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D.5.5 Success Examples Description Report

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Transfering
Energy Save
Laid on Agroindustry

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About this report

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Introduction

The identification and analysis of success cases of energy efficiency in the agrifood industry provides information for dissemination of good practices and encourages their practical application in other companies. This report describes examples of energy saving measures implemented in real companies, which allowed energy savings and consequently decreased production costs in the company.

This analysis includes the production capacity of the company, the energy consumed (type and value) and the description of the facilities in the situation prior and after the implementation of various energy saving measures. Modifications can be either in all the production process or focused only in some production phases. With these data we can assess the impact of these measures comparing the energy consumption before and after the implementation of the measures, for a given level of production of the company.

Once identified and analysed, the success cases are presented in this document, which is the deliverable D.5.5 Report Description Examples of Success, and it will be used in Task 7.2 Communication for SMEs Target - Brokerage Local Events.

Methodology

All the project partners were involved in this task in order to help identifying success cases in their respective countries. Information from Italy, Portugal and Spain are included in this report. Concerning Portugal, several companies were contacted, 15 in total, three of fruits and vegetables, six animal feed, three olive oil mills and three wineries. However, not all were available to collaborate in the project. The main reasons were the lack of available data and the non-existence of changes in the manufacturing process since the beginning of the company. The cases presented in this report refer data from the following companies:

ANECOOP - Fruits & Vegetables Sector

Cheste Agraria - Fruits & Vegetables Sector

Coop. Hortofrutícola Alzicoop - Fruits & Vegetables Sector

Cooperfrutas CRL - Fruits & Vegetables Sector

Rural San Vicente Ferrer, Coop V. - Fruits & Vegetables Sector

S.A.T. San Cayetano - Fruits & Vegetables Sector

Vitacress - Fruits & Vegetables Sector

Cooperativa Agrícola dos Olivicultores do Cano - Olive Oil Mills Sector

Adega Chão de Judeus – Winery Sector

Adega Cooperativa de Borba CRL – Winery Sector

WineryA - Winery Sector

Several coordinators of European projects dealing with energy efficiency were also contacted, such as:

- BESS (Benchmarking and Energy management Schemes in SMEs;
- ExBESS (Expanding the Benchmarking and Energy Management Schemes in SMEs to more Member States and candidate countries);
- ENGINE (Energy Efficiency in Small and Medium-sized Enterprises);- EINSTEIN (Expert system for an Intelligent Supply of Thermal Energy in Industry);
- EINSTEIN II - Expert-system for an INtelligent Supply of Thermal Energy in INdustry and other large scale applications (EINSTEIN II);
- AMETHYST (Integrated benchmarking and self-assessment tool – Wine Industry);

We had some responses but with no examples in the agro-food industry sector.

Success Examples

The following success cases are presented by agro-industry sector. The production process and the measures implemented are briefly described, and the comparison between energy consumption before and after the modification is presented. With this methodology it will be shown the improvements obtained by reducing production costs and energy consumption and the contribution for a better environment, by reducing the GHG emissions.

1.1. Fruits & Vegetables Sector

1.1.1. Cooperfrutas – Cooperativa de Produtores de Frutas e produtores Hortícolas de Alcobaça CRL

Location: Alcobaça (Center of Portugal)

1. *Situation before the implementation of energy saving measures*

The following characterization refers to the year 2011.

Product quantity: 9.000 ton (65% Pear, 34% Apple, 1% Peach and Plums)

Electricity consumption: 2.725.581 kWh

Diesel consumption: 76.628 kWh

CO_2eq emissions: 1.281 ton CO_2eq

The company works all year, however the month of greatest energy consumption is September and the lowest consumption is in June.

According to the Portuguese legislation (DLnº 71/2008, April 15), this company was considered an intensive energy consumer, as a result of a food/environmental auditing process. This process is mandatory for companies that have energy consumption higher than 500 toe per year.

The first step was to perform an energy audit in order to characterise the company energy consumption and to identify the critical points in this company production process. In the next figure it is showed the distribution of electrical energy consumption according to the processing phases or

equipment used. It can be seen that cold storage facilities are the mostly energy consuming (73%), followed by the equipment used for fruits and vegetables calibration (22%). All the rest is residual, so this shows clearly where the energy saving measures should be implemented.

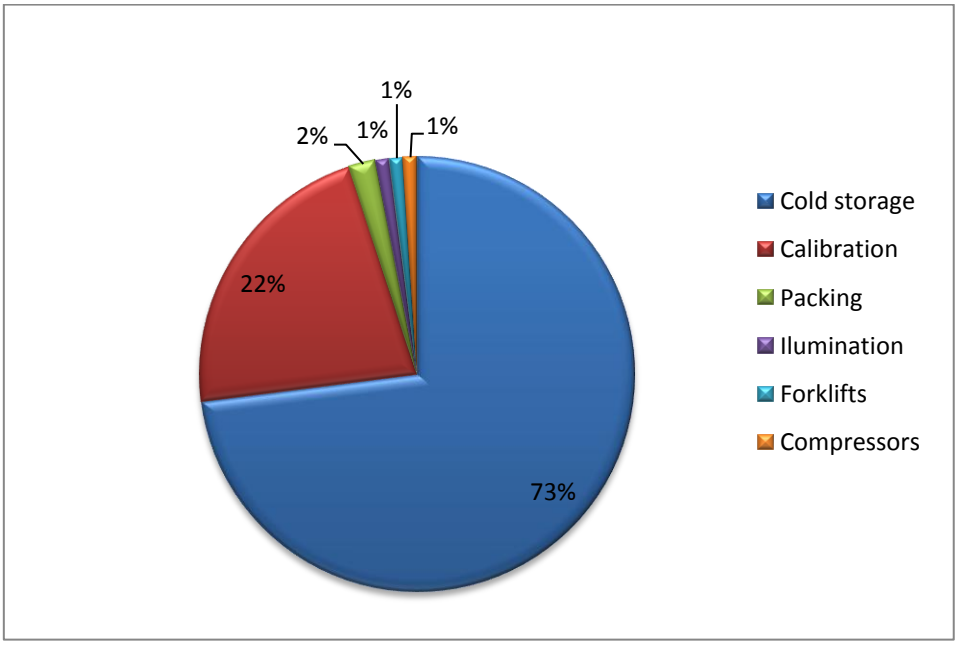

Fig 1 – *Electricity consumption distribution*

2. *Implemented energy saving measures*

The measures selected and implemented in this company were the following:

a) Increasing thermal insulation level in the installations (cement fibre plates replacement cover for sandwich panels).

