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Market of Olive Residues for Energy

D5.1.:Business plans for energy facilities exploiting olive-milling solid residues

ARE Liguria spa · Unioncamere Liguria · ANATOLIKI S.A. · agener agencia de gestión energética DIPUTACIÓN PROVINCIAL DE JAÉN · UP Università del Litorale Univerza na Primorskem · ZRS

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D5.1.:Business plans for energy facilities exploiting olive-milling solid residues

This document contains the abstracts of the 5 business plans defined by MORE project partners. The full documents are available on www.moreintelligentenergy.eu in the section "Download"

The business plans refer to a variety of situations.

- Liguria (Italy): pomace drying unit + heating plant
- Croatia: hot water pomace boiler system for district heating
- Jaén (Spain): combined solar thermal and biomass heating and cooling
- Crete (Greece): pomace heating plant and pelletizing plant
- Slovenia: olive pitting plant and olive pit fuelled heating plants

Business plan in Liguria, Italy

The business plan in Liguria 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. Alltogether, 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.

Available Quantities

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

	total	
virgin pomace amount	1075200	kg/year
water content in virgin pomace	516096	kg/year
vegetable water	1920000	kg/year
fully dried pomace	559104	kg/year
dried pomace	607722	kg/year

Trasport 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

DRIER characteristics

drier unit cost	286	€/(kg/h)	
operating daily hours	12		
drier size	907	kg/h	
plant cost	170000	€	
maintenance costs percentage	5	%	note: yearly maintenance cost to plant cost
maintenance cost	8500	€/year	
personnel and operative costs	16744	€/year	
total plant cost	170000	€	
CO_2 produced	24210	kg/year	

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	49.400	€
maintenance costs percentage	6	%
maintenance cost	2.964	€/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	€

Saved CO_2 (no use of natural gas for heating) = -30,030.00 kg/y
Total Saved CO2 (transport + drying plant + heating plant Arnasco) = -4952 kg/y

BEP 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

Business plan in Croatia

BIOMASS ENERGY FACILITY "IPTPO 1,3 MW"

Current state

Institute of Agriculture and Tourism Poreč and High school are located in the green zone in the town of Poreč, K. Huguesa 6 - 8. The size of location reaches about 28,980 m^2. About 3,500 m^2 of total area has been built, so there is enough space for possible expansion of facilities and construction of new facilities.

Institute and School have following facilities:

1. Institute building, approx. surface 1,000 m^2 – working and office space
2. High school classrooms approx. 3,500 m^2
3. Wine cellar with mini vinification line
4. Warehouses
5. 2 oil heating systems
6. 2 greenhouses

Current energy facilities (power 0.5 MW) are situated in Institute and High school buildings. The two facilities are not nor interconnected or connected to other facilities in the area. The plan is to build a new energy facility (hot water biomass boiler system based on different residues e.g. olives, vineyard, pine), which will be used for district heating.

Water is supplied from public water network system.

Electricity is supplied from electricity distribution network operator HEP.

- Current heating system in Institute of Agriculture and Tourism: Wolf MKS – 140: oil fired power 110 – 160 KW, gas-fired power is 117 – 144 KW, built in 1998.

- Current heating system in High school building: 2 x Wolf MKS – 750 – 800 KW oil fired power built in 1996.

Institute of Agriculture and Tourism and High school is located near the road, which allows easy supply of raw materials and shipment of finished products. Waste from agricultural production can be used as an energy source for the energy facility so the process of burning the solid residues is very efficient and low-cost.

Use of biomass as a renewable energy source

Future agricultural production of the Institute of Agriculture and Tourism (surface 322,099 m^2) in its full utilization could fully settle all energy needs set by this business plan.

Presently there are planted:

1. 4,578 m^2 under olives

2. 39,689 m^2 under vineyard

3. 4,343 m^2 under fig

4. 1,200 m^2 under other perennial plants

5. 276,489 m^2 arable land

Residues (bark wood, wood pellets, branches, olive pomace and vine, pits and other wood production waste) may be accumulated to at least 3,000 m^3/year and are suitable for biomass energy facility use due to following:

- There are sufficient amount of residues in relation to existing heat energy demand;

- There are sufficient number of existing and potential consumers willing to accept heat energy

- Existing heating system should be replaced, so after revitalisation it will be used as a cold reserve and for covering the peak loads.

Economic and environmental contributions

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Existing heating systems in public institution buildings, their premises and property is obsolete from technical and technological point of view while equipment has already passed an economic and projected lifetime.

The main financial and economic indicators are presented in tables below:

Profitability

Parameter		
Total investments	4.700.000	kn
Net savings	1.095.000	kn/year
ROI	4,3	year
Loan Repayment	4,3	year
Net present value	16.971.727	kn
Net present value quotient	3,61	
Internal rate of return	23	%

Conditions**:** Economic lifetime = 20 years
Real interest rate = 1,5 %

Financial plan

Owners equity	900,000	kn
Grant	200,000	kn
Loan (FZOEU)	1,700,000	kn
Loan (HBOR)	2,000,000	kn
Total investments	**4,800,000.00**	**kn**

Grant EU pre-accession funds and the Environmental Protection and Energy Efficiency Fund encourage the construction of energy facilities with greater energy efficiency and building energy facilities based on biomass and other renewable energy sources

Calculated savings:

Substitution of fuel oil consumption = 9,090 MWh/year = **1,006,645** ***litres LUL***/ year

Substitution of fuel oil consumption with heat from biomass heating system reduces consumption of fuel oil in small energy facilities with the level of activity η = 0.9,
This corresponds to the following reduction in total emissions into the environment:

Total emission reduction (ton/year)

	CO_2	**SO_2**	**NO_x**	**CO**	**Particles**
Heating oil emissions	3,273	5.12	3.07	0.21	0.26
Emissions after the implementation of the Project	0	0	7.82	4.27	-0.89
Total emission reduction	**3,273**	**5.12**	-4.75	-4.06	-0.63

The reduction of emissions is calculated based on fuel oil extra light.

Summary of cash flows for first 10 years [1 000 kn]

Cash flows of the Project	**Year**										
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Net cash flow	**-500.0**	**863.2**	**898.3**	**468.6**	**505.9**	**544.5**	**771.8**	**855.1**	**898.8**	**1,453.9**	**1,500.4**
Cumulative cash flow	-500.0	363.2	1,261.5	1,730.1	2,236.1	2,780.5	3,552.3	4,365.1	5,220.2	6,119.0	7,572.9

Business plan in Crete, Greece

The island of Crete has the second largest production in Greece. Crete, with a population of 650,000 in year 2005, is one of the 13 regions into which Greece is divided. It forms the largest island in Greece and the second largest (after Cyprus) in the Eastern Mediterranean. The island of Crete is a region of Greece, consisting of four prefectures:

- Chania
- Heraklion
- Lasithi
- Rethymno

Due to the hilly morphology of the territory and the insufficient road infrastructure, the 112 active olive mills in the Chania prefecture (535 in the whole island) are dispersed mainly on the north side of the region. The treated annually amount of olives in the prefecture is around 133,000 tn and the most used olive oil extracting process in the prefecture is the 3-phase centrifugal system.

