

Business Plan for the realization of a plant fuelled with pomace to generate energy in Liguria

December 2009

FOREWORD: The IEE Project "MARKET of OLIVE RESIDUES for ENERGY"

The main objective of "M.O.R.E." is to generate renewable energy using solid residues deriving from olive oil production process. The project involves 5 European countries (the main world olive oil producers): Italy, Spain, Greece, Croatia and Slovenia, by means of six different local organizations that make up the partnership. In Italy, two partners are involved: the project leader - Liguria's regional agency for energy, ARE Liguria – and the regional association of the four Ligurian Chambers of Commerce – Unioncamere Liguria.

In Croatia the partner is IPTPO, the Institute for Agriculture and Tourism

In Greece the partner is the Regional Agency for Energy of Central Macedonia

In Slovenia the partner is the Science and Research Centre in Koper

In Spain the partner is AGENER, the Regional Agency for Energy Management.

Running from November 2007 to April 2010, the project MORE aims to:

- Identify different methodologies to generate renewable energy using solid olive residues and produce related guidelines;
- Involve public and private stakeholders to develop the local markets and create supply chains;
- Carry out training and promotional activities;
- Define business plans for energy facilities running on olive solid residues;
- Deliver policy recommendations for local, national, EU governments.

IMPORTANT

This document is composed by 2 parts:

- a general part, which formulates business plans for a general area (Province of Imperia where most pomace is concentrated) based on a general principle of pomace supply equal to 30% of total production in the area (chapters 1-8)
- a specific part, related to a specific beneficiary according to the formal selection carried out in 2010 (chapter 9).

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1 Methodological approach

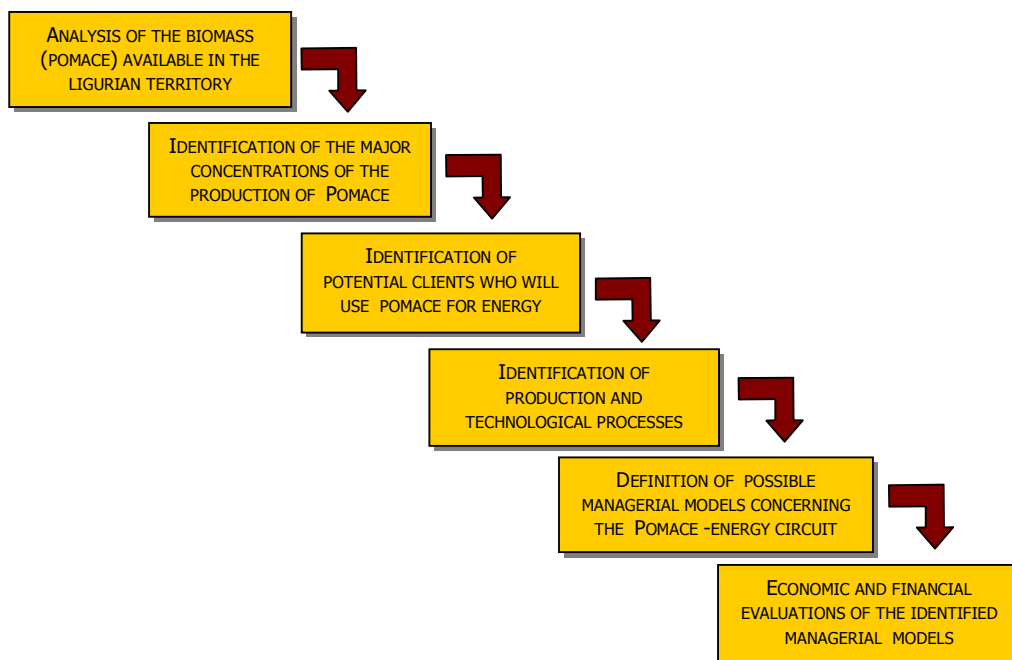
The aim of this feasibility study consists of evaluating the economic advantages of the implementation of a chain, based on the alternative use of oil from olive pomace as a biomass for the production of thermal energy, which could replace the use of fossil fuels (mainly oil and natural gas).

This project is planned within the European initiative "MORE" which wants both to implement a territorial policy based on the principle of energy saving and make the most of local resources, supporting, at the same time, the development of an economic circuit based on the "pomace-oil residue-energy" production.

We wish to point out that the settlement of the "pomace oil-energy" model should be principally in the Province of Imperia whose territory produces most of the Ligurian olive oil output and, consequently, most of the pomace residue.

This model, in reality is replicable in the other areas of the territory of Liguria, strongly characterised, though in various degrees of intensity, by substantial olive production and consequently by relevant concentration of pomace. The methodological approach followed in the formulation of this study is summarized in the chart below.

Fig. 1/1 The methodological approach adopted in the development of the project



2 Reference: pomace as a renewable alternative source of energy

Oil from pomace is progressively disappearing from both the European market, which is more and more interested in buying high quality extra virgin olive oil, and the world market where, in various countries only a modest percentage of olive oil is marketed (3% in Italy). Competition, as to price and image, with seed oil and other fats, has slashed consumption and, consequently, reduced the margin of profit of pomace producers.

Up to a decade ago, oil from pomace was a resource for oil mills that often got it free, from olive growers. Those mills, then, sold it to pomace oil mills, receiving a fair income. Today, instead, pomace oil mills very often collect pomace from oil mills free or, there is a growing trend, for them to charge a consideration, which covers transportation costs.

From resource to waste, this seems to be the inglorious end of a by-product which, together with vegetation water, causes many a worry to oil millers concerning their disposal.

In fact the waste, derived from olive pressing and the extraction of olive oil both by a two or three phase plant, pollutes as it contains a considerable amount of organic and fat substance, though in varying proportions.

With the passing of time the problem of using pomace again is on the agenda and various possible solutions have, in fact, been put forward, among which its use as biomass in the production of alternative energy.

In reality, within the use of alternative sources for the production of thermal and/or thermal-electric energy, biomasses have a growing role in the present socio-economic context and the scraps from the food industry, pomace included, are the most suitable along with cultivation by-products such as cellulose wood and the offcuts from the timber industry.

With regard to that, we underline how the calorific value of dried pomace is as much as 3,900 – 4,500 Kcal/kg, therefore quite elevated and suitable to power energy-plants with an automatic screw feeder. Its availability is not yet widespread, however wholesale sales are starting, at least in some regions.

3 Analysis of the availability of pomace in Liguria

The chart below shows the quantities of pomace produced in the four Ligurian provinces. The Province of Imperia stands out for its production of pomace of about 47% of the total regional output. It is followed by the province of Genoa with 21%, Savona with about 20% and La Spezia with 15%.

Tab. 1/3 The production of pomace in Liguria (values in 100 kg)

Year	Genoa	Imperia	La Spezia	Savona	Total Region Liguria
1990/91	-	8,908	4,534	3,883	17,325
1991/92	51,113	49,322	27,123	42,522	170,080
1992/93	19,725	49,990	9,814	13,167	92,696
1993/94	15,718	35,469	7,234	20,614	79,035
1994/95	39,468	57,053	23,428 2	24,163 2	144,112
1995/96	15,606	53,046	11,903	20,003	100,558
1996/97	36,423	54,334	20,340	27,614	138,711
1997/98	8,015	24,393	12,909	8,838	54,155
1998/99	35,559	87,663	18,983	33,012	175,217
1999/00	8,565	23,908	16,405	9,650	58,528
2000/01	17,895	83,942	14,179	23,980	139,996
2001/02	4,662	21,514	10,700	9,236	46,112
2002/03	38,821	94,443	26,042	34,640	193,946
2003/04	3,213	32,425	6,209	11,038	52,885
2004/05	-	66,784	26,625	29,911	123,320
mean	22,676	49,546	15,762	20,818	108,028
%	21.4	46.8	14.9	19.7	100.0

The state of the production of pomace reflects the historical analysis of the operation schedules of olives in oil mills, underlying trends that follow the typical productive alternation of olives (Chart 2/3).

Tab. 2/3 The production of olives processed in oil mills (values in 100 kg)

Period 1990-2005	Genoa	Imperia	La Spezia	Savona	Total Region of Liguria
AVERAGE	42,353	111,726	30,368	45,939	224,738
MIN	7,337	18,410	7,354	8,821	34,585
MAX	88,644	222,988	60,058	83,879	447,295

The regular fluctuations starting from the 1997-1998 production show the beginning of a period of production stability, due to the new adjustment that the sector had reached, in a progressive, though not uniform way, after the structural changes provoked by the

negative weather conditions occurring in 1985 and the degenerative consequences related to them.

This project has its focus in Imperia because of the major regional production of pomace obtained here. With regard to that, the details concerning the production of each Municipal District of the Province of Imperia are reported below.

Tab. 3/3 The production of pomace in the municipal districts of Imperia (values in 100 kg)

Municipality	Yearly average quantity of pomace (in 100 kg)	Municipality	Yearly average quantity of pomace (in 100 kg)	Municipality	Yearly Average quantity of pomace (in 100 kg)
Aquila di Arroscia	470	Diano Castello	434	Pigna	414
Aurigo	960	Diano Marina	102	Pontedassio	4,002
Badalucco	1,734	Diano S, Pietro	3,309	Prela	164
Borghetto di Arroscia	18	Dolceacqua	1,741	Ranzo	2,697
Borgomaro	3,681	Dolcedo	1,225	Rocchetta Nervina	379
Caravonica	446	Imperia	10,091	S, Bartolomeo al M,	2,429
Cesio	22	Isolabona	1,305	S, Lorenzo al Mare	996
Chiusanico	988	Lucinasco	756	S, Remo	596
Chiusavecchia	2,472	Montalto Ligure	502	Taggia	1,148
Cipressa	43	Perinaldo	583	Vasia	946
Civezza	24	Pitrabrana	1,910	Ventimiglia	2,013
Diano Arentino	717	Pieve di Teco	104	Villa Faraldi	1,260

In order to elaborate assessments in this document, we consider that a quantity of 20,660,000 kgs of virgin pomace is available on the local market to start an energy production process, this quantity is about 30% of the total amount of pomace produced, on average each year, in Savona-Imperia.

Tab. 4/3 Assessment of the pomace available for energy in Imperia

Production of pomace in the Provinces of Savona and Imperia (in 100 kg per year)	Estimated % of expected total production of pomace available on energy market	Expected quantity of virgin pomace available on the energy market (in 100 kg per year)
70,364	30%	20,660

Lastly, it is interesting to find out the potential benefits that the olive oil mills could enjoy, if they joined the initiative of supplying the pomace, against payment, to entrepreneurs able to turn their waste into a new alternative energy product.