b) Improving the equipment maintenance and monitoring activities.

c) Increasing the use of natural light in some areas of the industry.

d) Acquisition of a photovoltaic unit with 290.70 kWp to produce electricity, that is sold to the electrical company). Installation of a monitoring system composed by two energy analysers and 10 partial energy meters, with the aim of defining performance indicators and controlling the energy

consumption of the existing refrigeration systems, auxiliary equipment, packaging lines and fruit calibrator.

This monitoring system is supported by a remote system, Schneider Electric – Remote Energy Management, that allows following in real-time the energy consumption and used electric power, as well as other electrical parameters with relevance to energy management. There is also a system of alerts and performance indicators. This system records the consumption of electricity and allows knowing the kWh / kg of fruit, as well as Euro / kg of stored fruit. It is a tool for maintenance of equipment (refrigeration rooms), since it is easy to detected unusual changes in consumption.

f) Interventions in the cooling system:

- identifying points of refrigeration fluid losses;
- application of efficient thermal insulation to reduce heat losses;
- reduction of heat increase by convection into the refrigeration facilities by installing curtains in the doors;
- reduction of the light load inside the refrigeration chambers;
- decrease areas of ice accumulation by optimizing defrost.

For all these measures the investment was 892.130 € and the expected payback time is 8 years.

3. Results after the implementation of the energy saving measures

In the year of 2012, after the implementation of the measures described before, this company reduced the energy consumption in 49 kWh per ton (-16%), with an increase of the products processed, from 9.000 ton to 11.400 ton.

The electric energy consumption was 2.897.674 kWh and the CO_2 emissions was 1.362 ton.

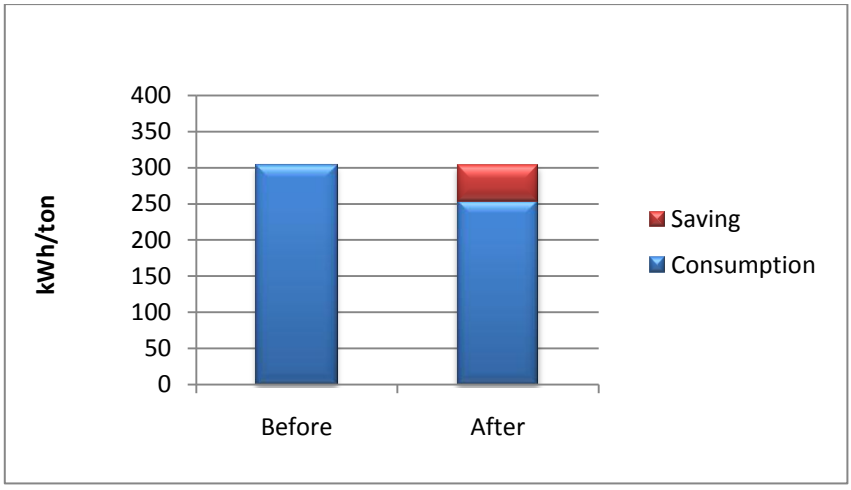

Fig 2 – *Total energy consumption before and after the implementation of the measures*

1.1.2. Vitacress – Iberian Salads Agriculture S.A.

Location: Odemira (South of Portugal)

1. *Situation before the measures implementation*

The following characterization is for year 2012.

Product quantity: 5.150 ton

Electric energy consumption: 5.122.791 kWh

CO_2eq emissions: 2.407 ton CO_2eq

The company works all year, with higher energy consumption in August.

2. *Implemented energy saving measures*

In this company, the modifications were:

a) Installation of frequency modulators;
b) Replacement of a compressor in the refrigerator system.

The investment was 54.520 € for the acquisition and installation of the frequency modulators and 21.060 € for the compressor. The correspondent expected payback period is 3,3 and 4,4 years, respectively.

3. *Results after the implementation of the energy saving measures*

In the year 2013, after the implementation of the measures described before, this company reduced the energy consumption and the GHG emissions in approximately 6 %.

Product quantity: 5.150 ton

Electric energy consumption: 4.800.000 kWh

CO_2eq emissions: 2.257 tons CO_2eq

In summary, the total investment is 75.580 €, which provides an annual savings of 19.500 €. The expected payback period is 3,9 years, with a reduction in the carbon intensity of 1.164 tCO_2/ton. Reductions in CO_2 emissions will be 150 ton CO_2.

