Project co-financed by the European Regional Development Fund

FORBIOENERGY - Forest Bioenergy in the Protected Mediterranean Areas

Planning sustainable forest-wood-energy supply chain in the protected areas

Appendix 3: Study area report - SPAIN

Workpackage 3 - Testing

Activity A.3.8. - Planning sustainable forest-wood-energy supply chain in the protected areas

Deliverable 3.8.1 - Planning sustainable forest-wood-energy supply chain in the protected areas

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1 Introduction

Case study “public forests of the municipality of Enguera (Valencia)”

In the Comunitat Valenciana there is a low profitability of the forest biomass use for energy purposes “high harvesting costs and lack of consolidated market at the local/regional level”.

Nevertheless, even though there is also a low demand of solid biofuels and a poor developed business fabric - few companies supplied with forest biomass in their production chain - it is noted that the forest biomass is a competitive resource in the renewable energy market for thermal/electrical energy. Moreover, this valorisation improves the forest conditions in terms of forest fires prevention and energy diversification.

The forestry sector is characterized by a low level of technology in the transformation, distribution and consumption of bioenergy products, conditioning the price of biofuels. Although, according to the National Action Plan for Renewable Energies in Spain (*Plan de Acción Nacional de Energías Renovables de España*, PANER) 2011-2020, forest biomass will contribute 10% of the total generation with renewable energy sources. Therefore, although this resource has not yet been guaranteed in a sustainable way over time to make viable minimum-sized facilities that use forest biomass as biofuel, there is an encouraging future for the forestry sector at the local level. Biomass can occupy its rightful place in the “energy mix”, having the bioenergy a leading role.

Concerning the specific situation of the municipality of Enguera, it is emphasized that the local economy depends, primarily, on agriculture, and secondarily, on some industry (mainly agrofood industry as a large industrial bakery COBOPA and some other small and medium-sized companies) and services (mainly rural tourism).

In Enguera, the potential development and use of forest-based biomass can contribute in net savings of more than 2 million €/year. Hence, the strategic challenge is to develop integral bioenergy projects in the rural areas in a sustainable way which can enhance the demand and consequently the silvicultural operations, at the same time that the environmental services are favoured in balance with the protected areas.

2 General objective

The general aim of this Pilot Action is to propose the development of an integral agroforest-based bioenergy supply chain at the local level in Enguera (Valencia) and to encourage local investors to implement an efficient energy-contracting system in order to increase the use of biomass.

3 Specific objective

In order to develop the agroforest supply chain, the specific objectives are:

a) To define the criteria for evaluating current and future availability of the local resources in Enguera;
b) To mobilize forest biomass in public forests with energy purposes;
c) To heat public buildings with forest biomass obtained from the maintenance of protected areas, being a good practice example for other potential users in the municipality;
d) To define the possibility of continuous supply of forest biomass to bioenergy industrial projects in the pilot area;
e) To facilitate the development of a competitive and sustainable market and supply chain of the forest biomass in Enguera.

These specific objectives contribute to the sustainable development of the municipaliy of Enguera, specially to:

a) Rural development, improving living conditions in the rural area of Enguera due to the establishment of forest companies through value-adding and quality employment.
b) Enhancement of the conditions of forest ecosystems, applying silvicultural treatments which reduce the risk of bushfires and improve the forest conditions.
c) The overall compliance with the European Renewable Energy Plan and the Kyoto Protocol with the reduction of CO2 emissions and bills due to the unfavourable balance of payments (BOP) in the energy market.

4 Methodology

The planning sustainable forest-wood-energy supply chain started within the PROFORBIOMED project with preliminary studies:

1) Working meetings and brainstorming session with local stakeholders.
2) Analysis of the main political, strategic and economic conditions to start industrial projects of small or medium size biomass plants or district heating/cooling systems at the local level in the pilot area.
3) The evaluation of the future potential of this sector in the pilot area.

That study has continued within the FORBIOENERGY project in the protected areas. Hence, the previous studies done in relation to the agroforest-based bioenergy value chain, at the MED, regional and local level are:

1) Baseline review of the study areas [D.3.2.1];
2) Barriers and potential solutions for increasing biomass production in the protected areas [D.3.3.1];
3) Impact assessment of increase biomass use in the short, medium and long term in the protected areas [D.3.5.1];
4) Regulatory framework and permit route concerning biomass use in the protected areas [D.3.6.1];
5) Forest Management Plan of the Biomass District in the protected areas [D.3.7.1].

5 Steps

There are eight required steps to establish a sustainable forest-wood-energy supply chain in the public forests of Enguera:

Step 1: Analysis of the present situation.
Step 2: End users' identification.
Step 3: Networking of interested stakeholders.
Step 4: Analysis of the potentials for biomass supply.
Step 5: Economic evaluation of a planned production chain.
Step 6: Evaluation of possible bottlenecks (SWOT analysis).
Step 7: Final recommendations.
Step 8: Technical assistance for project documentation preparation and finding funds for investments.

5.1 Analysis of the present situation (Step 1)

5.1.1. Short overview of the bioenergy sector

The situation of the Comunitat valenciana is characterized by an abandonment of the agricultural crops which have been colonized by pioneer forest species. As a result, the forest land increases at a rate of 3,000 ha/year. This leads to an accumulation of wood and biofuel in the forest, increasing the risks of bushfires and pests and, consequently, putting at risk the stability of the forest stands.

