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**Report on individual auditing studies
and diagnosis in Spain**

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About SUCELLOG project

The SUCELLOG project - Triggering the creation of biomass logistic centres by the agro-industry - aims to widespread the participation of the agrarian sector in the sustainable supply of solid biofuels in Europe. SUCELLOG action focuses in an almost unexploited logistic concept: the implementation of agro-industry logistic centres in the agro-industry as a complement to their usual activity evidencing the large synergy existing between the agro-economy and the bio-economy. Further information about the project and the partners involved are available under www.SUCELLOG.eu.

Project coordinator



Project partners



About this document

This report corresponds to a part of the D6.5 Summary of auditing studies and diagnosis in Spain, France, Italy and Austria of the SUCELLOG project. It has been prepared by:

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1. Introduction

SUCELLOG supports the creation of biomass logistic centres inside agro-industries covering the gap of knowledge faced when willing to start this new activity. Within WP6, SUCELLOG provides an auditing service facilitating the decision making to agro-industries interested in becoming a logistic centre. Beneficiaries have been object of a previous diagnosis in order to evaluate the degree of maturity to start-up the new activity, their potential and their knowledge gaps.

A total of 21 agro-industries have been diagnosed in Spain and 8 of them were supported with a techno-economic feasibility study through an audit.

This document includes, in a first part, a collection of the individual reports of diagnosis carried out in Spain and, in the second part, the collection of the reports of the auditing services.

Finally, a summary of the state of the country with respect to the implementation of the logistic centre in Spain is included.

2. Companies diagnosed in Spain

The following Table 1 presents the list of diagnosed agro-industries.

Table 1: List of diagnosed agro-industries in Spain.

Region	Agro-industry name	Sector
Aragón	Cooperativa Agraria San Miguel de Fuentes de Ebro *	Forage dehydration; Cereal dryer
Aragón	Destilerías San Valero*	Wine distillery
Aragón	S C del Campo San Isidro de Altorricón	Cereal dryer
Aragón	Sociedad Cooperativa Ganadería Unida Comarcal (GUCO)	Animal feedstuff producer
Castilla y León	Agropal, Soc. Coop.	Forage dehydration; Cereal dryer
Castilla y León	Cooperativa Agrícola Regional (CAR)*	Forage dehydration; Cereal dryer
Castilla y León	COPIISO Soria, Soc. Coop.	Cereal dryer; Animal feedstuff producer
Castilla y León	Ucogal	Forage dehydration; Cereal dryer; Animal feedstuff producer
Castilla y León	Cocope*	Winery and aromatic plants distillery
Cataluña	L'Avellanera	Nut industry
Cataluña	Linyola, SCCL	Cereal dryer
Cataluña	Miralcamp, SCCL*	Cereal dryer; Forage dehydration
Cataluña	Transalfals	Forage dehydration
Extremadura	Sdad. Cooperativa Sagrada Familia	Cereal dryer (Rice, corn); Tomato
Extremadura	Tabacoex, Soc. Coop. 2º	Tobacco dryer
Extremadura	Troil Vegas Altas, Soc. Coop.*	Transformation of the olive mills by-products
Extremadura	Viñaoliva, Soc. Coop. 2º	Wine cellar
Galicia	Aira	Animal feedstuff producer
Galicia	Eidosela	Wine cellar
Galicia	Melisanto*	Animal feedstuff producer
Galicia	Os Irmandiños*	Animal feedstuff producer

The diagnosis served to evaluate the potentialities of these agro-industries to become biomass logistic centres. After a fair and transparent process, some of them (marked

with an asterisk * in the table above) were selected to be beneficiaries of a more detailed study inside an auditing service.

2.1. Diagnosis of Coop. Agraria SAN MIGUEL DE FUENTES DE EBRO

2.1.1. Company description

The Cooperativa Agraria “SAN MIGUEL DE FUENTES DE EBRO”, is a cooperative which currently comprises 496 partners. The territorial scope of the Cooperative covers the populations of Fuentes de Ebro, Rodén, Mediana de Aragón, El Burgo de Ebro and Osera.

The cooperative is mainly engaged in the dehydration and commercialization of fodders, and in the drying of corn and the commercialization of several types of cereal. The cooperative’s facilities have 11 hectares of land with buildings and threshing floors, sufficient for the storage of all the products that are manufactured and commercialized. In recent years, they have expanded the facilities with the construction of several cells for the storage of fertilizers and buildings for the deposit of dehydrated bales.

Since the foundation in 1964, the Cooperative has a fodder dehydration facility for the manufacturing of pellets. Later, in 2010, a dehydration line for fodder was launched with the manufacturing of bales. Furthermore it has a corn dryer whose drying capacity is 15,000 Kg/hour, since it is a very important crop in the area of Fuentes de Ebro.

It also has a fertilizer mixer in order to be able to supply any form of fertilizer requested by the partners, both for the most common crops in the area and for the minority crops. Finally, it has a size grading machine for cereal and another for lucerne. They are producers of certified lucerne, wheat and barley seed. Furthermore they provide their partners with a service to select their own seed for the planting of their exploitation.

Currently they do not work with biomass for their drying lines, since they have a natural gas installation. Although they do not work and have no experience with biomass, they are very interested in the project since they have a great potential of resources from agricultural residues, such as the straw of different winter cereals, corn stalk and corn cob. Furthermore they have a chipping line, a drying line, a mill line and a pelletizing line that are much underused, since, due to the manufacturing costs, it is virtually unused.

Cooperativa Agraria SAN MIGUEL DE FUENTES DE EBRO, is located in Ctra. N-232, km 209,100 Fuentes de Ebro, Zaragoza.

2.1.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

It is an industry engaged in the dehydration process of fodder which is afterwards granulated or packaged for animal feed. They have two drying lines for fodder, one for the packaging and another one for the granulation. The granulation line is virtually unused due to the high manufacturing costs of the fodder granulation and the electricity cost associated. Furthermore they also dry and store corn and they store other types of cereals to be commercialized. They also have a fertilizer mixer, and size grading machines for cereal and lucerne seed.

B. Type of biomass resources available

The cooperative works and has the potential to work with a large amount of biomass. Mainly the agricultural residues from the harvesting of corn and other types of cereals could be used. On the one hand corn stalk and corn cob could be used as agricultural residues to manufacture any type of solid biomass using the existing and underused facilities. The price of corn stalk at the side of the agro-industry varies from 36 to 42 Euros/ton. These residues are manufactured in the harvesting period of corn, which begins in October and can last until January.

On the other hand we find cereal straw, which is another agricultural residue generated by the partners of the cooperative. These residues are mainly generated in June and July during the harvesting of cereal (mainly wheat and barleys), and their approximate price ex works would be around 36 Euros/ton.

The distance of these resources to the cooperative is small, around 10 km on average, although most of them may be closer because of the proximity of the agricultural land to the facilities of the cooperative.

Up to now, these residues are normally left on the field and are incorporated to the soil through labours as fertilizer. In some cases they can also be used for animal feed or livestock bedding.

C. Existing equipment in the agro-industry and availability

In its processing and dehydration line for fodder the cooperative has two lucerne chippers (BENSO 2000) for the cutting of fodder before passing through the drying line. It also has two drying lines, one aimed at the production of bales, and another one subsequently linked with the granulation process. The drying lines are formed by 2 rotary dryers. One is the AYPE Ecofiber 2009 for the line of bales. The other one is the PROMIL 20,000 for the granulated line. For the dehydration process of lucerne, it also has a mill and two pelletizer machines, the CPM PUR 220-2 and the MABRIK 7,000, all of them used for the granulation process.

Furthermore it has a corn dryer of the type silo, which is capable of drying around 15 tons of corn per hour, and a starting moisture value of 20%, and a final moisture value of 14%.

Underutilization dates of the equipment:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pelletizer	X	X	X	X	X	X	X	X	X	X	X	X
Rotary dryer	X	X	X	X	X	X	X	X	X	X	X	X
Mill	X	X	X	X	X	X	X	X	X	X	X	X
Chipper	X	X	X	X	X	X	X	X	X	X	X	X
Corn dryer		X	X	X	X	X	X	X	X			

Currently the whole granulation line for lucerne is underused and the cooperative intends to use it somehow, since it is a facility that can be used to obtain profitability. Part of the chippers has the capacity to be used more, and the rotary dryer, the mill and the pelletizers could be used continuously. This can be an important factor to manufacture any type of biomass in pellet form.

The drying line for corn is also underused during many months, since its work is mainly concentrated during the harvesting months of this crop. Furthermore in recent years, due to the price of corn on the market, this dryer is used less frequently each time during the harvest dates.

D. Knowledge on the bioenergy sector

The cooperative has no experience in the manufacturing of biomass or in its consumption, since they do not use biomass in their own facility for drying. They installed a gas line and they continue to work with it.

E. Biomass market in the region

In the area there is not a very large biomass market, since it is mainly agricultural, and the main consumers of thermal energy are those for the drying or dehydration of products, and currently they use gas for this purpose. Some pig farms could be added to the demand for biomass in the area, although there are very few. In adjacent areas maybe there could be greater demand, but this should be examined.

Although they have no experience with biomass, the cooperative has a great potential to be able to work with it due to its good underused facilities, and to the potential of agricultural biomass which their associates generate.

2.1.3. Conclusions

The main interest of the cooperative in this project is obtaining information in order to see how to obtain profitability from their facilities that are underused, furthermore to know what to do with many agricultural residues that are left on the field.

In many cases these residues are used for animal feed or they are incorporated to the soil as fertilizer, but other times they do not know what to do with them, and this way they could obtain profitability for the farmers and for the cooperative.

It would be a success to obtain functionality for the residues and the underused facilities of the agro-industry, obtaining “biofuels”, in pellet form e.g.

2.2. Diagnosis of DESTILERÍAS SAN VALERO Soc. Coop.

2.2.1. Company description

DESTILERIAS SAN VALERO Sociedad Cooperativa is a wine distillery for the processing and revaluation of winemaking by-products. They are principally engaged to transform marc's, lees and wines from their 45 partner wineries. With these raw materials they obtain alcohol, tartrates, grape pits as well as other valid by-products for their use as natural organic fertilizers. Their market is international and mainly oriented to the biofuels sector and the food industry, where they work with reference companies at national and international level.

Currently they already work with biomass for their drying line, and they even consume by-products from the wine-industry to produce thermal energy for this drying line. They are interested in the project to obtain more performance from possible by-products which currently are not used and may be used as biomass.

DESTILERÍAS SAN VALERO Soc. Coop. is located in Ctra. Valencia, KM 451.7, C.P. 50400, Cariñena (Zaragoza).

2.2.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

It is an industry engaged to transform and reevaluate winemaking by-products. They have a drying line which may be very interesting for the needs of the project although it is used throughout the year, as well as a pelletizer, which currently is not used.

B. Type of biomass resources available

The cooperative works and has the potential to work with a wide variety and quantity of biomass. The distillery receives the by-products of its partner wineries to transform them and obtain products that are valuable.

First, we mention that during their transformation process they obtain wine pomace without pits, which is the remaining skin of the grapes, and grape pits which are the seeds of the grape. Currently pomace is used as biomass to power the boiler they have in the dryer of the distillery. The grape pits (seeds), have a high economic value, since oils can be obtained from these seeds. The distillery sells the grape pit for 210 €/ton, to a company that deals with the extraction of the oil.

The distillery is not self-sufficient for the production of thermal energy, since the pomace produced is consumed quickly. Because of this, they buy biomass on the market. Or they buy from the same company that extracts the oil from the grape pit, the residue that remains after the process and which is called grape pit flour (55-70 €/ton), or they buy other types of biomass such as almond shell (60-70 €/ton) on the market. The company, from which we repurchase the pip flour, also sells part of this product to companies that use it for animal feed. Pomace is a by-product which is obtained in the harvesting months, after the extraction of the vine juice, approximately between August, September and October. The pip and therefore the flour can be obtained throughout the whole year.

Furthermore, in their own facilities and in those of much partner cooperatives, they have another product which is called stem. This is a product in the vegetative part of the raceme and is obtained after the de-stemming process of the grape. Currently it is a by-product that they have stored and they do not know yet what to do with it, since it is not used as fuel at the moment due to its sponginess. Maybe it could be used in the boiler of their own facility if it is crushed and pelletized, since if it would only be crushed, it would not serve because it would be too fine. Stem is also obtained in the harvesting months.

It is also important to mention that the distillery is located in a vineyard area, where a large amount of prunings of vines (shoots) are produced. This product is property of the farmers, but in many cases it is a problem because it needs to be managed, and it could be used for the combustion. Up to now, in most cases it is chopped into the soil or it is burnt in the agricultural holdings. There are several ongoing projects which are developing machinery and evaluating collection costs of the shoots to develop them as biomass. In the vineyard area of Cariñena, there is a great potential for this product. The pruning process is mainly carried out in December, January and February.

C. Existing equipment in the agro-industry and availability

The cooperative has drying equipment and a pelletizer in its facilities.

Underutilization dates of the equipment:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pelletizer	X	X	X	X	X	X	X	X	X	X	X	X
Dryer												

Currently the pelletizer is completely underused, since it is not employed for anything, and this can be an important factor in order to be able to manufacture any type of biomass in pellet form.

On the contrary, the drying equipment is continuously running, and they should examine in more detail if this is necessary, and how to organise the tasks.

D. Knowledge on the bioenergy sector

They do have experience with biomass since they consume around 3,000 tons per year of it. They know the market and the market prices. Furthermore they know very well the potential in the area in order to obtain performance of the possible resources to exploit them as fuels.

E. Biomass market in the region

In the area there is not a very large biomass market, since it is a wine region, and the wineries do not need a high consumption of thermal energy. In adjacent areas there may be a greater demand for biomass by pig farms, but they should have to conduct a more in-depth study.

The cooperative sees these farms as a large potential as possible consumers of biomass, since they consume around 3,000 tons per year, moreover since it is a more or less constant demand during this period.

Currently they are consuming their own pomace which they obtain from their transformation process, furthermore from grape pit flour and almond shell. The specifications for the purchase of biomass that they have set are:

	Moisture content (% m bh)	Ash content (% m bs)	PCI (kcal/kg, ar)	Price (€/t)
Purchased biomass	15	3-5	4,000-4,500	55-70

They believe that if their case is examined well, they could obtain any type of biomass to power their boiler, since they have the equipment and a large potential, both in quantity and variety of biomass.

2.2.3. Conclusions

The cooperative’s main interest in this project is obtaining information in order to know what to do with certain by-products they generate in their facilities, in the distillery’s partner wineries, and in the agricultural holdings of the wineries’ partners. The manager of the cooperative sees a large potential in the stem that is generated and in the biomass from pruning. It would be a success to obtain a functionality for the stem and an economically viable collection for the biomass from prunings, and thus to be able to use them directly as splinters in their boiler or manufacture pellets through their pelletizer.

2.3. Diagnosis of Soc. Coop. del Campo SAN ISIDRO DE ALTORRICÓN

2.3.1. Company description

The Soc. Coop. del Campo SAN ISIDRO DE ALTORRICÓN, is a cooperative which currently comprises 170 partners.

The cooperative is mainly engaged in the wholesale trade of cereals, and in the supply of fertilizers, pesticides and fuels to their associates.

Currently they do not work with biomass for their drying line for cereals, since they have a natural gas installation. Although they do not work and do not have experience with biomass, they have always been interested in the possibility to use crop residues, such as cereal straw, corn stalk and the wood prunings of fruit trees.

The Soc. Coop. del Campo SAN ISIDRO DE ALTORRICÓN, is located in La Melusa, 8, 22540, ALTORRICÓN (Huesca).

2.3.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

It is an industry engaged in the drying and storage of corn, and the storage of other types of cereals to be commercialized.

B. Type of biomass resources available

The cooperative works and has the potential to work with a large amount of biomass.

The agricultural residues from the harvest of corn and other types of cereals, and also the harvest of prunings from fruit trees in the area could mainly be used. These residues are the property of farmers in the area from whom some belong to the agro-industry and others do not.

On the one hand corn stalk and corn cob could be used as agricultural residues. The cooperative repudiates the prices that these residues could have. These residues are generated during the harvesting season of corn, which begins in September and can last until January.

On the other hand we find cereal straw, which is another agricultural residue generated by the cooperative's partners. This product is mainly produced in the months May, June and July, during the harvesting of cereals (mainly wheat and barleys). The cooperative repudiates the price of this residue.

Finally we find pruning from fruit trees, which is another residue generated in the area by the cooperative's associates and other farmers who are not associates. Pruning from fruit trees is generated during the pruning period which mainly lasts from November to February.

The distance of these resources to the cooperative is small, around 10 km on average, although most of them may be closer because of the proximity of the agricultural land to the cooperative's facilities.

Up to now, these residues are normally left on the field and are incorporated to the soil through labours as fertilizer. In some cases they can also be used for animal feed or livestock bedding.

C. Existing equipment in the agro-industry and availability

The cooperative only has a drying line for corn. The dryer of this line is a vertical dryer. The characteristics of the dryer are the following: Manufacturer - SAN JOSE (2004) and Model - IC 80.

Underutilization dates of the equipment:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Corn dryer		X	X	X	X	X	X	X				

The drying line for corn is underused during a lot of months in the year, since its work is mainly concentrated in the harvesting months of this crop.

D. Knowledge on the bioenergy sector

The cooperative has no experience in the manufacturing of biomass nor in its consumption, since they do not use biomass in their own drying facility. They installed a gas line and they continue to work with it.

E. Biomass market in the region

There is a biomass market in the area mainly formed by the consumption of the chicken and pig farms, and in a more timely manner by some households. The cooperative could consume an important part of the biomass if they had a boiler on biomass fuel, but the gas installation for drying functions correctly with currently lower fuel costs. Currently the farms in the area are consuming forest wood chips or almond shell with piñola of olive for oil production. The households with a biomass burner or biomass boiler currently consume forest wood pellets.

In adjacent areas maybe there could be a greater demand for biomass, both in farms and in other facility types that work with biomass, but this should be examined.

The cooperative does not have experience with biomass, although it does have a great potential of agricultural residues to be used, from the residues generated by associate farmers and farmers in the area. The drawback is that not all of the cooperative's facilities are adequate for the processing of biomass.

2.3.3. Conclusions

The cooperative's main interest in this project is obtaining information in order to see the options available in the market for the profitable use of the residues generated by the agricultural crops on the field. Currently these residues are being incorporated on the field as fertilizer, although in many cases they repudiate the real functionality of this process. In other cases these residues are collected in order to use them as livestock feed or bedding, or even removed in order to burn them. A lot of these actions are done in order to manage these residues, and not to generate value over them.

2.4. Diagnosis of Soc. Coop. Ganadería Unida Comarcal (GUCO)

2.4.1. Company description

The name GUCO name comes from the abbreviation of United Livestock Comarcal. The compound feed factory is the first company that is created in Rainbow Group, a business group which is part GUCO SAT. The beginnings date back to 1978, when 52 farmers of the region of Matarraña signed the charter of this company in order to manufacture feed together. Today GUCO has 627 partners in Teruel, Zaragoza, Castellón and Tarragona and produces feed for all livestock, reaching a production of 86,000 tons.

The animal feed factory was created in 1980. The facilities are located in Beceite km.23 Carretera s / n Valderrobles (Teruel). The weekly working time at the factory begins Monday at 7 am and ends on Saturday at 7 in the morning.

2.4.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

It is an industry dedicated to the manufacture of feed for its members. Is part of a business group called Rainbow Group, which are integrated various cooperatives, SAT and businesses. The group integrates the entire chain from the manufacture of animal feed, to its processing, packaging and sale.

B. Type of biomass resources available

The cooperative works with biomass for the production of thermal energy needed in the manufacturing process of feed. Also they act as small biomass and logistics operators who buy and sell solid biomass.

The main resources of the area are forest wood from Mediterranean forest, prunings of olives and almonds, olive pits and olive pomace and almond shells. Ownership of these wastes are farmers in the area that some of them belong to the agro-industry.

For the moment, the cooperative rejects the use of pruning of olive and almond tree because it is not currently being managed as waste for the production of solid biomass, but mainly burns or incorporated into the soil as fertilizer. Almond pruning is generated between the months of October and December mainly and olive pruning from March to April, and could be obtained from members of the cooperative or nearby farmers within 50 kilometres.

The cooperative has a biomass boiler for the production of thermal energy required for the manufacturing process of feed, which consumes mainly almond shells and olive pomace, from cooperatives in the area that extract it from its manufacturing process. Most of the year they are consuming almond shells because of its price and because it leaves less residue on the burner than other solid biomass. The almond shell is mainly produced in September and October with a price of around 65 Euros/tonne, and olive pomace between December and January, with an approximate price of 80 €/ton.

Moreover, the cooperative has access to forest thinning wood in the area supplied by a logistics operator, but has rejected it in several occasions by its high moisture content and the amount of ash left in the boiler burner.

Finally, it's worthy to remark that the cooperative is also working as a logistic operator, buying and selling wood pellets and olive pits, which sells to the cooperative members or other stakeholders in the area, mainly for boilers of the farms or household consumption.

Both the almond shell, the olive pomace and the olive pit have no use as fertilizer or animal feed in the area.

C. Existing equipment in the agro-industry and availability

The cooperative has only one manufacturing line for the pelletized feed. They have a biomass boiler with an annual consumption of 800 tons per year:



It has also two mills. One of 110 kW and another one of 160 kW. Finally, it has two pelletizing lines. A pelletizer of 162 kW and another one of 250 kW.

They don't have underused equipment as the animal feed factory works continuously throughout the year without stops.

D. Knowledge on the bioenergy sector

The cooperative does not have experience biomass manufacturing but is consuming and acting as logistics operator as explained in Section B.

E. Biomass market in the region

In the area there is a market of biomass formed mainly by consumption of pig farms, and an exceptional consumption for some households. Apart of these the own biomass consumption for their installations is quite high. The cooperative acts already as logistics operator to supply biomass in the area, but also buys olive pits from Andalusia, as in the area it's not possible to provide it.

Also in the area there is a very large potential for forest wood, although the only withdrawals made are from thinning because of the subsidies they give, and not good quality wood is obtained.

In the nearby areas there is also a very large potential for pruning wood, mainly from olive and almond trees, which are not being exploited because there is no supply chain that works for it.

2.4.3. Conclusions

The main interest of the cooperative in this project is to obtain information for existing options in the market for profitable use of waste generated by industries and farmers in the area. Their equipment cannot be used for transformation of biomass since have occupied all year round in the manufacture of feed. The cooperative is currently working as a biomass logistics operator, but if the market improved or could get quality products with residues of the area, could value the option of increasing the biomass management as logistic operator.

2.5. Diagnosis of AGROPAL GRUPO ALIMENTARIO

2.5.1. Company description

The registered office of the AGROPAL cooperative Food Group is located in Palencia, where the central administrative services are carried out from which the activity in the different centres of the cooperative is coordinated.

Among its many activities, the group markets cereals, lucerne and fodder, raw materials for animal feed and unifeed mixtures for ruminants, which are the main activities of the cooperative. In addition it relies on a supermarket with 1,500 m² of exhibition area, a dining room, a bank office and fuels distribution by means of a gas station. It also relies on a wholesale place for vegetables, fruits and pulses, a cheese factory which commercializes with an own brand of cheese and milk, produces calves with the guarantee mark Carne de Cervera as well as pardina lentil with the Protected Geographical Indication Tierra de Campos. Finally, it offers administrative services such as general and agricultural insurances, taxation, consultancy, and etcetera, constituting a unique collection of services for the farmer, breeder and their families. Currently AGROPAL counts on 32 production sites and 7 supermarkets and stores in Castile and León which employ more than 300 persons, billing more than 220 million euro per year.

Despite all of this, the cooperative still insists that its future lies in the diversification of its proceedings from the base, as well as developing new projects which involve future opportunities for its partners.

2.5.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The AGROPAL cooperative is a multidisciplinary Agri-food group, with adequate activities, facilities (12 production sites), machinery and a professional technical staff and high capacity to undertake the current project successfully.

The cooperative has 12 open centres with a constructed surface of 85,000 m², representing a storage capacity of 240 tons. These centres have different processing facilities for the processing or packaging of the partners' crops including 2 lucerne and fodder dryers, a feed mixer, two corn and sunflower dryers, eleven seed stations and one certified seed processing centre for cereals of the own production.

Similarly, the cooperative has other facilities for the input supply to the partners like two fertilizer mixing mills, a liquid fertilizers facility, two trucks for the fuel distribution and various types of machinery like dragged bulk spreaders, grinders and self loading fodder carts, wheel loaders, delivery vehicles and freight trucks.

Furthermore, it shows an important future vision in the diversification of its activities.

B. Type of biomass resources available

The cooperative has access to considerable amounts of arable residues (straw, corn stalk and sunflower) from the parcels of its more than 3,000 partners located at close ranges at 50 km of the action and which currently, with marginal use as fertilizer and with virtually no commercial power because of the high costs involved in the collection, they are used by the cooperative for the start-up of new equipments, which they acquired in the last two years, fuelled with biomass as only fuel.

However, it is important to highlight the interest which has aroused last year on the part of some industries in the area, as well as public buildings (local and regional government), for the possible sale of biomass materials (pellets) that AGROPAL could begin to market from the biomass of its partners.

The cooperative has its own means of transport for which the design of a logistic chain both for the collection of raw material and for the distribution of pelletized material to commercialize, should not pose a problem.

C. Existing equipment in the agro-industry and availability

AGROPAL has different equipments of great importance to perform the pre-treatment process of the biomass residues which is the intention of the SUCELLOG project.

The cooperative has two fodder dryers (horizontal), and three dryers for cereals, corn and sunflower of which two are vertical and the other is horizontal. It also has four pelletizers, dozens of cooling and storage silos, as well as mills, grinders and screening machines.

The material mentioned would be of great interest both by the type as by the number for the preconditioning of the raw material to be treated. This would allow a great versatility when undertaking the different works both in time and the type and amount of biomass material to be processed.

It is also important to highlight the large warehousing area of the cooperative (240,000 tons), which situated throughout the province of Palencia, could provide a golden opportunity for the logistics of biomass in the entire northwest of Spain.

With reference to possible seasonal confluences between the main activity of the cooperative and the activity to develop the proposal by the development of the SUCELLOG project, there would be no problems. Neither would there be drawbacks in the relation of the seasonal biomass production and the idle periods of the machinery in which it could be used for the pre-treatment of biomass. Moreover, the compatibility in this case would be perfect.

D. Knowledge on the bioenergy sector

The AGROPAL cooperative has enough knowledge to address a project not only related to the use of biomass in its own facilities but also to the manufacturing of pellets from biomass of its partners. It could become a supplier for other clients in the area with guaranteed success for profitability and supply. In recent years, the cooperative has been doing stress tests as well as technical and economic efficiency tests for the opening of this new sector as another of its activities.

E. Biomass market in the region

In recent years, the boom of biomass in the region of Castile and León has peaked. A multitude of the consumers at particular level installed biomass boilers to replace old oil-fired boilers. Likewise the local and regional governments are betting on the use of this type of renewable energies. This increases the demand for raw material in winter season in the form of quality biomass importantly, motivated by the fact that the manufacturing of pellets from arable residues from the partners of the cooperative could entail an excellent new business with which the cooperative can continue to diversify its activities.

In any case, and before definitely undertaking the project, a detailed study of biomass demands and the possibility of the availability of this will be necessary, as well as making sure that the distances for the collection of the raw material mentioned don't exceed 50 km. On the other hand, a study of the quality of the residues to be used as raw material in compliance with specifications such as heating value, moisture of the residues, as well as the value for money of the obtained biomass will be crucial when the cooperative approaches this project as a new business area with guaranteed success.

2.5.3. Conclusions

The interest of the AGROPAL cooperative for this project was really high in the beginning. However, over the months, its commitment in this regard has significantly changed because of various reasons. It seems that because the results obtained through the tests that they carried out internally were worse than expected, they are rethinking about the strategies to continue this new activity.

Even though Urcacyl has encouraged them to continue with the project to get a possible way of advice and guidance through the research they carried out with the development of SUCELLOG, the cooperative has declined the offer deciding to turn away from the consortium to be formed.

2.6. Diagnosis of Cooperativa Agrícola Regional (CAR)

2.6.1. Company description

The Cooperativa Agrícola Regional (CAR), with head office in the Palencia locality Carrión de los Condes, offers different services related mainly to the agricultural sector to its more than 320 partners. Mainly dedicated to the commercialization of crops from fodder and cereals from its associates, it also offers sale of input services and a fuel post. Furthermore, with the objective of increasing the services offered, they have built a new storage centre and a seed breeding station and a seed certification centre which allows increasing the surface of these units until it exceeds 4,000 square metres.

Furthermore, the cooperative also relies on a fodder dehydration plant with a capacity of 12,000 tons, and in the village of Saldaña, a plant intended to unifeed mixtures inaugurated in 1998, a silo from the SAGF (Spanish Agricultural Guarantee Fund) with a capacity for 5,000 tons of cereal and a store specialized in the commercialization of livestock and agricultural products, among which the pesticides and liquid and solid fertilizers with own application service.

The cooperative which also possesses sites in the Palencia localities Villamartín de Campos and Villoldo, reached a turnover of around 24 million Euros in the campaign that ended last year.

This is the first agrarian cooperative in the Province of Castile and León by year of foundation and it has planned to extend its business volume through a diversified production of which 70% corresponds to agriculture, 17% to livestock and the rest of the turnover comes from the services provided to its partners.

After the discussions held with the principals of the cooperative, it is highlighted that the company is immersed in an expansion process, in which the diversification of its activities through the start-up of this type of proceedings would be a possibility for a detailed study.

2.6.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

CAR is a cooperative dedicated to the primary agrarian production with residues from both the corn and cereal production of holdings from 320 partners in adequate amounts for the creation of a possible biomass logistics centre. Moreover, by its strategic location in the north of Spain, the cooperative presents the ideal location for the reception of raw material from the forestry sector, such as pruning and clean residue, which would be an excellent ally to the agricultural residues to achieve the high quality biomass which is much demanded by the consumer in this area.

B. Type of biomass resources available

As pointed out above, in the case of the cooperative CAR it is important to highlight its privileged location in the Province of Palencia, where it clearly would be capable to collect the biomass from both agricultural residues of its partners' holdings with marginal use such as own use fertilizer, and the forest residues in the area. The combination of both raw materials, mixtures in adequate percentages, would result in an excellent quality biomass raw material. In any case, these blending percentages of raw material to incorporate would have to be analyzed and studied in depth for the determination of the most adequate mixture regarding heating value as well as percentages of residues and impurities.

Regarding the distances to cover for the transport of the raw material, is it important to highlight that these would not exceed 35 km, which is a very advisable radius so that this logistics would not incur any additional problem, since in this case, it would be the own farmers in the zone which would be responsible to perform this work, without the need to hire any type of external agency.

The present-day consumer of this raw material is known to be a consumer demanding a high quality product. However, currently the cooperative doesn't have background knowledge in the sector, neither a contact network which facilitates the start-up of the project, nor a financial viability study, nor possibilities to continue the proceedings.