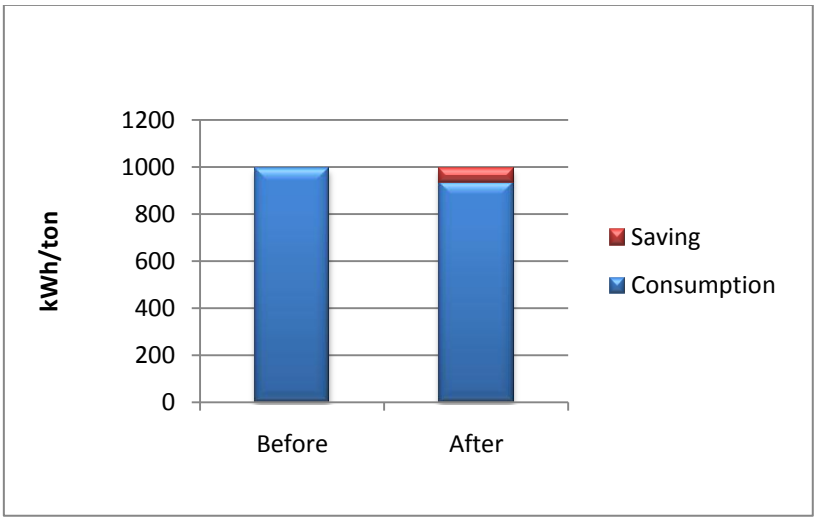

Fig 3 - *Energy consumption before and after the implementation of the measures*

1.1.3. Central Hortofrutícola S.A.T. San Cayetano

Location: Murcia (South-Eastern of Spain)

1. *Situation before the implementation of energy saving measures*

The following characterization is for the year of 2009.

Product quantity: citrus 7.314 ton, capsicum 14.177 ton, melon 836 ton

The company has the following energy consumption:

Electricity: 2.281.079 kWh

Fuel consumption: 96.000 L = 933.120 kWh

Butane gas consumption = 11.688 kg = 148.361 kWh

The electrical energy is used to operate all electric motors in the company; diesel is consumed in the drying process and butane Gas in the forklifts.

The annual energy cost presented a total of 356.484 €, corresponding 279.934 € to electricity, 67.200 € to diesel and 9.350 € to butane. These values were calculated based on the above presented energy consumed from each of the energy sources, and the prices of each source (a kWh of electricity costs 0.12 €, diesel is 0.07 € / kWh and butane 0.06 € / kWh).

The electricity consumption represents 68% of the total energy of the company. Diesel consumption is 28% and natural gas is 4% of the total energy consumption.

The electricity consumption is higher between May and August. These months concentrate 36.8% of the company output, corresponding to 45% of the annual electricity consumption. These are the months with higher air temperatures in the region, so it is necessary to consume more energy for the refrigeration systems in order to obtain the appropriate conservation temperature.

The period with lower electricity consumption is September, which coincides with the lowest production period, with less equipment use and smaller power needs. It is also the period when the summer production cycle ends and the winter crops start.

The energy used in each phase of the production process, taking into account each energy sources is presented in the next table.

Table 1 – Total energy consumption in each phase by energy source.

	Energy consumption (kWh)			Energy consumption by process phase (%)
	Electricity	Diesel	Butane gas	
Refrigeration	1.177.250			52%
Illumination	326.873			14%
Packing	274.887			12%
Wash	95.251			4%
Drying		933.120		100%
Forklifts			148.361	100%
Others	406.818			18%
Total	2.281.079	933.120	148.361	

It is possible to observe that 52% of electricity consumption is for the refrigeration system, being one of the most important equipment's that need more attention in order to lower the total electricity consumed.

Table 2 – Total energy consumption in each phase of the production process

	Consumption (kWh)	Consumption (%)
Refrigeration	1 177 250	35%
Illumination	326 873	10%
Packing	274 887	8%
Wash	95 251	3%
Others	406 818	12%
Drying	933 120	28%
Forklifts	148 361	4%
Total	3 362 560	100%