The chart below shows, in a synthetic way, the advantages for both the olive oil millers and the community.

Tab. 5/3 Benefits obtained by the olive oil millers that join the innovative pomace-energy production process

Benefits for the oil millers that joins the pomace-energy production process		Benefits for the local community
Economic benefits	Administrative benefits	
<ul style="list-style-type: none"> The pomace, from waste turns into a valuable resource: it is not a cost for its collection and disposal any longer but an income source for its sale to a structure that processes virgin pomace to produce energy. 	<ul style="list-style-type: none"> All bureaucracy, concerning the administrative procedures for the disposal of the pomace is avoided. 	<ul style="list-style-type: none"> The use of pomace to replace fossil fuel generates less pollution and, as a consequence, favours a better environmental quality that is a better quality of life. The pomace used to produce energy, is collected locally. So, it becomes an energy product called " zero Km" because the supplying and distributing processes do not provoke any negative environmental impact.

4 Analysis of the market opportunities and threats of the pomace to be used for energy

In order to better define the technical and managerial hypothesis concerning the energy production process, that is centred on the implementation of pomace processing, it is useful to find all the opportunities and threats which characterise such waste from olive oil production with a view to market it for the production of energy. This analysis has led us to express the indications synthetically stated in the following chart. Among the supporting elements for the use of pomace as an energy vector means (table 1/4), we want to stress the fact that this is used as alternative fuel in the form of dried pomace or pellets. In order to verify the economic advantage of their use, it is interesting to analyze the trends of the pomace demand in the two above mentioned forms.

Tab. 1/4 The opportunities and the threats concerning the market of pomace as fuel

Opportunities	Threats
<ul style="list-style-type: none"> Pomace is a source of energy with an elevated heating power (3,900-4,500 Kcal/kg) Significant quantities of waste from the processing of olive oil are available A sufficient knowledge for the exploitation of the waste from the processing of olive oil is available The price of pomace is highly competitive compared to the expensive price and the instability of fossil fuel Biomass plants generally create new jobs and value Possibility of using incentive schemes such as green certificates The development of energy production processes from olive waste is a sensible sustainable way to manage of waste disposal of the waste from production Pomace represents a valid eco sustainable alternative to fossil fuel Possibility of using pomace for the production of pellets 	<ul style="list-style-type: none"> The different methods of olive pressing produce pomace of different qualities, as a consequence the resource to be used is not always homogeneous High costs of the technology to be used Small dimensions of olive oil production units (and therefore of pomace) which make the creation and management of the production process more difficult Existence of legal and economic barriers concerning the use of pomace Lack of an adequate political and institutional support in the spreading of pomace in the energy field Weather conditions influence, in a relevant way, the annual quantity of olive production and, consequently, of pomace Possible polluting emissions caused by the combustion of pomace pellets.

5 The demand of pomace as alternative fuel

At present, no market data exists as to the use of dried pomace, and its use for energy aims is so occasional that its demand cannot be outlined. Currently there is commercial sized co-generation plant in Rossano Calabro and a production plant being constructed in Capo di Mele in Lazio.

Pomace pellets, instead, can be assimilated to the more common wood pellets, an energy product now consolidated on the market, whose demand reveals the characteristics stated below.

The total presence of pellet fired boilers in Italy is now calculated to be over 200,000 units mostly concentrated in Triveneto, Lombardia, Emilia Romagna, Marche and Abruzzo. Liguria and Sardinia turn out to be the regions with the least number of pellet fired boilers. Of the above mentioned number of boilers in Italy 90% are domestic boilers including wood burning stoves, the other 10% share are industrial strength boilers (for blocks of flats, communities, companies) and thermal-electric energy generators.

Their energy requirement needs are about 500,000,000 kg of fuel, while the estimated national production varies between 220,000,000 and 250,000,000 kg/year. The quantity which is necessary to meet the home market requirements is guaranteed by imports from Austria, Spain and increasingly Eastern Europe (Romania, Czech Republic, etc.).

Thanks to its convenience and low cost, this new fuel has been much in demand since its commercial introduction with a consolidated increase which, in the recent years, ranges around 20% per year.

An exponential increase in pellet consumption is expected, especially if we consider how the new market of heat management implies the re-conversion of large power plants.

The scenario that is emerging outlines the following types of heating systems: a substantial stabilization or a slight increase in the number of air stoves, a marked increase both in boilers, centralized, autonomous, either of small or substantial capacity, and industrial boilers and heat generators for public service systems.

Among the energy products coming from the residue of olive processing, stands out the "nocciolino" (crushed olive pit), whose optimal heating power (4,750 kcal) makes it an interesting combustible commercial object.

6 Definition of technical-managerial hypothesis

The technical-managerial hypothesis which is analysed in the present study comes from the result of both the potential customers we want to refer to and the type of productive process in dealing with pomace, as reported in the following table.

For the pomace to be both commercially attractive and sufficiently calorific a predefined amount of "nocciolino" must be present, due to its elevated energy power.

Tab. 1/6 The segmentation matrix and targeting

	Production procedure to process pomace	
	Drying	Drying and pelletization
Customer typology		
Households (that use biomass to produce thermal energy)		
Companies which do not need much energy (that use biomass to produce thermal energy)		
Companies which use a lot of energy (that use biomass to produce thermal/electric energy)		●
Commercial agents		●
Public Bodies (that use biomass to produce thermal/electric energy)	●	●

According to the present technical knowledge, pomace can be processed in two different ways in order to be used in the production of energy:

- drying process, by which "virgin pomace" is transformed into "dried pomace", losing about 42-46% of its weight, thus becoming fuel to be used in suitable boilers;
- drying process and subsequent pelletization, by which virgin pomace is first dried and then transformed into pellets that are very similar to the more common wood pellets as to their look, consistency, and thermal efficiency.

As regards the type of market that can be interested in pomace as an energy source, the following segments have been devised:

- private people (who use biomass to produce thermal/electric energy);
- companies (that use biomass to produce thermal/electric energy);
- commercial agents (who distribute energy products);
- Public Bodies (that use biomass to produce thermal/electric energy).

Depending on the above mentioned variables, two possible technical-managerial solutions may be derived, characterized by the following product-market combination:

- solution "A")** dried pomace to be aimed to a target basically made up of Public Bodies;
- solution "B")** pomace pellets to be aimed to various targets made up of:
- Public Bodies and companies, (both big potential users of biomass from the waste of the olive oil industry);
 - commercial agents, that is the distributors of biomass;
 - final diversified consumers, also of small or micro dimension (eg households that use pellet boilers as a source of energy).

The reasons that have led to single out a precise and diversified target concerning each of the two devised managerial solutions can be summed up as follows:

As to solution "A", the choice of public customers is made because dried pomace is not widespread on the energy market. In the hypothesis that has been formulated, Public Authorities are, consequently, called to play the role of innovative "scout" and act as a driving force, able to favour the commercial introduction of dried pomace, divulge the information concerning its features, and inform about its advantages in terms of costs, thermal efficiency and environmental impact.

The Public Authorities will have to bear most of the initial costs of the introduction of dried pomace fed boilers on the market, such costs will progressively decrease because of economy of scale as this technology will be appreciated and spread.

On the other hand, today as it was in the past, the Public Authorities play the role of developer of technological innovations in many fields, acting as a bridgehead on emerging markets. This is especially true in this case, as innovative implementations generate substantial, potential advantages not only for the community in terms of economic savings, but also for the industry in terms of development of new production sectors and job creation, as well as for environment safeguard and improvement of life quality.

As to solution "B", the customer target is wider than in solution "A". The pellet emerges as a product which is quite well-known and consolidated on the market. Therefore it is

thought that the pomace pellet does not need any particular support for its commercial introduction (presence of public customers) as its thermal efficiency and physical characteristics are similar to wood pellets.

The chosen segments of market are characterised by relevant levels of energy consumption and include:

- a. companies that use large quantities of energy;
- b. commercial agents who deal in alternative energy products,
- c. Public Authorities that have already been using pellets or have just entered this market.

Private customers (households included), retail sales and all those that use small quantities of pellets are excluded because the commercial management would be too expensive particularly in the start-up phase of the business.

The table below shows the advantages that the categories of customers outlined in the 2 managerial solutions could obtain by using pomace as energy vector instead of the fossil fuels now more largely used.

Tab. 2/6 Customers and their respective advantages

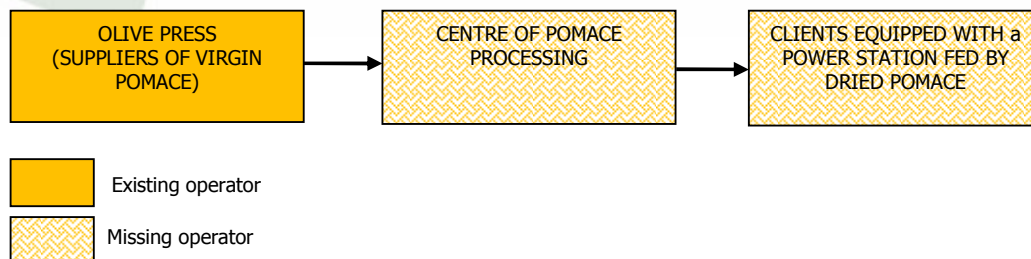
Customers	Energy vector	Benefits	Further benefits
Public Authorities (that use biomass to produce thermal/electrical energy)	<ul style="list-style-type: none"> ▪ Dried pomace ▪ Pomace pellets 	<ul style="list-style-type: none"> ▪ Reduction of energy costs ▪ Improvement of public image 	<ul style="list-style-type: none"> ▪ Improvement of environmental quality (less emission of pollutants in the atmosphere) ▪ Improvement in the balance of payments due to a reduced dependence on hydrocarbons ▪ Research incentive ▪ Development in the energy sector and in the technology connected to it ▪ New jobs
Private users (of biomass to produce thermal/electrical energy)	Pomace pellets	<ul style="list-style-type: none"> ▪ Reduction of energy costs 	
Companies (users of biomass for the production of thermal/electrical energy)		<ul style="list-style-type: none"> ▪ Reduction of energy costs ▪ Improvement of public image 	
Sales agents		<ul style="list-style-type: none"> ▪ Expansion of market opportunities (increase in sales) ▪ Improvement of the corporate image 	

7 Analysis of solution A

7.1 Analysis of the chain

The considerations reported in paragraph 5 underline the necessity to create a new economic production process, not currently available for pomace desiccation, and the demands of that energy vector in the object area of the present study.

