IEE/12/758/SI2.644752

D 6.2: Audit and training proposal Report (English)

Software for tool kit

tesla

Transfering
Energy Save
Laid on Agroindustry

Author: Abel Ortego
(Centre of Research for Energy
Resources and Consumptions)

Update version:
September 2013

Authors:
Centre of Research for Energy Resources and Consumptions (CIRCE)

About this report

This report has been develop in the framework of the TESLA project (Intelligent Energy in Europe) and has been founded by the European Commission.

Copyright

1. Introduction

The aim of this task is to check, according to the feedback from previous Deliverable 6.1 and some findings about tools developed by some companies involved in energy efficiency issues, how these software and tools could be used in TESLA auditing activities. All the conclusions will be incorporated in this report D 6.2 Audit and training proposal report.

2. Target

Target group of this document are auditors who attendance to TESLA training course and who will do 110 energy audits in cooperatives of TESLA project.

3. Methodology

To reach this purpose several previous tools to be used in auditing phase were analyzed and checked and as a result this guide has been elaborated to show how these tools can be applied in TESLA audits and what main results they offer. Previous tools analyzed are the following:

PINE: Tool analyzes both thermal and electric devices like lighting, boilers, cooling, engine, fan, compressed air, furnace, heating. As a result a report with suggestion and advices to implement in the installation is shown together with a Sankey diagram with the information of the energy consumes. This tool is very useful to check what energy efficiency state of cooperatives are and to show what is the distribution of energy flows.

ABB Pump save: Tool analyze the possibility to install a speed driver in engines installed in pumping process, analyzing what is the charge profile and the current engine power. As a result a graph comparing previous scenario and energy efficiency scenario is shown. The tool is very useful to analyze possibility to install frequency drivers in processes.

Eco8: It is a tool develops by Schneider electric in with is study the possibility to install a speed driver in engines installed both in fan like in pump applications. As a result payback time and energy saving are given. The tool is very useful to analyze possibility to install frequency drivers in processes.

PEP: This tool is directed to improve performance in combined heat and power production, compressed air, electrochemical processes, fans and blowers, industrial facilities (lighting, HVAC). As results are given: potential annual CO_2 saving from electricity, fuel and steam, a suggestion short text with the measures that should be implemented, graph with potential annual energy savings by process, and annual energy use, classify by energy type and cost.

Aislam: This tool is directed to improve the isolation devices: in flat plates, pipes, sphere and special applications. As a result final pipe temperature, thermal resistance, and thermal flow are given.

4. PINE

4.1. Tool description

Available in: http://circe2.deweb.es/herramienta/index.php

Every file or company data is kept and accessible by means of a username and password. If you want to access an existing file for a given cooperative in case you want to recover one diagnosis, please insert the login and password corresponding to the company. If you want to create a new file, click on "Press here to proceed to the energy audit questionnaire". To access the tool main screen there are two options:

1- Insert login and password should you be a registered user.

2- If not a registered user, you must click "here" and register for the first time to access the computer questionnaire tool.

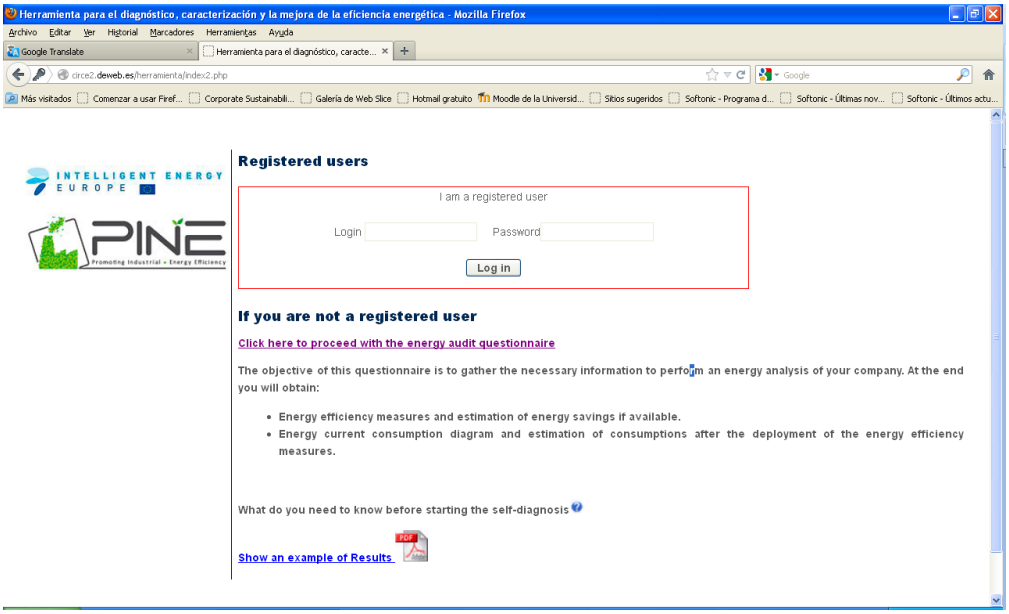


Figure 1: Mode in the tool

The questionnaire relating to the diagnosis tool, characterization and improvement of energy efficiency includes two types of questions: Company data and issues specific to the equipment installed in the company, their characteristics and mode of operation, well as the overall operation of

the facility. The first screen after registering the generic data corresponding to the company, is as shows Figure 2.

At the end of the generic data questionnaire you will be requested to provide a username and a password for this particular company. If any of the compulsory data fields are empty or wrong they will be marked in red after pressing "continue"

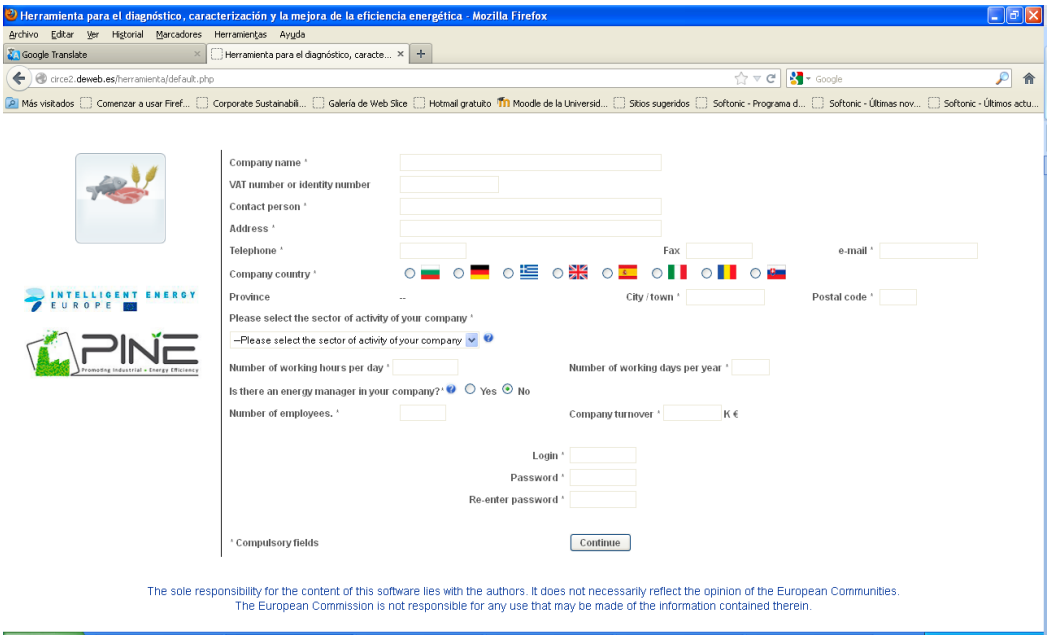


Figure 2: Screen details

To continue the questionnaire and move on to the following screen, at least the mandatory fields marked with an asterisk (*), must be completed then click on "Continue". Once the general data screen for the company, the different blocks in which the questions are divided for the sector of activity (NACE) - *in case of TESLA, all agro industrial activities are included and several specific NACE code for agroindustry cooperatives are available-* to which your cooperative belongs start:

- Technical data
- Boilers
- Cooling devices
- Engines, fans, pumps, compressors
- Furnaces.

On the left of the screen you will be informed about the module of information you are in. On the right top corner the company name and the log out button will be displayed. The first screen requests the amount of production per year in m^2, litres, tonnes or kg, as well as a free text box for additional explanations about the type of product. One or more types can be filled in.

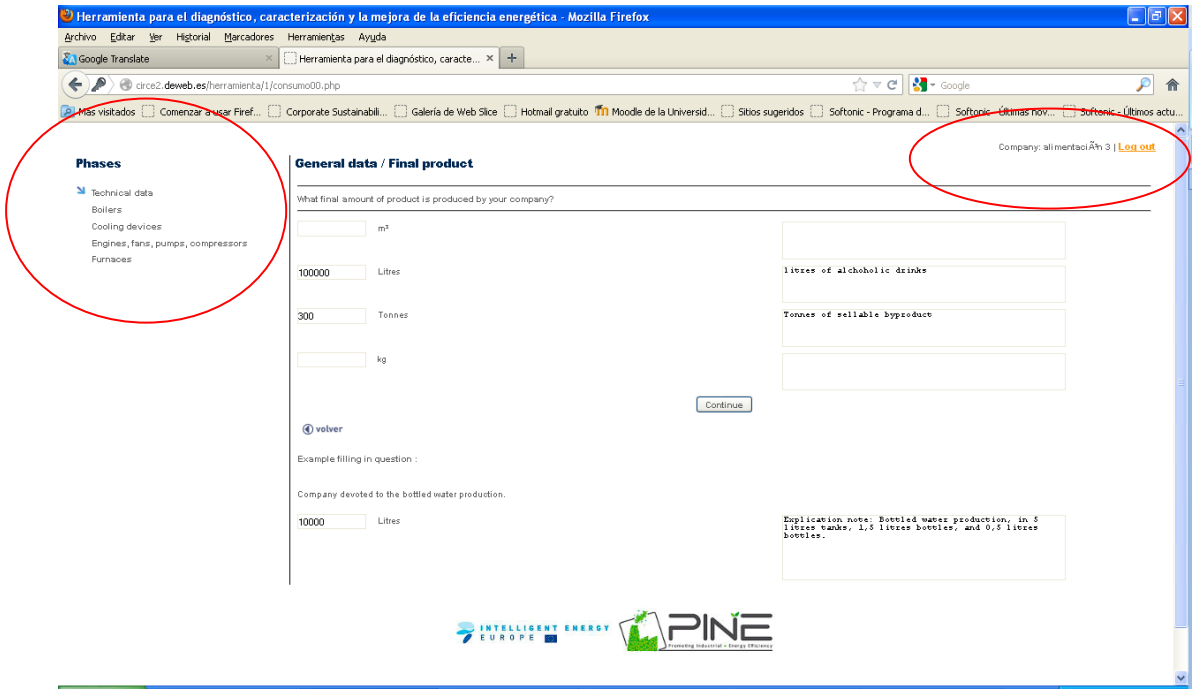


Figure 3: Screen details for production volume.

It shown in Figure 3, the various modules into which the screen is divided completion of the questions. The structure of all blocks independently is similar:

1- **Modules of the tool:** It left the area in which the block is to be completed over the computer tool.

We can observe that there are two symbols:

- : Indicates the block in which module you are now
- : Indicates that the block has been completed and completed correctly.

2- **Company name and log out button the tool:** at the top right. It displays the name of the company that is conducting the survey

Besides, you have the option "log out", which allows you to quit the tool to continue from that point later.

3- **Form:** It is the main module of the screen, since it shows the questions, answer choices and aids for completing them.

4- **<u>Back to the previous form:</u>** This option, located at the bottom left, drives you back to previous screens on error in filling in the data. Once you get back the necessary screens, it **is again necessary to complete the questionnaire from the point at which the tool is** at that time. The reason is because whatever changes made in the entered information may entail a path change in the decision tree.

In each of the forms, by continuing, any required information is missing, this will be marked in red as shown in Figure 4.