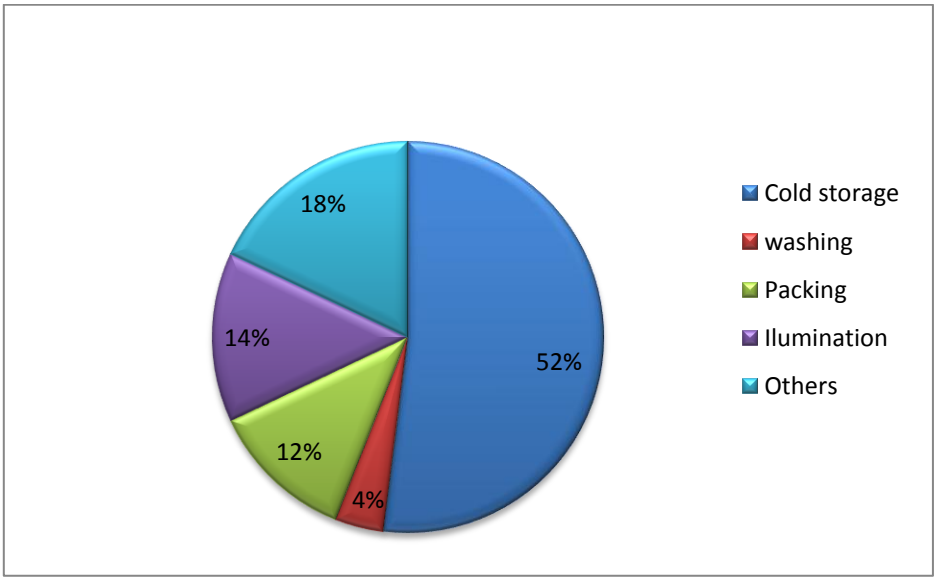

Fig 4 – *Electricity consumption distribution.*

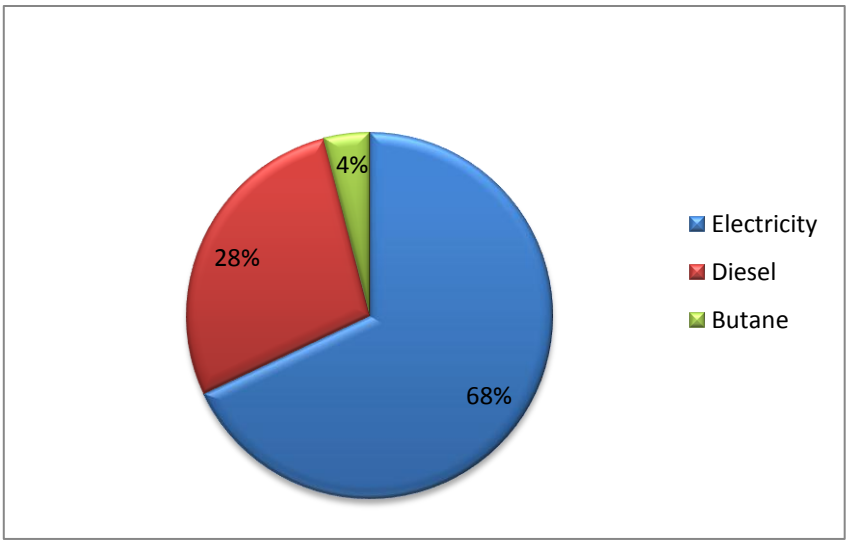

Fig 5 – *Energy consumption distribution.*

2. *Implemented energy saving measures*

1 Renegotiation of the electricity price ;

2 Replacing the lamps (replacement of lamps installed by others with less power;

3 Replacement of electromagnetic ballasts by electronic ones;

4 Installation of motion detectors in the refrigeration facilities;

5 Elimination of the equipment stand-by mode.

3. *Results after the implementation of the energy saving measures*

In the year 2010, after the implementation of the measures described before, this company reduced the energy consumption and GHG emissions in approximately 4 %.The volume of product processed was the same as before.

Table 3 – Energy savings and CO_2 emissions reduction after measures implementation and characteristics of investment.

Nº	Description of the measure	Annual savings			initial investment (€)	Payback (years)	annual reduction of CO2 emissions (kg CO2)
		kWh	%	€			
1	Renegotiation of the electricity price	0	0	5.475	0	0	0
2	Replacement of lighting	21.482	0,94	2.636	4.347	1,65	8.593
3	Replacement of electromagnetic ballasts by electronic ones	43.549	1,91	5.344	16.329	3,06	17.419
4	Installation of motion detectors in the cold rooms	26.490	1,16	3.251	2.175	0,67	10.596
5	Elimination of equipment stand-by mode	3.558	0,16	437	1.040	2,38	1,423

In summary, with these modifications we have:

- Investment: 23.891 €

- Saving energy: 95.079 kWh

- Saving costs: 17.143 €

- Reduction in CO_2 emissions: 38.032 kg CO2

- Mean estimated payback period: 1,4 years

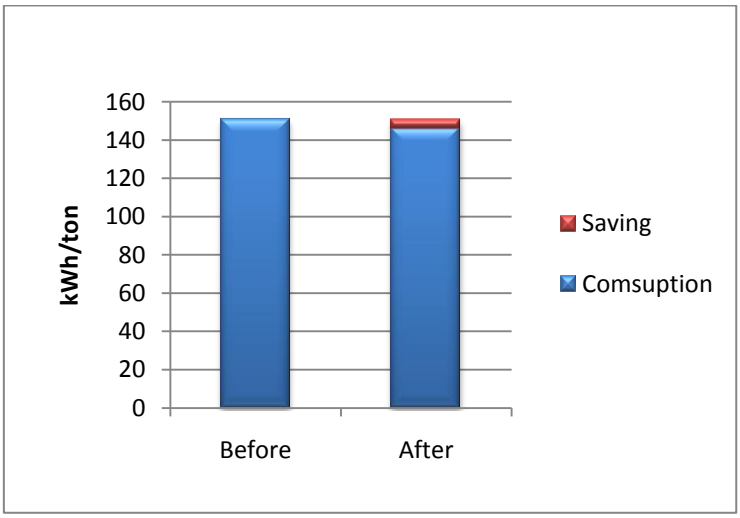

Fig 6 - *Energy consumption before and after the implementation of the measures*

1.1.4 CHESTE AGRARIA COOP. V.

Location: Valencia (Central east coast of Spain)

1. Situation before the implementation of energy saving measures

Product quantity: Oranges 24.190 ton, Clementins 3.790 ton.

This company operates between November and May and had the following energy consumption:

Electricity consumption: 985.980 kWh

Thermal Energy consumption (diesel): 63.875 L = 618.400 kWh

The thermal energy obtained from diesel is used in the boiler for heating water for disinfection and also boilers installed in drying tunnels. There are two types of boilers, one for heating the water (thermal power 350.000 kcal/h, 400 kW) and another for the process of fruit ripening (172.000 kcal/h, 125-280 kW). The burners are 4, with power ratings between 186 and 204 kW.

Three phases can be identified in this process:

- Disinfection and cleaning of oranges. The disinfection process uses hot water.

- Treatment of oranges to enter the distribution process: washing, waxing and drying.

- Storage of the oranges in refrigeration facilities while waiting for distribution.

2. Implemented energy saving measures

- Replacing diesel by natural gas;

Natural gas has higher calorimetric power, which means less consumption for the same energy released. It has also lower emissions of gases, such as CO2, CO and sulphur compounds. The total investment was 46.420 €. The expected payback period is 3 years.

3. Results after the implementation of the energy saving measures

In 2010, with the use of natural gas instead of diesel a 10% energy savings was obtained. The reduction was 61.840 kWh. With the use of diesel we had a cost of 38.324 € per year, since it had a consumption of 63.874 litres. In the case of natural gas, the costs were reduced to 23.018 € per year. This provides an annual savings of 15.300 €. It has also accomplished a reduction in CO_2 emissions, less 51,4 ton of CO_2.

