MòRe MARKET OF OLIVE RESIDUES FOR ENERGY

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

Designed by:
AGENERS.A.

1. OBJECTIVE

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, biomass installation for obtaining heating and cooling system.

2. LOCATION

Building: Local Council and police building
Place: Cazorla (Jaén)
UTM: X: 499947
Y: 4196092
Address: C/ Francisco Martínez Delgado, 1
23470 Cazorla
Construction Year: 1940
Year of reform: 2004
Built area: 767 m^2
Numbers of floors: 3
Useful area by floor: 237 m^2

3. BUILDING DESCRIPTION

The building which consists of the Local Council and Local Police is a construction reformed in 2004 whose distribution is of three floors of 237 square meters each one, being the useful total area of 711 square meters.

The building complex has a maximum daily occupation of 60 persons, and its average of occupation is 85%.

4. APPLICABLE REGULATIONS

- UNE 20.324 – Classification of protection degrees facilitated by the Enclosures.
- UNE 23.093 – Test about the fire resistance of the building structure and elements of construction.
- UNE 23.727 – Reaction test towards the fire of construction materials
- Classification of the materials used in the construction.
- UNE 100-000 – HVAC (Heating, Ventilating and Air Conditioning). Terminology.
- UNE 60601. - Installation of gas boiler for heating and cooling system and/or Sanitary Heating Water of nominal calorific consumption superior to 70KW(60.200 Kcal/h).
- Basic rules for interior installations of water supply
- Technological rules of building, NTE IFC Heating Water and NTE IFF Cooling Water.
- Rules for thermal installations in buildings (RITE 2007).
- Rules for Pressure Devices.
- Law 7/1994 May 18th, of Environmental Protection.
- Rules for Environmental qualification.
- Electronic Rules for Low Voltage and Complementary Technical Instructions (Royal Decree 842/2002 2nd August, 2002).
- NBE CPI-96 of Protection against fire in the buildings.
- NBE CA-88 of Acoustic Conditions in buildings.
- NBE CT-79 of Thermal Conditions in buildings.
- Rules for Thermal installation in buildings.
- Law 31/1995, 8th November, of Workplace Accident Prevention
- Royal Decree 1627/1997, 24th October of 1997, about minimum health and safety conditions at work.
- Royal Decree 486/1997, 14th April of 1997, about minimum health and safety conditions in workplaces.

- Royal Decree 485/1997 14th April of 1997, about minimum conditions in terms of security and health signs at work.
- Royal Decree 1215/1997 18th July of 1997, about minimum safety and health conditions for the use of work equipment by part of the workers.
- Royal Decree 773/1997 30th May of 1997, about the minimum safety and health conditions related to the use of individual equipment of protection by part of the workers.
- Technical Code for the Building, section HE4 "*Minimum solar contribution of Sanitary Heating Water*".
- Section HS-4 Water Supply of Technical Code for the Building.

5. DESCRIPTION OF INSTALLATIONS

Currently the building has an oil-boiler "*ROCA*" of 186 kW power to heat the building. The net of pipes and radiator of the heating system circuit are in good condition.

The demand of Sanitary Heating Water, currently, is covered with four electrical heaters with a total of 400 liters of capacity.

6. PROPOSAL OF RENEWABLE ENERGY IMPLANTATION

Using Renewable Energies, solar and biomass, it's expected to cover the foreseen heating demand by means of the energy of sun and agricultural products; and by means of a chiller plant of absorption, it's expected to facilitate the necessary cool water for the cooling system.

After analyzing the consumption data which are exposed in the table 1, it's the moment of studying the technical viability- the money invested in the implementation of a thermal solar energy installation for covering the demand of sanitary heating water as well as the installation of a biomass boiler and an absorption machine for covering the cooling and heating energy necessities.

When the cooling and heating water be generated, it will proceed to its distribution towards the different rooms of the building by means of a piping network previously isolated.

7. DESCRIPTION OF INSTALLATION WITH SANITARY HEATING WATER(SHW) AND SOLAR ENERGY

7.1 Demand of Sanitary Heating Water in the building

The building of study shows a demand of sanitary heating water of 400 litres per day, according to the consumption data facilitated by the owner, whose temperature of use is of 45ºC.

The average temperature of water inlet of the network in Jaén is of 12,33ºC, for the calculation of installation sizing, the temperature of sanitary heating water demand will be at 60ºC for the Legionellosis prevention according to RITE (Rules for Thermal Installation in Buildings, 2007)

So, the demand of Sanitary Heating Water at 60ºC would be calculated according to this formula:

$$D_i(T) = D_i(60\ ^{o}C) \times \left(\frac{60 - T_i}{T - T_i} \right)$$

Being:

Di (T), the demand of Sanitary Heating Water at 45ºC

Di (60ºC), the demand of Sanitary Heating Water at 60ºC

Ti, the average temperature of water in network at12'33ºC

T, the temperature of water that we want to transform (45ºC)

Inscrita en el Registro Mercantil de Jaén, al folio 147, tomo 385, hoja nº J-14625, inscripción 1ª, CIF A23571052. Sociedad Unipersonal.

As a result of this expression, we obtain that for the demand of Sanitary Heating Water at 60ºC (Di (60ºC)) of 274, 14 liters/day, there must be an accumulation of 300 liters.

