Bio South

Techno-economical assessment of the production and use of Biofuels for heating and cooling applications in South Europe

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FOREWORD

Biomass was the first source of energy used by mankind and today continues to be a very significant source of energy in certain countries. In Europe, it is being considered as a real alternative that can contribute to the solution of the current energy situation. The raw materials and applications are very diverse, which broadens the number of possibilities but also hinders the design of an integral strategy for its use.

Although its potential is huge, certain barriers limit its use, as they prevent it from competing with traditional sources of energy in terms of price.

In order to optimize the use of this resource, it is therefore necessary to develop technologies to maximize performance in the transformation process as well as in supply chains.

INTRODUCTION

The use of solid biofuel to generate heat has undergone significant development in northern and central European countries such as Finland, Sweden, Austria, Denmark and France. However, although there is huge potential in certain Southern European regions, use of this resource is much lower and no real biofuel market has been established. In order to properly harness this potential, it is necessary to transfer technology and experience from the countries where biofuel markets are more developed to the regions of Southern Europe and to implement the necessary adaptation to the specific conditions of these regions.

Following this approach, the Bio-South project involves the analysis of the entire cycle of harnessing and use of forest biofuel in two regions in the south of Europe; Tuscany (Italy) and Navarra (Spain). Both of these regions have vast forest surface areas and have significant potential.

There is no consolidated biofuel market for heating applications in either region.

It is important to note that harnessing forest residues for energy may contribute to the financing of forestry work, which is necessary to produce quality wood and to ensure environmental benefits, such as the reduction of forest fire risks and contributions to compliance with the Kyoto agreement to reduce CO_2 emissions.

In this brochure information will be presented about the collection, handling of forest residues and production of biofuels and distribution logistics for heating and cooling use.

OBJECTIVES

- Evaluate the production of forest biofuels and its use in Southern Europe;
- Analyse the current biofuel market and estimate development in southern Europe;
- Identify the market barriers faced by biofuel;
- Identify and quantify the social, environmental and economic benefits of using biofuels;
- Transfer results and conclusions to the appropriate authorities and the wood industry;
- Propose socio-political measures at local and regional level to promote the development of biofuels;
- Inform the public of the results of the study.

Partner of the Project

Belgium: EUBIA
Spain: CENER, GAVRN, NAMAINSA, ACCIONA Energía, L-SOLÉ, Iniciativas Innovadoras
Italy: ETAFlorence, University of Florence, Municipality of Abetone
Finland: VTT Processes
Sweden: Energidalen I Sollefteà AB
Slovenia: ApE

METHODOLOGY: Technical and economical study

The entire biofuel supply chain was analysed. In order to do this, the BIO-SOUTH project:

- Studied the specific circumstances of each of the two regions, Navarra (Spain) and Tuscany; Toscana (Italy), gaining results that can be transferred to other regions of Southern Europe;
- Established cooperation with Nordic Countries, which have vast experience in biofuels and the sharing of results in the E.U.

Work was divided into the following stages:

W.P.1 Evaluation of forest biofuels.
W.P.1.1. Evaluation of forest biofuels generated in Navarra and Tuscany.
W.P.1.2. Evaluation of residues generated by the wood industry in Navarra and Tuscany.

W.P.2 Collection and handling of forest residues.
W.P.2.1. Analysis of gathering, collection and handling methodologies.
W.P.2.2. Analysis of logistics, transport and storage.
W.P.2.3. Analysis of collection costs.

W.P.3 Production of biofuels and distribution logistics.
W.P.3.1. Wood biofuel marketplace.
W.P.3.2. Production process: drying, chipping, pelletising.
W.P.3.3. Cost analysis of biofuel production.
W.P.3.4. Logistics and costs of distribution and sale of biofuels.
W.P.3.5. Meeting with main players in the wood sector.

W.P.4 Use of biofuels: heating and cooling.

W.P.4.1. Case study: Heating and cooling in schools.
W.P.4.2. Case study: Small industry and tourism centres.
W.P.4.3. Case study: District heating and cooling.
W.P.4.4. Case study: Energy supplies for tourism centres in mountain areas.
W.P.4.5. Analysis of non-technical barriers.
W.P.4.6. Seminar.

W.P.5 Analysis of biofuel markets for heating and cooling.

W.P.5.1. Analysis of the current market situation.
W.P.5.2. Potential market and estimated development.
W.P.5.3. Socio-economic repercussions.
W.P.5.4. Estimation of the potential market in Southern Europe.

W.P.6 Sharing and communication of results.