C. Existing equipment in the agro-industry and availability

Currently, the existing equipment in the cooperative, from which the pre-treatment of biomass from farms could be carried out, is based on the dryers, both horizontal and vertical. They would need to make an investment in machinery of the type pelletizers, scales or mills for an adequate pre-treatment of the raw material to process.

D. Knowledge on the bioenergy sector

Currently, the cooperative CAR does not consume biomass for none of the equipments with which it works during its traditional activity. Neither the dryers nor the fodder dehydrator are powered with this fuel type, consequently if they will finally begin to work with an initiative of this type, the first thing they would have to do would be the adaptation of their machinery with the objective to be their own consumers of the produced energy.

On the other hand, we have to say that the cooperative neither has thorough knowledge about how to make or work adequately with this raw material, since it has no experience in the maintenance of this type of lines. However, it is known that there are success stories in companies with similar characteristics which encourage them to explore possibilities and follow in their footsteps.

E. Biomass market in the region

As pointed out above, the cooperative does not have reliable knowledge about the biomass market in its area of influence. Despite knowing that, in general, the current biomass client prefers high quality biomass, repudiates the prior requirements which the biomass should have as well as the most demanded standards and the prices at which the consumer acquire the biomass at the market.

A technological search for possible biomass consumers has led us to know that there are quite a few public buildings (schools and city halls) involved in this type of renewable energy in the area. In this case, the raw material which the cooperative could place on the market would be available in the time of the year in which these possible consumers have the highest demand.

2.6.3. Conclusions

The interest of the cooperative CAR to receive advice about this initiative is really high. However, seen everything commented above, the prior knowledge which the cooperative has about the material is not as deep as the development of the project requires so that it can diversify its business with guaranteed success.

On the other hand, and because the equipment available to carry out the pre-treatment of the raw material is not too wide, we note that the investment that they would have to make in machinery is very important, fact that the governing council of CAR should seriously consider.

Thus, before the implementation of the project, we consider it necessary to conduct a thorough analysis study and diagnosis of the cooperative's current situation both at technical and economic level.

All of this leads us to conclude the need that CAR acquires knowledge of the sector prior to the implementation and development of the proposal with the SUCELLOG project.

Despite this, we from Urcacyl are convinced that after this training and analysis period, the cooperative would reach a level that, together with its seriousness and maturity, would enable them to develop a project of these characteristics successfully.

2.7. Diagnosis of COPISO SORIA, Soc. Coop.

2.7.1. Company description

COPISO SORIA is a first-degree cooperative society with two main sections: feeds and crops. Agglutinates a large part of the agricultural activity of Soria and is an essential pillar of the economic and social development of the rural area in the Province of Soria. It has 1,231 partners and its average turnover exceeds 160 million Euros with a continuous growth of activity.

COPISO offers the following products and services: compound feeds, integration and commercialization of pigs, veterinary services, animal health products and swine insemination, commercialization of cereals, pulses and oilseeds, fertilizers, drying and commercialization of sunflower and corn, calibration and selection of seeds, supply of pesticides, diesels, deposits and services, biomass development.

The gradual increase of the activity has led to the creation of a business group by COPISO, composed of six societies in which the Soriana cooperative participates. One of them is Biocombustibles Forestales S.L., created for the development of biomass from agricultural residues.

2.7.1. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The lines of business developed by COPISO are fully aligned with the targets sets by the SUCELLOG project, processing more than 190,000 tons of feed per year, and marketing more than 128,000 tons of cereal and 13,000 tons of sunflowers. On the other hand, their facilities, all of them located in the Province of Soria, and the equipments they have, suggest that we are dealing with an excellent opportunity as an industry converted into a biomass logistics centre in central north-eastern Spain.

B. Type of biomass resources available

We are dealing with an industry, which because of its privileged location, presents an outstanding capability to collect raw material from agricultural residues from the agricultural holdings of its partners (straw and sunflower stalk) with residual use as fertilizer, as well as forest wood pruning and energy crops (high-density poplar) which have been planted with a magnificent development in the area for that purpose.

The said raw materials, from both the partners of the cooperative itself, as well as from invested agribusinesses by COPISO, are located in a radius of less than 50 km of distance, which would mean that we are dealing with an ideal distance for the logistic aspect of the possible biomass centre that could be put in operation. The farmer partners themselves could be the ones that transfer the agricultural residues to the facilities of the cooperative not assuming any obstacles for this matter. Furthermore, in the area there are already organized fleets of trucks capable of transporting raw material of biomass from energy crops.

C. Existing equipment in the agro-industry and availability

The existing equipments in the cooperative are very important in connection with the necessary machinery to carry out the pre-treatment of the raw material. COPISO has a vertical dryer, a mill and a pelletizer; high-capacity equipments and versatility in the use of conditioning raw material to biomass.

COPISO has a cereal storage capacity of 140,000 tons at present, divided in 12 own warehouses and another 9 silos, turning the cooperative into one the largest storekeepers of cereal in the Province of Castile and León.

COPISO is thus owner of different storage facilities with sufficient capacity to allow a correct storage of biomass for as long as necessary without disrupting the main activity of the cooperative.

Regarding possible seasonal confluences between the main activity of the cooperative and the activity to develop the proposal suggested for the development of the SUCELLOG project, there wouldn't be any problems. Nor would there be drawbacks in the relation of the seasonal biomass production and the idle periods of the machinery in which it could be used for the pre-treatment of the biomass in the case of the dryer. It could be more inconvenient to locate inactive periods of the pelletizer and the mill, since they are used throughout the year, however, if this new line of business were considered, adjustments could be made in the production that allowed the use of this equipment for this line

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pelletizer												
Dryer		X	X	X	X	X	X	X	X			
Mill												
RESOURCES												
Cereal straw								X	X			
Maize stalk										X	X	

D. Knowledge on the bioenergy sector

The cooperative COPISO besides being a biomass consumer in its own facilities by making use of biomass supplied by its farmers, has acquired sufficient knowledge in recent years to undertake a project such as SUCELLOG related to the conditioning and manufacturing of biomass from both residues from the agricultural holdings of its partners, as well as from energy crops cultivated for that purpose.

This suggests that COPISO could become a manufacturer and supplier of other clients in the area offering guarantees of constant supply during all seasons of the year in which there is no demand.

In recent years, the cooperative, interested in this new niche business, has acquired stake in a Soriana company dedicated to the planting of energy crops for the biomass production delivering excellent results. Thus, the acquired knowledge in the material and its quality characteristics, technological, regulatory and environmental aspects, as well as the consumer market and competition, are quite broad and realistic.

E. Biomass market in the region

The Province of Soria, in which the different units of the cooperative COPISO are located, is one of the areas where the biomass use has experienced a further increase, both at the level of the individual consumer and private enterprises such as fodder farms as well as public administration centres.

Its situation makes the amount of available biomass from agricultural and forest material very large, constant and safe, consequently different companies in the energy sector have built different energy production plants from biomass in the area.

This makes it necessary for COPISO to conduct a detailed study of the current consumer market as well as the evolution which the latter can experience over time, trying to ascertain the convenience of working alone or the construction of networks and cooperation with other industries established there.

A study of the features and quality of the agricultural raw material from the farmer partners is also recommended with the objective of trying to adjust to the maximum the blending percentages of raw materials from different sources as well as prices at which the resulting biomass should be placed on the market in order to be competitive in comparison with its homologation of its quality regarding moisture, ash content and heating value, to try to satisfy both prices and quality and supply.

2.7.2. Conclusions

COPIISO SORIA, cooperative society showed by all that is mentioned above the great interest it has to begin to work in this new business line. It considers that the special location of the cooperative is in a way an obligation to commit to this activity contributing decisively to maintain a sustainable rural development, not only in economic terms but also environmentally.

The role that COPIISO can play in the creation of a biomass logistics centre is essential both for its knowledge of the situation on the ground and for its connections which it already now has established with industries of the sector, creating synergies of great interest and benefit for the proper development of the SUCELLOG project.

We highlight the samples which the cooperative has given of its interest to diversify on this matter for a short period through its incorporation in an industry dedicated to crops and biomass production and the study of the opening of this new business line in its own facilities.

2.8. Diagnosis of UCOGAL

2.8.1. Company description

UCOGAL Soc. Coop. is a cooperative of farmers and breeders from the Province of León, with headquarters en Cabrerros del Río as main location and Veguellina de Orbigo as secondary, and the objective of marketing cereals, corn, fodder, beet, fertilizers, seeds, pesticides, fuels, and agricultural replacements in general for the benefit of its partners.

They address the full cycle, from the field to the farm, with the implementation of all systems that guarantee food security and a maximum quality of its products.

UCOGAL has 650 partners and a staff of 20 employees. Among its activities, in addition to the commercialization aforementioned, it exerts an advisory service to their member farmers, a key aspect both for the integrated productions as for the ecological and traditional productions. Moreover it's a collection point for packages in collaboration with Sigfito.

They belong to a second-degree cooperative, Agropecuaria Navarra Soc. Coop., which is in charge of the commercialization and distribution of all its products.

Since 2014 it has new facilities, in detail a dryer and a nave, whose feature is that they will use energy from biomass instead of diesel or conventional electricity. The nave will have a capacity to accommodate 40,000 tons of grain with a dryer and its corresponding cooling silos, with a drying capacity of 50 tons corn/hour.

2.8.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

UCOGAL is a logistics centre of the primary sector in the south of the Province of León, with 7 million kilos fodder, 60,000 tons cereals and 2.5 million tons fertilizers and the forecast to close the season with a volume of business of more than 16 million Euros.

With more than 650 members between its partners, 300 are under the age of 40, consequently the interests to continue the diversification of activities and the search for new niche businesses are quite important.

B. Type of biomass resources available

We find ourselves before an adequate cooperative for the development of the project that we are proposing, both by the type of raw material that could contribute to the project (corn stalk) with the production of its own partners, as well as by the available machinery for the processing of this raw material (fodder dehydrator and cereal dryer).

Its location could also prove attractive, since it is located in an adequate enclave for the reception of other types of agricultural residues from pruning of fruit trees and vineyard in areas near to its area, which are currently burned in most of the cases.

With regard to the origin of the raw material to be used, it is important to note that it, in most of the cases, would come from the remains which the farmers-breeders members, who are situated at less than 50 km from the cooperative's head office, would deliver under contract. These members would reach an agreement with the cooperative mainly regarding everything related to the delivery-collection dates, quality and logistics for the collection of the raw material residues mentioned.

Regarding the use of the pruning of fruit trees and vineyard, this would be a real opportunity for the cooperative in respect of the search for synergies with farmers that currently would not be related to the agro-industry studied.

However, and even though the cooperative currently uses organic raw material, which otherwise would not have any output type, such as power for its own dryer, the results obtained are inconsistent, consequently it is concluded that it is necessary to conduct a larger quality review of the material mentioned than the one conducted in first instance.

C. Existing equipment in the agro-industry and availability

Even though the existing dryer in the cooperative can power itself with any type of biomass, such as pellets, poplar splinters, olive pits, almond, hazelnut and pinion shells, and the new nave which has dimensions of 4,800 m² and is built on a plot of four hectares adjoining to the facilities which the company possesses in Cabrerros del Río, it would be necessary to make a large investment in the purchase of new equipments such as a pelletizer, a bagging machine or a chipper which will facilitate the pre-treatment of the raw material.

Regarding the rest of the available machinery in the cooperative with possibility of use for the possible logistics centre to be developed it is not sufficient to enter into the project without the need to engage important investments.

Why this project? In UCOGAL they assure it's due to the increase of irrigated area in the Province and the increased production by the new irrigation. And it's also due to the growing awareness to harvest the corn before December given the losses caused by our problematic winters, making the drying of the cereal essential.

D. Knowledge on the bioenergy sector

With the installation of the aforementioned dryer, it follows that currently the cooperative is an organization which consumes biomass from agricultural residues, both arable and pruning, available in its area of influence.

The main objective of the cooperative has always been to work sustainably, contributing as much as possible to the reduction of the environmental pollution as well as the reduction of costs in the drying of grain to make the crop more competitive by increasing the prices of commonly used fuels such as diesel.

Currently, UCOGAL is in full process of studying the features of the most convenient raw material to use, as well as the financial viability of the collection radius of the said raw material to turn this initiative into a cost-effective project.

E. Biomass market in the region

The existence of a 25 MW biomass plant of a well-positioned energy company, with potential and great knowledge in the sector, at close range of the cooperative studied, casts doubt on the real capacity of the cooperative to undertake a project with the size of a logistics centre such as the one proposed by the SUCELLOG project independently and with guaranteed success. The risk to suffer from the competition both in purchase prices of raw material to the farmer, as well as the profitability in logistics and procurement of fuels, makes it much more advisable to search for alliances with the facility of the new generation already installed there which ensures a economic development of the area and less risks.

2.8.3. Conclusions

At the time of the presentation of the SUCELLOG project to the cooperative UCOGAL, the interest of the latter was really high, since that was the moment that they started to enter into the development of the new initiative there, motivated consequently by the advice that if they could support the project, it would be of great value. However, as time passed, the cooperative, after making an internal analysis of its situation, considers that the real chances of success are much smaller than the expectations at the beginning.

At the present time, the cooperative refuses the proposal to become a biomass logistics centre due to lack of technical capacity and the need for a large investment, which their partners do not see with adequate guarantees. At the moment, they consider the investment made with the biomass dryer, is enough to observe the evolution of the sector and they considerer that their commitment with SUCELLOG so far has reached the maximum it can reach according to their initial diagnosis.

Thus, and even though in Urcacyl we believe in the capacity of the cooperative to develop this type of project, after the discussions held with them, it is not recommended to take part of the audit service.

2.9. Diagnosis of COCOPE Soc. Coop.

2.9.1. Company description

COCOPE is a cooperative society founded in the Peñafiel locality (Valladolid) in the year 1968. With an income above the 15 millions of Euros and more than 600 partners, it has a workforce of around 20 employees.

The cooperative develops since years a strategy based in the activity diversification. Thereby, the mentioned organization began its journey with the marketing of cereals and other services to its partners such as inputs supplier and insurance manager, between others; for later grow aromatic plants and get into the business of natural cosmetic production.

Later, in the year 2001, and with the support of 63 winemakers partners it was constituted the Pinna Fidelis winery, which is one of the higher production from the Designation of Origin Ribera del Duero.

In the last years, convinced of it important social work, and as response to one of the demands from its partners, they decided to take a huge step with the creation of one foundation (COCOPE Foundation) with the main objective of contribute to the wellbeing of the rural population of which its partners belong.

In this manner, in the year 2010 it was inaugurated a modern residence for the elderly, which based in the criteria of environmental sustainability and using mostly renewable energies, it makes COCOPE the first Spanish cooperative in having facilities of this kind, contributing in this way to the target of working under a strategy based in the activities diversification and consuming less resources for a smaller environmental impact.

2.9.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

For all the previously mentioned, the cooperative is currently an important regional reference, both because the diversity of services that offers to its partners and because the innovators that those result in the conception of the activities and in its management. A proactive vision of adaptation of the partner's exploitations to a complex globalized world, compatible with an improvement in its life quality, makes that they achieve important profits in all the sections in which it has activity.

The COCOPE cooperative is interested in keeping its business areas as a breakthrough for the life quality of its partners, besides that this contributes decisively to assure the sustainability of the place in which its exploitations are located.

For this reason, the valorization of agricultural residues from its exploitations (cereal straw, pruning from lavender and pruning from the vineyards) may imply a decisively breakthrough in the consecution of an environmental balance and its preservation for future generations.

The above statement clearly justifies the interest of the cooperative in the SUCELLOG project, since despite the lack of equipment with which carry out the residues pretreatment for its transformation into biomass, it does dispose of raw material of quality and in the sufficient amounts to be potentially self consumed in owned facilities.

B. Type of biomass resources available

As it has been previously mentioned, is important to highlight the diversity of agricultural residue material that the performed activities by the partners of the COCOPE cooperative generate. Materials as cereal straw, vine shoots from pruning vineyards or debris of lavender straw pruning, which currently suppose a waste problem for the farmer, could pose an important supply of biomass material once it was conveniently pretreated.

Currently, in all the cases, the residues at which we are referring present a marginal use without any business use or value that could pose an economic benefit for the farmer:

- Cereal Straw: it is left on the ground for providing organic matter to the soil in a natural way, but without controlling what this pose, since the quantity is very variable depending of the agricultural campaign.
- Vine shoots: burned in a controlled way.
- Debris of lavender straw pruning: burned in a controlled way.

All this resources, would come from exploitations belonging to its farmer partners located at an average distance of between 10 and 35 km, which supposes a very appropriate distance for that the transport management of this residues to the facilities of the cooperative do not be a limiting factor for their own consume in some of the facilities from the cooperative.

On the other hand, indicate that the area in which the cooperative is located, Ribera del Duero, is a wide extension of vineyards, so that a punctual lack of raw material supply by the side of the cooperative would not be a serious problem, since a previous agreement to supply vine shoots originated from a group of cooperative wineries could represent an opportunity to generate synergies.

C. Existing equipment in the agro-industry and availability

COCOPE does not currently possess any equipment necessary to carry out the raw material pretreatment coming from the agricultural residues for it conversion into biomass.

Hence, it is foreseen that the most beneficial alternative for this cooperative would be the use of the residual material coming from the exploitations of its partners, so after a minimum treatment, could be used in a model of self-consumption for the performance of some facilities which require energy.

D. Knowledge on the bioenergy sector

Currently, the COCOPE cooperative does not have any kind of knowledge regarding the agricultural biomass sector. From the cooperative it is stated that despite of it interest in the use of renewable energies, they had never considered the use of resources coming from agricultural material with marginal value, so in the case of start this activity, they would need of training, both basic (characteristics of the biomass quality: moisture, ash content and chlorine) and specific, adjusted to it particular situation.

On the contrary they state knowing other successful experiences carried out by other companies in the area, which encourage them to inquire in the possibilities of this new business line.

E. Biomass market in the region

As it has been mentioned in previous sections, the COCOPE cooperative is not currently consuming biomass in any of the equipment of its multiple facilities. Therefore, the degree of penetration and demand that the biomass has between the agro-industries of the area and the resident population is unknown, as well as the use made of it by the different public bodies (schools, institutes...) located in there. There are also unknown the characteristics of the sector as well as the state of the market dedicated to that raw material.

For this reason, in the case that they finally decide using the agricultural material as biomass resource, besides of being informed about costs and prices, they should analyze, in a detailed way, the most suitable facility (based on the use and yields) on which carry out the boilers modification for its operation from biomass, avoiding risks of purchasing non competitive materials.

2.9.3. Conclusions

Despite of the lack of equipment that the COCOPE cooperative has to carry out the agricultural residues pretreatment, it shows great interest for knowing the possibilities that its valorization and conversion in biomass material would have in its facilities using it in a self-consumption model.

To do this, it is needed to analyze and assess in a detailed manner in which location would be most appropriate and beneficial making the boilers modifications that would allow the use of this new organic fuel. The required investment for that must be studied by a technical team able of measuring the real need of it, without taking too many risks.

Therefore, before performing the self-consumption project and after developing the current diagnosis, from Urcacyl we share the need of carry out an audit study able of producing technical and economic data which help us to make decisions regarding it.

2.10. Diagnosis of L'AVELLANERA I SECCIÓ DE CRÈDIT, SCCL

2.10.1. Company description

Name: L'AVELLANERA I SECCIÓ DE CRÈDIT, SCCL

Sector: Nuts (Hazelnut and Almond)

Main activities: Nuts drying

Location: La Selva del Camp (Region: Baix Camp ; Province: Tarragona; AC: Catalonia)

Year foundation: 1986

Producers members: 312

Staff average: 23

2.10.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

Regular and main activity: nuts drying and olive oil mill

Secondary activities: pesticides and fuel commercialization to the associate producers.

Production figures (2014):

Almond (shell)	24 t
Hazelnut	1,242 t
Carob	34 t
Olive oil	86,2 t
Olive pomace	494 t

B. Type of biomass resources available

The biomass resources available within 50 km:

Resource	Main months availability
1-Pruning wood	September to February
2-Agro-industry by-products	September to Mars

C. Existing equipment in the agro-industry and availability

The cooperative has a silo dryer (brand: Jubus) and a screener. Months in which the equipment is available are the followings:

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dryer	X	X	X	X	X	X	X	X				
Screener				X	X	X	X	X				
RESOURCES												
Pruning wood	X	X							X	X	X	X
Agro-industrial R.	X	X	X						X	X	X	X

It can be observed that this equipment is not used from January to August, so it could be used for the periods when biomass resources are available as pruning wood from the area.

D. Knowledge on the bioenergy sector

The cooperative has self-consumption of biomass (250 t hazelnut shell) for heating.

They know the concept of humidity and heating power, but it seems they don't know the ash content concept.

E. Biomass market in the region

For the consumption of biomass in this region they declare that it's consumed by the agro-industries, and households. They say the consumers are in an average of distance from 10-35 km.

They know that the nature of biomass is consumed in the regions is: wood pellets, almond shell and hazelnut shell.

They don't have enough information about their quality characteristics and the prices.

The consuming high peak is in winter.

2.10.3. Conclusions

With the survey carried out it's noticed that the intention of the cooperative to become a biomass logistics centre is very limited since they are very cautious thinking about the investments needed to carry out this kind of initiatives.

They already commercialize most of their biomass production (shell of the produced nuts), or they consume it themselves for the drying and roasting of the nuts. Consequently the creation of a logistics centre would be the basis of a new business plan which cannot be laid out now.

The findings of the diagnosis shows that it would not be really appropriate to propose the cooperative for the next audit stage, especially because of a lack of technological capacity which cannot be solved without an important investment for the pelletizing and milling processes.

2.11. Diagnosis of LINYOLA AGROPECUÀRIA I SECCIÓ DE CRÈDIT, SCCL

2.11.1. Company description

Name: LINYOLA AGROPECUÀRIA I SECCIÓ DE CRÈDIT

Sector: Cereals

Main activities: cereal drying and feed production

Location: Linyola (Region: Pla d'Urgell; Province: Lleida; AC:Catalonia)

Year foundation: 1943

Associated producers: 200

Staff average: 18

2.11.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

Regular and main activity: cereal drying and feed production.

Secondary activities: pesticides, fertilizers and fuel commercialization to the associate producers.

Production figures (2013-2014 seasons):

Barley	1,600 t
Maize	36,000 t
Wheat	2,100 t
Alfalfa	9,200 t
Bovine feed	47,000 t

B. Type of biomass resources available

The biomass resources available within 50 km:

Resource	Main months availability
1-Cereal straw	June-July
2-Maize stalk	September-October
3-Pruning wood (fresh fruit)	November to January
4-Olive pruning wood	February to Mars
5- Olive pomace	January to February

(1-2): high availability from associated members and in the area of the cooperative.

(3-4-5) availability from own area and the contiguous ones (Segrià, Noguera, Urgell and Garrigues with intensive productions for these crops).

There is actually biomass providers and the price is 0.042 €/kg for cereal straw and for the corncob. The price for olive pomace is in average of 0.072 €/kg.

Other uses for these biomass products are the animal feed.

They don't have clearly defined a wood provider.

C. Existing equipment in the agro-industry and availability

The cooperative has the following equipment:

- A pelletizer (Brand. Systemgram).
- A vertical dryer (brand: LAW).
- A mill
- A screener

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pelletizer												
Dryer	X	X	X	X	X	X	X	X				
Mill												
Screener	X	X	X	X	X	X	X	X				
RESOURCES												
Cereal straw						X	X					
Maize stalk									X	X		
pruning wood	X										X	X
Olive pruning		X	X								X	X
Olive pomace	X	X										

It can be observed that the dryer and the screener are not used from January to August, so it could be partially used for the periods when biomass resources are available as cereal straw in June and July. The use of other biomass resources as maize stalk and pruning wood is obviously conditioned to the storage capacity which is now limited but could be considered if the economic revenue could be valuable.

D. Knowledge on the bioenergy sector

The cooperative do not consume biomass for heating or other purposes.

They don't have experience in solid biomass production.

They don't know which parameters have to ask for to the biomass provider.

E. Biomass market in the region

With regard the consumption of biomass in its region they declare that it's consumed by agro-industries, farms, industries, public buildings, district heating and households. They say the consumers are within 10 km.

The nature of biomass they know is consumed in the regions is:

- Low quality wood chips
- Forestry wood pellets
- Olive pits
- Grape marc
- Almond shell

They don't have enough information about their quality characteristics and the prices.

The consuming high peak is in winter.

2.11.3. Conclusions

When asked if the Linyola cooperative wants to be a biomass logistics centre, it is important to note that there is certain interest but very prudent, out of fear that the investment is not profitable.

The project, the diagnosis and the prospects involved for the sector seemed very interesting to them. There have been many comments about other similar or different industries, which use biomass, etc. But they do not use it because they do not benefit economically by two factors: the investment is really high and the fossil energy prices are more competitive at the moment. If it would be economically interesting they would make the investment in all probability.

It is true that the Linyola cooperative has technical capacity and available resources in the area. They would be especially interested to the extent that the activity would be economically viable. They are in a good financial situation and they are prepared to invest in economically and financially viable projects. But in general they repudiate the biomass sector, although they have received indirect information.

2.12. Diagnosis of AGRÀRIA DE MIRALCAMP, SCCL

2.12.1. Company description

Name: AGRÀRIA DE MIRALCAMP, SCCL

Sector: Cereals

Main activities: cereal drying

Location: Miralcamp (Region: Pla d'Urgell; Province: Lleida; AC:Catalonia)

Year foundation: 1954

Producers members: 120

Staff average: 8

2.12.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

Regular and main activity: cereal drying

Secondary activities: pesticides and fuel commercialization to the associate producers.

Production figures (2014):

Barley	1,900 t
Maize	38,800 t
Wheat	2,800 t
Rapeseed	67,4 t

B. Type of biomass resources available

The biomass resources available within 50 km:

Resource	Main months availability
1-Cereal straw	June-July
2-Maize stalk	September – October
3-Pruning wood	November to January
4-Almond shells	August to October
5-Peach seed	July to September

(1-2): high availability from associated members and the county.

(3-4-5) availability from own area and the contiguous ones (Segrià, Noguera, Urgell and Garrigues with intensive productions for these crops).

C. Existing equipment in the agro-industry and availability

The cooperative has a vertical dryer (brand: LAW). Months in which this equipment is available are the followings:

<u>EQUIPMENT</u>	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dryer		X	X	X	X		X	X				
<u>RESOURCES</u>												
Herbaceous						X	X					
Woody	X										X	X
Agro-industrial R.							X	X	X			

It can be observed that this equipment is not used from February to May and from July to August, so it could be partially used for the periods when biomass resources are available as cereal straw in July, almond shells in August and peach seed from July to August. The use of other biomass resources as maize stalk, pruning wood and peach seed it's obviously conditioned to the storage capacity which is now limited but could be considered if the economic revenue could be valuable.

D. Knowledge on the bioenergy sector

The cooperative is consuming near 500 t/year biomass to cover the demands of the dryer (olive oil seed, shell nuts, corncob) as heating fuel

They don't have experience in solid biomass production.

They know the concept of humidity and heating power, but it seems they don't know the ash content concept.

E. Biomass market in the region

Regarding the consumption of biomass in its region they declare that it's consumed in agro-industries, farms, industries, public buildings, district heating and households. They say the consumers are in an average of distance of 35-50 km.

They know the nature of biomass is consumed in the regions is:

Product	Moisture (% m bh)	Ash Content	PCI (kcal/kg)	Price (€/t)
Low quality wood chips	12		3,300	50
Forestry wood pellets	12		3,700	150
Olive pits	-	-	-	-
Grape marc	-	-	-	-
Almond shell	13		4,000	70

The consuming high peak is in winter.

2.12.3. Conclusions

During the visit for the diagnosis it was observed that the cooperative wants to become a biomass logistics centre. They are very interested on the subject.

They would be willing to be a distribution centre for biomass but they do not know or it is not clear for them if they could correctly supply to the potential biomass customers.

The technical and economic capacity is adequate to face new projects, including investments.

2.13. Diagnosis of TRANSALFALS & LA VISPESA, SCCL

2.13.1. Company description

Name: TRANSALFALS & LA VISPESA, SCCL

Cooperative grade: 2

Sector: Forage crops (alfalfa)

Main activities: alfalfa drying

Location: Bellcaire d'Urgell (Region: La Noguera; Province: Lleida; AC:Catalonia)

Year foundation: 1988

Producers members (cooperatives): 11

Staff average: 46

2.13.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

Regular and main activity: alfalfa drying

Production figures (2014):

Alfalfa	74,876 t
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B. Type of biomass resources available

The biomass resources available within 50 km:

Resource	Main months availability
1-Herbaceous	May-June
2-pruning wood	January-December

C. Existing equipment in the agro-industry and availability

The cooperative has a horizontal dryer, a pelletizer, a mill and a wood chipper. As it is shown in the following table, the pelletizer is only available on January so far. Since, they are using the pelletizer, the mill and the wood chipper for the manufacturing of wood pellets and chips for other companies this equipment is in operation throughout the year and, at least for the time being, would not be available unless Direction of the cooperative will opt for another line of business.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pelletizer												
Dryer	X											
Mill												
Wood chipper												
RESOURCES												
Herbaceous					X	X						
Woody	X	X	X	X	X	X	X	X	X	X	X	X

D. Knowledge on the bioenergy sector

The cooperative is consuming for heating fuel near 500 t of biomass for the dryer (almond shell).

They have experience in solid biomass production: sawdust, wood chips along the year.

They know only the concept of heating power, but it seems they don't know the ash content concept.

E. Biomass market in the region

With regard to the consumption of biomass in his region they declare that is consumed in agro-industries, farms, industries, public buildings, district heating and households. They say the consumers are in an average from 10-35 km.

The nature of biomass they know is consumed in the regions is:

Product	Moisture (%) m bh)	Price (€/t)
Sawdust	91	90
Pellets	91	160

The consuming high peak is in winter.

2.13.3. Conclusions

With reference to the question if the cooperative wants to be a biomass logistics centre, it can said that the cooperative is very interested in the subject.

There is notable technical capacity, with equipment such as drier, pelletizer, mills and wood chippers. However it does not seem that they have great knowledge of the biomass market, although they have been producing it and have the availability of sufficient biomass, and they are probably in a good financial situation and therefore it seemed consistent to assess the appropriateness of opting for the next audit level.

2.14. Diagnosis of LA SAGRADA FAMILIA, Soc. Coop.

2.14.1. Company description

The Cooperative LA SAGRADA FAMILIA was founded in September 1965 with 70 initial partners in the village of Zurbarán (Badajoz) and currently has 130 farmer partners dedicated to the production of tomato, rice, corn, fruits and olives.

The main activity of the cooperative is the procurement and commercialization of its partners' products as well as providing them the services which the farmer requires for an effective development of its activity (sale of seeds, pesticides, diesel, hardware, storages, management and administration...).

