

## Deliverable D 5.5

### Cheap-GSHPs DSS and web platform user manual

### WP5

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## **Publishable summary**

*The D 5.5 – “Cheap-GSHPs D 5.5 “Cheap-GSHPs DSS and web platform user manual” is a public document delivered in the context of WP5, Task 5.4: Cheap-GSHPs web platform. The document forms the user manual of the web-based Decision Support System developed in the project.*

*The current document represents the user manual of this web application. The instructions for creating a user account, accessing the site, creating and configuring projects will be presented. Also, the document shows the indications of how to interpret the results provided by the website.*

## Abbreviations

Cheap-GSHPs	<b>C</b> heap and <b>E</b> fficient <b>A</b> pplication of reliable <b>G</b> round <b>S</b> ource <b>H</b> eat Exchangers and <b>P</b> umps
AHP	<b>A</b> lytic <b>H</b> ierarchy <b>P</b> rocess
CDD	<b>C</b> ooling <b>D</b> egree <b>D</b> ays
DHW	<b>D</b> omestic <b>H</b> ot <b>W</b> ater
DSS	<b>D</b> ecision <b>S</b> upport <b>S</b> ystem
HDD	<b>H</b> eating <b>D</b> egree <b>D</b> ays
HE	<b>H</b> eat <b>E</b> xchanger
HP	<b>H</b> eat <b>P</b> ump
LCA	<b>L</b> ife <b>C</b> ycle <b>A</b> ssessment
RoI	<b>R</b> eturn <b>o</b> n <b>I</b> vestment

## 1 Introduction

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The objective of Cheap-GSHPs project is to substantially reduce the investment and operating costs of ownership of a shallow geothermal system, whilst increasing safety during installation and operation and increasing the awareness of this technology throughout Europe. These goals are being achieved, through improved drilling machines and innovations in ground source heat exchanger design and material as well as through the development of software tools for a holistic engineering approach in for the system optimisation in as part of building integration, district heating and cooling applications across the different underground and climatic conditions within the EU.

In this context, a user-friendly web application that enables end-users to choose the geothermal technology most suitable for their facilities and preferences has been developed. A rule based Decision Support System (DSS) engine, for assessment of the geothermal installations, has been developed. The DSS tool acts as an accelerator for technical offices, building owners and investors to introduce into the market the novel technologies developed as part of the Cheap-GSHPs project. The current document represents the user manual of this web application.

Following, Chapter 2 represents the general description of the developed website and decision support system. It includes a general view of the process and of the different user scenarios that have been considered.

Next, Chapter3 contains the instructions for the user to take advantage of the different services implemented: creating a user account, accessing the site or creating and configuring projects. Also, the chapter shows the indications of how to interpret the results provided by the website.

## 2 General Description of the website

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The DSS website allows users to estimate the best possible geothermal technology for their facilities. The website is aimed at non-expert users and requires basic information about the facilities and to allow the system to estimate the end use energy needs. Once these are input, the system defines a set of geothermal solutions that meet these energy requirements. Each of these geothermal solutions involve different types of technologies (borehole heat exchangers, heat pumps and occasionally other additional energy sources) that are analysed to determine their feasibility and estimate the dimensioning and basic configuration of the system. Then the user is requested to prioritise among several criteria (such as the cost of the installations or the system efficiency) and based on the user priorities selected, the system determines which of the proposed solutions best meets the user requirements.

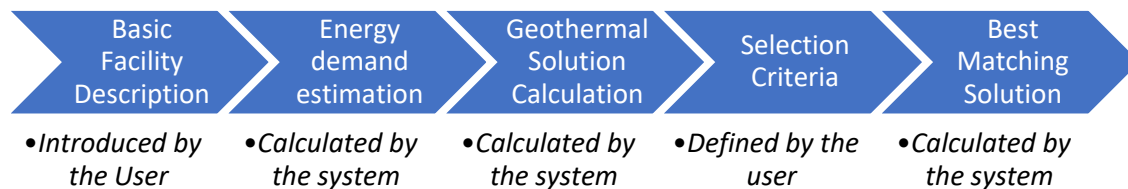


Figure 1. DSS Website process description

All the information related to this process is arranged in projects. Therefore, each project contains the following information:

- Facility description (basic information such as the location or the type of building)
- Set of feasible geothermal solutions, each of which will be a combination of:
  - Heat Exchanger (type, dimension)
  - Heat Pump
  - Additional energy sources (if necessary)
- Selection criteria preferences
- Solution ranking according to the preferences introduced

Each registered user can have different projects, thus being able to use the system for different facilities or to change some parameters and view their effects on the results. During the calculation process, the user can choose to log out and return and continue the process at another time.