W.P.6.1. Presentation of the results to the regional authorities.
W.P.6.2. Presentation of the results to the forestry associations and the wood industry.
W.P.6.3. Information to the public about the use of biofuels and its possibilities.
W.P.6.4. Diffusion in the European Union.

- Organisation of a Government Conference at European level.

W.P.7 Joint diffusion activities for the EIE programme.

- To encourage the creation of steady economical support policies and other political measures by the local governments (Navarra and Tuscany) to support the development of the biofuel heating local markets.
- The creation in Navarra of a biofuel residue "stock office" as an intermediate between small wood residue producers and biofuel manufactures.
- To promote the use of biomass for heat generation in Southern Europe.
- To make citizens aware of the biofuel heating potential and benefits in Spain and Italy.
- Contribution to the creation of new and stable rural employment in the forestry land for the collection of forest residues in Southern Europe.
- To contribute to gender equality with regard to rural employment through the mechanisation of forestry work for woody residue collection in Southern Europe.
- To contribute to the reduction of carbon dioxide emissions (Kyoto protocol) in Southern Europe.
- To contribute to the reduction of the risk of fires in forests through the cleaning activities in the forest and the collection of woody residues generated.

This brochure presents the technical and economical issues of using biofuels for heating and cooling. It specifically presents the description of the biofuels and resources properties. Also the main Technologies of production (Systems and handling of Forest Residues) and their costs are presented. Furthermore other issues like Environmental impact is taken into consideration. All that information is coming from the Finnish and Swedish experience where the forest industry is one of the most important industrial sectors. To conclude the advantages and constraints of the Spanish and Italian situation will be studied.

1. Forest Residues and fuels properties

The properties of wood fuels are based on the literature published in Finland and Sweden.

The main properties of the fuels to be considered are:

- Calorific value
- Chemical composition
- Moisture content
- Density, particle size and other fuel handling properties
- Ash content, ash melting behaviour and ash composition
- Concentrations of harmful substances, such as alkalis and heavy metals

The wood fuels where properties are summarised in this brochure are: wood chips, hog fuel, chopped wood, sawdust, bark, briquettes and pellets.

Leading exporting countries in the world
of pulp, paper and sawn timber 2003

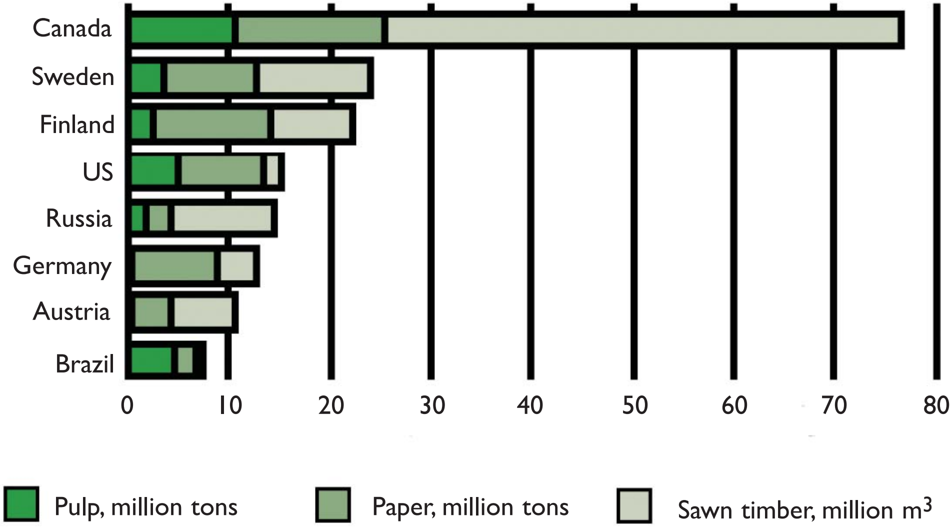

Fig. 1: Leading exporting countries in the world of pulp. Paper and sawn timber (2003)

The quality of wood fuels is determined for fuel types according to energy density, moisture content and particle size. The energy density is dependent on net calorific value, moisture content, bulk density and particle size of the fuel concerned. In deliveries of different wood fuels blends or mixtures, the parties should agree upon the application of quality classification and the quality determination of fuel considering the use and safety issues.

Quality limits for other characteristics of the fuel can be specified case by case for mechanical properties of the fuel and other properties.

