Triggering the creation of biomass logistic centres by the agro-industry

SUCELLOG: IEE/13/638/SI2.675535

D4.4c
Summary of Cooperative Luzéal-Saint Rémy Business Model

30.12.2015

Co-funded by the Intelligent Energy Europe Programme of the European Union

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.

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About this document

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This project is co-funded by the European Commission, contract N°: IEE/13/638/SI2.675535

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1. Introduction

Within WP4, SUCELLOG project performs a techno-economic feasibility study to one agro-industry per target country in order to evaluate their possibilities to develop a new business line as a biomass logistic centre. The study presented different possible scenarios of business among which the beneficiary has chosen the most convenient according to his situation and perspectives.

In the case of Cooperative Luzéal-Saint Rémy, the French agro-industry selected to be support by the project, the scenario chosen was to produce agro-pellets (more details can be found in document D4.3). The scope of this report is to present a tailor-made Business Model for it.

The Business Model is the set of organizational and strategic solutions through which the Cooperative acquires a competitive advantage: it describes the logic with which an organization creates a value proposition for the customer, performs it and gets a portion of the economic value generated.

The model is organized in conceptual blocks that allow making clear the relevant phenomena to the Cooperative's management and that are explained in **Table 1**.

Table 1: Basic building blocks of the Business Model.

Block	What does this block defines	What does this block identifies
Customer segments	The different groups of people or organizations that an enterprise aims to reach and serve	Subjects (people, companies) for whom we want to create value, dividing them into segments, and defining characteristic features (specific needs, different channels, types of relationships, different profitability)
Value propositions	The bundle of products and services that create value (benefit) for a specific Customer Segment.	Problems or needs to be solved or satisfied
Channels	How a Cooperative communicates with and reaches its Customer Segments to deliver a Value Proposition	Customers' favorite channels and their availability, integration, effectiveness and costs
Customer Relationship	The types of relationships a Cooperative establishes with specific Customer Segments	Types of relationships expected by the customer and their costs and integration with other components of the Business Model
Key Resources	This is the most important assets required to make a Business Model work: defines resources required according to the value proposition and the various processes to improve it, producing value and getting a significant part of it.	The human, financial, physical and intellectual resources.
Key Activities	The strategic activities that must be performed to create the Value Propositions, reach customers, maintain relations with them and generate revenues	The most important tasks that a Cooperative has to carry out in order to achieve its business objective
Cost structure	All costs incurred to operate a particular Business Model	The major cost areas in the Business Model: resources and fundamental processes costs (fixed costs, variable costs, economies of scale, etc.).
Revenue streams	The cash a Cooperative generates from each Customer Segment (costs must be subtracted from revenues to create earnings).	Forms of revenue, sale of goods, use of services, fees, rentals and leasing, brokerage fees, advertising fees

Block	What does this block defines	What does this block identifies
Key Partners/Suppliers	The network of suppliers and partners that make the business model work.	Fundamental partnerships (key partners and suppliers): resources and activities provided; suppliers of resources to optimize the business; risk coverage suppliers; critical resources suppliers
Competitors	Analysis of the competitive environment	Information on similar products available in the market (price, quality, service granted); profiles of competitors, strengths and weaknesses
Market	Optimal strategies for the acquisition of required market share and a good positioning compared to the competition	Ways to reach the customers target and the sales target. Analysis of marketing variables (product, price, place, promotion).
Authorization process and permits required	Main categories of permits and permissions required to start or change the activity	Summary assessment of their procedural complexity; estimated average timing for obtaining authorizations.

2. Agroindustry Luzéal-Saint Remy

After the feasibility study performed by SUCELLOG project, the Cooperative has decided that the best scenario for the new business line is to produce and sell:

- 10,000 t/yr of mixed cereal straw and sawdust pellets class A (ISO 17225-6).

This section starts from the collected data in other WP4 tasks in order to make an evaluation of the production line, of the market and of the target segment of customers aimed at finding the most competitive advantage of the planning idea.

2.1. Customer segments

In general, the Cooperative aims to produce biomass for energetic purposes to fulfill the needs for heating of some consumers within a radius of 50 km from the agro-industry.

The two main types of consumers of biomass for heating purposes in the area are:

- **small consumers (households)**, mainly using boilers or heaters built for using wood pellets and that, in Champagne-Ardenne region, represent the main consumers of this type of fuel. The technical specifications of these devices do not allow the use of other types of fuels different from woody resources, because of losing the warranty.
- **Big consumers**, using industrial boilers usually powered with wood chips but able, thanks to their specifications, to burn a large range of biomass types.

Considering the difficulties in penetrating the market of households owners of boilers with warranty, potential customers of the logistic centre have been researched mainly in the second category. Within 50 km from the agro-industry there are at least 24 heating plants consuming wood chips (from a total of 40 existing), mainly belonging to the public and service sectors (schools, hospitals, etc.), agro-food industries and

energy service companies (ESCO): 6 of these plants, of higher dimensions, absorb the 79% of the biomass market, with a consumption between 10,000 and 42,000 t/yr for each one and a total amount of about 150,000 t/yr of biomass consumed.

During the market assessment to industrial consumers, the interviews carried out have shown **an interest in the product offered by the logistic centre**. Since this type of facilities are fed by **wood chips**, with the change to agro-pellets the consumer would see as immediate advantage, a significant decrease of storage space needs and of number of supplies during the year. However, this consumer request competitive prices compared to chips and certainty about the characteristic of the agro-biomass that, for them, represents an unknown product (i.e. ash content, humidity, emissions, combustion in the boiler).

Taking into consideration the scenario resulting from the economic assessment **the customer segment of households owners of warranty-expired boilers or multi-fuels boilers, should be also evaluated**. This segment that consumes wood pellets, could change to agro-pellets (which quality characteristics should be in any case evaluated) experiencing big savings in purchasing costs.

The following table shows potential customer segments targeted by the Cooperative and the types of product which are normally used in the heating systems:

Table 2: List of potential target customers and currently used types of solid biomasses

Customer segment	Type of product currently consumed
Seller of heat to municipalities	wood chips
	wood pellets
	sawmill residues
Public buildings and agro-food industries	wood chips
Households	wood pellets

The output power of the boilers, the annual consumption of wood chips and the energetic needs of the main consumers representing the most suitable segment of customers for the Cooperative, are reported in the table below:

Table 3: Annual consumption of target customers

Type of customer	Boiler output power MW	Wood chips consumption t/yr	Energy consumption MWh/yr
Agro-food industry	19	42,000	110,000
Agro-food industry	16	16,000	42,000
Public buildings	16	27,000	71,000
Public buildings	10	10,000	26,000
Public buildings	10	19,000	50,000
Public buildings	8	20,000	53,000

2.2 Value Propositions

The main purpose of the Cooperative is **to reduce the fixed costs of the plant**, making a new product during the idle period.
The new product will be a class A mixed agro-pellets and it will be used tofulfil the needs of heating of some of the biomass consumers within a radius of 50 km from the facility.