The use and valorisation of forest biomass is considered as a competitive resource in the renewable energy market, as well as improving forest conditions in terms of forest fire prevention and energy diversification: reduction of the risk of forest fires; diversification of energy sources; limitation of external energy dependence; stability of the Spanish economy and reduction of the trade deficit of the balance of payments.

According to the General State Administration, the availability of forest biomass is approximately 10 million dry tons per year. Accounting for high value-added uses (example: panels), the energy valorisation of forest biomass for energy purposes is quantified in approximately 6 million dry tons annually. Therefore, the forecasts, made by PANER 2011-2020 regarding the biomass derived from silvicultural works, are covered.

A new management model focused on the joint use of wood and forest biomass, that would increase the service of wood production (industry) and forest biofuel for power generation, is considered as a solution (PATFOR 2013), being the sustainable forest management an essential tool to face climate change and the forest biomass, it is a resource to be valorised –currently, with the biomass obtained, 60,000 homes could be heated approximately.

Hence, even though there is no settled and guaranteed market, i.e. there is no balance between supply and demand, in the Valencian region, there are pellet factories based on forest biomass and several companies related to the manufacture and installation of pellet boilers. However, the production of woodchips is practically exported out of the region (last years by boat to Italy for pellet or direct combustion).

5.1.2. Market analysis of forest products

5.1.2.1. At the national level (Spain)

In table 1, fellings are included according to the species ownership, as well as the associated unit prices[1].

Table 1. Total fellings per specie, ownership and associated unit prices. Source: forest statistics annual directory 2016

Especie	Propiedad		Total m^3 cc	Precio CC.AA. €/m^3 cc		Precios percibidos (en pie) €/m^3 cc		Precios licitación MADEREA €/m^3
	Pública	Privada		En pie	En cargadero	Sierra	Trituración	
Pinus pinaster	598.455	2.684.526	**3.282.982**	16,48	38,35	27,34	17,35	18,92
Pinus radiata	212.709	2.348.294	**2.561.003**	26,25	50,80	24,99	18,23	25,34
Pinus sylvestris	854.132	326.201	**1.180.333**	22,04	43,50	27,34		21,01
Pinus nigra	302.919	182.647	**485.566**	17,10	37,45	17,93		14,36
Pinus halepensis	63.082	159.705	**222.788**	12,09	27,19	10,31		14,96
Pinus pinea	47.716	137.775	**185.491**	13,30	30,53	15,55		13,00
Otras coníferas alóctonas	31.765	39.674	**71.439**	22,52	47,38			23,38
Otras coníferas	90.030	54.933	**144.963**	20,30	39,46			14,84
TOTAL CONÍFERAS	**2.200.809**	**5.933.755**	**8.134.565**	20,33	42,58			
Eucalyptus spp.	230.778	7.125.743	**7.356.521**	20,93	31,43	31,88	28,88	23,20
Populus spp.	90.459	649.535	**739.993**	35,73	55,39	30,59		41,03
Quercus robur	4.508	137.345	**141.852**	23,97	48,63			13,87
Castanea sativa	4.983	122.325	**127.308**	21,96	42,45	33,79		26,15
Fagus sylvatica	76.060	10.050	**86.110**	30,42	59,93	28,29		22,44
Quercus ilex	1.504	74.956	**76.460**	20,78	53,67			
Otros Quercus	10.424	53.455	**63.879**	19,15	46,59			22,72
Otras frondosas alóctonas	14.970	21.152	**36.122**	25,66	48,97			23,20
Otras frondosas	9.120	75.885	**85.005**	23,89	51,11			17,26
TOTAL FRONDOSAS	**442.806**	**8.270.447**	**8.713.252**	22,38	34,75			

Being focused in *Pinus halepensis*, as main species in the pilot area, it is noted that the total m^3 with thick bark (tb) is 222.788 (28,31 % and 71,68 % in public and private ownership, respectively). The prices of the wood are analysed as average of the regions (standing and landing wood; 12,09 and 27,19 €/m^3 tb respectively) prices paid (lumber and pulp timber; only the price of lumber is available which is 10,31 €/m^3 tb) and bid prices Maderea (14,96 €/m^3 tb).

Concerning the historical series of firewood extraction and associated economic value, in Graph 1 and 2 it is possible to observe the evolution of the use of forest biomass since 1997 and the value in landing.

The extraction (=use) of forest biomass has been increasing more in broadleaved tress than in conifers, in which, a decrease is observed from 2015 to 2016.