In the local language this type of residue is called either depleted pomace or exhausted pomace. Cretan depleted pomace contains smashed olive kernel and dried olive pulp with humidity around 12% (no oil content)
Most of the Cretan olive growers (95-99%), give their crops to co-operatives which have their own olive mill, after harvesting the olives and pay the olive millers to extract the olive oil from their yearly crop. After the olive oil extracting process, the millers sell or exchange virgin pomace to the pomace oil refineries with depleted pomace. Depleted pomace in the island of Crete can be found at the price of 50 €/ton while virgin pomace at 15 € per ton. Pomace oil refineries extract the aprox. 2% content of pomace oil from the virgin pomace using a solvent, usually hexane (The price for pomace oil is 650 €/tn). Finally after the drying phase and the subtraction of the solvent the resulted product named depleted pomace is ready to be sold as a fuel.

The main disadvantages of the final product form (depleted pomace) are that:

- It can not be easily distributed over long distances
- It can not be stored for an extended period of time due to its chemical nature.
- The remained ash after the combustion is in higher quantities in contrast to other biomass fuel sources and needs to be removed in shorter periods of time.
- Some technical problems have been observed when combusted in small-size burners due to its chemical nature.

For this reason, it is mainly storage in bags (Picture below) and sold to the local small-sized industries for direct combustion.

Picture: Storage of depleted pomace in bags	**Picture:** Depleted pomace in its natural form
	

The depleted pomace heating value (3500-4000 Kcal/ kg) and its price (approximately 0.05 Euros/kg); make depleted pomace a very attractive option as a fuel in comparison to diesel. Presently, in Greece these types of residues are used for space heating at small houses in some villages, at greenhouses for hot water production or through drying process at pomace oil refineries.

The estimated solid residues amount after the olive oil and pomace oil extraction in the prefecture of Chania is around 3,000 tn. Half of this amount is used during the drying process as fuel and as a result the available amount to be entered in the market is approx. **18,000 tn.** The table below presents the treated olive amount and the estimated virgin pomace and depleted pomace derived from the processing methods.

Treated olive amount and estimated solid residues

Chania prefecture, island of Crete, Greece			
2007-2008 (in kg/year)			
Treated olive amount	Estimated virgin pomace content after the 3-phase processing	Estimated water amount content in the virgin pomace	Estimated depleted (exhausted) pomace after the pomace oil extraction & drying
133,002,302	74,982,078	36,458,073	35,991,398

By comparing energy cost for heating, depleted pomace has a significant advantage over heating diesel as the heat content per Euro is 15,454 kcal/€ for heating diesel (market price 0.60 €/L) and 81,020 kcal/€ for depleted pomace. Therefore, it is an opportunity for depleted pomace to become part of the solution for a non-fossil fuel energy system and ideally serve residential or/and industrial burner for heat production.

Given that the available depleted pomace to be sold as a fuel in the relevant market is around 18,000 tn per year (Table below) the corresponding energy potential is around 290,000 GJ/year (lower heating value 16.00 MJ/kg).

Average pomace annual quantities in the Prefecture of Chania, Crete

virgin pomace	74,982,078	kg/year
water content in virgin pomace	36,458,073	kg/year
depleted pomace	35,991,397	kg/year
depleted pomace lower heating value	16.00	MJ/kg
depleted pomace high heating value	18.10	MJ/kg
depleted pomace necessary to dry virgin pomace	17,995,699	kg/year
energy production by net depleted pomace	287,931,180	MJ/year
energy production by net depleted pomace	79,980,883	kWh/year

The energy value of the depleted pomace produced today in Crete is equivalent to approx. 20% of the total energy consumption of the island.

The simplest way to exploit depleted pomace for energy production is by direct combustion.

Explanations of technical-managerial hypotheses

In order to assess and project future financial viability of an operation regarding biomass exploitation, it is critical to define a clear framework of working hypotheses (Table below).

Hypotheses and explanations

Hypothesis	Explanation
Feedstock to pomace ratio	- No pit extraction - Ratio adjusted to local technology (mostly 3-phase)
Olive extraction technology	- No major technology improvements
Local availability of olive pomace	- Based on statistics from season 2007-2008
Olive pomace residue	- Residue ratio resulted from existing experience in olive pomace plants
Market for produced pellets	- Wholesale market - Stable demand
Installation costs	- Investment cost 375 €/(kg/h) (linear scale)
Management & Maintenance costs	- Linear scale (0.075 €/kg)

The following technologies for the business plan were considered:

- Burner/Combustion
- Pelletization unit
- Cogeneration

Out of these three, co-generation is considered the most difficult to implement because it requires a more intensive and larger scale production plant which is difficult to implement given the annual pomace quantities. On the other hand, small scale biomass burners would be a more sustainable solution for the case of Chania region. The potential of making pellets out of pomace is also a viable alternative.

Therefore, in order to promote and support the energy exploitation of solid residues from olive oil processing, in the present scenario is examined the direct collection of the depleted pomace from the olive pomace oil extraction mills and their proper transformation into combustible fuel.

a) Direct Combustion for the needs of space heating in a Greenhouse

Although solar energy represents a significant factor in greenhouse heating, supplementary systems are a necessity for year round heat production. Coal, oil and gas are the most common forms of energy used for greenhouse heating. The choice of which fuel to use is based primarily on economics. Depleted pomace is also a viable alternative.

Central Heating.
Hot water or steam heating systems can be used to preheat irrigation water and prevent cold-water shock to plants. The heat is centrally provided by the boilers and transferred to the greenhouse environment either by pipes that are smooth or finned or by unit heat exchangers equipped with fans.

Heat Transfer Coefficient for Greenhouse Construction Materials

Material	***Kcal/m²***
Glass single layer	7,065
PE film, single layer	7,819

The Tables below presents the Energy data for depleted pomace to be used in Greenhouse heating at Chania region and the corresponding money saved and years of repayment for the replacement of an oil burner with a biomass burner. The area to be covered is around 266 $m^{3.}$

Energy data for depleted pomace to be used in Greenhouse heating in Chania region

Depleted pomace burner power	150.000 kcal/hour
Hours of operation	800 hours/year
Annual burner heat output	120.000.000 kcal/year
Depleted pomace consumption	34.000 kg/year
Equivalent tonnes of diesel	12 TOE/year
Heat losses from the north greenhouse site	6.000.000 kcal
Total annual heat consumption	126.000.000 kcal
Equivalent electric energy	146.510 KWh
electric energy required for greenhouse equipment	8.195 KWh
Total greenhouse annual energy consumption	154.705 KWh
Percentage of electric energy consumption to the total annual greenhouse energy	5,3%
Average heat input requirements	7,74 Kcal/m^2
Price of 180Kw burner boiler	27.000€

Economic analysis

Equivalent tonnes of diesel	12 TOE/year	*0.60 €/liter[1]	=8,280€
Depleted pomace consumption	34,000 kg/year	*50 €/tn	=1,700€
		Financial Gain	6,580€

Years of pay-back

Price of 180 kW burner boiler	Money saved each year	Pay-back (simple method)
27,000€	/ 6,580€	=4.1years

b) Pelletizing plant
In the case of direct energy exploitation of pomace, these residues are collected and transported from pomace oil refineries to a central pelletizing facility, as bulk feedstock for pellets production.

To better promote and support the energy exploitation of solid residues from olive oil processing, in the present scenario is examined the collection of the dried solid olive residues (*depleted pomace*) from the pomace oil refineries and their proper transformation into pellets.