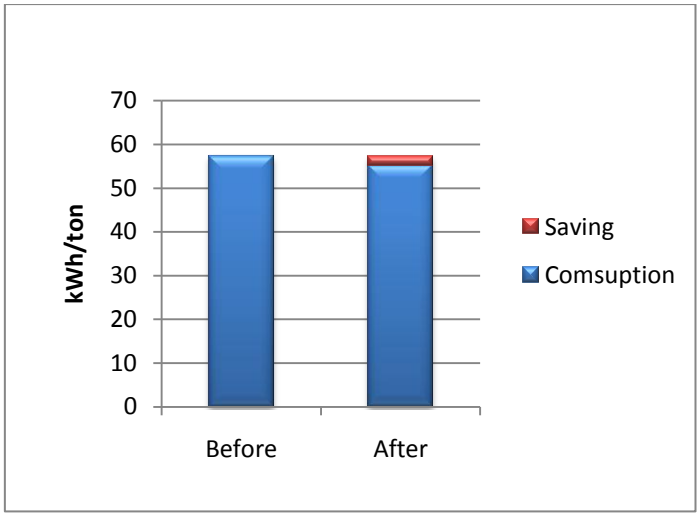

Fig 7 - *Energy consumption before and after the implementation of the measures*

1.1.5. RURAL SAN VICENTE FERRER COOP V

Location: Valencia (Central east coast of Spain)

1. *Situation before the implementation of energy saving measures*

Production: 25.054 ton of citrus, vegetables and watermelon.

The company has the following energy consumption:

Electricity consumption: 1.346.064 kWh

Diesel consumption: 670.045 kWh

2. *Implemented energy saving measures*

- Replacement of diesel by natural gas;

With this modification the power was increased from 2.467 kW to 2.529 kW.

3. Results after the implementation of the energy saving measures

The replacement of diesel by natural gas, led to 5% of savings in energy consumption (33.502 kWh). The cost of thermal energy was 0,067 € / kWh and now is 0,033 € / kWh. Total costs decreased 23.907 €. The total investment was 49.020 €. The payback period is estimated in about 2 years.

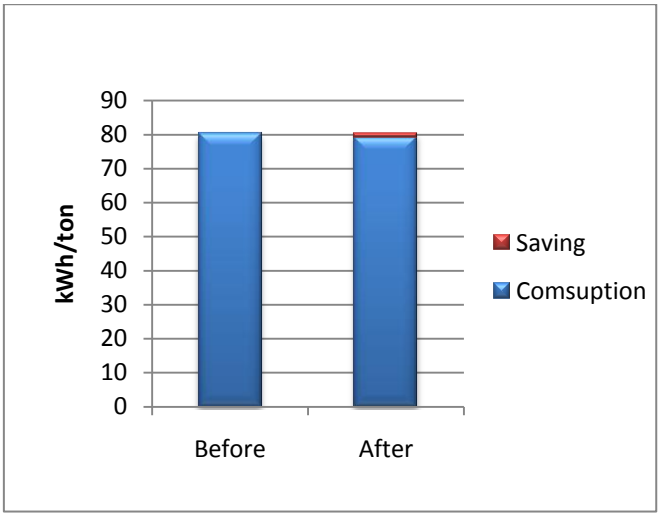

Fig 8 - *Energy consumption before and after the measures implementation*

1.1.6. COOP Hortofruticola Alzicoop COOP V

Location: Valencia (Central east coast of Spain)

1. Situation before the implementation of energy saving measures

Production: 15.310 ton of citric and persimmons.

The company had an energy consumption of 1.292.752 kWh.

The higher consumption of electrical energy occurs during the months that lasts the campaign, from November to June. This consumption is more accentuated in the months of November to January, which are the months of maximum production.

Diesel consumption: 308.513 kWh.

The consumption of thermal energy is distributed between the facilities of pre calibration and fruits drying.

2. Implemented energy saving measures

- Installation of monitoring, registration and management of the electrical consumption systems.

3. Results after the implementation of the energy saving measures

With the installation of the electronic management system, the company has obtained a saving of 41.400 kWh in electricity consumption. Total costs decreased 4.554 €.

The total investment was 6.720 €. The estimated payback period is about 1,5 years.

The annual reductions in CO_2 emissions are 16,2 ton (27%).

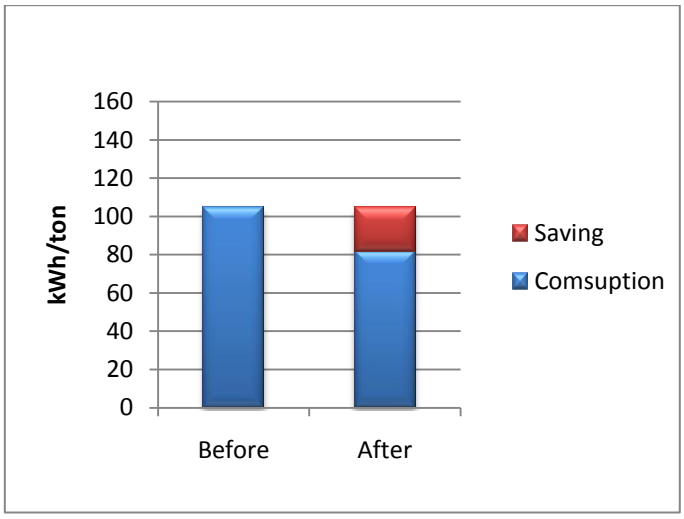

Fig 8 - *Energy consumption before and after the implementation of the measures*

1.1.7. ANECOOP S.COOP

Location: Valencia (Central east coast of Spain)

1. Situation before the implementation of energy saving measures

Production: 7.500 ton. Oranges, mandarins and some green vegetables.