[1] Methodology of obtaining data in https://www.mapa.gob.es/es/desarrollo-rural/estadisticas/aef2016_produccion_tcm30-503584.pdf

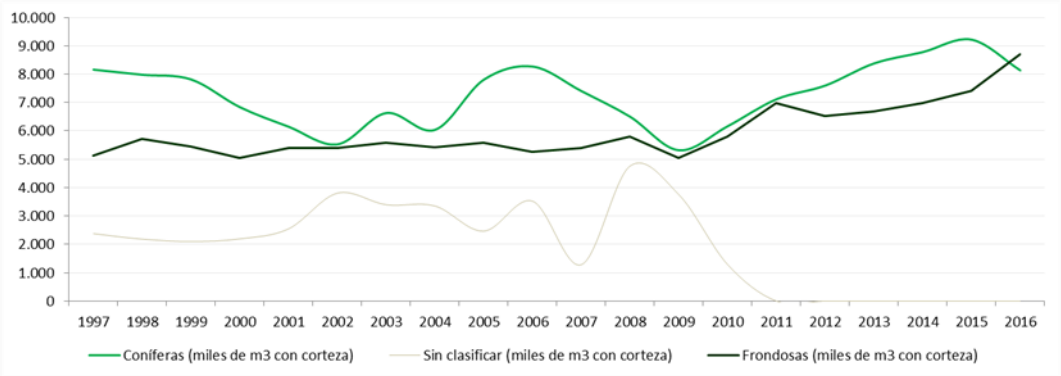

Figure 1. Historical series of firewood extraction (conifer, broadleaved trees and without classification). Source: data of forest statistics annual directory 2016

The forest production in thousands of tons has been decreased over the years, having its maximum around 2010. Nevertheless, the production passed from 2.500 thousands of tons (maximum) to around 1.200 thousand of tons in 2016.

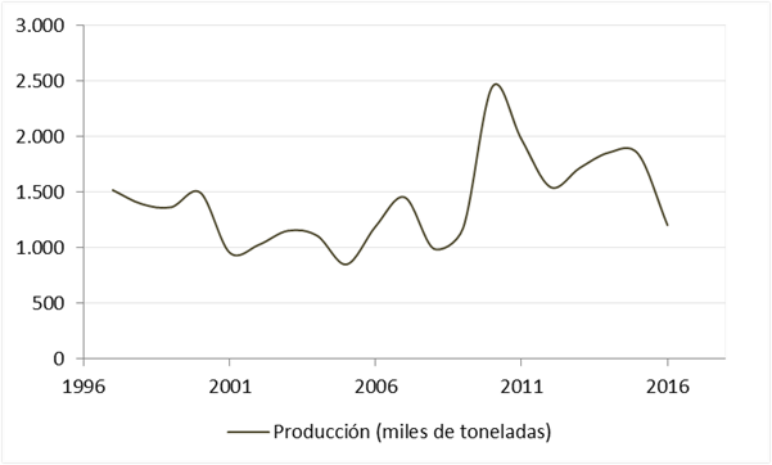

Figure 2. Production in thousands of tons. Source: data of forest statistics annual directory 2016

5.1.2.2. At the regional level (Comunitat Valenciana)

The regions with more fellings are Galicia (1), Castilla y León (2), País Vasco (3) and Asturias (4), as it can be observed in graph 3. The region of Valencia has a low amount of fellings.

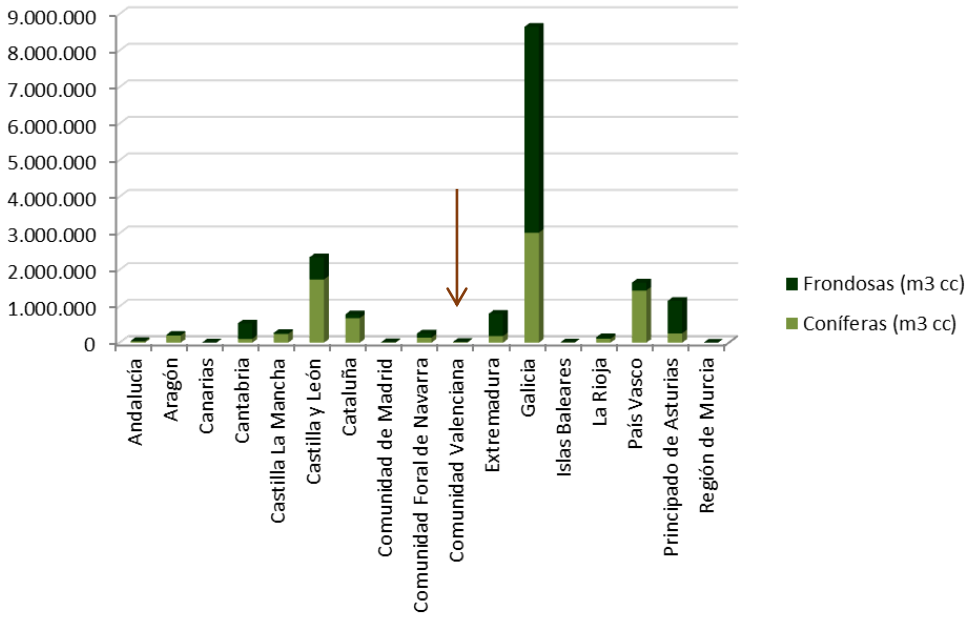

Figure 3. Total fellings per region, divided in confiers and broadleaved in m3 tb (2016). Source: data of MAPA

Concerning the extraction of firewood, the regions with more extracted tons (Graph 4) are Castilla y León (1), Cataluña (2), Extremadura (3) and Navarra (4). The Region of Valencia, even though there is not the region with less firewood extraction, its total amount is still very low if it is compared with its possibility (=annual allowable cut).