1.1 Determination of fuels main properties

a) **Moisture content**: the determination methods are mainly based on the ISO 589 method for analysing wood fuels in Finland. The sample is dried at a T°C of 105°C in air atmosphere until constant mass is achieved and percentage of moisture content is calculated for the loss in mass of the sample.

b) **Calorific values**: The net calorific value of solid fuels for dry matter is determined in accordance with standards ISO 1928. The Net Calorific value at constant volume is the absolute value of the specific energy of combustion, in joules, for unit mass of the biofuel burned in oxygen under conditions of constant volume.

c) **Ash content**: the method is based on ISO 1171

d) **Chemical analyses**: the most significant one being determination of elemental composition, can be carried out employing different analysers. The element analysed are Sulphur, Carbon and Hydrogen, Nitrogen, Phosphorus, Chlorine, Volatiles, Heavy metals, Others (Al, Si, K, Na, Ca, Mg, Fe, P and Ti).

e) **Volume and Density**: Bulk density is obtained by dividing the weighed mass of the load by its volume, it's not an absolute value, therefore conditions for its determination should be standardised in order to gain comparative results.

f) **Particle size**: the particle size of solid biofuels and distribution are determined for a sample of at least 20 litres with sieving method and sieves series agreed upon.

1.2 Wood fuels classification (*figure 2*)

The wood fuels can be classified according to their trade form (chips, bark, chopped log wood, refined wood fuels, like pellets, briquettes, and wood charcoal), or their origin.
The possible classification for wood fuels is as follows:

- Forest and plantation wood (includes fuels produced from wood or wood parts grown in forests or agricultural land;
- Industrial by-products and residues (includes wood fuels obtained as industrial by-products or wood residues);
- Used wood (recyclable wood fuels from society);
- Blend and mixtures (The mixing can be either intentional or unintentional).

a) **Wood chips and hog fuel**:
Wood chips or hog fuel are produced from whole-tree wood, delimbed trees, fortes residue, or other wood material. Logging residue chips or hog fuel are produced from tops, branches and bush final cuttings. Wood chips are used in heating boilers of buildings, at heating power plants and industrial heat and power plants. Moisture content is the most significant property of fuel chips or hog fuel.

b) **Whole tree and stem chips**:
Whole tree chips are used at smaller heating stations and in heating boilers in homes and at farms. The chips are made of unlimbed stem wood, being either unmarketable stem wood or wood defective for industrial use.

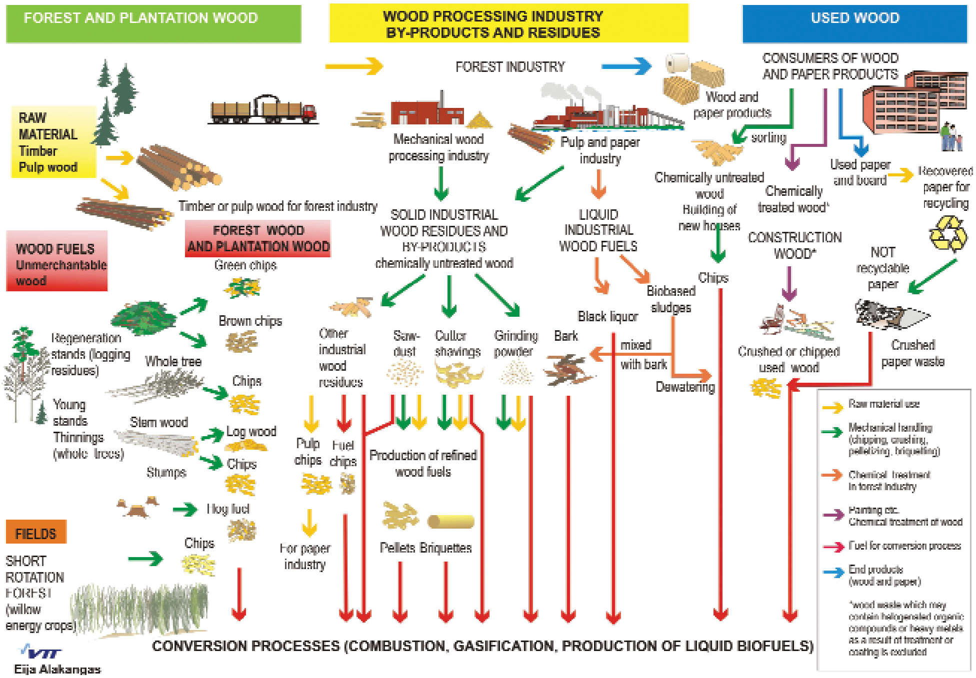

Fig. 2: Classification of wood fuels according to their origin

c) **Bark and Stumps**:
Fuel properties of bark may be upgraded by compressing drying or blending it among other fuels. Bark can be dried by heat or mechanically with a bark press.
Stumps are extracted mainly from final felling areas on fresh mineral soils. Soils disturbance is minimised as organic substances bind releasing nutrients and metals. About ¼ of stumps and greater part of all roots are left in the soil for forming rotten wood used by organisms and for securing humus porosity required to maintain its oxygen content.