Knowing the demand in liters of Sanitary Heating Water, in the table 1 is calculated the energy demand for heating water, according to the method of curves *f-Chart*[1]:

Moths	Demand SHW (litres/Day)	Useful Final Energy (kWh)
January	300,00	540
February	300,00	478
March	300,00	518
April	300,00	491
May	300,00	497
June	300,00	470
July	300,00	475
August	300,00	475
September	300,00	470
October	300,00	508
November	300,00	512
December	300,00	540
TOTAL YEAR	3.600,00	5.974
Value in MJ		21.507

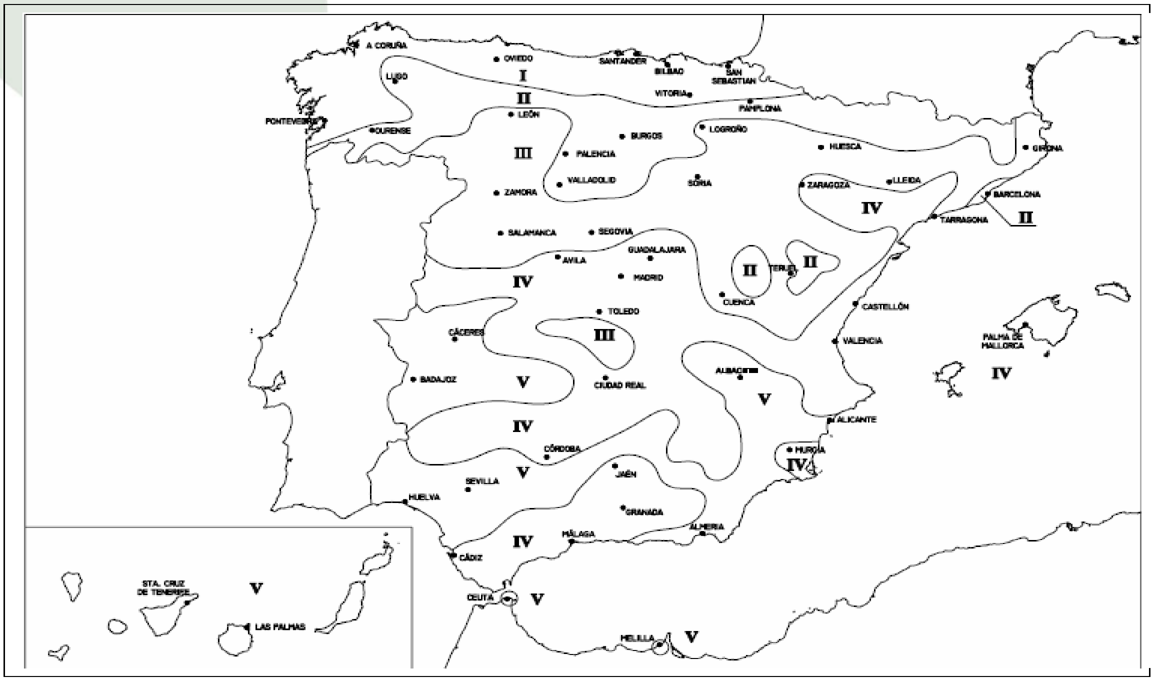
Table1. Demand in liters of SHW and energy demand per months

7.2 Characteristics of installation

The method used facilitates the forecast of monthly solar contribution depending on the foreseen demand. The sizing has been realized considering that solar collectors are orientated to the south and inclined 40 degrees with respect to the horizontal. This inclination favours the installation output with a regular consumption along the year.

[1] **Recommended Method for the calculation of thermal solar energy installations. Andalusia Energy Agency.**

As Jaén is located in the area IV (according to the Technical Code of Construction), the Thermal Solar installation is sized for satisfying at least 70% of energy demand corresponding to the Sanitary Heating Water production. (See table 2).



Map1. Climatic Areas according to CTE

Demanda total de ACS del edificio (l/d)	Contribución solar mínima en %. Caso general. Zona climática I	II	III	IV	V
50-5.000	30	30	50	60	70
5.000-6.000	30	30	55	65	70
6.000-7.000	30	35	61	70	70
7.000-8.000	30	45	63	70	70
8.000-9.000	30	52	65	70	70
9.000-10.000	30	55	70	70	70
10.000-12.500	30	65	70	70	70
12.500-15.000	30	70	70	70	70
15.000-17.500	35	70	70	70	70
17.500-20.000	45	70	70	70	70
> 20.000	52	70	70	70	70

Table2. Minimum Solar Contribution in percentage according to the demand and climatic area, when the auxiliary energy support is biomass, according to CTE.

With the annual solar energy contribution per square meter in Jaén, with latitude of 37º46' and a 40% inclination of collectors, and knowing the energy demand, we calculate the square meters of solar collection and then, the type of collector can be selected.

It's selected a domestic solar equipment of forced movement for daily consumption of 300 litres, named Disol range SA (high range) , model FI-300B-SA or similar. The equipment is composed by:

- 2 solar collectors, model SATIUS 22X
- Mounting Kit for a cover with an inclination of 40 degrees
- Solar storage battery with interior double heat exchanger of 300 liters
- Transfer station TRANSDISOL-60
- Expansion system
- Antifreeze at 98%
- Group of accessories for the hydraulic connection

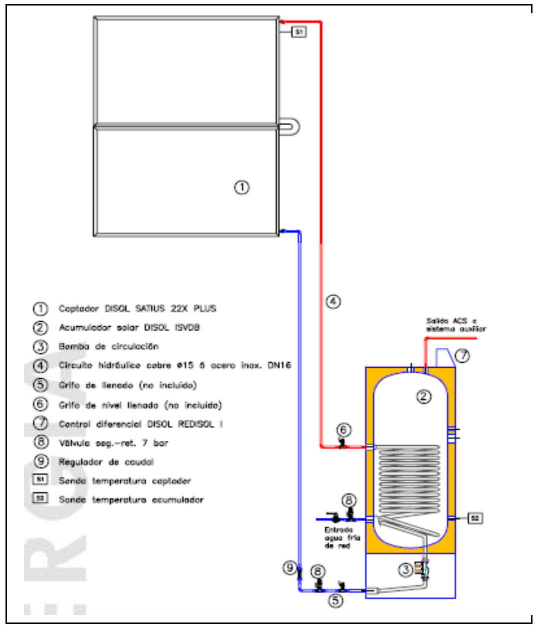


ILLUSTRATION1. Diagram of team forced/task forced

Here are the detailed characteristics of the *Disol* Equipment components.