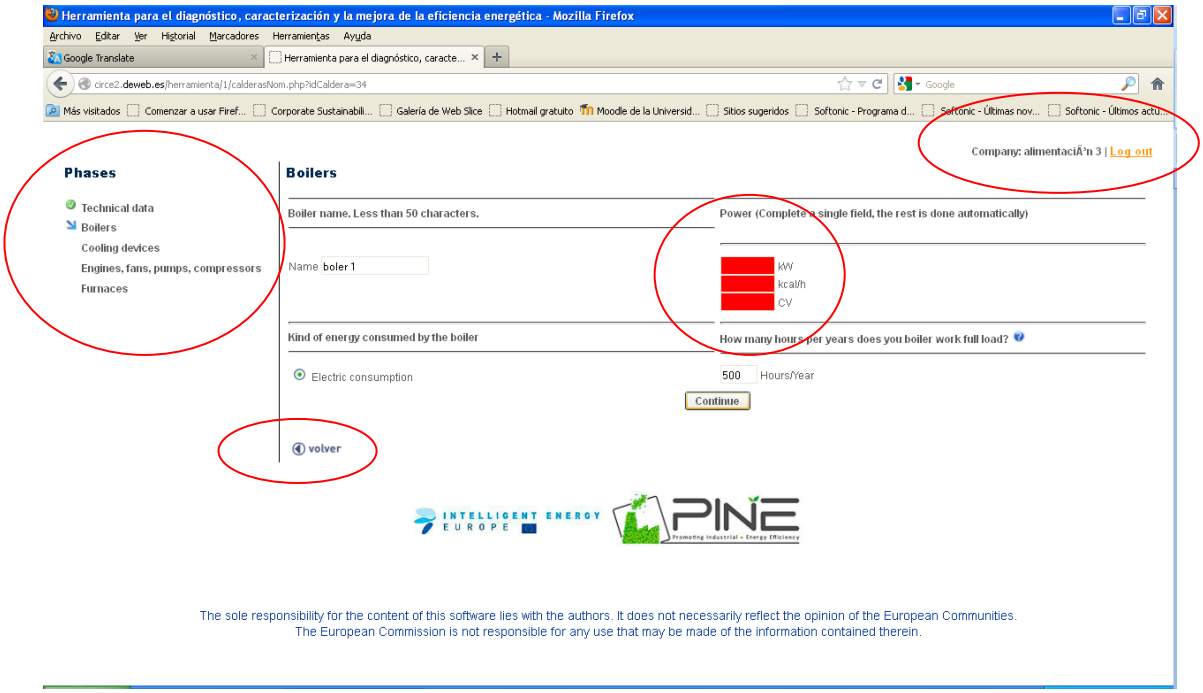


Figure 4: Image display incomplete data

At the end of each module a message communicates that you have successfully completed the module and indicates what will be the next module to appear. Some questions may not be clear. If a blue, appears, you can click for further details and explanations as the example below. Some questions are simply yes / no questions as in the example below. A default value will be proposed.

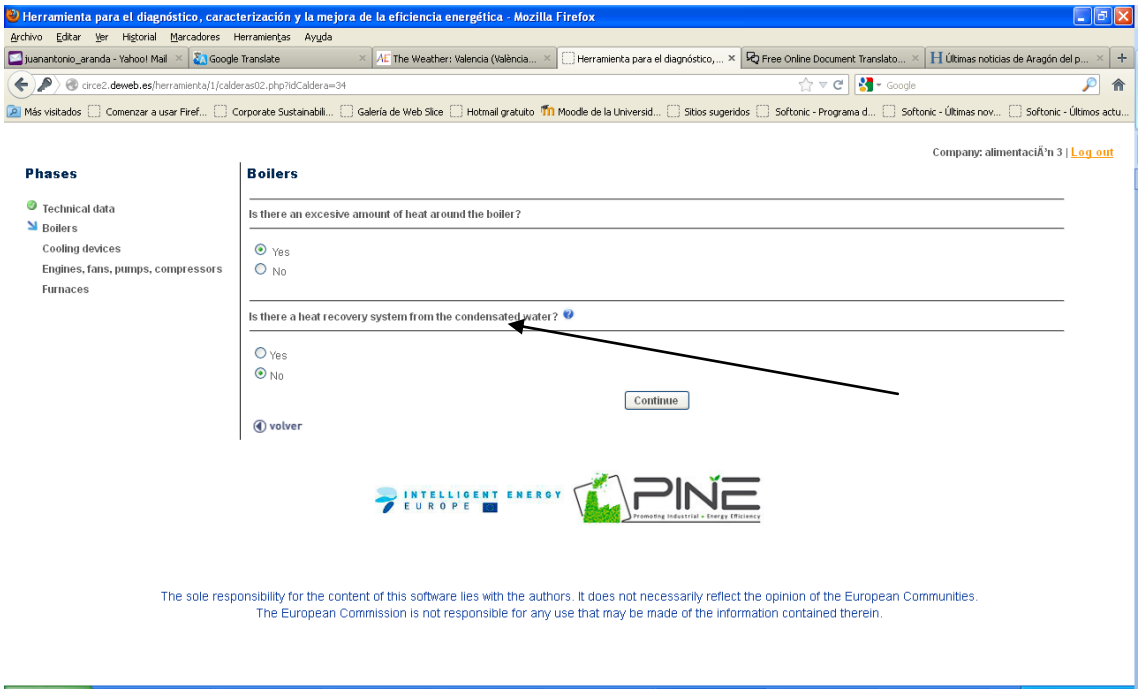


Figure 5: Yes / No questions

Some questions may not be clear. If a blue , appears, you can click for further details and explanations as the example below.

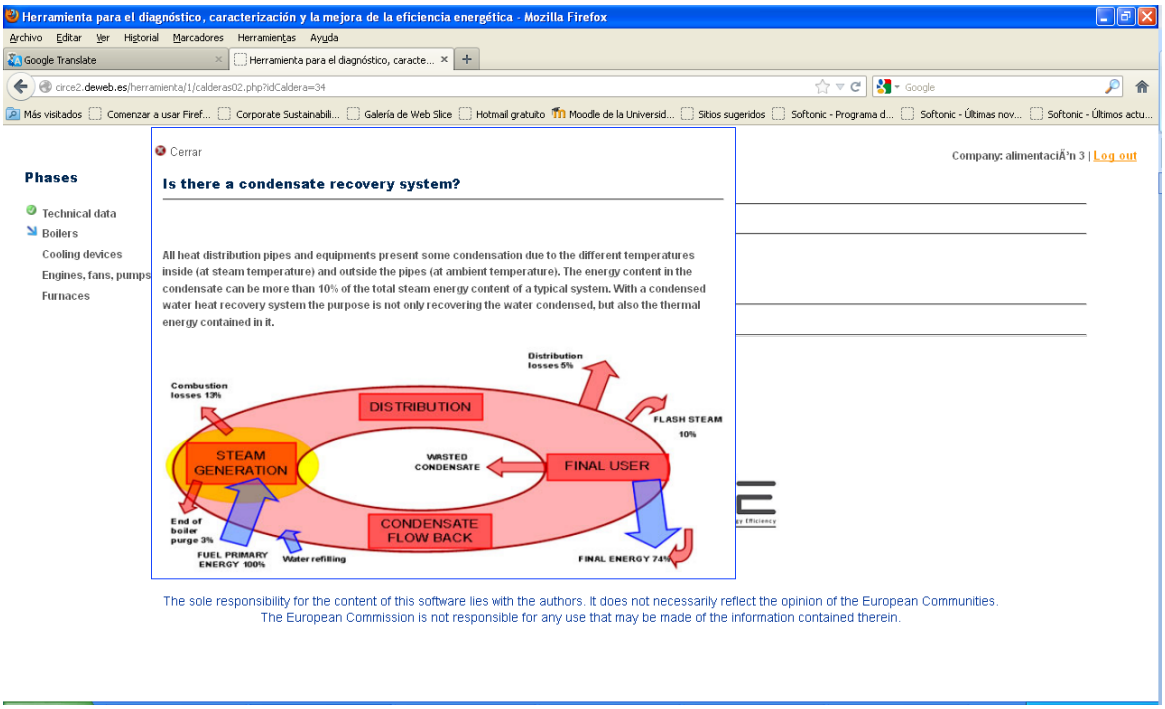


Figure 6: Help for a question

Every section starts by asking for the number of devices of each kind. You will be prompted to fill in a data sheet per each of the devices. If the company has several equal such devices you can fill in one, and copy the data for the following equipment, selecting it from the right column.

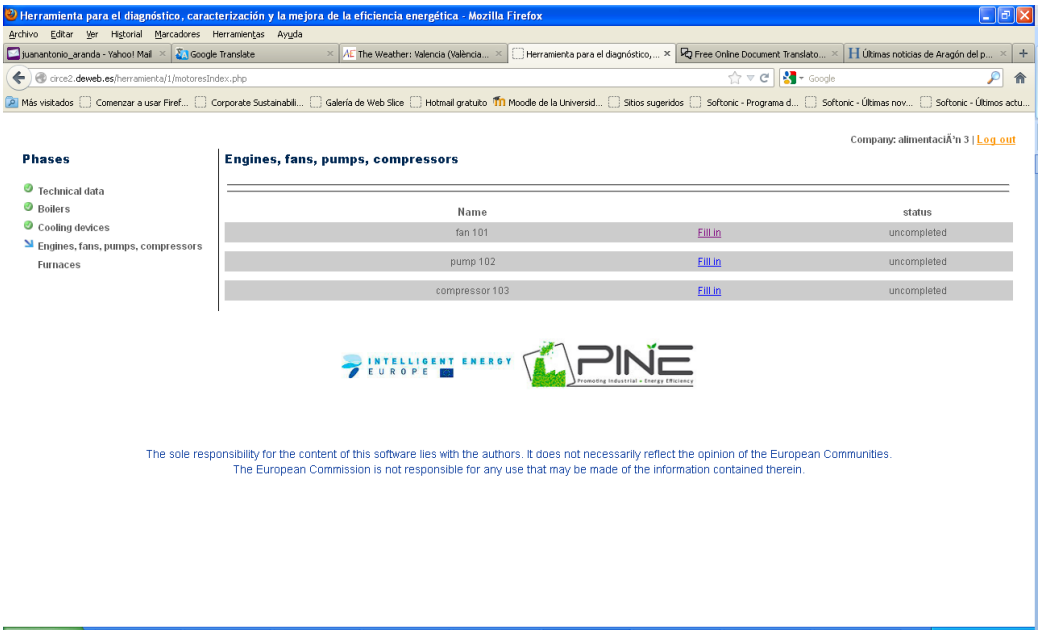


Figure 7: List of devices to be described.

Once inside the questionnaire, you will be requested to fill in the device characteristics depending on the device you are describing. An important data will the loading factor, from 0 to 1. If unknown the real value a 0.75 default value will be assigned.

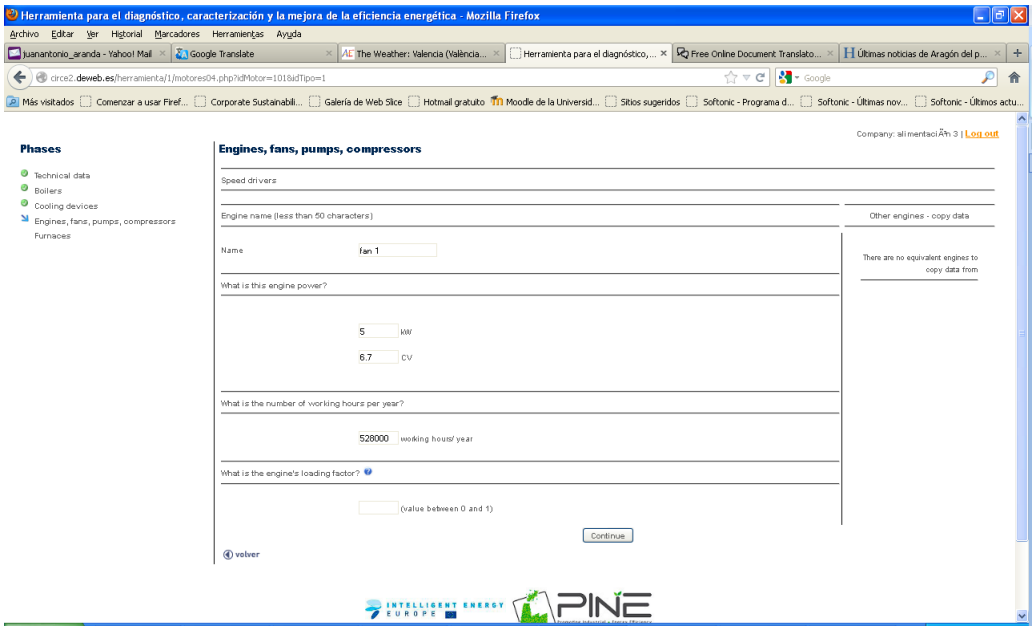


Figure 8: Sheet for device technical data.

4.2. PINE Report

Once you have completed all phases of the software tool, you enter the final report proposed measures for the company in question. The report is divided into several blocks, which are detailed below.

First, there is a first block which general data of the company have been made to the tool.

