PURPOSE

- KALKENER CALCULATES THE MAIN COMPONENTS OF CENTRALIZED SOLAR THERMAL SYSTEMS (THE MOST PROFITABLE CONFIGURATION) IN ORDER TO SUPPLY HOT WATER ACCORDING TO THE NEED OF ITS USERS.

- ONCE SUCH COMPONENTS ARE KNOWN, YOU WILL BE ABLE TO REQUEST OFFERS FROM DIFFERENT COMPANIES SO ALL OF THEM CAN MAKE A BID FOR THE SAME INSTALLATION.

- WHEN THE IMPLEMENTATION COST IS KNOWN, KALKENER ALLOWS YOU TO KNOW THE KEY PROFITABILITY INDICATORS (IRR, NPV) TO MAKE THE DECISION ON WHETHER OR NOT TO MAKE THE INVESTMENT.
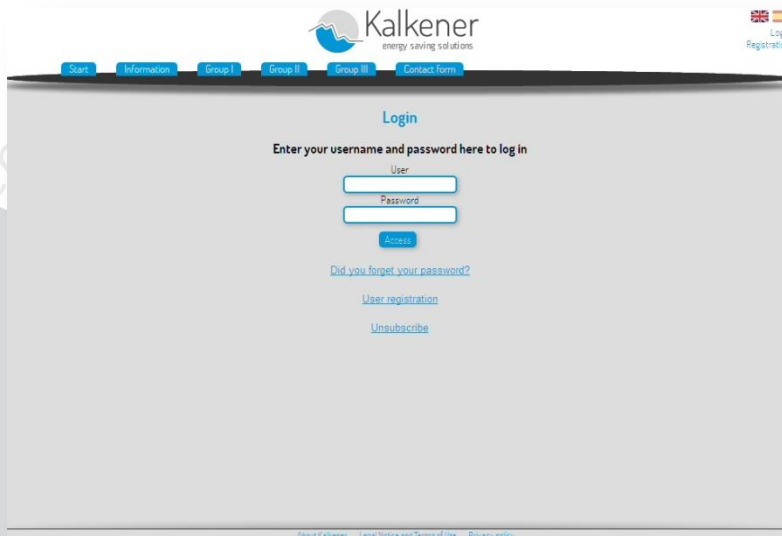
INFORMATION NEEDED

- **LATITUDE** OF THE LOCATION

- QUANTITY OF **HOT WATER** NEEDED AND ITS **TYPE OF USE**

- GEOMETRICAL FEATURES AND LOCATION OF **THE SURROUNDING OBJECTS (SOLAR SITE SURVEY)**

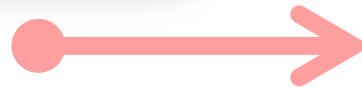- **ORIENTATION AND TILT OF THE ROOF** WHERE THE SOLAR COLLECTORS WILL BE PLACED
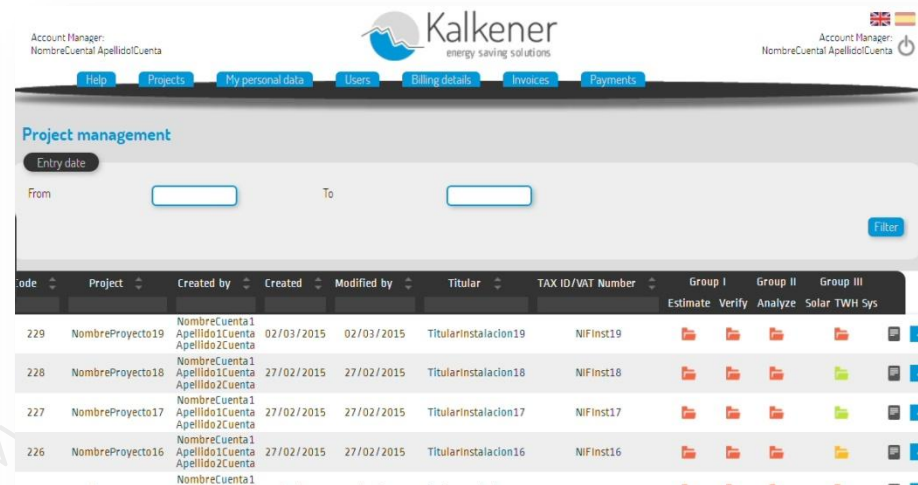
KALKENER WILL HELP YOU THROUGH **TUTORIALS**, THE **ONLINE HELP SYSTEM AND MAIL**

STEP 1 – ACCESS TO KALKENER

Log in to
Kalkener.com

ACCESS TO DASHBOARD

Kalkener
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Account Manager:
Billy San Martin

Account Manager:
Billy San Martin

Project management

Entry date

From   To

Filter

Code	Project	Created by	Created	Modified by	Titular	TAX ID/VAT Number	Group I		Group II	Group III
							Estimate	Verify	Analyze	Solar TWH Sys

There isn't any project yet

Create new Project

Description of colors

🟥 All the services have been purchased or It is not possible to access in English version because the calculation module has been designed just according to Spanish regulations.
🟧 Service/s remain to be purchased
🟩 No service has been purchased yet

2.1. CREATE NEW PROJECT

ENTERING DATA

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Account Manager:
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Services Group III.A   Solar Thermal Water Heating Systems

Project 228   NombreProyecto18

| Information | Surrounding conditions | Purchase services |

PLEASE, CLICK HERE TO DOWNLOAD THE TUTORIAL RELATED TO THIS MODULE CALCULATION

PLEASE, CLICK HERE TO ACCESS TO THE TUTORIAL TO CREATE THE SHADING CONTOUR OF THE OBSTACLES ON THE SOLAR CHART

Herein you will ... [implementation],
expenditures ... aisal: NPV and IRR,
both of them ...

Kalkener will f ... s well but, in any
case, you will ...

Thus, the aim ... hician through an
implementation ... e implementation
project.

In order to size ...

- The geo...
- The Mon...
- The tem...
- The aver...
- Roof featu...
- Type of colle...
- The profile of the obstacles that can cast shadows on the solar collectors.
- The average hot water consumption at 60 ºC per end-user and day
- The months scheduled for the STWH operation within one year
- The hot water consumption profiles classified by Month, week and day

EACH CALCULATING MODULE IS MADE OF **TABS**, WICH MUST BE FILLED IN **FROM LEFT TO RIGHT**

AT THE BEGINING OF THE TAB AN INFORMATIVE TEXT EXPLAINS THE DATA THAT WILL HAVE TO BE ENTERED. BESIDES, THESE TABS CAN INCLUDE DROP-DOWN BOXES AND BUTTONS TO CALCULATE RESULTS / SAVE DATA.