2.14.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The industrial activity of the Cooperative in question is different according to the product concerned:

- Tomato for industry. Procurement of the crops with the downstream industries and collection management and management of the deliveries to the industry.
- Rice. Organization of the rice harvest, drying process for the correct storage of the rice and commercialization of the harvest.
- Corn. Organization of the corn harvest, drying process for the correct storage of the corn and commercialization of the harvest.
- Olive. Reception, milling for the oil production and its commercialization.

With regard to the biomass production currently it does not have any industrial activity since it is not part of their production process.

B. Type of biomass resources available

The Cooperative Society LA SAGRADA FAMILIA would rely on different funding sources for the biomass production.

In summary form it would be the following:

- Remains of the drying processes. This is the residual plant material from the drying processes of rice and corn.
- Remains of the cereal, rice and corn stalk harvest. These are the plant residues for which it is necessary to have a system for management and collection from the field.
- Olive tree pruning
- By-products of mills.

Except the remains of the drying processes and those from the mills which are property of the agro-industry, the rest of the available resources is property of the cooperatives' partners and is confined to a maximum radius of 10 km.

C. Existing equipment in the agro-industry and availability

Because of the fact that the activity of the Cooperative LA SAGRADA FAMILIA is not the biomass production it does not have equipment for this purpose.

In contrast, what it does have and intends to optimize are the facilities for the drying of corn and rice, i.e. a vertical dryer of the type silo with control equipments which allow a perfect control of the drying process.

Moreover it has storage facilities for bulk goods that would be compatible with this new activity.

In the case of reusing the facilities mentioned for the biomass production, the possibility to acquire the necessary equipments for the management of the resources which can contribute viability to this business line would be evaluated.

D. Knowledge on the bioenergy sector

The industry does not consume biomass because of its characteristics and its production and furthermore, they are unaware of the detailed functioning of the bioenergy market.

E. Biomass market in the region

In the cooperative they know that there is no established biomass market in the region although they know they could have different biomass types if necessary.

Moreover they know that the percentage of companies that use biomass as fuel is very low currently and mainly use olive pits and chips of various origins and qualities.

2.14.3. Conclusions

Despite that the interest of the Cooperative LA SAGRADA FAMILIA to become a logistics centre is high because they see that in the medium term the demand can increase exponentially, their lack of experience and knowledge of the sector makes them quite careful when making investments and opening this new business line.

In principle the great advantage which it has is the large availability of resources for the biomass production, in a really close and cheap environment since it is the property of its partners.

However, there is no efficient collection system for the majority of these resources and this would be the first step, i.e. raising awareness amongst their partners and an effective work system.

The analysis of their situation regarding the possibility to devote to the biomass production could make them very useful in the medium term when they will clarify vital aspects such as those commented.

2.15. Diagnosis of TABACOEX, Soc. Coop.

2.15.1. Company description

The second-degree Cooperative Society TABACOEX is located in the municipality of Rosalejo (Cáceres) and consists of 8 first-degree cooperatives whose main activity is the tobacco production.

The activity of TABACOEX in this regard focuses on the service to its partner cooperatives and to its members. Within these services they highlight the procurement and commercialization of the cured tobacco of its partners with the first processors and the cure of green tobacco in a common plant situated in the facilities of the cooperative.

This plant is formed by a battery of large capacity dryers where the green tobacco is entered and, through hot air currents the moisture will be removed in the most appropriate way to optimize the performance and the quality of the final product.

The boiler system for the production of this hot air uses biomass as fuel, fundamentally olive pits and wood chips.

2.15.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

With small amounts of fresh fruit, tomato for industry and some other vegetable, the main activity is tobacco-related.

By the characteristics of the battery of hot air dryers which it has it is considered that it might be a good opportunity to reuse it during their idle period of 8 months per year to try to allocate it to the biomass production both for self-consumption and for commercialization.

B. Type of biomass resources available

TABACOEX, a second-degree Cooperative Society would count on different possible funding sources for the biomass production.

In summary form it would be the following:

- Remains of the drying processes. This is the tobacco that by breakage, low quality, etc. does not end up being packaged for its commercialization. It is an easy combustible dry by-product which could even be stored awhile before its direct use in boilers.
- Remains of the tobacco harvest. These are the green residues to collect from the field, with very high moisture content, both in the trunk of the plants and in the leaves which are left without harvesting.
- Forest material. The partners do not rely on this type of raw material in this case but, if they decide to try to work with it, there is close product availability.
- Maize straw and corn stalk. The practice of crop rotation and the diversification allow having this crop in relatively important amounts.

This resource type is the property of the partners of the cooperative and its availability is confined to a maximum radius of 15 km.

C. Existing equipment in the agro-industry and availability

Because of the fact that the activity of the second-degree Cooperative Society TABACOEX is not the biomass production it does not have equipment for this purpose.

In contrast, what it does have and intends to optimize with the facilities for the drying of tobacco, i.e. about 60 controlled-atmosphere and hot air large capacity dryers with control equipments which allow adapting the moisture of the product, the flow of air, the internal temperature, the ventilation, etc. of the equipments.

Moreover it possesses storage facilities for bulk goods.

In the case of reusing the facilities mentioned for the biomass production the possibility to acquire the necessary equipments for the management, fundamentally, of wood chips which is the most consumed product in the area, would be evaluated.

D. Knowledge on the bioenergy sector

The industry is clearly a biomass consumer because of its characteristics and its production.

They are unaware of the detailed functioning of the bioenergy market but they do have detailed knowledge about the characteristics which mark the quality of the biomass that they use and need for the drying of the tobacco, that fundamentally is about olive pits and wood chips with different qualities of moisture, ash and heating value.

Until the common plant for the cure of tobacco was implemented only some years ago, they used diesel or propane gas as fuel in the partners' holdings, with much more costs, residues and danger in handling.

E. Biomass market in the region

The tobacco sector in which the cooperative is immersed is currently the reference of biomass consumption in the region.

More than 75% of the tobacco produced in the region, which is just over 30 million kilograms is dried using wood chips and olive pits as fuel. They use 1 kilogram of biomass for each kilogram of dry produced tobacco.

In this regard, despite not having a market for the use of biomass, in the tobacco-growing area it is certain that there is a large wood chips availability of many different qualities and prices.

2.15.3. Conclusions

Potentially there could be a gap in this offer if the logistics centre is implemented in the cooperative both for self-consumption and to compete in a market close to the manufacturing area gaining clients of the same tobacco sector and nearby industries. Moving away from this area might be not really feasible.

They have great interest in optimizing the use of their facilities since there they have an idle period of more than 7 months but they would need to analyze the possibility of the treatment of tobacco residues in the field since they have high moisture content which can increase the drying costs.

They are also interested in analyzing the possibility of producing chips of competitive and acceptable quality as a solution maybe more feasible but with the drawback that they need to make the invest necessary for this purpose.

The lack of experience in the biomass production is a drawback but they count on the advantage of being high volume consumers which makes them connoisseurs of the characteristics of certain biomass types.

2.16. Diagnosis of TROIL VEGAS ALTAS, Soc. Coop.

2.16.1. Company description

TROIL VEGAS ALTAS SC is a further degree cooperative dedicated to the transformation of the by-products of oil mill, born from the initiative of the olive oil sector of Agro-food Cooperatives Extremadura.

It was founded in 1999. He began collecting “alperujo” the campaign 2001 – 2002, and began operation in August 2002.

TROIL VEGAS ALTAS SC has a storage capacity of 44,500 t of “alperujo” in three rafts, two of concrete and a raft of land waterproofed. The maximum annual processing capacity is 60,000 t, and is situated on a plot of 100,000 m² of the municipality of Valdetorres (Badajoz), of which 45,000 m² are urbanized.

The initial “alperujo” mass of approximately with 65-70% moisture content poured by gravity in the rafts. Hence, the mass is passed through a pulp-pit separating to be extracted about half of the wet pit of the “alperujo” (about 8% of the treated mass).

After the separation, deboning “alperujo” passes to an olive oil mill in which is processed to extract olive pomace oil. The milling capacity of the mill is about 14,500 kg / h.

The olive oil mill works in 3 phases and olive pomace oil, vegetable water and pomace is obtained with approximately 63% humidity.

In addition, TROIL VEGAS ALTAS SC has a cogeneration plant consisting of three generators powered by natural gas. The power generation capacity is 4.3 MWe hour. Hence, TROIL VEGAS ALTAS SC consumes its own energy and the surplus generated is exported to the grid.

2.16.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

TROIL VEGAS ALTAS, SC is an industry cooperative joint working exclusively in the olive sector, specifically olive oil since it is responsible for the management and enhancement of products and waste of its olive oil mills member.

Because of this, and the activity and processes detailed in the previous point is an industry with a perfectly adequate profile for becoming a biomass logistic center since they are engaged in this type of production and are possessing perfectly suited equipment for it or easily adaptable equipment for a variety of very important products.

B. Type of biomass resources available

Currently, because of its location and its activity the cooperative has access to a huge amount of resources likely to be used for the production of biomass.

The main raw material is from the olive oil mills of its members, i.e. “alpechines” of the production of olive oil.

Moreover, within a huge radius, there are other types of raw materials subject to revaluation and use for the production of biomass such as:

- Olive pruning residues (mainly), vines and fruit trees.
- Herbaceous residues of cereals such as wheat straw, corn stalk, remainders tomato plants, etc.
- Possibility of obtaining nearby forest resources.
- Other waste such as cork dust and remainders of drying corn and rice are also usable.

All these resources are available in the immediate post-harvest periods in the case of corn and tomato is in October and for winter cereals in June/July. Prunings and agro-industrial residues are more concentrated in the autumn/winter.

All these residues are owned by associated partners of the entities that make up TROIL as well as the own industries that produce it. And there are a lot of close associative entities which could collaborate for waste management. The logistics for the agro-industrial waste would not be a problem.

C. Existing equipment in the agro-industry and availability

For its normal industrial activity, TROIL VEGAS ALTAS SC has adequate and efficient equipment for everything related to the management of residues from olive oil mills. It has a horizontal dryer (Tromel type), a mill, storage rafts, evaporation tower, bagger, etc.

It also has a series of complementary equipment for such activities as a pelletizer, screener equipment, scales and even a greenhouse for solar drying product

With a view to the diversification of industrial activity of the company, it is scheduled acquiring the necessary processing equipment for the production of forestry chips, etc. such as a chipper, screener, sorting, etc

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pelletizer								X	X			
Dryer								X	X	X		
Mill												
RESOURCES												
Herbaceous						X			X	X		
Woody	X	X									X	X
Agro-industrial Residues	X	X	X	X	X	X			X	X	X	X

D. Knowledge on the bioenergy sector

The industry is not consuming biomass due to its characteristics but consumes part of the electricity produced in cogeneration.

On the contrary, he has a wide experience in the revaluation of olive oil mills waste to obtain, among other products, solid biomass (olive pit that we use to sell) which makes them having a good knowledge of the features that have their products mainly based on the heating value, ash content, moisture content and density.

E. Biomass market in the region

In the region there is no market to the use of biomass due to the low number of companies that use it so far.

Certainly, the number of consumers is increasing but slowly and in a much localized way in some sectors according to their necessities. The sector more focused on the use of biomass is the tobacco in northern Cáceres. They are alternating the use of the olive pit with wood chips. There are also olive oil mills, wineries, breeding farms and certain public buildings of new creation that are also using biomass.

There is a very important potential market where over time a lot of farming industries, public buildings and private consumers will be incorporated taking advantage of reduced energy costs resulting from their consumption.

Summarizing, in the region most of the biomass consumed is olive pits with average prices of 125 €/t and with the following quality parameters: around 8% moisture, 1% of ash content or heating value of 4,200 kcal/kg). The households prefer forest biomass with 15-20% moisture content, 2-4% of ash content and heating value near to 3,400 kcal/kg.

Regarding the periods of biomass demand, agro-industries are mainly demanding it during the production periods of each sector (tobacco, oil, wine, etc.). While in the households and in the farms the consumption is along all over the year, increasing the intensity in autumn-winter.

In addition to those mentioned above, some public buildings could be interested in using this type of fuel.

The intention of TROIL is to address a thorough analysis of product prices of solid biomass as well as the demands and types of consumers in order to balance price and quality characteristics.

The production of biomass from quality olive pits, at first sight, appears to be profitable due to lower acquisition costs. On the contrary, the production of chips should be deeply assessed due to the large number of types and qualities that could be considered and its biggest acquisition price also.

2.16.3. Conclusions

The interest of TROIL VEGAS ALTAS, Soc. Coop in this project is, since its beginnings, very high and remains at the same position. It is a company created to manage olive oil mills residues and by-products of their member cooperatives with two key objectives, to solve an environmental problem for members (agro-industries) avoiding individual management of it, but also, converting this residues and by-products into raw material for the production of various types of energy, mainly biomass. Both, the good working of the company in a collaborative way with their members and the little previous experience in the management and production of biomass are key elements to increase their interest in the goal of this project. Moreover they have set their sights on diversifying production by incorporating, in a more or less short time, equipment related to the treatment of woody material for biomass production.

After the diagnosis through the check list, the conversations with the cooperative, our full confidence to the capacity and reliability of them and the usual collaborative way of working with us, it could be concluded that this agro-industry could be a good candidate to be audited.

2.17. Diagnosis of VIÑAOLIVA, Soc. Coop.

2.17.1. Company description

The VIÑAOLIVA group is a second-degree Cooperative Society created in Almendralejo in 1998. It consists of 25 primary cooperatives, i.e. first-degree, which elaborate and commercialize the product resulting from the work of around 8,300 farmers which cultivate more than 78,000 hectares of vine and olive grove.

Among its partners they rely on 15 wine cellars, 9 mills and 12 olive presses.

The management of winegrowing by-products or alcoholics is an own section of the Cooperative. It is a recently created plant (2009) and it represents a further step in the policy of diversification and consolidation undertaken by the Cooperative in the late 90's.

It uses exclusively and for the time being the raw materials (by-products) of the associate cooperatives in this way providing a complementary service about the use of products and by-products elaborated in the winemaking.

The revalorized products after the different manufacturing and extraction processes are:

- Spirits: Resulting from the distillation of selected wines with a graduation.
- Neutral alcohols: Obtained by distillation and rectification of wines and wine by-products with a graduation >96%Vol. aimed at the elaboration of spirits.
- Distillate of vinous origin. Obtained exclusively by the distillation of by-products of winemaking with the graduation of 92.5% Vol. and destined for the market of industrial or energy use.
- Calcium tartrate: Obtained by the precipitation of the existing natural tartrate in marc's and wine lees, of high quality with a concentration >50% A.T. and its grading.
- Grape seed: Obtained by the separation and drying at mild temperatures of the grape marc for silage, allowing to keep the qualities of a product which is destined for the production of oil intact.
- Biomass: Product resulting from the separation, drying and sifting of grape marc, destined for a use as fuel for specific boilers (Moisture <10%). The amount generated of this product is not very important. The self-consumption of the industry and also some related companies consumption is the normal destination for this biomass at this moment.

Crude compost: Product resulting from the valuation and recycling of the vinous residues generated in the plant, used as compost on land with demand for organic matter.

2.17.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The section management of by-products of de Cooperative Society VIÑAOLIVA exclusively works in the wine distillation and distillation of by-products of the wineries and the subsequent treatment and revaluation of the residues of this treatment to obtain the range of products cited above.

The distillery is an industry with experience in the management of by-products and the biomass production which can adapt itself perfectly to become a biomass logistics centre. On the one hand it has great experience in the management of by-products; they have work lines adaptable to other production types and they have the intention to diversify processes and productions related to biomass.

B. Type of biomass resources available

The management of by-products of VIÑAOLIVA is situated in the heart of Comarca de Tierra de Barros, in the municipality of Almendralejo (Badajoz) about 4 km from the town centre and therefore physically surrounded by thousands of hectares of woody crops, almost exclusively vine and olive grove, both production system in dry land and in irrigated land.

Currently it relies only on the contribution of residues and own agricultural by-products of partners' wineries, i.e., wine pomace without pits, pulp, stalk and seeds from the grapes after the pressing in the production process of the musts and wines. With these by-products, which become industrial raw material, everything detailed in the beginning is produced. They have a large amount of this raw material in a radius of about 20 km although some of the partner cooperatives are located at maximum 50 km of the industry.

Furthermore the industry would have other types of agricultural residues directly available from its partners such as from the mills, i.e. alperujo and vegetable waters of the olive oil production. This type of raw material is located in areas similar to those from wineries.

Moreover, within a radius that can be made as wide as desired from the centre of the industry, it relies on other types of raw material subjected to revaluation and use to collect the biomass such as:

The other resource base for the biomass production that would be feasible to obtain by distances and available amounts are the olive grove and vineyard pruning residues and would pass by adapting the facilities for the collection and treatment of this type of materials.

Both the agricultural and woody residues are property of the cooperatives and the partners of VIÑAOLIVA and its availability depend on the industrial processes and the work in the field.

The residues of wineries would be available from August to October and are stored to distribute its management in the following months.

The residues from the mills are produced in autumn/winter and could be treated during the following months.

The woody residues from pruning are produced from November to February and their storage and management are also possible.

In the case of herbaceous residues from cereals (corn and wheat straw, corn stover, etc.) or from forest resources the availability would be lower and more costly because of the typology and distances to the production areas.

C. Existing equipment in the agro-industry and availability

For its normal industrial activity, VIÑAOLIVA’s section management of by-products has adequate and efficient facilities and equipments for everything related to the management of residues from the wineries.

In this way it has a horizontal rotary dryer, an evaporation tower, and rafts of storage and stalks and seed separators.

With a view to the diversification of the industrial activity of the company the acquisition of necessary equipment would be planned for the treatment of woody material to produce chips and pellets as well as machinery for the treatment of the alperujo of mills.

EQUIPMENT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Peletizer						X	X	X				
RESOURCES												
Vineyard pruning	X	X									X	X
Olive pruning	X	X									X	X
Olive pomace	X	X								X	X	X
Grape marc								X	X	X		

A priori, the use of the dryer during the month of August for the drying of grape marc, temporarily and technically would be viable

D. Knowledge on the bioenergy sector

The industry does not consume biomass; instead, it has much experience in the revaluation of wineries residues for the collection, among other products, of solid biomass which makes them connoisseurs of the characteristics that their products have mainly based on the heating value, ash content and moisture content.

E. Biomass market in the region

Due to the fact that the main activity of the cooperative in this regard is not the biomass production and commercialization, the current knowledge about the market is not very wide.

It is clear that there is no biomass market in the region fundamentally because of the low demand which is made occasionally and for certain products so far.

There is a very important possible market which will become reality as the companies are incorporated taking advantage of the reduction of energy costs associated with its consumption and with characteristics, above all, economically affordable.

The consumers than can be incorporated giving structure and basis to this market can go from particular agro-industries (including VIÑAOLIVA's partner entities) and cattle ranches to intensive production.

Currently the consumption of biomass in the region focuses on olive pits, with different qualities, and on medium and low-quality wood chips.

2.17.3. Conclusions

The section of the Cooperative Society VIÑAOLIVA dedicated to the distillation of by-products and wines manages about 20 million kilograms of wineries marc's for the collection of a wide variety of products.

The interest of the entity to redirect the destination of these products towards energy uses as well as diversify their lines and productions is really high since they are framed in a very concrete and directed sector which does not allow them to manoeuvre much in the market which is the one that looks for a company of this dimension.

In this regard they rely on the advantage that it is an industrial section of the cooperative which was almost exclusively created for the management of agricultural by-products from partner wineries to valorise them and to look for added value to the resulting range of products and at once to resolve the management problem of its partner cooperative wineries.

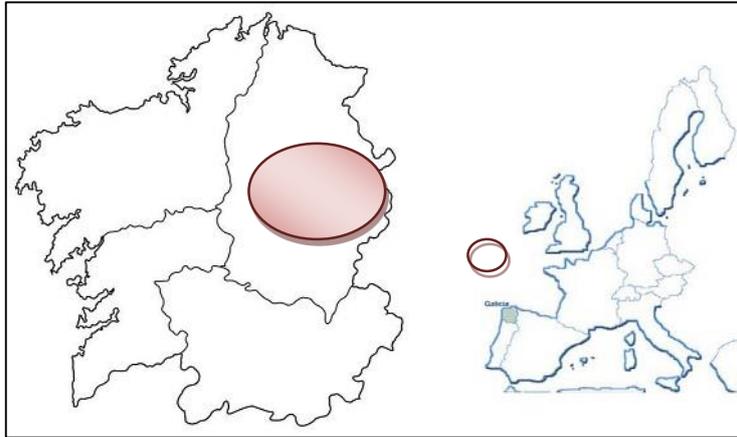
In the interviews and contacts held with them we noted the interest to increase the diversity of productions, to make the necessary investments to optimize facilities and to take advantage of the strategic situation of the proximity to other type of raw material for the biomass production. In addition to this, they rely on experience, facilities and capacity to this end.

2.18. Diagnosis of AIRA, Soc. Coop. Galega

2.18.1. Company description

AIRA, Soc. Coop. Galega is a second-grade cooperative with the activity of manufacturing compound feeds for animal feed, mainly dairy cattle from the associate

holdings. The cooperative was created in 2005 as a result of the merger of seven supply cooperatives situated in the south centre of the province Lugo. The plant is located in Taboada (Lugo).



2.18.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

AIRA, Soc. Coop., is owner of a compound feed plant installed in 2008. This plant has the machinery necessary to produce different types of compound feeds with a receiving system for raw materials, metallic silos for the storage of raw materials (corn, barley, pulps, etc.), a mill, a mixer, granulation and grinding systems, the delivery of the finished product both bagged and in bulk, and other facilities necessary in order to carry out the production activity of manufacturing compound feeds.

The activity of producing feeds keeps the plant busy throughout the year, working two daily shifts.

B. Type of biomass resources available

The agricultural non-forest biomass of AIRA, Soc. Coop. Galega, is minimised to some grain consignments in bad condition (mycotoxins problem by increasing its moisture content during the transport from the port) or to the manufacture of poorly formed feeds by mistake. The first-mentioned is returned to the supplier and the poorly formed feeds can be recycled in the own plant provided that the feeds are not medicated. In this case they are sent to the incineration plant for solid urban waste.

The cooperative repudiates the production and commercialization cost of biomass.

There is a forest biomass producer/marketer in Palas de Rei, at about 30 km, which supplies briquettes and pellets for domestic boilers.

C. Existing equipment in the agro-industry and availability

The feed mill has machinery which could be used for the treatment of biomass (pelletizer, mill) that are adapted to the processing of different raw materials.

A possible cessation of the compound feeds production causes temporary difficulties since the plant fully operates with double shifts throughout the year.

D. Knowledge on the bioenergy sector

The cooperative does not produce nor consume biomass. It has also no experience in working with this product.

The interviewee says that he knows that it is important to know the moisture content of the biomass, repudiating other minimum quality characteristics of the biomass or other biofuels.

E. Biomass market in the region

In Aira, Soc. Coop. Galega's area of influence the biomass market is rather weak. Only small amounts are commercialized for households in the urban area. The cooperative repudiates its price.

The households in the rural area are self-sufficient with biomass in the form of firewood and/or chips to be used in the kitchen, for Domestic Hot Water (DHW) production and for the heating of the house, in the communal mounts.

The cattle farms (DHW) and pig/poultry farms (heating) in the region can be potential consumers of biomass.

It can be interesting to conduct a detailed study of the demand of potential biomass consumers in the urban area: qualities, marketing channels, costs

2.18.1. Conclusions

The cooperative AIRA, Soc. Coop. Galega, shows little concern in this project for the production/commercialization of non-forest biomass. The cooperative's main activity is the manufacture of compound feeds, leaving the distribution logistics and storage to the associate cooperatives. It has very little knowledge about the biomass production and no experience in this activity.

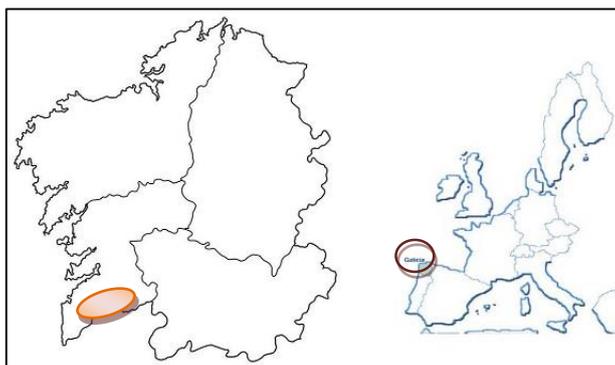
After meetings held with the cooperative and after conducting the diagnostic completing the check table, in the interview, they showed very little intention to deepen the project, maybe because of the lack of knowledge about the subject or because their external financing capacity is conditional on the amortisation payments of the contracted debt in the facility of this plant.

Another drawback is the possible delay to begin the prior feasibility study at the beginning given that, as we are talking about a second-grade cooperative, the possible initiatives of financial investments have to be approved by all of the cooperatives integrated in AIRA, Soc. Coop. Galega

2.19. Diagnosis of EIDOSELA, Soc. Coop. Galega

2.19.1. Company description

EIDOSELA, Soc. Coop. Galega, is a cooperative with a winery for the production and bottling of wines, installed ten years ago. It has an annual production of 3,000 hl. It is located in Arbo, Condado de Tea, south of the province Pontevedra.



The winery is included in the QWpsr (Quality Wines Produced in Specified Regions) "Rías Baixas" and in the region there are many small wineries.

2.19.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The winery of EIDOSELA, Soc. Coop. Galega, has sufficient machinery and equipment to handle up to 500,000 kg of grapes: acceptance hopper, stemmer, press, fermentation tanks and a bottling line, everything in stainless steel.

Currently the cooperative handles around 300.000 kg of grape to produce around 2.500 hl of wine, and commercializes bottles under the designation of origin "Rías Baixas".

B. Type of biomass resources available

The cooperative produces annually around 90,000 kg of bagasse to be distilled in order to obtain spirits. The bagasse is produced during the harvest season (September-October) and is sent to the distillation. The pomace is obtained in January-February, after distillation and is used as organic fertilizer in the plots of the winegrowers. Other residues of this industry are stem and lees, which are also used as organic fertilizer, as well as the remains of pruning from vineyards.

The cooperative is not aware of existing production and storage centres of biomass in the area. It is also not aware of the costs related to this production.

C. Existing equipment in the agro-industry and availability

The winery has the machinery needed to produce and bottle wines. It does not have machinery that can be used for the processing of biomass.

D. Knowledge on the bioenergy sector

EIDOSELA, Soc. Coop. Galega, does not produce nor consume biomass, and has no knowledge about the biomass features that should be required in order to compare the cost of the different types of biomass.

Until now they have not considered the possibility to enter into the biomass market. In the area there is no logistical chain to harvest or collect the agricultural residues (remains of pruning) from the plots of the cooperative's partners or other wineries. They could consider the possibility to examine this new line of business.

E. Biomass market in the region

In the region of EIDOSELA Soc. Coop. Galega the biomass market is rather weak. Only small amounts are commercialized for households in the urban area. The cooperative repudiates its price.

2.19.3. Conclusions

The cooperative EIDOSELA, Soc. Coop. Galega, shows little concern in this project for the production/commercialization of non-forest biomass, maybe because of the lack of knowledge about the subject. The cooperative's main activity is the production and bottling of wines. It has very little knowledge and no experience in this processing of biomass activity.

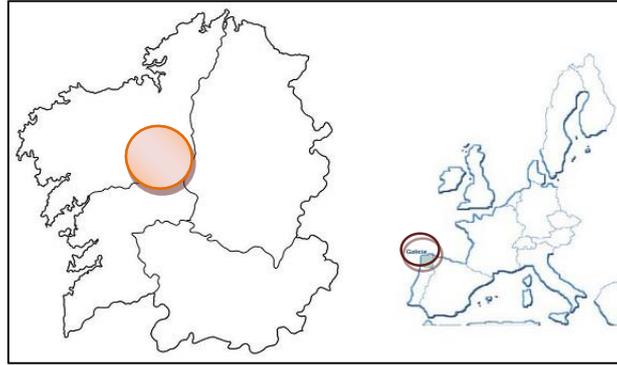
After meetings held with the cooperative and after conducting the diagnostic completing the check table, in the interview they showed very little intention to deepen the project, to see how far the cooperative can go, maybe because of the lack of knowledge about the subject. Provided that it does not incur costs for the cooperative, the management could collaborate in the feasibility study of the idea and, afterwards, decide the actions to be taken.

We work closely together with this cooperative on many actions and we trust in its operational capacity. It may be a good candidate to conduct the feasibility study for the implementation of the project.

2.20. Diagnosis of MELISANTO, Soc. Coop. Galega

2.20.1. Company description

MELISANTO, Soc. Coop. Galega, is a cooperative which has a compound feed plant installed more than twenty years ago even though it has improved over the years. It is located in Melide, south of the province La Coruña.



The cooperative also has a shopping centre with a covered surface of almost 1,000 m², where it commercializes the products and inputs necessary in the livestock farms of their partners. Among other things, it distributes hardware material, veterinary products and pesticides, work clothes, seeds and gardening products, feedstuff for domestic animals, etc.

The proposal to commercialize biomass could be an activity to be examined.

2.20.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The plant of MELISANTO, Soc. Coop. Galega, has the machinery necessary to produce different types of compound feeds and mixtures, with an output system for bulk feedstuffs, metallic silos for the storage of raw materials, a mill, a mixer and a grinding system and other facilities necessary to carry out the production activity.

B. Type of biomass resources available

Non-forest biomass is scarce in this cooperative's area of influence. During the process of manufacturing the feeds, around 2,000 t/year of poorly formed feeds can be produced (0.5% of the annual production). The poorly formed feeds (1,500 t) can be recycled. The rest, because they carry medicated components, cannot be recycled and is transported to the incineration plant for solid urban waste.

The cooperative repudiates the existence of production plants of non-forest biomass in the region. Therefore they repudiate the production/marketing cost of this biomass.

There is a forest biomass producer/marketer in Palas de Rei (Lugo), at around 20 km, which supplies briquettes and pellets for domestic boilers.

C. Existing equipment in the agro-industry and availability

The feed mill is equipped with the machinery and equipment that could be used for the preparation of biomass.

There is no possibility of stopping the feed production since the plant operates throughout the year.

D. Knowledge on the bioenergy sector

The cooperative MELISANTO, Soc. Coop. Galega, does not produce nor consume biomass. Their only experience with biomass is minimised to their commercial works of providing the partners with small consignments of biomass in briquettes for sporadic consumption.

The manager of the cooperative repudiates the different qualities of biomass that influence its final cost.

E. Biomass market in the region

The biomass market is slowly developing in the region of Melide. Small amounts are commercialized for households in the urban area in the form of forest wood pellets.

There is a significant consumption of forest biomass, in the form of firewood and/or chips, to be used in the kitchen, for Domestic Hot Water (DHW) production and for the heating of the house near the livestock farm. This firewood comes from the communal mounts.

The cattle farms are potential consumers of biomass, mainly for the DHW production to wash the milking equipment.

2.20.3. Conclusions

Although when conducting the diagnostic interview and the check table the management repudiated the production/marketing process of biomass, there could be certain commercial interest in the project.

Provided that it does not incur costs for the cooperative, the management could collaborate in the feasibility study of the idea and, afterwards, decide the actions to be taken.