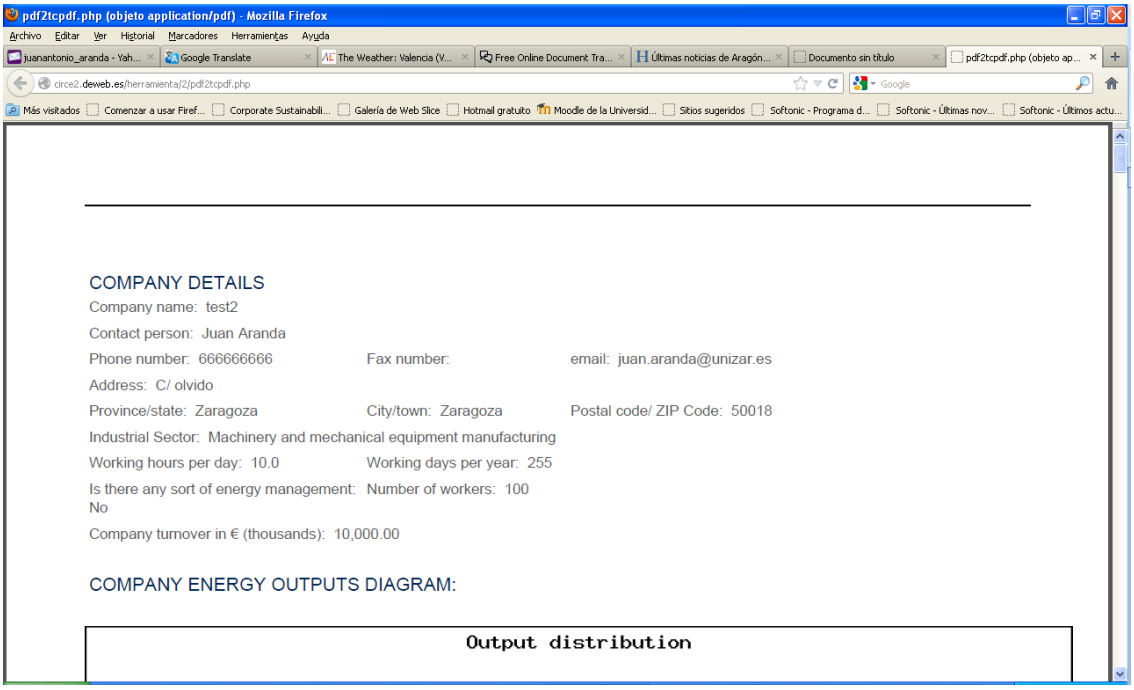


Figure 9: Image general report data

Next, the report shows a pie chart showing the share of the existing cooperative consumption by type of equipment. This diagram only shows consumer distribution outputs, if you want to also represent inputs, then you should open an energy Sankey diagram of the company in which both aspects are represented, for that purpose click on "View". This diagram will be added at the end of the report pdf version.

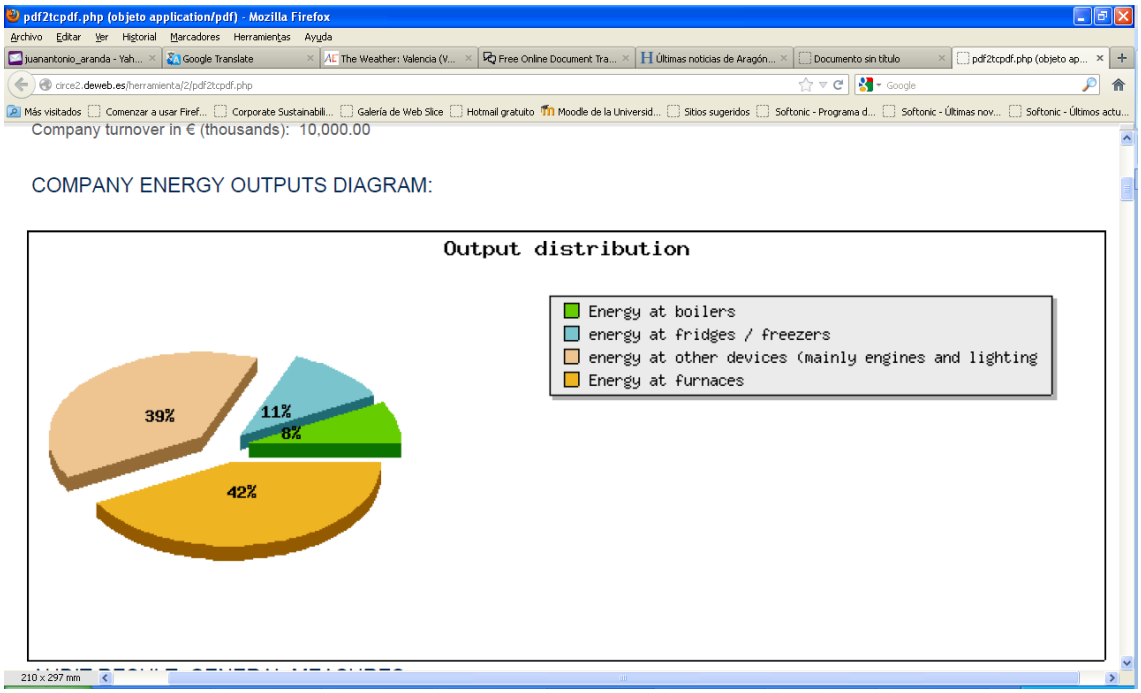


Figure 10: Company energy outputs diagram

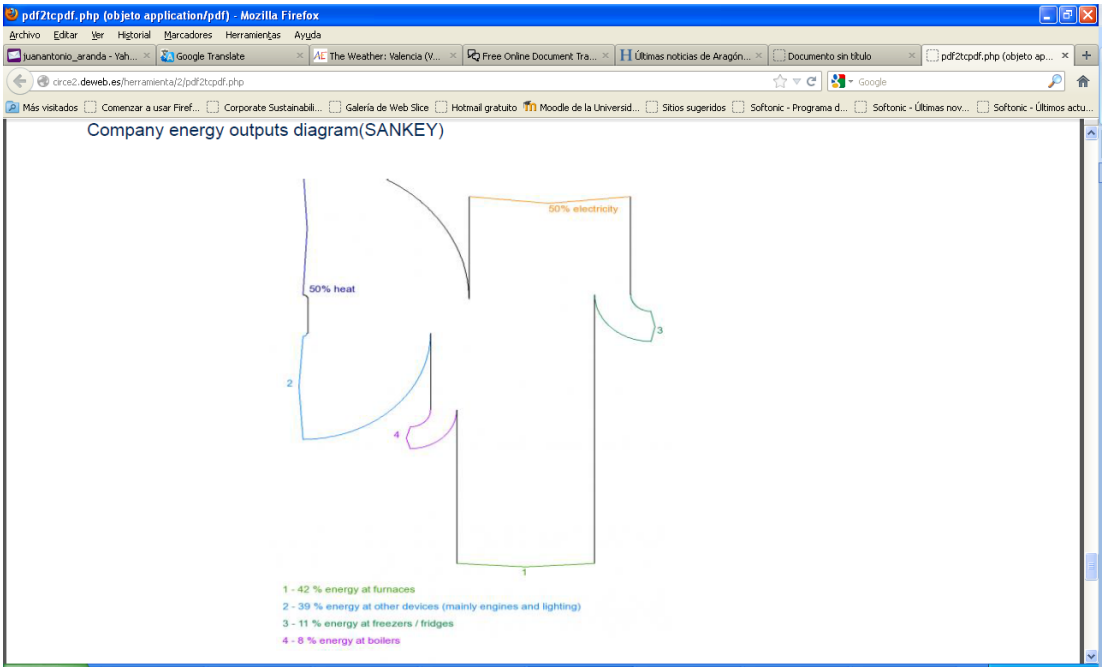


Figure 11: Sankey Diagram

The next block in the report shows the general measures (without quantification) proposed to improve the energy performance of the company. For each of the measures the corresponding device described by the given name will be displayed in brackets.

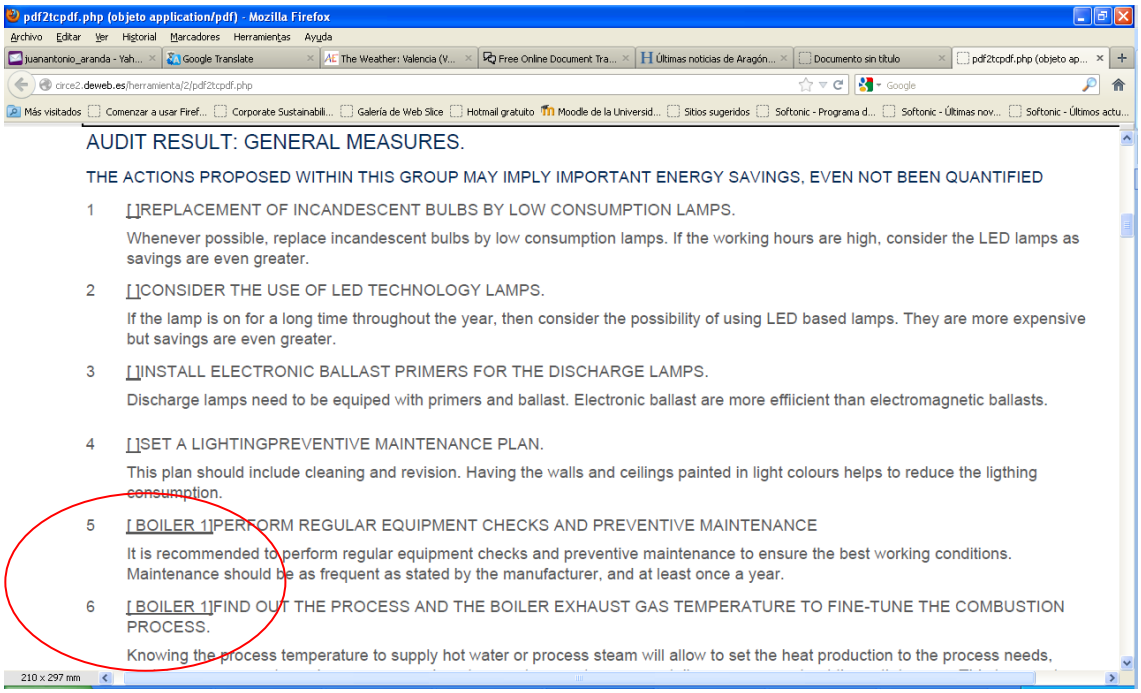


Figure 12: General recommendations for energy improvement

Following, there is a general measures block with those measures by type of energy that it is possible to quantify.

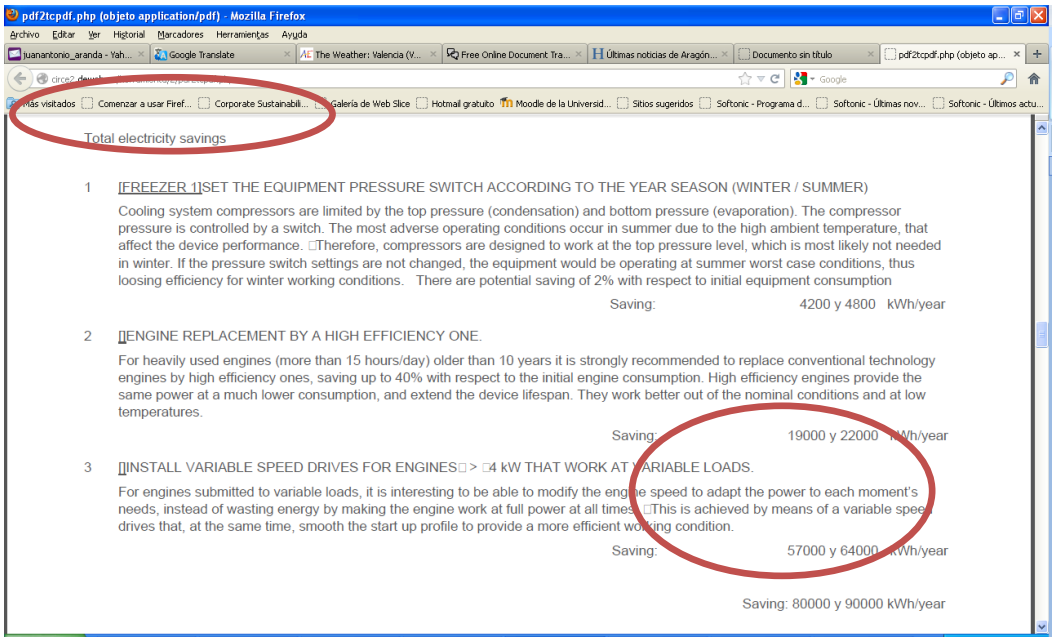


Figure 13: Energy improvements report, quantified measures

As seen in Figure 13, the savings are quantified using a range of values. Below is an overview of the initial situation of the company, shown by a red bar, and the consumption after the implementation of the measures proposed in the diagnostic report shown by a green bar.

Figure 14 shows the energy consumption by type showing the initial and the final consumption estimations. Please bear in mind that this is an average estimation of the savings achieved only by the full deployment of the quantitative recommendations. If the generic recommendations were implemented as well, the savings would be larger, although impossible to estimate.