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SURROUNDING CONDITIONS

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Services Group III.A — Solar Thermal Water Heating Systems

Project 228 - NombreProyecto18

Information | **Surrounding conditions** | Purchase services

▸ Location

▸ Roof features

▸ Surrounding obstacles definition

▸ Hot water required according to types of end-users

▸ Features of the water heating system before the STWH implementation

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Project 228 - NombreProyecto18

Information | Surrounding conditions | Purchase services

▾ Location

STEP 3: LOCATION DATA

Province/State	Height above sea level (m) *	Historical minimum temperature *	Reference city *
VALENCIA	❓	❓	

CALCULAR

Select the type of coordinates — Degrees Minutes Seconds ❓

IN ANY CASE OF DOUBTS, PLEASE REFER TO THE HELP ICONS

Latitude (° ' ") *   00 00 00 N ❓
Longitude (° ' ") *   000 00 00 E ❓

ANNUAL SOLAR RADIATION ON THE HORIZONTAL PLANE ❓		COLD WATER INLET TEMPERATURE		AVERAGE DAYTIME TEMPERATURE	
MES	Hh[Wh/m²day] *	Inlet water Temp. [ºC]	Kalkener's proposal	Daytime Temp. [ºC]	Kalkener's proposal
January					
February					10
March					

STEP 3 – LOCATION

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Project 228 - NombreProyecto18

| Information | Surrounding conditions | Purchase services |

▼ Locatio

http://re.jrc.ec.europa.eu/pvgis/

1. Select the continent in the tab named 'Interactive access to solar resource and photovoltaic potential'
2. Once the continent is choosen click on the location of the roof where the solar collectors will be placed [As far as the cursor moves over the map the geographical coordinates in decimal numbers are displayed on the upper right corner of the screen]
3. At the right, select the option 'Monthly radiation'
4. Enable or disable the following options:

    Radiation Database: Classic PVGIS

    Horizontal Irradiation: Enable

    Irradiation at opt. angle: Disable

    Irradiation at chosen angle: Disable

    Linke turbidity: Disable

    Dif/Global Radiation: Disable

    Optimal inclination angle: Disable

    Monthly ambient temperature data: The 3 checkboxes disabled

    Output Options: Select 'Web Page'

5. Enable 'Calculate'
6. A new window will pop up showing, for each month of the year, the Hh values [Solar radiationon the horizontal plane shown in Wh/m^2 and day]. Please, copy the values shown in that column and paste them here, in the following one.

EXAMPLE OF ASSISTANCE IN ORDER TO OBTAIN IRRADIATION DATA FROM AN INDEPENDENT SOURCE

ANNUAL SOLAR RADIATION ON THE HORIZONTAL PLANE ?		COLD WATER INLET TEMPERATURE		AVERAGE DAYTIME TEMPERATURE	
MES	Hh[Wh/m²day] *	Inlet water Temp. [ºC]	Kalkener's proposal	Daytime Temp. [ºC]	Kalkener's proposal
January					
February					||
March					

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Services Group III.A   Solar Thermal Water Heating Systems

Project 228 – NombreProyecto18

| Information | **Surrounding conditions** | Purchase services |

▸ Location

▸ Roof features

▸ Surrounding obstacles definition

▸ Hot water required according to types of end-users

▸ Features of the water heating system before the STWH implementation

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▾ Roof features

BY FOLLOWING THESE INSTRUCTIONS YOU WILL BE ABLE TO SET T

19 - Identify the surface where the solar collectors will be placed
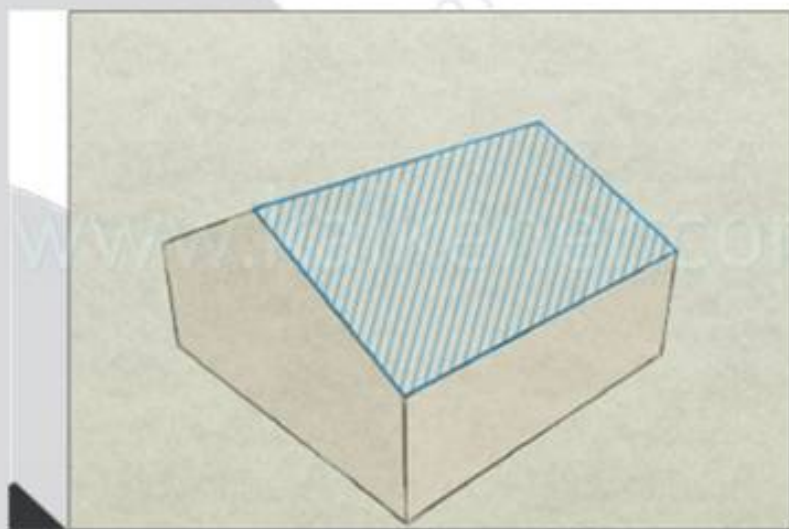
THE USER SETS THE GEOMETRICAL FEATURES OF THE ROOF WHERE THE SOLAR COLLECTORS WILL BE PLACED:

- Deviation from South*: (D)

- Slope: (A) y (B)

- Type of placement for solar collectors on the building

* When the facility is located in the Northern Hemisphere (NH). If it is located in the Southern Hemisphere (SH) the North is taken as reference

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▾ **Roof features**

Horizontal imaginary plane

D = 45°
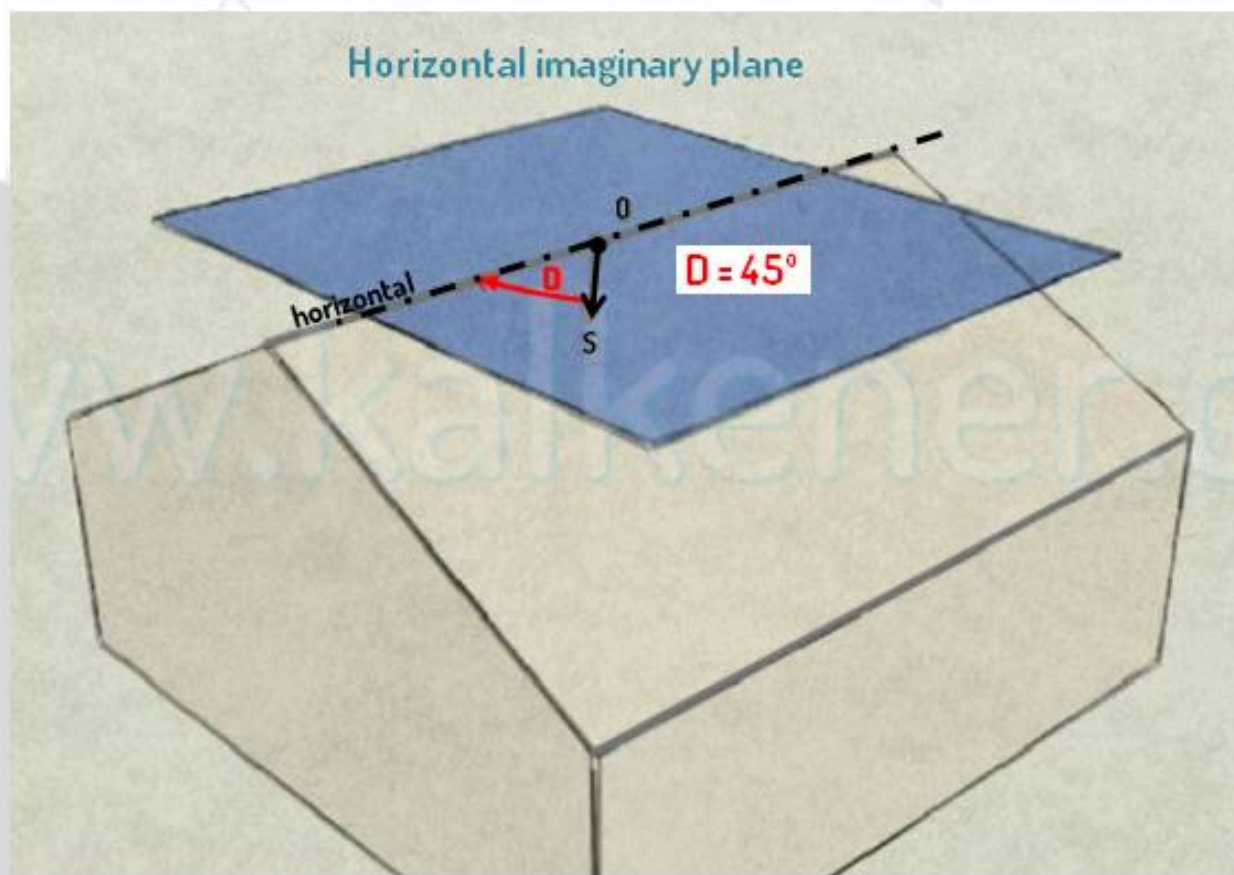
- Deviation from the South* (D):
The angle formed between the South and an horizontal reference line on the sloping roof. Clockwise is adopted as a positive value, viewed downwards.