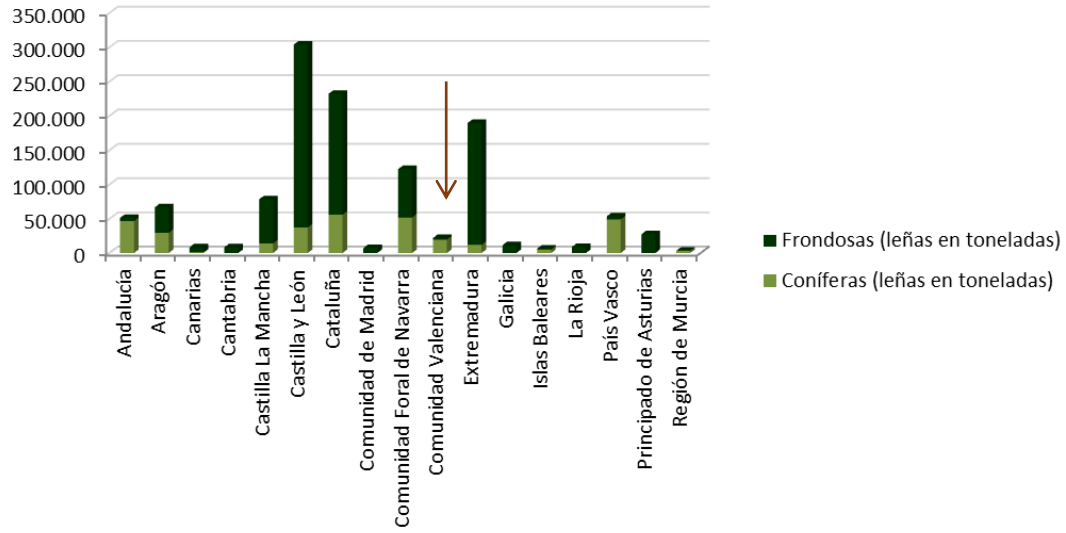

Figure 4. Total firewood extraction per region, in conifers and broadleaved in tons (2016). Source: data of MAPA

Regarding the stocks and possibility of biomass and wood, one of the main economic services of the forest is the production of wood and forest biomass; these products are increasingly obtained more from forest plantations (energy crops, plantations of noble woods).

In the Comunitat Valenciana pine forests of *Pinus halepensis, Pinus pinaster* and *Pinus nigra* as well as holm oak and quejigo oak, are accumulating wood and biofuel due to the absence of management, which could and should be extracted. Considering the current stocks in the forests of the region, through sustainable forest management, up to seven times more than what is now extracted from wood (59,938 m^3/year), and more than 142,600 t/year of forest biomass that can be used for energy purposes could be extracted (PATFOR 2013).

Table 2. Stocks and possibility of wood and biofuel in the forest lands of the Region of Valencia. Source: PATFOR and IFN3.

					Average data per hectare			
	Wood stock (m^3)	Biomass stock (t)	Wood possibility (m^3/year)	Wood boimass (t/year)	Wood stock (m^3/ha)	Biomass stock (t/ha)	Wood possibility (m^3/ha/year)	Biomass possibility (m^3/ha/year)
Alicante	2.014.710	1.633.044	60.518	19.340	19,82	10,92	0,60	0,21
Castellón	5.915.753	5.916.667	183.058	63.906	29,54	286,46	0,90	0,36
València	6.489.067	4.424.473	193.130	59.379	24,06	12,72	0,72	0,25
Comunitat Valenciana	14.419.531	11.974.184	436.705	142.625	73,43	310,10	2,22	0,81

The forestry business sector has also suffered its particular crisis associated with the generalized abandonment of forest management. In recent decades the extraction of timber products has ceased to be profitable. The price of wood is at similar levels to or even lower than those of 15-20 years ago (20 €/m^3 of roundwood), while the costs have considerably increased.

Specifically, in the Valencian Region, it is estimated that the volume of wood extracted has decreased more than 50% since 20 years. In the best years of cutting, approximately 10% of the possibility has been reached, which is barely 100,000 m^3.

5.1.2.3. At the local level (Enguera)

2 MW connection point for power generation could be established in Enguera. In a radius of 20,000 m, it covers all of forests under study, from which forest biomass can be harvested. It is also noted the several regional roads that facilitate the access of the forest to the plant

Origin of the forest biomass

The origin of the biomass comes from the forest, the agriculture, as well as from the industrial residues.

Forestry:

There are mainly young and medium-aged forest stand of *Pinus halepensis,* specially being naturally regenerated forests after bushfires and forests from afforestation. There is also a

small percentage of the pilot area occupied by young, medium-aged and some mature forests of *Pinus pinaster;* normally mixed with *Pinus halepensis.*

Concretely, the forest biomass in Enguera can be obtained through:

1. Silvicultural treatments on forest stands

    a. Intermediate or improvement treatment, especially for the prevention of forest fires: pruning, thinnings and clearings. Clearings are performed on small-sized young trees without economic return and thinnings on larger trees with occasionally economic yields.
    b. Final cuts (=final use of forest resources). This step is oriented to the natural regeneration of the forest stands and it can be obtained greater economic.
2. Silvicultural treatments on the brush, especially for forest fire prevention. There is a significant cost due to these treatments are directed only in a timely manner (clearings for forest fire prevention, as preparatory work for forest operations etc.).