The product should fulfill as much as possible the following requirements:

- **fulfill techno-economical needs** (quality/price) of one or more segments of customers, demonstrating to have qualitative characteristics comparable with the products in the market, and therefore increasing the competitiveness.
- **enter in the biomass market as an innovative product,** that could increase the range of solid bio-fuels, currently covered by forestry wood fuels. In fact, although there are, in the South of France, agro-pellets classified as Class A according to the standard ISO 17225-6 (brand Calys), already accepted by some boiler makers, they are not yet consumed as fuels in the area of interest of the agro-industry.

The idea of business of the Cooperative is based on the aim of penetrating the market of the owners of industrial boilers that, currently, have been using wood chips but that can also accept other types of fuel, offering them a profitable product either technically and economically.

This business will produce the **advantages** below:

- **a main important economic advantage** for the Cooperative from the utilization of the facility during the idle period: the depreciable costs of the involved two production lines could be loaded also over the activity of the agro-pellets production. The advantage will increase according to the increase of the production of agro-pellets during the period.

- **A profit for the Cooperative**, corresponding to the difference between the production cost and selling price, that is also an increase of the income of partners (see section 2.8).

- **An increase of the hours of work of the part/time employees**, or the employment of new workers, for the working of the production line during the idle period.

- **An additional income for the associated farmers in the area**, as suppliers of the straw to produce agro-pellets, and for the sawmills providing by-products from the wood processing industry (sawdust).

- **The availability, for the consumers, of a locally produced biofuel**, because the Cooperative wants collect raw materials within a radius of 30km and sell the product within 50 km distance.
- **The possibility of using the product in existing industrial boilers**, or in household devices with expired warranty or multi-fuel, able to accept also different types of fuels.
- From the first checks about the quality of the product, **the ash content are in the range of the currently used wood chips**: this is an interesting data, considering that potential consumers with industrial boilers should not notice any important difference concerning the disposal of the combustion residues.
- Due to high energetic density of mixed agro-pellets, comparable with that of forestry wood pellets, the consumers will need **less storage space compared to wood chips but not compared to other types of pellets in the market**; for the same reason, it will be possible **to reduce the number of product supplies during the year**, as stated in the following table:

Table 4: Supply frequency or storage volume ratio of mixed agro-pellets

Type of product (depending on boiler)	Bulk density kg/m3	Supply frequency or storage volume ratio of new product vs. current solid biomasses (different bulk density)	
wood chips	250	mixed agro-pellets vs. wood chips	0.4
wood pellets	650	mixed agro-pellets vs. wood pellets	1
agro-pellets class A (Calys)	650	mixed agro-pellets vs. agro-pellets class A	1

Possible expected **disadvantages** are:

- **the combustion of herbaceous material can imply the generation of slagging problems in the boiler due to the low melting point of ash fraction.**
- **The high content of chlorine in the straw** causes the presence of corrosive compounds which could damage the metal components of boilers. However, due to the content in woody resource in the future product it is expected that this problem could be overcome.
- **Compared to wood pellets, the ash content of the new product increases 5 times**: this can represent a problem in the management of a so high quantity of combustion residues.
- Currently, **no data concerning the behavior of the agro-pellets inside boilers are available**, so specific tests in the boilers of the customers should be carried out during supply. These tests could highlight **the need of some adjustments in the blend of the components or the need of additives** to cut down the possibility of slagging and fouling, with an increase of the production costs.

- **Price fluctuations of raw materials year by year** can cause big difficulties, for the agro-industry, in maintaining the price of the product stable and convenient. The risk is that, in an unfavorable year, an increase of the price of the straw or of the sawdust pushes consumers back to the use of wood chips or other types of considerably cheaper biomass.

2.3 Channels

The selection of the communication channels must be made in agreement with the offered products and the customer categories which have to be reached.

The Cooperative aims selling the new product in its point of sale using, as trade channels, its own sales agents.

The new products may be advertised as follows:

- **direct contact with potential customers**, as identified within biomass consumers of the region (within 50 km from the logistic centre);
- **word of mouth**, within the partners, the network of firms working in the dehydration activity and the haulers, to advertise about the beginning of the new activity of the Cooperative;
- **improving the website of the Cooperative**, including a specific section about the characteristics of agro-pellets (source of the raw materials, blend, quality, etc.) and marketing information (size and packaging, prices, etc.);
- **articles or advertising pages** in regional and specialized magazines.

In next future, **participation in agricultural or biomass fairs** (machinery, livestock, animal feed, etc.) should be taken in account, to extend the advertisement of the product to new potential consumers. Demonstrations on site should also be taken into consideration.

2.4 Customer Relationship

Considering the supplying costs for raw materials and production costs, the mixed agro-pellets produced in the logistic centre will be sold at a **competitive price only comparing to wood pellets, but without the same characteristics** such as heating power, ash content (5 times higher) and content of Chlorine.

Households result as the main wood pellets consumers: they usually have boilers or stoves for which the usage of different types of fuels could cause the loss of the warranty. Even in the case of old devices (with an expired warranty) or multi-fuels boilers, able to accept the product from the logistic centre, the consumer would have to manage large quantities of ash (problem of disposal), **unless they are rural consumers (out of towns) with garden or vegetable garden**.

Certainly, for this type of consumers, the change from wood forestry pellets to mixed agro-pellets **could result very convenient, due to the lower cost of the energy**:

these are the customers to whom the Cooperative should practice a price policy, offering an alternative low cost fuel.

Contrariwise, **wood chips consumers with industrial boilers** within a radius of 50 km from the logistic centre, have devices able to accept other types of biomasses, with consumptions between 10,000 and 42,000 t/yr of fuel (corresponding to 26,000 and 110,000 MWh/yr produced).

The expected selling price of the product is, however, **not really cheap compared to the price of the product (wood chips) to be substituted** (considering the energy cost).

