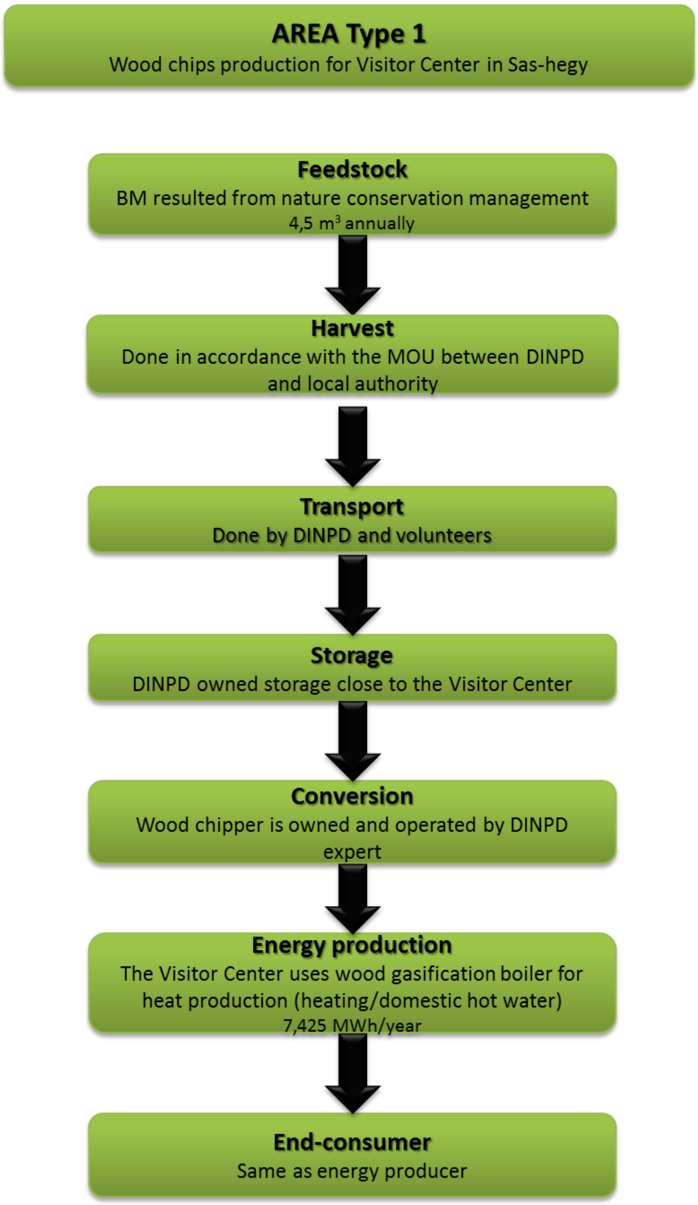
1. Small branches, narrow wood from pre-com thinning, coppice from roads
2. Woody biomass from nature conservation
3. Firewood

In the administrative area of the DINPD, an additional significant amount of BM is available within the forestry management areas of Ipolyerdő Zrt. and NEFAG Zrt, however this BM potential was not examined within the project.