It's difficult to chip stumps, therefore they are usually crushed. Stumps wood has good storage properties. Therefore they are an ideal fuel at the large power plants to decrease the average moisture of whole fuel blend.
At the power plant the biggest problems related to stump fuel are soil, stones and other impurities, which increase the ash content.

d) **Sawdust and cutter shavings**:
Sawdust used as fuel is obtained as a by-product of timber sawmills, and cutter shavings from planting machines. Sawdust is usually of wet and light material. Sawdust is burnt with other fuels in boilers of wood processing industries and heating stations.

e) **Wood briquettes and pellets**:
Wood briquettes are compressed from dry sawdust, grinding dust and cutter chips. Usually no binding agents are used, as the own constituents of wood stick the briquette together. The cross section of wood briquettes is usually round or square. The length or diameter is 50-80 mm. In round briquettes there may be a hole of 10-20 mm in diameter. During compression, the moisture content of wood is less than 15 %. The dry mass of wood briquettes is on average 1 000kg/bulk m3. Compared to the other fuels, the wood briquettes are heavy and dry.

f) **Wood pellets**:
Wood pellets are compressed, cylindrical, sometimes quadratic grains, diameter being 8-12 mm and length 10-30 mm. For example, industrial wood residues, bark and wood chips can be used as raw materials. Wood pellets are suitable for heating one family houses, farms and block buildings. Equipment designed especially for pellets are used in the combustion of wood pellets. At big heating or power plants the pellets are crushed prior to feeding into pulverised combustion boilers. The bulk density of wood pellets is 600-750 Kg/bulk m3.

2. Technology production: Systems and handling of Forest Residues

In this section the current technology of harvesting of forest residues and chips.
There are several methods to harvest forest residue fuel. Information on following subjects has been considered for the raw materials:

- Selection of production sites for harvesting of logging residues for fuel
- Yield of harvested logging residues for fuel (*figure 3*)
- Harvesting technology of forest residues for fuel
- Organisations that harvest logging residues for fuel

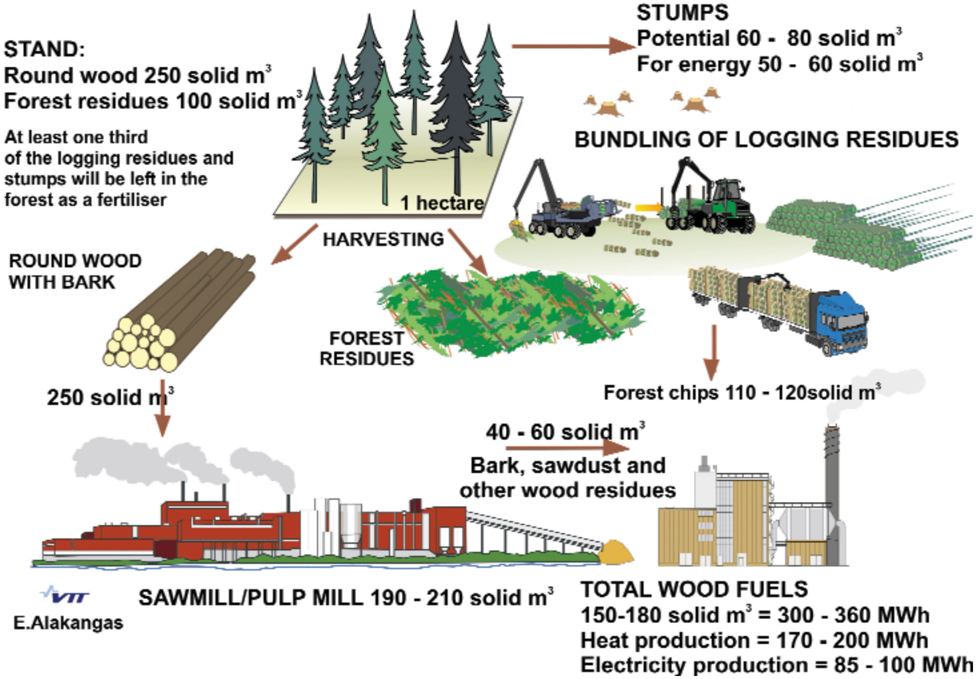

Fig. 3: Yield of different wood products and fuel from 1 hectare of spruce stands for final cutting (VTT)