For that reason, a low price policy cannot be practiced with this type of consumers. It is therefore essential to highlight advantages of the use of the new product compared to the currently used biomass:

- **the energetic density** of mixed agro-pellets is more than twice the density of wood chips: this allows a sensible decrease of the storage space and of the number of supplies during the year. The advantage results particularly important for public consumers in non-rural areas and moreover if consumers are schools or hospitals, thanks to the reduction of the heavy traffic for the supplies.
- **The quantity of ash** produced by agro-pellets can be compared to the quantity produced by wood-chips (about 1.2 times): the management of this waste from combustion does not get worse because of the change.

Secondly, **providing a consultancy service and monitoring the behaviour of the product in the boiler**. Considering that the potential consumer will evaluate a new typology of fuel, the Cooperative should guarantee some **tests with the boiler**, to verify either the quality of the fuel and the behaviour of the boiler, either to monitor, in case, the blend of the pellets and adjusting it taking into account the specific technical requirements of the consumer's device.

These tests (calorific power, ash content, emissions, slagging and fouling) should be provided either at the offer time (the customer *tests* the product) either during the boiler working period.

2.5 Key Resources and key activities

The key resources of the whole process, necessary to create the logistic centre, are:

- raw materials;
- available equipment in the agro-industry;
- storage capacity.

Raw materials

The principal resource on which the whole process of creation of the logistic centre is based (as proved by the feasibility study) is the raw materials, i.e.:

- cereal straw;
- residues from forestry timber processing.

These materials will be used for the production of solid biomasses for energetic purposes to be introduced on the market.

Straw is a by-product of cereal crops in a radius of about 30 km from the agro-industry: in this area, the availability of straw is more than enough as raw material needed by the logistic centre to produce agro-pellets. This by-product is bought in bales with a moisture content of 15% (drying in field) and it should be grinded before pelletising.

The residues from forestry timber processing (sawmill) are **sawdust** of forest wood (broadleaf and coniferous): sawdust is important to improve the characteristics of the straw (in particular, to decrease the production of ash and the content of Chlorine) and of the final product. Sawdust is bought with a moisture content of about 45% and it should be dried before pelletising.

The available equipment

The Cooperative has all the necessary devices to make the blend and the agro-pellets.

Into the agro-industry there are two twin processing lines (to pelletise alfalfa): both processing lines will be used to produce agro-pellets. The processing scheme is reported in the below section of Key Activities.

The equipment consists of: a particle size reducer, two dryer, two milling devices and seven pelletisers (details are reported in the feasibility study, see document D4.3).

The tube grinder needed for the particle size reduction of the straw, owned by the Cooperative, is located in another facility and it has to be moved and installed into the logistic centre.

The key activities are represented by:

- particle size reduction (only for cereal straw);
- drying (for forest sawdust);
- milling and mixing;
- pelletising of the straw and sawdust blend;
- both storage of the straw bales and produced agro-pellets.

The manufacturing processes carried out by the logistic centre are summarised in the following flow diagram (Figure 1):

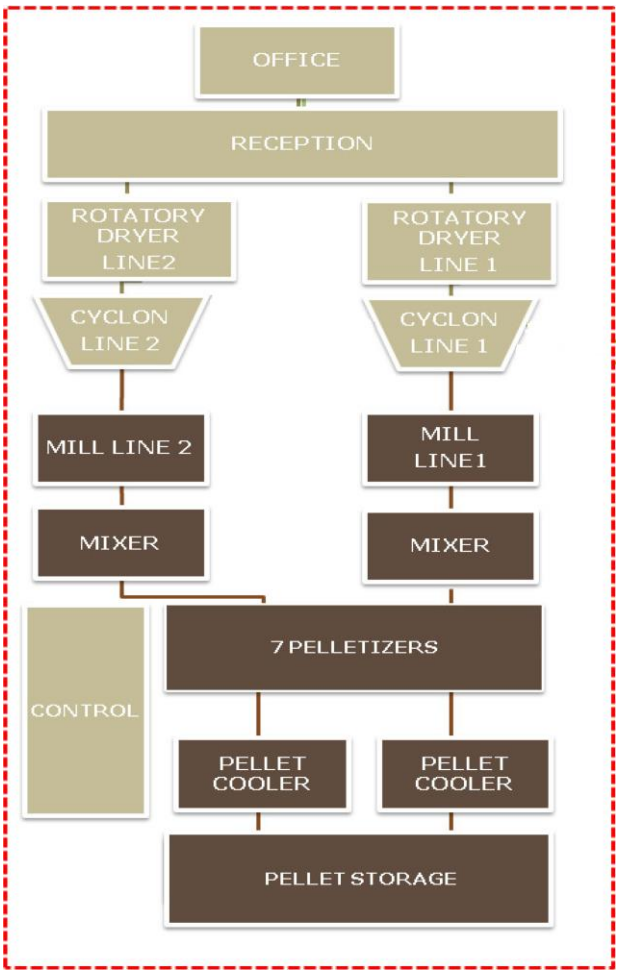

Figure 1: Scheme of logistic centre manufacturing processes.

2.6 Cost structure

Regarding production costs, these consider:

- investment costs;
- raw materials purchasing costs;
- pre-treatment costs;
- storage costs;
- transport costs.

The investment costs are related to the displacement from another facility and to the installation in the logistic centre of the tube grinder, needed to grind the straw to the useful size for pelletising. The Cooperative aims to split the investment costs, of 100,000 €, **in 4 annual amortisation charges of 25,000 €**.

The price of the straw, which is purchased in bales from farmers of the area or from retailers, is really variable from year to year. According to the market assessment

provided in the document D4.3, usually prices are between 67 €/t and 95 €/t, but it has been assumed that the final price after negotiations could be **75 €/t** including transport to the facility, in particular in case of plurennial supply contracts.

Concerning **sawdust**, it is a mixed product from the working of coniferous and broadleaf trees: the average purchase price of this raw material is **50 €/t**, including transport costs to the logistic centre. Also in this case, the price is variable from year to year.