The company works all year and has the following energy consumption:

Electric and Thermal energy consumption: 1.500.000 kWh

The energy consumed by compressed air equipment was 141.745 kWh / year.

2. Implemented energy saving measures

Introduction of auxiliary equipment in the compressed air system, that allows a better management. The total investment was 2.220 €, with an estimated payback period of 2,1 years.

3. Results after the implementation of the energy saving measures

In 2010, after the implementation of the referred measure, the energy consumption due to the compressed air equipment was reduced to 131.375 kWh / year, corresponding to energy savings of 10.370 kWh / year. The costs reduction was of 1.037 €, with a reduction of 4,04 ton of CO_2 emissions.

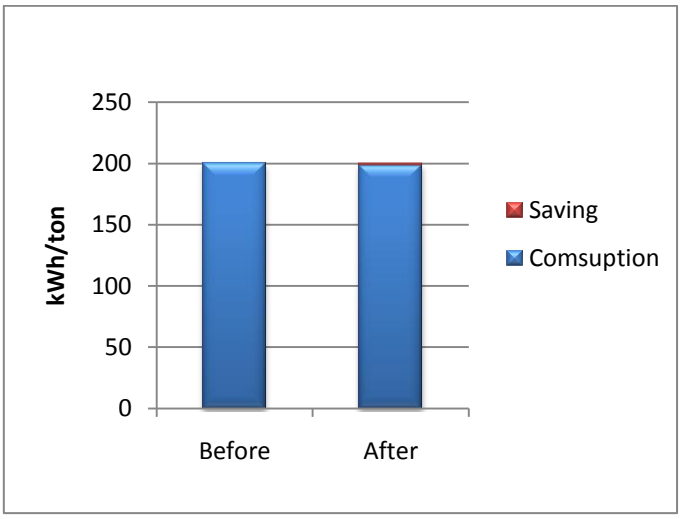

Fig 9 - *Energy consumption before and after the measures implementation*

1.2 Olive Oil Mills Sector

The maximum electricity consumption is concentrated between December and March, coinciding with the period of operation of the mill. In the remaining months consumption is constant and considerably lower.

Biomass is used in boilers that heat the water for some equipment devices, such as mixers and centrifuges for the production of olive oil. The boiler heat is also used for acclimatization of the administrative facilities. The olive pit used in the boiler is obtained at the mill as it is a sub-product resulting from the olive oil production process.

1.2.1 Cooperativa Agrícola dos Olivicultores do Cano

Location: Estremoz (South of Portugal)

1. Situation before the implementation of energy saving measures (2008)

1.300 ton of olive processed, 189 ton olive oil produced

Electricity consumption: 23.497 kWh

Biomass Consumption: 15.750 kWh

2. Implemented energy saving measures

The olive oil mill was converted from a 3 phases to 2 phases olive oil mill. This conversion originated the replacement of all the equipment in the mill.

a) Dry equipment - increased capacity of the washing machine with a decreased consumption due to decrease in the number of engines;

b) Hammer mill - replaced by other with higher power;

c) Mixer - replaced by another with higher power and greater capacity. Started to beat 7000 kg / hour, instead of the old 1,000 kg / hour;

d) Decanter – the existing three-phase decanter was replaced by a two-phases decanter;

e) Centrifuge - two centrifugal were originally needed, the first for withdrawing the impurities still contained in the oil and the second to withdrawing the oil which was still in the water. Now it has only one centrifuge that removes impurities that may still be in the olive oil.

f) Boiler - it was installed a higher power boiler, which is fed with a sub product of the mill, the olive pit. This boiler is used to heat the water for olives washing and to keep the dough from the mixer running at optimum temperature.

3. Results after the implementation of the energy saving measures (2008/2009)

Table 4 – Total electricity consumption in each phase of the production process

	Electricity consumption (kWh)
Reception and washing	5.187,2
Mass preparation	7.780,8
phase separation	10.374,4
Storage	2.593,6
Total	25.936

In addition to electrical energy consumption, there is also some thermal energy consumption.

The boiler consumes during the time of operation of the mill, middle of November until the end of December, 10 kg / h of olive pit. Works 10 hours a day, using a total of 5.000 kg of olive pit, per campaign. This amount of material produces 25.000 kWh.

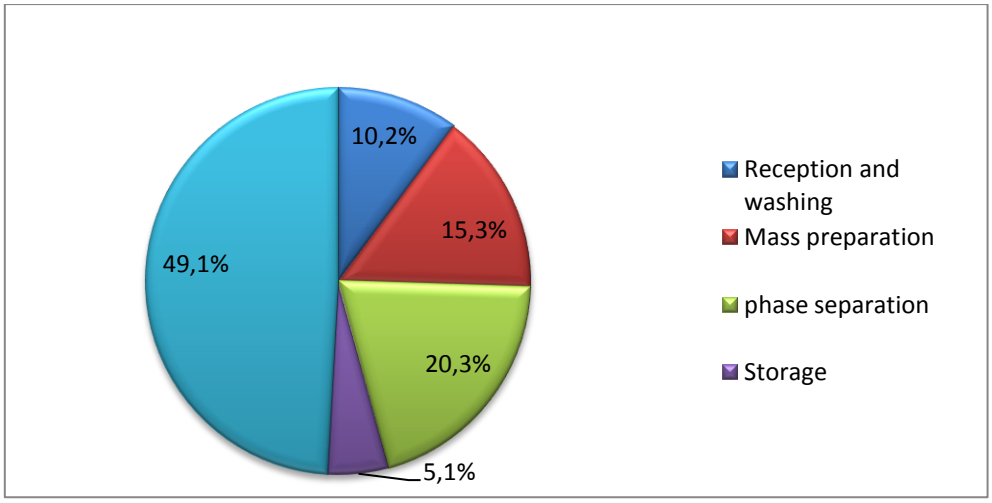

Fig 10 – *Energy consumption distribution*

Production: 2.144 ton of olive processed, 345 ton olive oil produced

Electricity consumption: 25.936 kWh

Biomass Consumption: 25.000 kWh

In 2008/2009, after the implementation of the energy saving measures the company had annual savings of 60 kWh per ton. The investment was 333.000 € and the estimated payback period is 8 years.