8.4.3 Description of the production chain

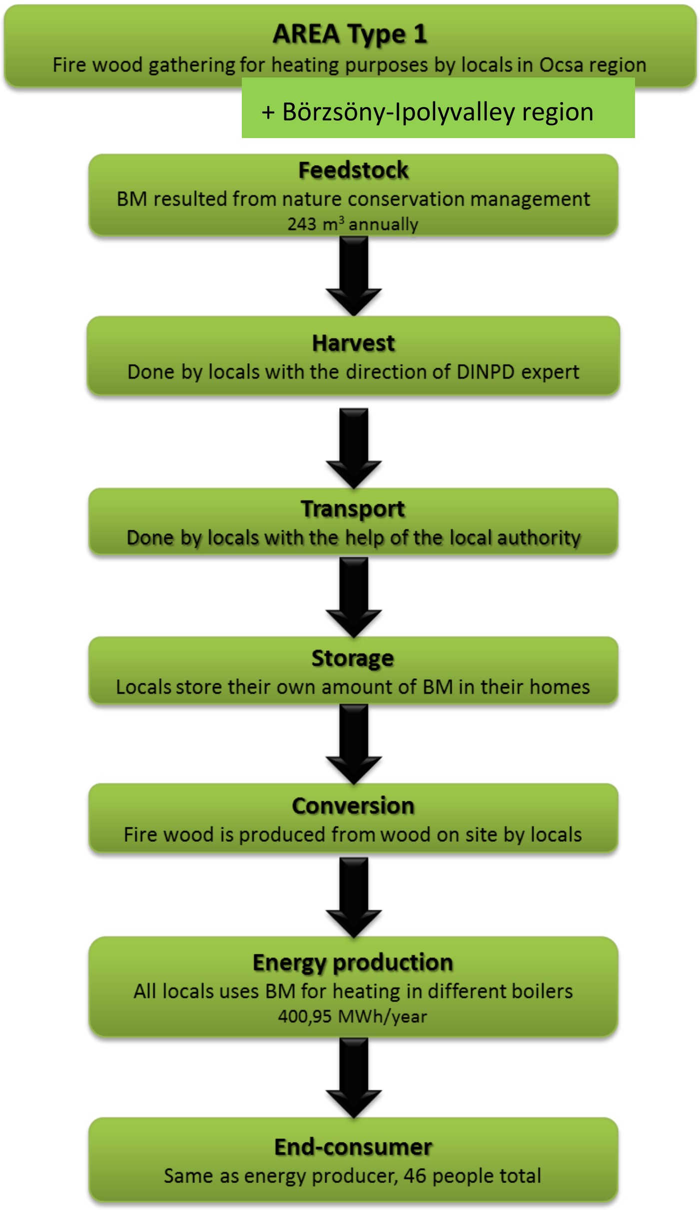
Three types of local supply chains (LSC) were set up within the project:

Type 1 LSC is set up in DINDP sites, producer and end-user of the biomass is the DINPD itself, and all other processes in between are mainly done by the DINP as well.



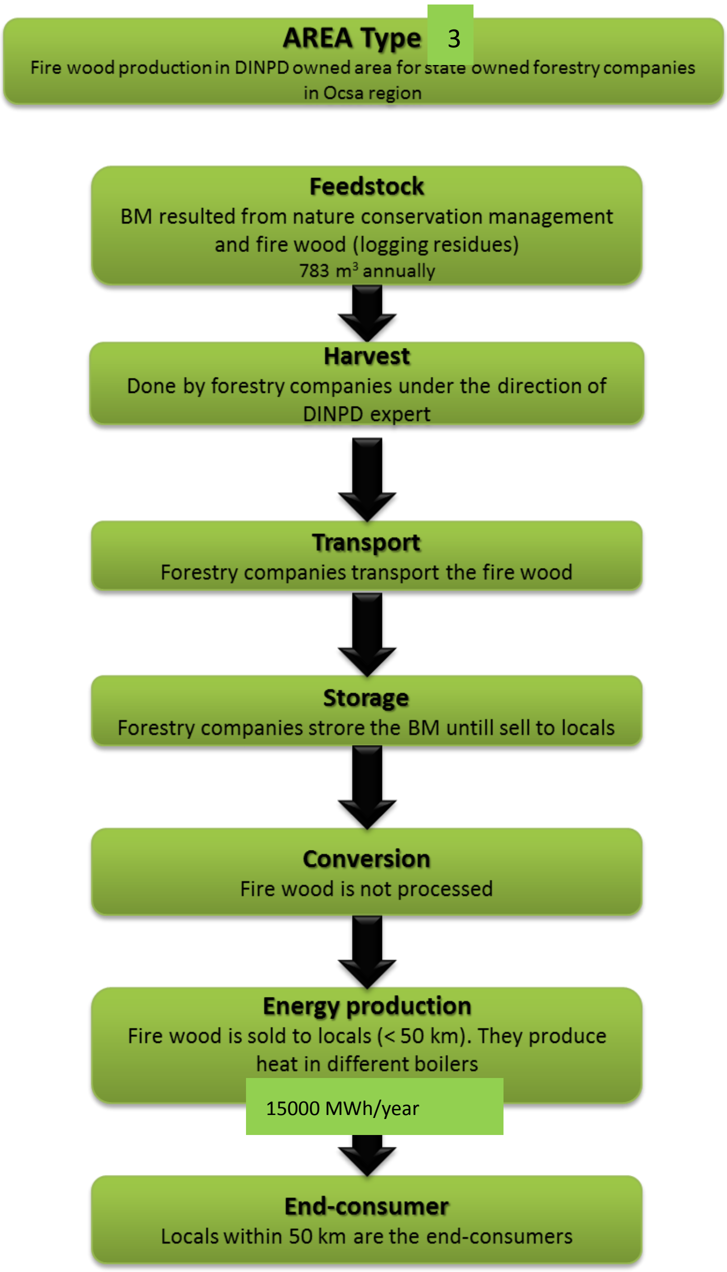
Picture 28 Type 1 local supply chain in the park