The table below shows the purchase costs of raw materials which are necessary for the new business line:

Table 5: Raw material purchasing costs

Residues type	Quantity	Price*	Total costs
	t	€/t	€
Cereal straw (M 15%)	6 353	75	476 471
Sawdust from forestry wood (M 45%)	6 545	50	327 273
Total	**12 898**		**803 743**

* Transportation costs included

The main pre-treatment costs are represented by:

- handling of straw bales;
- particle size reduction of straw;
- drying of sawdust (moisture decreases from 45 to 13%); the straw does not need to be dried because it naturally dries during the storage period (moisture decreases from 15 to 13%);
- pelletising of the blend of cereal straw and sawdust, after that a product (agro-pellets) with a moisture content of 10% is obtained

as showed in the table below:

Table 6: Pre-treatment costs

Type of product	Pre-treatment type				Total costs
	Handling	Particle size reduction	Drying + pelletising	Pelletising	
	€	€	€		€
Cereal straw	63 529	108 000		217 715	389 245
Sawdust			216 120		216 120
Total					**605 365**

Pre-treatment costs include:

- the work of the employees for the production of pellets in the logistic centre;
- consumptions (electricity and, in case of sawdust, also fuel for the two burners which provide heat to the dryers of the two production lines);
- equipment maintenance;
- amortisation charges.

As it has been mentioned before, there will not be any extra investment cost, apart the ones already considered to install the tube grinder, as the equipments which will be used are already available in the agro-industry.

Other costs are represented by **the storage costs (10 €/t)** for the final product.

Lastly, we shall consider the transport costs to consumers (average **10 €/t**).

The results are visible in the following table

Table 7: Production costs of mixed agro-pellets

Solid biomass type	Quantity produced	Total costs						Production costs
		Fixed costs		Purchasing costs	Pre-treatment costs	Storage costs	Transportation costs	
		Investment	Personnel*					
	ton	€	€	€	€	€	€	€
Mixed cereal straw and sawdust pellets	**10 000**	25 000	0	803 743	605 365	100 000	100 000	**1 634 108**

* Already included in pre-treatment costs

2.7 Revenue streams

For the new business line as biomass logistic centre, the Cooperative intends to produce and sell:

- 10,000 t/yr of mixed cereal straw and sawdust pellets class A (ISO 17225-6) that is composed by:
  - cereal straw (60% of the agro-pellets);
  - sawdust from wood processing (40% of the agro-pellets).

As a result of the sale, it intends to reach the revenue of **1,700,000 €** according to the following table

Table 8: Sales revenue of mixed agro-pellets

Type of solid biomass SALE	Quantity	Production costs	Sales revenue		
			Selling price	Profit	Total revenue
	t	€/t	€/t	€/t	€
Mixed cereal straw and sawdust pellets	10 000	163	170	7	**1 700 000**

Since there is no defined price for the type of mixed agro-pellets offered by the agro-industry, the selling price of the product results from:

- production costs;
- the comparison between characteristics (calorific value, bulk density and ash content) of mixed agro-pellets to be produced by the agro-industry and other class A agro-pellets in the market (agro-pellets Calys) having a current price of 175 €/t, **so that the maximum market price adopted by the Cooperative for selling its own product is 170 €/t**;
- minimum acceptable profit to the Cooperative.

From previous considerations, the Cooperative, with a production cost of about 163 €/t, **gains a profit of 7 €/t of mixed agro-pellets** that is supposed to be enough to start the new business line.

2.8 Key Partners/Suppliers

The **most important partnerships** are represented by:

- **the farmers associated** who own the cereal fields and are located in the vicinity of the Cooperative (maximum 30 km away), since they will be suppliers of agricultural residues (straw) necessary to produce mixed pellets in the logistic centre;
- **contractors**, that manage the gathering of the straw bales from farmers, for the next delivery to the Cooperative;
- **the company** who will supply sawdust to produce mixed pellets.

2.9 Competitors

The market of the solid biomasses in the Champagne-Ardenne is, mainly, represented by forestry products.

Main products are:

- **wood chips**, directly from the work of the wood of conifers and broadleaf originating from the maintenance of certified forests, less from pallets and wood boxes chipping;
- **wood pellets**, from forestry wood;
- **sawdust**, from processing waste of forestry wood from sawmills.

Wood chips, used in individual or collective boilers, are locally marketed by forestry Cooperatives or by biomass specialized retailers that, generally, advertise their products on websites: retailers stock themselves from regional production centres or from other close regions. Usually, the transport of the bulk material at destination is included in the price.

Wood pellets, used in low consumption boilers or stoves, even them produced from French wood, are certified (DIN or NC QHP) and they are offered by the same retailers and with the same modalities described above. The product is provided as bulk product or in 15 kg bags.

Currently, in the region, no pellets from agricultural residues are marketed. However, there is a reference price for this type of fuel (agro-pellets Calys, source RAGT).

Table 9: List of Company main competitors in the region

Company	Biomass Products	Location
Forêts & Bois de l'Est	Forestry wood chips Firewood	Lorraine
Terrenergie	Wood chips from forestry and recycled wood Certified forestry pellets	Île-de-France
Deglaire Vincent (Le Marché du Bois)	Certified forestry pellets Firewood	Alsace
Cooperatives and Retailers	Forestry wood chips Certified forestry pellets	Champagne Ardenne

The average prices, transport included, charged by the competitors are listed as follows:

- Wood chips: from 60 €/t to 100 €/t.
- Certified forestry wood pellets: about 250 €/t.
- Agro-pellets Calys: 175 €/t.

These prices do not include VAT.

2.10 Market

Currently, France is still depending from fossil fuels to satisfy the heating request.

During the last years, specific funds to help the projects for the use of renewable energies in services sector, industry and agriculture have been created. The aids pushed a lot this sector, fostering a very fast development of the solid biomass market, that now represents the 45% of the consumption of renewable energies with the goal of achieving the 69.5% of the consumptions within 2020.

Both national and regional market are characterized by a strong supply of forestry woody biomass, such as firewood, wood pellets, wood chips and residues from wood processing (sawdust from sawmill industry): these absolutely represent the main consumed products, moreover strongly advertised by the Energy French Agency (ADEME Champagne-Ardenne) and by the local farmers.

Unlike other European situations, where a large part of the consumed woody biomass, both regionally and locally, comes from abroad because of the competitive prices (usually coming from Eastern Europe), in the Champagne-Ardenne region the biomass (firewood, wood chips e wood pellets) in the market is locally collected

forestry wood or, at least, coming from close regions. In fact, main providers of raw wood (firewood), half-processed (chips) or processed (pellets) are located within a radius of about 100-120 km from the future agro-industry logistic centre.

Two main types of **wood chips** are in the market:

- **high quality**, from broadleaf or coniferous forests certified and sustainably managed, used in individual or collective small or medium boilers;
- **low quality**, from chopping of recycled timber (pallets, woody boxes, etc.), used in industrial boilers with high consumptions.