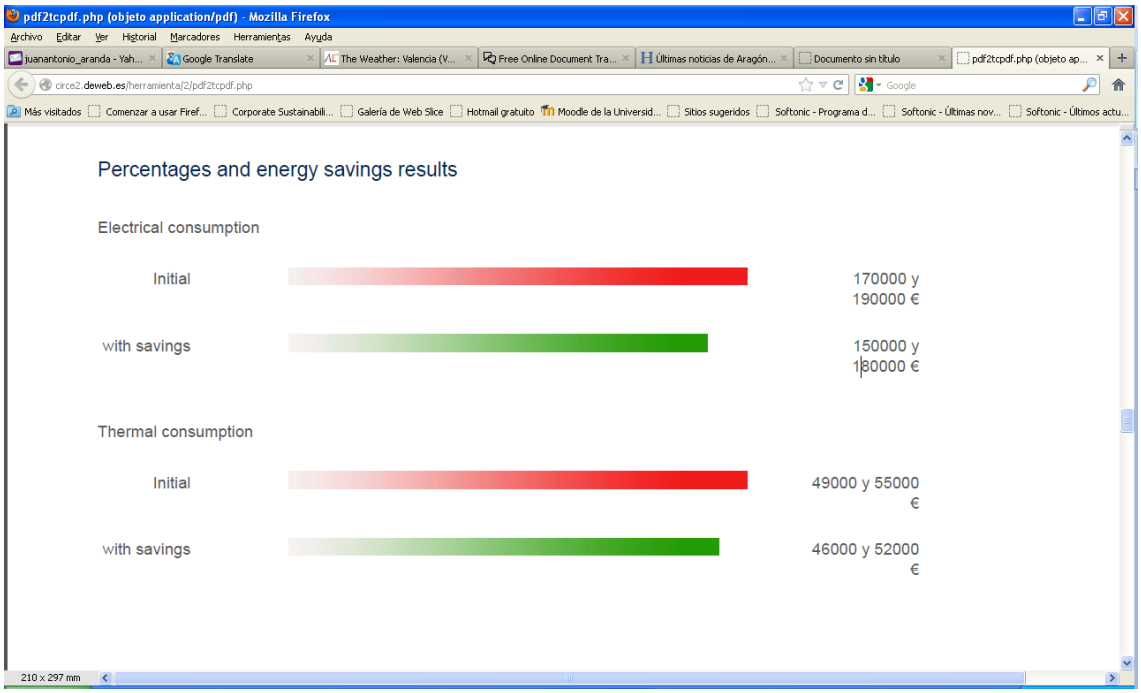
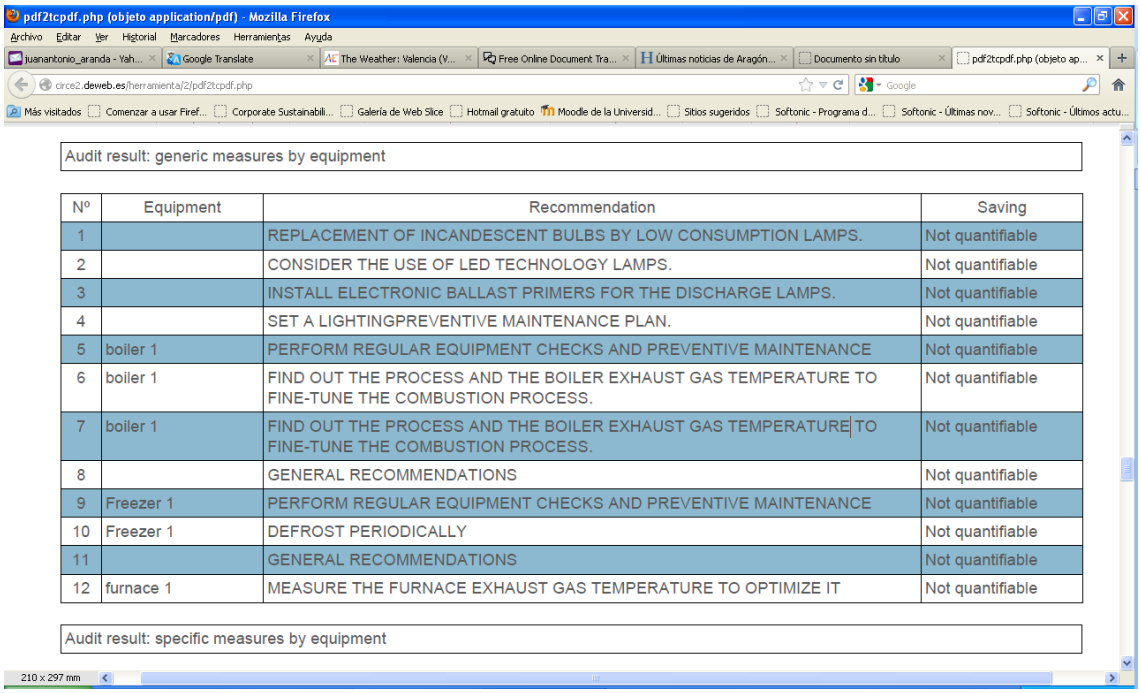


Figure 14: Picture showing the initial and final company consumption estimation

To summarize the actions proposed and the expected estimated impact a final summary table is provided, first showing generic qualitative measures and the associated equipment, and then, showing the quantitative measures and the amount and range of savings by type of energy as shown below.

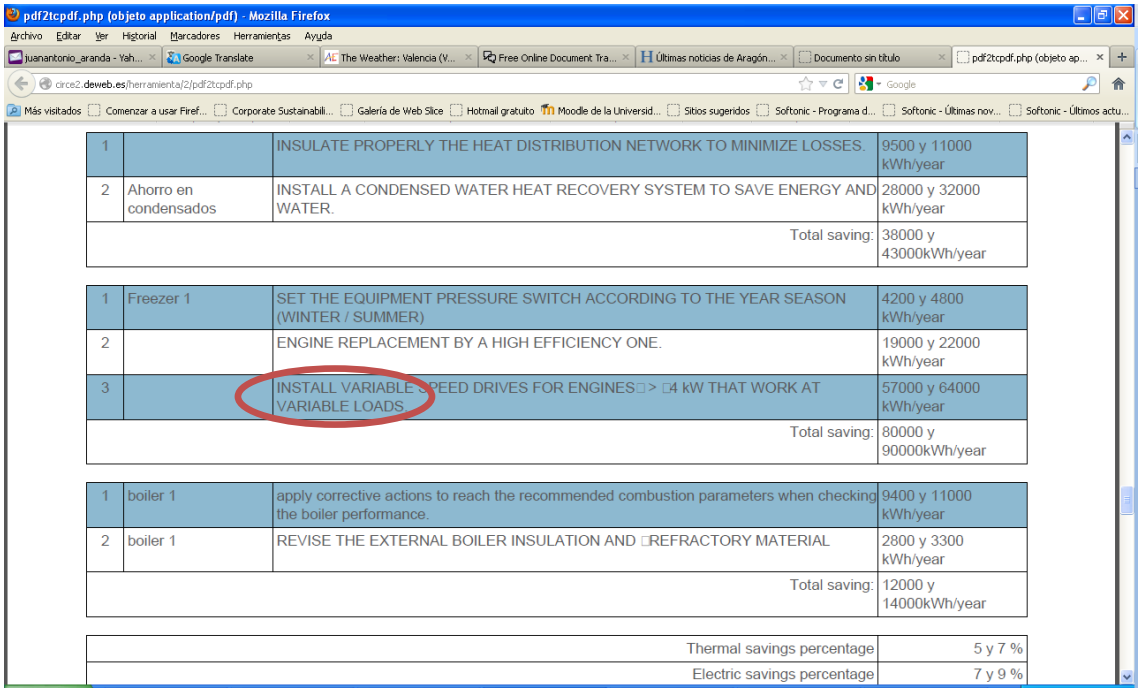


Audit result: generic measures by equipment

Nº	Equipment	Recommendation	Saving
1		REPLACEMENT OF INCANDESCENT BULBS BY LOW CONSUMPTION LAMPS.	Not quantifiable
2		CONSIDER THE USE OF LED TECHNOLOGY LAMPS.	Not quantifiable
3		INSTALL ELECTRONIC BALLAST PRIMERS FOR THE DISCHARGE LAMPS.	Not quantifiable
4		SET A LIGHTINGPREVENTIVE MAINTENANCE PLAN.	Not quantifiable
5	boiler 1	PERFORM REGULAR EQUIPMENT CHECKS AND PREVENTIVE MAINTENANCE	Not quantifiable
6	boiler 1	FIND OUT THE PROCESS AND THE BOILER EXHAUST GAS TEMPERATURE TO FINE-TUNE THE COMBUSTION PROCESS.	Not quantifiable
7	boiler 1	FIND OUT THE PROCESS AND THE BOILER EXHAUST GAS TEMPERATURE TO FINE-TUNE THE COMBUSTION PROCESS.	Not quantifiable
8		GENERAL RECOMMENDATIONS	Not quantifiable
9	Freezer 1	PERFORM REGULAR EQUIPMENT CHECKS AND PREVENTIVE MAINTENANCE	Not quantifiable
10	Freezer 1	DEFROST PERIODICALLY	Not quantifiable
11		GENERAL RECOMMENDATIONS	Not quantifiable
12	furnace 1	MEASURE THE FURNACE EXHAUST GAS TEMPERATURE TO OPTIMIZE IT	Not quantifiable

Audit result: specific measures by equipment

Figure 15: Summary table with the generic recommendations and the associated equipment



1		INSULATE PROPERLY THE HEAT DISTRIBUTION NETWORK TO MINIMIZE LOSSES.	9500 y 11000 kWh/year
2	Ahorro en condensados	INSTALL A CONDENSED WATER HEAT RECOVERY SYSTEM TO SAVE ENERGY AND WATER.	28000 y 32000 kWh/year
		Total saving:	38000 y 43000kWh/year

1	Freezer 1	SET THE EQUIPMENT PRESSURE SWITCH ACCORDING TO THE YEAR SEASON (WINTER / SUMMER)	4200 y 4800 kWh/year
2		ENGINE REPLACEMENT BY A HIGH EFFICIENCY ONE.	19000 y 22000 kWh/year
3		INSTALL VARIABLE SPEED DRIVES FOR ENGINES□> □4 kW THAT WORK AT VARIABLE LOADS	57000 y 64000 kWh/year
		Total saving:	80000 y 90000kWh/year

1	boiler 1	apply corrective actions to reach the recommended combustion parameters when checking the boiler performance.	9400 y 11000 kWh/year
2	boiler 1	REVISE THE EXTERNAL BOILER INSULATION AND □REFRACTORY MATERIAL	2800 y 3300 kWh/year
		Total saving:	12000 y 14000kWh/year

Thermal savings percentage	5 y 7 %
Electric savings percentage	7 y 9 %

Figure 16: Summary table with the quantitative recommendations and the associated equipment, as well as the savings estimation.

Finally, there is a table with the percentage of savings by type of energy that would result from the implementation of the proposed measures. In the example these values are the following:

- Thermal savings percentage 5 y 7 %
- Electric savings percentage 7 y 9 %

Please bear in mind that

- This is an estimation range varying from a top number and a bottom number these are based on the implementation of all recommended measures and always compared to the best available technology. Hence, these are maximum ranges of expected savings.
- The total savings will depend on the actual consumption.

In case you want to save the final report document, print it, etc ... you can have it in PDF format, by clicking on "View document in PDF format" at the top of the final energy assessment report.

5. ABB PumpSave

5.1. Tool description

Available in: http://www.abb.com/product/seitp322/5fcd62536739a42bc12574b70043c53a.aspx

To access to this tool is necessary to download before the software from company webpage indicate above. Once software has been downloaded you can use it. It is important to indicate that this tool is developed in excel file so it is not necessary to install any software, only download and open excel file. To do an assessment is not necessary to complete different stages due to all information is in main screen shows in Figure 17 .