- Harvesting costs of forest residue chips for fuel
- Logging residue chips' quality
- Environmental impacts of harvesting logging residues for fuel

2.1 Logging residue production sites

On an atypical felling site of spruce, approximately 100 m3 solid of logging residue per hectare accrues while 200 to 250 m3 solid of merchantable wood per hectare is harvested. Nowadays recovery rate of logging residue is 65-75 % in Finland. Usually forest residue is harvested in summer time, when logging residue is dry. Swedish studies during winter indicated that the recovery rate of logging residue was 75 %.

A good harvesting site is described as:
- As much spruce as possible; good recovery rate and productivity,
- Fertile soil,
- A sufficiently large felling site or a concentration of stands,
- Easily traversed, well bearing ground,
- No undergrowth which hinders logging,
- Short terrain transport distance and,
- A spacious roadside storage area for long distance transport.

Advantages of harvesting logging residue:
- Nutrient leaching to waterways is decreased,
- Soil preparation can be accomplished with less radical means,
- More natural development in regeneration areas,
- Because planting can be done earlier, regeneration areas are not covered with grass and there is less need for fighting against grass,
- Planting is easier, it is often possible to use smaller sapling,
- Aesthetic and recreational value of involved areas is enhanced,
- Forest regeneration costs are remarkably decreased and,
- Forest regeneration is faster and results are expected to be better.

Possible disadvantages of harvesting logging residue:
- Organic material is removed from the nutrient cycle,
- The amount of humus protecting the soil is decreased,
- Some nutrients are removed from the ecosystem,
- Risk of acidification is increased and,
- Danger of growth losses.

2.2 Industrial timber harvesting

When working at a final felling site the harvester operator cuts trees on either one or both sides of the strip road. It is possible to harvest logging residue if the residue is located in fairly large, clearly delineated piles beside the strip roads and have not been run over. This requires that working methods are modified in such a way that logging residue is piled on either side of the harvester.

Harvesting logging residue is possible if:
- Logging residue is placed in fairly large and clearly delineated piles,
- They have not been run over by forest machines and,
- Logging residue is piled on the side of strip roads.

When harvesting logging residue in piles:
- The recovery rate of logging residue is higher,
- The forest haulage of logging residue is more productive and,
- Logging residue is cleaner and of better quality.

2.3 Production technology of logging residues from final felling stands

A forest chip production system consists of a sequence of individual operations performed to process biomass into commercial fuel and to transport it from source to plant. The main phases of chip procurement are purchase, cutting, off-road transport from stump to roadside, comminution, measurement, secondary transport from roadside to mill and receiving and handling at the plant. The system offers the organization logistics and tools to control the process.

Comminution at landing
Logging residues, chipper-truck

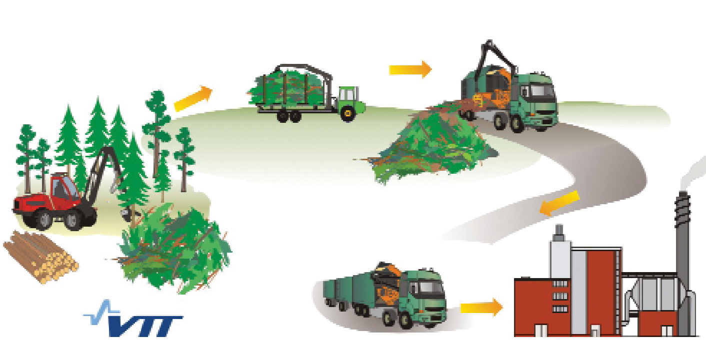

Fig. 4: Chipping of forest residue at the road side (VTT)

Comminution at landing
Logging residues, truck mounted-chipper

Fig. 5: Chipping of forest residue at the terminal (VTT)

The main methods used for production of forest chips are:

a) **'Chipping at the roadside landing' method** (*figure 4*): logging residue are hauled to the roadside landing all year round from the surroundings of the terminal.
Specifications of a good logging residue chipper:

- High productivity,
- Long feeding table,
- Must have forced feed but be resistant to clogging,
- Drum chippers are not as sensitive to impurities as disc chippers,
- Drum chippers produce a more even quality of chips than crushers.