About **wood pellets**, taking into account the results of the document D4.3, the main part of the sold product is used by households: they request a certified product, of known origin and good quality. Other type of solid biomass would make them loose of the boiler/stove warranty. **At the moment, a check about expired warranty or multi-fuel boiler is missing: they could represent a further market segment to be considered for the offer of the alternative product**.

Currently, in the region, the solid biomass fuels are just represented by straw bales (with some projects for the utilization in industrial boilers).

In the area, pellets from raw agricultural materials or from agricultural residues are not produced or commercialized at the moment, also because no consumers for this kind of fuel have been identified, even if in France there are some pilot projects: so that, the reference product are the agro-pellets Calys (from RAGT); it is produced in the Midi Pyrénées region, in the South of France, and it is considered such as a good quality product regarding the standards of this type of fuel (Class A ISO 17225-6, NF Agro-pellets High Performance) and, moreover, it is already allowed by some boilers manufacturers.

As a summary, it can be said that currently the local market seems to be characterized by a large offer of forestry biomass, with several suppliers and prices that are aligned to the other European countries. **The consequence for the installation of the agro-industry logistic centre is that local market looks very competitive and marketing of a new product should be carefully evaluated.**

Considering the goals that should be achieved within 2020, **a steady increase of biomass request and consumption can be assumed in the next years**: raw agricultural materials and agricultural residues products can find a place in the renewable energy market, as innovative fuels and locally supplied (short chain) with low prices. Moreover, they are also welcomed by the most “radical” environmentalists, because being sub-products from the common agricultural activities, they do not change natural ecosystems, such as the forestry one.

However, it is necessary to implement a marketing policy that fosters the purchase of multi-fuel boilers, able of consuming different types of solid biomass, such as the agro-pellets, or that fosters the gradual replacement of the common boilers that have

too strict requirements. In fact, **the product that can be replaced by the agro-pellets with the highest convenience, both for the consumer and the seller, is the wood pellets**.

So that, it is possible not only a diversification of the offer in the market by introducing other types of fuels, "alternative" comparing to the forestry fuels, but also an easier achievement of the national goals of consumption of renewable energies, through an increment of the request and, then, of the offer.

The evaluation of the real convenience of the offered products price, compared to main competitors in the region, was carried out with reference to the cost of energy, comparing the €/kWh price of mixed straw and sawdust pellets (class A) with the one of the product it would replace. The results are indicated in Table 10.

Table 10: Evaluation of convenience of product comparing with other type of solid biomass

Competitors							Cooperative Luzéal-Saint Rémy						
Type of biofuel	Bulk density kg/m3	Ash content w-% db	M %	LHV ar kWh/kg	price €/t	price €/kWh	Type of biofuel (wood-fuel substitute)	Bulk density (kg/m3)	Ash content (w-% db)	M %	LHV ar kWh/kg	price €/t	price €/kWh
wood chips	250	≤ 3	38	2.9	100	**0.034**	mixed cereal straw and sawdust pellets class A	650	3.63	10	4.39	170	**0.039**
wood pellets	650	≤ 0.7	10	4.80	250	**0.052**							
agro-pellets class A (Calys)	650	≤ 5	10	4.75	175	**0.037**							

Moreover, an estimation of the convenience of mixed pellets compared to other products in terms of money savings was made, comparing the unit cost of energy (€/kWh) of each product. The results can be observed in the following table:

Table 11: Comparison between products cost (cost per unit of energy)

Substitutable products	Savings of mixed cereal straw and sawdust pellets
mixed agro-pellets class A vs. wood chips	- 13%
mixed agro-pellets class A vs. wood pellets	**26%**
mixed agro-pellets class A vs. agro-pellets class A (Calys)	- 5%

In the tables it is highlighted that, if we take in account the price of mixed agro-pellets in the market as indicated in the economic assessment (with a profit of 7 €/t for the agro-industry) **the product is just competitive with wood pellets** (with a saving of 26%). Considering this type of fuel, mixed agro-pellets have an ash content up to 5 times higher: this may cause increase of boiler cleaning frequency and higher costs to manage and dispose of these residues of combustion.

Contrariwise, concerning the comparison to Calys agro-pellets, a product that currently aims to compete with wood pellets, **the data is just a reference for the**

producer, to establish the price of his product according to the price of the only similar known product. Compared to the energy cost of 0.037 €/kWh of the Calys agro-pellets, **the established price for the product of the logistic centre is not convenient** (0.039 €/kWh = +5%): a break point could be found just selling the product at cost price with no profit (163 €/t = 0.037 €/kWh).

It should be highlighted then that a probable entry of the Calys product into the regional market is **a risk for the activity of the logistic centre**: in fact, this product is competitive with wood pellets but, perhaps, also with the wood chips consumed by the customer segment identified by the Cooperative.

Comparing to wood chips, the product does not provide any economic advantage concerning the energy cost, but it has a bulk density 2.6 times higher, enabling a decrease of the number of supplies and of the storage space.

2.11 Authorization process and permits required

To be able to integrate the new production line in the agro-industry, the Cooperative does not need any new license or authorization, since this is a simple variation of the existing producing processes.

The new product (agro-pellets) is originated by a production process and is directly used following to a standard physical-mechanical industrial practice consisting of a “densification”, employing equipment already available in the logistic centre.

However, **the production process of agro-pellets for energetic use (so not for food purposes**) requires the use of equipment which is usually designed for *the production of feed for animals for human consumption*: in this regard there will be a risk of contamination of such feed, as besides cereal straw which do not represent a problem, the production mixture will also contain forestry timber sawdust.

The Cooperative already has a specific Self-regulation manual, in agreement with the CE Regulation 183/2005, for the Hazard Analysis and Critical Control Points (HACCP) of the whole food processes. The law requires that for every change which should occur in an existing production chain already subjected to HACCP control for that specific activity**, the Self-regulation manual should be updated in order to allow detection of the new critical points, handling the revision of hazard analysis with the description and introduction of the appropriate practices**.

Therefore, with regard to the logistic centre, it will be necessary to integrate the Self-regulation manual of food production chain, taking account of the potential risks which could arise from the periodic use of no-food materials (sawdust) and that any contamination could affect human health.

3. Recommended Business Strategy

Previous analyses have shown which is the target segment of customers for the new activity. In this section, the best production and commercial strategy for the Cooperative is identified. This strategy is the one where there is a meeting point between:

- the needs of product quality and price convenience from the customers and
- the expectations of the Cooperative in maximising the gross operative margin.