System of collection

The installation of the system of collection will be constituted by two solar collectors which are plain and approved of high efficiency SATIUS 22X:

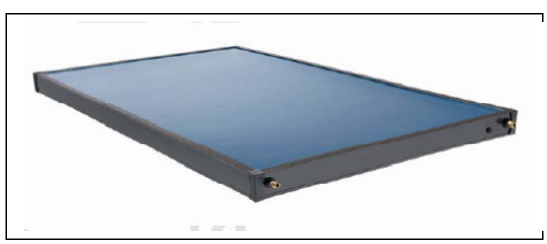


ILLUSTRATION2. Collector SATIUS 22X

COLLECTOR SATIUS 22X o similar	
Useful area	**1,97 m²**
Wide	**1150 mm**
Height	**1870 mm**
Depth	**95 mm**
Vacuum Weight	**33,5 kg**
Liquid capacity	**1,15 litros**
Maximum pressure	**10 bar**
Stagnation Temperature	**201ºC**
Absorption degree	**95%**
Emission degree	**5%**
Output Curve	**n= 0,786 - 3,24 (AT/G) - 0,0161 AT2/G**
Absorption machine	**Aluminium Sheet with selective covering of titanium oxide and grate of 10 tubes of cooper of Ø 8 mm joined to 2 collecting tubes of copper of Ø 18 mm**
Transparent cover	**Safety Solar Glass and low iron content, warm, of 3,2mm thickness.**
Collector Box	**Profile frame of aluminum which is extracted. Depth realized by aluminium sheet.**
Thermal isolation	**Mineral wool of 50 mm thickness**
Connections	**2 unions for thread of 1/2" macho**

Table3. Collector Characteristics

In total, the two collectors add an area of collection of 3, 94 m^2. The relation of volume/surface of capturing for this system is of 76, 14, thus the required condition is fulfilled by the CTE where it's expressed that: 50<V/A<180.

The collectors will be fixed in a supported structure of aluminium for an inclination of 40º towards the south.

The fluid will be water in network with antifreeze always fulfilling the limits indicated in the technical specification considering the risk of frozen in the area.

System of accumulation

The system of heating water accumulation will be constituted by a vertical inner accumulator thermally isolated with inner exchanger of coil, protected internally with double layer of vacuum vitrified enamel and externally with plastic cover.

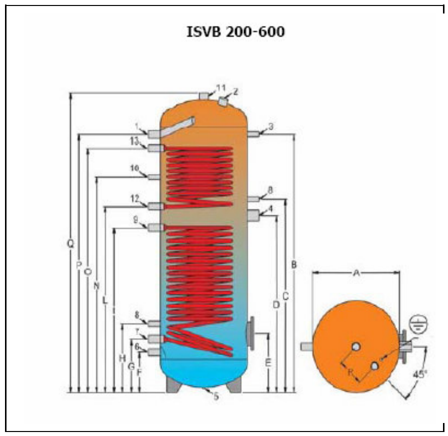


ILLUSTRATION3. Diagram about the Inner accumulator of 300 liters

ACCUMULATOR ISVB 300 or similar	
Total Volume	**291 litres**
Total Diameter and height	**600-1615 mm**
Diagonal	**1730 mm**
Vacuum Weight	**130 kg**
Location	**interior**
Maximum Pressure of SHW	**10 kg/cm3**
Material	**Carbon Steel**
Internal Protection	**Double vacuum vitrified DIN 4753**
Maximum Temperature of work	**95 ºC**
Isolation, material	**Injected Rigid Polyurethane**
Isolation, thickness	**50 mm**
Isolation, protection	**plastic cover**
Exchanger, Material	**Coil**
Exchanger, surface inf/sup.	**1,8/1,1 m^2**
Exchanger, Maximum Pressure	**6 kg/cm^2**

Table4. Accumulator Characteristics

System of Transference

Group of transmission completely pre-assembled in insulated box for its connection and launching and circuit return of solar collector, that includes:

- Pump of circulation Grundfos.
- Valve of Ball and Retention with Thermometer, at launching and return.
- Regulator with water flow-meter 1-19 l/min.
- Security Group with safety valve of 6 bar and manometer with graduated scale 0-10bar
- Connection Point for Expansion Vessel (not included)
- Air evacuation machine with filter of mesh strainer
- Two side outlets with ball valve for filling up/emptying
- Accessories for wall installation
- Insulated Box in two parts.

ILLUSTRATION4. Diagram of transference system

TECHNICAL DATA TRANSDISOL-60 or similar	
Measures	**420x250x246 mm**
Weight	**4,8 kg**
Diameter connections	**25 (3/4´´RH) DN**
Maximum Pressure	**6 bar**
Maximum Temperature	**110 ºC**
Level flow-meter	**1-19 l/min**
PUMP OF CIRCULATION	**GRUNDFOS UPS 25-60**
Maximum volume of flow	**3.300 l/h**
Maximum Height of pressure	**6 m**
Nominal Tension Pump	**230 V**
Maximum power Consumption	**45-65-90 W**

Table5. Transference system Characteristics

The design, components and assembly/mounting of installation will carry out the "Technical specification of design and assembly of thermal solar installation for the heating water production" approved by the Andalusia Regional Council and updated within the Programme PROSOL.