The main features of the website and its functioning will be explained in the sections below. For more clarity, the different steps of the process have been split into four scenarios:

- Scenario 0: User login and project set-up

- Scenario 1: Basic facility description
- Scenario 2: Feasible alternatives retrieval
- Scenario 3: Alternatives ranking



### 3 Use of the website

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#### 3.1 SCENARIO 0: USER LOGIN AND PROJECT SET-UP

The first scenario involves the registering of users and the project set-up. It allows end-users (for example, building owners or technical offices) to register and log-in to the system. Once logged-in, the user can create a new project or select an existing one. The project manager can invite users to the project or even grant access to several resources attached to the project, such as files or other documentation.

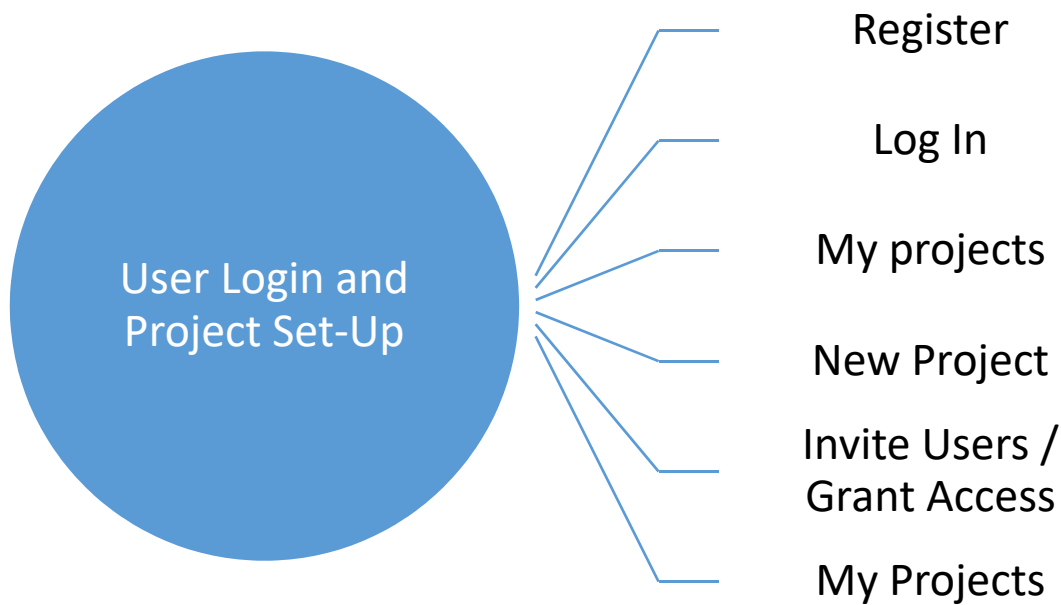


Figure 2. User Log in and Set up steps

### Step 1: Register

The user must be registered on the system in order to use the tool.

Information requested for the registration:

- Full Name
- Email Address
- Password

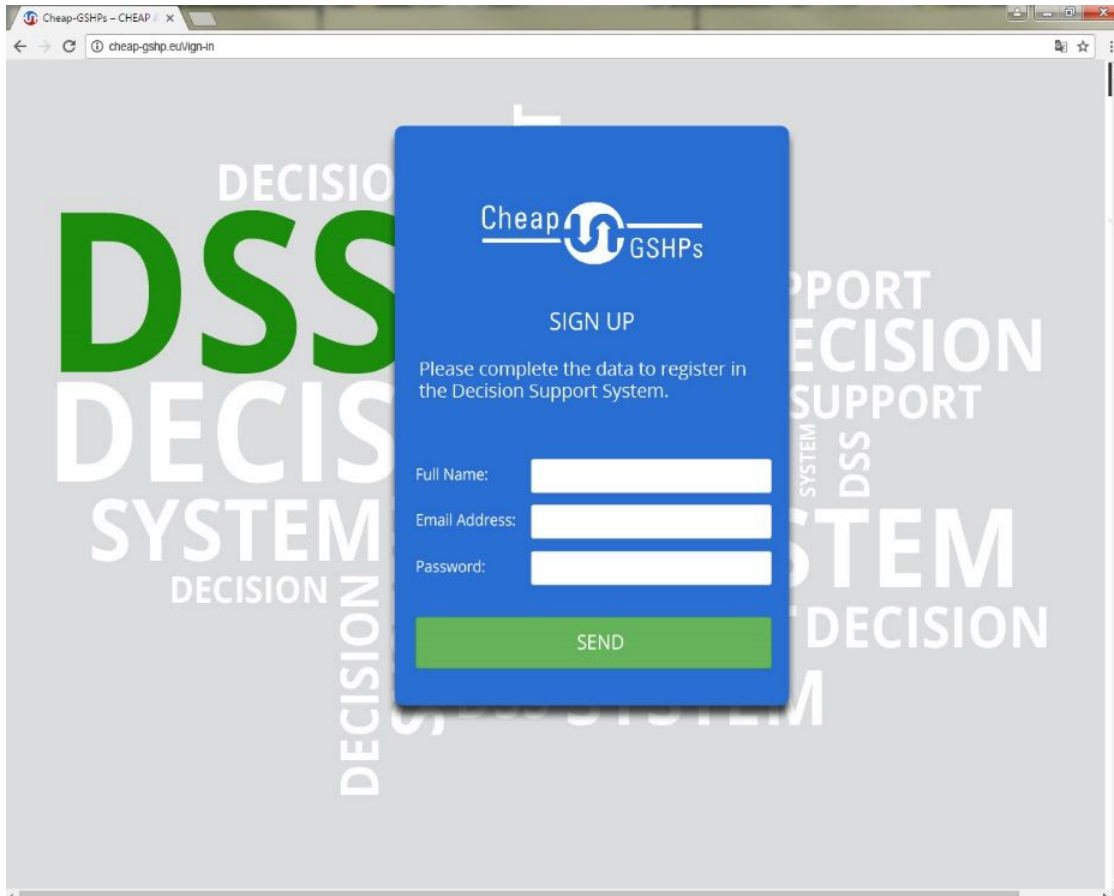


Figure 3. DSS Website - Register page

## Step 2: Log in

Once the users have a valid account, they can log-in.

Information required for log-in:

- Email Address
- Password

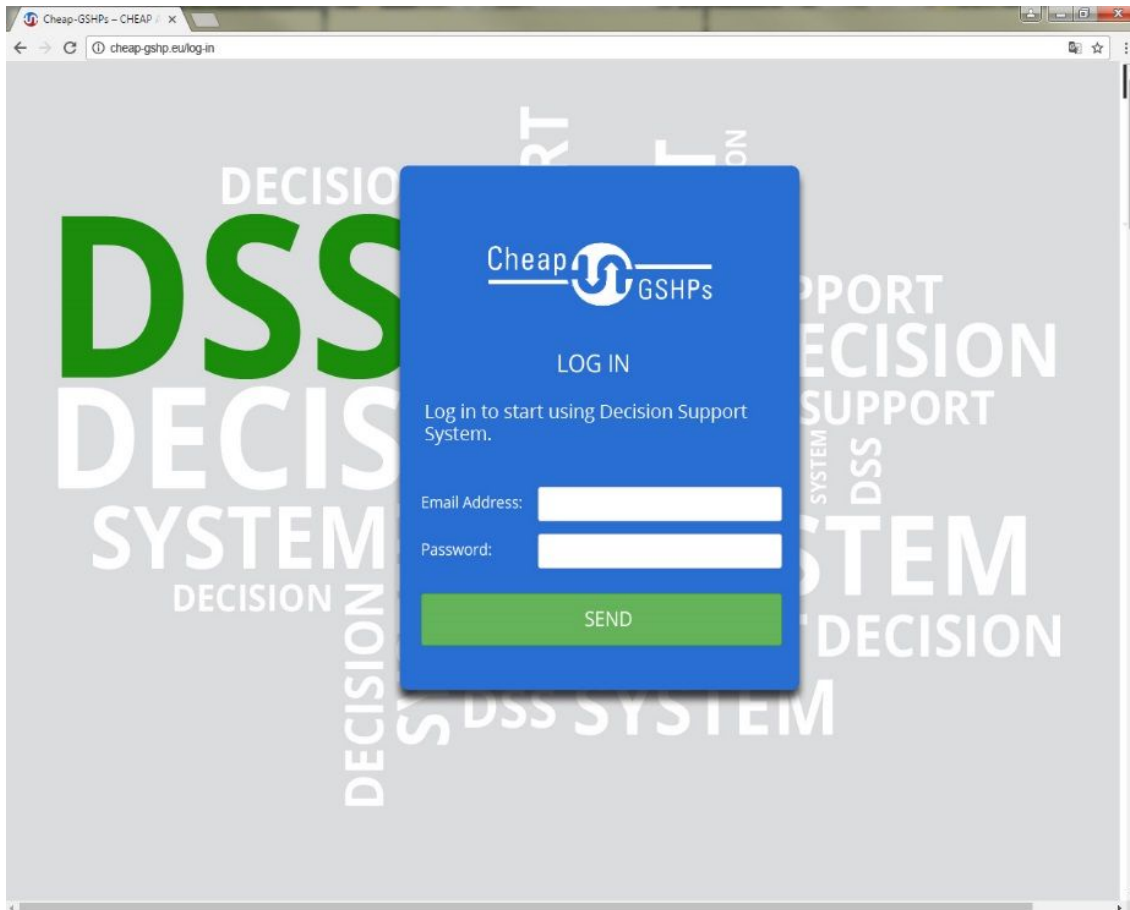


Figure 4. DSS Website - Log-in page

### Step 3: My Projects

If there is no project associated to the user account, the option to create a new project is presented to the user.

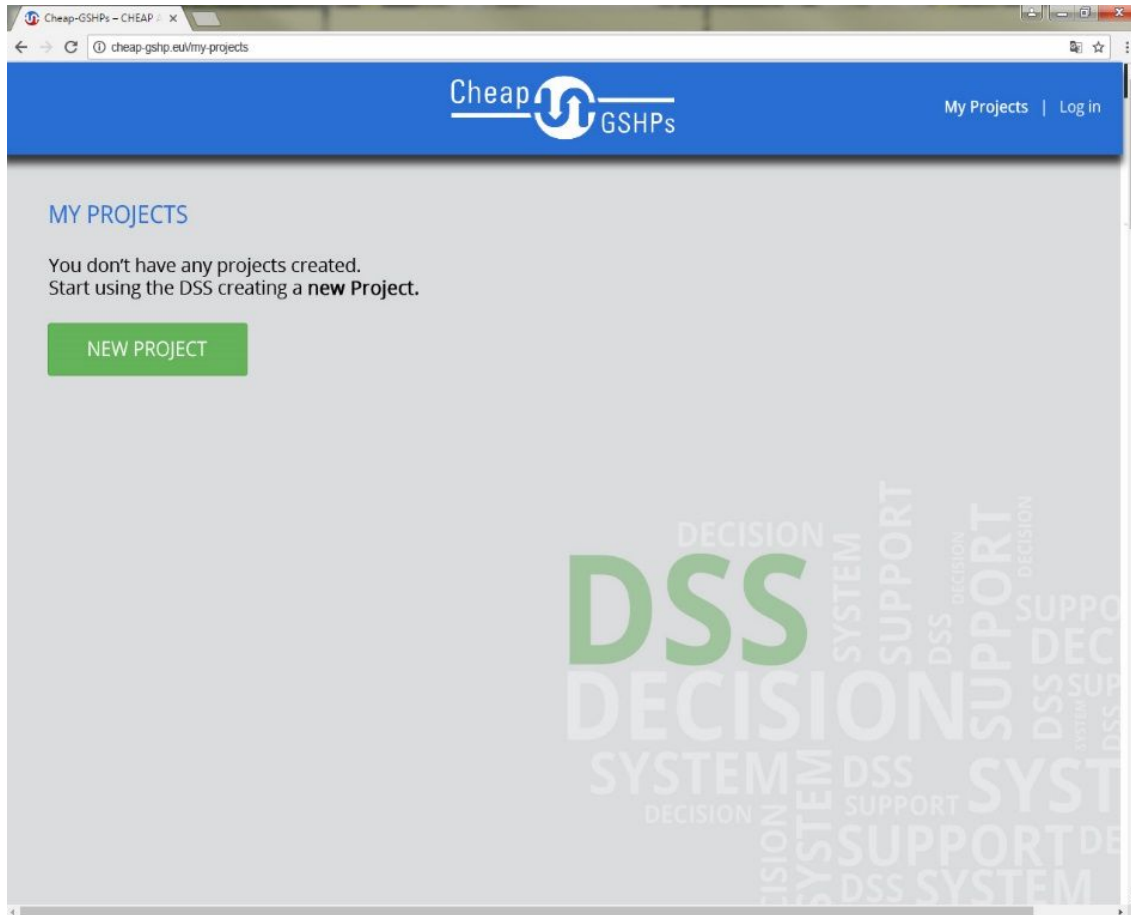


Figure 5. DSS Website - Empty project list

#### Step 4: New Project

The new project creation process requires the following information:

- Project Name: Name that will be used to identify the project.
- Project Description: Additional information describing the project.