Comminution at plant
Logging residues

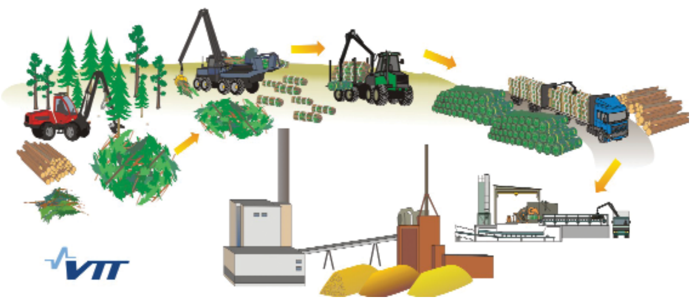

Fig. 6: Bundled forest residue chipped or crushed at power plant (VTT)

b) **'Chipping at the terminal' method** (*figure 5*): The production phases of the forest residues harvesting chain of forest residues for fuel based on the chipping at fuel terminal.

c) **'Chipping at the stand' method**: Terrain chipping is based on a single machine, so called 'terrain chipper', which chips forest residues into a container at the stand and hauls the chips in a container to the landing or to the roadside.
The advantages and disadvantages of terrain chipping:

- Terrain chipping does not involve a hot chain,
- Organisation of work is easier,
- Storage space requirements are less than for roadside chipping,
- It is difficult to produce good quality chips around the year,
- Poor ability to work in difficult terrain conditions,
- Competitiveness weaker in long forest haulage distances than it is in road side chipping.

d) A promising alternative for transporting whole logging residues **is bundling before long distance transport and chipping at power plant** (*figure 6*).
Chipping/crushing logging residue at the end use facility.

- Hot chain problems are avoided,
- Chipping/crushing can be done more economically than in terrain or by the roadside,
- Productivity is 20% better than for roadside chipping,
- Chipping at the end use facility is the most economical option when the transportation distance is less than 55km,
- Lorry transport of logging residue is not economical without compacting,
- The profitability of transportation can be improved either by compacting the load or extending the load space,
- Heavy crane must be used.

2.4 Production of forest residues from thinning

Thinning attempts to replicate the forest's natural development, the aim normally being to achieve a uniform age composition. Thinning is used to ensure growing space for the forest's best trees by felling those with retarded growth and those which are diseased and of poor quality.
Many times the felling for wood thinning is made manually with a chainsaw, using a felling-piling technique. The smaller the harvested trees are, the more profitable it is to harvest them manually. Thus logging sites with only energy wood should be harvested manually using the felling piling method (*figure 7*).

2.5 Production of stump and root residue (*figure 8*)

The stump-root system is defined as all wood and bark of a tree below the stump cross-section. Stump-root systems can only be salvaged from clear-cutting areas. Extraction of stumps is carried out with heavy machines and, therefore, only stumps from saw timber-sized trees can be accepted. The removal of stump-root systems facilitates site preparation for regeneration. It also involves an opportunity to exterminate the root rot fungus from the stand, since the fungus survives in a regeneration area in the stumps and gradually infects the trees of the new generation.

3. Production costs

a) **Production costs of forest residual fuel**

While fossil fuels occur i large deposits and can be produced at a constant cost, forest fuels are scattered and must be collected from a large number of locations. Technical logging conditions vary widely, and the variations are reflected in the productivity and cost of work.
Korpilahti (2000, 2001) has calculated the harvesting cost of forest residue chips for four main methods used in Finland.
The most economical harvesting chain of forest residue chips was chipping at the power plant.
The most expensive harvesting chain of forest residues was chipping at the terrain. The economy of bundling becomes better, when transport distance grows. Developing the bundling technology cost degrees (Korpilahti, 2001).

	Production method							
	Haulage 150 m, transport 40 km				Haulage 300 m, transport 80 km			
Work phase	Bundle €/MWh	Terrain chip €/MWh	Road chip €/MWh	Plant chip €/MWh	Bundle €/MWh	Terrain chip €/MWh	Road chip €/MWh	Plant chip €/MWh
Bundling	3.31	-	-	-	3.31	-	-	-
Forest haulage	1.22	-	2.18	2.18	1.62	-	2.58	2.58
Chipping at stand or road-side	-	6.03[1]	2.54	-	-	7.08[1]	2.54	-
Road transport	2.26	2.64[2]	2.28	3.19	3.46	4.17[2]	3.32	4.79
Chipping at power plant	0.71	-	-	0.82	0.71	-	-	0.82
Total	**7.50**	**8.67**	**7.00**	**6.19**	**9.09**	**11.25**	**8.44**	**8.19**

The costs of the four harvesting chains of forest residues (Korpilathi, 2001) bundle means bundling harvesting chain, Terrain chip is chipping at terrain chain, Road chip is chipping at roadside chain and Plant chip is chipping at the plant harvesting chain.