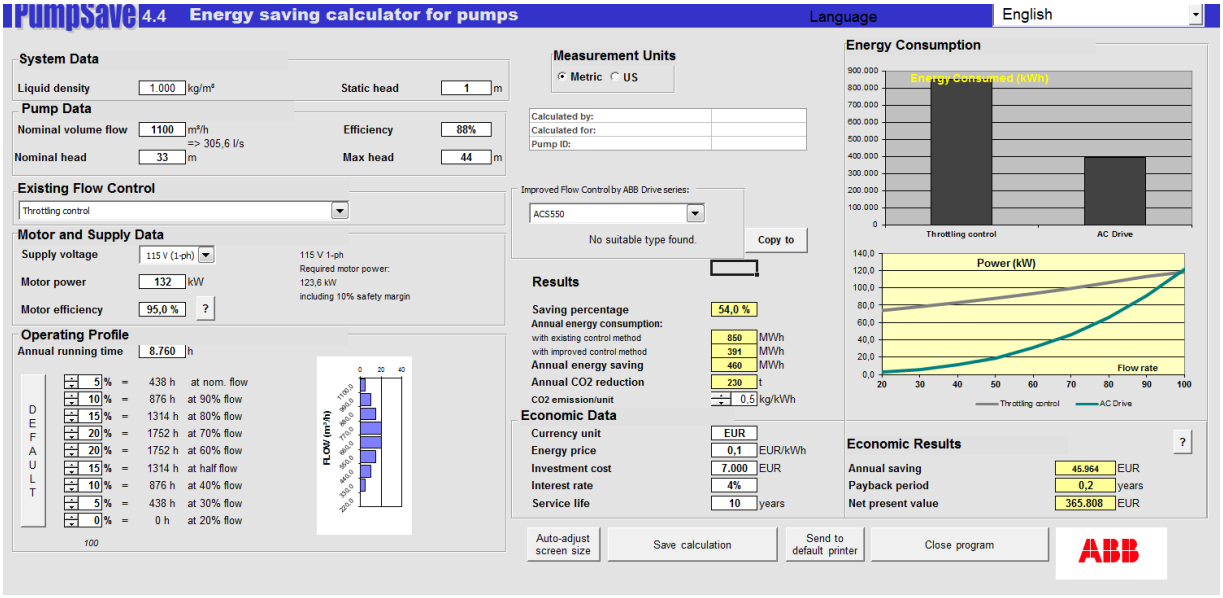


Figure 17: ABB Pump Save tool, main screen.

Language can be chosen by clicked in window located in the top right area of the screen.

To do a completed assessment is necessary to follow the following steeps:

System data: it is requested information about liquid density (kg/m^3) and static head (m).

Pump data: it is requested information about pump, like efficiency (%), pump max head (m), nominal head (m) and pumping flow (m^3/h).

Existing flow control: it is requested information about what flow control is installed. It is possible to select: "throttling control", "on / off" and "hydraulic control".

Motor and supply data: In this area information about electric engine must be completed, like supply voltage, power and performance.

Operating profile: It is requested information about how many yearly operation hours the engine has and what is the profile charge.

5.2. ABB PumpSave report

As a result tool offers several results as are show in Figure 18.

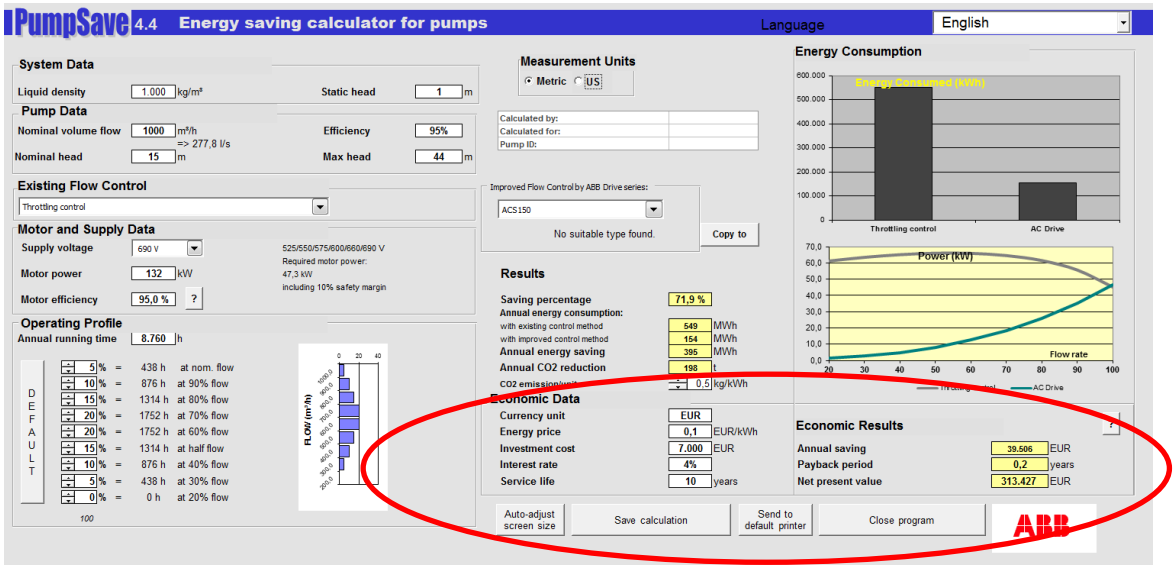


Figure 18: ABB PumpSave economy results

Main offered results are saving percentage, annual energy saving and annual CO_2 reduction. Moreover economy results like payback time or net present value are also calculated.

To give additional information some graphs are shown in which energy consumption in current and efficiency energy situation is offered and comparison between flow rate and power demand by speed driver and by current regulation control are given.

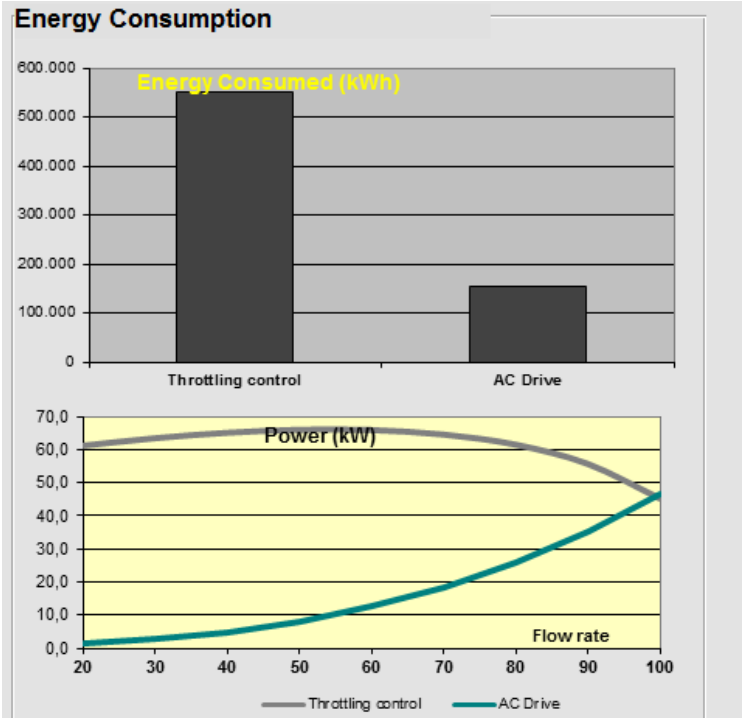


Figure 19: ABB PumpSave energy graphs

To finish is necessary to mention that by click in "save calculation" button is possible to save the assessment process and by click in "send to default printer" is possible to print it.

6. Eco8

6.1. Tool description

Available in: http://www.schneider-electric.com/products/ww/en/5100-software/5110-electrical-design-software/2235-eco-8/

To access to this tool is necessary to download before the software from company webpage indicate above. Once software has been installed in your computer is possible to use it as is described below. In main screen shows in Figure 20 are 5 steeps to complete the assessment process. These processes are:

Project information: it is requested general information about project name, company name; responsible to do the assessment, etc… these fields are not mandatory to be completed. However is recommended to do it, due to tool allows saving files in your computer and this information can be useful to identify a calculation process saved in your computer.

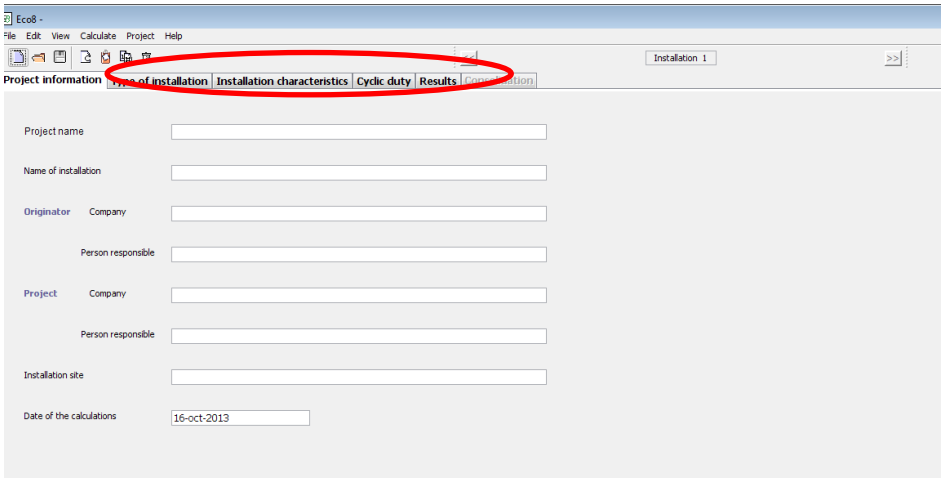


Figure 20: Eco8 main screen, project information definition

Type of installation: it is necessary to indicate if installation is for industrial or for building applications; moreover the use of engine must be indicated choosing pump or fan processes. In this stage if there is any control system of process like bypass in pumping or dumper in fans must be clicked.

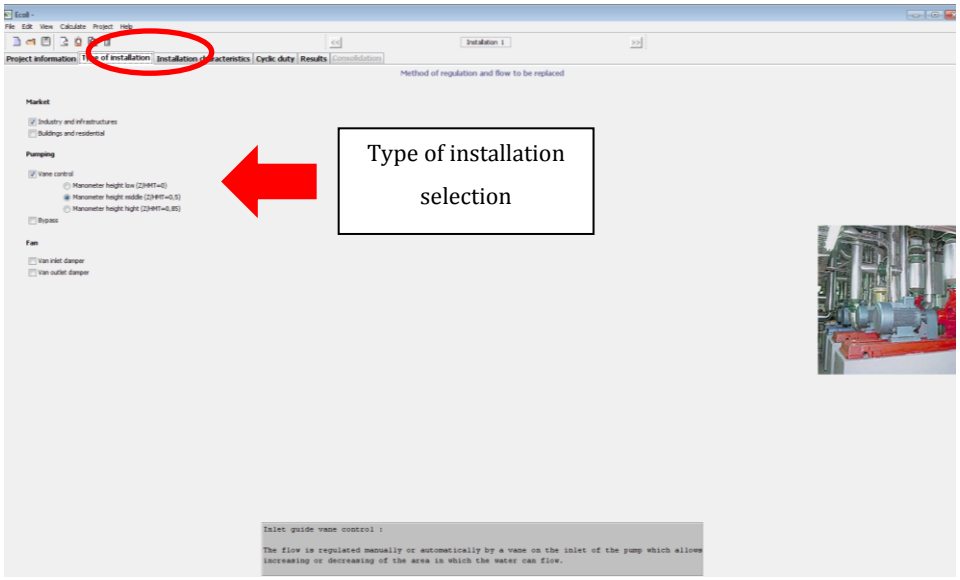


Figure 21: Eco8 type of installation screen

Installation characteristics: power of electrical engine must be indicated, with this information tool establishes a predetermined values of current, cos phi and engine performance, however this values can be modified. Moreover is possible to indicate IP protection grade of device from IP2* to IP5*. With this information software offers the model of speed driver to be installed in this application. At the end is possible to indicate the price of

equipment that must be obtained from key actors and the price of electricity. This information will be used to calculate economy payback time.

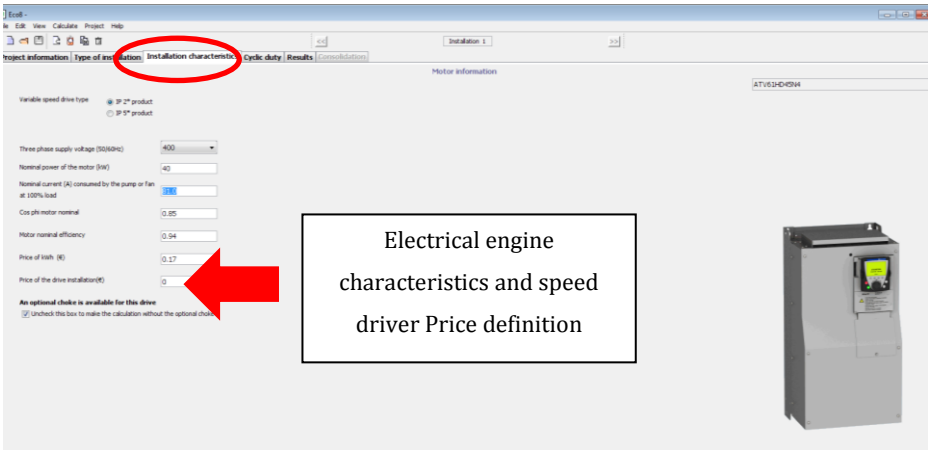


Figure 22: Eco8 installation characteristics screen

Cyclic duty: this screen offers possibility to indicate what is the operating profile charge of the engine, indicating how many hours is working the engine at different power and how many hours or days per year operates this process. It is recommended to complete it with information obtained from grid analyzer in measuring process.