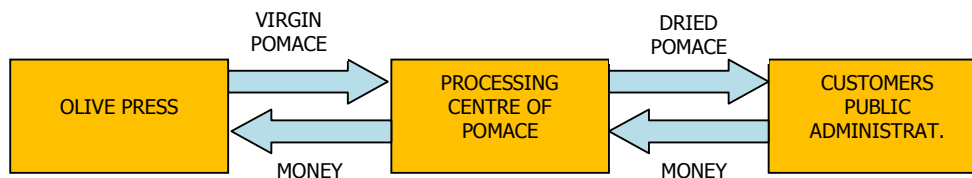
Fig 1/7 Principal operators involved and present situation of the chain



The creation of a new economic production process, particularly if aimed at the introduction of innovative technology needs, especially in the initial phases a supporting public authority.

In this case the actions of support hypothesized are those from the creation, from one side of a system of infrastructure, building of a processing plant for the virgin pomace and from the other, of a "captive" market built from the supporting public authorities that use the dried pomace to feed their own power stations (thermal or thermal-electric), obtaining meanwhile considerable savings on their energy costs.

Fig 2/7 The model of the chain in relation to solution A



The processing centre of the pomace takes the key role of the joint between offer and demand of the energy vector and at the same time supplies to the public authorities

(clients), the logistic services aimed at the distribution of the dried pomace, affording an effective and efficient management of the plants.

7.2 Ownership structure

The characteristics of the model above leads to devise the setting up of a private-public partnership for the management of the transformation centre of the pomace. The public side can be set up from the Public Bodies already present in the buyer's territory, the energy vector and benefit from savings on the energy bills and the environment by reducing CO₂ emissions. The private side however will be formed from organisations representing the agricultural entrepreneurial world, and those olive oil suppliers of the raw material.

The innovative character from the economic activities and its modest profitability (7.6 Economic-financial valuation) hypothetically returns less the participation of the olive press producers of the pomace and of other private subjects.

The processing centre can assume the legal form of a consortium or a limited company. It carries a list of possible subject participants to the property of the processing centre, at the time of its setting up to which, in time they can add further entities.

- Province of Imperia.
- Province of Savona.
- Council of Imperia.
- Council of S. Remo.
- CIA (Confederazione Agricoltori Italiani).
- Confagricoltura.
- Coldiretti.
- Association of Olive Press owners in Liguria (ad es.: COREFLI).
- Companies in the olive oil sector.

7.3 Organisation structure

In order to make the slimmest possible organisation structure of the processing centre for the pomace, the least burden of fixed costs, it is hypothesised to confer to outsourcing the entire management of the operating activities to an already existing firm in the market (eg.: a social co-operative or a public service company) and in level to assure the correct management of the processing plant of the pomace and to effectively run the services of picking and distribution, either with their own means or using the services of a third-party. The strategic direction of the firm, together with the marketing that will be developed in time, will be kept the property of the management, while the administrative aspects will be reserved to a professional studio.

The organisational structure to which will be entrusted the management of the plant estimates to employ 120 days/a man year for 3 people in operative roles and of 150 days/a man year for someone suitable for managerial tasks.

Tab. 1/7 Functional areas and relative distribution of responsibilities

Functional area	Responsibility
Marketing	Owner
Production	Specialized company already existing on the market
Supply and distribution logistics	<ul style="list-style-type: none"> ▪ Specialized company already existing on the market ▪ Transport company
Administration	Professional studio

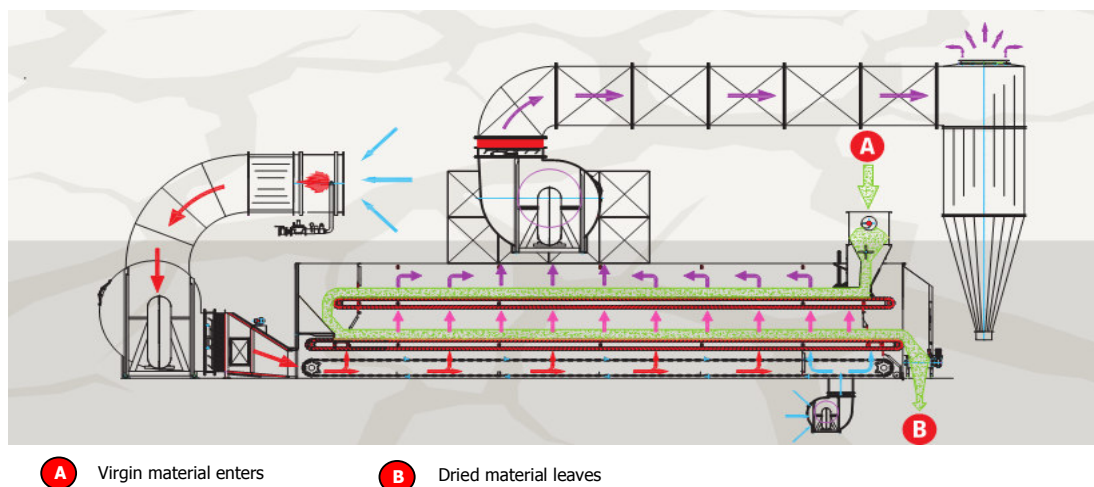
7.4 Technological structure

The technological configuration pre-chosen for the drying plant for the transformation of the virgin pomace to the dried pomace is that so-called "moving carpet". The system of drying is based principally on a horizontal tunnel with a rectangular base into which flows hot air at 75°C. The table below shows the principle technological components of the plant.

Tab. 2/7 Components of the drying plant for the pomace

• Feeder to the automatic carpet, adapted to receive uniformly the virgin loose pomace, which has a feed hopper and a screw leveller to position the product on the carpet.
• Bench of driers, that unrolls on the carpet above and below.
• Rotating cleaning system that across a rotation of 360° of 2 tubes which have blade of air in the ends guarantee the breath of air to the entire width of the carpet.
• Unloading screw of the dried product.
• Carpet scraper.
• Hot air ventilator.
• Battery of air-liquid changers at high efficiency.
• Suction ventilator connected to the air-flu for saturated air.
• Cyclone for the reduction of the dust provided by the unions for the relief of the emissions.
• Shutter of partialisation placed on the ventilators.
• Wooden and metal structure for the elevation of the bench of driers to a height suitable to permit the flow scraping to clean it.
• Electronic command panel, that works from the signs from the temperature probes in place inside the drier and of a planned set point, to carry out as an inverter, an automatic variation of the speed of the carpet drier.

The drier plant described above is able to guarantee on leaving a pomace dried with a level of humidity not lower than 12 %, going from original values (virgin pomace) of 45-50 %. The pre-chosen technical characteristics of the plant reveal a productive capacity equal of around 0.8 – 0.9 Ton/h of dried pomace, an installed electric power of 40 KW, a thermal power from the exchanger of 580 KW and an exchange of water temperature of 95 °C.

Fig. 3/7 Functional outline of the drying plant

7.5 Place and logistic aspects

The area necessary to the pomace processing centre is estimated to be about 1,200 sqm of which 875 sqm covered (shed) and 325 of work yards.

It can be sub-divided into the following functional spaces:

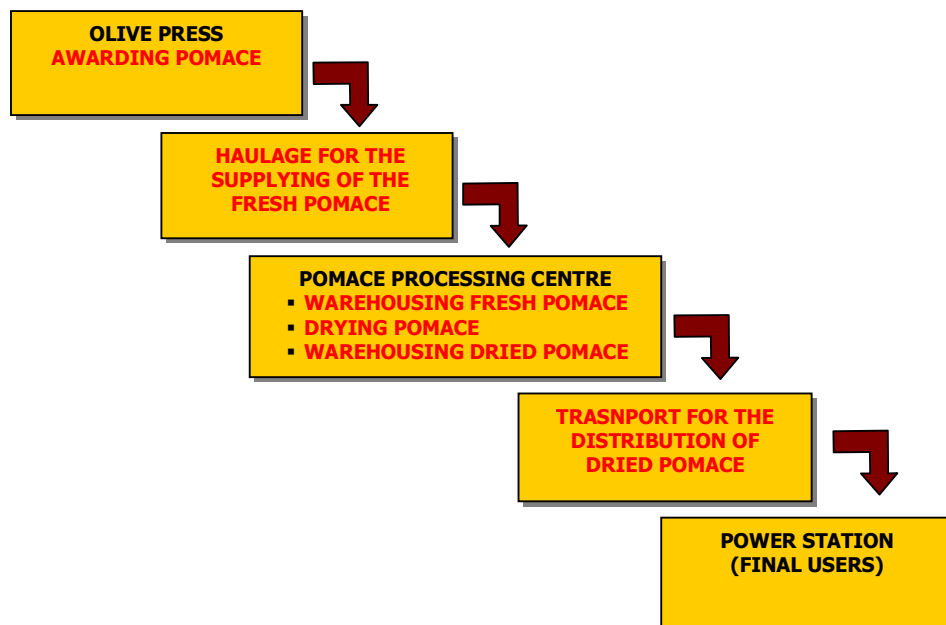
- warehousing of the virgin pomace;
- warehousing of the dried pomace;
- drying plant;
- weighing of the pomace;
- general services.

In order to limit the management costs of the centre we make the hypothesis that one of the participants of the private-public partnership of the centre gives the area for free. Its costs of renovation however will be charged to the centre.

The logistic aspects have great importance for the management of the chain (Fig 4/7):

- the points for supplying of pomace are many (36) and spread within the territory at a maximum distance of 15 km from the pomace drying centre;
- the period of conferring is concentrated in a short time of the year;
- the supply of dried pomace must be guaranteed with the aim to eliminate the interruption of the working of the power stations;
- the final power stations are spread over the territory at a maximum distance of 30Km.

Fig. 4/7 The logistic chain relative to the managerial model A



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7.6 Economic – financial assessment

7.6.1 Introduction

The assessment of solution A, from the economic-financial point of view has been made using two different profiles:

- value analysis;
- break even point analysis.

In particular, the value analysis affords to verify the capacity of the processing centre to sustain itself, both from an economic point of view and a financial one, repaying the investment sustained. The analysis of the balance permits us instead to identify the quantity of the product that must necessarily be sold to obtain an equality between the revenue and the costs, given a certain structure of costs and a certain price level.

In paragraphs 7.6.2 and 7.6.3 the evaluations have been made without considering the benefits derived from the use of easy-term loans.

This statement intends to point out the feasibility possibilities of the initiative released from the uncertainty of public financing regards to the availability of financial resources and time of disbursement.

In any case, in par. 7.6.4 we point out the possible economic-financial improvements for the project in case of utilization of public funds.

7.6.2 Value analysis

The input data relative to the present model of valuation are built from revenues, investment costs and running costs concerning the processing centre and originate from the hypothesis stated in the preceding paragraphs. The time-frame utilised for the valuations is 20 years, as it is dealing with activity of significant investment in which effects are reflected in the time. That time-frame corresponds to the duration of useful life of the drying plant for the pomace.