*In case of location in NH. If it is located in the SH the North must be taken as reference.

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Roof features

A	-10.00
B	-5.00
(B/A) %	50.00 %

The slope of the roof, that is perpendicular to the selected horizontal reference line, is set through A and B values
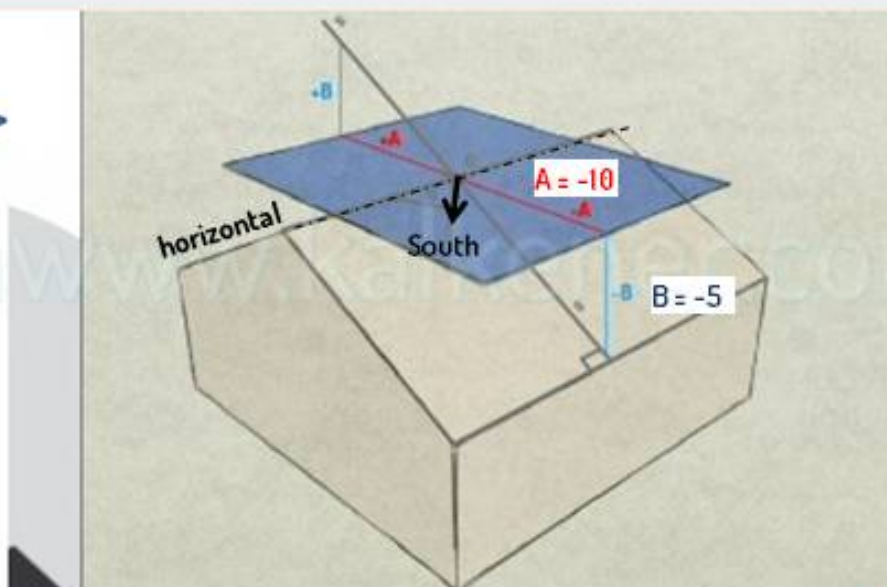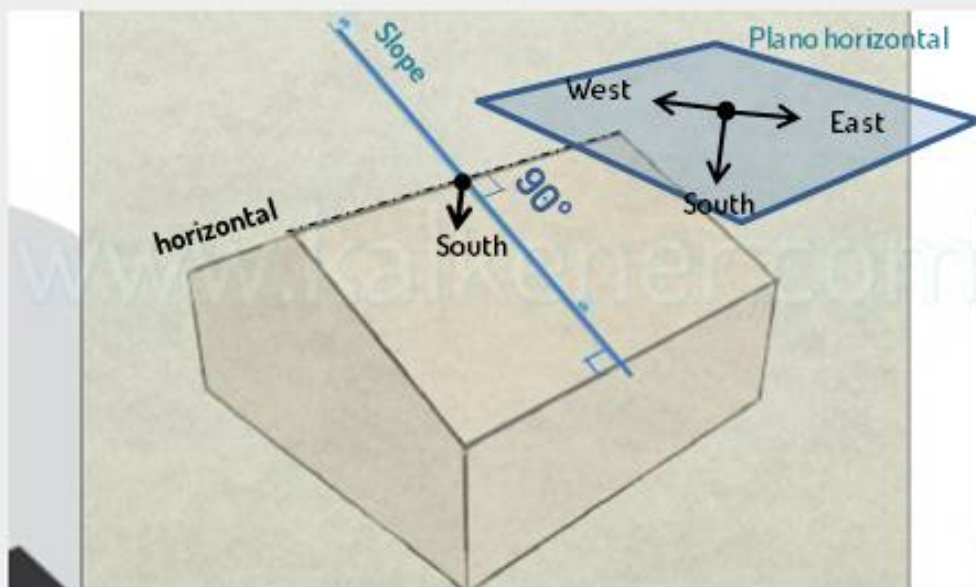
A: Measure the progress of 's' on the horizontal plane. In the NH this value is positive if it progress towards West from the reference source '0' (negative towards East).

B: Measures the height variation of 's' according to its progress. This value is positive if the heigh variation goes upwards from the reference source '0'. Negative if goes downwards.

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▼ Roof features
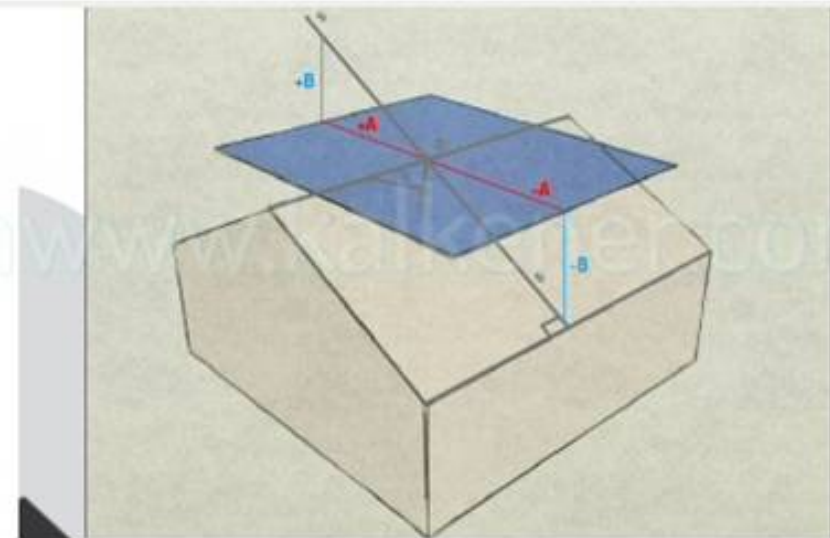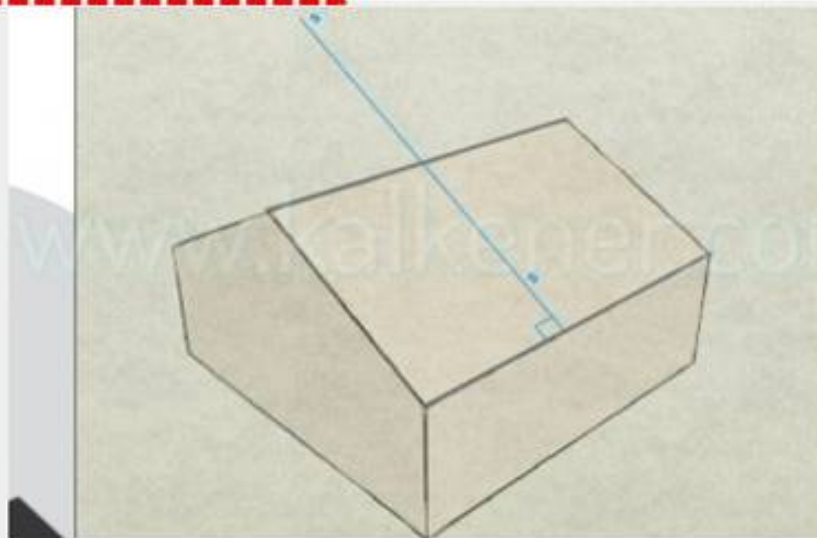
6º - Indique cómo se integrarán los captadores solares en la edificación

Seleccionar *   [General ▼] ❓

–**General:** Collectors are placed freely, without constraints
–**Superposición arquitectónica**: Collectors placed parallel to the building envelop
–**Integración arquitectónica**: when the solar collectors replace conventional building elements or are constituent elements of the architectural composition

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STEP 5 – OBSTACLES

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Services Group III.A   Solar Thermal Water Heating Systems

Project 228 - NombreProyecto18

| Information | **Surrounding conditions** | Purchase services |

▸ Location

▸ Roof features

▸ Surrounding obstacles definition

▸ Hot water required according to types of end-users

▸ Features of the water heating system before the STWH implementation

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▶ Location

▶ Roof features

▼ Surrounding obstacles definition

Set the location of the solar collectors as reference source and enter the values, based on a Cartesian coordinate system, of the surrounding objects to the collectors field in order to create the contour line of those items.