The following summary tables have been filled in, in order to identify the best outcome among the above mentioned components (**Table 12** - **Table 13**).

Table 12 summarizes and compares the main technical and economical positive or negative features of the different types of fuel supplying scenarios chosen by the customers.

Table 12: Added values for the customers

Type of product (depending on boiler)	Savings of mixed agro-pellets (energy cost)	Supply frequency or storage volume ratio (different bulk density)	Ash content w-% db ratio	Industrial boilers (public sector) average savings per 26,000 MWh/yr	Industrial boilers (agri-food sector) average savings per 110,000 MWh/yr	Boilers (households) average savings per 45 MWh/yr
				€	€	€
mixed agro-pellets vs. wood chips	-13%	**0.4**	1.2	- 116 423	- 492 558	-
mixed agro-pellets vs. wood pellets	**26%**	1	5.2	**-**	**-**	**601**
mixed agro-pellets vs. agro-pellets class A (Calys)	-5%	1	0.7	-	-	-85

- **The first column** shows possible replacement with mixed agro-pellets compared to those currently in use;
- **the second column** shows possible energy costs savings by using mixed agro-pellets;
- **the third column** shows increase ratio of stocking or frequency of supplies due to the different energy density of the compared products;
- **the fourth column** shows the increase medium ratio of ashes between the different products;
- **the next columns** show the main type of potential customers, selected in accordance with typology and energy requirement (data extracted from D4.3): **this shows the annual saving (in euros) they could achieve replacing biofuels.**

Taking into account the results obtained in the table, it can be stated that **the best customer segment is composed of the wood pellets consumers with household boilers,** because a saving of 26 % is gained.

Wood chips consumers, contrariwise, do not get any saving concerning the energy cost (-13%) and the use of mixed agro-pellets could increase the purchasing costs, for the industrial users, of an amount between 116,000 and 492,000 €/yr. These consumers, however, could **significantly reduce the number of biomass supplies during the year and the space to store** the agro-pellets. This can be translated from the social point of view into an environmental advantage and for public interest (heavy traffic reduction):

- **neither for the consumer that already has the place to store the wood chips**, because:
  - he should underuse the space, thanks to the higher energy density of pellets;
  - he could use the whole space, reducing the number of supplies, but without any saving because the transport cost is included in the purchasing price of the fuel;
- **neither in case of a new installation**, even if the building costs of a silos for pellets are significantly lower than a storage for wood chips, because this is just a financial advantage: in fact, the lower start-up costs for the silos for pellets are crossed out by the higher energy cost compared to wood chips, after about 190 utilizations of the storage (between 5 and 15 years of usage, depending by the numbers of supplies).

Comparing to the Calys agro-pellets, there is not any saving in the energy cost or in the storage space, because the two products have the same energetic density.

However, it is important to keep into consideration that proposed **mixed agro-pellets produce an ash quantity comparable to wood chips and Calys agro-pellets, but 5 times higher than wood pellets** (meaning more boiler maintenance required).

This means that, comparing to wood pellets, consumers who would switch to the much more economic agro-pellets, having old boilers or stoves (expired warranty) or multi-fuel, could have problems in managing such high amount of ash content: these difficulties can be reduced in case of rural consumers (not in towns) with small gardens where to dispose the combustion residues.

Evaluating, on the base of the data previously assessed, the hypothesis of business of the manager, the following considerations can be achieved.

Table 13 shows the production costs of the manufactured products of the new line, besides quantities, production cost, sales revenue, gross operating profit (EBITDA), Return On Sales (ROS) and ratio between costs and revenues, **for a sale price of 170 €/t.**

Table 13: Economical convenience of the product

Type of product	Quantity	Production costs	Sales revenue	Profit (EBITDA*)	ROS*	Cost/Revenue ratio
	t	€	€	€		
Mixed cereal straw and sawdust pellets	10 000	1 634 108	1 700 000	65 892	3.88%	96.12%

* EBITDA = Earnings Before Interest, Taxes, Depreciation and Amortisation; ROS = Return On Sales

As shown in the table, with an investment from a production cost of about 1,634,108 €, a gross operating profit of only 65,892 € is obtained (ROS 3.88%): **this highlights a non-acceptable firm risk**.

The hypothesis of the manager foresees a start-up investment of 100,000 €, to be amortized in the first 4 years: from that, the necessity of producing an enough amount to regain 25,000 €/yr of the investment. This amount is the **Break Even Point**. The formula to calculate this index is:

BEP = Fixed costs/UCM*

* Unitary Contribution Margin = 170 €/t (*sale price*) - 160.91 €/t (*production costs, excluded investment costs*) = 9.09 €/t

where:

BEP = € 25,000 / € 9.09 = **2750.52 t**

is **the minimum amount to be produced that, with a selling price of 170 €/t, allows the balance between costs and revenues.**

Table 14: BEP between revenues and costs for a sale price of 170 €/t

Type of product	Quantity	Production costs	Sales revenue	Profit (EBITDA*)	ROS*	Cost/Revenue ratio
	t	€	€	€		
Mixed cereal straw and sawdust pellets	2 750.52	467 588	467 588	0	0%	100%

The higher risk for the Cooperative is the difficulty of selling the product in the market at the decided price, because compared to the fuel to be substitute (wood chips), it has an higher energy cost for the consumer (+13%) and a lower quality (Chlorine content, ash quality).

The 10,000 t/yr of expected production by the manager get the **BEP with a selling price of 163.41 €/t**: this means that with this price just the costs are recovered, without any profit. Moreover, the price is, as in the previous situation, not competitive with wood chips (+9% of energy cost).

Table 15: BEP between revenues and costs for a sale price of 163.41 €/t

Type of product	Quantity	Production costs	Sales revenue	Profit (EBITDA*)	ROS*	Cost/Revenue ratio
	t	€	€	€		
Mixed cereal straw and sawdust pellets	10 000	1 634 108	1 634 108	0	0%	100%

So, in both cases the proposal is not very desirable for consumers, both economically and qualitatively.

An offer that would be competitive comparing to the competitor target product, for the identified customer segment, should foresee **a selling price of the agro-pellets that determines an energy cost equal or lower than wood chips**. From calculations, the selling price of the future agro-pellet that, including production and investment costs, considers the same energy cost as the wood chips (0.034 €/kWh) is **149.26 €/t**.