The valuations are moreover carried out on fixed prices, the effects of inflation in such a long period not being predictable.

Reported uniquely, in the following table are the most significant annuals and the first overheads nominated, conventionally Year1.

As it concerns the estimate of the quantities sold, at this time, the definitive demand of dried pomace as a combustible does not exist, we have preceded considering three parameters:

- the absorbable quantity from the local market for wood pellets, similar energy vector;
- the necessity to reach considerable quantities of product aimed at the realisation of economy of scale and to enable the recovery of the capital invested of modest unitary margins;
- the availability of the primary material (virgin pomace) in the area.

Concerning the third parameter we underline how the quantity of virgin pomace necessary for the production, in the year, of 1,178,931 kg of dried pomace corresponds to 1,939,340 kg, equal to 28% of the raw material produced in the Imperia/Savona territory.

It is necessary to point out that, for the estimate of the price, we can't make reference to any average price in the market because, at the moment, there is not an offer for this energy source in the territory concerning this project or, at a structural level, in Italy. We proceeded to the estimate of the price through the method of the "direct cost" which enables the establishment of the unit price of the product so as to make possible the attainment of a set objective for a net operating revenue.

In this specific case, we proceeded to find a level of net operating revenue so that it enables the project to obtain a positive ratio and to ensure the debt service concerning the financing sources used.

Besides, during the analysis it has been inserted the criteria that the unit price of dried pomace can't be superior to that of the wooden pellet, that is a comparable energy source having a consolidated market.

It underlines still how the quantities of hypothesised sales satisfy an annual energy need equal to around 6 MW, which corresponds to around 10 medium big scaled customers, with an average power of about 0.6 MW, typical of the target users (public authority subjects) identified in the production process model.

Tab. 3/7 Revenue (values in €)

Description	Total	Year 1	Year 2	Year 20
a) Dried pomace in kg		937,300.00	1,178,931.00	1,178,931.00
b) Price in kg		0.221	0.221	0.221
c) Revenue (a*b)	5,157,600.00	207,150.00	260,550.00	260,550.00

It is supposed that full scale production will commence in the Year 2.

Table 4/7 reports the estimated costs of the investments necessary for the realisation of the centre.

Tab. 4/7 Investment costs (values in €)

Description	Total	Year 1
a) Drying plant (incl. loading & unloading screws)	433,000.00	433,000.00
b) Furnishing and tools	10,000.00	10,000.00
c) Price of building	3,500.00	3,500.00
d) Total investment cost ($\Sigma a+c$)	446,500.00	446,500.00

Tab. 5/7 e 6/7 report, respectively, the operation costs of the centre and the parameters utilised for their estimate.

Tab. 5/7 Operating Costs (values in €)

Description	Total	Year 1	Year 2	Year 20
a) Virgin pomace	384,020.00	15,420.00	19,400.00	19,400.00
b) Logistic costs (transport for buying and distributing pomace)	600,790.00	24,140.00	30,350.00	30,350.00
c) Costs of direct work	810,210.00	37,290.00	40,680.00	40,680.00
d) Unforeseens	89,920.00	3,850.00	4,530.00	4,530.00
e) Direct production costs ($\Sigma a+d$)	1,884,940.00	80,700.00	94,960.00	94,960.00
f) Electrical energy	120,000.00	6,000.00	6,000.00	6,000.00
g) Plant maintenance	734,210.00	30,310.00	30,100.00	43,300.00
h) Depreciation	446,500.00	23,600.00	23,600.00	21,650.00
i) Rent	1,050,000.00	52,500.00	52,500.00	52,500.00
l) Indirect work costs	402,300.00	17,550.00	20,250.00	20,250.00
m) General expenditure	125,000.00	5,000.00	5,000.00	7,500.00
n) Indirect costs($\Sigma f+m$)	2,878,010.00	134,960.00	137,450.00	151,200.00
o) Total operating costs (e+n)	4,762,950.00	215,660.00	232,410.00	246,160.00

Direct costs level get normal from the second year, being correlated to the trend of the product quantity (Tab 5/7). The indirect costs instead remain substantially constant until Year 10, for then they suffer an increment due to the additional expenditure of maintenance and general expenditure.

Tab. 6/7 Parameters for the estimate of the operating cost

Costs		Parameters used	Values
a) Virgin pomace		Unit cost to buy per kg Virgin pomace in kg	0.01 € 1,939,340.00
b) Logistics	Transport for supplying virgin pomace	Virgin pomace in 1000 kg, Dried pomace in 1000 kg, Loading and unloading costs in 1000kg, Transport costs a 1000 kg/km Mid-distance for the supplies Mid-distance for the distribution	1,939.34 1,178.93 5.00 € 0.54 € 8.00 km 10.00 km
	Transport for distributing dried pomace	Virgin pomace in 1000 kg, Dried pomace in 1000 kg, Loading and unloading costs in 1000 kg, Haulage costs a 1000 kg/km Mid-distance for the supplies Mid-distance for the distribution	1178.93 5,00€ 0.54€ 15,00km 30,00km
c) Direct Work		Day costs Working days in a year Employed for the management of the plant	113.00 € 120.00 3
d) Unforeseens		Percentage of its direct costs	5.00%
f) Electricity		Fixed price	6,000.00 €
g) Plant maintenance		Years 1-10 : percentage of plant costs Years 11-20: percentage of plant costs	7.00% 10.00%
h) Depreciation		Plant costs / years of useful life Furnishings and tools: costs / years of useful life Expenditure of construction: cost/ years of useful life	20 years 8 years 5 years
i) Rent		Covered surface in square metres m ² Cost of rent in square metres m ²	875.00 60.00 €
l) Indirect work		Day costs Working days in a year Employed for the management of the plant	135.00 € 150.00 1
m) General expenses		Years 1-10: fixed price Years 11-20: fixed price	5,000.00 € 7,500.00 €

Table 7/7 reports the calculation of the **Net Operating Revenue** that represents the result of the management characteristics of the centre. The Net Operating Revenue appears negative, even if only a little in the first year, because the volumes of production are still too low to cover the direct costs of the enterprise. Its progress in the successive years is tied to the progress of the indirect costs previously described, the other two variables remaining constant.

Tab. 7/7 Net Operating Revenue (value in €)

Description	Total	Year 1	Year 2	Year 20
a) Net Revenue	5,157,600.00	207,150.00	260,550.00	260,550.00
b) Direct production costs	1,884,940.00	80,700.00	94,960.00	94,960.00
c) Contribution margin (a-b)	3,272,660.00	126,450.00	165,590.00	165,590.00

d) Indirect costs	2,878,010.00	134,960.00	137,450.00	151,200.00
e) Operating revenue	394,650.00	-8,510.00	28,140.00	14,390.00

The **Operating Cash Flow** enables to assess the capacity of the centre to self-finance, through the management of its activity, and to remunerate the capital invested. It indicates, in fact, the amount of resources annually available or required to carry out the initiative without specifying needs or over production.

Tab. 8/7 Operating Cash Flow (value in €)

Description	Total	Year 1	Year 2	Year 12	Year 20
a) Net Operating Income	394,650.00	-8,510.00	28,140.00	14,390.00	14,390.00
b) Taxes of the Operating Income	131,100.00	0.00	9,150.00	4,680.00	4,680.00
c) Depreciation	446,500.00	23,600.00	23,600.00	21,650.00	21,650.00
d) Cash-flow (a-b+c)	710,050.00	15,090.00	42,590.00	31,360.00	31,360.00
e) Fixed Investments	446,500.00	446,500.00	0.00	0.00	0.00
f) Operating Cash Flow (d-e)	263,550.00	-431,410.00	42,590.00	31,360.00	31,360.00
g) Cumulated Operating Cash-flow		-431,410.00	-388,820.00	12,670.00	263,550.00

Starting from Year 2 the Operating Cash Flow becomes positive with the full scale production of the activity and after having made the necessary investments for the realisation of the centre.

In Year 12 the cumulated Operating Cash Flow becomes positive, signalling the recuperation of the capital investments before the end of the useful life of the drying plant for the pomace (20 years). The Operating Cash Flow, in other words, provides the elements to effect a valuation of synthesis of the economic sustainability of the plan made up of two indicators.

- NPV (Net Present Value).
- IRR (Internal Rate of Return).

The calculation of the two indicators is obtained by the actualising of the Operating Cash flow referring to the whole time frame during which the activity develops, so making the values referring to the various years homogeneous as to time factor.

The rate used is equal to the mean weighted average cost of the total investment or WACC that, in this case, is 4.77%.

The specific cost of the separate financing funds used (Cfr.Tab. 10/7) is the following: long-term loans 4.56% (IRS ten year rate dated 10/22/2009 increased by 1 point of spread), account 8%, equity 5% (this rate is usually used for public investments).

NPV represents the incremental profit generated by the investment, which is expressed as if it were available immediately at the time of the investment. Its acceptance level is any value greater than zero.

The IRR, however, on one side expresses the gross income obtainable from the implementation of the project, uniquely based on levels and regular cash flow. From the other the maximum debt that finances the investment and to be able to service the debt.

This can be accepted when $IRR \geq$ to the discount factor used, in this case 4.77%.

Examination of Tab. 9/7 shows the feasibility of the project, in fact, all the indicators used exceed the acceptance levels.

Tab. 9/7 Indicators of project feasibility

Indicator	Value obtained	Value accepted
NPV	24,817.80	> 0
IRR	5.79%	> 4.77.00%
Pay back period	12 years	< 20 years

Table 10/7 shows the **Financial sustainability** of the initiative, which represents the origin and the destination of the financial resources necessary to realise the plan and its management during the time frame considered.

Tab. 10/7 Financial sustainability (value in €)

Description	Total	Year 1	Year 2	Year 20
a) Net Cash flow	263,550.00	-431,410.00	42,590.00	31,360.00
b) Financial costs	89,660.00	15,280.00	14,040.00	0.00
c) loans M-L/T	335,000.00	27,185.00	28,427.00	0.00
d) Reimbursement equity	128,000.00	0.00	0.00	0.00
e) Tot, outflows / inflows (a-b-c-d)		-473,875.00	123.00	31,360.00
f) Equity	128,000.00	128,000.00	0.00	0.00
g) Long term debt	335,000.00	335,000.00	0.00	0.00
h) Short term loans	12,800.00	10,875.00	0.00	0.00
i) Total sources of financing (f+g+h)	475,800.00	473,875.00	0.00	0.00

I) bank accounts balance trend	-10,875.00	-10,752.00	173,890.00
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In this case, it is assumed that the financial income needs of the project of the first year come from the centre partners 128,000.00 € which is 27% of the total requirements and from a 10 year loan of 335,000.00 € (71% of the total sources of financing) at 4.56% interest (IRS interest from 22/10/2009 increased by 1 %). The Net Cash Flow produced by the project in the various years allows the debt service, the reimbursement of the equity and a profit of 173,890.00 € at the end.