Two contours as a maximum will be possible to be defined, each of them made up of 13 points as a maximum. Units in meters.

Tutorial to create the solar site survey

LINK TO TUTORIAL TO CREATE THE SOLAR SITE SURVEY

CONTOUR OS SURROUNDING OBSTACL

CARTESIAN COORDINATES	CONTOUR 1			CONTOUR 2		
	ΔW ?	ΔS ?	ΔZ ?	ΔW ?	ΔS ?	ΔZ ?
POINT1						
POINT2						
POINT3						
POINT4						
POINT5						
POINT6						
POINT7						

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Afer having entered in cartesian coordinates the points that made up the contour of the objects that cast shadows Kalkener plots the elevation and plan views to check them.
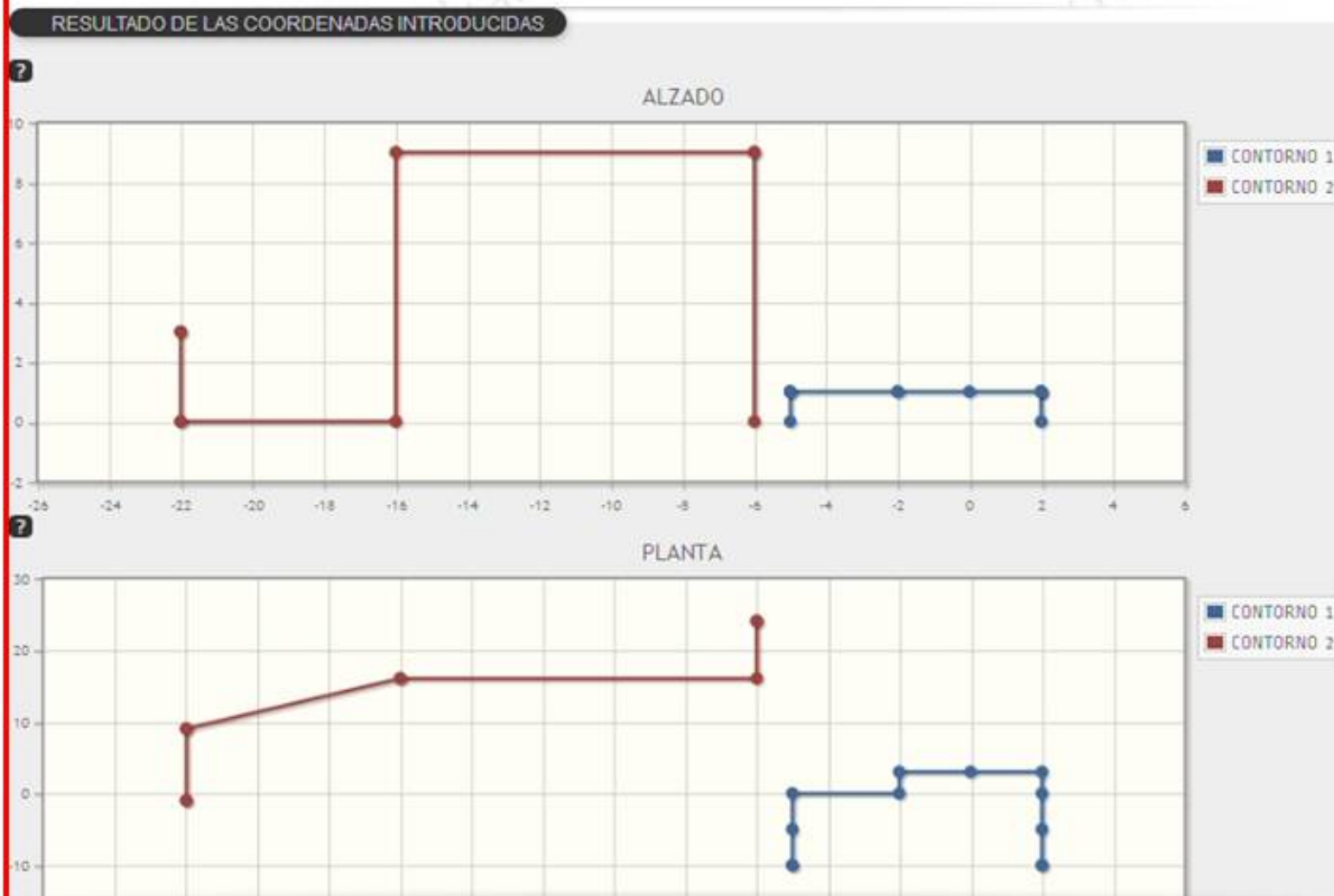
RESULTADO DE LAS COORDENADAS INTRODUCIDAS

ALZADO

CONTORNO 1
CONTORNO 2

PLANTA

CONTORNO 1
CONTORNO 2

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Information   **Surrounding conditions**   Purchase services

▶ Location

▶ Roof features

▶ Surrounding obstacles definition

▶ Hot water required according to types of end-users

The user sets the average consumption of hot water at 60°C (liters/day). Next, the monthly, weekly and daily hot water consumption profiles are defined.

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Information | Surrou

▸ Location

▸ Roof features

▸ Surrounding obstacles definition

▾ Hot water required according to types of end-users

Select type of end-user and the hot water average daily consumption

Type 1 *	Parameter	End-users	Liters/day unit
multi-family housing	Persona	4	28.00 ❓

Type 2	Parameter	End-users	Liters/day unit
Others			❓

Type 3
<no typologies>

Select the type and set up the amount of hot water consumption

Total volume of water at 60 °C required per day by the facility: 1200 liters/day ❓

MONTHS OF THE YEAR SCHEDULED FOR THE STWH OPERATION

ANNUAL

Period of time scheduled for the STWH operation: Yes

Set up the working frametime

MONTHLY / WEEKLY / DAILY HOT WATER PROFILES REQUIRED

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| Monthly profile | Weekly profile | Daily profile |

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Consumption profiles:

MONTHLY (in %)

WEEKLY (in %)

DAILY (in %)

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Services Group III.A   Solar Thermal Water Heating Systems

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| Information | **Surrounding conditions** | Purchase services |

▶ Location

▶ Roof features

▶ Surrounding obstacles definition

▶ Hot water required according to types of end-users

▶ Features of the water heating system before the STWH implementation

All the STWH must have a back up water heating system in order to provide energy in the absence of solar irradiation.

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STEP 7 – BACK UP SYSTEM

Information | **Surrounding conditions** | Purchase services

▸ Location

▸ Roof features

▸ Surrounding obstacles definition

▸ Hot water required according to types of end-users

▾ Features of the water heating system before the STWH implementation

HOT WATER HEATING SYSTEM PREVIOUSLY TO THE IMPLEMENTATION OF THE STWH. IN CASE OF A NEWLY-CONSTRUCTED BUILDING, PLEAS
ENTER THE TYPE OF EXPECTED FUEL TO BE USED.

BEFORE THE STWH INSTALLATION		HOT WATER DISTRIBUTION SYSTEM
Type of fuel of the hot water installation	Efficiency [%] ❓	Efficiency [%] ❓
Electricity ▾		

NEW BACK-UP HEATING SYSTEM

Note: If you want that Kalkener sizes the back-up heating system please don't fill any field in the subsection named 'BOILER'. In that case, It will be supposed
that the type of fuel and the boiler efficiency are the existing ones.