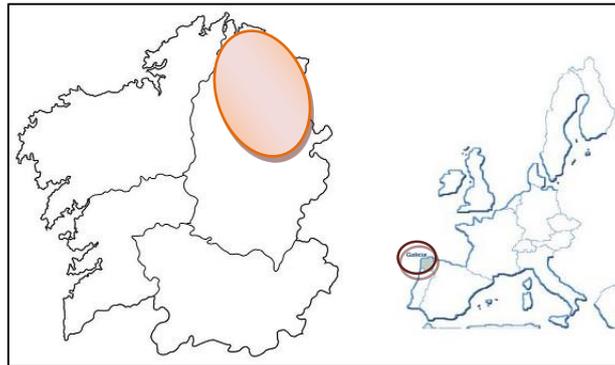
The possibility to create a space in order to commercialize biomass should also be studied, depending on the investment required.

We work closely together with this cooperative on many actions and we trust in its operational capacity. It may be a good candidate to conduct a feasibility study.

2.21. Diagnosis of OS IRMANDIÑOS, Soc. Coop. Galega

2.21.1. Company description

OS IRMANDIÑOS, Soc. Coop. Galega is a cooperative which has a compound feed plant installed more than twenty years ago and it has even been improved over the years. It is located in Ribadeo, north of the province Lugo.



The cooperative also has a shopping centre with a covered surface of almost 2,500 m², where it commercializes the necessary products and inputs for the livestock farms of its partners. Among other things, it distributes hardware material, veterinary products and pesticides, work clothes, seeds and gardening products, feedstuff for domestic animals, etc.

The proposal to commercialize biomass could be an activity to be examined.

2.21.2. General overview of the diagnosis

A. General information about their regular activity as agro-industry

The plant of OS IRMANDIÑOS, Soc. Coop. Galega has the necessary machinery to produce different types of compound feeds and mixtures, with an output system for bulk feedstuffs, metallic silos for the storage of raw materials, a mill, a mixer, pelletizing and grinding systems and other facilities necessary in order to carry out the production activity.

B. Type of biomass resources available

The cooperative hardly has access to agricultural biomass. Throughout the year they can produce 3,000 tons of poorly formed feeds (0.5% of the annual production). The poorly formed feeds (2,000 tons) can be recycled. The rest is transported to the incineration plant for solid urban waste.

The cooperative repudiates the existence of production plants of non-forest biomass in the region. Therefore they repudiate the production cost of this biomass.

At regional level they could make use of the discards of the forestry production destined for the pulp mill of Navia (Asturias).

C. Existing equipment in the agro-industry and availability

The feed mill is equipped with the machinery and equipment (mill, pelletizer) that could be used for the preparation of biomass.

There is no possibility of stopping the feed production since the plant operates throughout the year.

D. Knowledge on the bioenergy sector

The cooperative OS IRMANDIÑOS, Soc. Coop. Galega does not produce nor consume biomass. Its only experience with biomass is minimised to its commercial works of providing the partners with small consignments of biomass in briquettes for sporadic consumption.

The manager of the cooperative knows that, when choosing one biomass or another, there are some features that are important in order to compare the final price: the moisture and heating value, depending on the quality of the wood used. These characteristics are reflected in the price of the product.

E. Biomass market in the region

In OS IRMANDIÑOS, Soc. Coop. Galega area of influence, the biomass market is rather weak. Small amounts are commercialized for households in the urban area in pellet form from forest wood. The cooperative calculates an average price of 250 €/t, for its commercial distribution.

The households in the rural area that use biomass in the form of firewood and/or chips to be used in the kitchen, for Domestic Hot Water (DHW) production and for the heating of the house, are self-sufficient in the communal mounts.

The cattle farms (DHW) in the region can be potential consumers of biomass, mainly for DHW production to wash the milking equipment. It can also be used in the house near the farm for DHW and heating.

2.21.3. Conclusions

It observed a certain commercial interest in the topic during the conversations with the cooperative's management conducted since the launching of the project.

When conducting the diagnostic interview and the check table, it seems that there is certain commercial interest in the project. The manager should study the possibility to create a space in order to commercialize biomass depending on the investment required. He could study the feasibility of the idea and, afterwards, decide the actions to be taken.

We work closely together with this cooperative on many actions and we trust in its operational capacity. It may be a good candidate to conduct the feasibility study.

3. Companies audited in Spain

3.1. Auditing study of C. A. SAN MIGUEL DE FUENTES DE EBRO

3.1.1. Company description

The Agrarian Cooperative “SAN MIGUEL DE FUENTES DE EBRO” is a cooperative which currently gathers 496 members. The territorial scope of the Cooperative covers the populations of Fuentes de Ebro, Rodén, Mediana de Aragón, El Burgo de Ebro and Osera.

The cooperative is mainly engaged in the dehydration and commercialization of fodders, and in the drying of corn and the commercialization of several types of cereal. The cooperative’s facilities have 11 hectares of land with buildings and threshing floors, sufficient for the storage of all the products that are manufactured and commercialized. In recent years, they have expanded the facilities with the construction of several cells for the storage of fertilizers and buildings for the deposit of dehydrated bales.

From its foundation in 1964, the Cooperative has a fodder dehydration facility for the manufacturing of pellets for animal feeding. Later, in 2010, a dehydration line for fodder in bale format was launched. Furthermore, it owns a dryer whose drying capacity is 15 t/h, for processing corn since it is a very important crop in the area of Fuentes de Ebro.

Currently they do not work with biomass for their drying lines, since they have a installation running on natural gas. Although they do not work and have no experience with biomass, they are very interested in evaluating their possibilities as biomass logistic centre since they have a great potential of resources from agricultural residues, such as the straw of different winter cereals, corn stalk and corn cob. Additionally they have a chipping, drying, mill and pelletizing line that is importantly underused due to the manufacturing costs.

The Cooperativa Agraria SAN MIGUEL DE FUENTES DE EBRO, is located in Ctra. N-232, km 209,100 Fuentes de Ebro, Zaragoza. (Figure 1).



Figure 1: Coop. Agraria SAN MIGUEL DE FUENTES DE EBRO. (Source: Google Maps).

3.1.2. Synergies to become an agro-industry logistic centre

3.1.2.1. Biomass resources availability:

As shown in Figures 2 and 3, the amount of agricultural residues available in the area is considerable.

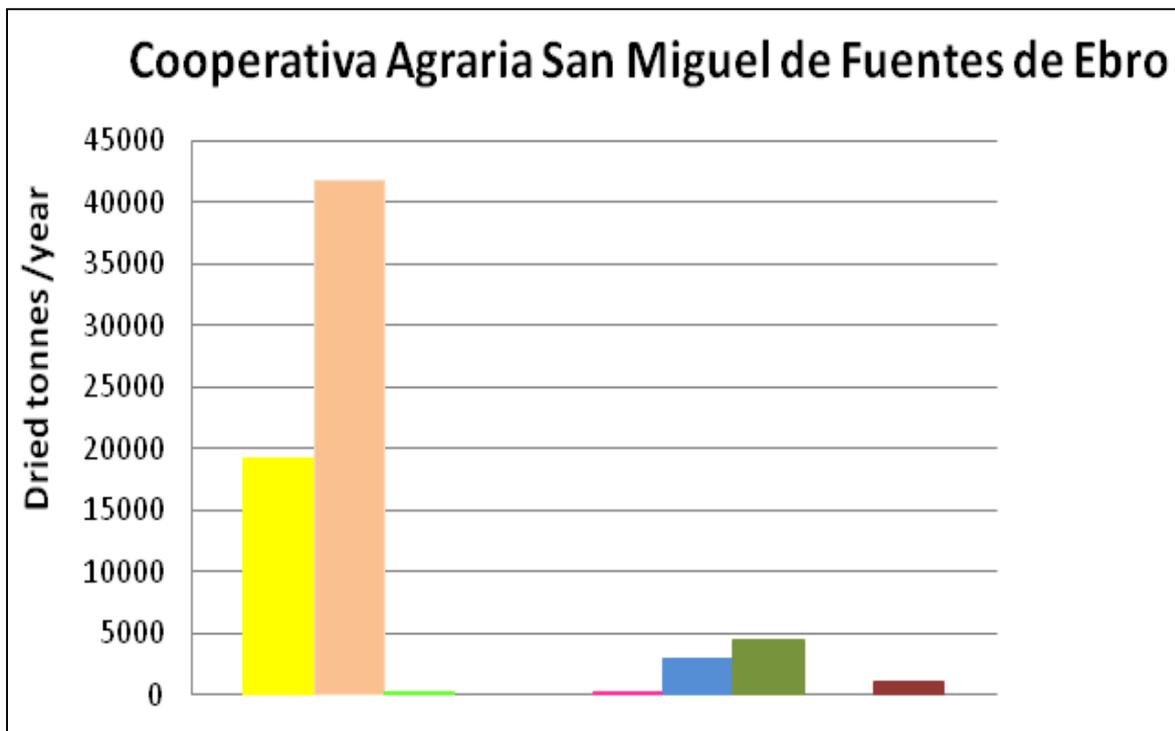


Figure 2: Amount and type of resources available in a 30 km radius.

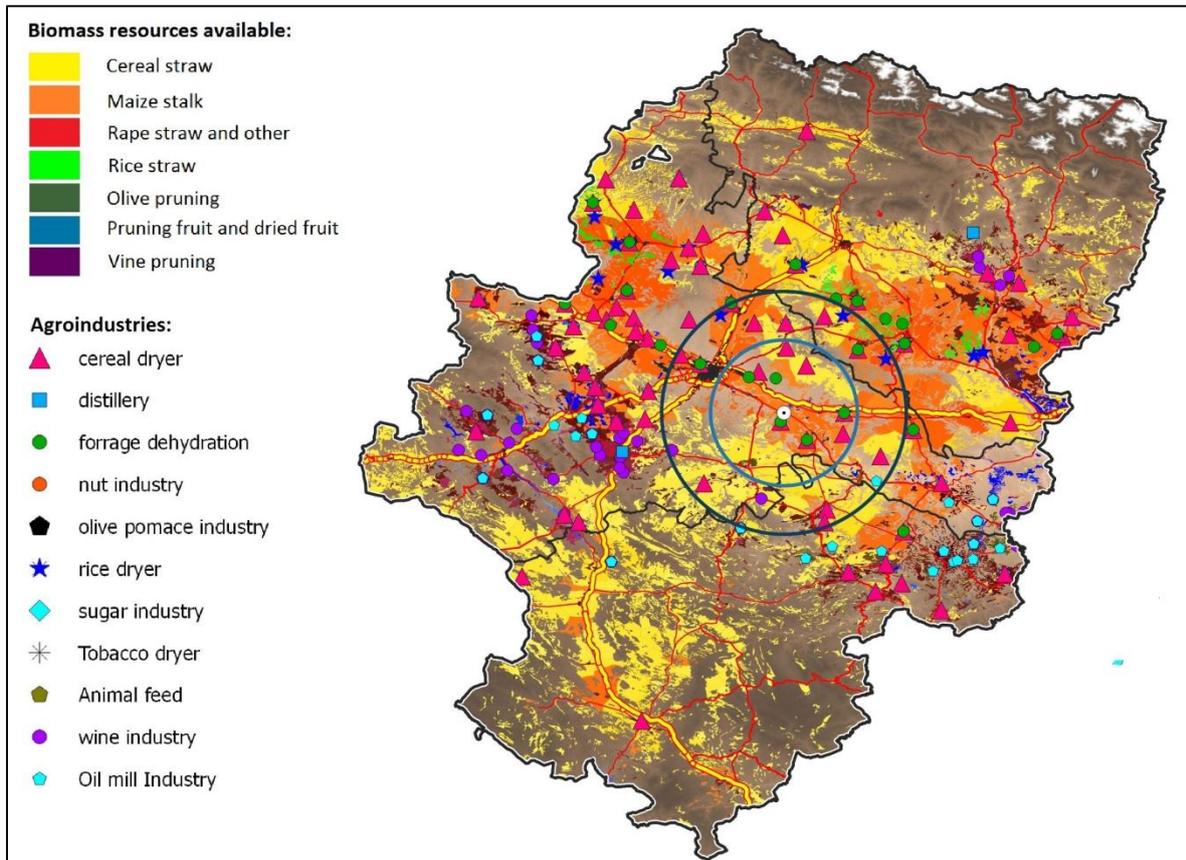


Figure 3: Map of available resources in a 30-50 km radius.

An assessment of the amount of available herbaceous resources from only the associated partners of the cooperative and other nearby agro-industries nearby have been performed. For that study, the manager, the production manager, farmers and a logistic operator in the area have been interviewed. According to these conversations, it has been considered that around 13,500 tons of cereal straw (wet base) would be available per year within 30 km, although this amount could vary somewhat depending on the year. The corn stalk from the area has been rejected as a possible raw material because its collection is complicated (rainy season) and use for the production of solid biomass products is less attractive (high content of ash due to sand/stones collected when harvesting).

The available quantities, moisture content (weight percentage in wet base, w-% ar), months of production and purchasing price (including transport to the cooperative) of the straw are shown in Table 2.

Table 2: Data on the available residues in 30 km distance.

Type of residue	Quantity available t/yr	Moisture content w-% ar	Months of harvest	Purchasing Price (transport included) €/t
Cereal straw	13,500	15	June-July	36 (baled)

The use of straw will be complemented with forest wood in order to increase the quality of the final product. Wood chips will be purchased in the market at 73 €/t (moisture content of 17 %, w-% ar)

3.1.2.2. *Equipment and facilities available*

The technical evaluation has been conducted according to the logistical components that are in the cooperative, taking into account the needs for the new business line. The lines of production of the cooperative have been assessed and it has concluded that the technical equipment used for drying and storage of corn is not compatible to work with herbaceous raw materials.

Thus, only the two production lines of alfalfa have been studied. The feasibility study developed in this report considers that the production facility used for alfalfa is compatible with the resources to be used in the new business line. The stages of the new process of production solid biomass will be the following: particle size reduction, drying, milling, pelletizing and storage.

Alfalfa campaign runs from April to November. The fodder dehydration plant has a dehydration line oriented to the production of high quality bales, and another one oriented to alfalfa pellets production. The two lines are completely independent of each other.

The alfalfa with lower quality (produced in the first and last cut), is intended for the production of pellet, so the pelletizing line is available for the production of biomass pellets for almost 9 months a year, and the bale production line could be accessible for drying wood during 4 months.

The equipment that is susceptible to be used for the new business line as biomass logistics centre is highlighted in the diagram of Figure 4.

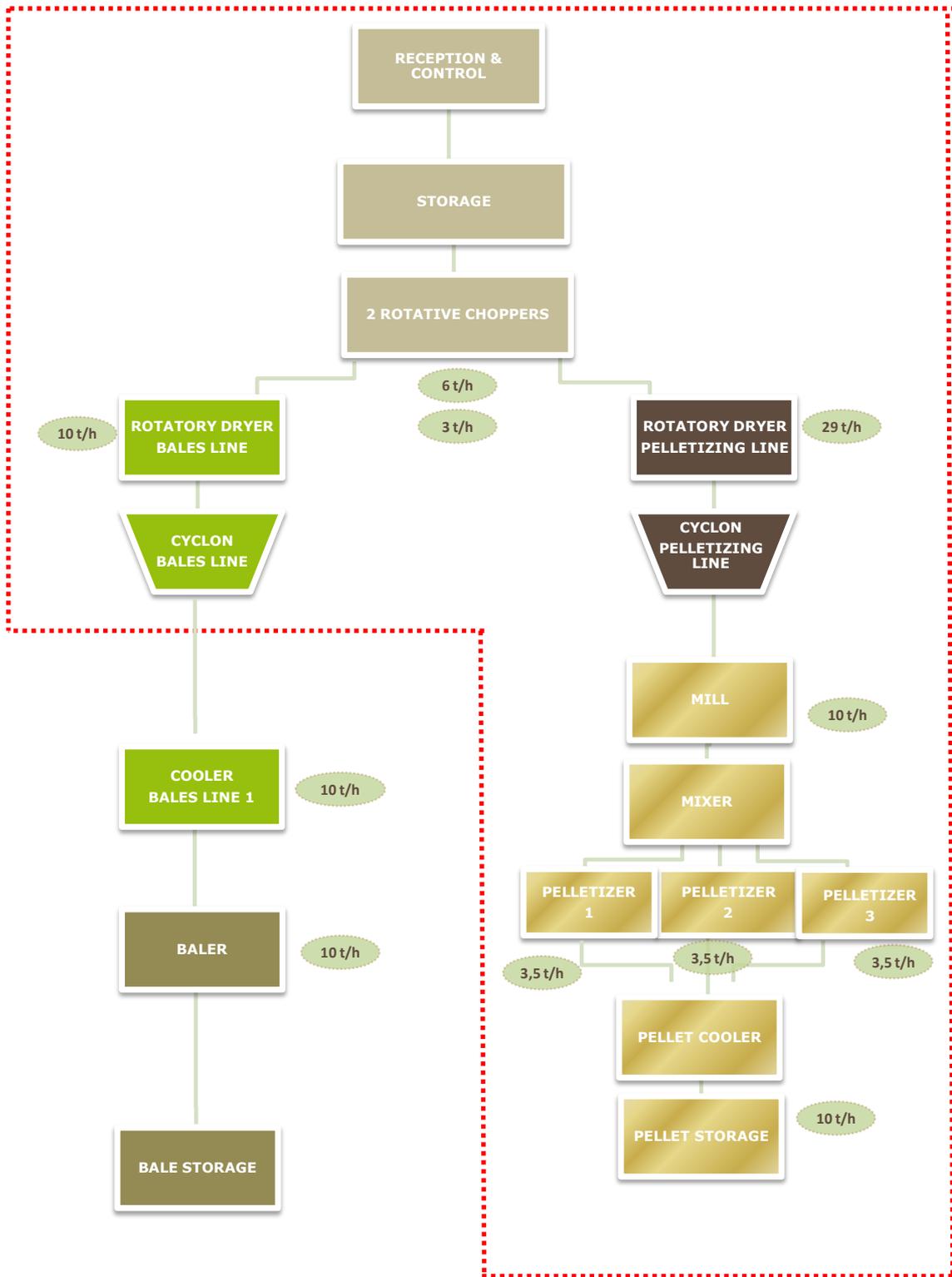


Figure 4: Flow diagram of the current biomass pelletizing line.

3.1.2.3. Bioenergy market potential

An assessment of the bioenergy market near the cooperative has been done. There are agro-industries consuming biomass but are focused on the use of almond shell or forestry chips and are not interested in changing the fuel. It also evaluated the possibility of supplying the pig farms, which are normally consumers of pellets, but there are hardly any in the area of the cooperative.

Even though the market of biomass is not very mature in the area, the cooperative would like to explore this new business to be prepared for the moment in which fossil fuels prices start to grow.

In SUCELLOG study, it has also been evaluated the possibility of making high quality wood pellets for other companies, so offering the service of pelletizing.

The current solid biomass products in the market are mainly agro-industrial waste, whose price fluctuates significantly from year to year. The main raw materials of the area, the price including transport (excluding VAT) and ash content (w-% db) (with an estimated value since providers sometimes cannot provide these data) are the followings:

Table 3: Data of the competitors.

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Almond shell	60-80	0.015-0.027	<1
Olive pomace	80-90	0.023	5-7
Olive pit	150	0.031	1-4
Forestry wood chips	73	0.022	<3
Forestry wood pellets	160-180	0.035	<3

3.1.3. Feasibility of the new business line as agro-industry logistic centre

The cooperative is interested in assessing the feasibility of beginning a new business line as biomass logistics centre for production and sale of the solid biomass products. The cooperative has suggested 3 lines of study:

- Production of cereal straw and wood pellets (50% - 50%)
- Providing the service of pelletizing wood pellets for other companies (benefit of 10 €/t).
- Installation of a multi-fuel burner in the line of production of alfalfa bales (with the corresponding investment costs, 434,200 €) fed by chopped straw.

For the production and fabrication of pellets for other companies, taking into consideration the months that the alfalfa dehydration equipment is without activity, it has been proposed to produce 2,000 tons of 100% wood pellet, and 1,000 tons of mixed pellets 50% straw and 50% wood.

Table 4: Solid biomass products for the new business line.

Type of solid biomass	Amount of production (t/yr)
Mixed pellets of cereal Straw (50%) + forestry wood (50%). Class B.	1,000
Forestry wood pellets. Class A.	2,000

For the first scenario, the drier of the line of alfalfa bales can be used for drying the wood, while for the second one the line for the production of alfalfa pellets will be used.

Both scenarios related to pellet production have been studied according to the ISO 17225 standard.

Regarding production of agro-pellets a mixture of 30 % wood and 70 % of cereal straw could fulfil Class B according to theoretical values of the raw material and the limits stated by ISO 17225-6. Over 70 % percent of straw would not satisfy the quality of Class B. A conservative scenario of producing a mixture of 50 % straw and 50 % wood has been preferred because previous experience in other areas of Aragon have shown the problems that straw has because of its high chlorine content. In any case, to strictly assess the percentage of each raw material to include in the mix in order to meet quality requirements, it should be necessary to carry out an analysis of representative samples of cereal straw to know its content of chlorine in the area.

With regard to the production costs:

Scenario 1: Mixed pellets of cereal Straw (50 %) + forestry wood (50 %). Class B.

The total cost of producing the mixed pellets proposed is 125 €/t. The graph below shows the relative importance of each cost: The purchase of raw materials constitutes 47 % of the total cost while the pre-treatment means 27 % of total production costs. The personnel costs include both the maintenance and operational but also management and sale personnel costs and mean a 26%.

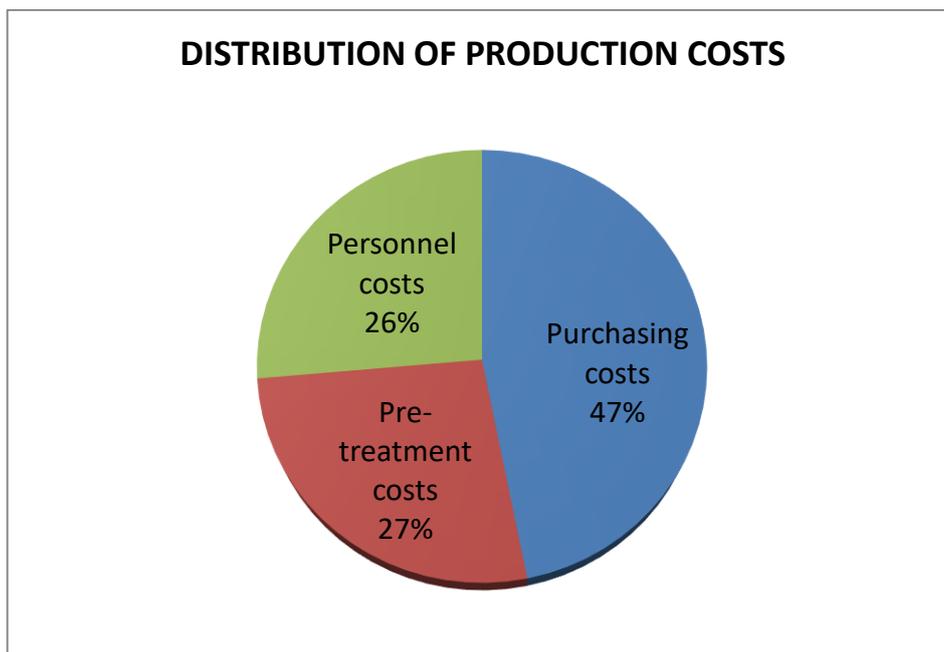


Figure 5: Allocation of production cost of mixed pellets for Scenario 1.

Scenario 2 where the 100 % wood pellet manufacturing for other logistic operator is evaluated, it is also a good scenario to consider, although so far no logistic operator in the area interested in this business has been found. Annual benefit estimated is 20,000 €/yr and the pay-back will be 1 year. Currently the most viable scenario for the cooperative would be assessing the incorporation of a multi-fuel burner (scenario 3) to reduce costs in the alfalfa production line (67,318 €/yr savings), although the risks assumed by the investment required are high this scenario will also be considered by the cooperative.

Finally, Scenario 1, is a scenario that could be considered although, compared to the rest of biomass in the market, the mixed pellets (145 €/t, 0.03318 €/kWh, 2.65 % (w-% db) of ash content) are only competitive with wood pellets.

The main risk for the new line of business as biomass logistic centre of agro-pellets would be, on the one hand, the difficulty of finding a number of potential consumers in the area, because the biomass market present a large variety of biomass at low price and, on the other hand, the generation of products that could satisfy consumers demand from the quality point of view.

3.1.4. Conclusions

The Cooperativa Agraria SAN MIGUEL DE FUENTES DE EBRO is an agribusiness cooperative whose current activities include the production of pellets and bales of alfalfa. The cooperative is interested in creating a biomass logistics centre for production of solid biomass, to take advantage mainly of their pelletizing facilities that are currently underused and also to produce biomass from agricultural residues of its members, creating thus an added value for them.

An assessment of both boundary conditions (biomass resources and market) and the conditions of the company (equipment and management) has shown that:

- Agricultural waste available for the logistics centre is mainly cereal straw. The annual amount produced by its members, within 30 km, is significant.
- The current biomass market is not mature, there are not potential consumers of biomass or has not been detected yet. A more intense study should be conducted in order to look for new opportunities.
- The 2 alfalfa production lines existing can be used for pre-treatment of solid biomass: The current bales production line can be used for drying wood for the production of agro-pellets (mix straw-wood). The current pelletizing alfalfa production line can be used for the production of agro-pellets (mix straw-wood) and wood pellets for other companies (manufacturing wood pellets 100%).

In any case, the production of solid biomass pellets can be fulfilled with no investment.

It has also been assessed the installation of a multi-fuel burner fed by chopped straw that can generate heat for drying alfalfa in the bales production line I. Although the investment related is high, the savings on natural gas can cause great benefits to the cooperative in a long-term.

Production of 100 % wood pellets for another company has also been explored, since it is a good way to give some utility to underused facilities operating without launching a business line of that takes many risks. In this case it should be necessary to find a logistics operator interested in this manufacturing service.

Finally, regarding the technical and economic study of mixed pellet production, the product is nowadays only competitive with wood pellets in terms of price-energy. The solid biomass (agrarian and not agrarian) in the area is currently marketed at a very low price due to the low price of fossil fuels. These types of residues also suffer high fluctuations depending on the agrarian campaign.

When external conditions become favourable, the mixed pellet production could become more appealing to consumers. Before starting a new business, it is advisable to perform a preliminary analysis of the quality (especially the determination of moisture content, heating value, ash content and the percentage of chlorine) of a representative sample of the straw to be used as raw material in the logistics centre. A thorough evaluation of the quality of the product will prevent unexpected consumer dissatisfaction.

3.1.5. Summary of additional support actions

The support actions carried out in relation to the cooperative Fuentes de Ebro were based on two important points:

- Dimensioning of multi-fuel burner since, from all the studied scenarios it was the most appealing for the agro-industry
- Awareness raising and dissemination activities in the area.

The first of these was based on the analysis of the demands made by Fuentes de Ebro in terms of its interest in the possible use of the straw of its associates, which currently does not have a highly developed market, for self-consumption in the facilities of the cooperative. Specifically destined to cover the energy demands for alfalfa drying in the bale production line substituting the natural gas by straw from the members of the cooperative. For this reason, a more detailed study was carried out by Green Future Consulting, complementing the one from SUCELLOG project.

Undoubtedly, despite the fact that due to the size of the investment that needs to be made, it results in a pay-back of 7 years (scenario just for the alfalfa line), this is considered by Fuentes de Ebro as an interesting scenario that could generate considerable benefits for the cooperative and its associated members, given the use of the resources that they are currently producing without a relevant market.

After analysing the data provided, Green Future Consulting proposed an additional scenario for the cooperative based on the installation of the proposed burner, not only used in the alfalfa dehydration facility but also in the maize dryer (like a district heating). This was proposed due to the short distance between the 2 facilities and the synergies of the period in the 2 facilities (use of the dehydration from April to Nov. – use of the maize drying from Nov. to Febr.), which will increase the operational hours and the natural gas savings and therefore will decrease the pay-back period. This additional study is still on the way.

On the other hand, regarding the awareness and dissemination of the SUCELLOG project in the area of Fuentes de Ebro, CIRCE attend to a workshop organized by the DGA with agents of the agri-food sector. The possibilities of exploitation of the agricultural resources of the zone (cereal straw and corn stalk) destined to biofuel were exposed and it was debated with the present how could be articulated this initiative commenting the case of the cooperative of Tauste.

3.2. Auditing study of DESTILERÍAS SAN VALERO Soc. Coop.

3.2.1. Company description

DESTILERIAS SAN VALERO Cooperative Society is a wine distillery of by-products transformation and revalorization. Mainly, they are devoted to transform olive pomace, lees and wines of its 45 associated wine cellars. It is a second degree cooperative. With these raw materials they obtain bioethanol, alcohols, tartrates, grape seeds as well as by-products valid for its use as natural organic fertilizers. Its market is international and mainly orientated to the biofuels sector and food industry, where they work with reference company both at national and international level.

The distillery works as a by-products processing center of the associated wine cellars, collecting olive pomace, lees and wine of low quality. Currently they already work with biomass to cover its heat necessities in the process (both in the drier as in the heat generation boiler). Part of the by-products of its own productive process are used to this end (mainly wine pomace without pits).

DESTILERIAS SAN VALERO Cooperative Society is located in the Valencia road, km 451.7, C.P. 50400, Cariñena (Zaragoza).



Figure 6: DESTILERÍAS SAN VALERO, Soc. Coop.
(Source: Google Maps)

DESTILERÍAS SAN VALERO Cooperative Society is interested in the support of the SUCELLOG Project for the creation of a biomass logistic center from the utilization of agricultural residues generated in its facilities, in the associated wine cellars facilities, as in the agricultural exploitations of the associated farmers of the cooperative wine cellars of first degree from the area.

The objective of this study is to assess the feasibility of substituting as much as possible the consumption of the biomass that is purchased, with products generated in the own industry or associated wine cellars, as the grape stem; or residues generated in the agricultural exploitations of the area, as it can be the vineyard pruning.

3.2.2. Synergies to become an agro-industry logistic centre

3.2.2.1. Biomass resources availability

Figure 7 shows the types of agricultural residues that are available and, therefore, that could be used for the production of solid biomass.