Agricultural and industrial biomass:

The dominant rainfed agricultural mature crops are the olive trees, followed the vineyards, also re-emerging during the last years. There also are almond trees plantations in the area of Navalón and some citrus plantation in the valley close to the municipality and to the neighbouring municipality of Anna.

Concerning the industrial biomass, it is noted the oil mill of the Agriculture Cooperative. This biomass is really interesting due to the easy disposal and the low valorisation cost.

Possibility per public forest (MUP) "offer"

Being focused on the forest biomass, the possibility of the public forest of Enguera is included in table 3, with a total of real possibility of 191.162,32 m^3.

Table 3. Total possibility of the public forest of Enguera. Source: LIFE+ BIOENERGY AND FIRE PREVENTION (2013)

Total MUP possibility	Slope surface, ha	Total surface, ha	Theoretical possibility m^3	Real possibility m^3	Theoretical possibility m^3/year	Possibility m^3/year
V-072	3.541,82	3.541,82	15.8862,75	83.920,02	10.511,80	5.515,62
V3002V072	4.298,43	4.298,43	61.722,08	22.112,94	4.114,81	1.474,20
V-074	3.104,19	3.104,19	90.124,22	56.612,60	6.008,28	3.774,17
V3023V075	2.828,95	2.828,95	74.144,24	28.516,76	4.942,95	1.901,12
Total	*13.773,39*	*13.773,39*	*384.853,29*	*191.162,32*	*25.577,84*	*12.665,11*

MUP	Theoretical possibility tm	Real possibility tm
Total possibility V-072	88.963,14	46.995,21

Total possibility V3002V072	34.564,36	12.383,25
Total possibility V-074	50.469,56	31.703,06
Total possibility V3023V075	41.520,77	15.969,38
Total	*215.517,83*	*107.050,90*

The possibility, in m^3 and in Tm, is calculated for the 15 years of validity of the project. For this reason, considering as example the MUP V-072 which has a theoretical possibility of 88.963,14 Tm, in that period, there is a possibility of 5.930,88 tm/year.

Comparing the theoretical possibility with the silvicultural or real possibility of the MUP of Enguera, the situation of this project is an accumulation of stocks or where no treatments were implemented of improvement at the right time (real possibility < theoretical possibility). Therefore, it is concluded that there is an unbalanced class balance towards the adult stands which confirm the need to overcome the theoretical possibility and bring it closer to the forestry one.

Nevertheless, it is noted that in the calculation of the real possibility, it has been considered the areas where silvicultural works cannot be implemented. Hence, the coefficient by which multiplies value of 0, since on slopes greater than 60% cannot perform silvicultural treatments. This explains that the real possibility is less than the theory due to in this last one, the calculation is done for all types of surfaces without considering parameters such as the one mentioned above.

Demand side

To establish industrial/district heating, valorising the use agroforest biomass in the municipality.

5.2 End users' identification (Step 2)

5.1.1. Stakeholders

The identified stakeholders in Enguera are the legal representative of the municipality of Enguera, the responsible of Environment and Energy, representatives of the local administration, municipal energy and other local companies, technicians of the regional administration and representatives of the scientific universities.

5.1.2. Customers

The main customers identified are public buildings as the school, the health care and cultural centre, museum and library, the elderly housing, swimming pool, sports hall, music hall, town hall and the parish, domestic houses, as well as the small industries.

5.3 Networking of interested stakeholders (Step 3)

Based on the main conclusions of the Strategic Paper on Integral Model of Bioenergy at the Local Level (PROFORBIOMED project), a first working meeting with a brainstorming session were organised with local stakeholders in Enguera.

The different working issues with the main outputs were:

1. Forest biomass management and supply plans based on sustainability and subsidiarity

   Outputs:

   i. Presentation of results of the Forest Inventory
   ii. Evaluation of forest-based and agricultural biomass potential
   iii. Synergy with the Sustainable Forest Management Plan of Enguera (2014-2034)
   iv. Model of bioenergy contracting based on public-private participation

2. Development of advanced forest harvesting systems and optimisation of transport and logistics

   Outputs:

   i. Presentation of basic processes by forest types
   ii. Evaluation of harvesting costs by processes
   iii. Definition of pilot trials (pilot action 1.4)
   iv. Definition of objectives and challenges
   v. Basic definition of business unit 1: Biomass Logistic Platform

3. Development of solid biofuels with high added value

   Outputs:

   i. Presentation of basic processes of pellet mill
   ii. Evaluation of costs by processes
   iii. Definition of objectives and challenges
   iv. Basic definition of business unit 4: Pellet mill

4. Valorisation of thermal and electrical bioenergy: CHP plant

   i. Information exchange on actual situation of public support for CHP in Spain
   ii. Presentation of basic infrastructures for a small CGP plant
   iii. Evaluation of investments and costs by processes
   iv. Definition of objectives and challenges
   v. Basic definition of business unit 2: CHP plant

5. Valorisation of thermal and electrical bioenergy: industrial/district heating

   i. Information exchange about actual situation of public support for CHP plants in Spain

ii. Presentation of basic infrastructures for a small CGP plant
iii. Evaluation of investments and costs by processes
iv. Definition of objectives and challenges
v. Basic definition of business unit 2: CHP plant

As conclusion, in the region of Valencia, the integral business models proposed include:

1. A sustainable and subsidiary biomass management and supply chain plans.
2. Development of advanced forest harvesting systems and optimisation of transport and logistics.
3. Valorisation of thermal and electrical bioenergy: CHP plant and industrial/district heating.
4. Development of solid biofuels with high added value.