AFTER THE STWH INSTALLATION	
Type of fuel	Efficiency [%] ❓
▾	

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▶ Location

▶ Roof features

▶ Surrounding obstacles definition

▶ Hot water required according to types of end-users

▶ Features of the water heating system before the STWH implementation

CURRENCY

Please, select the currency to use in this calculating module
Currency *   EUR € ▼

Set up new currency

ENERGY COSTS

Note: It is recommended to enter data obtained from the last electricity bill

Natural Gas

€/kWh [Without VAT or Taxes] * ❓

Others (Fuel Oil, pellet, etc.)

€/kWh [Without VAT or

CURRENT ENERGY COSTS ACCORDING TO SELECTED CURRENCY PER kWh

Electricity

Electricity *   ▼ ❓

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| Information | **Surrounding conditions** | Purchase services |

▸ Location

▸ Roof features

▸ Surrounding obstacles definition

▸ Hot water required according to types of end-users

▸ Features of the water heating system before the STWH implementation

Once all these features habe been entered, the user must choose the services to purchase. **Before continue please, check all the data. After making the payment they can not be modified.** In any case of doubts please don't hesitate to <u>contact us</u>. **We will be pleased to help you with whatever you need.** 26

STEP 8 – SERVICES PURCHASE

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Services Group III.A   Solar Thermal Water Heating Systems

Project 228 – NombreProyecto18

Information   Surrounding conditions   **Purchase services**

Fee-for-service or annual flat for fee units, according to your needs.
Prices can change depending on the features of the project.

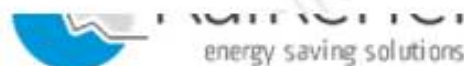| Selección	Service	Precio [€]	Descuento [%]
☐	📁 S12: Access to Solar Thermal Water Heating systems calculating module	📁 5,80 €	📁 0,00 %
☐	📁 S13: Issuance of the profitability report	📁 8,10 €	📁 0,00 %

Total according to selection: 0,00 €   Prices (VAT not included)

Purchase

Click on each services to read the description

Use the promotional codes to access to special discounts

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STEP 8 – SERVICES PURCHASE

Help   Projects   My personal data   Users   Billing details   Invoices   Payments

Services Group III.A   Solar Thermal Water Heating Systems

Project 327 - Proy326

Information   Surrounding conditions   **Purchase services**   Collectors field   Solar chart   STWH Sizing   Profitability   Profitability report

AFTER HAVING PAID THE PURCHASE, THROUGH PAYPAL, OR 3D SECURED CREDIT CARD PAYMENT GATEWAY, OR USING THE KALKENER POINTS BALANCE, PLEASE CLICK ON 'PERFORM CALCULATIONS'

Seleccion	Service	Precio [€]	Descuento [%]
	S12: Access to Solar Thermal Water Heating systems calculating module	20,80 €	0,00 %
	S13: Issuance of the profitability report	8,10 €	0,00 %

Total according to selection: 0.00 €   Prices (VAT not included)

Purchase

The purchase of the selected service/s allows you to use our optimization/calculation tools.
¿Do you want to make the computation?

PERFORM CALCULATIONS

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FEATURES OF THE SOLAR COLLECTORS AND LOSSES CALCULATION

FEATURES OF THE SOLAR COLLECTORS AND LOSSES CALCULATION

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Services Group III.A   Solar Thermal Water Heating Systems

Project 229 – NombreProyecto19

Information | Surrounding conditions | Purchase services | **Collectors field** | Solar chart | STWH Sizing | Profitability | Profitability report

▸ Selecting design parameters

▸ Orientation and tilt associated losses

Information   Surrounding conditions   Purchase services   **Collectors field**   Solar chart   STWH Sizing   Profitability   Profitability report

▼ **Selecting design parameters**

YOU CAN USE OUR DATABASE OR YOUR OWN CERTYFIED MANUFACTURER'S SOLAR COLLECTOR DATASHEET

SELECT SOLAR COLLECTOR

MANUFACTURER

MANUFACTURER *   LUMELCO

MODEL *   ST-2500

$$\eta=\eta_0-K_1\cdot[T_m-T_a]/G_\beta-K_2\cdot[T_m-T_a]^2/G_\beta$$

Collector height [m]	2.05		
Collector Width [m]	1.28		
Solar collector weight full of water [kg]	50.71	**PERFORMANCE RATIOS**	**CONVERSION SETTINGS**
Solar collector's flow rate [l/m² h]	125.00	η_0 0.7671	$G_\beta [W/m^2]$ 800.0000
Useful collector's capture area [m²]	2.32	K_1 3.7479	Mass flow rate kg/s m² 0.0150
Collector's pressure drop [mmWG]	14.87	K_2 0.0147	Cp [Water] kJ/kg°C 4.1800
Maximun number of collectors in parallel:	6		

SELECT THE TYPE OF SOLAR HOT WATER STORAGE SYSTEM

Select type:

◉ Optimum. Select this option if the mismatch between the time energy is needed [consumption] and the time solar energy is available [there is solar radiation] is less than 24 horus. this option is usually used in housing, hotels, etc.

○ Select this option if there is no mismatch between the time energy is needed and the time solar energy is available.

○ Select this option in case of large hot water consumption with large mismatch between the time energy is needed and the time solar energy is available [greater than 72 hours].

h: Horizontal reference line
b: Extended solar collector's baseline

α: The angle between an horizontal reference line on the roof (eaves or ridge) and the solar collector baseline (Positive if clockwise viewed downwards.

β: The angle between the solar collector and the roof. Positive if counterclockwise viewed by an observer located at the origin 'O'.

STEP 10 – ORIENTATION AND TILT LOSSES

▸ Selecting design par

▸ Orientation and tilt associated losses

α: The angle between an horizontal reference line on the roof [eaves or ridge] and the solar collector baseline [Positive if clockwise viewed down over the roof]

β: The tilt angle ["sky ward orientation"]: The angle bet flat plate. Positive if counterclockwise viewed by an observer

Optimal α and β	REF. ROOF
α:	0.00
β:	31,13

Kalkener calculates the optimum α y β in order to obtain the maximum irradiation during the specified timeframe

Please, enter the values:

SELECTED α and β	REF. ROOF
α:*	0.00
β:*	31.00

The user sets the α y β according to his/her needs and Kalkener calculates the associated losses with regard to the optimum ones

The mismatch between both values, selected and optimum, has been calculated as a percentage:

LOSSES	REF. ROOF
Tilt β and orientation α losses [%]:	0.00

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NombreCuenta1.

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Services Group III.A   Solar Thermal Water Heating Systems