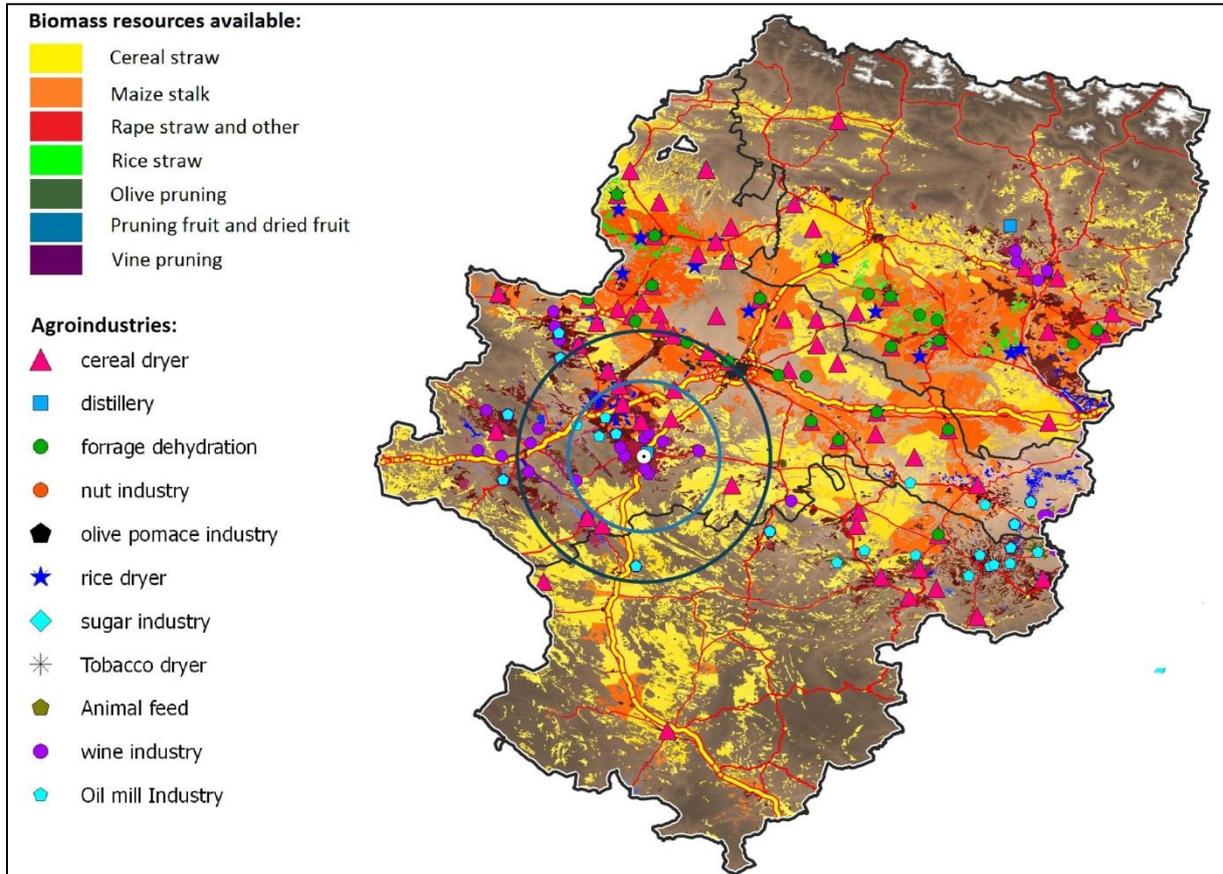


Figure 7: Map of available resources in a 30-50 km radius.

As a result of the conversations with the cooperative and consult of general data of the area of the cooperative, the available quantities, moisture content (weight percentage in wet base, w-% ar), months of production and purchasing price including transport to the cooperative are shown in Table 5.

Table 5: Data from the available agricultural residues in a 30 km radius.

Type of residue	Available amount t/year	Moisture content w-% ar	Months of harvest	Purchasing price
				(transport included) €/t
Grape stem	2,700	70	August-September	0-3

After some experience in the area for assessing the collection of pruning, as the performed through the Europruning European project, and the different conversations with farmers of the surroundings, it has been discarded the vineyard prunings due to the difficulty in its collection.

The distillery sees the greatest potential in a residue that is not currently being used or properly managed, which is the grape stem. Currently, this grape stem is abandoned in non-productive fields or transported to the distillery, where they receive it and storage in the outside.

Other cooperatives can use it as food for the livestock, mainly cows, but marginally and only because they need to remove the residue. The data concerning the transport cost has been obtained of the price that currently costs them to carry one ton of grape stem from the associated wine cellars of the area to the own distillery. If the transport would rise, the remaining cost would have to be assumed by the associated wine cellars.

By comparing the quality values resulting from the grape stem tests against the wine pomace without pits (main fuel used in the burners), the grape stem is considered a fully valid fuel for the installation which is intended to feed due to its lower ash and chlorine content (despite its lower heating value). The incorporation of the grape stem as fuel displaces other resources such as grain pits flour or dry pomace pellet which, on the other hand, present better quality (but have to be bought from other industries).

3.2.2.2. Equipment and facilities available

As it has previously mentioned, the objective of the study is to assess the feasibility of substituting as much as possible the consumption of the biomass purchased, with products that the own industry or associated wine cellars generate. For this purpose, DESTILERÍAS SAN VALERO Cooperative Society will use its current facilities for the consumption of biomass, beside of making an investment in the purchase or rent of the shredding equipment for the management of the new biomass that will be used in its process.

The possibility of using a mobile system was evaluated so the chopped of the grape stem would performed in the own wine cellar to reduce the residue transport cost to DESTILERÍAS SAN VALERO. For that reason, the technical and economic feasibility of the acquisition of a chipper was assessed.

The wine pomace without pits is currently used to cover the steam process requirements of the all the distillery through its combustion in a biomass boiler (8.4 MW) and for the heat production in the drier burner (4.6 MW).

The distillery also disposes of a pelletizer, currently completely underused. At the moment, the use in the facilities does not seems to be possible as the combustion systems of the facility do not need that the fuel to be in a pellet format.

3.2.2.3. Bioenergy market potential

In order to see if grape stem exploitation (instead of purchased biomass to other companies) is economically profitable, it has performed a small evaluation of the biomass market from which is supplied the distillery.

Table 6: Biomass parameters provided by the distillery.

Type of resource	Price		Ash content w-% db	Low heating value (15% wb) kWh/t
	€/t	€/kWh		
Almond shell	64	0.0134	<1	4,780
Grape pits flour	50	0.0106	3-4	4,700
Olive oil pomace pellet	49	0.0102	5-7	4,800

3.2.3. Feasibility of the new business line as agro-industry logistic centre

As it has previously stated, the cooperative is interested in starting a new business as biomass logistic center for improving the profitability of its productive process, substituting the purchase from part of the biomass currently acquired by residues produced by their associated wine cellars (grape stem). Therefore, the goal is to prioritize the grape stem use of its cooperatives for its own energetic demands against the biomass that is currently acquired. A previous pretreatment of the biomass through a shredding process, which is foreseen to be performed with a chipper acquired by the distillery is needed.

For the performance of the feasibility study it was carried out, in first place, a comparative between the main fuels utilised currently (wine pomace) and the new proposed fuel (grape stem) in terms of heating value to understand the amount of stem that is required. After that, it has been carried out an evaluation of the investment costs for the new business and other related costs, determining, in a second stage, the purchasing cost of the agricultural residues, of the pretreatment, personnel and other expenses.

The results of the benefits obtained by the new line of self-consumption in the distillery are shown in Table 7.

Table 7: Total benefits and incomes by substitution of fuel.

BENEFITS AND INCOMES		Year 1	Year 2-10
Expenses (€)	Investment costs	17,000	0
	Pretreatment costs	853	853
	Maintenance costs	600	600
Save (€)	Savings income	50,942	50,942
Benefit (€)		32,488	49,489
Payback		1 year	

According to the data obtained in the study, the investment needed to work with the new fuel would be recovered within the first year, due to the saving which supposes substituting part of the biomass that is purchased. During the first year, the savings achieved would allow to recover the investment and obtain 32,488 €. Next years, having the investment amortized, an annual benefit could be obtained coming from the saving for the change of part of the fuel of 49,489 €.

In the next figure it is exposed, in function of the % of the covered energy with the grape stem utilization:

- The savings generated in the facilities (without taking into account the expenses of the investment).
- The amounts of grape stem which would have to be acquired to the wine cellars for that end (or the amount of grape that should be used those wine cellars having into account that a 3 % is grape stem).

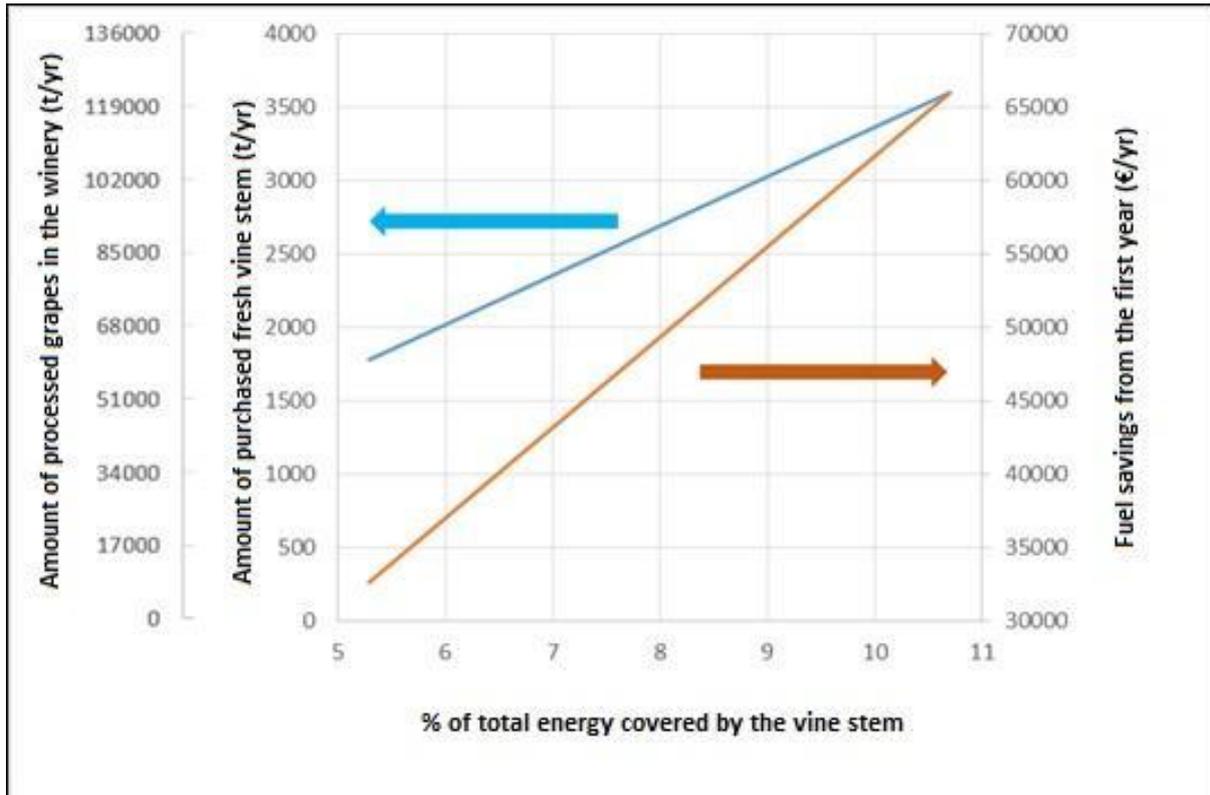


Figure 8: Summary graph of the new initiative.

3.2.4. Conclusions

The DESTILERÍAS SAN VALERO Cooperative is an agroindustrial cooperative whose activity is to produce alcohols from the transformation and revalorization of wine-making by-products. Mainly they are dedicated to transform marcs, lees and wines from its 45 partner wineries.

DESTILERÍAS SAN VALERO Sociedad Cooperativa is interested in the support of the SUCELLOG project for the creation of a biomass logistic center based on the use of agricultural residues generated both in its facilities, in the facilities of its associated wineries and in the exploitations of the farmers who are members of the cooperative wineries of the area.

The cooperative is interested in the creation of a biomass logistic center in order to be able to cover the heat needs of its own production process in the first place and, in the future, be able to act as a center for the processing of agricultural residues that can store and transform, and then be able to market.

An assessment of both the boundary conditions (biomass and market resources) and the conditions of the company (equipment and management) has shown that:

- The main waste that can be used by the cooperative is the grape stem (2,700 t/year).
- Vineyard pruning, an important agricultural residue in the area due to its quantity and quality, being a woody residue, has been discarded due to its difficulty in collecting it. In any case, the SUCELLOG project has contacted an initiative (Vines4Heat) that is working on demonstrating an integrated pre-pruning and collection system to improve the collection of this resource and the maintenance of its quality.

The Project has assessed the possibility of replacing part of the biomass that the cooperative purchases, for the grape stem that the cooperative can access through its associated wineries.

In order to be able to use the grape stem in the installation, it has to undergo a process of reduction of particle size through a chopping process, since the biomass fed to the combustion processes is done through screws with certain dimension characteristics.

However, before starting the new activity, it was advisable to carry out a quality analysis (especially the determination of the moisture content, heating value, ash content and percentage of chlorine) of a representative sample of the grape stem that is going to be used to replace part of the biomass purchased by the cooperative to cover the heat needs of the same.

The analysis has been carried out and as a main conclusion it could be emphasized that, although in comparison with the grape pits or the dry olive pomace one can see a worse quality (purchased biomass), the grape stem is considered a totally valid fuel for the installation where it proposes to be fed by its lower ash content and chlorine. However, it is considered necessary to perform tests to see the effects that the composition of the ashes (not considered in this report) could generate in the combustion process (for example slagging).

The substitution of part of biomass purchased by the grape stem to which the cooperative could accede (we assume in the study 2,700 tons), would lead to an annual saving of 49,489 Euros, with an amortization of the equipment of crushed that would have to buy for the pretreatment of the grape stem of less than 1 year.

The study has also proposed through a graph the hypothesis in which the cooperative could not access to that amount of grape stem annually, which amount of savings would in each case suppose the substitution of part of the fuel purchased by the grape stem. It is important to highlight that the grape stem allows the cooperative to increase their energy independence in the face of the great fluctuation of prices suffered by the fuels they now purchase (dry olive pomace, grape pits and almond shell) and which have an impact on their production costs.

3.2.5. Summary of additional support actions

As additional support actions to DESTILERÍAS SAN VALERO, the following two stand out:

- Management of chemical analysis for the characterization of resources with an external lab: wine pomace and grape stem.
- Machinery for the pretreatment of the grape stem.

The action indicated in the first place was made in order to be able to carry out a comparison between the residue used as a fuel at the present time, the wine pomace, and the residue that was tried to pose as an alternative, the grape stem.

In light of the results, and as has already been gathered in the conclusions section, compared to the wine pomace without pits, it is observed that it presents a lower content of ash and chlorine, and therefore it is considered an adequate fuel.

Apart from this, it has also been considered necessary to analyze this new waste from the technical point of view, so the precise machinery for its treatment has been studied.

After the analysis it was decided to propose as a more favorable option the specific chopper for grape stem, since this type of system has been specifically designed for a resource like the grape stem and is frequently used in other distilleries or warehouses for its crushing.

3.3. Auditing study of Cooperativa Agrícola Regional (CAR)

3.3.1. Company description

Cooperativa Agrícola Regional (CAR), with the head office in the Palencia locality Carrión de los Condes, offers different services related mainly to the agricultural sector to its more than 320 members. The cooperative commercializes crops from fodder and cereals from its members and input services to their members (liquid and solid fertilizers, fuels, etc.). Furthermore, with the objective of increasing the services offered, they have built a new storage centre, a seed breeding station and a seed certification centre which allows increasing the surface of these units to 4,000 square meters.

Furthermore, the cooperative relies on a fodder dehydration plant with a capacity of 12,000 t/yr, a plant producing unifeed mixtures and a silo with a capacity for 5,000 tons of cereal.

After the discussions held with the manager board of the cooperative, it is highlighted that the company is immersed in an expansion process, in which the diversification of its activities through the start-up of a biomass logistic centre would be a possibility for a business in the future.

SUCELLOG study has been focused in evaluating the real possibilities of implementation a new business line using agricultural residues from its members.

The implementation of actions related to the possibility of giving value of agricultural residues can improve their bottom line and contribute to sustainable development of the environment and rural area where the cooperative is located.

The head office of Cooperativa Agrícola Regional (CAR) and the main facilities of the cooperative are located in Carrión de los Condes (Palencia). (Figure 9 and 10).



**Figure 9: Head office of Cooperativa Agrícola Regional (CAR).
(Source: Google Maps).**



**Figure 10: Fodder dehydration facilities of Cooperativa Agrícola Regional (CAR).
(Source: Google Maps).**

3.3.2. Synergies to become an agro-industry logistic centre

3.3.2.1. Biomass resources availability:

As shown in Figures 11 and 12, an amount of agricultural residues that could be used for the production of solid biomass is available. As it can be observed, the main resources are herbaceous: cereal straw and maize stalks.

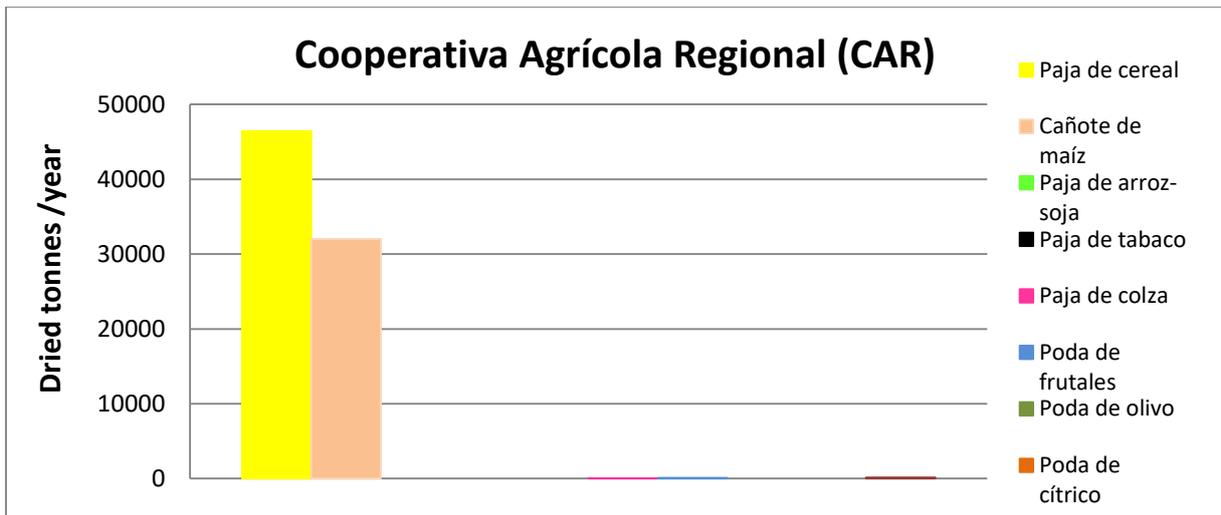


Figure 11: Amount and type of resources available in a 30 km radius.

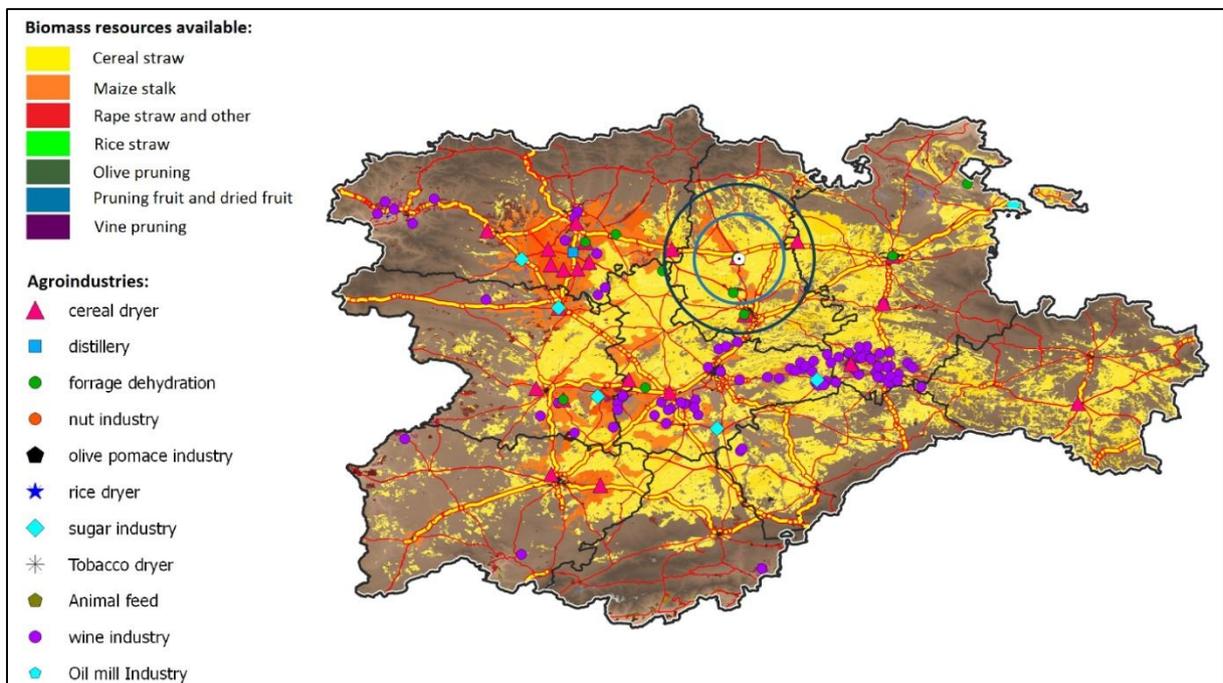


Figure 12: Map of resources available in a 30-50 km radius.

According to the conversations with farmers in the area, there are certain limitations in the use of these quantities of residues. In the case of straw, about 60 % of it is used for livestock bedding or incorporated into the soil. Therefore, only 40 % of the indicated amount (27,860 tons) would be available for its use as biomass.

In the case of maize stalks, which is normally incorporated to the soil, the reality is that the difficulty of harvesting the product, together with the need of performing an initial drying to reduce its moisture content (25 %, w-% ar), makes its use too complicated. That is why the proposal of using maize stalk has been rejected.

Concerning the straw, the available quantities, moisture content (weight percentage in wet base, w-% ar), months of production and purchasing price are shown in Table 8.

Table 8: Data on the available residues in 30 km distance.

Type of residue	Quantity available	Moisture content	Months of harvest	Purchasing Price (transport included)
	t/yr	w-% ar		€/t
Cereal straw	27,860	15	Jul-Ag	36

3.3.2.2. *Equipment and facilities available*

In SUCELLOG feasibility study a self-consumption scenario has been assessed, being focused to the consumption of the biomass residues of the associated members of the cooperative. The cereal straw provided by the farmers in a radius of no more than 30 km would be used as fuel in the facilities of the cooperative with the aim of reducing the fossil fuel consumption used for the heating demands during 6 months in the fodder dryer.

Currently, the needs of the cooperative in terms of energy consumption are higher than 300,000 l/yr of gasoil for cereal dryer and its dehydration processes, of which about 195,000 l/yr correspond to the fodder dehydration plant producing 10,000 t/yr of forage

In this case, it has been foreseen that the use of the fodder dehydration plant using biomass as fuel need of substitution of the burner which currently operates exclusively with gasoil. Such adaptation will consist on the replacement of the burner and the incorporation of a device for the initial chopping (particle size reduction) of the cereal straw bales. The installation of the new burner, which would run with 100 % biomass (according to manufacturer specifications) would require proper adjustments (adequacy of the feed rate, maintenance requirements) to be optimized.

In the future, if the combustion camera performance acquired is suitable, the governing team would assess the possibility of adapting the rest of the heat exchanger with options of automatic ignition, regulation of fans, a screw for removing the ashes after burning straw bale and other automated maintenance processes.

Figure 13 shows a scheme of the planned installation for hot air production to be used in the fodder dehydration process.

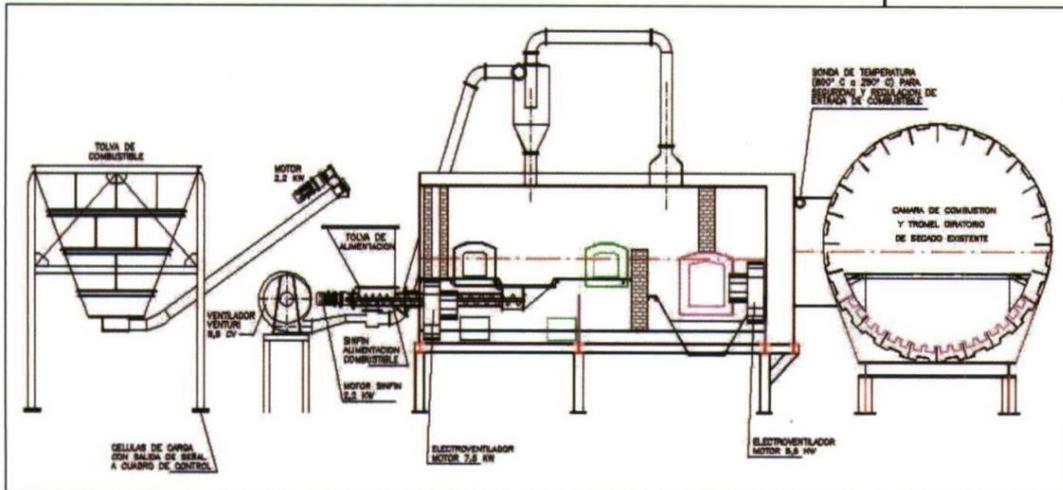


Figure 13: Facility of hot air generation by burning biomass

3.3.2.3. Bioenergy market potential

Even though this study has been addressed to the biomass self-consumption, a preliminary assessment of the market has been carried out to have an initial idea of the potential consumers in the area with the purpose of studying other alternatives related to the production of other solid biomass products in the future.

In a radius of 50-70 km, the main consumers are households but, because of their high quality biomass requirements only fulfilled with forestry wood products, they would never be considered as potential customers.

In the last years, the local administrations are starting to demand biomass as fuel for covering the heating demands of the public buildings, being an interesting customer to explore when developing this business line.

The main competitors of the area, the price (including transport and VAT) and ash content (w-% db) are the followings:

Table 9: Data of the competitors.
(Source: Bioenergy International, March 2016)

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Forestry wood chips	109	0.028	3-4
Forestry wood pellets	270	0.054	2

3.3.3. Feasibility of the new business line as agro-industry logistic centre

The cooperative is interested in starting the development of the fodder dehydration section replacing the gasoil burner for a biomass burner with an investment of 412,000 €.

The raw material for the new business line would be purchased to the cooperative members located in the vicinity (up to 40 km).

Taking into account the substitution of the 100% of the gasoil used by cereal straw for covering the heating demands of the fodder dehydration facility, it has been suggested the acquisition of 474 t/yr of cereal straw.

For feeding the new burner, reduced pre-treatment would be needed, including only the particle size reduction, since the fuel to be used (cereal straw at 14 % moisture content), does not need drying.

With regard to the production cost, the total cost of producing the cereal straw ready to be used in the biomass burner is 49.1 €/t. The graph below shows the relative importance of each cost: The purchase of raw materials constitutes 77 % of the total cost while the pre-treatment means 9 % of total production costs. The personnel costs related to maintenance and operation have been included in the pre-treatment costs so the personal costs referred in this graph are only relating to management and sale personnel (14 %).

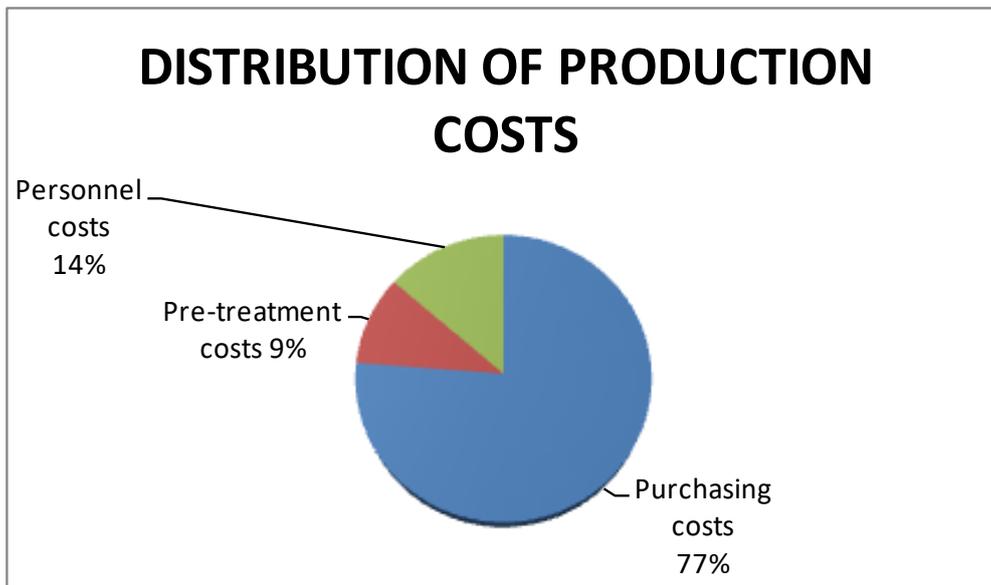


Figure 14: Allocation of production cost.

The economic study has concluded that taking into consideration a discount rate of 4 %, the cooperative could get a positive NPV and an IRR of 24 % return with a pay-back of 4 years. Moreover it is remarkable the savings incomes obtained by the use of biomass as fuel instead fossil fuels (161,850 €/yr).

3.3.4. Conclusions

The main goal of SUCELLOG techno-economic feasibility study has been to analyse the possible use of the agricultural residues of the members of the cooperative, as a new business to be developed in order to diversify the activities of the cooperative.

After several visits to the facilities of the cooperative and meetings with their technical and management teams, it has been agreed that the only viable scenario to be analysed is to use the cereal straw as fuel in the dehydration facilities replacing the fossil fuels utilised.

Drying system used by the cooperative currently consists of a rotatory drier using gasoil as fuel for the heating demands incurring in important costs every year. Given the fluctuating prices of fossil fuels and the possibility of continued use of residual biomass from the members (with acceptable quality and reasonably priced), the cooperative would consider the acquisition of a 5 MW biomass burner to replace the existing gasoil burner, making an investment next to half a million Euros.

In any case, the arguments for installation apart from a reduced pay-back period (4 years) are those listed below:

- Cheaper energy costs incurred by the cooperative, savings of 161,850 €/yr.
- Reduce annual CO₂ emissions by improving the energy rating and carbon footprint of the resulting products of the cooperative.