Lastly in Tab. 11/7 the estimated profit and loss appropriation account for the centre, is reported.

Tab. 11/7 Profit & loss appropriation account (Value in €)

Description	Total	Year 1	Year 2	Year 20
a) Net revenue	5,157,600.00	207,150.00	260,550.00	260,550.00
b) Direct production costs	1,884,940.00	80,700.00	94,960.00	94,960.00
c) Contribution margin (a-b)	3,272,660.00	126,450.00	165,590.00	165,590.00
d) Fixed costs	2,878,010.00	134,960.00	137,450.00	151,200.00
e) Net operative income	394,650.00	-8,510.00	28,140.00	14,390.00
f) Financial costs	89,660.00	15,280.00	14,040.00	0.00
g) Gross income (e-f)	304,990.00	-23,790.00	14,100.00	14,390.00
h) Taxes		0.00	0.00	5,370.00
i) Net income/revenue (g-h)	187,640.00	-23,790.00	14,100.00	9,020.00

7.6.3 Break even point analysis

Table 12/7 shows the values concerning the invoices and the break even point, as well as the safety limit, concerning the two relevant 'yearly' time periods used in the assessment:

- Year 2, (year productive levels are reached) for volumes of revenue and direct costs
- Year 11, year when fixed costs increase.

Tab. 12/7 Break even point analysis

Description	Year 2	Year 11
Estimated sales	260,550.00 €	260,550.00 €
Break even point of sales	216,300.00 €	236,250.00

Estimated quantity of product	1,178,931.00 kg	1,178,931.00 kg
Break even point of product	978,733.00 kg	1,069,004.00 kg
Safety margin	20.00%	10.00%

7.6.4 Effect of public financing

In case of resorting to easy-term loans to support the project, two institutional sources available at the moment have been identified as:

- "Measure 1.2.3" of the rural development plan for the Liguria region
- the technological innovation fund (FIT) 2009 of the economic development office.

According to the formalities of access to these sources and in relation to the management hypothesis formulated, we consider that the centre for the treatment of pomace may profit from the contribution for a share that is 30% of the investment supported by the centre.

In tab. 13/7 we point out the main results produced by the use of this share of public financing on the economic-financial parts of the project.

Besides, an analysis of the table give a synthesis of economic-financial values considered of great importance between the two hypothesis "with" or "without" a public financing.

Tab. 13/7 Comparison between the solutions with and without public financing

Project variables	Hypotesis without public financing	Hypotesis With public financing	Difference %
a) Sources of financing			
a,1) Equity	128,000.00	125,000.00	-2.40%
a,2) Long term Loans	335,000.00	200,000.00	-67.50%
a,3) Public financing/capital grants	0.00	135,000.00	100.00%
a,4) Short term loans	12,800.00	2,421.00	-428.71%
b) WACC	4.77%	3.37%	-41.54%
c) Indicators of feasibility			
c,1) NPV	32,514.67	44,207.98	26.45%
c,2) IRR	5.79%	4.60%	-25.99%
c,3) Pay back period (in years)	12	14	14.29%
d) Investment costs	446,500.00	446,500.00	0.00%
e) Economic results for a standard year (Year 12)			
e,1) Revenue	260,550.00	260,550.00	0.00%
e,2) Operatine costs	246,160.00	246,160.00	0.00%
e,3) Operating incombe	14,390.00	14,390.00	0.00%
e,4) Net cash flow	31,360.00	31,360.00	0.00%
f) Unit price			
f,1) Period: Year 1- Year 10	0.221	0.215	-2.79%
f,2) Period: Year 11 - Year 20	0.221	0.221	0.00%

The public financing enables to reduce the loans in medium range of 67.5% and the utilization of equity of 2.4%.

This fact makes possible a better management of the debt service, to reduce the weighted average cost of capital of about 41.5%, to utilize the start price of the energy vector lower of about 2.79% in the first ten years of management and even more to obtain a sensible improvement of the economic value produced by the project, pointed out of an increase of NPV of about 26.45%.

The IRR decrease of about 26% and the prolongation of the pay back period for about two years (+14.29%) results from the hypothesis to lower the unit start price of energy vector through 10 years. In any case the two ratio are both superior to the respective thresholds of acceptance for the valuation of the feasibility of the project:

- IRR: 4.60% > 3.37%.
- Pay back period: 14 YEARS < 20 years.

7.6.5 The costs for the final user

We point out that the sustainability of the model of the chain (Cfr. Par.7.1) is based on the exclusive presence of public customers that are able to ensure the use of pomace.

To perform this role, the customers have to bear the investment costs concerning the acquisition of new boilers that are in a position to use the new source.

In the following table the investment value estimated with reference to 3 power values considered of major interest for the market has been transcribed.

Tab. 14/7 Costs of the new technology for the customer

Customer	dried pomace boiler (KW)	Purchase cost of new dried pomace boiler (€)
Public Bodies in Savona and Imperia area	500	200,000.00
	600	240,000.00
	700	280,000.00

We likewise think it convenient to point out that in case the client would use public financing amongst other things at the moment these are located in the ambit of MEASURE 1.2.5 of Rural Development plan of Liguria Region.

The investments inherent to the acquisition of new thermal plant fuelled by pomace would profit of the contribution to the bound equal to 80% of their value.

7.7 Cost benefit analysis

The cost-benefit analysis verifies the economic profitability, that customers enjoy in making use of pomace in respect to other fuels, and the impact on the environment derived from this energy vector if compared to fossil fuels.

ab. 15/7 Differential Cash Flow

Description	Total	Year 1	Year...	Year n
a) Boiler with XXX (non-defined fuel)				
a,1) Cost of buying the boiler				
a.2) Annual maintenance costs				
a.3) Annual fuel costs				
a.4) Cash flow for XXX ($\Sigma a.1 \div a.3$)				
b) Boiler fed with dried pomace				
b,1) Cost of buying boiler				
b.2) Annual maintenance costs				
b.3) Annual fuel costs				
b.4) Cash flow for pomace ($\Sigma b.1 \div b.3$)				
c) Differential Cash flow (b.4-a.4)				
d) Cumulated differential cash flow				

The solution with pomace fuelled boilers seems to be better than the alternative solution when the differential Cash flow is positive, representing an economic saving and when the 2 indicators NPV & IRR, obtained from the actualisation of the differential net cash flow of each year exceed the acceptance threshold, represented by zero and 5% values.

Tab. 16/7 reports the synthetic results in the application of this model, comparing the situation characterised by the use of a pomace fuelled boiler with that of a methane fuelled boiler.

Since the prices for the pellet fuelled boiler and the annual maintenance are identical the only difference and economic advantage for client is the difference of the annual fuel consumption.

The latter is less by than about 15-16%.

The powers taken into consideration come from the analysis of some plant samples which can be found with public operators in the territory of Imperia. The time frame considered for the valuation is 15 years, corresponding to the average life expectancy of a boiler.

Tab. 16/7 Results of cost benefit analysis

Description	DCF	NPV	IRR
Oil plants			
a) Boiler with 500 KW power	389,750.00	233,890.00	33.76%
b) Boiler with 600 KW power	414,000.00	243,500.00	29.74%
c) Boiler with 700 KW power	505,750.00	299,840.00	31.18%
Natural gas plants			
d) Boiler with 500 KW power	103,250.00	35,640.00	9.51%
e) Boiler with 600 kw power	91,500.00	20,350.00	7.18%
f) Boiler with 700 kw power	120,250.00	33,080.00	8.02%

The analysis of the results confirms the economic advantage of pomace if compared to the other two alternative vectors considered. The major benefit obtained, when compared with oil, depends on the cost of the fuel, which is higher than the cost of methane.

As to the second aspect considered in the cost benefit analysis, the environmental impact due to reduced CO₂ emissions, compared to those when using fossil fuels, a 6 MW pomace boiler has been used.

The comparative analysis has shown an estimated saving in CO₂ shown in the table below. It also shows the savings in social costs caused by climate change, thanks to the use of dried pomace pellets. The estimates are based on the parameters given by the IPCC (Intergovernmental Panel on Climate Change), a United Nations Organisation.

Tab. 17/7 Reduced CO₂ emissions, thanks to the use of pomace pellets (values in 1000 kgs)

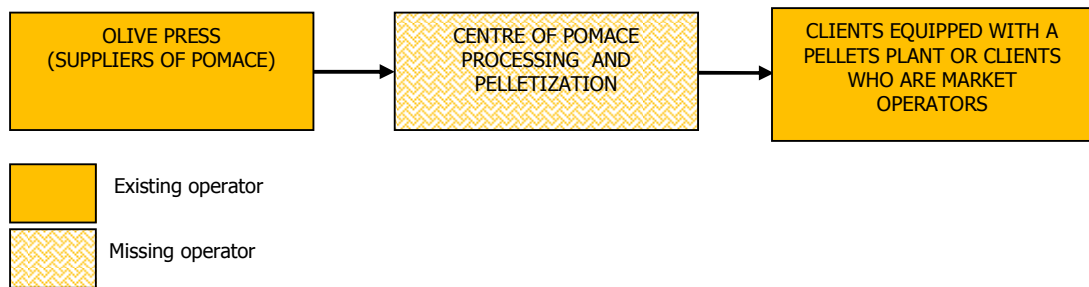
CO ₂ reduction compared with the use of METHANE (1000 kgs)	CO ₂ reduction compared with the use of OIL (1000 kgs)	Mean social cost per 1000 kgs of CO ₂ (€/1000 kgs)	Social cost savings compared with using METHANE (€)	Social cost savings compared with using OIL (€)
1,007.7	1,924.5	18.00	18,140.00	34,640.00

8 Analysis of solution “B”

8.1 Analysis of chain

The management model concerning solution “B” presents aspects which are different from solution “A” (Fig. 1/8). It is in fact, a more consolidated production process in which the pomace pellets, obtained from a drying/pelletizing process, is basically similar to the wood pellets, an energy vector already spread and consolidated on the market, as it is used in power plants of various dimensions, above all in households.