8. SIZING OF SHW INSTALLATION

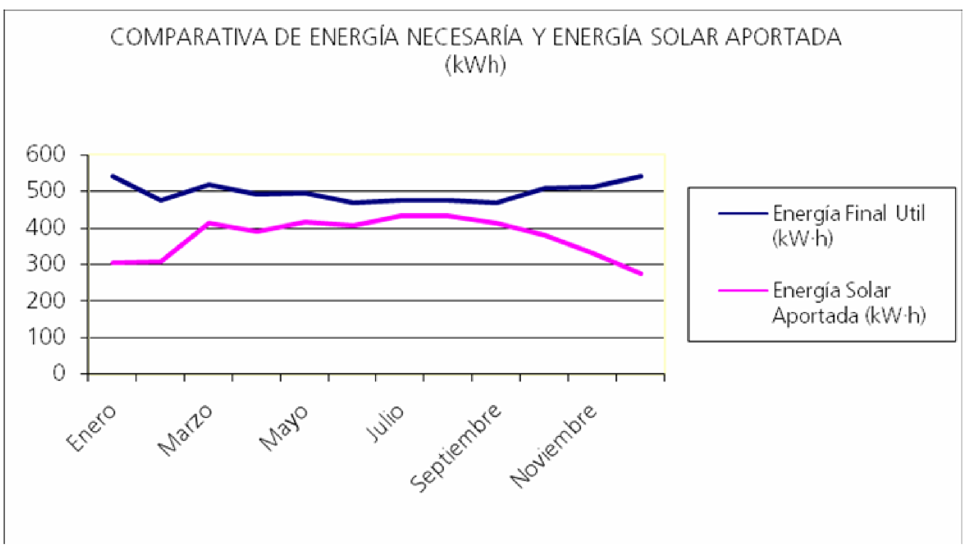
PRELIMINARY/INITIAL DATA:

	Time of use [years]
Maximum daily use	**300 litres**
Temperature of Heating water	**60ºC**
Total surface of solar collection	**3,94 m^2**
Orientation and inclination	**South – 40º**
Volume of Accumulation	**300 litres**
Relation of accumulation-surface	**76**

Taking this initial data, the following operation is to calculate the energy consumption, solar energy input, auxiliary support and their respective percentages:

Moths	Demand SHW (litres/day)	Useful Final Energy (kWh)	Solar Energy Contribution (kWh)	Solar Contribution %	Auxiliary Energy (kWh)	Auxiliary E. Contribution %
January	**300**	**540**	**307**	**56,8**	**233**	**43,2**
February	**300**	**478**	**309**	**64,7**	**169**	**35,3**
March	**300**	**518**	**415**	**80,0**	**104**	**20,0**
April	**300**	**491**	**390**	**79,3**	**102**	**20,7**
May	**300**	**497**	**419**	**84,3**	**78**	**15,7**
June	**300**	**470**	**407**	**86,6**	**63**	**13,4**
July	**300**	**475**	**433**	**91,2**	**42**	**8,8**
August	**300**	**475**	**434**	**91,3**	**41**	**8,7**
September	**300**	**470**	**413**	**87,8**	**57**	**12,2**
October	**300**	**508**	**381**	**75,2**	**126**	**24,8**
November	**300**	**512**	**333**	**65,1**	**179**	**34,9**
December	**300**	**540**	**276**	**51,2**	**264**	**48,8**
TOTAL YEAR	**3.600**	**5.974**	**4.518**	**75,6**	**1.457**	**24,4**
Value in MJ		**21.507**	**16.178**			

Table6. Energy consumptions, solar energy input and support



9. 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 100kw 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 18,6kW 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 120kW. The period of heating system use is for 6 months/year and the rest of the year is devoted to the refrigeration.

9.1 Parameters of Biomass Boiler

Characteristics of the boiler:

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**

Table7. Characteristics of boiler

The biomass boiler obeys the requirements of the rule EN 303/5 related to heating system. Part 5; special boiler for solid fuels.

The model of the boiler selective has the following components:

- Casting Boiler
- Endless Fuel feed system with hopper
- Burner
- Fans of primary and secondary air
- Device of automatic ignition
- Combustion/Fuel Gas Extractor
- Electrical Control Panel

The minimum characteristics of used fuels have to be:

Granulometry	**Maximum 30 mm**
Heating Power	**Minimum 3.100 kcal/kg**
Humidity	**Maximum 20%**

Table8. ***Fuel Characteristics***

9.2 Storage Silo:

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 m^3 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.

9.3 Inertia Deposit

The boiler has got a black steel deposit of inertia of 1000 litres installed, without covering, with a coil and without register entrance, appropriate for close heating and cooling circuits. The minimum characteristics that must fulfil are those which are detailed in the table 9:

- Maximum Pressure of work: 6 bar
- Maximum Temperature of work: 80ºC
- Insulated with expanded polyurethane without CFC

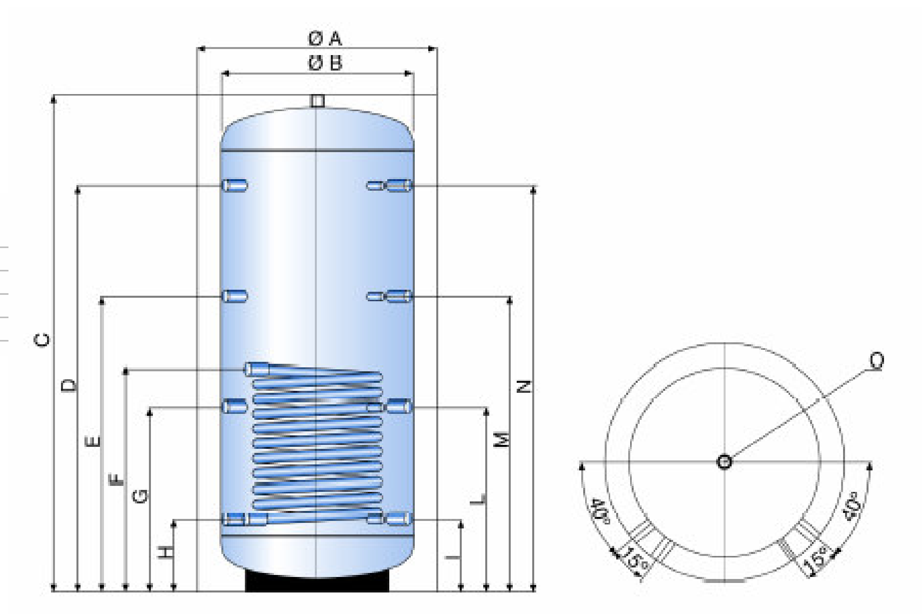
MODEL	VOLUME (litres)	A (mm)	B (mm)	C (mm)	D ø1 ½" (mm)	E ø1 ½" (mm)	F ø1" (mm)	G ø1 ½" (mm)	H ø1" (mm)	WEIGHT (kg)
DPBS/E/DI 1000 (or similar)	1000	990	790	2030	1710	1245	960	310	1 ¼"	190