Project 229 – NombreProyecto19

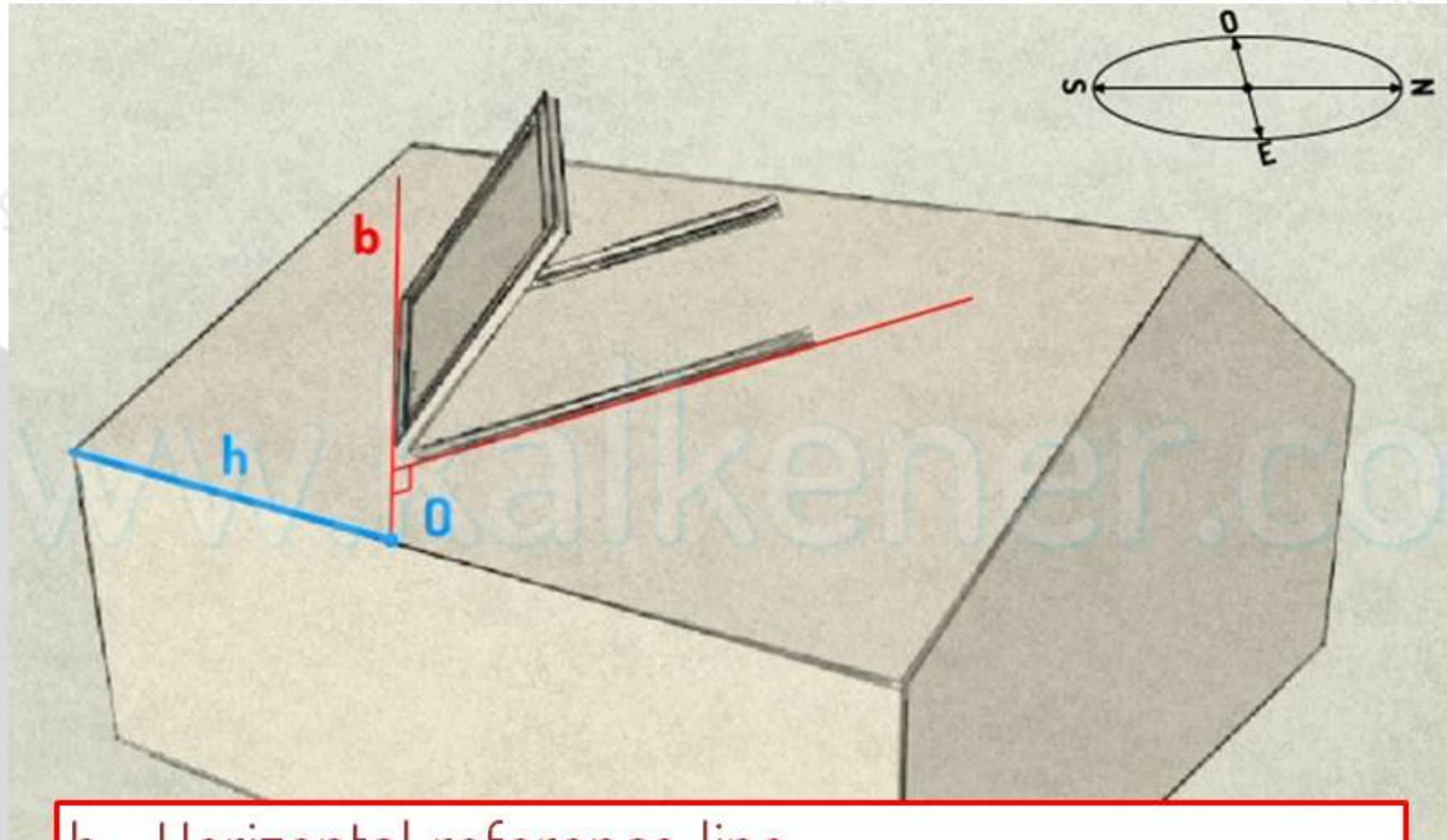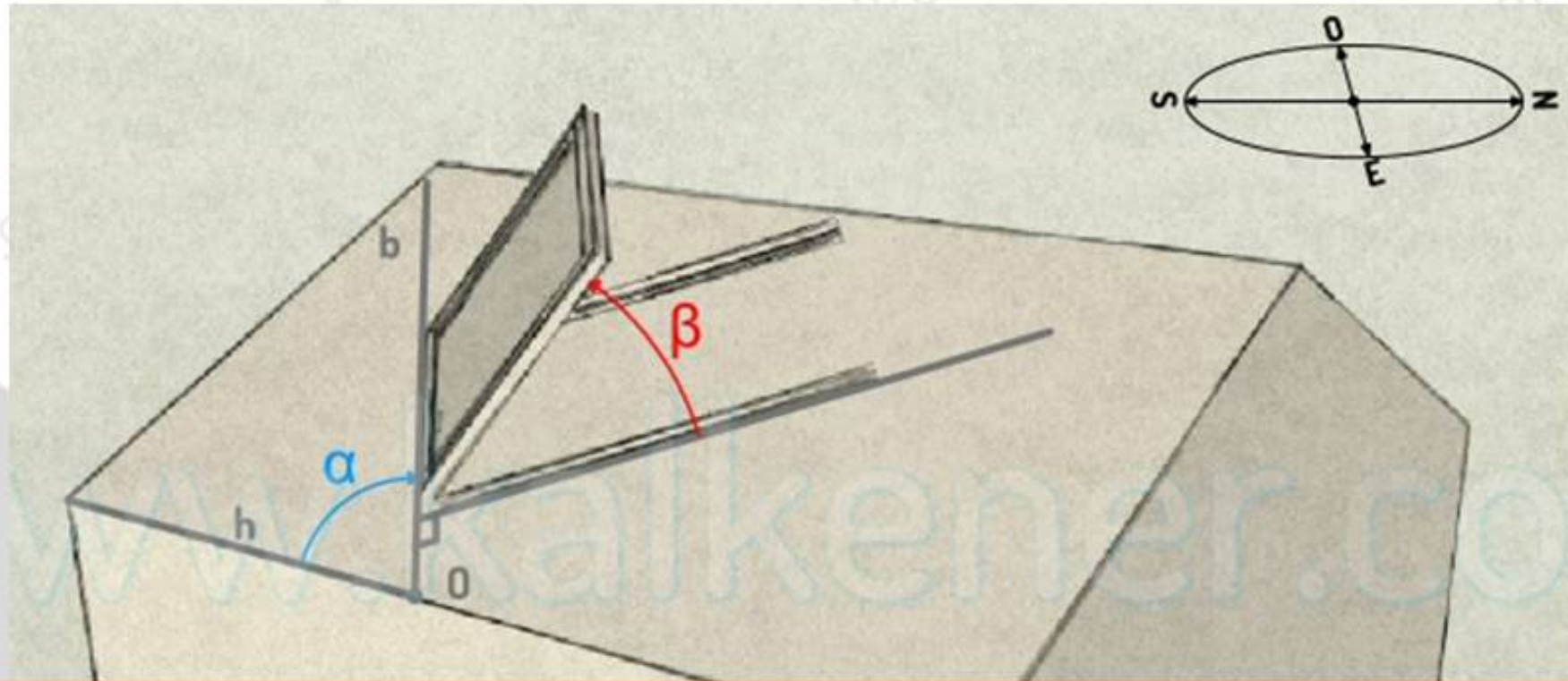| Information | Surrounding conditions | Purchase services | **Collectors field** | Solar chart | STWH Sizing | Profitability | Profitability report |

▶ Selecting design parameters

▶ Orientation and tilt associated losses

In the 'Solar chart' tab Kalkener draws the annual solar path according to the latitude where the facility is located, overlays the contour of the obstacles (defined in step 5) that surrounds the collector field and calculates the shading losses.