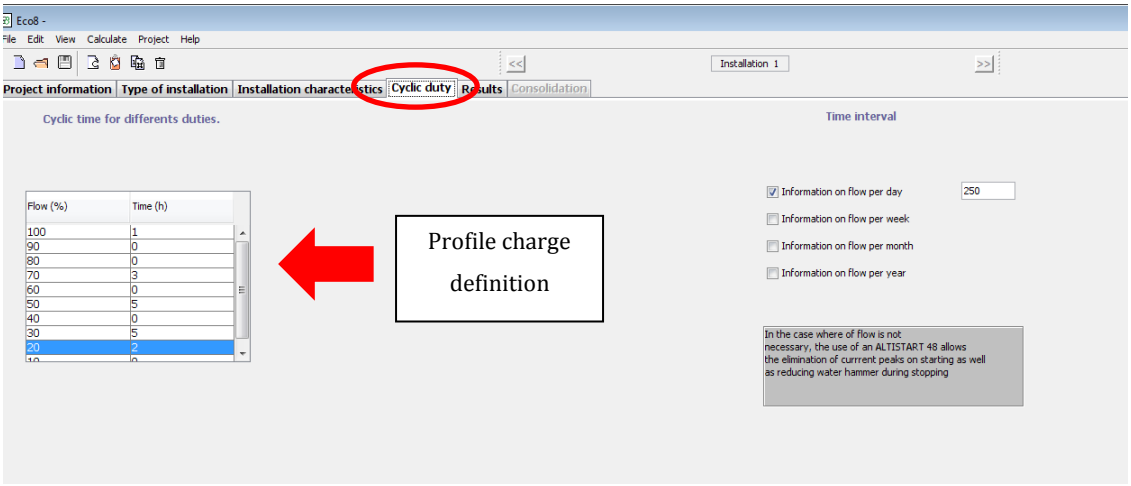


Figure 23: Eco8 profile charge definition screen

6.2. Eco8 report

Results: It is lastest window of software. It offers information about how much active and reactive energy can be yearly saved, what is yearly economy savings and what is the economy payback time of the investment measured in month.

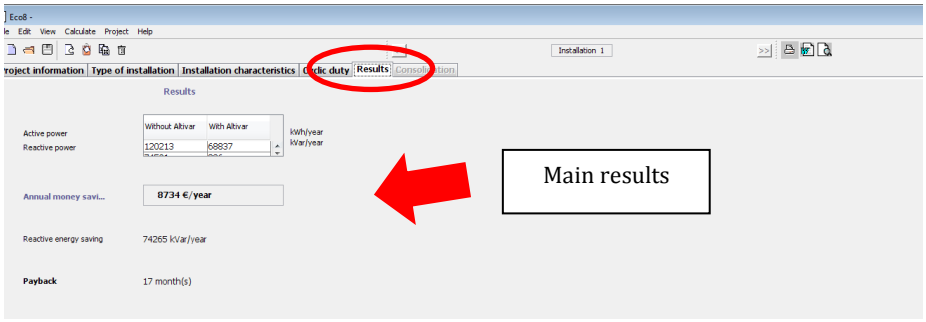


Figure 24: Eco 8 result screen

In case you want to save the final report document, print it, etc ... you can have it in PDF format, by clicking on "File" menu and after that in "Save as" or in "Configure printer" options.

7. PEP

7.1. Tool description

Available in: https://ecenter.ee.doe.gov/em/tools/Pages/Downloads.aspx

To access to this tool is necessary to download before the software from U.S department of energy webpage indicate above. Once software has been installed in your computer is possible to use it as is described below. In main screen shows in Figure 25 are 8 steeps to complete the assessment process. These processes are:

Steep 1 – Case information: In this screen general information about cooperative may be indicated, like: name, type of industry and contact name. There are other not mandatory fields like region or country that have not to be completed, moreover due to is a tool develop in US European regions are not available.

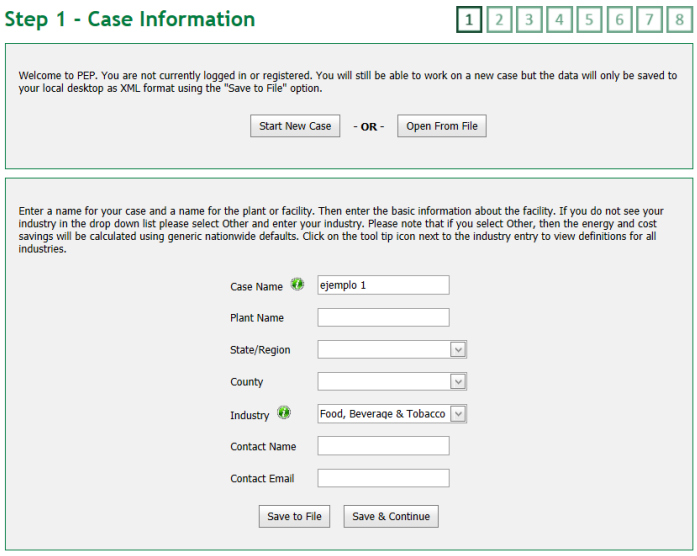


Figure 25: PEP software main screen

After that by clicking in save and continue button is possible to pass to the next screen.

Steep 2 – Energy use systems: In this screen what systems are installed in the cooperative may be indicated by click as it is shown below:

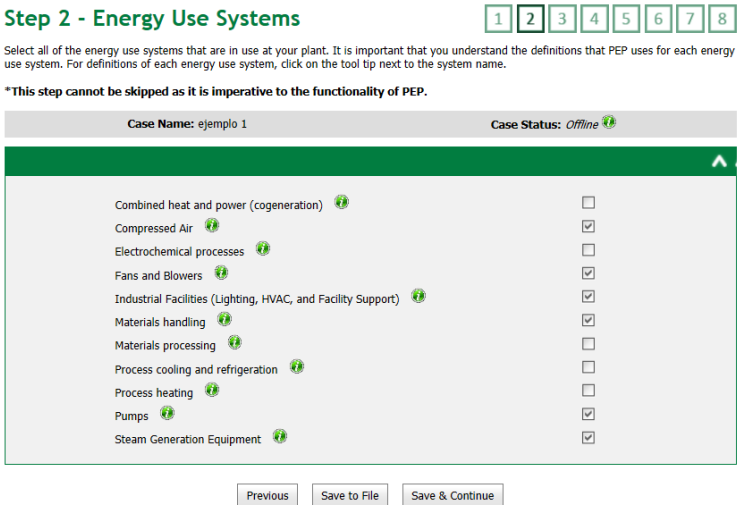


Figure 26: PEP software energy use systems definition

After that by clicking in save and continue button is possible to go to the next screen.

Steep 3 – Energy use systems scorecards: In this screen there are four questionnaires to know what in the energy management. These questionnaires are: general energy management questions, compressed air scorecard, pumps scorecard and steam generation equipment scorecard. In each of these several questions about energy management plan, operation condition and maintenance about equipment are requested.

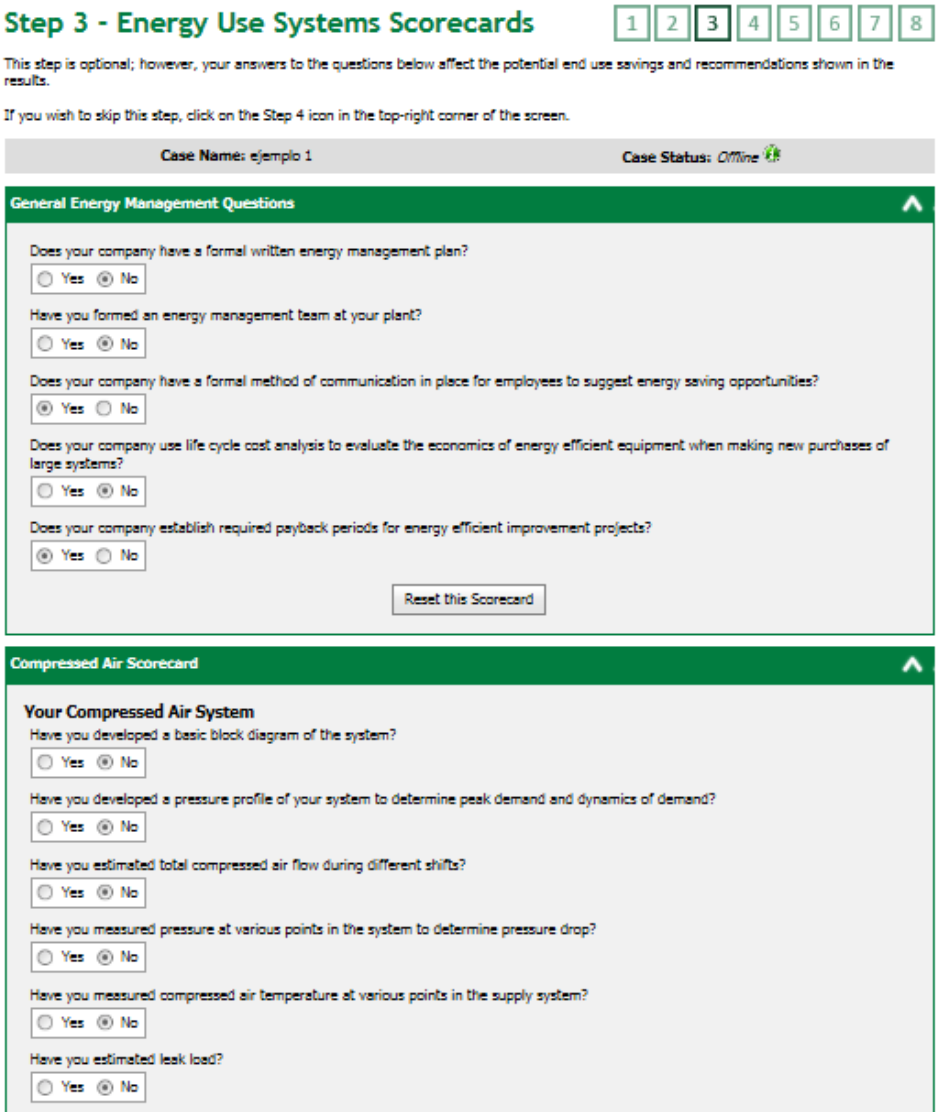


Figure 27: PEP software steep 3 screen

After that by clicking in save and continue button is possible to pass to the next screen.

Steep 4 – Production information: Complete this information is optional. The purpose is to evaluate energy intensity and energy savings on per unit of production basis. By click in link "Add new production stream" is possible to add new products.

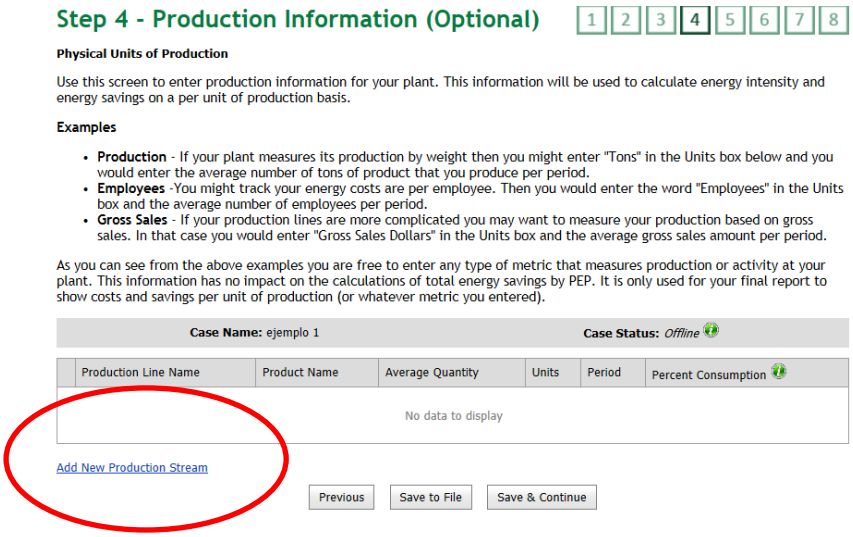


Figure 28: PEP steep 4 screen

In the following figure is possible to see one example of product introduce in tool.