3.4. Auditing study of COCOPE, Soc. Coop.

3.4.1. Company description

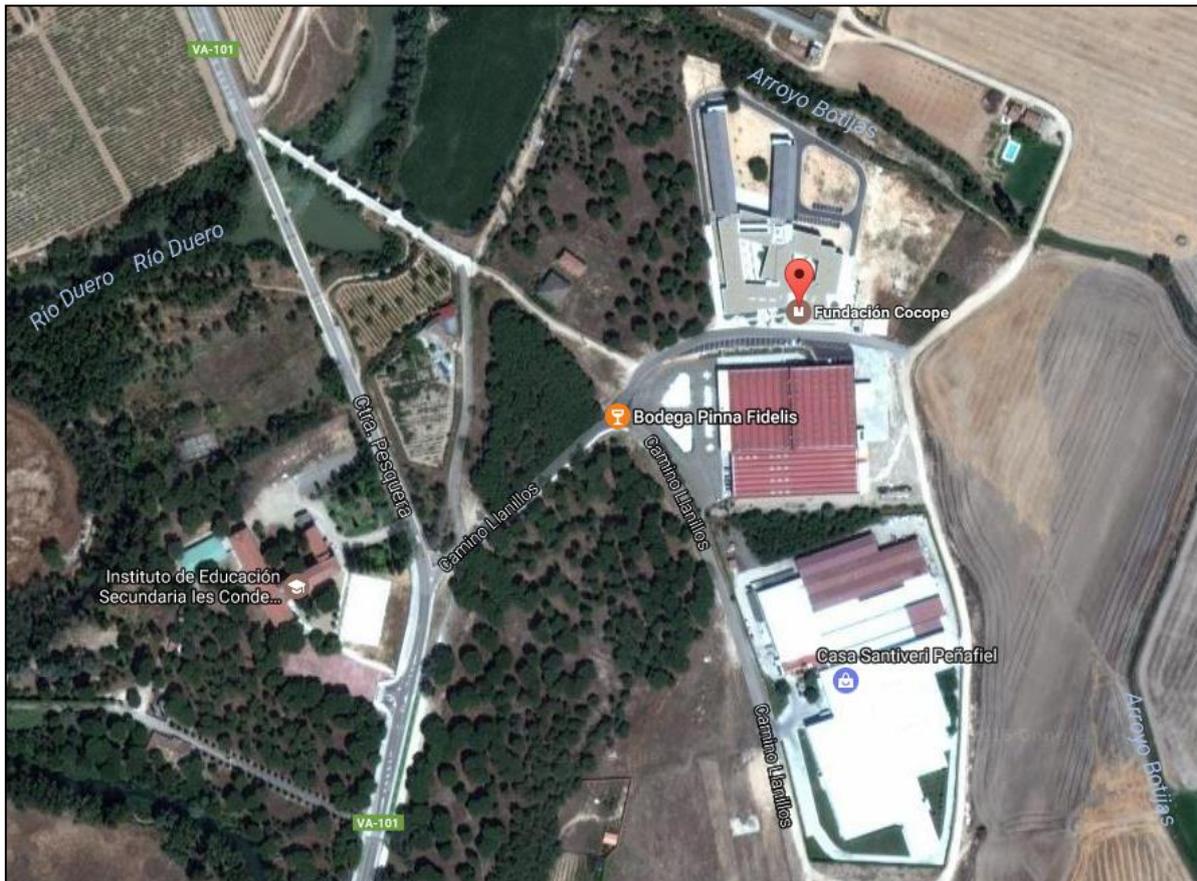
COCOPE is a cooperative society with a turnover higher than 15 million Euros and more than 600 partners, manage a workforce near to 20 employees. Its main activity was focused, since its beginnings, in the cereal marketing and the provision of diverse services to its partners as input supplier and agricultural insurances managing (it has offices and storage buildings separated from the rest of facilities) among others; later, and paralleling to the mentioned activities, it started with the growing of aromatic plants which after its distillation are destined to the production of natural cosmetic. In 2001 and with the support of 63 winemakers partners, it is constituted the wine cellar with the name Pinna Fidelis, dependent of the cooperative, and which currently represents one of the higher production of the Denomination of Origin Ribera del Duero.

Last years, convinced and implicated with a model based in contributing into a social action as well as in the maintenance of the rural areas through fixing the population of those environments, they decided to create the COCOPE Foundation in order to contribute to the wellbeing of a large part of the population of the rural areas of which its partners belong. In this manner, in the year 2010 they inaugurate a modern nursing home, based in environmental sustainability criteria and partly using renewable energies.

The COCOPE Cooperative is interested in that its business areas continue meaning an advance for the life quality of its partners, besides contributing in a decisive manner to guarantee the sustainability of the area in which their exploitations are set. For this reason, the valorization of agricultural residues coming of those exploitations (cereal

straw, remnants of the lavender prunings, remnants of vineyard prunings and stem generated during the wine cellar destemmed) could imply a decisive advance in the consecution of the environmental balance and its preservation for the future generations.

The headquarters of the cooperative, as well as the rest of the facilities which are part of the cooperative (wine cellar and nursing home), are placed in the Peñafiel locality (Valladolid; Figure 15).



**Figure 15: Foundation and wine cellar of the COCOPE Cooperative.
(Source: Google Maps).**

The cooperative is very interested in the SUCELLOG Project since, in spite of the lack of equipment with which carry out the pretreatment of the generated residues for its transformation in biomass, it disposes of raw material of quality and in enough amounts as to consider the option of producing energy for self-consumption in its different facilities. In order to assess this possibility, it was performed a feasibility study with the support of an energy company called Green Future Consulting.

3.4.2. Synergies to become an agro-industry logistic centre

3.4.2.1. Biomass resources availability:

Figures 16 and 17 show the type of agricultural residues that are available and, therefore, that could be used for the production of solid biomass.

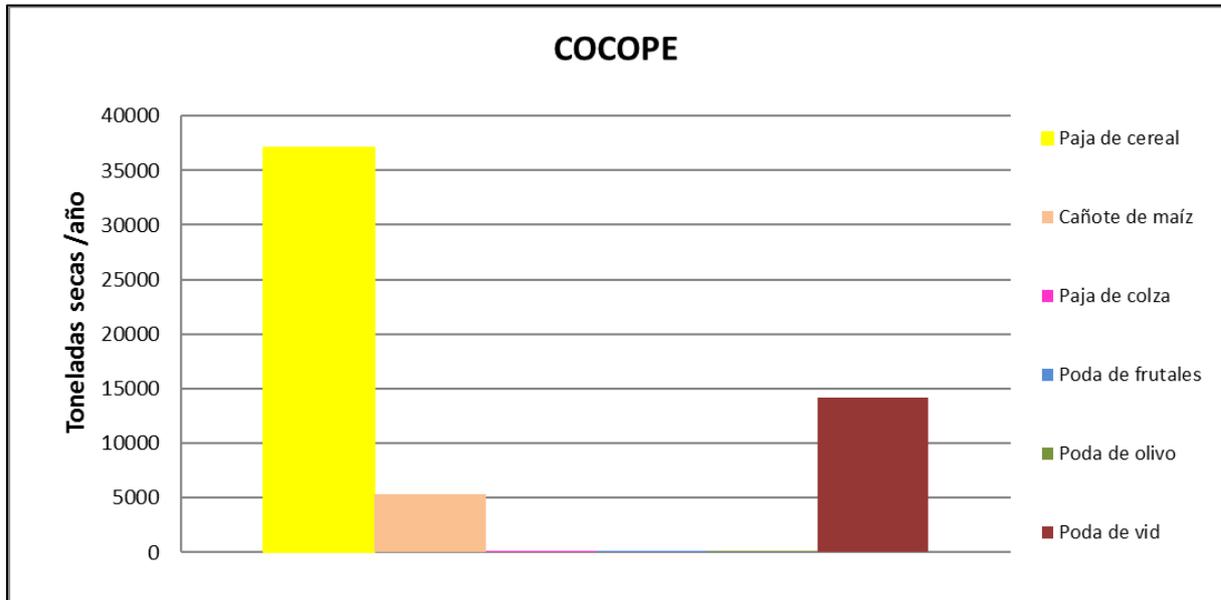


Figure 16: Amount and type of resources available in a 30 km radius.

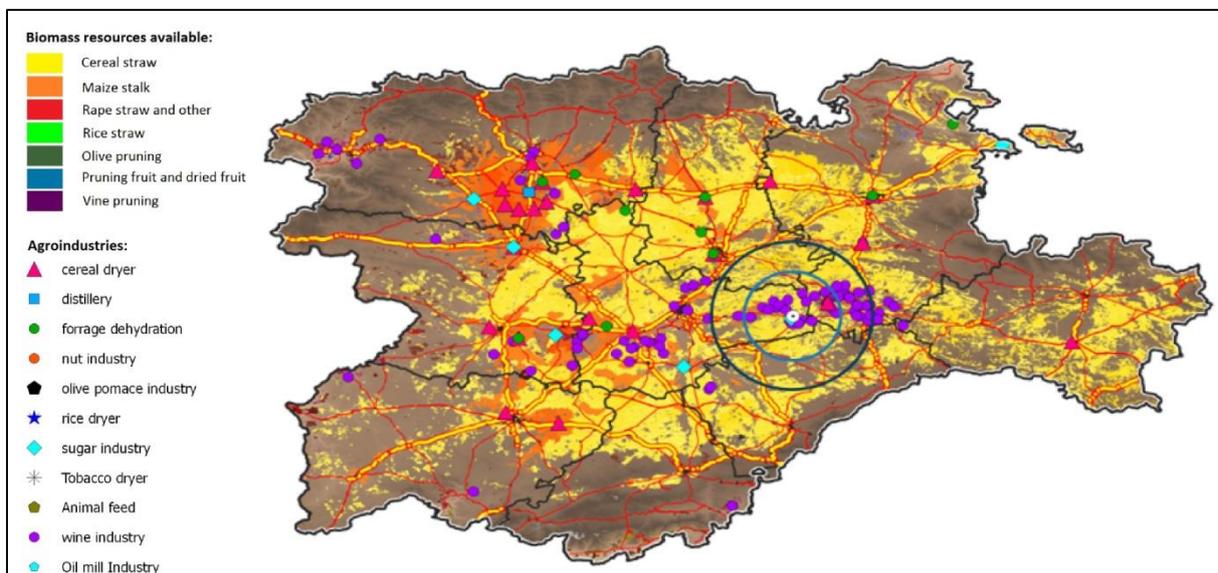


Figure 17: Map of available resources in a 30-50 km radius.

As a result of the conversations with the cooperative and consult of general data of the area of the cooperative, the available quantities, moisture content (weight percentage in wet base, w-% ar), months of production and purchasing price including transport to the cooperative are shown in Table 10.

Table 10: Data on the available residues in 30 km distance.

Type of residue	Quantity available	Moisture content	Months of harvest	Purchasing Price (transport included)
	t/yr	w-% ar		€/t
Cereal straw	30,000	14	July/August	36*
Lavender Straw	500	60	August/September	0
Grape stem	45	60	October	0
Vineyard pruning	400	20	Dec/Jan/Feb/Mar/Apr	30

*The straw price correspond to the farmer payment (10-20 €/t) added to the cost of collecting (packed and transport, 10-20 €/t) plus the benefit of the straw logistic operator (10-20 €/t). This price could suffer fluctuations depending of the season.

After some considerations relative to the fluctuation of the straw price and, because the pickup of the vineyard pruning could offer greater difficulties of collecting than the straw lavender, finally, this last one and the stem has been chosen as the most appropriate resources for their energetic use (besides that they cause an important management problem to the cooperative). Being generated in the own facilities of the cooperative, close to the nursing home where the combustion facility would be located, it wouldn't be necessary to consider the purchasing and transport costs, because they are property of the cooperative.

3.4.2.2. *Bioenergy market potential*

After consulting several operators (boiler manufacturers, biomass producers and the Castilla y León Board Administration), it was determined that the main potential market of biomass consume in the region would be the residential housing. The current consumption of biomass for industrial or urban thermal energy in Castilla y León focuses on the use of by-products generated by the wood industry (shavings and saw dust) as wood chips and pellets (80% of the total energy consumption), olive pit and dry fruit nut shell (18%) and consumption of biomass coming of the vine by-product (2%). Castilla y León is the second autonomous community with more biomass heating networks installed.

The characteristics of the forestry biomass (main competitor) offered by the current suppliers of biomass in Castilla y León are shown in Table 11.

The quality of the biomass currently demanded (wood pellet) by the residential housing consumers is high because the installed boilers don't accept raw materials with high ash contents and low heating value, besides, in such cases the consumer demands boilers that, in addition of being efficient, generate minimum technical problems; reason for which the agricultural residue still generates some reluctance for its use as biomass.

**Table 11: Data of the main competitors (VAT and transport included).
(Source: Bioenergy International, September 2016)**

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Wood chips	109.9	0.025	3.4
Wood pellets	237.1	0.050	2

3.4.3. Feasibility of the new business line as agro-industry logistic centre

Following, the feasibility study performed to COCOPE is summarized. In it, in first place, it has been considered the pretreatment of the agricultural residues surpluses (lavender straw and stem) for their transformation into biomass. After that, it has been assessed the necessity of investment for their use in the production of thermal energy (heating and sanitary hot water) in a biomass poly fuel boiler of new acquisition (in addition to the lavender and the stem, it would accept more resources as vineyard pruning and herbaceous) in possible combination with the energy system previously installed in the nursing home, as the best option for the cooperative (self-consumption).

Not having the needed equipment for performing the mentioned pre-treatment it is proposed to subcontract the briquette production to the Solver Agroindustrial S.L. Company. Its composition is showed in the next table:

Table 12: Biomass products for self-consumption.

Type of solid biomass	Amount of production (t/yr)
Mixed briquettes of lavender straw (90%) + stem (10%)	200

As it can be observed, the agricultural biomass briquettes are composed of by-products coming from agro industrial activities: 90% straw lavender and 10% of stem from the wine cellar. The cost of manufacture those briquettes was estimated (after consulting Solver Agroindustrial S.L.) in 20 €/t, including transport.

Given the self-consumption scenario, the feasibility of this new business line has been assessed considering the possible savings which could be generated and the investment amortization needed for that (accounting a reasonable pay-back for the cooperative of 5 years), including the purchase and pretreatment costs of the raw material (following are presented two cases).

The COCOPE energetic necessities would suppose an annual net expenditure of 59,000 €/year, so this figure represents the incomes by saving that would be obtained when substituting the current fuel.

The only necessary investment for starting the mentioned scenario would be the purchasing of a new poly fuel biomass boiler which, according to the provider (Green Future Consulting), would imply an amount of 131,000 €. The residues transport and its pretreatment would suppose an investment of 8,500 €/year, while the acquisition of the residues has been considered at zero cost because it belongs to the cooperative.

The specific results related with the total benefit obtained as savings because of the self-consumption are shown in Table 13.

Table 13: Benefits in the scenario of raw material at zero cost.

		Scenario I
Expenses (€)	Investment costs	131,000
	Purchasing costs	0
	Pretreatment costs	8,500
	Personnel costs	0
Incomes (€)	Savings income	59,022
TIR (%)		29
VAN (€)		207,945
Payback (years)		4

As it can be observed, the exposed scenario is very favorable. Considering this data, it should be taken into account the possibility of reverse part of these benefits to the COCOPE partners, by paying the farmers for the resources used as raw material. The results related with this future scenario, including the maximum payment to the partner (35 €/t, to accomplish the 5 years pay-back) for the resource, are shown in next table:

Table 14: Benefits in the scenario of payment to the farmer.

		Scenario II
Expenses (€)	Investment costs	131,000
	Purchasing costs	14,875
	Pretreatment costs	8,500
	Personnel costs	0
Incomes (€)	Savings income	59,022
TIR (%)		15
VAN (€)		87,295
Payback (years)		5

In any case, in the project future stages, when it could be collected more specific data about the new activity, it should be considered a scenario which would assess in the most detailed way, the personnel necessities, especially in the resource management and final product, given that in this study those haven't been taken into account.

3.4.4. Conclusions

The final target of the present report was to study a possible use of the agricultural biomass surplus from the partners of the COCOPE cooperative (devoted to the agricultural products marketing, essential lavender oil extraction, wine cellar and nursing home) through the technical and economic feasibility analysis, as a new section to develop for the activities diversification. After performing several visits to the cooperative facilities, meeting with its technicians, as well as the manager, and with the support of the specialized company Green Future Consulting, there were analyzed two possible scenarios; one of utilization of the resources from the cooperative partners for their use as self-consumption in the cooperative facilities (two variants: with or without electricity production), and another of design of the boiler installation for the use of agricultural residues in the thermal energy production for self-consumption in the cooperative facilities and others near, but non belonging to it (Conde Lucanor Secondary Education Institute, a biscuit factory, Finca El Marqués, etc.).

Finally, it is determined as feasible scenario the use of two types of agricultural residues (lavender straw and stem) and its valorization through its pretreatment for being used as biomass fuel in the generation of thermal energy necessary for the nursing home facilities owned by the cooperative (first scenario, without electric generation). For that, it is proposed the installation of a poly fuel boiler of 180 kW, so that, initially, could be fed with the predicted residues (lavender straw and stem) but, if necessary, it can also be used for the combustion of other resources of which the cooperative partners dispose, as cereal straw and vineyard pruning.

The proposed pretreatment is to make briquettes from the resources. As COCOPE does not dispose of equipment for performing it, it is considered the possibility of subcontract this service to a specialized company.

Currently, the thermal energy production system of the nursing home generates higher expenses than 41,000 €/year in the acquisition of fuel (natural gas). The use of the biomass in substitution of the natural gas, in spite of the initial investment necessity in a 180 kW boiler, could suppose a saving of 36,300 €, which supposes the 88% of the total fuel invoice.

The fossil fuel price fluctuation and the possibility of continued use of a residual biomass coming from the surpluses of the partners (lavender straw and stem from the destemmed), of acceptable quality and, till the moment without cost for the cooperative, advise the acquisition, by the side of the cooperative, of a poly fuel biomass boiler that, substituting the current one of natural gas, would imply an investment of 131,000 €, which according to the calculations, would be amortized from the fourth year of acquisition.

If this scenario would be considered, with the premise of reverse a benefit to the partners for this new activity through a payment for the given resources, a maximum payment of 35 €/t would be estimated, with a pay-back of 5 years.

The main reasons for its installation are the indicated following:

- Reduce the cost of the energetic consume of the nursing home facilities.
- Reduction of the annual emissions of CO₂ as the CO₂ issued by a biomass boiler results with a neutral balance.

3.4.5. Summary of additional support actions

On October 5th, 2016, a meeting was held among the Regional Union of Cooperatives of Castilla León (URCACYL), CIRCE and Spanish Agro-Food Cooperatives to analyze the lines in which COCOPE had shown interest and to analyze the actions of support to carry out. This cooperative, despite its activities, does not have biomass processing equipment, nor is currently a consumer of biomass, it could dispose of waste that could potentially be used as solid biomass with energy use. On the other hand, it would be interested in evaluating the possibility of consuming the solid biomass produced in its facilities as fuel in the nursing home that also owns.

In this line, several aspects were raised in which to go in depth:

- Resources: determine the pros and cons of each resource potentially usable by the cooperative, quantities that could be available, issues related to the logistics of them, etc. Evaluate other previous experiences.
- Combustion equipment: Contacts with boiler manufacturers, and the continuation of the contact already initiated with Green Future Consulting, in order to analyze the possible use of waste from the cooperative in its equipment.

In relation to the first one, previous experiences in the use of pruning of vine for energy use were presented to COCOPE. On the other hand, the analysis of the rest of the resources available to the cooperative was also deeply done.

Following these analyzes, which were included in this audit report, and as a result of different meetings with the specialized company Green Future Consulting, it was possible to determine, as stated in this report, the priority for the use of lavender straw and stem from the destemming of the cellar. However, the other resources (cereal straw and remains of vineyard pruning) were considered as also potentially usable in times of need. Therefore, in the chosen scenario, the acquisition of a multi-fuel boiler capable of accepting all of them was considered.

Additional support actions based on the inquiries about combustion equipment with the collaboration of Green Future Consulting allowed improving COCOPE's vision to increase the value of its resources through consideration of a second future scenario.

The future scenario would be based on the design of installation of boilers for the use of agricultural waste in the production of thermal energy for self-consumption in cooperative facilities and others outside annexed to it. In this case, it would be a question of adding to the scenario studied in this audit report the study of a district-

heating from the nursery home that satisfies the energy demands of Bodega Pinna Fidelis, the offices of COCOPE, with a possible extension to the Secondary Education Institute, a biscuit factory, the Finca El Marqués as well as private homes. As mentioned above, this second scenario has not been analyzed in the frame of SUCELLOG project, but this audit has allowed COCOPE to consider it as a very interesting future opportunity. Now COCOPE and Green Future Consulting continue working in this line.

3.5. Auditing study of AGRÀRIA DE MIRALCAMP, SCCL

3.5.1. Company description

The AGRÀRIA DE MIRALCAMP, SCCL cooperative is a first-degree cooperative founded in 1954 which currently has 207 members. Their activity is the drying of cereals (barley, wheat), corn and rape coming mainly from their members.

Its production in the 2014-2015 campaign was as indicated in Table 15.

Table 15: Raw materials of the cooperative.

Products (of its associated members)	Quantity (t)
Barley	3,096
Rape	29
Corn	17,112
Wheat	2,225

It is located in the Pla d'Urgell, in the middle of the Lleida plain. The facilities are located 1 km far from the centre of the municipality of Miralcamp (as it can be observed in Figure 18), at approximately 1.5 km from the centre of the capital region, Mollerussa.



**Figure 18: AGRÀRIA DE MIRALCAMP, SCCL.
(Source: Google Maps).**

AGRÀRIA DE MIRALCAMP, SCCL is interested in becoming a biomass logistic centre in order to use the residues produced by their members, which are currently left on the soil.

3.5.2. Synergies to become an agro-industry logistic centre

3.5.2.1. Biomass resources availability:

Figure 19 shows the type of agricultural residues that are available in the surroundings of the cooperative, which could be used for the production of solid biomass.

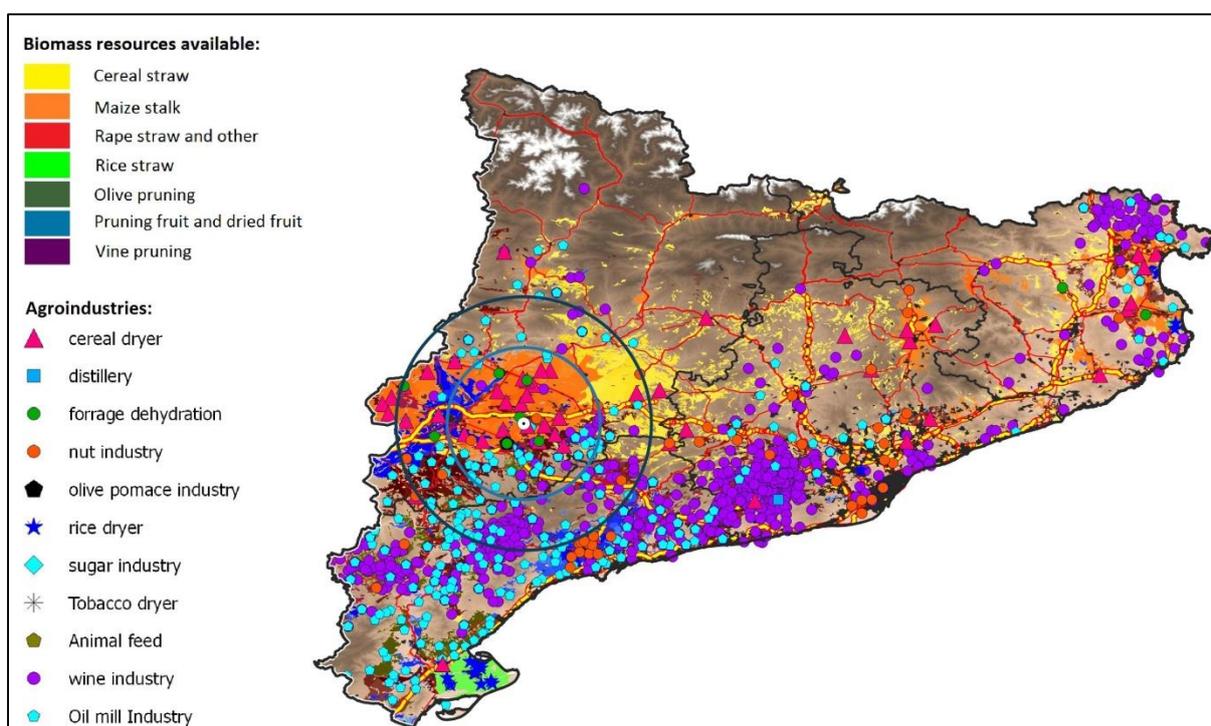


Figure 19: Map of resources available in a 30-50 km radius.

However, the conversations with the cooperative and the consultation of general data of the area have concluded in different type of resources to be used for a possible biomass production: corn cobs and peach pits.

The available quantities, moisture content (weight percentage in wet base, w-% ar), months of production and purchasing price are shown in Table 16.

Table 16: Data on the available residues in 30 km distance.

Type of residue	Quantity available	Moisture content	Months of harvest	Purchasing Price (transport included)
	t/yr	w-% ar		€/t
Corn cob (from associated members)	5,000	25	Sep-Oct	40
Peach pit (from non-associated members)	-	15	July-Sept	60

The main raw material for possible future use would be the corn cob produced by the members of the cooperative. This material is not currently used, leaving it with the stalk in soil after the harvest, or burying when the weather permits.

3.5.2.2. Equipment and facilities available

Two scenarios have been assessed for the new business line as biomass logistic centre:

- (1) Scenario for the medium term, related to self-consumption of corn cob (in loose format) replacing the biomass currently used in the maize grain dryer heat gas producer;
- (2) Scenario for long-term, related to the commercialization of corn cob grits in which the main target customers would be the pig farms.

AGRÀRIA DE MIRALCAMP, SCCL is equipped with a vertical dryer but this type of dryer is not compatible with the drying if loose cobs or grits. Cobs are planned to be dried naturally during storage. Enough surface is available for long storage in case it is needed.

Loose cobs would be used, according to scenario 1, for their heating demand mainly in June (cereal) and from September to January (for the corn).

The cooperative would need to acquire a machinery to transform the loose cobs into grits (scenario 2) and owns a screener that can be used to market the grits without fines after being chopped.

Both scenarios require, however, the possibility of performing the corn cob harvesting through the adaptation of the current machinery, in order to be able to separate the grain from the cob, has been taken into consideration. This potential investment that would be done by the logistic operators that carry out the harvesting (which can be around 90,000 € according to contacts with machinery manufacturers) has not been considered in this study but it could be interesting to asses it in future stages.

3.5.2.3. Bioenergy market potential

The characteristics of biomass offered by current suppliers of biomass in the area of the cooperative are shown in the following table. Forestry biomass is not usually used due to its high price, so this kind of biomass has not been considered among the competitors.

Table 17: Data of the competitors.

Type of residue	Price		Ash content w-% db
	€/t	€/kWh	
Olive pomace	110	0.023	6
Olive pit	150	0.031	1-4
Almond shell	60	0.015	<1

The target market for the new business line would be, apart from the self-consumption, the pig farms in the area.

Since the pig farm sector has great economic importance in the area of the cooperative and in the Catalanian region, a thorough analysis of biomass consumption for covering heating demands in the pig farms should be made in a next stage.

3.5.3. Feasibility of the new business line as agro-industry logistic centre

The cooperative is interested in assessing the feasibility of starting a new business line as biomass logistics centre for the consumption of their own residues as well as the production and sale of the solid biomass products. The amount of solid biomass to be generated by the logistic centre is shown in Table 18.

Table 18: Solid biomass products for the new business line.

Type of solid biomass	Amount of production (t/yr)
Scenario 1: Self-consumption: Corn cob (loose)	550
Scenario 2: Commercialization: Corn cob grits	4,500

The raw material for the new business activity will be supplied by the associated farmers to the cooperative located in the vicinity (maximum 30 km).

For the first scenario, focused in the use of loose corn cobs for self-consumption, as it has been previously mentioned, no investment would be needed since the natural drying has been proposed and the dried product will be directly fed into the burner of the maize drier of the cooperative.

For the second scenario, it will be necessary the acquisition of a chopper (price considered: 30,000 €).

The techno-economic analysis performed has calculated production costs, for the first scenario, of 45 €/t. When comparing this cost with the price of the solid biomass currently used in the facility (almond shell), the economic advantages seem not so wide (0.012 €/kWh for the cobs against 0.015 €/kWh for the almond shell). However, this means savings of 7,500 € per campaign.

The selling price in the market calculated for the corn cob grits is around 67 €/t (0.016 €/kWh). This price is very close to the price of the almond shell in the area (60-66 €/t; 0.015 €/kWh) so it could be difficult to compete with it in the market. However, due to the fact that the cooperative is, above all, looking for the use of their members residues, who in turn will receive 40 €/t, it is considered that it would not be difficult to promote the corn cob grit consumption among their associates owning pig farms.

Figure 20 Figure 1 shows the relative share of each cost in both scenarios. As it can be observed, the purchase of raw materials constitutes 92-94 % of the total cost while the pre-treatment means 7-2 % of total production costs. The personnel costs related to maintenance and operation have been included in the pre-treatment costs so the personal costs referred in this graph are only relating to management and sale personnel.

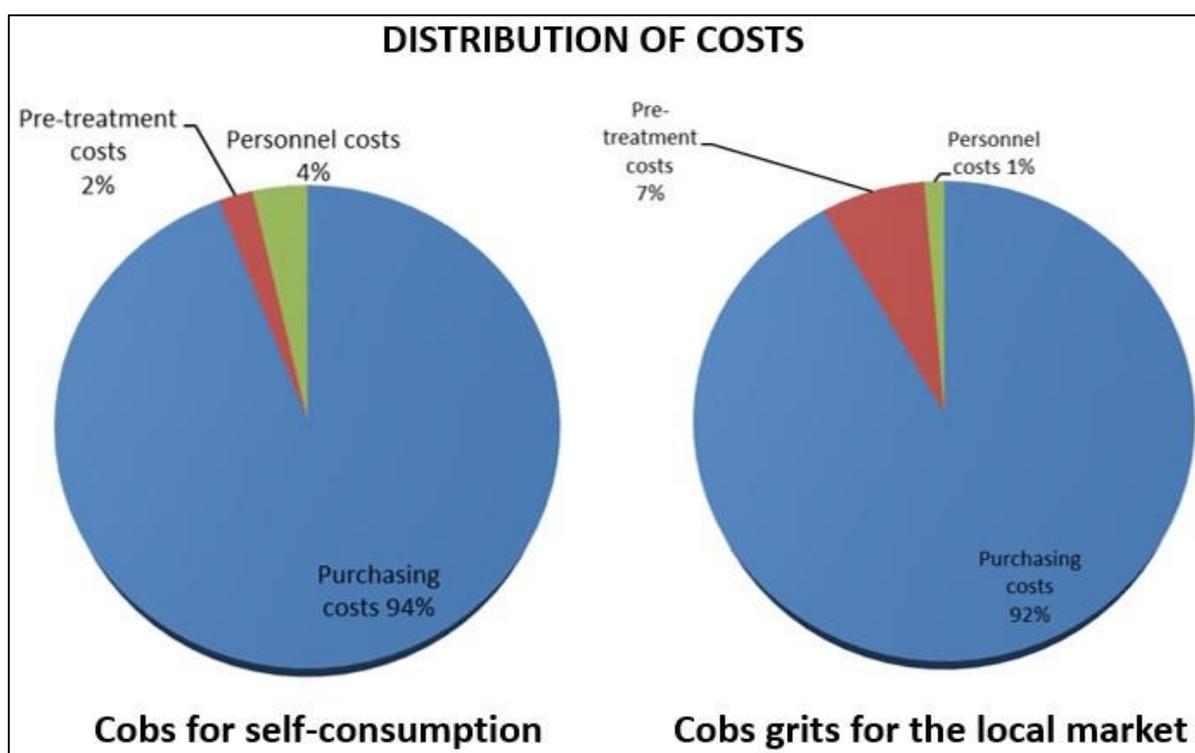


Figure 20: Allocation of production cost for the two scenarios considered.