With regard to the development of solid biofuels, this business model is not developed for the municipality of Enguera, due to this model has already been implemented in the municipality of Moixent.

5.4 Analysis of the potentials for biomass supply (Step 4)

The analysis of the main environmental conditions which affect directly the management and harvesting of forest-based bioenergy value chain in the pilot area of Enguera were analysed by the technicians of the municipality of Enguera within the PROFORBIOMED project.

On the one hand, according to the Sustainable Forest Management Project of Enguera (2014-2034), it is calculated a real possibility of 8.000 tons per year of forest biomass in the pilot area, coming from the municipal forests. To these should be added that from private forests.

On the other hand, according to studies developed by the UPV, the annual allowable agricultural biomass is about 5.000 tons, especially derived from pruning of all these agricultural crops. Concretely, regarding the information provided within the PROFORBIOMED project (2013) the Agriculture Cooperative of Enguera (CAMPOENGUERA, Coop. V.) has an average production of 7 million of kg of olives for oil production.

Within the establishment of a district heating, local companies will have the opportunity to accede to these harvesting operations in a long-term bioenergy contract, in addition to integrate the additional agricultural and industrial biomass from the Agricultural Cooperative CAMPOENGUERA Coop.V. which will also have a huge opportunity to the rational management and collection of this biomass in an economic viable and cost-efficient way. Specially, this mill produces yearly an average of 1.500 t of dry olive cake, being this biomass really interesting for its easy disposal and the low cost of its valorisation. All technical approaches for the thermal valorisation of biomass in the pilot area of Enguera should include it.

5.5 Economical evaluation of a planned production chain (Step 5)

For the economical evaluation of the agroforest based bioenergy value chain, two business models are developed:

(1) *Biomass logistic Platform:* including the sustainable and subsidiary forest biomass management and supply chain.

(2) *Agroforest biomasss valorisation:* Valorisation of thermal and electrical bioenergy

(1) Biomass Logistic Platform

The first business model is to develop a Biomass Logistic Platform in public-private cooperation between the municipal energy company Eléctricas Enguerinas SA and the Agriculture Cooperative CAMPOENGUERA Coop.V. This model should integrate the forest operations for harvesting, chipping and transporting the forest biomass from the municipal forests of Enguera.

In any harvesting and logistics system to be chosen, it is necessary to calculate the cost and experience of the company in order to achieve an optimization of three main processes:

- HARVESTING: economic viable silvicultural treatments (mentioned above) with a low environmental impact; considering felling operations (Stihl chainsaw), extraction (forwarder) and storage (chipper connected to a truck, collecting the woodchips).
- IN SITU CHIPPING: good quality raw material by shredding through mobile autopropelled chippers
- TRANSPORT: transport of the woodchip to plant with multilift container truck with trailer.

The Biomass Logistic Platform should be located nearby the Agriculture Cooperative with an area of 8.000 m^2 for chipping/refining, drying and classification of the chipped biofuels.

The final objective is to achieve a plant price of not more than 45 €/ton woodchip to 25-35% moisture. Nowadays, above this price, it will be “off market”.

Table 4. Biomass Logistic Platform (investment, potential investors and financial support and direct employment)

Total investment	1.200.000 €
Investors:	Eléctricas Enguerinas SA and Coperativa Agrícola de Enguera
Financial support	IVACE and own resources
Direct employment	24

(2) District heating system

The third business approach is the development of a district heating system in the municipality of Enguera. Based on the Biomass Logistic Platform, the district heating should provide, firstly, heating and domestic hot water to public buildings and, secondly, to private

houses. In Enguera, with the connection of firstly 20 public buildings (two school buildings, the health care centre, the cultural centre, museum and library, the elderly housing, swimming pool, sports hall, music hall, town hall and the parish) which represent a total heat demand of 2000 MWh annually, the total investment is estimated 1 million € (400.000 € for the heat plant including the boiler and 600.000 € for the distribution network of pipelines), creating 8 new direct jobs. For this model, the public energy company Eléctricas Enguerinas SA should be the driving force

The envisaged system in Enguera is a prefabricated transportable heating plant with a boiler of 1500 kW - being feed by the woodchips obtained from the forest biomass of the MUP (public forest) of Enguera, and the pipe network should be of about of about 2,5 km of double pipeline. The main pipe network is fabricated of double district heating pipes of steel with polyurethane insulation and a polythene casing. The pressure of the net should be built for 16 bars with a maximum temperature of 110 ºC and the average inside pipe diameter of the network 45-50mm.