Type 2 LSC is based on biomass produced in the DINPD managed sites and the end-users of the BM are local inhabitants or small local entrepreneurs. Transport, storage, conversion and energy production are done by the end-users.



Picture 29 Type 2 local supply chain in the park

Type3 LSC is based on BM produced by the Pilisi Parkerdő Zrt.



Picture 30 Type 3 local supply chain in the park

Environmental sustainability of the production is ensured by nature conservation and forestry legislation and the management plans of the sites. The DINPD as the nature conservation manager can check the fulfilment of the regulations.

DINPD being a governmental body Type 1 supply chain serves both economic and social sustainability by decreasing heating costs of the visitor centre and the animal farm of the DINPD.

Type 2 and Type 3 LSC serves the local economy, and in case of local inhabitants as end-users, the relatively low price of the firewood is an important social factor in the less developed areas of Ocsa and Nograd.

8.4.4 Description of producers, suppliers of wood biomass

Most of the forest areas are managed by the state owned forestry companies. Some areas are privately owned or owned by the municipalities. Forestry management is done in accordance with forestry plans. Environmental sustainability is ensured by the Forest Law and Nature Conservation Law of Hungary.

In the LSCs, the BM supplier (wood producer) is either the DINPD or the Pilisi Parkerdő Zrt.

FSC Forest Management Certification has not been issued to any forestry company in the operational area of the DINPD, and PEFC has not been introduced in Hungary yet (national standards have not yet been elaborated). However, there are sites where the forestry management meets the requirements of the FSC principles, however the managers have not applied for the certification. This is also valid for Pilisi Parkerdő Zrt.

In each case, the BM is a product of nature conservation management or selective cutting in the protected areas.

In grassland areas, the BM is a product of nature conservation management: removal of invasive species and shrubs. The harvesting is done by DINPD workers or subcontractors. In some cases (invasive removal), volunteers also help with harvesting.

With woodchips, conversion is done by the BM producer. In some cases, subcontractors are involved as well. Transporting the BM is done by the supplier, subcontractor or end-user.

8.4.5 Description of end-users

The end-user in Type 1 LSC is the DINPD: BM heaters are installed in its facilities. The type of the heater was selected in consideration of the type of the BM available in nearby sites. The Sas-Hill Visitor Centre's heater uses woodchips as fuel. The heater in Esztergom farm can use different fuel types: woodchips, hay and firewood. These installations are high-tech and the conversion is very effective.

Local inhabitants are the end-users of the firewood mainly burnt in traditional ovens or in household scale facilities. A small local pasta factory in Ocsa also buys firewood as fuel for its small scale heater facility. The way of harvesting and the short transport results in relatively cheap prices of the BM fuel, which makes this type of a supply chain both socially and economically sustainable. The local inhabitants transport the wood themselves; this is another source of financial sustainability. Environmental sustainability is ensured by rangers controlling the transport process and establishing special nature conservation criteria in the supply chain contracts. The small scale transport based on manpower is the best solution from the viewpoint of nature conservation.

Wood chips produced by the Pilisi Parkerdő Zrt. are used in heating facilities of small entrepreneurs (e.g. hotels) and small facilities of the army.

8.4.6 Setting up the production chain

The local supply chain plan was set up in consideration of the nature conservation priorities, the availability of BM and the existing or possible end-users. The overlapping of possible production areas with small scale energy production facilities was the basis for selecting possible project areas.

Institutions of the DINPD, municipalities and forestry companies were the focus of the supply chain plan. The potential consumers of energy were involved from the beginning based on the existing cooperation between the DINPD and these organizations. The main tool for involving individuals and local inhabitants was the organization of awareness-raising events and specific meetings.