3.5.4. Conclusions

AGRÀRIA DE MIRALCAMP, SCCL, is interested in becoming a biomass logistic centre in order to use the corn cob of its associated members since this product has currently no market.

The direction of the cooperative has agreed to consider two scenarios for the analysis of the new business line. The first scenario assessed is focused on the self-consumption for the drying process, to stop buying biomass (peach pits and almond shell) to third parties. The second scenario considers the commercialization of corn cob grits for the pig farms located in the area, being a type of customer very familiar and accessible for the cooperative.

The cooperative would have to acquire a chopper in the second scenario, while no investment is needed for the first one. It would be necessary to prepare enough storage space in order to allow the natural drying of the corn cobs. Experiments in order to test the drying process from harvesting operations and combining different types of handling and storage are highly recommended.

A modification of the harvesting machinery able to separate cobs from the grain should be agreed with the logistic operation in the area offering the cooperative 40 € for each ton of cob.

The scenario related to the self-consumption is seen a bit risky since the price difference between the corn cobs and the almond shell is very low to compensate the uncertainties generates due to the changes needed in the handling, logistic issues and so on. However, 75,000 €/campaign savings are expected if this line is successful. Regarding the case of the second scenario of commercialization corn cob grits, this new line should be offered to the associates owning pig farms as an opportunity to sell their residues instead of leaving them in the soil.

After the study carry out by SUCELLOG and even being aware of the difficulties in this new business line, the cooperative maintain its interest in exploring it.

3.5.1. Summary of additional support actions

After the meeting held on October 13th, 2016 among the Federation of Cooperatives of Catalonia (FCAC), CIRCE and Spanish Agro-Food Cooperatives, which conveyed the interest of the cooperative in going in depth with the possibility of managing the corn cob through the contribution of the SUCELLOG project in several fields, a series of additional support actions were carried out.

The main themes were:

- Machinery: possible adaptation of the machinery for the separate collection of corn cob. Aspects related to manufacturers, cost analysis and limitations.
- Logistics: as an important part of the logistics chain, the possible assumption of the cost of the modification by the logistic operators was deal with.
- Farmers: as potential suppliers of the corn cob, we tried to assess the possible interest, conditions of collection and price of the resource.
- Consumers: potential consumption was also assessed from two points of view. On the one hand, the relative to which the pig farms of the area could be carried out and, on the other hand, the one related to the possible self-consumption of MIRALCAMP, expanding information on the equipment of combustion that the cooperative currently owns.
- Extraction of corn cob in the process of obtaining the seed.

After the actions carried out in relation to the points marked above, it was found that the adaptation of the machinery could be based on previous experiences carried out both in Spain and outside it, so it could be viable.

However, the conditions would have to be agreed with the logistic operators as the investment needed to adapt the harvester would be on their side, but obviously the economic conditions of harvesting would be affected.

On the part of the farmers there is no greater problem in that they surrender the corn cob to MIRALCAMP, since it could be agreed through the Governing Council of the cooperative determining also the conditions of price and delivery schedule.

In relation to the consumption by the pig farmers of the area, there was a great general ignorance among all the consulted about the use of the corn cob as biofuel. However, they do use biofuel in the boiler of their farms such as pellets and forest chips, almond shell and olive pit, and it is estimated that they could at some point choose to substitute it for the corn cob generated by MIRALCAMP, provided an interesting product with interesting conditions was offered to them.

Given the above considerations about possible solutions for the adaptation of harvesting machinery and since the potential consumers - pig farms in the area - are already familiar with the biomass consumption and that MIRALCAMP would maintain its interest in self-consumption of the corn cob to cover its thermal needs, the option to launch this initiative has been seen in an interesting way by MIRALCAMP. For this reason, in the future, in the medium term, and based on the findings of this report, MIRALCAMP could be in a position to start implementing this initiative that would generate an extra benefit for all the actors involved (farmers, logistic operators, machinery companies).

3.6. Auditing study of TROIL VEGAS ALTAS S.C.

3.6.1. Company description

TROIL VEGAS ALTAS S.C. is a second degree cooperative dedicated to the transformation of the by-products coming from olive oil mills, born from the sectorial initiative of the olive oil of the Extremadura Union of Agricultural Cooperatives (UNEXCA), now Extremadura Agri-food Cooperatives. It was founded in 1999. It began collecting olive pomace in the 2001-2002 campaign, and started its activity in August 2002. The pomace oil production and many other sub-product from the olive oil mill industry is its main activity and, despite they are used as biomass in some facilities in the area, they are not yet self-consumed in the agro-industry itself.

TROIL VEGAS ALTAS, S.C. is an agro-industry of cooperative character which works exclusively in the olive tree sector, more specifically of the oil olive sector since it is in charge of the management and revalorization of the by-products and residues of its partners oil mills. It has a storage capacity of 44,500 t of olive pomace in three ponds

(Figure 21), two of concrete and one pond of waterproof land. The annual maximum processing capacity is of 60,000 t and it is located in a parcel of 100,000 m³, 45,000 m² of which are urbanized. The headquarters of the cooperative, as well as the rest of its facilities, which are part of the cooperative, are located in the Valdetorres locality (Badajoz, Figure 21).

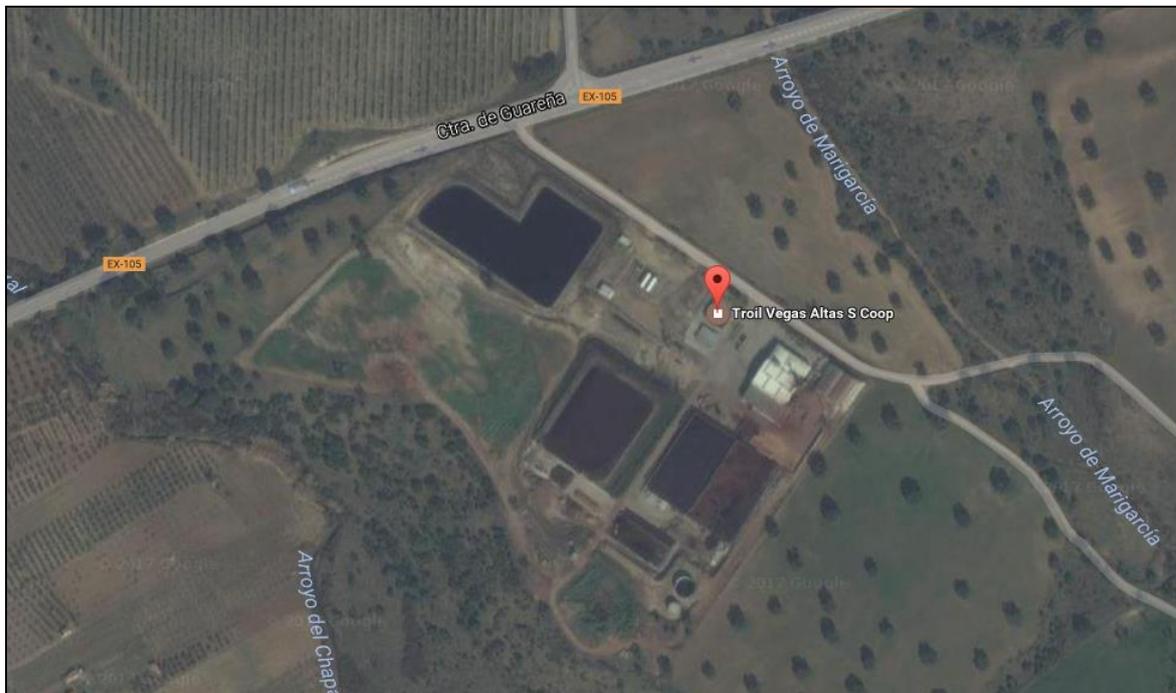


Figure 21: TROIL VEGAS ALTAS Soc. Coop facilities.
(Source: Google Maps).

The continued interest on the improvement and diversification of the activity of TROIL VEGAS ALTAS S.C. led them last years to take interest in the development of diverse projects for searching the feasibility of new business lines similar to those already started and/or innovators and different to diversify the activity always in the frame of the biomass production.

As the situation and perspectives of the cooperative has been analyzed searching the most proper working lines, it has been assessed possibilities of starting several lines that, by diverse motives, finally did not set and have been discarded, in some cases for assessing them forward and in others because the technical or economic unfeasibility since the beginning.

Some of these options have been:

- Start-up of a pellet production plant.
- Start-up of a wood chips production plant.

- Global coordination of a logistic system of collection of prunings and agriculture residues from the cooperative partners of the TROIL group for its later valorization.
- Substitution of the natural gas by biomass as fuel in the cogeneration plant.

Finally, and after diverse meetings and analysis, it is concluded that, currently, the cooperative priority should be the adaption to its partners demand in materials at which is currently dedicated, at the same time that an optimization of the energetic cost in the production processes is searched.

On that line, it is noteworthy that TROIL VEGAS ALTAS esteems that in the next years the residues reception necessities coming from the oil mills of its partners could double in the best of the campaigns. In this way, TROIL would pass of having the necessity of evaporate 20 million kilos of water (current capacity) to 40 million kg of water. That is to say, duplicating its drying capacity. That would imply the installation of a drying line completely new, which could be fed with biomass, unlike the current one, fed with the cogeneration gases from natural gas.

This study has focused, therefore, on evaluating the feasibility of the start-up of a biomass-fed drying plant.

3.6.2. Synergies to become an agro-industry logistic centre

3.6.2.1. Biomass resources availability:

Figure 22 shows the types of agricultural residues that are available and, therefore, that could be used for the production of solid biomass.

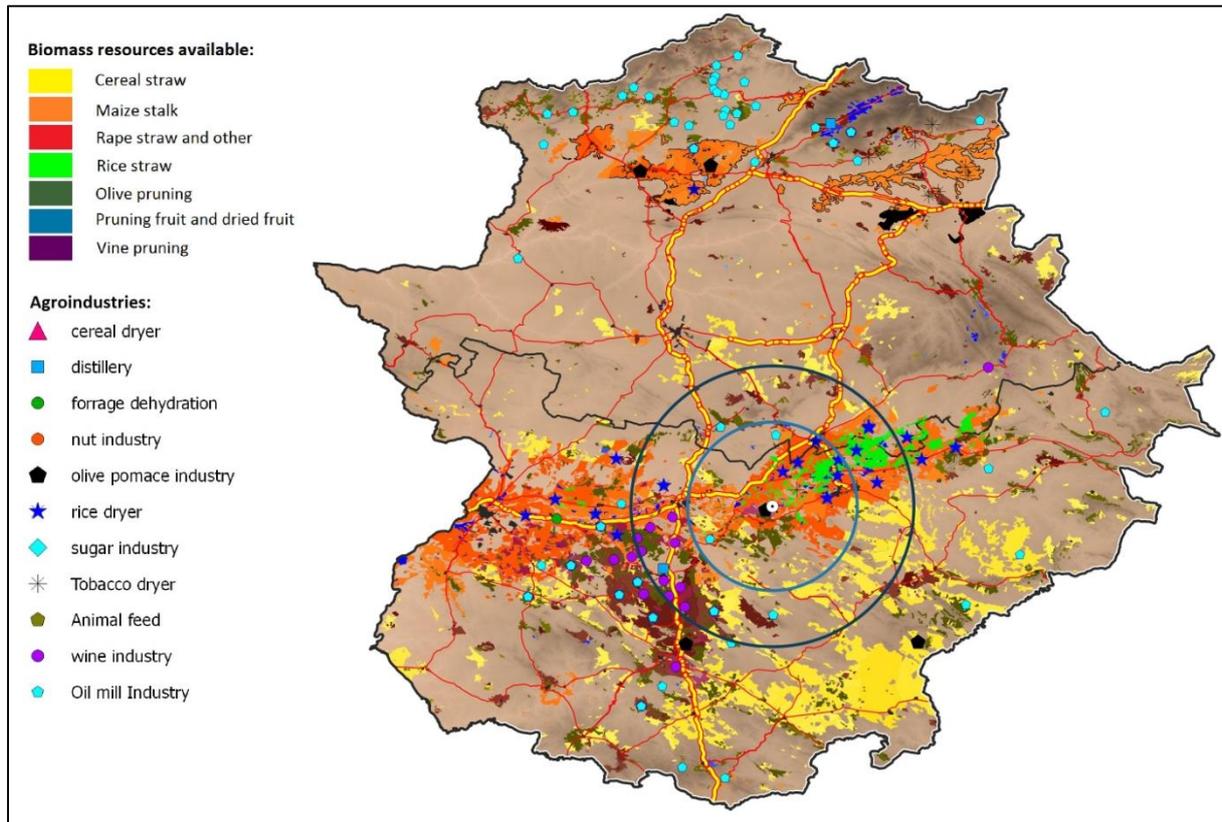


Figure 22: Map of available resources in a 30-50 km radius.

As a result of the conversations with the cooperative and consult of general data of the area of the cooperative, the available quantities and months of production are shown in Table 19.

Table 19: Data on the available residues in 30 km distance.

	Distribution	Surface (ha)	Resources (t/ha)	Resources (t/yr)	Harvesting months
Available surface	100%	6,500			
Pruning remains					
Traditional olive crop	65%	4,225	0.75	3,168.75	January-March
Intensive olive crop	20%	1,300	1.50	1,950	January-March
Superintensive olive crop	15%	975	0	0	January-March
			Total (t/yr)	5,118.75	
			Considered real availability (t/yr)	3,071.25	

Taking into account that the resources amounts are availability estimations, that not all of the cooperative partners will want to participate in the pruning collecting system and the impossibility of performing collections in certain areas because of the geographical complexity, this study has considered an average of 60% (3,071.25 t/year) of the calculated availabilities.

Other residues or crop residues from other crops (e.g., tomato matting, fruit pruning) have not been taken into account for several reasons, such as the complexity of the

collection, the low availability, the low acceptance on the part of the farmers to enter a system of collection of remains mainly on arable lands, the meteorological difficulties at the time of the collection, etc.

By proximity and being the main Partner Cooperative of TROIL VEGAS ALTAS, the members of the Cooperative Society of the Campo San Pedro de Guareña will be taken as the main providers of pruning biomass of olive crops.

The process of collection and gathering of the necessary biomass would be carried out by a specialized external company since TROIL does not contemplate the possibility of carrying out these tasks. The work of this company would be therefore to collect, chop and supply the pruning remains according to the needs of TROIL. The gathering would be held at the TROIL VEGAS ALTAS facility. Conversations with the TABISA company (local company), have concluded that the cost to the farmer would be around 100 €/ha without taking into account the income subsequently passed on by TROIL VEGAS ALTAS to the farmer for the biomass used.

3.6.2.2. Equipment and facilities available

At present, the cooperative has a horizontal type dryer and three rafts of storage but, given the nature of the line of action proposed (where another company would be in charge of the collection, pretreatment and supply of the biomass), the dryer is of no interest nor function for the present case. However, storage ponds do show potential utility for being able to house the biomass ready for consumption and provided by the company TABISA, so it would have to evaluate its use and real occupation throughout the year. In spite of this, it is foreseeable that, given the investment expectations in a new dryer, these ponds could not accommodate such an increase in production and, in that case, they would have to expand their surface or even build new ones (potential use).

3.6.2.3. Bioenergy market potential

Due to the characteristics of this study, it is not considered necessary to analyze the potential biomass market in the area, since TROIL VEGAS ALTAS becomes the biomass consumer itself. However, it is interesting to analyze and expose the market situation of alternative materials to the pruning of olive tree crops that the cooperative would use as fuel (to produce the necessary heat in the drying process) to complete the needs facing the shortage of olive pruning. In this sense, the following table shows the prices of this alternative biomass supplied in the area:

Table 20: Approximate prices of alternative biomass in the area.

Type of resource	Price
	€/t
Almond shell	60-80

Dry pomace	55
Olive pits	150
Wood chips	55

In the normal biomass market activity of the cooperative, with respect to olive pits, demand is increasing and, due to the high quality of the product, very profitable for the company. In a normal campaign, the commercialization of this product amounts to about 2.5 million kg at prices ranging from 140 €/t in the smaller formats to 100 €/t in bulk for industrial use.

3.6.3. Feasibility of the new business line as agro-industry logistic centre

As it was expressed at the beginning of this report, the study has focused in assessing the feasibility of the start up of a drying facility fed with biomass. For that, an energetic analysis was performed, which validates the possibility of carrying out the proposed line of actuation, starting from the forecast expressed by the cooperative of begin an expansion process of it drying capacity in 20 millions of kg of evaporated water, in order to satisfy the necessities of its partners.

Since currently TROIL VEGAS ALTAS utilizes the emitted gases by the cogeneration plant for the input of the required heat to the drier for its annual capacity (20 millions of kg of evaporated water at year) and that, due to economic reasons, is interested in maintaining this heating input (as it does not represent any expenditure and the facility works properly) it was calculated the remaining heating necessities which could be covered with the available biomass. In first place, it was observed the energetic potential of the same:

Table 21: Energy inputs from available biomass.

t/year	Biomass LCV (kJ/kg)	Energy (kJ/year)	Energy (kWh/year)
3,071.25	12,500	38,390,625,000	10,664,063

Three different working points were projected (implies different consumes), obtaining the next results:

Table 22: Estimation of energy demand covered by pruning.

Additional heating requirments			Heating input of olive pruning		Percentage covered with pruning
kg H ₂ O/year	kJ/year	kWh/year	kJ/year	kWh/year	
10,000,000	41,800,000,000	11,611,111	38,390,625,000	10,664,063	91.84%
15,000,000	62,700,000,000	17,416,667	38,390,625,000	10,664,063	61.23%
20,000,000	83,600,000,000	23,222,222	38,390,625,000	10,664,063	45.92%

In conclusion, regarding the heating necessities and the different viewed scenarios:

- In years with heating necessities for evaporating near to 30 millions of kg of water (the current 20 million plus 10 additional millions), TROIL VEGAS ALTAS would cover those with the input of the heat produced in the cogeneration process (20 million kg) plus the use of the olive pruning collected in the partner exploitations. Additionally, taking into account that maintaining the collecting

system of the olive pruning in the current conditions and during several years would generate utilizable surpluses from one year to other.

- In the most adverse case due to the amount of residues received in the agro-industry (drying necessities of 40 millions of water per year), TROIL VEGAS ALTAS would cover approximately the 73.41% of the heating necessities having into account the cogeneration gases and the olive pruning, and would remain for covering the approximated necessities indicated in the next table:

Table 23: Estimation of energy demand without covering in the adverse case.

	Requirements	Combustion gases	Olive pruning	Remaining
kg H ₂ O /year	kJ/year	kJ/year	kJ/year	kJ/year
40,000,000	167,200,000,000	84,355,646,400	38,390,625,000	44,453,728,600

In this case, it would have to be covered that necessity with other fuels in approximated amounts to the indicated in the next table. This study has only targeted in the 2 products which, due to the availability and the management, would better adapt to the facility requirement of TROIL VEGAS ALTAS.

Table 24: Technical parameters of the dry pomace.

DRY POMACE 15 % moisture		
Energy requirements (kJ/year)	Biomass LCV (kJ/kg)	Required biomass (t/year)
44,453,728,600	17,280	2,573

Table 25: Technical parameters of the wood chips.

WOOD CHIPS 35 % moisture		
Energy requirements (kJ/year)	Biomass LCV (kJ/kg)	Required biomass (t/year)
44,453,728,600	11,000	4,041

That is to say, it has been presented two scenarios:

- Pruning scenario + dry pomace
- Pruning scenario + wood chips.

To perform the economic assess of the proposed facility (based in the two previous scenarios) in this analysis are going to be taken into account concepts as the required investments, annual costs, raw material, etc.

The investment costs to consider in the study will be exclusively linked to the multifuel burner (260,000 € and 10 years amortization).

The purchasing cost of the olive tree pruning will be the defined by the specialized company in logistic which would be in charge of that. The estimative price for this work is currently valued in some 0.0165 €/kWh which are traduced in some 57.3 €/ton of pruning (25% moisture) delivered in the agro-industry. On the other hand, the dry

pomace prices (15% moisture) and the wood chips (35% moisture) estimated (including transport to the agro-industry) are of 22 €/t and 55 €/t respectively.

In our case, pretreatment costs would not be taken into account as all the types of biomass which would be utilized in the production process would be disposed in the format and quality for being directly utilized.

Regarding the production costs, personnel and other costs, it is going to be taken into account the cost of an employer partially during the 15% of its dedicated time to the feeding of the burning system and the maintenance of the same. As well as the 20% of the amortization costs of a machine dedicated to the biomass manipulation. The cost that the company has to assume will be valorized in 2,700 €/year in the workforce and 500 €/year in machinery.

The agro-industry benefit would be reflected as the energetic save compared with the other fuel which, because of the availability conditions, is more feasible to use, as it is the natural gas. Therefore, the save which supposes the use of the biomass independently of the utilized type against natural gas is the next:

Table 26: Estimated saving by biomass use.

Fuel	Annual cost (€/year)	Difference (€/year)	Fuel savings (%)
Natural Gas	552,296		
Dry pomace	105,473	446,823	81%
Olive pruning + dry pomace	232,553	325,051	58%
Olive pruning + wood chips	398,226	179,607	28%

Taking into account all the costs of the initiative (including costs of investment and personnel), comparing the natural gas with the pruning scenario and dry pomace, result that with the savings generated by the biomass consume it is paid the biomass burner installation in the first year.

Table 27: Savings by the use of biomass (olive pruning + dry pomace).

Fuel	Fuel cost (€/year)	Burner amortization cost (€/year)	Workforce cost (€/year)	Drying process cost (€/year)	Saving against natural gas (€/year)
Natural gas	552,296	6,500	0	558,796	-
Olive pruning + dry pomace	232,553	26,000	3,200	261,753	297,043

*For those calculations a 10 years amortization period has been considered for the burners and the natural gas burner cost as ¼ of the biomass. It has not been considered the personnel cost or other costs associated to the natural gas utilization in the drying facility.

3.6.4. Conclusions

The second degree cooperative TROIL VEGAS ALTAS is devoted to the management and valorization of the partner's oil mill residues.

In recent years it has experimented an increasing of the intensive and super intensive crops systems in the exploitations of partners farmers, which multiplies by 5 the olives production and, therefore, of residues of the oil mills from the partners cooperatives.

Faced with this situation, which will become apparent in the coming years, TROIL VEGAS ALTAS has the need to adapt. For that, it would have to increase the processing capacity of high moisture level residues, holding a low level of production costs, according with the type of agro-industry and the products which generates.

Taking into account that, until now, the heat generation cost for the drying of the dry pomace has been practically null, due to the utilization of the cogeneration process gases that has installed the cooperative, the work capacity expansion is going to result more expensive due to the acquisition of the needed raw material. This study has analyzed the possibility of substituting heat necessities by biomass from olive tree pruning mainly and, additionally of wood chips or the dry pomace obtained from thirds.

Since the economic point of view, the saving level that is achieved without using the natural gas is, in principle, the most comfortable option that a lot of agro-industries choose. In one year, due to the minor price of the biomass in relation with the natural gas, it could be amortized the extra cost that generates the installation of a biomass multifuel burner with respect to one of natural gas.

Among the types of biomass that have been analyzed, due to the current situation of prices in the biomass market, the dry pomace is undoubtedly the most profitable fuel and that most savings generates in such an installation. However, it is a fuel that does not affect in any way the members of the cooperative as can do the use of olive tree pruning. On the other hand, it is a fuel with a high ash content and with a dusty format whose safety implications should be examined with caution. Knowing this, it is considered a very interesting opportunity for TROIL to start a new line of olive tree pruning consumption of its partners.

The collection of olive tree pruning, regardless of cost, is something that is considered indispensable because it proves to be an environmental measure and agronomically useful for the members of their cooperatives. In fact, it is expected that its progressive implementation will be possible based on the estimation made in this study until trying to fully cover the needs of heat and even have surpluses for sale.

In order to comply with the rules of conditionality, reduce the occupational hazard, increase the environmental efficiency of collection, etc., the system of collection and management of pruning remains of the olive trees is a priority. In order to advance in this aspect, it is considered indispensable field tests with a company as well as convincing actions by the TROIL member cooperatives to their farmers.

The start in the management of biomass beyond the products generated by the agro-industry is intended to be the beginning of the possibility of opening new lines of work. Among them could be the complementarities with the activity of the composting plant that will soon launch the management of other types of agricultural waste and the diversification of products to market as is done with high quality olive pit, the oil pomace, etc.

With all this, it is considered that the action planned by TROIL VEGAS ALTAS taking advantage of the olive pruning resource of its partners is totally viable technically, economically and environmentally and that is also necessary for its activity and sustainable over time.

3.6.5. Summary of additional support actions

In October a meeting was held among Agro-food Cooperatives of Extremadura, CIRCE and Agro-food Cooperatives of Spain in order to agree on the actions to be taken to determine how TROIL could be supported to diversify its activity. TROIL focuses its activities on managing the by-products of its partners' olive oil mills and valuing them and is interested in the project because it believes that it could provide support to valorize other by-products that the cooperative does not value today.

At first, it is proposed to focus this support on two possible lines in relation to potentially available resources:

- Olive pit: evaluating its potential market, focusing, as far as possible, on its residential use. Evaluating, in addition, the current market and, finally, trying to categorize the quality of the pit that they have.
- Remains of olive pruning: analysis of the use of this resource for self-consumption and, even considering the possibility of replacing the natural gas with agricultural residue in the cogeneration that they currently do.

After going in depth with the aspects related to them, through talks with TROIL, and as referred at the beginning of this audit report, it was decided to discard the line related to the olive pit since this product is already considered of high value and quality and already has an interesting and sufficiently mature market.

This is why the additional support focuses on the exploitation of the remains of the olive tree pruning of the members of the cooperative to cover the thermal needs of the TROIL process. This line is also a little more precise, since in an initial diagnosis about current and future thermal needs, TROIL manifests its interest in maintaining

cogeneration with current natural gas, not expanding it, but opting to complement the heat provided by the cogeneration through the use of the pruning remains of its partners.

Thus, as detailed in the reports of local meetings related to TROIL in D6.7, a series of meetings were held with agents of interest to be able to provide support in two areas:

- Available resources and management: quantity, seasonality, logistics operations, etc.
- Combustion equipment: TROIL requirements, feasibility of using TROIL resources as fuel, etc.

In terms of resources, the manager of one of TROIL's member cooperatives, the largest cooperative in the area in relation to the olive groves of its partners, provided interesting information about aspects related to the farms of its partners (size, accessibility, etc.), as well as their previous experiences in similar initiatives that were not finally carried out by different problems.

On the other hand, in the same way, the logistic operator TABISA Servicios y Obras analyzed the case of TROIL based on previous experiences in the management of olive tree pruning remains. In the same way, the visit to the Provisiona Verde facilities allowed us to conclude that the use of olive tree pruning for energy use was possible provided that it was accompanied by an adequate pre-treatment.

In relation to combustion equipment and drying equipment, the meeting with Calquega Biomass, as an expert in combustion equipment with the resources of low-medium quality and, in addition, drying facilities, allowed to know the possibilities of equipment that would adapt more to the future needs of TROIL.

Analyzing the above aspects, and as shown in the conclusions of this report, the results have shown the future viability of the use of the olive tree pruning remains of TROIL partners. It was therefore marked the beginning of this action that would have to be complemented with field tests by some logistic operator in the plots of the partners, as well as sensitizing them regarding the delivery of the pruning remains.

3.7. Auditing study of MELISANTO, Soc. Coop. Galega

3.7.1. Company description

MELISANTO Cooperative Society is made up of 675 farmers and has an economic activity primarily based on the manufacture of compound feed and marketing of agricultural inputs. Generally, the main purposes of the activities of MELISANTO are the distribution of necessary elements for the livestock farms of their associated farmers and provide them with services.

MELISANTO owns a compound feed factory, established in 1984 which has been improved over the years. This factory has the necessary machinery to produce 20,000

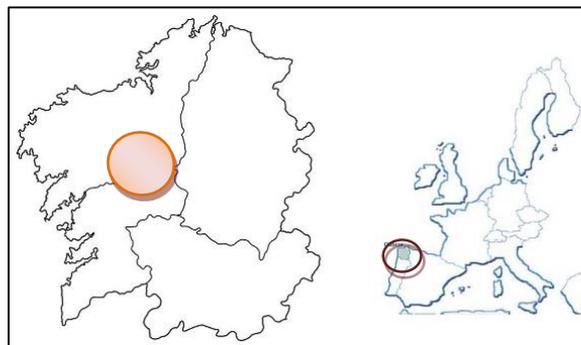
tons/year of compound feed in pellet format, metal silos for storage of raw materials (corn, barley, pulp, etc.) and other necessary installations for the manufacture of compound feed.

The cooperative also has a shopping centre with a covered surface of around 1,000 m², where it commercializes the products and inputs necessary in the livestock farms of their partners. Among other things, it distributes veterinary products and pesticides, working clothes, seeds and gardening products, feedstuff for domestic animals, etc.

The MELISANTO, Soc. Coop. Galega, cooperative is not a producer or consumer of biomass currently. It has only experience in the commercialization of biomass by providing their members small batches of wood biomass briquettes for occasional use.

The General Manager of MELISANTO is interested in the performance of a techno-economic study to determine the feasibility to become a Biomass Logistics Center (BLC) and, subsequently, to decide the actions to follow within the General Board of the cooperative (composed of 10 members), who is the decision maker.

It is located in Agüeiros-Furelos (Melide - A Coruña) as can be seen in Figure 23.



**Figure 23: MELISANTO, Soc. Coop. Galega.
(Source: Sigpac).**

The main activities of the cooperative are the followings:

- Manufacture of compound feed: With a compound feed factory that produces about 2,000 t/month of different types of feed.
- Joint marketing of the productions of its partners farms: Mainly milk and beef calves.
- Joint purchasing of inputs: fertilizers, pesticides, animal health, plastics and other inputs and agricultural products needed in farms.
- Training of the partners: through seminars and training organized by the cooperative in specific areas of agricultural character.
- Technical Services: The cooperative has some technical and veterinary services to facilitate decision-making partners resulting from their activity.

3.7.2. Synergies to become an agro-industry logistic centre

3.7.2.1. Biomass resources availability:

Figure 24 shows the type of agricultural residues that are available and therefore that could be used for the production of solid biomass.