Considering that the current processing costs are 163.41 €/t, **it seems necessary to act on these values to achieve a competitive price in the market**. From an assessment over the processing costs, it is highlighted that the higher values are related to the raw material purchasing and pre-treatment, as reported in the table below:

Table 16: Summary of costs sharing for each production item

Type of product	Investment costs/Sales revenue ratio	Raw material purchasing costs/Sales revenue ratio	Pre-treatment costs/Sales revenue ratio	Transport costs/Sales revenue ratio	Storage costs/Sales revenue ratio
Mixed cereal straw and sawdust pellets	1.47%	**47.28%**	**35.61%**	5.88%	5.88%

Pre-treatment costs come from the specific operations of this phase and from the price of the fuel used for drying: it seems not possible to act **sensibly** on these two items in order to get a sufficient costs reduction.

Differently, it could be possible to act on the raw material purchasing, where the price of the straw looks overvalued, also according to the price in the other countries involved in the SUCELLOG project (prices between 36 and 50 €/t, transport included).

For example, a production cost of 147 €/t, sufficient to get a small profit from the selling of the product (about 2 €/t) with an energy cost for the consumers comparable to wood chips, can be achieved by purchasing the straw at a price of 60 €/t and the sawdust at a price of 40 €/t, **so just with a 20% reduction of the raw material purchasing prices**.

This opportunity can be achieved through **supplying plurennial contracts** with the associated farmers, the retailers and the sawdust suppliers that, even with a lower profit, could be sure about the selling of their product for the whole period. Additionally, this turns into a security of raw material prices for the logistic centre.

Alternatively, the reduction of about 16 €/t of the production cost, that is necessary either to obtain a minimum profit either to provide an energy cost comparable to wood chips, can be achieved **by decreasing of 10% all the cost items (purchases, pre-treatment, transports, storages)**.

Secondary advantages

The foreseen scenario by the manager, even if it highlights difficulties in generating direct profits, can anyway foster some **secondary or indirect advantages**, either strictly economic-financial, either concerning the inside relationships of the company and social relationships in the community.

In fact, the higher expected production of 10,000 tons of agro-pellets rather than the current production, can reduce the idle period and, consequently, allocate the amortisation costs over a larger quantity of product.

To evaluate this advantage, balance items missing, an **estimation of the total value of annual amortisation charge of the current production line** has been carried out, allocating the due over the main working phases. These values are reported in the table below:

Table 17: Estimation of the amortisation costs of the current production line

Type of product	Quantity	Pre-treatment costs ratio*		Current amortisation*	Amortisation costs*
		Drying	Pelletising		
	t	%	%	€/t	€/yr
Bales of alfalfa	140 000	36.6%	-	1.06	148 986
Pellets of alfalfa	18 000	36.6%	63.4%	2.91	52 380
Pellets of corn	2 500	36.6%	63.4%	2.91	7 275
Pellets of sugar beet pulp	4 000	36.6%	63.4%	2.91	11 640
TOTAL	**164 500**				**220 281**

** Estimated data from Feasibility Study*

Once established the total amount of the annual amortisation charge, it has been allocated over the total foreseen production, including also the new production line, as reported in the table below:

Table 18: Estimation of amortisation costs abatement in the manager hypothesis

Type of product	Quantity	Pre-treatment costs ratio		Current amortisation	Amortisation costs
		Drying	Pelletising		
	t	%	%	€/t	€/yr
Bales of alfalfa	140 000	36.6%	-	0.94	131 601
Pellets of alfalfa	18 000	36.6%	63.4%	2.57	46 268

Type of product	Quantity	Pre-treatment costs ratio		Current amortisation	Amortisation costs
		Drying	Pelletising		
	t	%	%	€/t	€/yr
Pellets of corn	2 500	36.6%	63.4%	2.57	6 426
Pellets of sugar beet pulp	4 000	36.6%	63.4%	2.57	10 282
Mixed straw and sawdust pellets	*10 000*	*36.6%*	*63.4%*	*2.57*	*25 704*
TOTAL	**174 500**				**220 281**

In the data, it is highlighted a reduction of about the 12% of the amortisation unitary dues for any type of product.

This reduction can directly become a profit for the company or, otherwise, can be used to reduce the selling prices of the products, to achieve a higher competitiveness in the market.

Another indirect advantage, that can improve the inside relationship in the company or in the community, is the **increase of the employment**, of about 862 h/yr, needed for the new production line and to be recruited in the area. This will permit an improvement of the reputation of the Cooperative, a higher local visibility and, finally, a better acceptance of the impacts on the territory that Company activities can cause.

Assumptions of alternative scenario – Integrated heating service

Considering the difficulties in making competitive the agro-pellets compared to wood chips, **an alternative scenario can be assessed**. This scenario considers either the choice of a different segment of customers compared to the one decided by the Cooperative and a substantially different commercial policy. It is proposed that the agro-industry becomes a heater supplier for small households: the agro-industry installs the boiler/stove (multi-fuel), takes care of their performance and also of the supply the solid biomass (agro-mixed pellet class A).

As target segment, the **small wood pellets consumers (household) segment** is identified: they generally have 20-25 kW boilers characterized of a cost of about 8,000 € and an average consumption of about 9-10 t/yr of fuel.

From the market survey, the average selling price of wood pellets is 250-320 €/t (energy cost between 0.052 and 0.067 €/kWh). From the executed calculations, the energy cost of the agro-pellets produced by the logistic centre is 0.039 €/kWh (corresponding to a selling price of 170 €/t), therefore clearly less than the wood pellets energy cost: unfortunately this competitive advantage cannot be exploited by the common wood pellets boilers because of the lower quality, the risk of the loss of the warranty and for the difficulties in the use (possible technical problems).

Therefore, **the only possibility to try of exploiting this competitive advantage comes out by offering to the consumers not only the fuel but selling directly**

the heat, with an integrated service of providing either of the boiler either of agro-pellets.

This hypothesis foresees the identification of a **multi-fuel boiler** with the best technical characteristic for the produced agro-pellets: this can be achieved through several combustion tests to be implemented also with different blends.

The average costs of a multi-fuel household boiler, in the French market, is about 14,000 €, while the selling price of agro-pellets, as defined by the Cooperative to obtain a profit, is 170 €/t.

To identify a selling price of the service, competitive compared to wood pellets, the following simulation has been carried out, taking into account the variability of the wood pellets prices in the market and the average household consumption.