1 Includes forest residue chipping and terrain haulage of chips
2 Road transport is carried out by using exchangeable containers

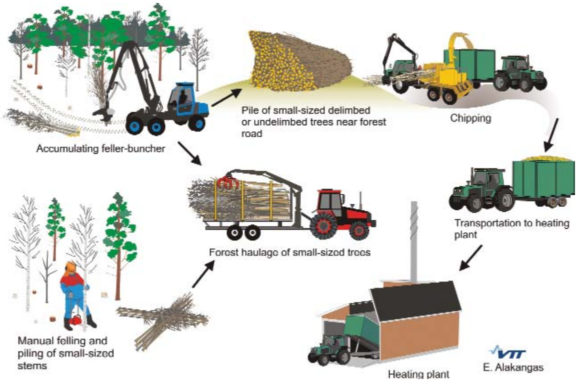

Fig. 7: Whole-tree chip harvesting chain from first thinning and first commercial thinning when only wood fuel chips are produced (VTT)

b) **Production costs of forest residues from thinning**

The costs of the harvesting chains of thinning are dependent on harvesting machinery, harvestin method and harvesting conditions in different stands. The harveting costs are furthermore affected by total amount of merchantable and energy wood, haulage distance, terrain accessibility and other factors. The mechanical harvesting devices are most applicable to loggin sites, which produce both energy wood and merchantable round wood (Savolainen & Berggren 2000).

Integrated production of round wood and energy wood is cheaper than production of alone. The smaller the harvested trees are, the more profitable it is to harvest them manually (using chain saw) see next table.

4. Environmental Impacts

The balance of forest ecosystem is disturbed when timber is harvested.

Furthermore, when foliage is removed in addition to the stem wood, disturbance becomes more serious, nutrient losses are evident and the fertility of the forest soil may decrease.

An ecological sustainable solution would be the recycling of wood ash formed in the combustion, so that all nutrients (excluding Nitrogen) lost during the accrual of the biomass would be returned to the stand in question. There are, however, some problems and restrictions in the practice.

Forest regeneration is an integral part of the sustainable use of forests. Growing stock is removed with the idea of replacing it with a new generation is always the aim wherever possible : about 100-150 trees have to be left standing at the cutting site for the purposes of seeding a new generation of trees.

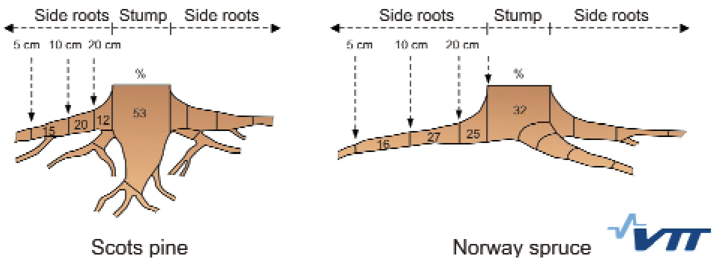

Fig. 8: Distribution of dry mass in a stump-root system of saw timber-sized trees. Under 5cm root sections excluded (Hakkila 2004)

5. Spanish and Italian Situation (advantages and constraints)

Spanish Situation

- The forest biofuel evaluation has confirmed the significant potential of this fuel in Navarra, which is currently not used. The biomass available in Navarra could represent approximately 1.5% of the primary energy consumed.
- The generation of forest residues is related to forestry activity. The current situation of the sector, which is clearly in decline, does not favour the generation and collection of forest residues.
- The collection of forest residues for energy uses must be integrated with the other uses planned for forest residues. Work systems should be used to leave residues in the same place to facilitate their collection. This would significantly reduce collection costs.
- Existing machinery, such as packing machines, should be adapted for the collection of residues in order to handle the steep inclines where a large percentage of forest material is found.
- An interesting option to connect the availability of raw materials for the production of biofuels with the producers of this fuel is the creation of a public biofuel marketplace to facilitate relations between both parts of the solid biofuel production chain.
- Based on the studies performed in the Biosouth project, it has been proven that biofuels can be produced at a competitive price for the generation of heat and cooling applications for end customers compared to heating oil and, in many cases, natural gas.

- The use of forest residues for the production of high-quality solid biofuels, such as pellets for domestic use, has technical barriers such as the high levels of ash produced. It is necessary to study the mixing of different materials that comply with the parameters established in the current technical specifications (CEN/TS 14961).
- Based on estimations, the solid biofuel market is forecast to grow to a consumption of 15,000 tonnes per year by 2012 in Navarra. The development of this market would have a positive effect on maintaining forests, creating employment and reducing CO2 emissions.