DP: deposit; BS: Black Steel; E: exchanger DI: deposit of inertia

Table9. Characteristics deposit of inertia

TABLA E/S

C	SALIDA A.C.S.
D	ENTRADA AUXILIAR
E	SALIDA AUXILIAR
F	ENTRADA SERPENTÍN
H	SALIDA SERPENTÍN



10. DESCRIPTION OF COOLING SYSTEM INSTALLATION

The available heating water that coming from the biomass boiler at 95ºC, is used for stoking the absorption machine of simple effect, that employs LiBr as absorbent, and it's able to proportionate cooling water at 5,5ºC, returning at 12ºC. 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.

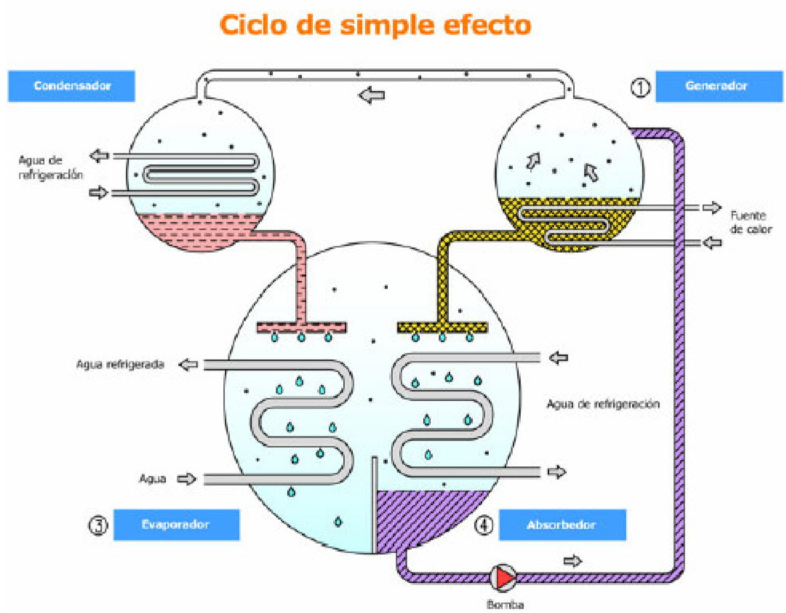


ILLUSTRATION 6 Diagram system of absorption

10.1 Parameters of absorption machine

Characteristics absorption machine:

Model	**LWM – W003 or similar**
NOMINAL COOLING CAPACITY	
Cooling capacity	**99 kW**
HEATING WATER CIRCUIT	
Volume of flow	**8 m^3/h**
Water entrance Temperature	**95ºC**
Water exit Temperature	**80ºC**
Loss of load in the generator	**1,1 mAq**
Diameter of connection	**40 DN**
Diameter Valve of control	**40 DN**
COOLING WATER CIRCUIT	
Volume of flow	**17,1 m^3/h**
Water entrance Temperature	**12 ºC**
Water exit Temperature	**7 ºC**
Loss of load in evaporator	**2,2 mAq**
Diameter of connection	**65 DN**
COOLING WATER CIRCUIT (TOWER)	
Volume of flow	**37,4 m^3/h**
Water entrance Temperature	**31 ºC**
Water exit Temperature	**36,5 ºC**
Loss of load in collector +Condenser	**2,5 mAq**
Diameter of connection	**80 DN**
SIZES AND WEIGHTS	
Length	**2.020 mm**
Wide	**1.344**
Height	**1.952**
Weight in load	**2,1 tn**
Vacuum Weight	**1,8 tn**

Table10. Characteristics of absorption machine

11. SIZING AND CONSUMPTION OF BIOMASS INSTALLATION

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. In the following table it appears the work hours per month:

MONTH	DAILY HOURS		Days/Month	MONTHLY HOURS
January	Morning	4	31	217
	Afternoon / night	3		
	Total	**7**		
February	Morning	4	28	196
	Afternoon / night	3		
	Total	**7**		
March	Morning	4	31	217
	Afternoon / night	3		
	Total	**7**		
April	Morning	3	30	180
	Afternoon / night	3		
	Total	**6**		
May	Morning	4	31	217
	Afternoon / night	3		
	Total	**7**		
June	Morning	4	30	210
	Afternoon / night	3		
	Total	**7**		
July	Morning	4	31	217
	Afternoon / night	3		
	Total	**7**		
August	Morning	4	31	217
	Afternoon / night	3		
	Total	**7**		
September	Morning	3	30	180
	Afternoon / night	3		
	Total	**6**		
October	Morning	3	31	186
	Afternoon / night	3		
	Total	**6**		
November	Morning	4	30	210
	Afternoon / night	3		
	Total	**7**		
December	Morning	4	31	217
	Afternoon / night	3		
	Total	**7**		
			TOTAL YEAR	***2464 hours***

Table11. Work Hours Biomass installation

INITIAL DATA:

	Time of use [years]
Equipments	**20**
Installation	**20**
Construction	**50**

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*

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*

12. MINIMUM REQUIREMENTS OF BOILER ROOM

The Engine Room is the technical place where all the equipment/devices for the heating and cooling production, other auxiliary equipment and accessories of installation are housed.