In the case of pelletization, the produced solid residues which are collected and transported from olive oil extraction mills to pomace oil refineries are suggested to be forwarded to a pelletizing plant, as bulk feedstock for pellets production.

[1] One tonne of oil equals just over seven barrels or about 1,150 litres of oil

In order to mitigate the vulnerability of the venture regarding the acquisition of feedstock and to sustain the cooperation of the pomace oil refineries owners, the ownership structure of the business is containing a partnership between the feedstock providers and a private financing. It is strongly proposed to be developed a joint venture between local refinery owners and private investors, where feedstock acquisition would be ensured. This will create synergies and a win-win situation for the stakeholders and will reduce risk and sustain the business operational.

Position of the pelletizing plant

Among the various possible locations for the installation of the plant, the wider area of Kolymbari at the north-west coast of Crete island was selected as the most suitable The best location of the processing installation units considered to be somewhere between the pomace oil refineries A & B & C (Picture 11) with the biggest production of depleted pomace.

The proposed project scheme requires the installation of a drying unit for the further humidity reduction of the depleted pomace to reach the homogeneous humidity. In addition to this, a pelletizing unit able to process the total dried residue amount is required to be installed in a location close to the pomace oil refineries in order to minimize the transportation cost.

The drying phase of virgin pomace is taking place at the 3 pomace oil refineries of the region.
For the pelletiser unit we need

- Land
- Building Construction (600m^2)
- Equipment of production line
- Trucks
- Staff

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The Equipment of the production line is shown below

	**HAMMER MILL**	135,000€	70 KW
	**PELLETISER**	225,000€	10 KW
	**DRIER** (In case of non existence of pomace oil refineries)	600,000	120 kw
	**COOLING**	60,000€	10 KW
	**STORAGE**	165,000€	5 KW
	**ELECTRONIC CONTROL SYSTEM**	15,000€	5 KW

The total installation costs as well as other cost issues are presented the table below as were resulted from the cost calculation tool provided by the ARE Lig agency.

The current energy market in the region of Chania is mostly based on electricity and fossil fuel consumption, which, due to the isolation from the mainland electricity network and the high transportation cost for fossil fuels, has limited security, increased cost and it is unsustainable. Thus, energy supply cost in Crete is dependent on the cost of fossil fuels and increased compared to the price of energy in the Greek mainland. In order to evaluate and assess the economical feasibility of the project, when evaluating the market penetration and acceptance, special attention must be given due to the close relationship and bonds of local community to olive tree products.

Pellet Plant figures

pellettiser unit cost	375	€/(kg/h)
working days	300	dd/year
maintenance-management unit costs	0.075	€/kg
Virgin pomace available	17,995,699	kg/anno
plant size	4,999	kg/hr
plant cost investment	1,874,552	€
pellet price	0.17	€/kg
operational costs	0.075	€/kg
yearly production	17,995,699	kg/year
pellet production intermediate income	1,538,632	€/year
pomace transport cost	251,940	€/year

depleted pomace cost	899,785	€/year
pellet production income	386,908	€/year

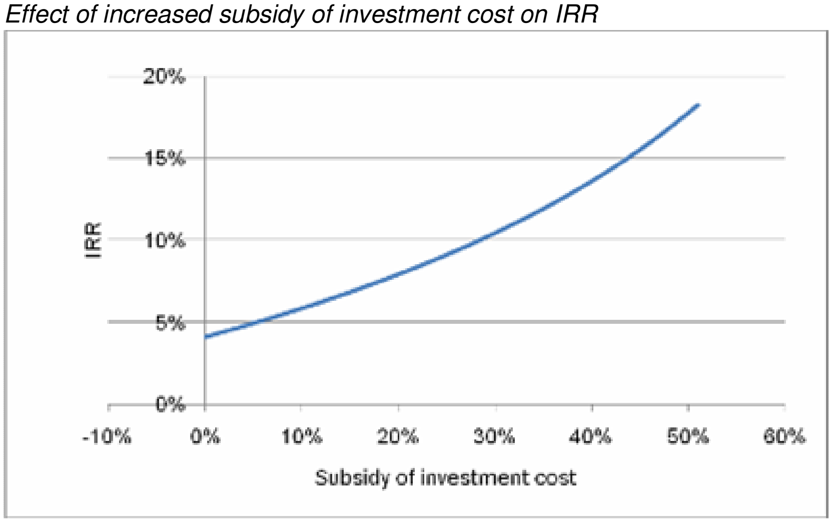
Investment payback period

year	disc. fact.	cash flow	net preset value
1	0.990099	232,145	-1,644,706
2	0.980296	232,145	-1,417,136
3	0.9705901	232,145	-1,191,818
4	0.9609803	232,145	-968,732
5	0.9514657	232,145	-747,855
6	0.9420452	232,145	-529,164
7	0.9327181	232,145	-312,639
8	0.9234832	232,145	-98,257
9	0.9143398	232,145	114,002

Sensitivity analysis
Due to the limited profitability of the proposed plan and in order to examine the risk of price fluctuations for pomace and pellet market, a sensitivity analysis is performed in order to assess the vulnerability of the project. On the graphs below, are depicted the effect of increased subsidy of the investment cost and pellet price on the Internal Rate of Return (IRR) of the investment.

From the diagrams below, it is concluded that the viability and the profitability of the venture is strongly dependant on the examined parameters (pellet price and subsidy percentage). Therefore, it is crucial to define a market penetration strategy and to exploit subsidy opportunities beforehand in order to secure optimal financial efficiency of the investment.

Effect of increased subsidy of investment cost on IRR



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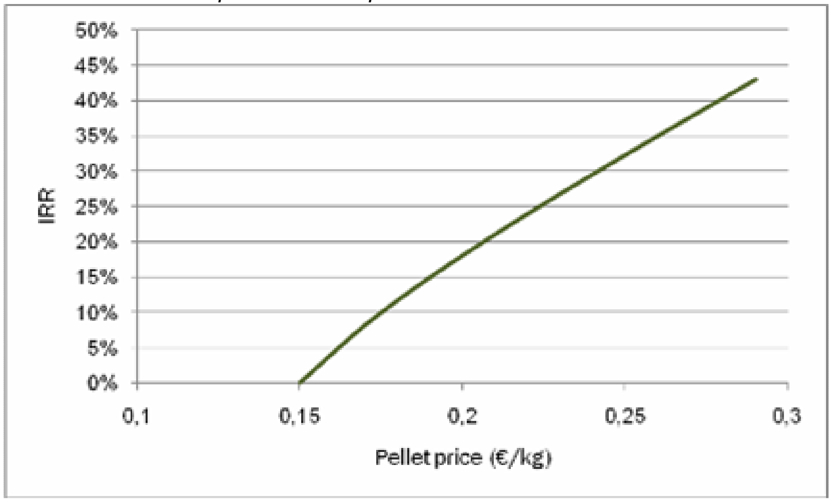
Effect of increased pellet market price on IRR



Business plan in Slovenia

1. BUSINESS PLAN FOR THE ŠMARJE PRIMARY SCHOOL

The ŠPS is currently heated with extra light fuel oil. The total heated surface area covers 3,368 m^2. The current boiler room houses two old boilers with a power of 350 kW and low energy efficiency of approximately 70%.