Fig 1/8 Main operators involved and present state of the chain



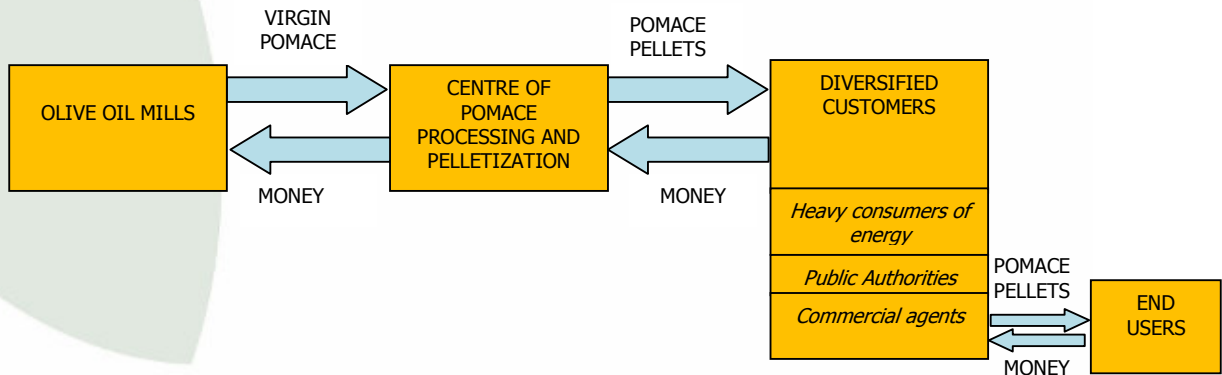
The supporting action, therefore, needs only be centred on the creation of the infrastructure made up of the plant for the processing of virgin pomace and pelletization.

The Public Authority support, necessary to the implementation of the plant, is due to the present limited diffusion of virgin pomace processing technology and its consequent high cost, therefore it little appeals to private economic operators.

This support will consist of preferential rate contributions and long-term repayment times which will allow a considerable reduction of the costs resulting from a higher expenditure to buy the technology.

In Fig. 2/8 the stakeholders involved and the related economic exchange are shown.

Fig. 2/8 The model of the chain related to solution "B"



In solution B, pellets are sold to large energy user companies, to Public Authorities and commercial agents. The choice of selling the products directly, only to customers who buy large quantities is due to the necessity of reducing the organizational complexity and therefore the commercial costs of the processing centre.

8.2 Ownership structure

The remarks stated in the previous paragraph enable us to speculate about the creation of a private company for the management of the processing centre.

As to its structure, the participation of operators economically linked with the olive oil and energy sectors can be assumed, such as, for example:

- ligurian olive oil miller associations (for example: COREFLI).
- companies operating in the olive oil sector.
- companies operating in the energy sector.

8.3 Organizational structure

The organizational structure of the processing centre will be streamlined also thanks to limited staff and outsourcing to comply with logistic and administrative activities. In particular a staff of three people: 1 coordinator and 2 power station operators.

The coordinator will be employed for 150 days a year and will have to coordinate the company activities and the management of the pellet commercialization process.

However, the 2 power station operators will be employed for 120 days a year. The operators are less than in solution "A" because of the different type of productive process and also because of the choice of a more automated technology.

Tab. 1/8 Functional area and related distribution of responsibility

Functional area	Responsibility
General coordination	Coordinator
Marketing	Coordinator
Production	2 Power station operators
Supplies and distribution	<ul style="list-style-type: none"> ▪ Coordinator ▪ Transport company
Administration	Professional studio

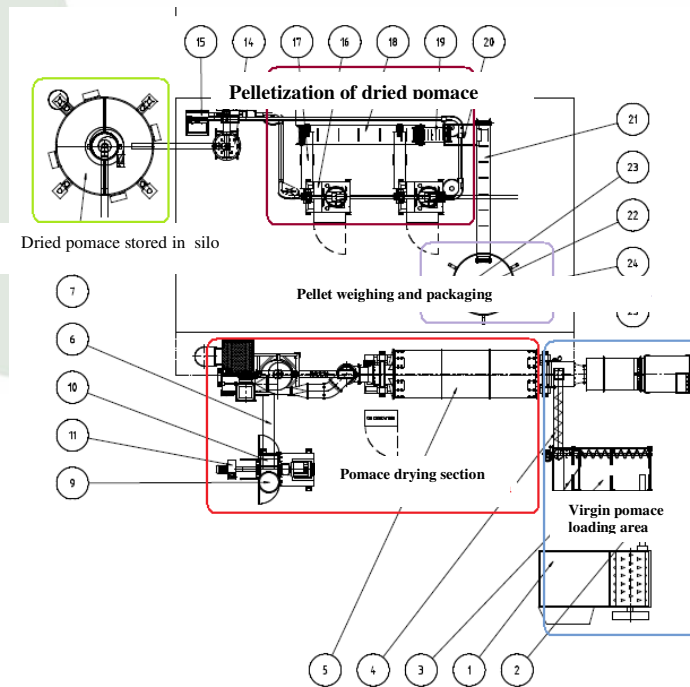
8.4 The technological structure

The technological model of the plant chosen for drying and pelletizing virgin pomace, is expected to have such characteristics as to guarantee a production with quality standards compliant to the regulations UNI/TS11263:2007.

The table below shows the main technological components of the proposed drying and pelletization plant.

Tab 2/8 The main technological components of the proposed drying and pelletization plant.

- Grinder
- Hopper connected to a series of screws for the transfer into the drier
- Drier fitted with a burner using our own dried pomace
- Magnetized selector
- Hammer-crusher to break the product into fine particle-size material
- Ground material extractor ready to be stored in silos
- Warehousing silo
- Moisture pre-mixer
- Pelletizing machine
- Weighing equipment
- Packaging system

Fig 3/8 Functional scheme of the drying and pelletizing plant


The most critical component of the plant is the cuber (pelletiser): this part has the task of aggregating ground and fine particle-size material which do not possess any binding power, and whose cohesion only depends on the relevant pressure generated during the pelletizing phase.

Hence the necessity of heavy-duty pelletisers, both to be able to guarantee managerial costs compatible with the pellet market price, and to endow the final product with that optimal quality which makes an efficient and regular combustion possible.

The drying and pelletizing plant is able to yield a pomace pellet with a humidity degree of about 10 %, starting from initial values (virgin pomace) of around 45-50 %.

The technical characteristics of the chosen plant reveal a productive capacity of about 800 kg/h of pomace pellets and an installed electric power of 40 KW.

8.5 Place and logistical aspects

Virgin pomace, as well as pomace pellets, will be warehoused inside the area where the company has its premises, whose overall surface, as an indication, measures 750 square metres, 500 of which are covered (warehouse) while 250 square metres are work yards.

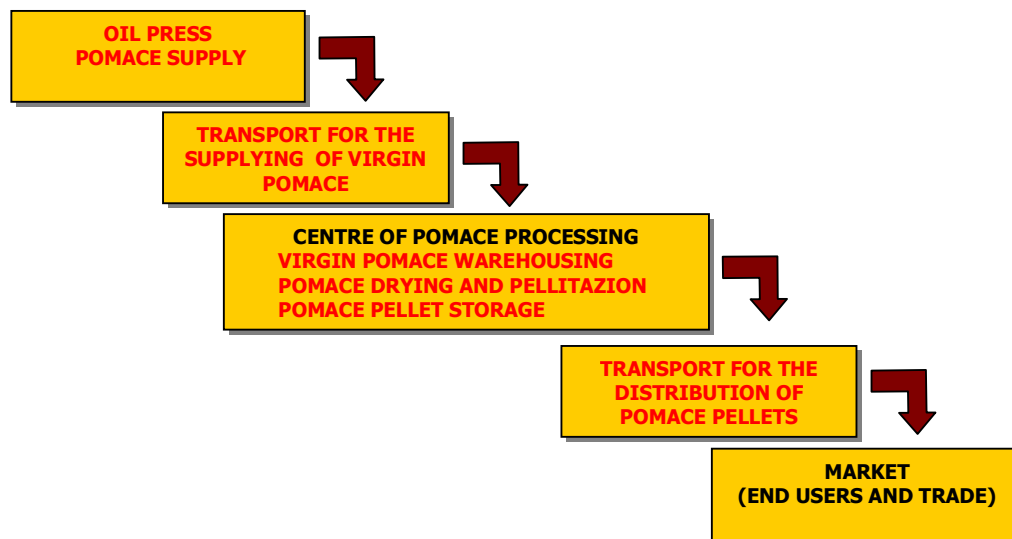
It will be divided into the following functional spaces:

- virgin pomace warehousing.
- pomace weighing.
- drying plant.
- pellet plant.
- pellet warehousing.
- general services.

As in solution "A", the transport service for both the supply and the sale of virgin pomace to the pellet market, will be out-sourced.

As to the location of the company, the hypothesis is that it is rented, as it should be quite reasonable to presume that industrial warehouses, free from economic activities, are easily available in the analysed territory.

Fig. 4/8 The logistic chain related to the managerial model B



8.6 Economic and financial assessment

8.6.1 Preliminary remarks

As in solution A, the economic and financial assessment for solution B has been made using the two profiles previously described in paragraph 7.6.1.

Similar to this last solution, we also point out that, in paragraphs 8.6.2 and 8.6.3 the evaluations have been carried out without considering any benefit coming from the use of public financing. This solution underlines the feasibility of the initiative, released from the randomness of public financing in terms of availability of funds and time of disbursement.

In any case, in par. 8.6.4, we describe the possible economic-financial improvement for the project derived from the hypothesis of using public funds

8.6.2 Value analysis

The same basic hypothesis, formulated in the analysis of solution "A", has been adopted here:

- time frame used for the evaluations: 20 years.
- constant prices for the economic variables used in the evaluations.
- direct pressure of taxation of 37.25 %.

In this case too, the discount rate utilized for the calculation of the feasibility NPV and IRR indexes is equal to WACC that is, in this case, 4.77%.

The precise cost of the separate financing funds used (Cfr. Tab. 10/8) is the following: long-term loans 4.56% (IRS ten year rate dated 22/10/2009 increased by 1 point of spread), short-term debts 8%, equity 5% (this rate is usually used for public investments).

Table 3/8 shows the revenue trend of the most significant annuals.

As to the estimate of sales three parameters have been considered:

- the absorbable quantity from the local market for pellets.
- the necessity to reach considerable quantities of product aimed at the realization of economy of scale as well as enabling the recovery and the profitability of the capital invested in presence of modest unitary margins.

Concerning the third parameter, we underline how the quantity of virgin pomace, necessary for the production, in one year, of about 1,237,230 kg of pellets, is about 2,066,170 kg, equal to about 30% of the raw material produced in the Imperia and Savona territory.

The price estimate was done referring to the average price quoted in the market for pellets (in wood).