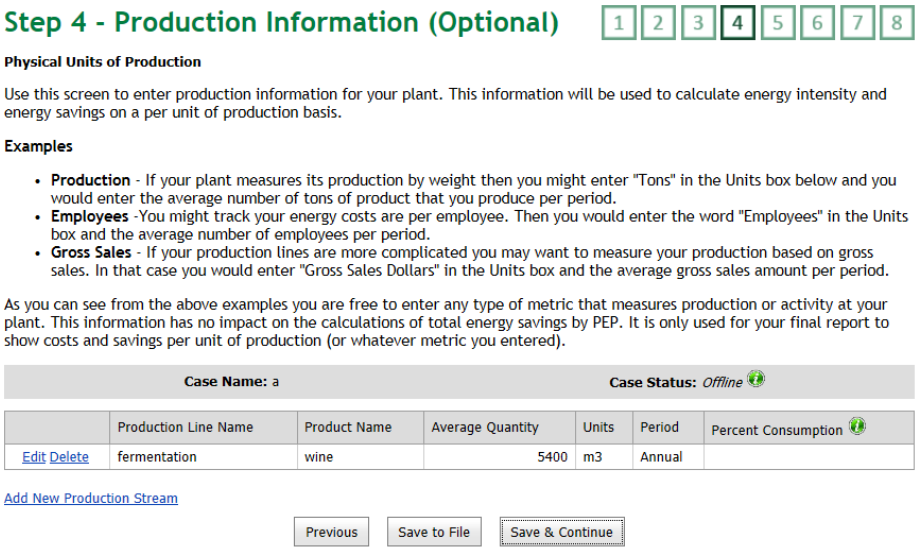


Figure 29: PEP production information

After that by clicking in save and continue button is possible to pass to the next screen.

Steep 5 – Supplied energy: Complete this information is optional. The purpose is to evaluate energy consumption and cost of cooperative, by click in "add new energy stream" link is possible to add different energy suppliers with their own information like quantity of energy (kWh), cost and type of energy.

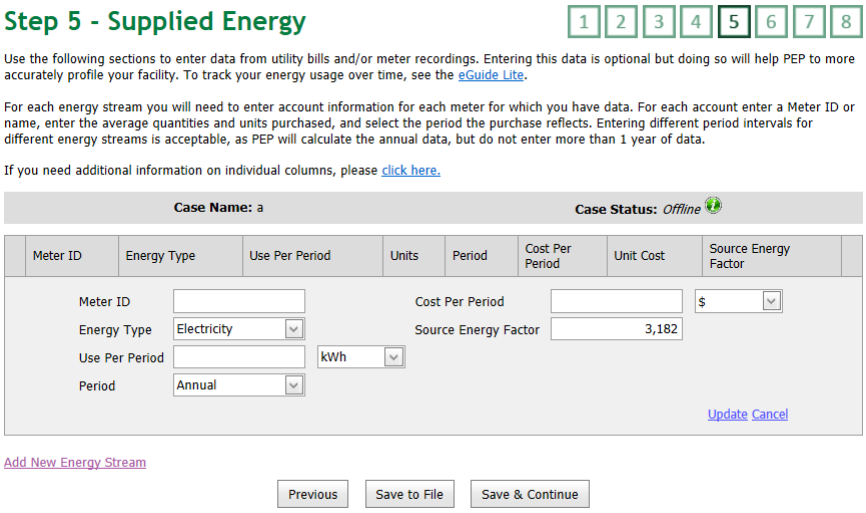


Figure 30: PEP supplied energy information

After that by clicking in save and continue button is possible to pass to the next screen.

Steep 6 – Supplied energy: This screen allows defining the percentage of total annual source energy that each major system in cooperative consumes by click in the gap available for each devices.

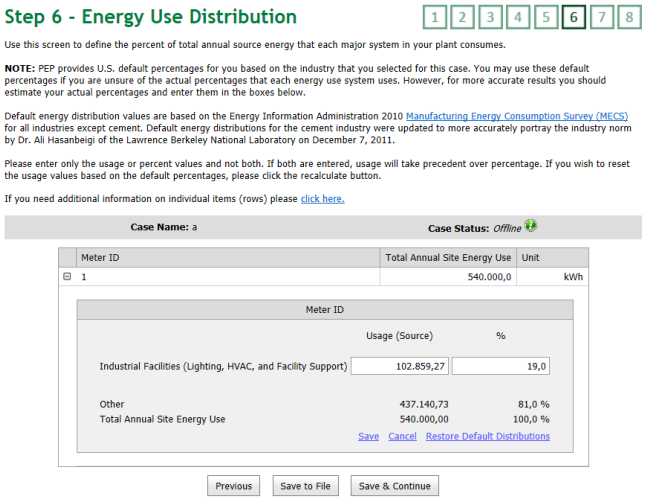


Figure 31: PEP energy used distribution

After that by clicking in save and continue button is possible to pass to the next screen.

Steep 7 – Energy saving opportunities: This screen allows indicating for each device what is the possibility to develop improvement measures selecting: "high", "medium" or "low".

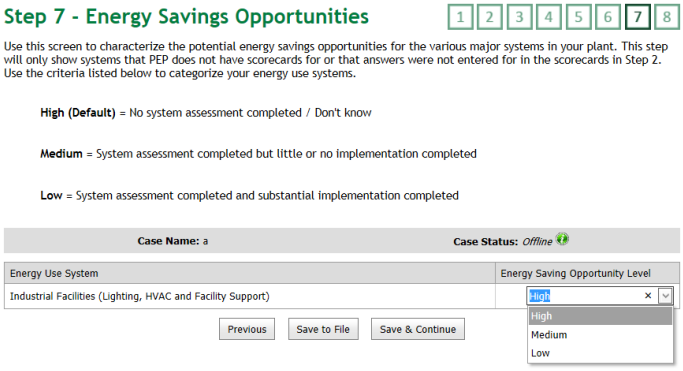


Figure 32: PEP energy saving opportunities screen

After that by clicking in save and continue button is possible to pass to the next screen.

7.2. PEP report

As a result of assessment process PEP offers a report in last steep (8) with information about annual energy consume and cost and potential energy saving. In following figure is shown an example of diagrams that are shown as report.

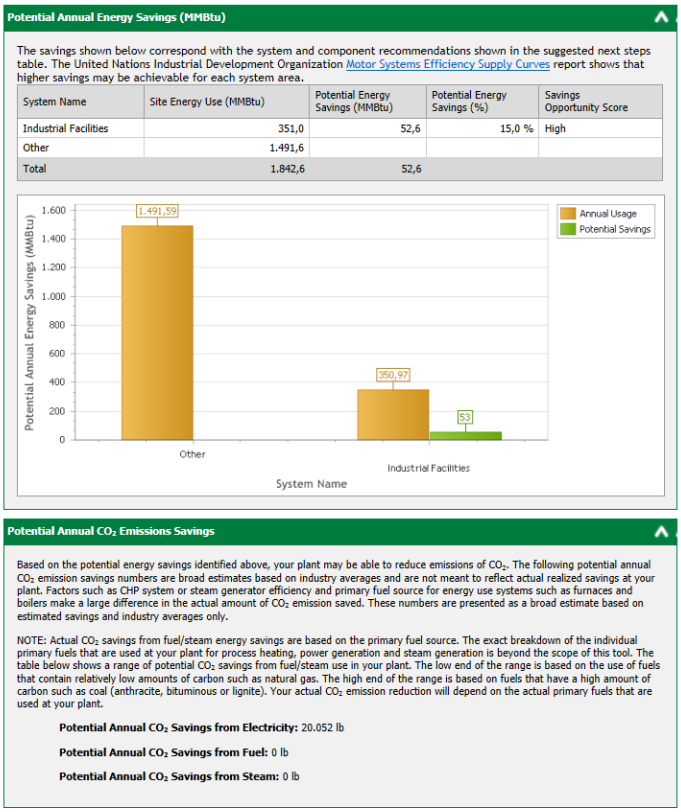


Figure 33: PEP potential annual energy savings screen

After that by clicking in the top right button "print" is possible to print the report.

8. AISLAM

8.1. Tool description

Available in:

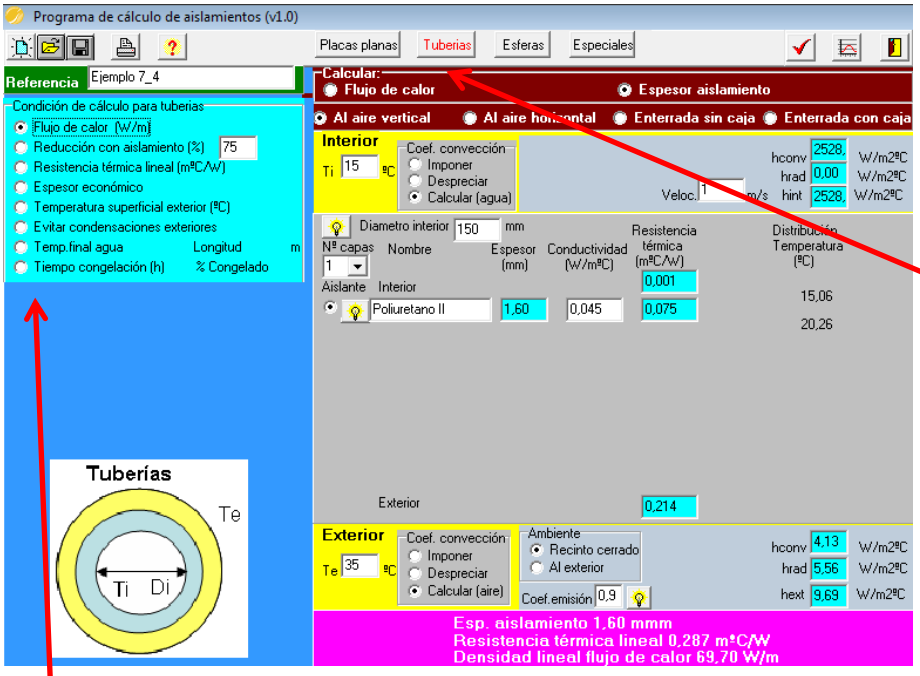
http://www.idae.es/index.php/relcategoria.1030/id.430/relmenu.347/mod.pags/mem.detalle

To access to this tool is necessary to download before the software from Saving and Diversify Spanish National Institute which webpage is indicated above. Once software has been installed in your computer is possible to use it as is described below. First of all is important to remark that software is in Spanish language, however due to the most quantity of information is about temperatures, energy flows and so on, with the following description is easy to use it. Moreover Software is going to be explained for two main applications:

- Evaluate how much energy we can save isolating a pipe.
- Evaluate how much energy we can save improving isolating in cooling chambers.

Evaluate how much energy we can save isolating a pipe.

Firstly is going to be explained the first case *"how much energy can be saved by means of isolate a pipe"*



Selection of type of calculation we are going to do: flat plate heat exchanger (placa plana), pipe (tuberias), sphere (esfera), special applications (especiales)

Figure 34: Aislam software main screen. Menu description.

Calculating conditions selection, most used will be thermal flow (flujo de calor) and reduction by means of isolate (reducción con aislamiento %).

Secondly is neccesary to select what type of calculation we want to use, in this case (evaluate energy savings in pipes) is neccesary to select "tuberias". Moreover calculating conditions can be choosen, the most important options are *"flujo de calor W/m2"* in which is evaluated what is the thermal losses measure in W/m^2 and *"reducción con aislamiento %"* in which you indicate what is the percentage of energy consumption you want to have respect the case of have pipe without isolating.

In this first example is shown the case of calculate using heat flow conditions.

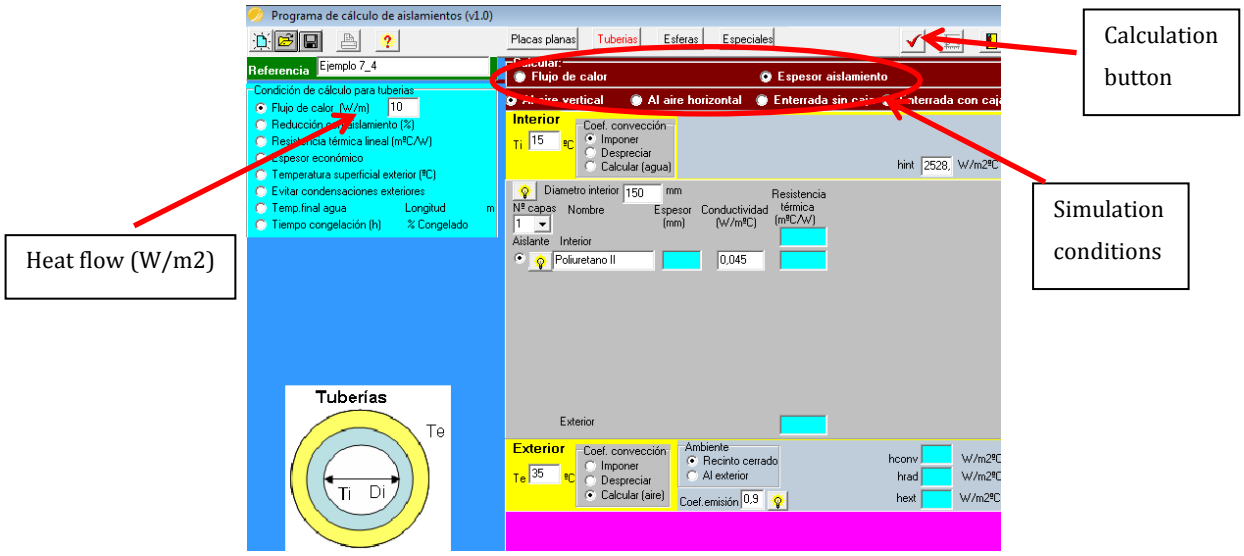


Figure 35: Aislam screen. Pipe calculation

In this case you indicate what the maximum energy flow you want to have in pipe is. In the right part of the menu is shown the simulation conditions, in the top is possible to select "*flujo de calor*" that menas heat flow or "*espesor de aislamiento*" that means isolating thickness. Choosing the second one will be calculated what the isolating thickness neccesary to have the energy flow previously indicated is. In the example conditions are: exterior temperature → 35ºC, interior temperature → 15ºC, pipe diameter → 150 mm, isolating polyurethane with thermal conductivity → 0,045 W/mºC. With this information by clicking in calculation button results are shown.