Heating with Olive Pomace

ŠPS would replace extra light fuel oil with olive pomace. Dried olive pomace would be supplied by a company collecting and supplying dried residue. A decrease in the consumption of the energy-generating substance would be achieved by the installation of a less powerful boiler since the two boilers currently used are too powerful. The energy efficiency of the new boiler would be around 93%. The calculation of the thermal energy needed for heating the building was made on the basis of average energy consumption per square meter of heated area in the last five years.
The new heating system would be composed of:

- Boiler (400 kW)
- Olive pomace storage tank
- Storage unit for accumulated heat (2 x 2,000 l)
- Olive pomace feeder (snail)
- Automatic ash disposer
- Circulating pumps with frequency regulation
- Automatic regulation system

Transportation

The Primorska region generates around 700–1000 tons of (fresh) olive pomace per year. Transportation costs include the costs of the potential volume of all pomace collected in the area (within a radius of 25 km) plus the costs of combined transport of dried pomace. According to our estimation, the latter range from € 7,542 and € 8,977 and include the following two items:

- Removal of fresh olive pomace from olive growers: € 5,274 – € 6,277
- Delivery of dried olive pomace to buyers interested in using them for heating: € 2,269 - € 2,700

The calculation is based on a transportation fee of 30 €/ton per 100 km.

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Technical Data

Table 4 shows the comparison of main technical data related to 3 heat generation alternatives.

Comparison of technical data

	Variant 1 (ELFO)	Variant 2 (ELFO)	Variant 3 (Olive pomace)
Thermal energy consumption (MWh/year)	238	238	238
Boilers	Extra light fuel oil: 2 x 350 kW	Extra light fuel oil: 400 kW	Olive pomace: 400 kW; heat storage unit: 2 x 2,000 l
Boiler efficiency (%)	70–75%	93%	93%
ELFO consumption (l)	31,000	26,000	0
Olive pomace consumption (t/year)	0	0	54

Investment

The costs arising from the renovation of the entire boiler room and the implementation of the new heating technique are shown in Table 5. Total costs of the purchase and installation of a modern boiler and its appertaining equipment (Variant 2) would amount to €32,600. Variant 3 envisages the purchase and installation of a new boiler and its appertaining equipment, with their costs amounting to €76,000. In addition, the replacement of the energy-generating substance would require the renovation of that part of the building that would house the olive pomace storage tank, with the estimated costs of relevant construction works amounting to €12,300. Total investment costs prior to the new boiler start-up would thus amount to €88,300.

Investment

	Boiler with equipment	Construction costs	Total
Variant 2	€ 32,600		**€ 32,600**
Variant 3	€ 76,000	€ 12,300	€ **88,300**

Cost of Energy-Generating Substances

The building consumes 238 MWh of thermal energy per year. Table 6 shows the costs of energy-generating substance for all the three variants: heating with extra light fuel oil with or without system renovation and heating with olive pomace. The annual costs of heating in accordance with Variant 1 (heating with extra light fuel oil, no system renovation) amount to € 18,620. The estimated annual costs of heating in accordance with Variants 2 and 3 (extra light fuel oil after system renovation vs. olive pomace) would amount to € 15,689 and € 6,600 respectively. The calculation was made on the basis of the current price of fuel oil and the envisaged price of olive pomace €26/MWh.

Annual costs of energy-generating substances

Annual costs	Variant 1 (ELFO)	Variant 2 (ELFO)	Variant 3 (Olive pomace)
Olive pomace price	/	/	€ 26/MWh
ELFO price	€ 62/MWh	€ 62/MWh	/
Fuel price	€ 18,170	€ 15,239	€ 5,900
Costs of electric energy	€ 450	450	€ 700
Total costs of energy-generating substance	€ **18,620**	**€ 15,689**	€ **6,600**

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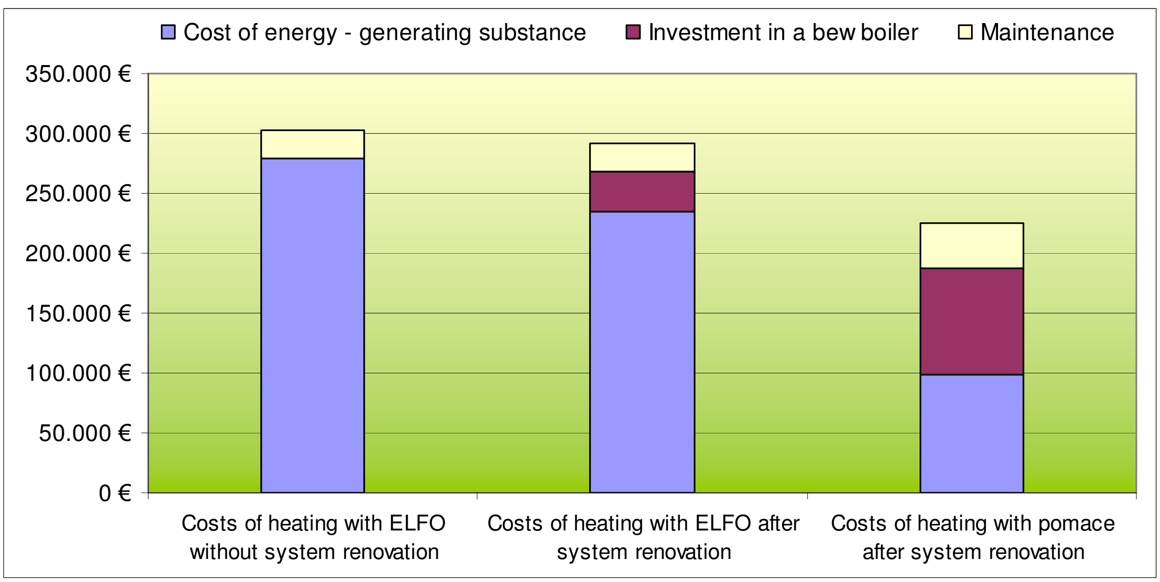
Operating costs and labour costs

Annual costs	Variant 1 (Boilers currently used - ELFO)	Variant 2 (Boiler room renovation - ELFO)	Variant 3 (Olive pomace)
Labour costs	€ 600	€ 600	€ 1,100
Other operating and maintenance costs	€ 1,000	€ 1,000	€ 1,400
Total annual operating and maintenance costs	**€ 1,600**	**€ 1,600**	**€ 2,500**

Cost-benefit analysis

Diagram below shows annual costs of heating for both variants (extra light fuel oil vs. olive pomace) for the next 15 years. Variant 1 envisages that the existing system of heating with extra light fuel oil will stay in use and, consequently, there will be no need to renovate the boiler room and to purchase a new boiler. The costs of heating and maintenance within the next 15 years would then amount to € 303,000. Variant 2 envisages the boiler room renovation and the use of the same energy-generating substance (fuel oil). In this case, the estimated costs of investment, maintenance and the energy-generating substance would amount to € 291,235 in the next 15 years. Variant 3 (heating with olive pomace) envisages the renovation of the boiler room, the installation of the new equipment and the use of a new energy-generating substance, with estimated total costs for the same period amounting to € 224,800. The calculation was made on the basis of the current price of fuel oil and the envisaged price of olive pomace.

Diagram: Heating costs within 15 years – ŠPS



For the envisaged period of 15 years, the difference between total costs of heating with extra light fuel oil after system renovation and heating with olive pomace amounts to € 67,135, with the latter being more economical than the former. The calculation was made on the basis of the current prices of the two energy-generating substances and regular maintenance of the heating systems.