Amongst the available options, priority was given to feedstock, which is available at the lowest risk to biodiversity and can be harvested with the highest level of sustainability.

In this way, the "lowest risk to biodiversity" condition can be fulfilled and checked easier if the feedstock is produced in the areas managed by the DINPD itself.

In case of biomass, obtained from maintenance and invasive removal compliance with one of the existing forestry or agricultural standards, further stricter environmental sustainability criteria are guaranteed by the nature conservation management plans and management conceptions of the DINPD, available for all protected areas.

In case of woody biomass produced in forest areas, the basic standards are required by the national legislation (EU legislation is adopted). Some additional nature conservation requirements were specified in the supply chain contracts.

The planned CHP installation capacity was examined as well. Mayors were invited to a meeting where they were informed about the possibilities and asked about their willingness to participate in the supply chains. Local governmental institutions are open to the development of a local CHP (under 50 kW of rated electric power) for supplying schools, kindergartens, nursing homes and other buildings, however governmental funding will be needed to implement such projects. Partnership between one local government and biomass experts resulted in submitting a common application requiring funding for a small scale BM heater development.

As a result of specific meetings, the leaders of DINPD decided to change the plans of the farming facility in Esztergom and a BM heater was installed.

The involvement of Pilis Parkerdő Zrt. was based on the long existing partnership between the DINPD and the forestry company. Negotiations were carried out with the other forestry companies as well – this might result in setting up further LSCs in the future.

Long term agreements and annual contracts were signed. In the Ocsa region, the local inhabitants signed the contracts themselves, while in Type 3 LSC, the inhabitants were represented by the local governments in the contracts due to the huge number of individuals involved.

9 Benchmarking

The benchmarking of relevant projects is one of the key elements to providing a coherent project guideline without doubling efforts already dealt with in previous projects. Therefore in the first step within WP3, the following EU projects were benchmarked by the project research partners: EUBIONET3, AFO, SOLIDSTANDARDS, BEN, MAKE-IT-BE, PromoBio, AGRIFORENERGY, WHS, BIOMASSTRADECENTRES[1].

On the basis of benchmarked projects, it can be said that especially the experiences in establishing a sustainable supply chain in different regions as well as the forms of stakeholder engagement can be of use. For the task of capacity building, the projects BIOMASSTRADECENTRES, AGRIFORENERGY 2, EUBIONET3, AFO, PromoBio and WHS are especially relevant. The most important synergies from these different projects will be discussed briefly in this chapter in order to create a reference document when working on different tasks within the work packages.

The project BIOMASSTRADECENTRES[2] deals with creating a regional network for producing and trading top-quality wood fuels, run by local farmers and/or forest entrepreneurs. This is one of the essential approaches for a quick switch from fossil fuels towards renewable energy sources in a sustainable way. The process for convincing market players to go into investments is a very challenging target, requiring a great effort and often producing results in longer terms. The framework conditions (legislative, fiscals) are often decisive when deciding to make the investment by either private or public bodies in evolving renewable fields. Training programmes, addressed at wood fuels producers, are fundamental to improving the professionalism of primary producers and their capacity and competence in marketing their products and the concrete application on the market of the EU quality standard for firewood and chips (EN 14961), lowering the emissions of domestic heating appliances.

The consortium of BIOMASSTRADECENTRES edited the Guideline "Biomass Logistic&Trade Centres – 3 steps for a successful project realization" in five languages[3]. This represents one of the most important deliverables of the action which aims at making the know-how and tools gained during the action available on regional, national and EU levels, and providing

[1] EUBIONET3 – Solutions for biomass fuel market barriers and raw material availability, AFO – Activating private forest owners to increase forest energy supply, SOLIDSTANDARDS – Enhancing the implementation of quality and sustainability standards and certification schemes for solid biofuels, BEN – Biomass energy register for sustainable site development for European Regions, MAKE-IT-BE – Decision-making and implementation tools for delivery of local and regional bioenergy chains, PROMOBIO – Promotion to regional bioenergy initiatives, AGRIFORENERGY2 – Promoting and securing the production of biomass from forestry and agriculture without harming the food production, WHS – Woodheat solutions, BIOMASTRADECENTRES – Supporting the organization of spot markets supply for wood chips and firewood.