The calculated total consumption for the start-up phase is around 1.000 t/year forest biomass. Estimating the emissions in comparison with the oil furnace heating, approximately 40 tons of CO_2-equivalents per year are reduced. Hence, the increased generation of thermal energy and/or electricity from forest biomass contributes to raise the use of renewable energy sources.

In addition, Enguera is a municipality where almost all energy used comes from external energy sources, with a high dependence of fuels. For this reason, the use of this renewable energy source contributes to ensure continuous biofuel supply, with a stable price, and to have net savings of more than 2 million €/year; at the same time that the forest ecosystems are preserved.

The long-term comparison of cost of different energy sources (natural gas, fuel oil, pellets, firewood and woodchips) shows (Graph 5) the advantages of biofuels as ecological heating, economically attractive.

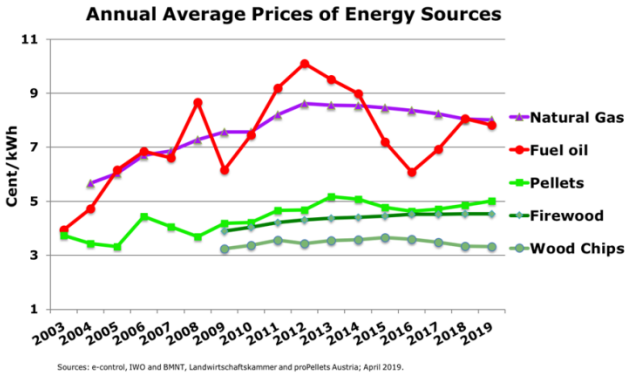

Figure 5. Annual Average Prices of Energy Sources. Source: Bioenergy International (2018)

Table 5. Local district heating (investment, potential investors and financial support and direct employment)

Total investment	1.000.000 €
Investors	Eléctricas Enguerinas SA
Financial support	IVACE, EU Regional Incentives, own resources, private investment, cooperation with Saxony-Anhalt, Germany
Direct employment	8

It is only note that due to the continental influenced Mediterranean climate in the pilot area, the buildings requirements of thermal energy in heat form for the cold winter months (from November to March) and in cool form for the hot summertime (June to September).

5.6 Evaluation of possible bottlenecks (SWOT analysis) (Step 6)

SWOT analysis is a strategic planning tool which will help to identify strengths, weaknesses, opportunities, and threats related to wood-energy supply chain:

Weaknesses and Threats

(1) Heterogeneity of public and private forest ownership.
(2) Ceased of the benefits (employment and wealth) derived from the forestry sector in rural areas.
(3) Excessive legislation, often contradictory and excessively protectionist.
(4) Lack of potential and facilitation of the sustainable forest management; lack of active forest management to face forest fires.
(5) Loss of the primary activity.
(6) Excessive administrative procedures and protagonism and cost of public companies.
(7) Lack of efficiency in scarce public economic resources.
(8) Instability in the production and seasonality of the use.
(9) Physical conditions of the terrain, as the orography.
(10) Instability in product availability in quantity, quality and price.
(11) Lack of an established market.
(12) Low profitability of using forest resources.
(13) Lack of demand of forest energy products.
(14) Reticence to use the biomass.

Strengths and opportunities

(1) Benefits derived from the use of agroforest biomass, promoting the economic development of the sector.
(2) Development and business opportunity for forestry companies which have a greater performance and degree of mechanization, as well as for specialized logistics operators.
(3) Development and business opportunity for electric and thermal energy transforming companies (CHP) at the local/district level with a capacity of 2 MW.
(4) Development and business opportunity for the electrical/thermal energy and solid biofuels distribution companies

(5) Possibility to put in value the agricultural and industrial biomass that complement the forest biomass in the regular supply of the plant in the municipality, as well as the rehabilitation of the abandoned agricultural land (energy forest crops) and the use of its biomass.
(6) Creation of (in)direct employment in rural areas.
(7) Legal forest associations which represent the ownership in the region.
(8) Use of forest bioenergy at the local level; use of thermal energy in buildings for public and private use (pellet boilers in homes, district/industrial heating systems…)
(9) Technological innovation, training and specialization in a future economic sector.
(10) Improvement of the forest stands conditions (reduction of the risk of forest fires and its consequence in the environmental services.
(11) Active contribution to compliance with the Kyoto Protocol on climate change and the reduction of CO_2 emissions.
(12) Generation of energy without negative effects on the natural environment in the area. Emissions of sulfur dioxide (SO_2) and oxides of nitrogen (NO_X) which cause the acid rain are negligible in the processes of transformation of forest biomass into thermal and/or electrical energy.
(13) Existing subsidies which promote the use of renewable energies as forest biomass.
(14) Reduction of energy dependence, activation of the economy at the local level, improvement of the phytosanitary status and pest control, as well as the wildlife mobility and the maintenance of forest roads and paths.

5.7 Final recommendations (Step 7)

The main key issues to develop an integral model of agroforest-based bioenergy at local level in Enguera are:

1. One of its main drawbacks of the bioenergy valorisation based on the forest biomass is the high production cost, mainly due to the dispersion of the resource and the high costs of processing and transportation. These drawbacks can be alleviated in the short and medium term with public subsidies and in the long term, it should be regulated by the market.