2. BUSINESS PLAN FOR THE TRUŠKE INN

The Truške Inn currently uses extra light fuel oil for heating the entire facility. Its owner is interested in replacing it with olive pits.

Heating technique

The tourist facility currently uses extra light fuel oil for heating. The total heated surface area covers 350 $m^{2,}$ which includes six rooms and two apartments for tourists, a storehouse, a kitchen, a dining hall, bathrooms and toilets. The power of the boiler currently in use is estimated to be 100 kW (the estimation was done on the spot as the boiler has no specification with technical characteristics).

Figure: Truške Inn

In the last few years, the average annual consumption of fuel oil (for heating the entire facility) amounted to 4,400 l.

Heating with Extra Light Fuel Oil and Boiler Room Renovation (Alternative 2)	**Heating with Olive Pits (Variant 3)**
the facility could still be heated with extra light fuel oil on condition that it witnessed the installation of a new boiler of a lower maximum power, a new burner and an automatic regulation system. The calculation of the thermal energy needed for heating the facility was made on the basis of the average energy consumption in the last few years. The new heating system would be composed of: • Boiler using ELFO • Burner using ELFO • Automatic regulation system	olive pits could be used for heating the facility. Dried pits would be supplied by an olive mill operating in the vicinity. Currently active only in the field of olive oil production, the mill generates a large quantity of olive residue, which is returned to olive orchards as mulch. The calculation of the thermal energy needed for heating the facility was made on the basis of the average energy consumption in the last few years. The new heating system would be composed of: • Olive pit burner • Olive pit storage tank • Olive pit feeder (snail) and • Automatic regulation system

Transportation

According to the agreement between the owner of the facility (who intends to use olive pits for heating purposes) and the supplier of dried olive pits, the transportation costs will be included in the price of pit supply. The owner of the heated facility will therefore have no direct transportation costs. In view of that, the business plan envisages no transportation costs.

Economic and financial aspects

Technical Data

Table below shows the comparison of main technical data related to both heat generating variants.

Comparison of technical data – Truške Inn

	Variant 1 (ELFO)	Variant 2 (ELFO)	Variant 3 (Olive pits)
Thermal energy consumption (MWh/year)	34	34	34
Boilers	Extra light fuel oil: 90 kW	Extra light fuel oil: 50 kW	Olive pits: 90 kW
Boiler efficiency (%)	70–75%	90%	70 -75%
ELFO consumption (l)	4,400	3,960	0
Olive pit consumption (t/year)	/	/	9.6

Investment

Investment – Truške Inn

	Boiler with equipment	Installation	Total
Variant 2 (ELFO)	€ 2,600	€ 500	**€ 3,100**
Variant 3 (Olive pits)	€ 5,800	€1,200	**€ 7,000**

Cost of Energy-Generating Substances

The facility consumes 67 MWh of thermal energy per year. Table 6 shows the costs of energy fuel for all the three variants: heating with extra light fuel oil with or without boiler room renovation and heating with olive pits. In case of Variant 1, the annual costs of heating amount to around € 2,890, in case of Variant 2 to € 2,610, and in case of Variant 3 to € 1,280. The estimation was made on the basis of the current price of fuel oil and the price of olive pits (€ 26/MWh). The pits will be supplied by the Hrvatin's Olive Mill, with the price being already determined.

Annual costs of energy fuel – Truške Inn

Annual costs	Variant 1 (ELFO)	Variant 2 (ELKO-renovation)	Variant 3 (Olive pits)
Olive pit price	/	/	26 €/MWh
ELFO price	€ 62/MWh	€ 62/MWh	/
Fuel price	€ 2,800	€ 2,520	€ 1,170
Costs of electric energy	€ 90	€ 90	€ 110
Total costs of energy-generating substance	€ **2,890**	**€ 2,610**	€ **1,280**

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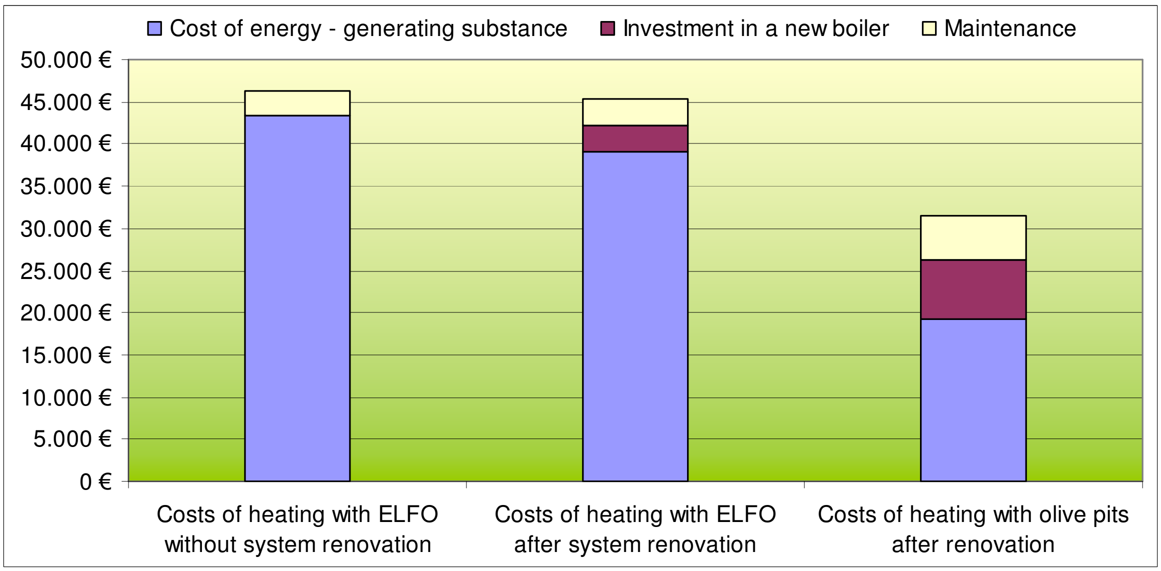
Operating costs and labour costs – Truške Inn

Annual costs	Variant 1 (Boiler currently used - ELFO)	Variant 2 (New boiler- ELFO)	Variant 2 (Olive pits)
Total annual operating and maintenance costs	**€ 200**	**€ 200**	**€ 350**

Cost-benefit analysis

Diagram 1 shows annual costs of heating for all the three variants (heating with extra light fuel oil with or without boiler room renovation vs. heating with olive pits after renovation) for the next 15 years. Variant 1 envisages that the existing system of heating with extra light fuel oil will stay in use. The costs of heating and maintenance within the next 15 years would then amount to € 46,350. Variant 2 envisages the replacement of the boiler and the burner and the use of fuel oil; in the next 15 years, total heating costs would then amount to € 45.250. Variant 3 (heating with olive pits) envisages the purchase of a new burner and its installation on the existing boiler. In this case, total costs for the same period would amount to € 31,450. The calculation was made on the basis of the current price of fuel oil and the current price of olive pomace (26 €/MWh).

Heating costs within 15 years – Truške Inn



For the envisaged period of 15 years, the difference between total costs of heating with extra light fuel oil after boiler room renovation and heating with olive pits amounts to € 13,800, with the latter being more economical than the former. The calculation was made on the basis of the current prices of the two energy-generating substances and regular maintenance of the heating systems.