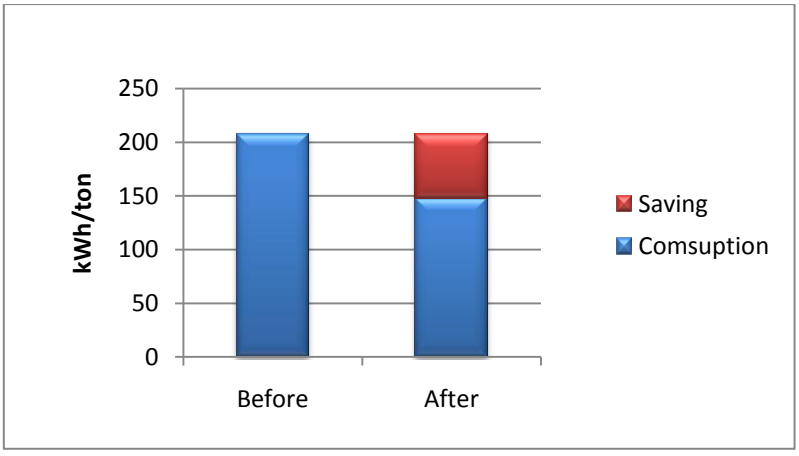

Fig 11 - *Energy consumption before and after the implementation of the measures*

1.3 Wineries Sector

1.3.1.Adega Cooperativa de Borba

Location: Borba (South of Portugal)

1. Situation before the implementation of energy saving measures

Production: 9.826 ton of grapes processed, 7.370 ton of wine produced

The company had the following energy consumption:

Electricity consumption: 885.057 kWh

2. Implemented energy saving measures

The implemented energy saving measures investment was 4.600 € and the estimated payback time is 0,42 years and consisted in:

- Installation of a control system in the refrigeration equipment;

- Replacement of incandescent bulbs by energy saving lamps;

- Replacement of diodes lamps by LED's.

3. Results after the implementation of the energy saving measures

Production: 13.245 ton of grapes processed, 9.934 ton of wine produced

Electricity consumption: 963.844 kWh

The total amount of emitted CO_2 before the change was 416 ton CO_2, or 56 ton CO_2 / ton of product produced. After the change, the total amount was 453 tons CO_2, and 46 tons CO_2 / ton of product. Although the total amount increased, due to a higher amount of processed grapes, there was a decrease in the emission of CO_2 per ton of product produced.

The same applies to the total consumption of kWh. Spite of its increase from 885.060 to 963.845 kWh, its value per ton of produced product decreased from 120 to 97 kWh.

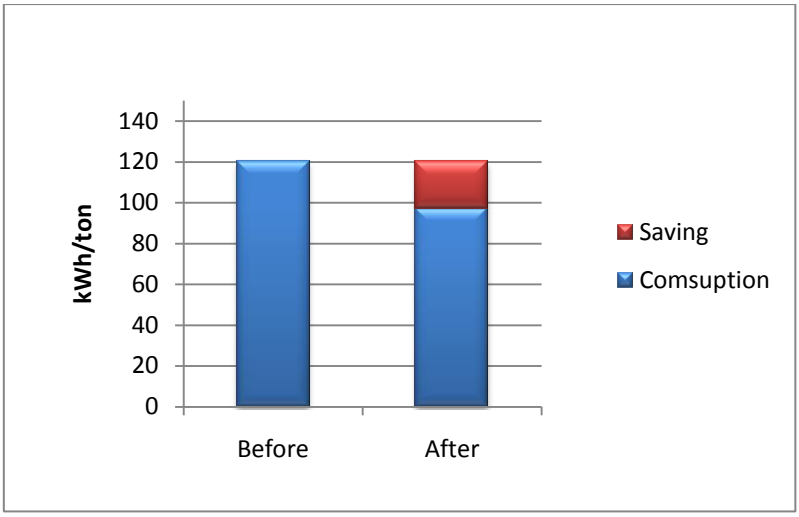

Fig 12 - *Energy consumption before and after the implementation of the measures*

1.3.2.Adega Chão de Judeus

Location: Borba (South of Portugal)

1. Situation before the implementation of energy saving measures

Production: 3.425 ton of grapes processed, 2.569 ton of wine produced

The company has the following energy consumption: Electricity consumption: 505.690 kWh

2. Implemented energy saving measures

- Installation of capacitor banks.

3. Results after the implementation of the energy saving measures

Production: 5.155 ton of grapes processed, 3.866 ton of wine produced

Electricity consumption: 542.632 kWh

Although there is an increase in the total amount of CO_2 emissions, they had a decrease of 27 ton per ton of product.

The total amount of CO_2 emitted before the change was 238 tons, i.e., 92.5 tons CO2/ ton of produced product. After the changes, the total amount of CO2 emitted was 255 ton CO_2, or 66 ton CO_2/ ton of product. Although there was an increase in the total amount, there was a decrease in the emission of CO_2 per ton of produced product.

The same applies to the total consumption of kWh. Spite of its increase from 505.690 to 542.632 kWh, its value per ton of product produced decreased from 197 to 140 kWh.