Tab. 3/8 Revenue (value in €)

Description	Total	Year 1	Year 2	Year 20
a) Pellets in kgs		1,237,230.00	1,237,230.00	1,237,230.00
b) Price per kg		0.235	0.235	0.235
c) Gross revenue (a*b)	5,815,000.00	290,750.00	290,750.00	290,750.00
d) Vacancy	116,180.00	5,800.00	5,800.00	5,810.00
e) Net revenue (c-d)	5,698,820.00	284,950.00	284,950.00	284,940.00

The plant is supposed to be in full production starting from the first year.

For prudent reasons, a 2% vacancy has been used in the price estimate in consideration of the fact that the model of the production process to make pomace pellets includes also private clients as a segment of its own market.

Tab. 4/8 Investment costs (values in €)

Description	Total	Year 1
a) Drying and pelletising plant	680,000.00	680,000.00
b) Bagging machine	30,000.00	30,000.00
c) Furnishing and tools	10,000.00	10,000.00
d) Start-up costs	3,500.00	3,500.00
e) Total investment costs (Σa÷c)	723,500.00	723,500.00

Tables 5/8 and 6/8 show respectively the operating costs of the centre and the parameters used for their estimate.

Tab. 5/8 Operating costs (values in €)

Description	Total	Year 1	Year 11	Year 20
a) Virgin pomace	413,400.00	20,670.00	20,670.00	20,670.00
b) Logistical costs	709,800.00	35,490.00	35,490.00	35,490.00
c) Costs of direct work	542,400.00	27,120.00	27,120.00	27,120.00
d) Unforeseen expenses	83,400.00	4,170.00	4,170.00	4,170.00

e) Direct production costs ($\Sigma a+d$)	1,749,000.00	87,450.00	87,450.00	87,450.00
f) Electrical energy	200,000.00	10,000.00	10,000.00	10,000.00
g) Plant maintenance	1,156,000.00	47,600.00	68,000.00	68,000.00
h) Depreciation	723,500.00	37,450.00	35,500.00	35,500.00
i) Rent	600,000.00	30,000.00	30,000.00	30,000.00
l) Indirect work costs	405,000.00	20,250.00	20,250.00	20,250.00
m) General expenditure	125,000.00	5,000.00	7,500.00	7,500.00
n) Indirect costs ($\Sigma f+m$)	3,209,500.00	150,300.00	171,250.00	171,250.00
o) Total operating costs (e+n)	4,958,500.00	237,750.00	258,700.00	258,700.00

Also the direct operating costs start from the first year, as they are correlated to the quantities produced (Tab. 3/8). The indirect costs, instead, remain essentially constant till the end of the 10th year, then, they increase because of the higher maintenance and general costs.

Table 7/8 shows the calculation of the **Net Operating Revenue** of the company. The result of the management is positive starting from the very first year, as the company immediately goes to full production. In the following years, its trend is linked to the trend of the fixed costs previously described, while the other two variables remain constant.

Tab. 6/8 Parameters for the estimate of the operating costs

Costs		Parameters utilised	Values
a) Virgin pomace		Unit cost to buy per kg Virgin pomace in kgs	0.01 € 2,066,170.00
b) Logistic	b1) Transport for supplying virgin pomace	Virgin pomace in 1000kgs Pellets in Ton, Loading and unloading costs per 1000 kgs Haulage cost in 1000 kgs Mid-distance for the supplies Max-distance for the distribution	2.066,17 5,00 € 0,54 € 8,00 km 15.00 km
	b2) Transport for distributing dried pomace	Virgin pomace in 1000kgs Pellets in Ton, Loading and unloading costs per 1000 kgs, Haulage cost in 1000 kgs Mid-distance for the supplies Max-distance for the distribution	1.237,23 5.00€ 0,54€ 15,00km 30,00km
c) Direct work		Day costs Working days in a year Employed for the management of the plant	113.00 € 120.00 2.00
d) Unforeseen expenses		Percentage on direct costs	5.00%
f) Electrical energy		Fixed price	6,000.00 €
g) Plant maintenance		Years 1-10: percentage of plant costs Years 11-20 percentage of plant costs	7.00% 10.00%
h) Depreciation		Plant: costs/ years of useful life Bagging machine: costs / years of useful life Furnishing and tools: costs / years of useful life Start-up costs: costs / years of useful life	20 years 20 years 8 years 5 years

i) Rent	Covered surface in square metres	500.00
	Rent per square metre	60.00 €
l) Indirect work	Day costs	135.00 €
	Working days in a year	150.00
	Employed for the management of the plant	1.00
m) General costs	Years 1-10: fixed price	5,000.00 €
	Years 11-20 fixed price	7,500.00 €

Tab 7/8 Net Operating Revenue (values in €)

Description	Total	Year 1	Year 11	Year 20
a) Net revenue	5,698,820.00	284,950.00	284,940.00	284,940.00
b) Direct production costs	1,749,000.00	87,450.00	87,450.00	87,450.00
c) Contribution margin (a-b)	3,949,820.00	197,500.00	197,490.00	197,490.00
d) Indirect costs	3,209,500.00	150,300.00	171,250.00	171,250.00
e) Net operating revenue	740,320.00	47,200.00	26,240.00	26,240.00

Tab. 8/8 Operating Cash Flow (values in €)

Description	Total	Year 1	Year 2	Year 11	Year 20
a) Net operating income	740,320.00	47,200.00	47,200.00	26,240.00	26,240.00
b) Taxes on net operating income	240,670.00	15,340.00	15,340.00	8,530.00	8,530.00
c) Depreciation	723,500.00	37,450.00	37,450.00	35,500.00	35,500.00
d) Cash-flow (a-b+c)	1,223,150.00	69,310.00	69,310.00	53,210.00	53,210.00
e) Fixed Investments	723,500.00	723,500.00	0.00	0.00	0.00
f) Operating cash flow (d-e)	499,650.00	-654,190.00	69,310.00	53,210.00	53,210.00
g) Cumulated operating cash flow		-654,190.00	-584,880.00	20,760.00	499,650.00

The **Operating Cash Flow** becomes positive starting from the second year, when the investments necessary to the implementation of the centre are completed, as they were concentrated in the first year. During year 11 the cumulated operating cash flow becomes positive, showing the recovery of the capital invested before the end of the useful life of the pomace drying/pelletizing plant, which is 20 years.

Tab. 9/8 shows the indicators used to check the feasibility of the business, based on the hypothesis previously formulated. All the indicators are positive exceeding their respective acceptance thresholds.

Tab. 9/8 Indicators of project feasibility

Indicator	Value obtained	Value accepted
NPV	97,030.00	> 0
IRR	6,99%	> 5,00%
Pay back period	11 years	< 20 years

The financial sustainability of the project is shown in Tab 10/8.

Tab 10/8 The financial sustainability (value in €)

Description	Total	Year 1	Year 2	Year 20
a) Operating cash flow	499,650.00	-654,190.00	69,310.00	53,210.00
b) Financial costs	147,220.00	25,080.00	23,050.00	
c) Reimbursement loans	550,000.00	44,634.00	46,669.00	
d) Reimbursement equity	170,000.00			0.00
e) Tot, outflows/inflows (a-b-c-d)		-723,904.00	-409.00	53,210.00
f) Equity	170,000.00	170,000.00	0.00	0.00
g) Long term debt	550,000.00	550,000.00	0.00	0.00
h) Short term loans	23,250.00	3,904.00	409.00	0.00
I Tot sources of financing (f+g+h)	743,250.00	723,904.00	409.00	0.00
I) Trend of bank account balance		-3,904.00	-4,313.00	352,430.00

In this case, it is hypothesised that the financial income needs of the project, in the first year, come from the centre partners for an amount of 170,000.00 € which is 23% of the total requirements and from a 10 year loan of 550,000.00 € (76% of the total serviceable debt) at 4.56% interest (IRR interest from 22/10/2009 increased by 1 %). The Net Cash Flow produced by the project in the various years allows the debt to be serviced, the reimbursement of the equity and a profit of 352,430.00 € at the end of the project.

Lastly in Tab. 11/8 the estimated profit and loss appropriation account for the centre, is reported.

Tab. 11/8 Profit and loss appropriation account (values in €)

Description	Total	Year 1	Year 2	Year 20
a) Net cash flow	5,698,820.00	284,950.00	284,940.00	284,940.00

b) Direct production cost	1,749,000.00	87,450.00	87,450.00	87,450.00
c) Contribution margin (a-b)	3,949,820.00	197,500.00	197,490.00	197,490.00
d) Fixed costs	3,209,500.00	150,300.00	171,250.00	171,250.00
e) Net operating revenue	740,320.00	47,200.00	26,240.00	26,240.00
f) Financial costs	147,220.00	25,080.00	0.00	0.00
g) Gross revenue (e-f)	593,100.00	22,120.00	26,240.00	26,240.00
h) Taxes		8,240.00	9,780.00	9,780.00
i) Net revenue (g-h)	366,900.00	13,880.00	16,460.00	16,460.00

8.6.3 Analysis of the break even point

Tab 12/8 shows the values concerning the invoices and the break even point, as well as the safety limit, concerning the two relevant 'yearly' time periods used in the assessment:

- Year 1, year levels are reached for volumes of revenue and direct costs;
- Year 11, year when fixed costs increase.

Tab. 12/8 Analysis of the break even point

Description	Year 2	Year 11
Estimated Invoices	248,950.00 €	284,950.00 €
Break even point of invoices	216,850.00 €	247,077.00 €
Estimated Quantity of product	1,237,230.00 kg	1,237,230 kg
Break even point of product	922,766.00 kg	1,051,390.00 kg
Safety limit	31.00 %	15.00 %

8.6.3 Effect of public financing

In the hypothesis of resorting to public financing aimed at supporting the project, we have identified two sources available at the moment:

- MEASURE 1.2.3 of the rural development plan of the Liguria Region;
- the national technological innovation fund (FIT) 2009 of the economic development office.

According to the formalities of access to these sources and in relation to the management hypothesis expressed, we consider that the centre for the exploitation of pomace may profit from the contribution of a share of 30% of investments supported by the centre itself.

In tab. 13, we point out the main results produced by the use of this share of public financing the economic-financial parts of the project. Besides, the analysis of the table gives a synthesis of economic-financial values considered of great importance between the two assumptions "with" or "without" public financing.