3. BUSINESS PLAN FOR MARINKO HRVATIN'S OLIVE MILL

Currently, Hrvatin's Olive Mill is heated with an electric stove (as part of the central heating system), an air conditioner and another electric stove, which means that it is heated exclusively with electric energy.
Its owner is interested in replacing the energy fuel. In future, he intends to heat the entire facility with olive pits obtained in the process of olive oil production through pitting. Thus he will reduce not only the quantity of olive residue, but also the cost of its disposal. Even if he will have no expense with the purchase of olive pits, he will have to invest in the purchase of a depitting machine and in labour. Total costs are estimated to amount to € 100/ton.

Technique Currently Used: Heating with Electricity (Variant 1)

Hrvatin's Oil Mill includes the main hall with the mill and bottle filling equipment, a tasting room and several office rooms, with the entire facility being heated with electricity. The heated surface area covers 250 m^2, of which 90 m^2 are used for the mill and the filling equipment, 40 m^2 for the old tasting room (which will be turned into a boiler room), 50 m^2 for the new tasting room, and 70 m^2 for office space. The facility is currently heated with an electric stove (as part of the central heating system), an air conditioner and another electric stove.

During winter, the heating costs amount to an average of € 320/month, with the average electricity consumption in 6 months being 16 MWh.

Heating with Olive Pits (Variant 2)

The quantity of pits obtained in a year considerably surpasses the quantity that would be needed for heating the facility. The 2-phase method generates wet pomace from which pits are removed. The owner will have to invest in the purchase of the pitting machine (centrifuge) separating the pits from the pomace. According to our estimation, total costs related to the pits will amount to € 100/ton and will include the cost of the purchase of the depitting machine and pumps, the cost of labour, and some other costs.
The new heating system will be composed of:

- Boiler (65 kW)
- Olive pit storage tank (600 l)
- Olive pit feeder (snail)
- Circulating pumps with frequency regulation
- Five convectors
- Automatic regulation system

Technical Data

Shows the comparison of main technical data related to both heat generating alternatives.

Comparison of technical data – Hrvatin's Oil Mill

	Variant 1 (Electricity)	Variant 2 (Olive pits)
Thermal energy consumption (kWh/year)	16,000	17,500
Heating system	Electricity: central heating system, air conditioner, electric stove	Olive pits: 65 kW
Electricity consumption	16,000	0
Olive pit consumption (kg/year)	0	3,600

Heat generation with the technique currently used (Variant 1) requires 16,000 kWh of electric energy per year, while heat generation in accordance with Variant 2 would require 3,600 kg of dried olive pits.

Investment

Table below shows the costs of the entire investment (i.e. the renovation of the existing boiler room and the application of the new heating technique). The costs of a modern boiler with its appertaining equipment and its installation are estimated to amount to € 8,300. The cost of installing convectors circulating warm air throughout the rooms is estimated to amount to € 2,200.

Investment – Hrvatin's Oil Mill

Variant 2: Heating with olive pits		
Boiler with equipment	Convectors	Total
€ 8,300	€ 2,200	€ **10,500**

Cost of Energy-Generating Substances

The facility needs 14 MWh of thermal energy per year. Table below shows the costs of energy-generating substance for both variants: heating with electricity and heating with olive pits. The estimated costs of the former amount to € 1,920 per year, and the estimated costs of the latter to € 360. The estimation was made on the basis of the current price of electricity and the envisaged price of olive pits. Arising from the purchase of the pitting machine (the purchase of pomace incurs no costs) and from investment in labour, the latter amount to € 21/MWh

Annual cost of energy-generating substance – Hrvatin's Olive Mill

Annual costs	Variant 1 (Electricity)	Variant 2 (Olive pits)
Price of olive pits	/	21 €/MWh
Price of electricity	120 €/MWh	/
Costs of fuel	/	€ 360
Cost of electricity	€ 1,920	€ 90
Total costs of energy-generating substance	€ **1,920**	€ **450**

Operating and Maintenance Costs

Smooth operation of the heating system requires occasional minor repairs. Operating and maintenance costs are slightly higher in the case of heating with olive pits (Variant 2). Higher costs arise from the fact that such a heating system needs more frequent maintenance since it is composed of a different type of feeder (the snail operates on machine drive) and a bigger number of components. Heating with electricity incurs costs related to the removal of calcified deposits in electric heaters. The heaters have to be periodically cleaned or, when they cannot be repaired, replaced.

Operating costs and labour costs – Hrvatin's Olive Mill

Annual costs	Variant 1 (Heating technique currently used)	Variant 2 (Heating with olive pits)
Labour costs	/	€ 103
Other operating and maintenance costs	€ 160	€ 130
Total annual operating and maintenance costs	€ **160**	€ **233**

Cost-benefit Analysis

Diagram 1 shows annual costs of heating for both variants (electricity vs. olive pits) for the next 15 years. Variant 1 envisages that the existing system of heating with electricity will stay in use. The costs of heating and maintenance within the next 15 years would then amount to € 31,200. Variant 2 (heating with olive pits) envisages the installation of a boiler with an olive pit storage tank and an automatic regulation system and the use of a new energy-generating substance. In this case, total costs for the same period would amount to € 20,745. The calculation was made on the basis of the current price of electricity and the envisaged price of olive pits.

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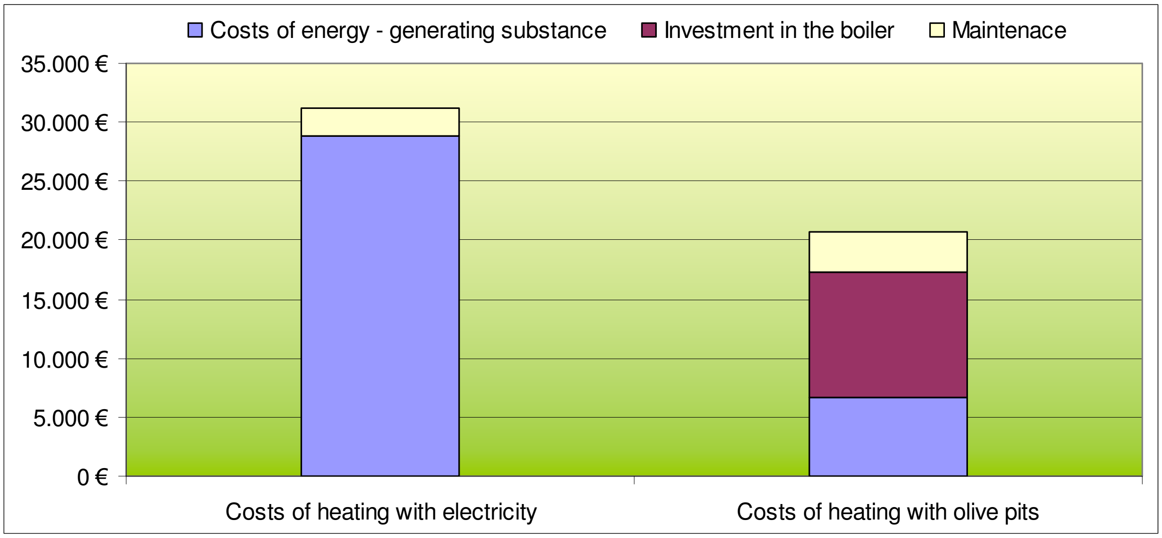
Heating costs within 15 years – Hrvatin's Olive Mill



For the envisaged period of 15 years, the difference between total costs of heating with electricity and heating with olive pits amounts to € 10,455, with the latter being more economical than the former. The calculation was made on the basis of the current prices of the two energy-generating substances and regular maintenance of the heating systems.