Italian Situation

Harvesting of residues in Tuscany is difficult because the road nets are unsuited, the cost for harvesting is high and the forests are small and not contiguous. Furthermore there is a lack of specific trade and some difficulties of mechanization.

There is a very different level of mechanization according to different regions due to the:

- Low homogeneity of territory;
- High slopes and irregular lands;
- Small wood companies (low capital outlay);
- Unsuited road nets.

The conditions necessary for mechanization are qualified manpower and a significant volume of work of the forest company. The Mechanical work would have to be cheaper than manual work and for this a detailed organization of work is necessary.

The harvesting cost can be decrease by the standardization of work phases and processes. This standardization is easier in a simplified forest. A simplified forest requires homogeneity with regular density, contemporary vegetation of one or two species. It is necessary to plan the reforestation in order to avoid the ecological risk.

In Tuscany there is the necessity of fixing chips price which takes into account the economical difficulties of the companies for the starting of these chains. Financing for the starting of the chain is still necessary. Moreover there is the possibility of setting up of a few big supply chain to produce wood chips for an industrial sale. From the ecological point of view it is necessary to establish and prescribe the intensity of harvesting of residues according to the ecological requirement of forests. Moreover one of the most important goals of the project must be the diffusion and spreading of results and technologies, to transfer the know-how especially to small municipalities and forest wood companies which showed a high interest.

	Costs €/m³					
	Manual Felling-Piling (with felling frame)		Narva-Syke - felling head		AM 240 - felling head	
	Whole tree	Delimbing long wood	Integrated round and energy wood	Only energy wood	Integrated round and energy wood	Only energy wood
Harvesting	4.20-7.06	14.78	7.60-7.90	11.09	6.55-9.74	13.78-14.62
Forest haulage of whole trees	4.54-5.88		4.54-5.88	4.54-5.88		
Forest haulage of delimbed long wood		3.19-3.86			3.19-3.86	3.19-3.86
Total €/m³	**8.74-12.94**	**17.97-18.64**	**11.60-13.78**	**9.74-13.60**	**18.48**	**16.97**

Cost comparison of manual and mechanical harvesting methods in thinning (Ihonen 1997a,1998).

General Conclusion

Difficulties to apply Working Systems from Northern Europe to Southern Regions.

The main barriers for the development of the use of forest residues for solid biofuel production are:

Technical barriers

- Ownership structure of the forest surface with small properties,
- Terrain relief and slopes (Orography),
- Lack of suitable forest roads to access the forest with machinery,
- Limit to the maximum weight of truck for transportation,
- Seasonal production of forest residues,
- Lack of Knowledge in some key sectors: architects, building promoters,….
- Lack of good inventories (or statistics data) about available biomass fro energy purposes.

Economical and trade barriers

- Cost of collection and transport of forest residues,
- Particles emissions of biomass boilers (PM10) in comparison with natural gas,
- Exportation of forest residues pellets for cofiring,
- There is a future risk of the quality of pellet produced if the production capacity increases over the availability of quality raw material,
- There are no forestry firms which work on the collection of the forest residues because there is no demand,
- There is not yet a consolidated market of solid biofuels.

Social barriers

- Lack of knowledge by the general public. Potential users.

Political barriers

- Lack of use of standards for chips quality proposed by the boilers constructors and its exigency to the biomass providers,
- In Italy and Spain, lack of technical regulations until now for the installations of biomass boilers.

Some possible promotion measures from the experience of different northern and southern countries.

- Support from the administration to the collection of forest residues;
- To create collaboration/association to commercialise forest products from a group of forest owners. To compensate for the distribution size of forest properties;
- To support not only the implementation of boilers (demand side) but also the production of biofuels (supply side) to avoid any possible future lack of balance in the biofuel market;
- Implement biomass boilers in public buildings as demonstration units for diffusion as BEST PRACTICE. These projects should be conducted very carefully to avoid any possible failure that could give bad image. Therefore the first cases should be selected accordingly;
- To increase the communication and diffusion of the possibilities of biofuel utilisation;
- Implementation of District Heating Plants with public support to increase the demand of forest chips in a similar way as it was done in Austria;
- Implement an ECOLABEL to guaranty the sustainability practices in biofuel production and distribution;
- Promotion to final consumer should not only be based on cost of biofuels but also in other advantages such as rural development and environment.

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