[2] For more information on the project see: www.biomasstradecentre2.eu

[3] Downloadable at: http://www.biomasstradecentre2.eu/biomass-trade-and-logistics-centers/btc-generic-guidelines/

technical-economical support to all those market players who intend to evaluate the possibility of investing into carrying out new BLTCs. In some regions the BTC concept – thanks to this action – was recognised to be of strategic importance for the sustainable development of the biomass sector, therefore measures for supporting the realization of BLTC were introduced in the Regional Rural Development Plans. For partners to this project it will be important to take the good examples from BIOMASSTRADECENTERS when looking at successfully implementing their projects and also when facing difficulties in the set-up of their supply chains.

AGRIFORENERGY2[4] had the goal of facilitating the communication between producers and consumers of bioenergy. This could be very useful for BIOEUPARKS, as it provides some insight into how to bring those two groups together. In nature parks, this is very important considering that locals can possibly be worried about the impacts of the increased use of certain types of biomass from protected areas.

According to AGRIFORENERGY2, one of the main problems is the lack of communication between the energy supply side and the customers. In order to make investments happen and bioenergy plants set-up, the approach was to organise workshops, study tours and one-to-one meetings in the European target regions. Workshops allowed potential bioenergy providers (e.g. farmers and cooperatives, forest owners, forest entrepreneurs) and potential end-users to meet and gain awareness of their respective offers and requirements. Study tours allowed these actors to gain confidence in bioenergy businesses by visiting real bioenergy plants. One-to-one meetings allow going one step further by gathering committed actors from the supply and demand side to discuss in further detail their business cases with the technical support of project partners.

Some lessons were learnt, linked to the economic and political backgrounds. If we focus on the wood biomass part of the project, lessons learnt show the following:

- The biomass heat sector still has a great developing potential, the availability of woody biomass is still very high in rural and mountain regions (wood exploitation ~ 30% of annual increment). The energy prices of wood fuels are highly competitive compared to those of fossil fuels.
- The high investment costs for biomass projects still remain the most important barrier, even though the energy prices of wood fuels are highly competitive compared to those of fossil fuels.
- Awareness of potential investors, both public and private, is growing. It is also getting more and more difficult for investors to get financial credits.

[4] For more information on the project see: http://ec.europa.eu/energy/intelligent/projects/en/projects/agriforenergy-2

- Promotion activities (WSO) and best practice examples have positive impacts on target groups.

From the project EUBIONET3[5] we can draw the conclusion that the key is to look at best-practice examples and to make sure to have a sound data source regarding the existing biomass potential. From EUBIONET3 we learn that the greatest potential for an increased use lies in forest residues and herbaceous biomass. This can be interesting when establishing new supply chains from scratch. Furthermore, trade barriers were evaluated and some solutions developed: the project has contributed to the development of combined nomenclature codes for wood pellets, price indexes for industrial wood pellets and wood chips, and the CEN standards for solid biofuels. Wood fuel price mechanisms were analysed, national/international sustainability criteria for biomass were evaluated, “new” unexploited agro-industrial biomass sources were identified, and case studies of biomass heating substituting fossil fuels and a biomass boilers producers' catalogue were prepared. An analysis of the competition and price situation of the woody biomass use in forest industry and energy sector was carried out.

According to EUBIONET3, the most relevant sustainability criteria are the minimization of GHG emissions and the optimisation of the energy balance. The stakeholder groups show differences in priorities between the criteria. Measuring and quantifying sustainability of bioenergy is a very complicated issue.

The project AFO[6] is also useful when working on tasks related to stakeholder engagement and the activation of the supply chain. AFO can help in activating forest owners. It can also be helpful when defining a strategy on how to reach important stakeholders.

The AFO project operated in 5 selected target regions with vast private forest ownership (France, Slovenia, Latvia and UK). The project was aimed at activating private forest owners (PFOs) to supply more wood fuel for an increasing demand of small and medium scale users. The main target groups were PFOs, wood fuel users, forestry entrepreneurs, harvesting contractors, and regional authorities.