Adjoined premises to the engine room that connect with the rest of the building or with the outside through the same room are considered part of the same.

It won't be considered as part of engine room those places where there is heating generator with thermal power of no more than 70kw or autonomous cooling equipment of whatever power.

The room which houses the equipment of cool and heat production must fulfill with the following statements:

- The access door will connect directly with the outside or through the lobby with the rest of the building. No point of the room will be further than 15metres with respect to any exit-

- The access door will be opened just/always outwards.
- Doors will have a permeability of no more than 1L/ (s. m^2) under a differential pressure of 100 Pa, except when they will be in direct contact with outside.
- The fire resistance of the structural and element delimiters elements will be RF-180 (See the rule UNE 23-727), at least.
- The type of combustion capacity of the materials which are used in the closings and endings of the Room will be MO (See the rule UN 23-727).
- It will not be allowed any point of ventilation that connects with other close premises.
- When the Room be adjacent to an occupied premise, the acoustic attenuation of the element of separation will be of 50dB minimum in the band of eighth of central frequency 125 Hz.
- The closing elements of the Room will not allow humidity filtrations.
- The Room will have at its disposal an efficient system of drainage by means of the force of gravity or, in a necessary case, by means of pumping.
- The electrical panel of protection and control installed in the Room or, at least, the general switch will be situated in the proximities of the main access door. This switch cannot cut the electrical supply to the cooling system of the Room.
- The switch of the forced ventilation system of the Room, if exists, it will also be situated in the proximities of the main access door.
- The average level of illumination used in the Room of Machine will be of 200 lux. Minimum with a average uniformity of 0.5, and this can be reinforced by means of portable elements in order to access in hidden places. The lighting and Outlets will take a degree of protection IP 55 and a mechanical protection degree 7 (see the rule UNE 20-324), at least/ minimum.
- Each of the room exits will be signposted by means of an emergency autonomous device.

13. HIGH SECURITY ENGINE ROOM

The installations that require High Security Engine Room are the following:

I. Those realized in the institutional buildings or public concurrence (See the definition in the rule UNE 100.000)
II. Those which work with water at temperature superior to 110C.

Besides of the demanded requirements in the previous section for any Engine Room, a High Security Engine Room must fulfill with the following:

· The fire resistance of the structural and element delimiters will be at least RF-240.
· No point in the Room will be at a distance of more than 7,5 meters with respect to the exit, when the Room has a floor area of more than 100 m^2
· When the Room has two or more accesses, one of them, at least, will be connected directly with the outside. This Access will be neither near any stairs, nor near smoke or fire escape.
· The electrical panel of protection and remote control of the installed equipment in the Room, at least, the general switch and the switch of the ventilation system must be situated outside of itself and near one of the Access.

14. 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 450ºC.

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.

In figure 1 it can be observed the minimum free spaces that there must be around the heating generators, according to how they will be stoked, by gaseous oil, liquid oil or solid oil.

fig. 1: Espacios libres mínimos en Salas de Calderas (cotas en cm.)

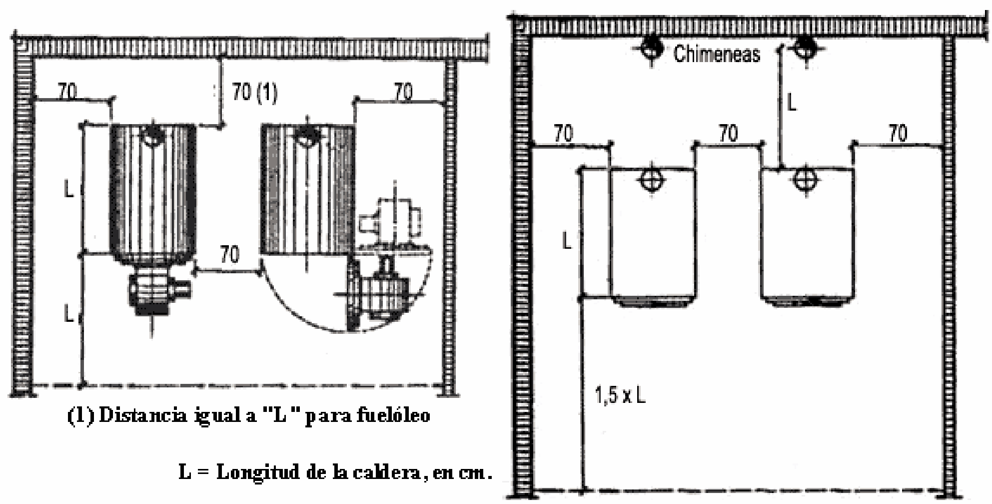
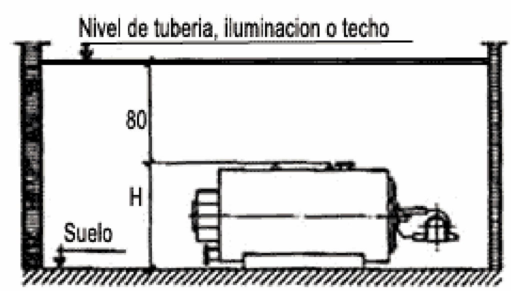