Business plan in Province of Jaen, Spain

Spain Pioneer Project of Central heating Installation, Sanitary Heating Water (SHW) and Biomass and Solar absorption"

In compliance with the objectives included on this project called "M.O.R.E", it's written the current document like a pioneer project of a renewable energy installation for covering the energy demand (thermal and cooling) of a prototype building by means of thermal solar energy installation for obtaining Sanitary Heating Water (SHW) on the one hand and on the other hand, pomace biomass installation for obtaining heating and cooling system.

LOCATION

Building: Local Council and police building

Place: Cazorla (Jaén)

Address: C/ Francisco Martínez Delgado, 1 - 23470 Cazorla

*Constructio*n Year: 1940

Year of reform: 2004

Built area: 767 m^2

Numbers of floors: 3

Useful area by floor: 237 m^2

DESCRIPTION OF HEATING INSTALLATION BY MEANS OF BIOMASS

According to the building energy necessities, and taking as a base the square meters that must be heating, it has been dimensioned a biomass installation with a 100 kW power that covers the cooling and heating necessities.
Considering that the biomass installation must also cover the energy necessities like a support to the thermal solar energy installation, it's dimensioned 18.6 kW with biomass for SHW (Sanitary Heating Water).
The power needed for the installation, and taking into account the market dimension, is a biomass boiler of 120 W. The period of heating system use is for 6 months/year and the rest of the year is devoted to the refrigeration.

Model	BIOSYSTEM 105 or similar
Nominal Power	120 kW
Minimum Power	90
Fuel consumption (PCI 4100 kcal/kg, Humidity 10%)22 – 31 kg/h	22 – 31 kg/h
Output	82 – 86
Gas Temperature	110 – 180 ºC
Volume of water	61 litres
Maximum Pressure of work	4 bar

The biomass installation has an associated a storage silo with the fuel that is going to be used whose capacity will be approximately of 40 m3 initially; this can assure the fuel supply for a month. In case of having at one's disposal space, it will be sized the storage silo with a superior size, with the purpose of storing biomass for a longer period.
Fuel is transported to an endless screw, which gets the entrance deposit, which directly communicates with the entrance of the boiler.

DESCRIPTION OF COOLING SYSTEM INSTALLATION

The available heating water that coming from the biomass boiler at 95 ºC, is used for stoking the absorption machine of simple effect, that employs LiBr as absorbent, and it's able to proportionate cooling water at 5.5 ºC, returning at 12 ºC. Thus, Cold is produced from heating water, without any other additional energy consumption of importance.
The functioning of a cooling machine by absorption is the following; the cooling machine by absorption of simple effect is composed by evaporator, collector, Condenser, heating exchanger, pumps and auxiliaries.

Hours of work: It has been considered that the selective building has the local police dependencies and this implies a longer period of daily work, including the weekends and festivities.

FINAL ENERGY DEMAND

Boiler Power	***Absorption Power***	***Work Hours***	***Final Energy demand***
[kW]	*[kW]*	*[h/year]*	*[kWh/year]*
120	99	2,464	295,680

Fuel	Olive Pit		
Unit Price	0.09	€/kg	
LHV	4,100.0	kcal/kg	4.77 kWh/kg
Estimated annual Demand	81,836	kg/year	

FUEL CONSUMPTION

Month	***Work Hours***	***Monthly Consumption of fuel (kg)***	***Monthly Cost (€/month)***
January (Heating)	217	6,351	571.61
February (Heating)	196	5,737	516.29
March (Heating)	217	6,351	571.61
April (Cooling)	180	5,268	474.15
May (Cooling)	217	6,351	571.61
June (Cooling)	210	6,146	553.17
July (Cooling)	217	6,351	571.61
August (Cooling)	217	6,351	571.61
September (Cooling)	180	5,268	474.15
October (Heating)	186	5,444	489.95
November (Heating)	210	6,146	553.17
December (Heating)	217	6,351	571.61
TOTAL	***2.464***	***72,117***	***6.490.54***

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ENERGY GENERATED BY THE BOILER

Month	*Work Hours*	*Energy (kWh/month)*
January (heating)	217	26,040
February (heating)	196	23,520
March (heating)	217	26,040
April (cooling)	180	21,600
May (cooling)	217	26,040
June (cooling)	210	25,200
July (cooling)	217	26,040
August (cooling)	217	26,040
September (cooling)	180	21,600
October (heating)	186	22,320
November (heating)	210	25,200
December (heating)	217	26,040
TOTAL	***2,464***	***295,680 kWh/year***

INSTALLATION OF MACHINERY

The heating generators and the refrigeration machinery/equipment must be situated in separated rooms, except when the Engine Room is an exempt building, with multiple exits connected directly to the exterior. In a room designed to house heating generators can be installed autonomous heating and cooling systems equipment.
Anyway, the cooling machine must be situated, physically, in a building separated from the rest of equipments, where, besides, neither the production of fire nor the presence of surface heated up more than 450 ºC.
The machinery must be accessible in every of its part and thus, it can be realized in an appropriate way and without any type of danger, the maintenance, vigilance and conducting operation.

Total Solar-Biomass Saving

Months	**Total Energy Saving (€)**	**Total Economic Saving(€)**	**Total CO2 Saving (kg)**
January	233.14	2,713.99	21,232.28
February	*168.59*	*2,347.39*	19,152.35
March	103.50	2,393.01	21,154.50
April	101.59	1,880.77	11,838.35
May	78.03	2,157.34	14,245.13
June	63.22	1,890.27	7,106.53

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July	41.63	1,894.60	*7,329.20*
August	41.28	1,893.72	7,328.99
September	57.15	1,770.75	11,811.69
October	126.04	2,143.57	9,115.23
November	178.81	2,510.54	20,519.29
December	263.70	2,789.65	21,250.62
TOTAL YEART	***1,456.69***	***26,385.60***	***172,084.16***

BUDGETS OF INSTALLATION

Investment Cost of SHW installation with solar energy

DESCRIPTION	**COST(€)**
Disol equipment	1,460.00
Conductions and Insulation(30 m of tube of 18mm of copper)	223.38
EXPANSION VESSEL (35 litres) Y ACCESORIES	383.67
ASSENBLY or MOUNTING	313.69
TOTAL	**2,380.74 + VAT**

Investment Cost of biomass installation (heating and absorption)

Biomass Boiler and components	26,000 €
Absorption Machine and components	35,500 €
Installation	13,500 €
Civil Work and adjustment	13,000 €
Total	**88,000 € + VAT.**

Total Investment

Solar Installation	2,380 €
Biomass Installation	88,000 €
TOTAL INVESTMENT	**90,380 € + VAT**

As we are dealing with a combined installation of solar and biomass, this is framed in the group of special installations, that depending on the performance, can have 70% of subsidy as maximum.
It's estimated that this Project will be able to get a subsidy of 50%.