First, PFOs interested in the wood fuel supply in the target regions were identified. Barriers to the production of wood fuel by PFOs were also surveyed. Second, the current and future potential of the wood fuel supply in the target regions was studied. Third, the current and future potential of wood fuel consumption in the target regions was analysed. Fourth, sub-regional wood fuel supply clusters were established and developed through workshops, study tours and face-to-face meetings. Fifth, co-operation between wood fuel suppliers and users was implemented by bringing stakeholders together, and thus matching demand with supply. Finally, through effective dissemination on both local and European wide levels, PFOs were activated to provide more wood fuel in non-partner countries. Through EU-wide

[5] For more information on the project see: www.eubionet.net

[6] For more information on the project see: http://ec.europa.eu/energy/intelligent/projects/en/projects/afo

dissemination, the proven activation methods and supply chain models will support the ambitious energy and climate policies of the whole EU-27.

The lessons learnt from AFO for BioEUParks are among others the following: the small size of the forest holdings – the average size of a forest holding is just a few hectares in many countries. Due to the small size, the forest holding is not considered to be an actual investment. Basically, the bigger the forest holding, the more actively it is being utilized. Furthermore, as forest holdings are small, many forest owners do not live near their forest, and many owners are of an older age, so activating of PFOs takes a long time. In addition to economic or silvicultural encouragement, it is necessary to motivate PFOs to supply wood fuel with other reasons as well, for example addressing climate and environmental issues and providing help in wood sales and harvesting. We learn from AFO that there is a need for further on-going support to the wood fuel supply chain sector and the PFOs. A good momentum started in AFO should be maintained by providing continuity and consistency in regional support, for example by follow-up of PFOs and potential investors, and by further local adaptation of the AFO working model.

The project PromoBio[7] can be useful when trying to define new potentials for biomass use. Its main characteristic is the transferability of good bioenergy examples from areas with well developed bioenergy sectors to areas with underutilized bioenergy sources.

The objective of the PromoBio project was to provide support to the regional bioenergy initiatives and to facilitate new bioenergy business projects in Eastern European countries where potentials in particular of forest and agricultural biomass, have been utilised insufficiently. Best bioenergy practices and successful business models from the partner countries Finland and Austria were tested and transferred to the target regions. The aim was to provide the local stakeholders with the grounds to make informed decisions in developing the bioenergy markets of their region. The project provided concrete supporting actions both to decision makers and to companies starting or developing bioenergy business.

From the PromoBio project we learn that it takes time to engage people in project activities, and the implementation of new bioenergy investments require building trusting relationships and good networks. Furthermore, when preparing a regional action plan for bioenergy, it is important to develop the plan in line with the national/regional strategies, action plans as well as legislation.

WHS[8] addressed barriers of insufficient cooperation, information and training within the agricultural and forestry sectors as well as the lack of public awareness. The results from this project could again be used to help implement and bring together stakeholders in nature parks.

[7] For more information on the project see: www.promobio.eu
[8] For more information on the project see: http://ec.europa.eu/energy/intelligent/projects/en/projects/whs

The project particularly addressed the barriers of insufficient co-operation, information and training within the agricultural and forestry sector and the lack of public awareness among decision-makers, to mobilise the large biomass potential from fragmented privately owned forests and from agricultural land by increasing co-operation among farmers and forest owners, to integrate the agricultural and forestry sector into the energy market as a raw material supplier (e.g. wood chips) or as an energy supplier (e.g. bioheat), and to stimulate national and international exchange of experiences and knowledge transfer.

The most important summarized results that should be taken into consideration when drafting supply chain guidelines within BIOEUPARKS are the following:

- Previously successfully implemented actions and best-practice examples are important,
- Common guidelines on sustainability criteria and certification schemes need to be agreed on by all partners, as different approaches can be misleading,
- It is important to adapt the training material for different countries and nature parks,
- Assessment of bioenergy potentials and the differentiation between types of biomass,
- Taking into consideration the competition between material usage of raw material, energy production, food, and feed and eco-system services.
- The largest share of biomass comes from by-products and residues from the forest industry,
- GHG savings need to be calculated for every different feedstock and energy use,
- Drafting and signing Memorandums of Understanding is an important first step,
- Biomass pricing models should be considered,
- R&D, local policy for biomass and support schemes are important factors for the start of a project.

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