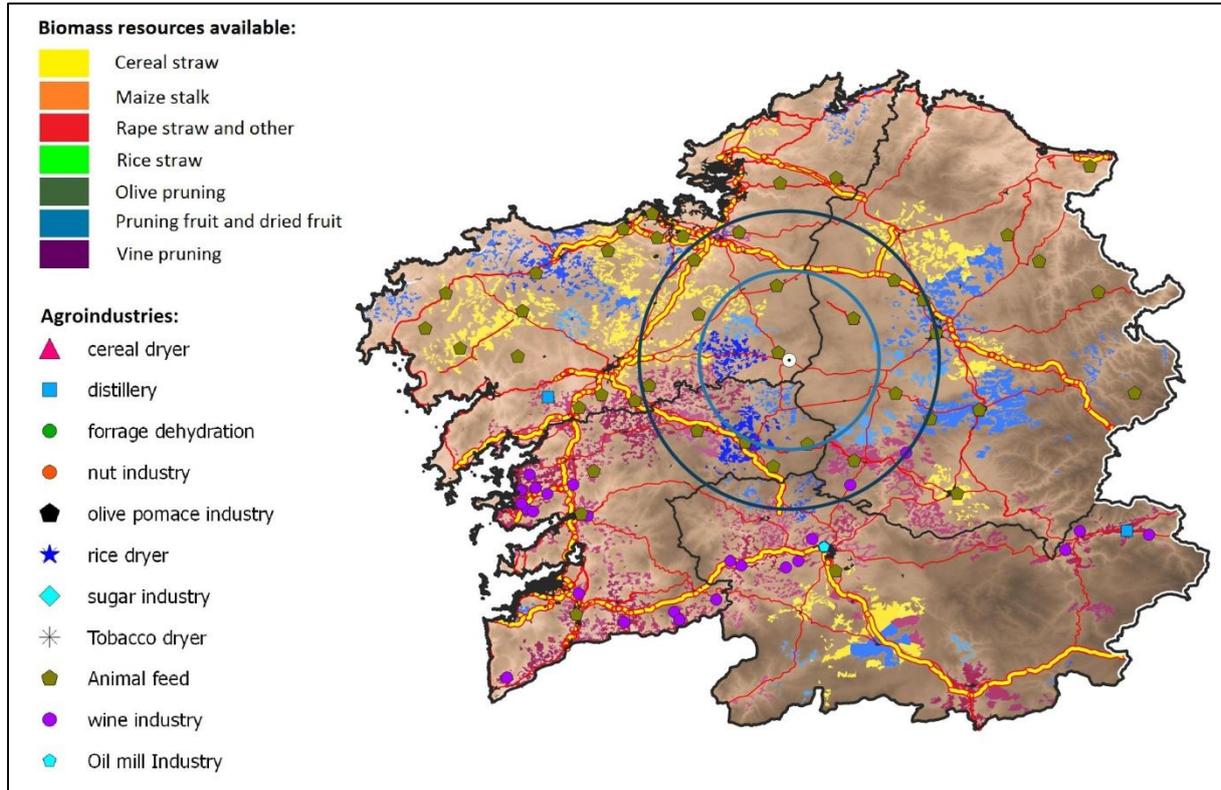


Figure 24: Map of resources available in a 30-50 km radius.

As result of the conversations with the cooperative and consulting general data of the area of the cooperative, the available quantities, moisture content (weight percentage in wet base, w-% ar), months of production and purchasing price including transport to the cooperative are shown in Table 28.

Table 28: Data on the available residues in 30 km distance.

Type of residue	Quantity available	Moisture content	Months of harvest	Purchasing Price (transport included)
	t/yr	w-% ar		€/t
Cereal straw	500	15	Jul/Sep	39
Animal feed (cereals flour)	200	5	All the year	-
Pruning wood	800	60	March/May	47
Forestry wood	10,000	50	All the year	57

The poorly formulated feed that cannot be used for animal feed, are currently managed and treated as municipal solid waste and will not be considered in the production of solid biomass.

As a first stage, it will be taken into consideration all the available resources to make a mixed pellet. The Cooperative should make an effort to promote the creation of logistics chain on vineyard prunings within the near-by caves since currently do not exist in the area.

3.7.2.2. Equipment and facilities available

Due to the activity of the animal feed factory, the cooperative owns most of the equipment needed for the biomass pellet production. It is equipped with a 100 hp mill with a milling capacity of 15 t/h and 180 hp pelletizer with a capacity of 10 t/h.

The equipment that is proposed to be used for the new business line as biomass logistics centre is highlighted in the diagram of Figure 25.

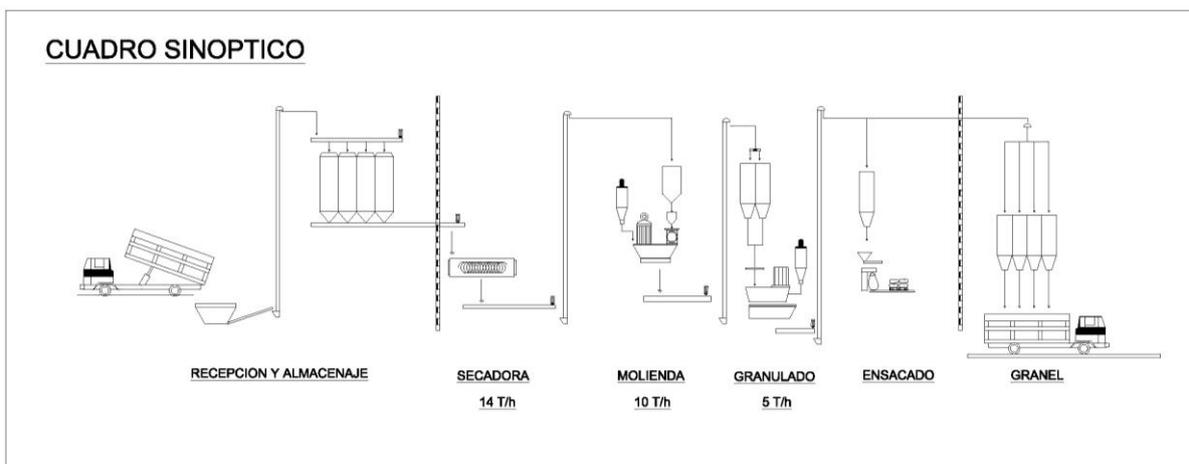


Figure 25: Flow diagram of the biomass pelletizing line.

As it can be observed, there is not available equipment for drying. Additionally, due to the reduced idle period of the pelletizing line a series of investments for the new business line have been considered:

- Rotatory drier.
- Mixer – Pelletizer.
- Conveyor belts.

The period of production of solid biomass will be set according to the availability of the storage of the resources, but it will be probably carried out in the middle of the year.

3.7.2.3. Bioenergy market potential

According to preliminary studies, in the region the potential consumer market of biomass to be targeted are the cattle and pig farms, as well as for the house of the farmers. They are mainly consumers of forestry pellets.

The characteristics of biomass offered by current suppliers of biomass in Galicia are shown in Table 29.

The market of biomass is quite demanding in terms of quality. In conversations with the manager and users of biomass for farming applications, certain distrust of the installation of large consuming equipment has been detected, because installers do not take into account the need to maintain the process temperature. They point out that a variation of 5° C in the ambient temperature of a pig farm could mean significant losses, stopping the growth of animals. Another difficulty arises from the malfunction of biomass feed system to the boiler. In addition, the maintenance of these facilities requires more labour in cleaning chimneys and boilers than diesel facilities.

Table 29: Data of the competitors.

Type of residue	Price		PCI	Ash content
	€/t	€/kWh	kWh/t	w-% db
Wood chip (bulk) (12 tonnes truck)	109	0.025	4,420	3.5
Forestry pellet (sack) (pallet 945 kg)	248	0.055	4,536	0.50
Forestry pellet (bulk) (tank 5000 kg)	245	0.054	4,536	0.50
Forestry pellet (big bag) (950 kg)	233	0.055	4,200	0.60
Forestry pellet (sack) (pallet 1155 kg)	205	0.052	3,960	0.70
Olive pit (bulk) (12 tonnes truck)	173	0.036	4,760	4.00

3.7.3. Feasibility of the new business line as agro-industry logistic centre

The cooperative is interested in assessing the feasibility of starting a new business line as biomass logistics centre for production and sale of the solid biomass products included in Table 30.

Table 30: Solid biomass products for the new business line.

Type of solid biomass	Amount of production t/yr
-----------------------	---------------------------

Mixed pellets of cereal straw (30%)+ feed flour (10%)+wood (pruning +forestry) (60%)	1,500
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These mixed agricultural biomass pellets are formed with some products and residues from agricultural activity: 30 % of cereal straw, 10 % of poorly formulated feed and 60 % from prunings and forestry wood. The share of each raw material has been evaluated to fulfil the quality parameters stated in ISO 17225-6 standard.

Taking as reference ISO 17225-6 Standard and according the literature with regard to the resources characteristics, it can be said that:

- The pellet obtained has a net heating value (on wet basis) of 4.44 kWh/kg, ash content of 3.50 % (w-%db) and chlorine content of 0.13 % (w-% db).
- Comparing these values with the requirements of the ISO-17225-6 standard, this pellet should be consider as type B since the chlorine content estimated (coming mainly from the cereal straw) makes impossible to fulfil class A.

The performance of this new production line has been calculated in a feasibility study, according a production period of 50 days per year (7 h/day) and a pelletizer performance of 5 t/h. Thus, the foreseen production will be 1,500 t/year considering technical stops that can influence in the computation time.

With regard to the production costs, the total cost of producing the mixed pellets proposed is 133 €/t. The graph below (Figure 26) shows the relative importance of each cost: The purchase of raw materials constitutes 56 % of the total cost while the pre-treatment means 44 % of total production costs. The personnel costs have been included in the pre-treatment costs. In this study management and sale personnel costs have not been considered for this new production.

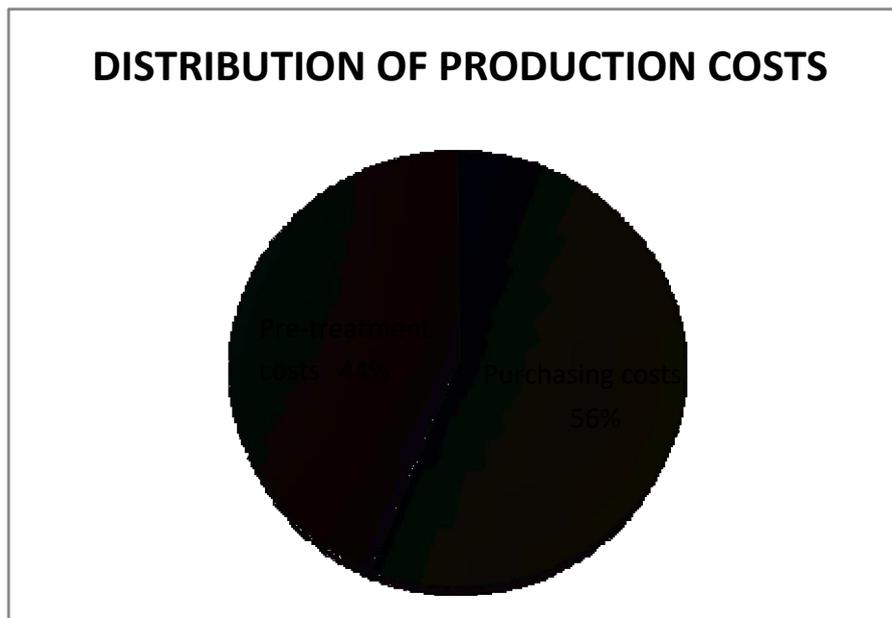


Figure 26. Allocation of production cost of mixed pellets

In order to compare the final product with competitors, the minimum selling price should also include transport costs to consumers.

In this case, it has been considered a hypothesis of a minimum benefit between 0 – 15 €/t and transport costs between 10 - 15 €/t depending on the type of truck (tanker or dump) for an average distance of 100 km (round trip). The calculations indicate that the minimum selling price in the market could be between 152 €/t and 172 €/t (0.033 to 0.038 €/kWh). This price includes the amortization quota of the investments planned.

The product, which has a competitive price in terms of energy compared to wood pellets distributed in the area, could be sold in the shops that the cooperative owns. A deeper assessment on their quality properties is needed as to determine the real values of the mixture, especially in what concerns the ash content.

3.7.4. Conclusions

MELISANTO Cooperative Society carries out a social work in the region with their members and is interested in the performance of a technical-economic study to determine the feasibility to become a biomass logistics centre.

In the region there is enough raw materials to be used for the production of solid biomass and exploited as a source of thermal energy for a potential consumer market. The target segment of consumers includes the cattle and pig farms, as well as the farmers households.

According to the quality data of the available raw material, the theoretical calculations indicate that there is a possibility of producing a mixed agricultural pellet of by-products and residues from agriculture with the following mixture: 30 % of cereal straw, 10 % of poorly formulated feed and 60 % of pruning and forestry wood. The pellet obtained would have a net heating value (ar) of 4.44 kWh/kg, ash content of 3.50 % (w-%db) and chlorine content of 0.13 % (w-% db). According to these values and the requirements of the standard ISO-17225-6, this pellet could be classified as type B.

In this initial study to determine the feasibility of the biomass logistics centre, it has been taken into account the costs of a minimum investment in machinery and equipment, the purchase costs of agricultural residues, pre-treatment costs including personnel costs of maintenance and operation, and other associated expenses. The calculations indicate that the minimum selling price could be between 152 €/t and 172 €/t (0.033 to 0.038 €/kWh).

The prices seem to be competitive in the market compared to wood pellets currently marketed. However, especial attention should be paid on the higher amount of ash content compared to forest-derived products. Consumers will require higher maintenance in their combustion equipment in contrast to a more competitive price. For this reason, chemical analysis of the product and test in target consumers' equipment are highly recommended before marketing the product.

The economic study has concluded that taking into consideration a discount rate of 4 %, the cooperative could get a positive NPV and an IRR of 11 % return with a pay-back of 6 years.

With regard to the commercialization of these products, with the amount of production proposed, the needs of the local market could be covered, provided that the pellet quality is maintained, there are no problems in the supply chain (especially in what concerns the pruning) and the operation of the consumer's facility is adapted to the characteristics of an agrarian pellet.

3.8. Auditing study of OS IRMANDIÑOS, Soc. Coop. Galega

3.8.1. Company description

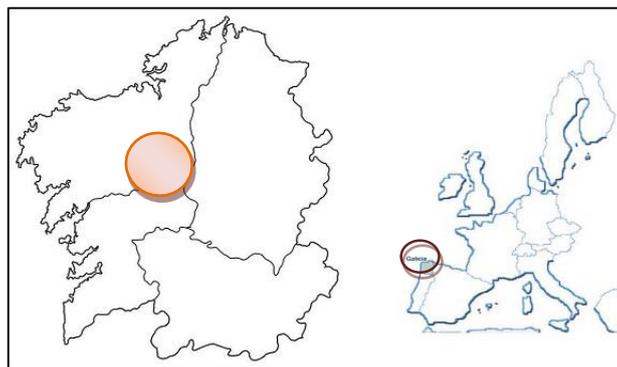
OS IRMANDIÑOS Cooperative Society is made up of 1,100 farmers and has an economic activity primarily based on the manufacture of compound feed and marketing of agricultural inputs. Generally, the main purposes of the activities of OS IRMANDIÑOS Cooperative Society are the distribution of necessary elements for the livestock farms of their associated farmers and provide them with services.

OS IRMANDIÑOS Cooperative Society owns a compound feed factory, established in 1978 which has been improved over the years. This factory has the necessary machinery to produce 80,000 tons/year of compound feed, a bulk exit system with a metal structure cover, metal silos for storage of raw materials (corn, barley, pulp, etc.) and other necessary facilities for the manufacture of compound feed.

OS IRMANDIÑOS Cooperative Society is not a producer or consumer of biomass currently. It has only experience in the commercialization of biomass by providing their members small batches of wood biomass briquettes for occasional use.

The General Board of the cooperative is the one that makes the decisions that will be developed by the technical team supervised by the Director-Gerent. The General Manager of OS IRMANDIÑOS Cooperative Society is interested in the performance of a techno-economic study to determine the feasibility of becoming a Biomass Logistic Center (BLC) and, subsequently, to decide the actions to follow.

It is located in A Devesa (Ribadeo - Lugo) as can be seen in Figure 27.



**Figure 27: OS IRMANDIÑOS Cooperative Society.
(Source: Sigpac).**

The main activities of the cooperative are the followings:

- Manufacture of compound feed: With a compound feed factory that produces about 6,000 t/month different feed types.
- Joint marketing of the productions of its partners farms: fertilizers, phytosanitary, zoosanitary, plastics and other inputs and products necessary in agricultural exploitations.
- Use of common agricultural machinery.
- Training of the partners: through seminars and training organized by the cooperative in specific areas of agricultural character.
- Technical services: the cooperative has some technical and veterinary services to facilitate decision-making partners resulting from their activity.

3.8.2. Synergies to become an agro-industry logistic centre

3.8.2.1. Biomass resources availability:

Figure 28 shows the type of agricultural residues that are available and, therefore, that could be used for the production of solid biomass.

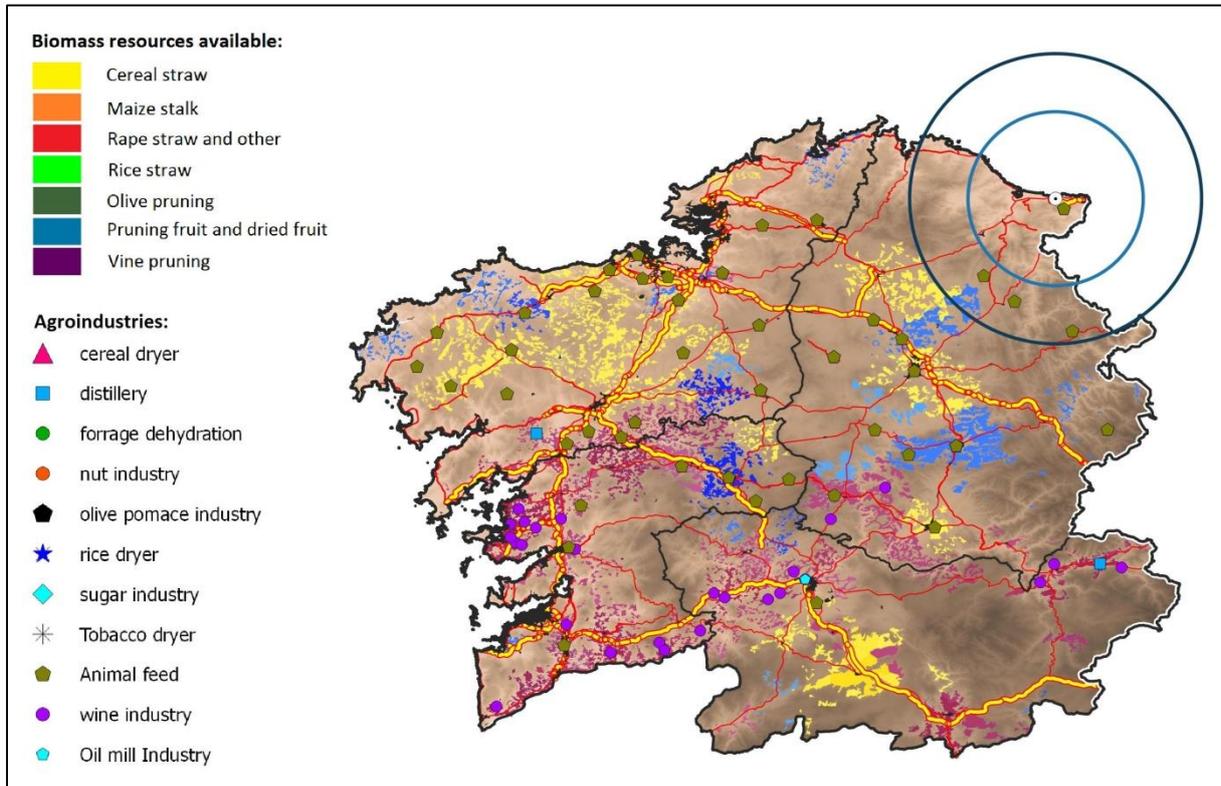


Figure 28: Map of resources available in a 30-50 km radius.

The available quantities, moisture content, months of production and purchasing price, including transport to the cooperative, are shown in Table 31.

Table 31: Data on the available residues in 30 km distance.

Type of residue	Available amount	Moisture content	Harvest months	Purchasing price (transport included)
	t/year	% m/m wb		€/t
Cereal straw	100	15	July/September	39.00
Feed (cereal flour)	2,000	5	All the year	0.00
Pruning wood	800	60	March/May	47.00
Forestry wood	10,000	50	All the year	57.00

The poorly formulated feed that cannot be used for animal feed, are currently managed and treated as municipal solid waste and will not be considered in the production of solid biomass.

3.8.2.2. Equipment and available facilities

Although it does not exist the possibility of paralyze the production of feed since the factory operates throughout all the year, OS IRMANDIÑOS Cooperative Society is interested in the technical-economic study for the creation of a biomass logistic centre.

For this purpose, OS IRMANDIÑOS Cooperative Society could utilize part of its current facilities also making and investment in the purchase of the necessary machinery. At the request of the management, this feasibility study is proposed for a processing plant of up to 1,500 t/year of agricultural and forest biomass to make pellet, with the following processes:

1. Raw material pre-treatment, chipped (to be made in the field).
2. Storage, cleaning and dosing of the raw material.
3. Thermal drying.
4. Grinding.
5. Granulation.
6. Bagging/palletizing
7. Bulk storage with direct cargo to truck.

The necessary investments will be determined according to the needs of the process and the availability of existing machinery.

The following figure shows the basic outline of the new biomass handling and processing plant for the production of pellets.

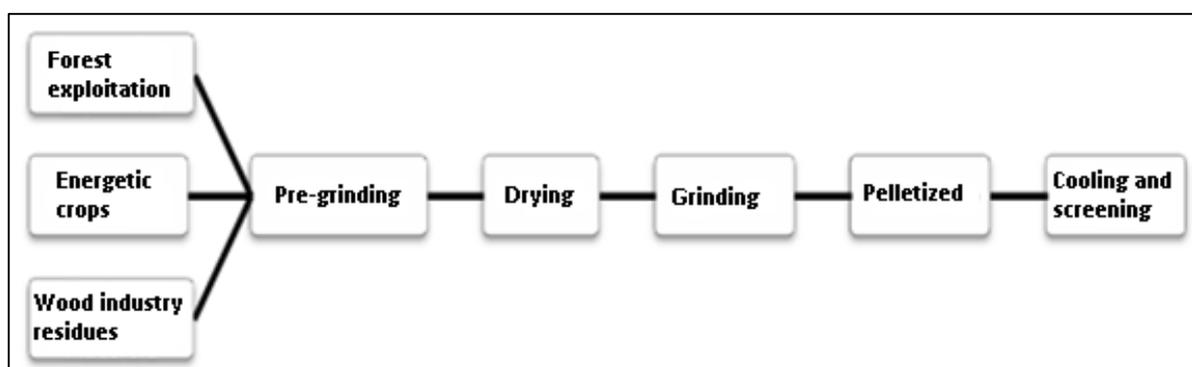


Figure 29: Flow diagram of the pellet manufacture.

Drying is a basic operation to remove moisture from the biomass and facilitate processing. This operation requires high energy consumption to reduce humidity from 30-50 % wb to 10 % wb. It must be done at low temperatures, in a rotary drier or trómel.

Grinding is performed to make the particle size of the biomass more uniform, in order to facilitate pellet formation. To achieve the granulometric reduction, a hammer mill is used.

The pelletization of the biomass is carried out by means of a flat die press. Once the pellets are made, they are cooled and subjected to a last sieve to remove any possible leftovers. The parameters that should be monitored in the pelletizing are the moisture and biomass size, the physical and chemical properties of each biomass, the diameter of the alveoli of the pelletizer matrix to obtain a homogeneous pellet diameter, and the length of compression. In order to carry out a successful pelletizing, the raw material must not have moisture content higher than 10 % wb.

Finally, the pellet is prepared for shipment, in bulk, big-bag or bagged.

3.8.2.3. *Bioenergy potential market*

According to preliminary studies, the potential consumers market of biomass to be targeted in the region are the cattle and pig farms, as well as for the house of the farmers.

Drying is a basic operation to remove moisture from the biomass, in order to facilitate processing. This operation requires high energy consumption to reduce humidity from 30-50 % (w-% ar) to 10 % (w-% ar). It must be done at low temperatures, in a rotary drier or trómel.

The characteristics of biomass offered by current suppliers of biomass in Galicia are shown in Table 32.

Table 32: Current biomass suppliers data.

Product	Price €/t	PCI kWh/t wb	Price €/kWh	Ash content (w-% ar)
Bulk forestry chip (12 t truck)	109	4.420	0,025	3,50
Sack forestry pellet (945 kg palet)	248	4.536	0,055	0,50
Bulk forestry pellet (5.000 kg tank)	245	4.536	0,054	0,50
Big-bag forestry pellet (950 kg)	233	4.200	0,055	0,60
Sack forestry pellet (Palet 1.155 kg)	205	3.960	0,052	0,70
Bulk olive bone (12 t truck)	173	4.760	0,036	4,00

The price (€/t) does not include transport or VAT.

Some suppliers give the data of PCI in kcal/kg and others provide the data in kWh/kg. In the table the values of the suppliers are transformed to kWh/kg.

3.8.3. Feasibility of the new business line as agro-industry logistic centre

The cooperative is interested in assessing the feasibility of starting a new business line as biomass logistic centre for production and sale of the solid biomass products included in Table 33.

Table 33: Solid biomass products for the new business line.

Solid biomass type	Production amount (t/yr)
Straw pellets + flours + woods	1,500

These mixed agricultural biomass pellets are formed with some by-products and residues from agricultural activity: 15 % of cereal straw, 30 % of poorly formulated feed and 55 % from prunings and forestry wood.

The performance of this new production line has been calculated in a feasibility study, according a production period of 50 days per year (7 h/day) and a pelletizer performance of 5 t/h.

$$\text{Production} = 5 \text{ t/h} \times 7 \text{ h/day} \times 50 \text{ days/year} = 1,750 \text{ t/year}$$

Thus, the foreseen production will be 1,500 t/year considering technical stops that can influence in the computation time.

The chipping of pruning/forestry is done in the field, which would require a drying system, a mixer-pelletizer and two conveyor belts. In principle, the bagged is not considered since the pellet will be sold in a big bag of 900 kg.

With regard to the production costs, the total cost of producing the mixed pellets proposed is 123.98 €/t. The graph below (Figure 30) shows the relative importance of each cost: The purchase of raw materials (biomass) constitutes 61 % of the total cost while the pre-treatment means 39 % of total production costs. The personnel costs have been included in the pre-treatment costs. In this study management and sale personnel costs have not been considered for this new production.

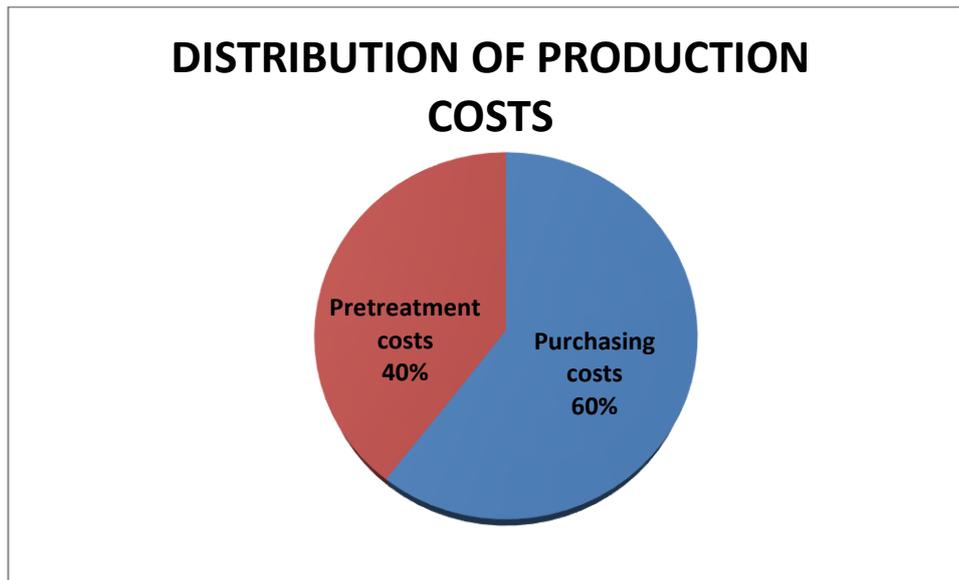


Figure 30. Allocation of production cost of mixed pellets

In order to compare the final product with competitors, the minimum selling price should also include transport costs to consumers. In this case, it has been considered a hypothesis of a minimum benefit between 0 – 15 €/t and transport costs between 10 - 15 €/t depending on the type of truck (tanker or dump) for an average distance of 100 km (round trip). The calculations indicate that the minimum selling price in the market could be between 151.18 €/t and 171.18 €/t.

3.8.4. Conclusions

OS IRMANDIÑOS Cooperative Society carries out a social work in the region, since it is not only the company in which the farmers are provisioned of the raw materials and agricultural products that they need in their exploitations. It also serves as a marketing channel for the agricultural production of these farms.

The OS IRMANDIÑOS Cooperative Society is not a producer or consumer of biomass. With a future vision, the management of OS IRMANDIÑOS is interested in the realization of this technical-economic study to know the feasibility of becoming a Biomass Logistic Center (BLC) and then, decide the actions to be followed.

In conversations with the manager and users of biomass for farming applications, certain distrust of the installation of large consuming equipment has been detected, because installers do not take into account the need to maintain the process temperature. They point out that a variation of 5° C in the ambient temperature of a pig farm could mean significant losses, stopping the growth of animals. Another difficulty arises from the malfunction of biomass feed system to the boiler. In addition, the maintenance of these facilities requires more labour in cleaning chimneys and boilers than diesel facilities.

In the region there is enough raw materials to be used for the production of solid biomass and exploited as a source of thermal energy for a potential consumer market. The target segment of consumers includes the cattle and pig farms, as well as the farmers households.

According to the quality data of the available raw material, the theoretical calculations indicate that there is a possibility of producing a mixed agricultural pellet of by-products and residues from agriculture with the following mixture: 15 % of cereal straw, 30 % of poorly formulated feed and 55 % of pruning and forestry wood. The pellet obtained would have a net heating value (wb) of 4.70 kWh/kg, ash content of 3.00 % (w-% db) and chlorine content of 0.07 %. According to these values and the requirements of the standard ISO-17225-6, this pellet could be classified as type A.

In this initial study, to determine the feasibility of the biomass logistics centre, it has been taken into account the costs of a minimum investment in machinery and equipment, the purchase costs of agricultural residues, pre-treatment costs including personnel costs of maintenance and operation, and other associated expenses. The calculations indicate that the minimum selling price could be between 151.18 €/t and 171.18 €/t.

In the comparison with the production of non-forest biomass pellets, the quality obtained indicates that it is possible to compete with existing suppliers. With regard to the commercialization of these products, with the amount of production proposed, the needs of the local market could be covered, provided that the pellet quality is maintained, there are no problems in the supply chain (especially in what concerns the pruning) and the operation of the consumer's facility is adapted to the real necessities of thermal energy production.