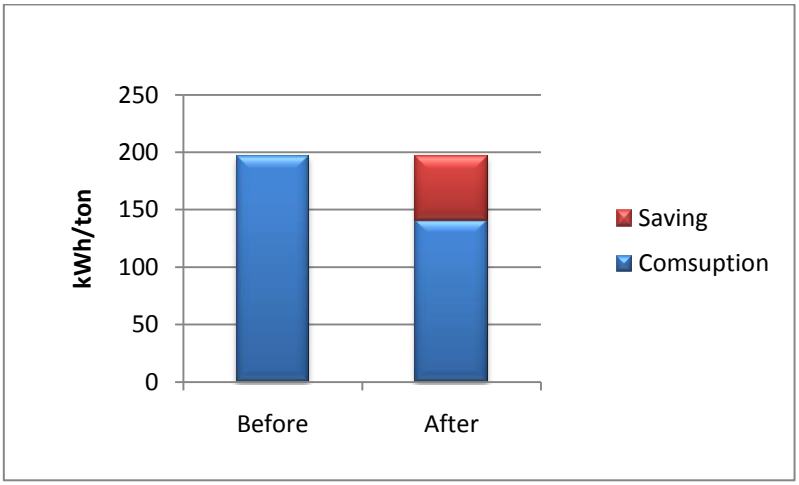

Fig 13 - *Energy consumption before and after the implementation of the measure*

The investment was 5.500 € and the expected payback time is 0,58 year.

1.3.3.Winery A

Location: Italy

1. Situation before the implementation of energy saving measures

Production: 4.500 ton of grapes processed, 3.700 ton of wine produced

The company has the following energy consumption:

Electricity consumption: 875.000 kWh

Natural gas consumption: 1.168.297 kWh

Natural gas is used in space heating, wine-production, heating and flushing out. Electricity is used in lighting, air compressors, chiller, and electric motors for bottling, pressing and handling.

2. Implemented energy saving measures

The investment represented 82.000 €, and the average estimated payback period is 4 years. The implemented measures were:

- Substitution of the lighting system (fluorescent lamps with electromagnetic reactor) using LED technology keeping the luminous flux unchanged;
- Chiller replacement with a high efficiency model and heat recovery from chiller condenser;
- Substitution of the boilers with new models;
- Compressed air leakage localization and air pressure adjustment;
- Substitution of one electric motor by a higher efficient model.

3. Results after the implementation of the energy saving measures

Production: 4.500 ton of grapes processed, 3.700 ton of wine produced.

The company had the following energy consumption:

Electricity consumption: 801.000 kWh

Natural gas consumption: 1.064.297 kWh

CO_2 emissions were reduced in 35 tons per year.

The total amount of CO_2 emitted before the change was 416 ton or 56 ton CO_2/ ton of product produced. After the changes, the total amount of CO2 emitted was 453 ton CO_2, so 46 ton / ton of product. Although there was an increase of the total amount of emitted CO_2 , there was a decrease in the emission of CO_2 per ton of product produced.

The same applies to the total consumption of kWh. In spite of its increase from 885.060 to 963.845 kWh, its value per ton of produced product decreased from 120 to 97 kWh.

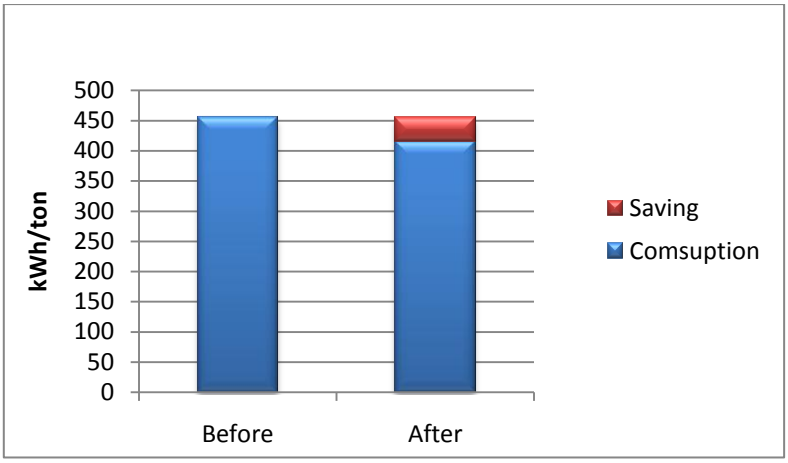

Fig 14 - *Energy consumption before and after the implementation of the measures*

Summary

The table below summarizes the energy consumption and CO_2 emissions before and after the implementation of the energy saving measures in the different analysed agro-industry sectors.

		Energy (kWh/ton)		CO_2 emissions (CO_2eq/ton)			
		Before	After	Before	After	Investment	Payback
Fruits & Vegetables	Cooperfrutas	303	254	0,14	0,12	892 130	8
	Vitacress	995	932	0,47	0,44	75 580	3,9
	San Cayetano	151	146	0,05	0,05	23 891	1,4
	Cheste	57	55	0,02	0,02	46 420	3
	San Vicente Ferrer	80	79	0,03	0,03	49 000	2
	Alzicoop	105	82	0,004	0,003	6 720	1,5
	ANECOOP	200	199	0,09	0,09	2 220	2,1
Olive oil mills	Coop Oliv Cano	208	148	0,06	0,04	333 000	8
Wineries	Adega Coop Borba	120	97	0,06	0,05	4 600	0,42
	Adega Chão dos Judeus	197	140	0,09	0,07	5 500	0,58
	Winery A	194	178	0,09	0,08	82 000	4

In all analysed situations the implement measures allowed an energy saving for ton of produced product, with the maintenance or reduction of the CO_2 emission values. Investments were very variable (from 892 thousand to 2,2 thousand Euros), but in most cases the estimated payback time do not exceed four years.

This analysis shows that in many cases, and in different agro-industry sectors, small investments in energy saving measures can allow energy savings and the decrease of production costs.

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Vitacress