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Services Group III.A   Solar Thermal Water Heating Systems

Project 229 - NombreProyecto19

| Information | Surrounding conditions | Purchase services | Collectors field | Solar chart | STWH Sizing | Profitability | Profitability report |

SHADING LOSSES

CONTOUR 1

CONTOUR 2

Legend:
- marzo
- abril
- mayo
- junio
- 5 h
- 6 h
- 7 h
- 8 h
- 9 h
- 10 h
- 11 h
- 12 h
- 13 h
- 14 h
- 15 h
- 16 h
- 17 h
- 18 h

These checkbox enables or disables the shading contours (from the solar site survey) and Kalkener calculates the shading losses
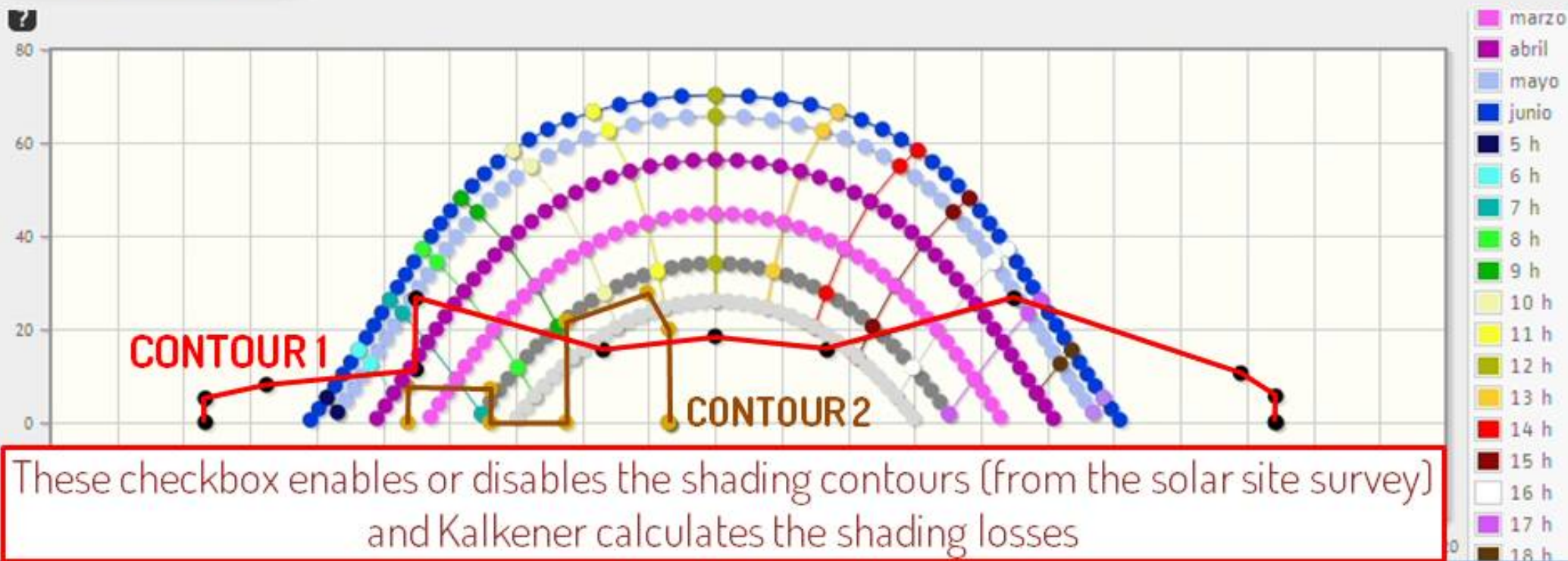
ENABLE CONTOUR 1 ☑

ENABLE CONTOUR 2 ☑

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Information | Surrounding conditions | Purchase services | Collectors field | Solar chart | **STWH Sizing** | Profitability | Profitability report

According to surrounding conditions, the sizing of the solar installation has been calculated through a dynamic, deterministic and discrete operating year, in order to achieve the desired Solar Fraction.

Using this simulation software you will be able to:

- Set the desired Solar Fraction value to be generated by the STWH or set the number of solar collectors to be installed.
- According to these values (desired Solar Fraction or number of collectors) Kalkener will calculate both parameters, the simulated Solar Fraction and size o the STWH, whose features will be available through drop-down subsections.

If you change any value and click on 'Recalculate Solar Fraction,' Kalkener
simulated Solar Fraction.

SOLAR FRACTION

Annual Solar Fraction recommended by Kalkener(%)   30.00

Please, select one of the following options:

○ Set your desired annual Solar Fraction (%):
● Set the desired number of solar collectors:

Number of solar collectors: 30 ❓
Annual Solar Fraction simulated by Kalkener(%)   32.53

Kalkener Rrecommends a value for the Solar Fraction but the user can sets the desired Solar Fraction (Kalkener will calculate the number of solar collectors needed) or the number os solar collectors to be installed (in that case Kalkener will calculate the respective Solar Fraction)

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Information   Surrounding conditions   Purchase services   Collectors field   Solar chart   **STWH Sizing**   Profitability   Profitability report

PARAMETERS

STWH works as a set, so if any parameter of its components is modified, please click on 'Save' button to run the simulation again to calculate the n

▸ 1 - solar collector field

▸ 2 - Solar primary loop

▸ 3 - Plate heat exchanger

▸ 4 - Solar secondary loop

▸ 5 - Solar storage tank

▸ 6 - Hot water storage tank

▸ 7 - Back-up heating supply system

▸ 8 - Energy contribution

In this tab every drop-down box refers to a main component of the STWH. Kalkener proposes the size of each one in order to obtain the recommended Solar Fraction but the user can modify these values according to his/her own criteria. In that case, Kalkener calculates the new simulated Solar Fraction
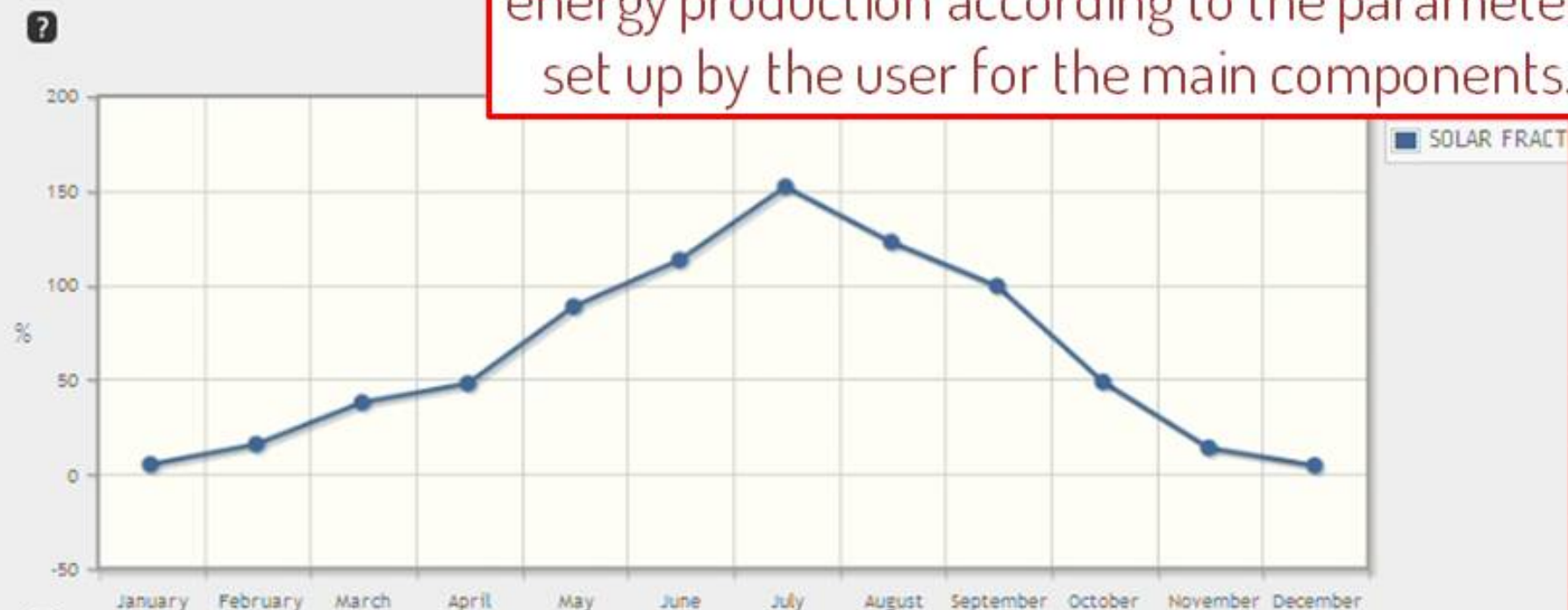
Save