fig.1.1: Generador de calor con combustibles gaseosos o líquidos

fig.1.2: Generador de calor con combustibles sólidos

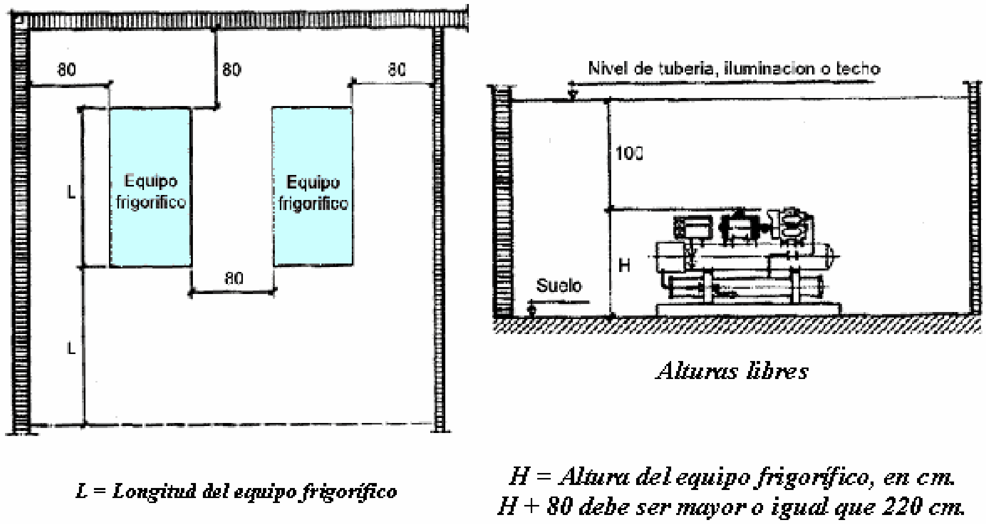
fig.1.3: Alturas libres



H = Altura de la caldera, en cm.
H + 80 debe ser mayor o igual que 220 cm.

In case of refrigeration equipments, the minimum free spaces will be indicated in figure 2.

fig. 2 - Espacios libres mínimos en salas de maquinaria frigorífica (cotas en cm.)



Anyway, it must be followed the instructions that the manufacturer indicates for the installation of equipment, just when its requirements exceed the minimum indicated in the cited figures.

Furthermore, between the machinery and the elements that delimit the Engine Room there must be free Access to let movement of equipments, or from part of them, from the Room to exterior and vice versa. There will be a special care with the accessibility of connection between heating generators and chimneys. The same attention will have the power transmission between engines and machine which are moved and furthermore, must be protected against accidental contacts.

In case of machinery situated outside, the minimum spaces between the equipments will be suitable previously for indoor. Besides, it will be taken into account the requirements of the exterior exchanger related to the cooling machinery and the refrigeration tower in terms of air movement, with respect to the equipments and obstacles presented by constructions nearby.

15. ENERGY SAVING AND ENVIRONMENTAL IMPACT

15.1 Thermal Solar Energy

Months	Useful final Energy (kWh)	Energy Saving *(kWh)*	*Economic Saving (€)*	*CO2 Saving (kg)*
January	**540**	**233,140**	**577,254**	**139,884**
February	**478**	**168,590**	**417,429**	**101,154**
March	**518**	**103,502**	**256,272**	**62,101**
April	**491**	**101,590**	**251,536**	**60,954**
May	**497**	**78,035**	**193,214**	**46,821**
June	**470**	**63,221**	**156,536**	**37,933**
July	**475**	**41,633**	**103,083**	**24,980**
August	**475**	**41,278**	**102,204**	**24,767**
September	**470**	**57,155**	**141,516**	**34,293**
October	**508**	**126,043**	**312,082**	**75,626**
November	**512**	**178,809**	**442,731**	**107,285**
December	**540**	**263,695**	**652,910**	**158,217**
TOTAL YEAR	*5.974*	*1.456,690*	*3.606,765*	*874,014*

15.2 Biomass Boiler + absorption

Moth	Biomass monthly Cost (€/month)	Fuel monthly Cost (€/month)	Electrical Cooling system monthly Cost	Economic Saving (€/month)	CO2 fuel Emission (186 kW))	CO2 Biomass Emission (120 kW)	Electrical CO2 Emission of cooling system(kg)	CO2 Saving (kg)
January	**571,61**	**2.708,35**	**0,00**	**2.136,74**	**24.217,20**	**3.124,80**	**0,00**	**21.092,40**
February	**516,29**	**2.446,25**	**0,00**	**1.929,96**	**21.873,60**	**2.822,40**	**0,00**	**19.051,20**
March	**571,61**	**2.708,35**	**0,00**	**2.136,74**	**24.217,20**	**3.124,80**	**0,00**	**21.092,40**
April	**474,15**	**1.123,28**	**980,10**	**1.629,23**	**10.044,00**	**1.296,00**	**3.029,40**	**11.777,40**
May	**571,61**	**1.354,17**	**1.181,57**	**1.964,13**	**12.108,60**	**1.562,40**	**3.652,11**	**14.198,31**
June	**553,17**	**0,00**	**2.286,90**	**1.733,73**	**0,00**	**0,00**	**7.068,60**	**7.068,60**
July	**571,61**	**0,00**	**2.363,13**	**1.791,52**	**0,00**	**0,00**	**7.304,22**	**7.304,22**
August	**571,61**	**0,00**	**2.363,13**	**1.791,52**	**0,00**	**0,00**	**7.304,22**	**7.304,22**

September	**474,15**	**1.123,28**	**980,10**	**1.629,23**	**10.044,00**	**1.296,00**	**3.029,40**	**11.777,40**
October	**489,95**	**2.321,44**	**0,00**	**1.831,49**	**10.378,80**	**1.339,20**	**0,00**	**9.039,60**
November	**553,17**	**2.620,98**	**0,00**	**2.067,81**	**23.436,00**	**3.024,00**	**0,00**	**20.412,00**
December	**571,61**	**2.708,35**	**0,00**	**2.136,74**	**24.217,20**	**3.124,80**	**0,00**	**21.092,40**
TOTAL	*6.490,54*	*19.114,45*	*10.154,93*	*22.778,83*	*160.536,60*	*20.714,40*	*31.387,95*	*171.210,15*

15.3 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**
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*

16. BUDGETS OF INSTALLATION

16.1 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

16.2 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.