Table 19: Economic simulation to define the selling of the integrated service

Type of product	Market price	Energy cost	Energy consumption	Total energy costs	Biomass quantity required	Boiler amortisation (10 years)	Heating price	Heating price
	€/t	€/kWh	kWh/yr	€/yr	t/yr	€/yr	€/yr	€/t
wood pellets	250	0,052	45 000	2 344	9.4	800	3 144	**335**
wood pellets	320	0,067	45 000	3 015	9.4	800	3 815	**405**
mixed straw and sawdust pellets	170	0,039	45 000	1 742	10.2	1 400	3 142	**307**

In the table it is highlighted that the base selling price of the heat from agro-pellets, competitive compared to wood pellets, is about **307 €/t**. This price can be raise up to **350 €/t** including the installation costs and the variability of the prices of the wood pellets.

Therefore, the offer can be configured in two ways:

- **the first one, for consumptions of about 10 t/yr,** consists in providing the boiler to the customer as *free loan for use*, increasing the unit cost of the fuel, considering the amortisation and maintenance costs, ensured during the life time of the contract. The selling price of the fuel, including the free loan for use, could be about 350 €/t.
- **the second one, for consumptions between 12 and 14 t/yr,** foresees the payment, by the customer, of a **monthly split annual fee**, for the boiler providing and installing and for the fuel supply. This comprehensive fee can be about 4,500-5,000 €/yr.

4. Summary and conclusions

The analysis of the work blocks carried out in this Business Model allowed to highlight the strong and weak points of the best scenario provided in the feasibility study. As a summary, a scheme of the selected setting is reported (see Figure 2) highlighting the main points of each block

The analysis was carried out in order to be able to prove real economical convenience of the new business line; this also allowed to make hypothesis regarding possible changes to the scenario resulting from the feasibility study selected by the agro-industry (see D4.3), in order to achieve the maximising of profit or of effectiveness of commercial strategies.

Marketing policy of the agro-industry consists in including a new product (mixed straw and sawdust pellets) in an established market already controlled by big wood chips consumers.

According to the results of the assessment, the feasibility of the marketing policy looks difficult: **the agro-pellets that should be produced, in fact, do not show any competitive advantage compared to the fuel that it is supposed to substitute** (wood chips). The higher energy cost and the lower quality of the product, considering just a temporary advantage in the storage space, do not foster a wood chips consumer in choosing this alternative fuel for his heating needs.

Acting on the selling price up to reaching the competitiveness with wood chips causes negative profits, unless a reduction of the production costs is promoted.

As partial compensation of these negative profits, there are some indirect advantages, such as:

- **a better distribution of the amortisation costs** of the facilities;
- **the positive social effects in the area, not economically evaluable**.

According to these considerations it seems essential, to continue with the entrepreneurial enterprise as it is settled by the Cooperative, **a reduction of the production costs and the offer, in the offer phase, of additional services** to the potential customers (start-up advices, acceptability tests of the product in the boilers, monitoring during the functioning).

After the difficulties highlighted by the market survey on the customers represented by wood chips consumers, an **alternative scenario** has been proposed: it defines the households wood pellets consumers as target customers, because this is the product to which the agro-pellets can effectively be a competitor. **The scenario foresees that the Cooperative does not provide just the biomass but also the heating system, through plurennial free loan for use contracts.** The Cooperative

will sell the fuel increasing the price to recover the expenses for the purchase and the maintenance of the boilers and considering an average consumption of fuel.

Cooperative Luzéal-Saint Rémy

Authorization process and permits required: 1. No authorizations required; no new permits required. Necessary to update the HACCP Manual.

Key Partners/Suppliers
- ✓ Farmers associated
- ✓ Logistic operators
- ✓ Company supplier of sawdust

Competitors

Regional and local suppliers of:
- ✓ wood chips
- ✓ wood pellets
- ✓ sawdust

Key Resources

Raw materials:
- ✓ cereal straw
- ✓ sawdust from broadleaved and conifers species

- ✓ Particle size reducer, dryer, mill, pelletiser
- ✓ Storage
- ✓ Heat production for self consumption

Key Activities
- ✓ Particle size reduction (straw)
- ✓ Drying (sawdust)
- ✓ Milling (straw and sawdust)
- ✓ Pelletising (straw and sawdust)

Value Propositions
- ✓ Creation of a new agro-fuel production line
- ✓ Better allocation of amortization costs

- ✓ Local availability of the agro-fuel
- ✓ Competitive price of product
- ✓ Sales on local market

- ✓ Possibility of feeding industrial boilers and multi-fuel boilers

Positive social impacts
- ✓ Economic enhancement of not used residues from local farmers
- ✓ Increase in employment levels

Customer Relationships

Pricing policy
- ✓ Average quality product
- ✓ Competitive prices for wood pellets consumers
- ✓ Lower storage required in comparison with wood chips

Customer care
- ✓ Problem solving approach
- ✓ Execution of combustion tests
- ✓ Home supply

Channels
- ✓ Direct contact with customers (industrial boilers)
- ✓ Word-of-mouth advertising
- ✓ Articles in magazine
- ✓ Website
- ✓ E-commerce

Customer Segments
- ✓ Local consumers of wood chips with industrial boilers
- ✓ Consumers of wood pellets with multi-fuel boilers

Market
- ✓ Strong offer of solid biomasses fuels (wood chips and pellets)
- ✓ Price of raw materials widely variable from one year to another
- ✓ The price of agro-fuel is not competitive with wood chips
- ✓ Reduced use of agro-fuel in the region
- ✓ Agro-fuel competitive with wood pellets in terms of energy cost
- ✓ The agro-fuel can enter the renewable energy market in view of 2020 objective set by National Action Plan

Cost Structure
- ✓ Investments
- ✓ Raw material purchasing (cereal straw, sawdust)
- ✓ Pre-treatment (particle size reduction, drying, milling and pelletising)
- ✓ Storage
- ✓ Transport

Revenue Streams

Sale of product:
- ✓ Mixed straw and sawdust pellets class A ISO 17225-6

Recommended Business Strategy
- ✓ Reduction of raw materials purchasing costs
- ✓ Reduction of pre-treatment costs
- ✓ Plurennial supply agreements with farmers
- ✓ Creation of an integrated service for the sale of heat to wood pellets consumers

modified from BMCalc (created by Diderikvan Wingerden, based on Alexander Osterwalder's Business Model Canvas)

Figure 2: Business Model Canvas