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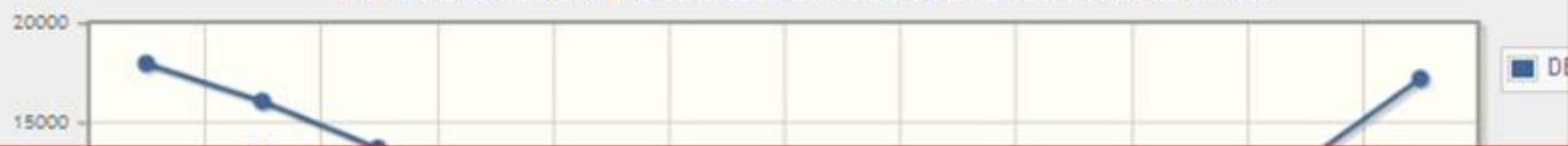
NombreCuenta1 Apellido1C

8 – Energy contribution

Servicios

Proyecto 229 –

Información

Average system efficiency [%]   36,34
Annual Solar Fraction [%]   32,53

PAR

STWH

1 – so

2 – S

3 – P

4 – S

5 – S

6 – H

7 – B

8 – Energy contribution

In the drop-down box named 'Energy contribution' Kalkener shows the expected energy production according to the parameters set up by the user for the main components.

SOLAR FRACT

%

200

150

100

50

0

-50

January February March April May June July August September October November December

DEMAND OF THERMAL ENERGY AND SOLAR ENERGY CONTRIBUTION

20000

15000

DE

Save

40

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According to the size of the main components (collecting surface, storage volume, etc.) you can request bids (so all of them were refered to the same installation and can be comparable with each other) and be aware of the implementation and maintenance costs. Entered these costs in this section, Kalkener will calculate the key profitability indicators (IRR and NPV) to make the decision on whether or not to make the investment.

| Information | Surrounding conditions | Purchase services | Collectors field | Solar chart | STWH Sizing | **Profitability** | Profitability report |

ENERGY PRICE INDEX

Enter the Energy Price Index which, similar to the 'Energetic CPI,' is the percentage that measures changes in the price of the following primary energy:

Natural Gas (%) *   [5,00]

Others (Fuel Oil, pellet, etc.) (%) *   [6,00]

Electricity (%) *   [6,00]

EXPENDITURES

Implementation cost rate per m² of solar collector (€/m²) *   [700,00]

Annual maintenance rate per m² of solar collector (€/m²) *   [10,00]

Other costs per year (wardening, monitoring, etc.) *   [1,00]

FINANTIAL RATIOS ?

Year of implementation*   [2.015] ?

APR of reference (%)*   [6,50] ?

Consumer Price Index (%)*   [3,33] ?

INSURANCE EXPENDITURES

Replacement value   [48.000,00] ?

Insurance cost rate per year (% over the replacement value)   [1,00] ?

GRANTS

Eligible costs   [   ] ?

Grant (% Gross Grant Equivalent):   [   ] ?

[Save and calculate]

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Services Group III.A   Solar Thermal Water Heating Systems

Project 229 – NombreProyecto19

Information | Surrounding conditions | Purchase services | Collectors field | Solar chart | STWH Sizing | Profitability | **Profitability report**

S13: Issuance of the profitability report

Issuance of report PDF | Issuance of report DOCX | Report body language | English

INFORMES
informe.pdf : issued on 02-mar-2015 20:30:30
informe.docx : issued on 02-mar-2015 15:27:48

Kalkener allows the issuance of a professional report, about 30 pages in length, in both formats: pdf and docx, where all the results calculated are summarized.
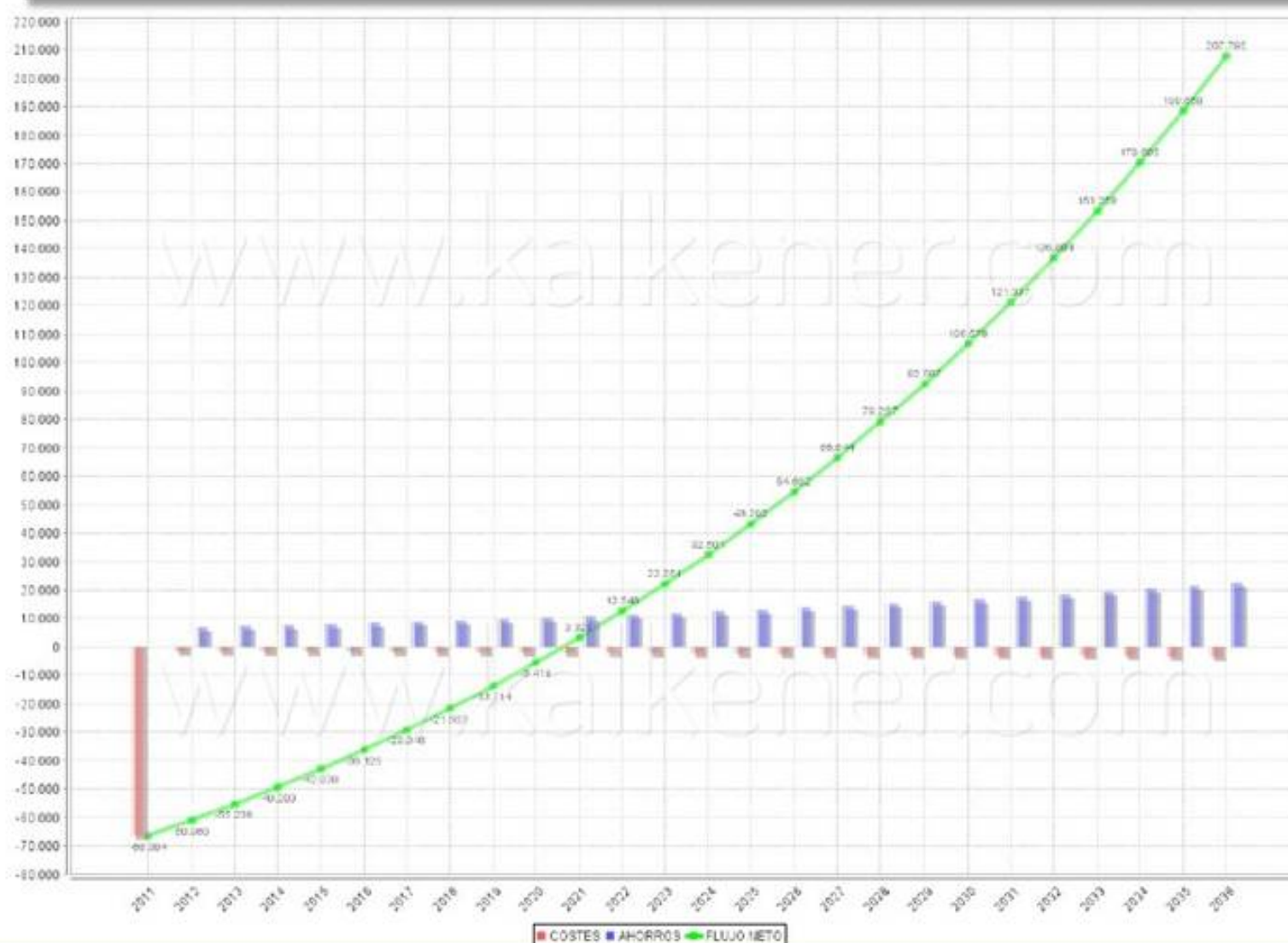
Please, take in account that once the report has been issued, the previously entered data can not be modified.

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Key profitability indicators: IRR and NPV

FOR FURTHER INFORMATION DON'T HESITATE TO CONTACT US:
info@kalkener.com

DISCCOUNTS AND SPECIAL OFFERS BY CLICKING ON HERE

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