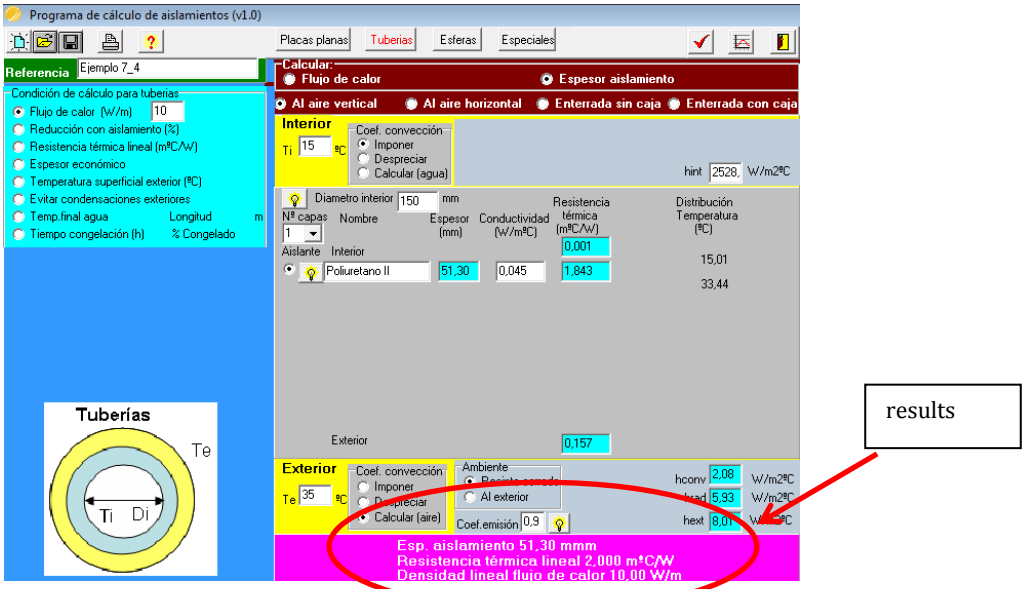


Figure 36. Aislam results screen in case: evaluate isolation thickness in piping by means of indicate what the maximum allowable thermal flow is.

As a result is shown that isolation thickness is 51,3 mm. Moreover if we want to know what will be final temperature of water in one pipe as a determinated length is possible to do it by selecting "*thermal flow*" in the top menu and as a result following screen is shown in which is indicated the thickness previously selected and also length pipe in meters can be indicated in screen left size.

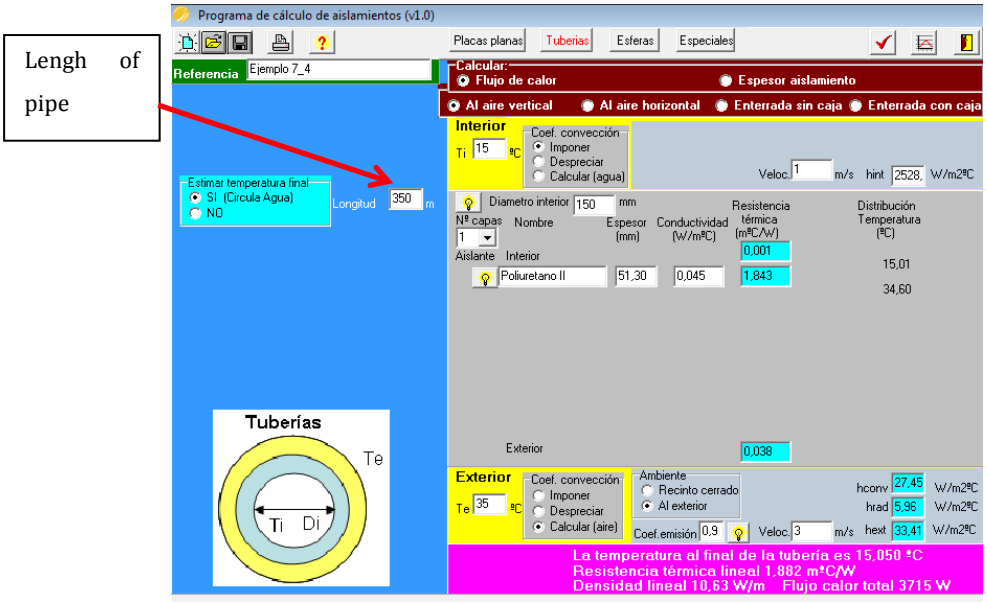


Figure 37: Aislam results screen in case: evaluate isolation thickness in piping showing final pipe temperature.

By clicking again in calculation button results are shown, and in example case final pipe temperature is 15,047ºC (considering a lengh of 350 m and pipe location in exterior).

If we want to calculate how many energy we can save is possible to do it by selecting "*reducción con aislamiento*" in left menu.

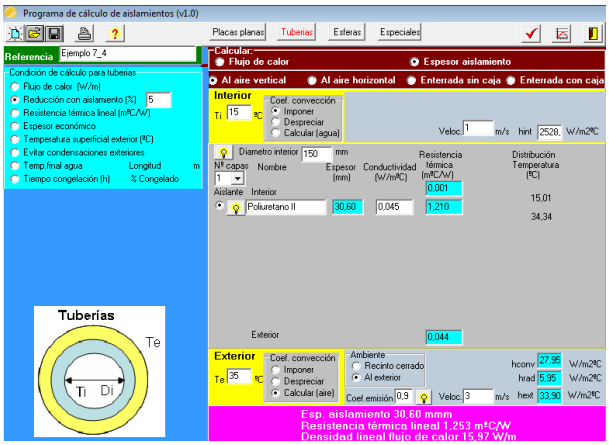


Figure 38: Aislam results screen in case: evaluate isolation thickness in piping by means of indicate what the energy consumption respect don´t use isolating is.

In example is indicated 5 %, that means we want that energy consumption will be only a 5 % respect don´t use isolating. With these conditions and choosing polyurethane like isolating software indicates that thickness should be unless 30,6 mm.

<u>Evaluate how much energy we can save improving isolating in cooling chambers.</u>

Once how to evaluate energy savings in pipes has been done, second case that can be studied in TESLA is going to be shown, this process is evaluate improvement in cooling chambers by means of type of isolation changing (thickness and / or material).

First of all case of "*placas planas*" must be clicked.

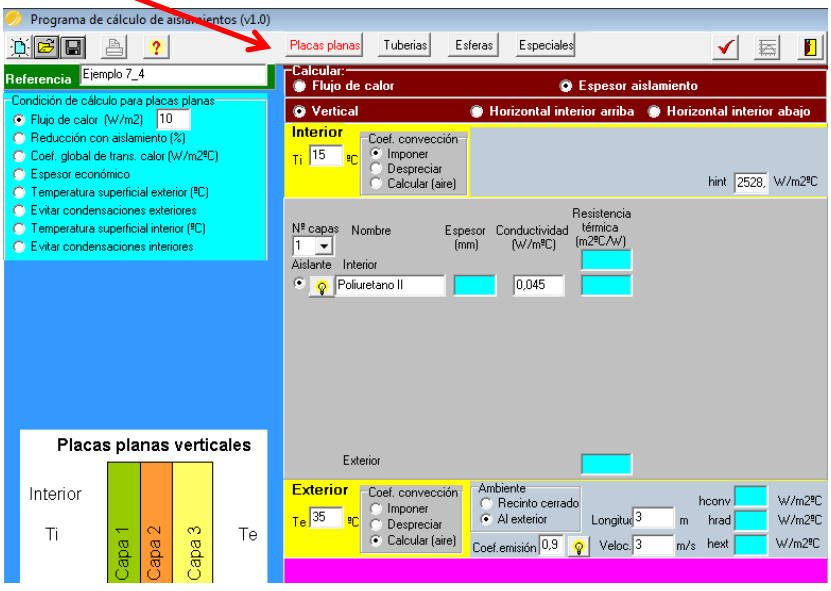


Figure 39: Screen to evaluate savings in cooling chamber walls

In this case only will be shown the case of "*heat flow*" due to there has not sense calculate a cooling chamber without isolating. So it is neccesary to put the maximum value of heat lost we want to have. In example is considered 10 W/m^2. Afterthat both interior like exterior temperature should be indicated, in this case used values are 15ºC and 35ºC respectively. To finish what is the type of isolating you want to use also is neccesary to be indicated.

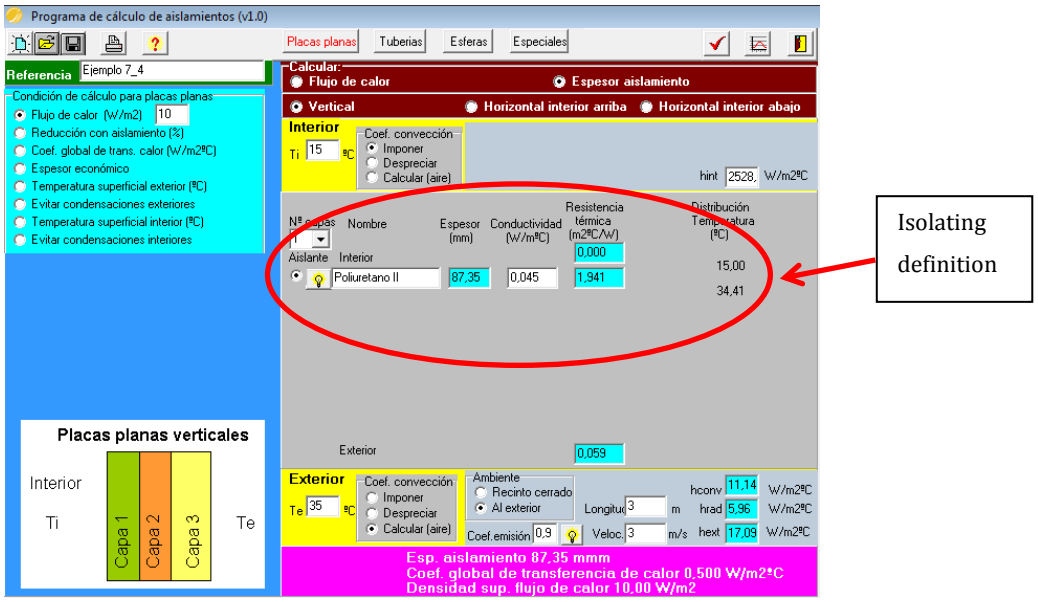


Figure 40: isolating and calculating definition

With these information and by clicking in calculation button software shows results, in example case program indicates a isolating thickness of 87,35 mm. In this same case if we want to reduce heat flow to the middle it should be neccesary 177,35 mm.

SUMMARY

	PINE	ABB PumpSave	Eco8	PEP	AISLAM
Wine cooperatives	Apply to estimate what is the current situation of the cooperative and to inventory types of energy and main installed components	It can be useful to evaluate energy savings in pumping processes mainly to move wine for one tank to another one.	It will allow to estimate how much energy can be saved installing frequency drivers in reception phase	Apply to estimate what is the current situation of the cooperative and what is the energy savings potential	Very useful to calculate thermal losses in cooling fermentation from cooling machine to fermentation tanks
Olive Oil cooperatives	Apply to estimate what is the current situation of the cooperative and to inventory types of energy and main installed components	Not apply	It can be useful to calculate potential savings in electrical engines installed mainly in centrifugation and grinding processes	Apply to estimate what is the current situation of the cooperative and what is the energy savings potential	Not apply
Animal food production	Apply to estimate what is the current situation of the cooperative and to inventory types of energy and main installed components	Not apply	It can be useful to calculate potential savings in electrical engines installed mainly in grids or pellet machines	Apply to estimate what is the current situation of the cooperative and what is the energy savings potential	Very useful to evaluate how much heat are lost from the steam boiler to final application
Fruit and vegetable cooperatives	Apply to estimate what is the current situation of the cooperative and to inventory types of energy and main installed components	Not apply	It is useful to calculate energy savings in conveyor belts during transport process	Apply to estimate what is the current situation of the cooperative and what is the energy savings potential	Useful to calculate the improvement that can be reach by means of increase thickness or change wall materials in cooling chambers

INDEX