16.3 Total Investment

Solar Installation	**2.380 €**
Biomass Installation	**88.000 €**
TOTAL INVESTMENT	90.380 € + VAT

17. BUBSIDIES AND PERIOD OF RECOVERY

17.1 Subsidies

"Order 4th February 2009, which establishes the regulatory basis of an incentive program for the sustainable energy development in Andalusia and it will be effective for the years 2009-2014".

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]

17.1 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.

BIOMASS MARKET ANALISYS

Generating thermal energy with biomass, Andalusia has a significant industrial tradition, associated mainly to the olive oil industry. The intensive as well as a more efficient use of biomass requires having standardized fuels. In this case, pellets and olive stones offer the possibility of improving combustion systems.

Andalusia has experimented a fast development in biomass becoming the first region in Spain in producing these fuels. There are 6 pellet production plants, 2 in the province of Jaén. This province also has approximately 400 local olive mills producing olive stones.

A parallel evolution of available biomass must be produced to expand the biomass market to make it competitive against traditional fuels there must be different programmes which increases its demand.

1- **Subsidiaries for biomass boiler installations.**
2- **Promotional measures by Regional Councils, Government, etc.**
3- **Competitiveness against traditional fuels.**

1- Subsidiaries from Ministry of Innovation, Science and Enterprise (Junta de Andalucía), through Andalusia Agency by means of decree 4th of March 2009, which establishes the requirements of an incentive programme. With this programme the installations of boilers can reach up to 60% of the investment in big companies, 70% in medium companies or non-profitable companies and 80% for small companies.

2- The Ministry of Agriculture and Fisheries in collaboration with the Provincial Council (Agener S.A.) has presented a project to finance the installations of biomass boilers in educational centres and municipal buildings in the rural areas of Jaén, with the aim of promoting the use and assessment of renewable energetic resources from olives. There are plans to install these kind of boilers in 95 municipalities which will heavily increase the demand of biomass, establishing an important market for a by-product which is so abundant, guarantying its use in the province of Jaén.

3- To make it competitive with respect to traditional fuels, we have to analyse both, the costs of the products and its supplying chain.

Olive stone

The mill uses an olive stones separator to remove the stones from the grinded olive matter called alperujo (virgin pomace). Once separated, they are put in a drier and then stored during the hot summer months to accelerate the loss of moisture.

The olive stones in not only a great renewable energy fuel to be used in biomass boilers but also an excellent way of saving energetic bills.

Comparing the lower heating value (LHV), the olive stone (4,70 kWh/kg) and central heating diesel (9,95 kWh/l) and considering the prices between olive stone and diesel the following unitary costs are obtained:

-Olive stone: 0,0127 €/kWh

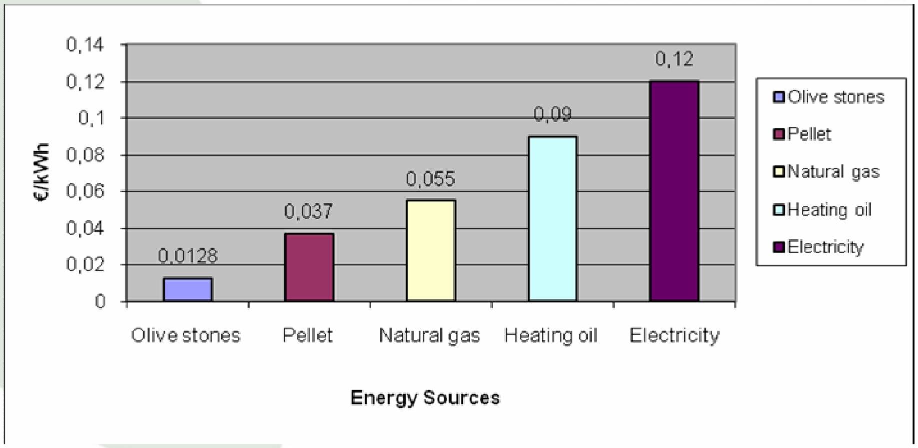
-Diesel (Heating oil): 0,0906 €/kWh

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

1. **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

There is a parallel relation in logistic development between olive stones and pellets. As demand for pellet raises the olive stone starts taking off as an energetic resource in the biomass sector within our province, with 2 specialized companies in commercializing this product:

-ECOLOMA Phone: 0034 620083703

-CODYMOL CLIMATIZACIÓN S.L Phone: 0034 953757552

SWOT analysis

Strengths

- Jaen is the main region of olive oil in the world
- Economic support on a local, regional and national level.
- High calorific value of pit.
- High concentration/cooperation among millers so high quantity of raw material.
- Presence of good practices in the region.
- Involvement of the regional companies which support biomass energy.

Weaknesses

- Difficulty of managing large quantity of biomass (transport, awareness, etc).
- Large investment cost.
- Use only one type of biomass on a local and regional level.

Opportunities

- Increase of the price of fossil fuels.
- Big companies invest in this type energy.
- This type of energy helps environment and it helps to reduce levels of carbon dioxide so renewable energy generation.
- Introduction of Centre for Technology Innovation in the biomass sector (GEOLIT).

Threats
➢ Normative change at present the economic incentive benefits small companies (Power ≤ 2 Mega Watt). ➢ Professional insufficiency in the sector. ➢ Lack of connection in the biomass sector. ➢ The population's ignorance of renewable energy and of energy efficiency and their opportunities. ➢ Utilization of other energy resources.