Investment without subsidies + VAT	104,840.8 €
Andalusia Regional Subsidy (About 50%)	52,420.4 €
Investment with subsidy + VAT	52,420.4 €

[The local administrations includes the VAT in subsidies]

Period of Recovery

Investment without subsidy + VAT(€)	104.840,8
Investment with subsidy + VAT (€)	52.420,4
Solar Energy Saving (kWh/year)	1.456,690
Biomass Energy Saving (kWh/year)	0
Solar Economic Saving(€/year)	3.606,765
Biomass Economic Saving (€/year)	*22.778,83*
Period of simple return without subsidy (years)	3,9
Period of simple return with subsidy (years)	1,98

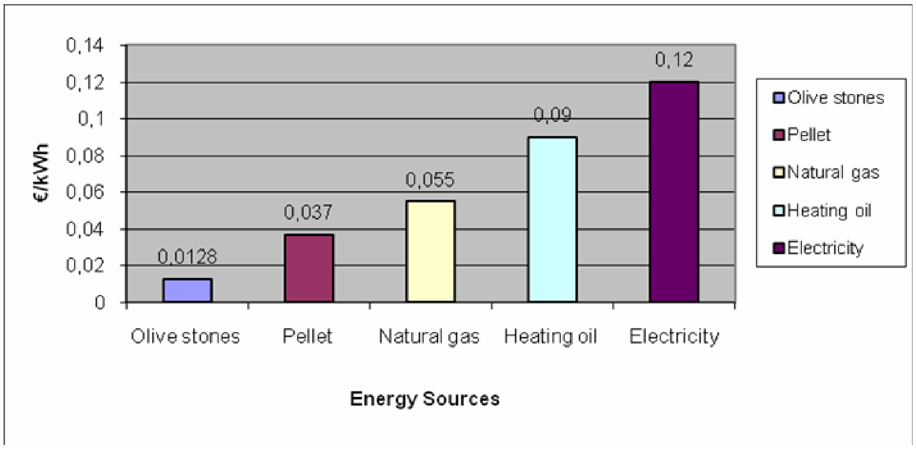
It's obtained a recovery period of 2 years with the current subsidies for Renewable Energy Installations.

Comparing both values, the olive stone heating value in kWh is 7 times cheaper than heating diesel (heating oil) value in kWh.

We can find different prices and cost in energetic resources used for central heating:

ENERGY SOURCES PRICE AND FEATURES			
ENERGY RESOURCES	L.H.V. kWh/kg	PRICE €	€/kWh
Olive stone	**4.77**	**0.06**	**0.0128**
Pellet	**4.86**	**0.18**	**0.037**
Natural gas	**10.52**	**0.578**	**0.055**
Heating oil	**9.95**	**0.895**	**0.09**
Electricity		**0.12**	**0.12**

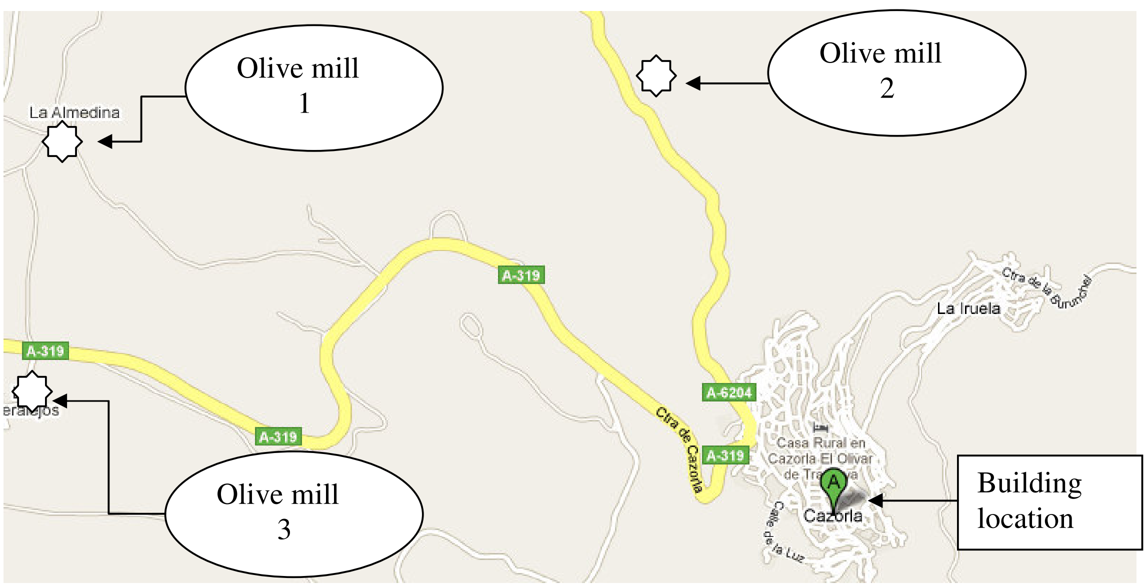
Different L.H.V. Energetic Resources Used



In this area there are 3 olive stone supplying mills and a pellet producing plant 4 km from the village, therefore, there are no problems for supplying biomass.

1. Olive mill: SCA. Aceites Cazorla – Phone 0034 953724031
2. Olive mill: La Almedina de Cazorla – Phone 0034 953720331
3. Olive mil: S.A. Vado Olivo – Phone 0034 953730733

CAZORLA



Summary of business plans characteristics and features

			size	*investment*	*quantity of pomace used*	*quantity of energy generated*	*saved money*	*saved fuel*	*CO2 saved*	*payback year*
1	Italy	Pomace drier	907 kg/h	€ 170.000,00	1075200 kg/y	n.a.				10 (with 50% financing)
1bis	Italy	heating plant	130 kW	€ 60.000,00	34000 kg/y	171600 kWh	12000 €/y		30030 kg/y	7
2	Greece	Direct combustion of depleted pomace for greenhouse heating	180 kW boiler	€ 27.000,00	34000 kg/Y	154705 kWh/y	6580 €/y	12 toe/y	38 ton/y	4,1
3	Greece	Pellet plant	4,999 kg/hr	€ 1.874.552,00	17995699 kg/Y			6351 toe/y	20179 ton/y	9
4	Slovenia	Smarje Primary School heating	400 kW boiler	€ 88.300,00	54 t/y	238 MWh/y	8189 €/ y	26000 lt/y of fuel oil	71 ton/y	8
5	Slovenia	Trutske inn heating (pit)	90 kW boiler	€ 7.000,00	9,6 t/y pit	34 MWh/y	1180 €/y	4400 lt/y of fuel oil	12 ton/y	4,5
6	Slovenia	Hrvatin's Olive mill heating (pit)	65 kW boiler	€ 10.500,00	3600 kg/y pit	17500 kWh/y	1397 €/y	16000 kWh/y electricity	84,8 ton/y[2]	7,5
7	SPAIN	Local council and police building heating and cooling system	120 kW	€ 88.000,00	81836 kg/y pit	295680 kWh/y	22778,83 €/y	38.871,72 lt/year of diesel oil	172.084,16 kg/year	4
8	Croatia	boiler for district heating of IPTPO premises + high school	1,3MW	4700000 kn (€ 648.000,00)	250000 kg/y pit	9090 MWh/y	1095000 kn/y	1,006,645 lt/y fuel oil	3273000 kg/y	4,3

[2] conversion for electricity Slovenia for year 2009 equal to 530 kg of CO2 per MWh

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