2. To use the additional supply of agricultural/woody energy crops to complement the use of forest biomass with energy purposes; ensuring the viability of the activity.

3. To make efficient use of forest biomass in order to implement precise techniques which are specifically designed and planned, from the beginning of the value chain to the final use.

4. The implementation of the Sustainable Forest Management Project of Enguera (2014-2034) -to preserve the forests, create employment and economy in the rural area.

5. The limited public support should aim face the major innovation challenges which are required to articulate the system in Enguera, once the feasibility of the integrated management, supply, recovery and use of forest-based bionenergy project has been demonstrated. .

Thus, the development model of the forest-based bioenergy at the local level contributes directly to rural development. Thus, the development model of the forest-based bioenergy at the local level contributes directly to rural development. This is mainly due to the integration management and procurement phases of raw materials, the valorisation of the energy from the industrial projects and the distribution and consumption of electrical/thermal energy produced in the municipality of Enguera.

5.8 Technical assistance for project documentation preparation and finding funds for investments (Step 8)

The Rural Development Plan of the Comunitat Valenciana (PDR-CV 2014-2020) integrates and support business projects at the local level in the following measures established, prioritizing actions, as well as the public-private participation with owners and local companies:

Measure 8: Investments in the development of forest areas and improvement of the forest viability.

Submeasure 8.5. Investments that increase the capacity of adaptation, the environment value and the potential mitigation of forest ecosystems.

8.5.1. Sustainable forest management instruments

- Drafting of forest management instruments to guarantee through its application, the environmental and socioeconomic sustainability in the use of the forest resources with energy purposes and prioritizing bioenergy-based forest biomass projects.

- These planning documents should constitute the basic tool for the forest management based on the study and inventory of resources, their natural values and the temporal and spatial planning of their sustainable and sustained use, favouring the integration of advanced information technologies, such as remote sensing or terrestrial/aerial laser sensors.

- The Forest Management Plan/Project should be differentiated according to the forest area to be managed, favouring the projects of shared or adjoining multi-ownership.

Submeasure 8.6. Investment aid and forest technologies for the transformation, mobilization and commercialization of forest products.

8.6.1. Investments for the transformation and commercialization of forest products.

- In this action line, the promotion of business mechanisms should be encouraged, including a minimum of co-financing by companies and with a guarantee of sustainability through a non-refundable subsidy aimed at valuing through responsible marketing the production of solid biofuels (woodchips and pellets).

- The projects to be supported should always be linked to a Forest Management Plan/Project in the supply area of the company.

- Technical assistance could be subsidized regarding:

    - Sustainability analyses of business projects: economic and environmental viability, business plans, etc.
    - The preparation of all types of forestry and environmental documents related to the activity: instruments of forest management, environmental impact assessments, etc.
    - Acquisition of machinery for the harvesting and primary transformation of biofuels (felling and delimbing machinery, chipping and transport)
    - Investments related to the treatment and trade of solid biofuels (chipping, pelletizing and distribution at the local local).
    - The companies to support should be priority SMEs located in the area of implementation of the projects.

6 Bibliography

BIOENERGY INTERNATIONAL (2018). Austrian pellet prices remain stable amid fossil fuel price hikes. Recovered from: https://bioenergyinternational.com/markets-finance/austrian-pellet-prices-remain-stable-amid-fossil-fuel-price-hikes

LERMA ARCE, V. (2015). Planificación, logística y valorización de biomasa forestal residual en la provincia de Valencia. Universitat Politècnica de València. doi:10.4995/Thesis/10251/52391.

LIFE+ BIOENERGY AND FIRE PREVENTION (2013). Contribution of forest biomass generated in the prevention of forest fires in the EU energy strategy. LIFE09 ENV/ES/000450. 2011- 2013.

MAPA (2016). Ministerio de Agricultura, Pesca y Alimentación. Anuario de Estadística Forestal 2016. Recovered from: https://www.mapa.gob.es/es/desarrollo-rural/estadisticas/forestal_anuario_2016.aspx

MAPA (2019). Minsiterio de Agricultura, Pesca y Alimentación. Estadística Histórica y Anuarios de Estadística Forestal. Recovered from: https://www.mapa.gob.es/es/desarrollo-rural/estadisticas/forestal_anuarios_estadisticas_forestales_historicas.aspx

PROFORBIOMED (2010-2013). Interreg MED project “Promotion of residual forestry biomass in the Mediterranean basin”. Preparation of pre-feasibility projects of a small or medium size biomass plant or district heating/cooling system – a casa of energy contracting.

PROGRAMA DE DESARROLLO RURAL DE LA COMUNTIAT VALENCIANA (PDR 2014-2020). Recovered from: http://www.avfga.gva.es/es/pdr-cv-2014-2020

TECHNICAL DOCUMENT “Integración de Retos, Oportunidades y Modelos de Negocio de Bioenergía Forestal en Planes y Programas de Desarrollo Rural en la Comunitat Valenciana (2019)”. Recovered from: https://www.camaravalencia.com/es-ES/competitividad/medioambiente-energia/Paginas/ForBioEnergy.aspx

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