Tab. 13/8 Comparison between the solutions with and without public financing

Project variables	Hypotesis without public financing	Hypotesis with public financing	Difference %
a) Sources of financing			
a,1) Equity	170,000.00	145,000.00	-17.24%
a,2) Long term Loans	550,000.00	330,000.00	-66.67%
a,3) Public financing/capital grants	0.00	220,000.00	100.00%
a,4) Short term loans	23,250.00	1,018.00	-2183.89%
b) WACC	4.77%	3.22%	-48.14%
c) Indicators of feasibility	723,500.00	723,500.00	0.00%
c,1) NPV			
c,2) IRR	110,019.01	209,077.27	90.04%
c,3) Pay back period (in years)	6.99%	6.99%	0.00%
d) Investment costs	11	11	0.00%
e) Economic results for a standard year (Year12)			
e,1) Revenue	284,940.00	284,940.00	0.00%
e,2) Operatine costs	258,700.00	258,700.00	0.00%
e,3) Operating income	26,240.00	26,240.00	0.00%
e,4) Net cash flow	53,210.00	53,210.00	0.00%

Public financing allows for the reduction of the loans of about 66.7% and the use of equity of 17.2%. This fact enables a better management of the debt service, to reduce the *weighted average cost of capital* (WACC) by about 48.1% and to obtain a clear improvement of economic value produced by the project with an increase of NPV by about 90%.

8.7 Cost benefit analysis

Also for solution B the cost benefit analysis is carried out. It verifies the economic profitability enjoyed by the potential customers of the pomace centre as well as the positive environmental impact as CO₂ emissions. In order to verify the economic advantage

of the perspective clients to use pomace pellet at the hypothesised price, the **Differential Cash Flow** (DCF) has been used, as described in par. 7/7, developed in a time frame of 15 years.

Table 14/8 shows the synthetic results of the analysis, comparing the situation of the pomace fuelled plants with those of oil or natural gas.

Tab. 14/8 Results of cost benefit analysis

Description	FCD	NPV	IRR
Oil plants			
a) Boiler with 500 KW power	367,250.00	218,325.00	31.72%
b) Boiler with 600 KW power	387,000.00	224,830.00	27.78%
c) Boiler with 700 KW power	474,250.00	278,040.00	29.19%
Natural gas plant			
d) Boiler with 500 KW power	80,750.00	20,075.00	7.58%
e) Boiler with 600 KW power	64,500.00	1,670.00	5.18%
f) Boiler with 700 KW power	88,750.00	11,290.00	6.05%

On examining the results, the economic advantage of pomace pellets are confirmed when compared to the two other alternative vectors taken into consideration. The major benefits obtained when compared to oil depend on the cost of the fuel, which is definitely more expensive than natural gas.

As to the second aspect considered in the cost benefit analysis, the environmental impact due to reduced CO₂ emissions, compared to those when using fossil fuels, a 6 MW fed pomace boiler has been used.

The comparative analysis has highlighted an estimated saving in CO₂ shown in the table below. It also shows the savings in social costs caused by climate change, thanks to the use of pomace pellets. The estimates are based on the parameters given by the IPCC (Inter-governmental Panel on Climate Change), a United Nations Organisation.

Tab. 15/7 Reduced CO₂ emissions, thanks to the use of pomace pellets (values in 1000 kgs)

CO ₂ reduction compared with the use of NATURAL GAS (1000 kgs)	CO ₂ reduction compared with the use of OIL (1000 kgs)	Mean social cost per 1000 kgs of CO ₂ (€/1000 kgs)	Social cost savings compared with using NATURAL GAS (€)	Social cost savings compared with using OIL (€)
1,007.7	1,924.5	18.00	18,140.00	34,640.00

9. Business plan for the Municipality of Arnasco, Province of Savona

This specific business plan derives from a specific call for interest open to all public and private entities located in Liguria, that was launched in March 2010 by ARE Liguria and Unioncamere Liguria. The selection was made according to a set of criteria that were awarded to the 5 declarations of interest received. The winner was the Municipality of Arnasco, a rural village of 625 inhabitants, located in the Province of Savona.

In the Municipality of Arnasco there is an olive growers cooperative (Cooperativa Olivicola di Arnasco) where a mill is located. They produce 120 tons of virgin pomace each year and they separate the pit to give it to the Church which uses it as fuel for its small district heating system.

Now the administration of Arnasco is interested in using the virgin pomace to heat some public buildings concentrated in a small area: municipal building, kindergarten, primary school, multimedia room which sum up to a heating power of 130 kW.

Unfortunately the quantity of pomace yearly available is not enough to develop a sustainable business plan, because of the need to have a drier to transform the virgin pomace.

We therefore tried to involve a bigger mill (Frantoio Anfosso), available in the surroundings, that had sent its declaration of interest as well but was not selected. Altogether, the quantity of virgin pomace reaches 1000 tons/y.

These are the main features of the business plan related to Arnasco:

- The pomace drier takes the key role of the joint between offer (Frantoio Anfosso) and demand of energy (public buildings in Arnasco)
- The drier will be located in an industrial area under renovation, located in the territory of Arnasco but only 5 kms away from Frantoio Anfosso. The cost of the shed is therefore not calculated in the business plan and will be provided for by the municipality of Arnasco

- The Municipality of Arnasco and the miller Anfosso will therefore need to sign a PP partnership
- The dried pomace will be delivered back to Arnasco to fuel the stoves of the public buildings; the remaining dried pomace can be sent to the many local greenhouses for heating
- The drying unit is composed by two centrifugal fans (at entrance and exit of the drier), a heater, two mobile conveyors on which the pomace is dried through the air blown from the fan outlet, cyclone system for smokes to be expelled into the atmosphere. The organisational structure to which will be entrusted the management of the plant estimates to employ 120 days/y (106 days for production + 14 for maintenance) for 1,5 people in operative roles. The drier will receive the pomace for free and sell it at 80 €/ton (less than pellet cost = 220€/ton and less than wood chip cost = 120€/ton)
- The assessment has been made through the break even point analysis: the drier payback period, with 50% public funding is at about 10 years. The pomace stove payback period, with no public funding, is 6 years.

9.1 Available Quantities

Frantoio Anfosso (4/5 of total) and Cooperativa Olivicola Arnasco together account for:

	total	
virgin pomace amount	1.075.200	kg/year
water content in virgin pomace	516.096	kg/year
vegetable water	1.920.000	kg/year
fully dried pomace	559.104	kg/year
dried pomace	607.722	kg/year

9.2 Technical solutions and break even points

DRIER characteristics

drier unit cost	286	€/(kg/h)	
operating daily hours	12		
drier size	907	kg/h	
plant cost	170000	€	

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maintenance costs percentage	5	%	note: yearly maintenance cost to plant cost
maintenance cost	8500	€/year	
personnel and operation costs	16744	€/year	
total plant cost	170000	€	
CO ₂ produced	24210	kg/year	

Break even point

BEP with 0% public fundings

year	disc. fact.	cash flow	net preset value
1	0.99009901	8,885	-161,203
2	0.980296049	8,885	-152,493
3	0.970590148	8,885	-143,869
4	0.960980344	8,885	-135,331
5	0.951465688	8,885	-126,877
6	0.942045235	8,885	-118,507
7	0.932718055	8,885	-110,220
8	0.923483222	8,885	-102,014
9	0.914339824	8,885	-93,890
10	0.905286955	8,885	-85,847
11	0.896323718	8,885	-77,883
12	0.887449225	8,885	-69,998
13	0.878662599	8,885	-62,191
14	0.86996297	8,885	-54,461
15	0.861349475	8,885	-46,808
16	0.852821262	8,885	-39,231
17	0.844377487	8,885	-31,729
18	0.836017314	8,885	-24,300
19	0.827739915	8,885	-16,946
20	0.81954447	8,885	-9,664
21	0.811430169	8,885	-2,455
22	0.803396207	8,885	4,684
23	0.795441789	8,885	11,751
24	0.787566127	8,885	18,749
25	0.779768443	8,885	25,677
26	0.772047963	8,885	32,537
27	0.764403924	8,885	39,328
28	0.756835568	8,885	46,053
29	0.749342147	8,885	52,711

BEP with 50% public fundings

year	disc. fact.	cash flow	net preset value
1	0.99009901	8,885	-76,203
2	0.980296049	8,885	-67,493
3	0.970590148	8,885	-58,869
4	0.960980344	8,885	-50,331
5	0.951465688	8,885	-41,877
6	0.942045235	8,885	-33,507
7	0.932718055	8,885	-25,220
8	0.923483222	8,885	-17,014
9	0.914339824	8,885	-8,890
10	0.905286955	8,885	-847
11	0.896323718	8,885	7,117
12	0.887449225	8,885	15,002
13	0.878662599	8,885	22,809
14	0.86996297	8,885	30,539
15	0.861349475	8,885	38,192
16	0.852821262	8,885	45,769
17	0.844377487	8,885	53,271

POMACE HEATING PLANT IN ARNASCO

Pomace stove

burner unit cost	380	€/kW
heating beginning date	1/11	
heating end date	15/4	
operating yearly days	165	dd/year
operating daily hours	12	hh/dd
burner size	130	kW
seasonal efficiency	0,70	
plant cost	49400	€
maintenance costs percentage	6	%
maintenance cost	2964	€/y
energy production	171600	kWh
dried pomace	34704	kg
dried pomace cost	2776.32	€ (0,08 €/kg)
dried pomace net LHV	17.80	MJ/kg

Thermal plant room area

thermal plant room area	3	m ²
thermal plant room height	2.5	m
thermal plant room volume	7	m ³
construction/renov. unit cost	100	€/m ³
construction cost	10000	€

Break even point with 0% public financing

year	disc. fact.	cash flow	net preset value
1	0.9901	7027.68	-39841.90
2	0.9803	7027.68	-32952.70
3	0.9706	7027.68	-26131.70
4	0.9610	7027.68	-19378.24
5	0.9515	7027.68	-12691.64
6	0.9420	7027.68	-6071.25
7	0.9327	7027.68	483.59
8	0.9235	7027.68	6973.54
9	0.9143	7027.68	13399.22
10	0.9053	7027.68	19761.29
11	0.8963	7027.68	26060.36
12	0.8874	7027.68	32297.07
13	0.8787	7027.68	38472.03
14	0.8700	7027.68	44585.85
15	0.8613	7027.68	50639.14
16	0.8528	7027.68	56632.49
17	0.8444	7027.68	62566.51
18	0.8360	7027.68	68441.77
19	0.8277	7027.68	74258.86
20	0.8195	7027.68	80018.36

9.3 Transport costs and CO₂

total transport cost	10416	€/year
transport to drier	5975	€/year
transport to burner	4442	€/year
average transport speed	20	km/h
specific CO ₂ production	4,32	kg/h/t
wet pomace x drier distance	1109	t*km
dry pomace x burner distance	2884	t*km
CO ₂ produced	862	kg/year

Saved CO₂ (no use of natural gas for heating) = -30,030.00 kg/y

Total Saved CO₂ (transport + drying plant + heating plant Arnasco) = -4,952 kg/y