When they save the information, the users can choose to directly grant access to other users with whom they might want to share the project.

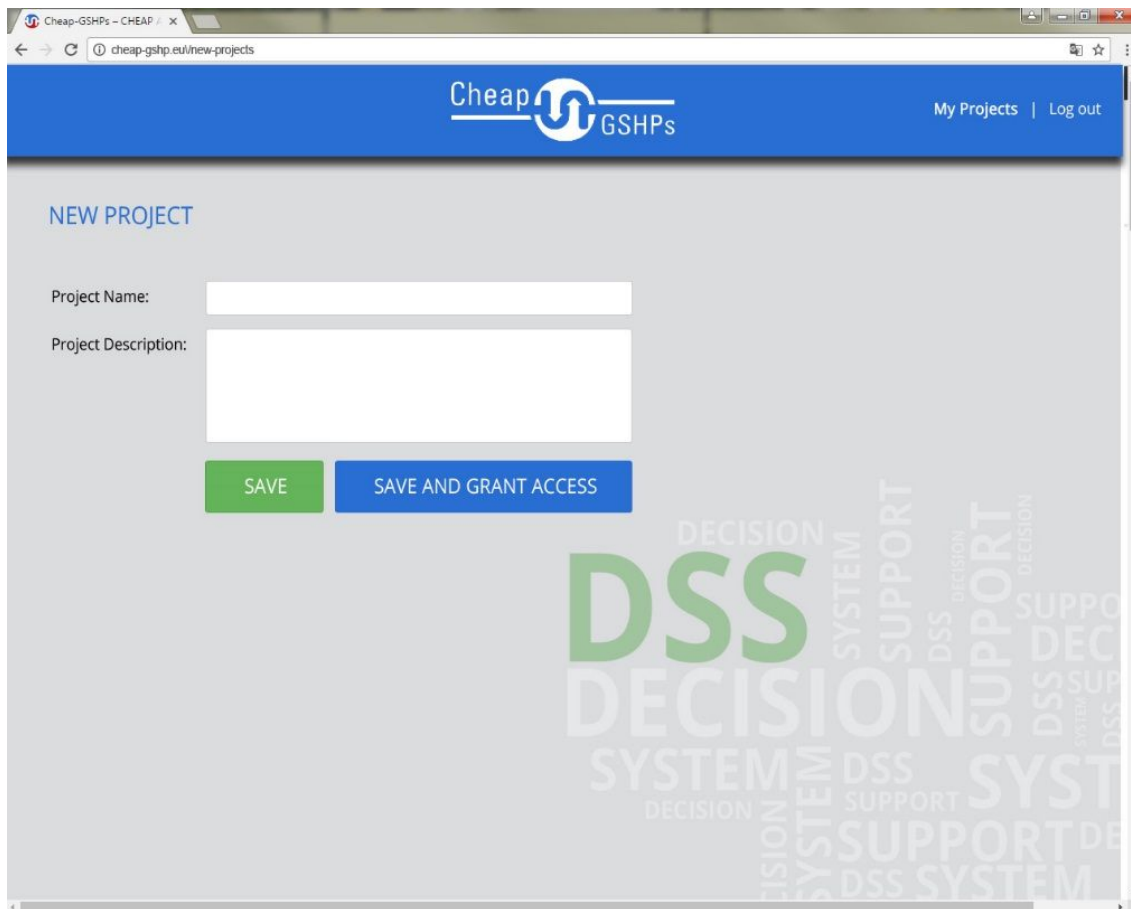


Figure 6. DSS Website – Project setup

### Step 5: Invite users / Grant access

The user that created the project might grant access to other users, in order to share the project with them.

Requested information:

- Email Address of the person invited to join the project

An automatic email will be sent, informing the invited users of the access grant, as well as the instructions for accessing the DSS Website and for viewing the shared Project.

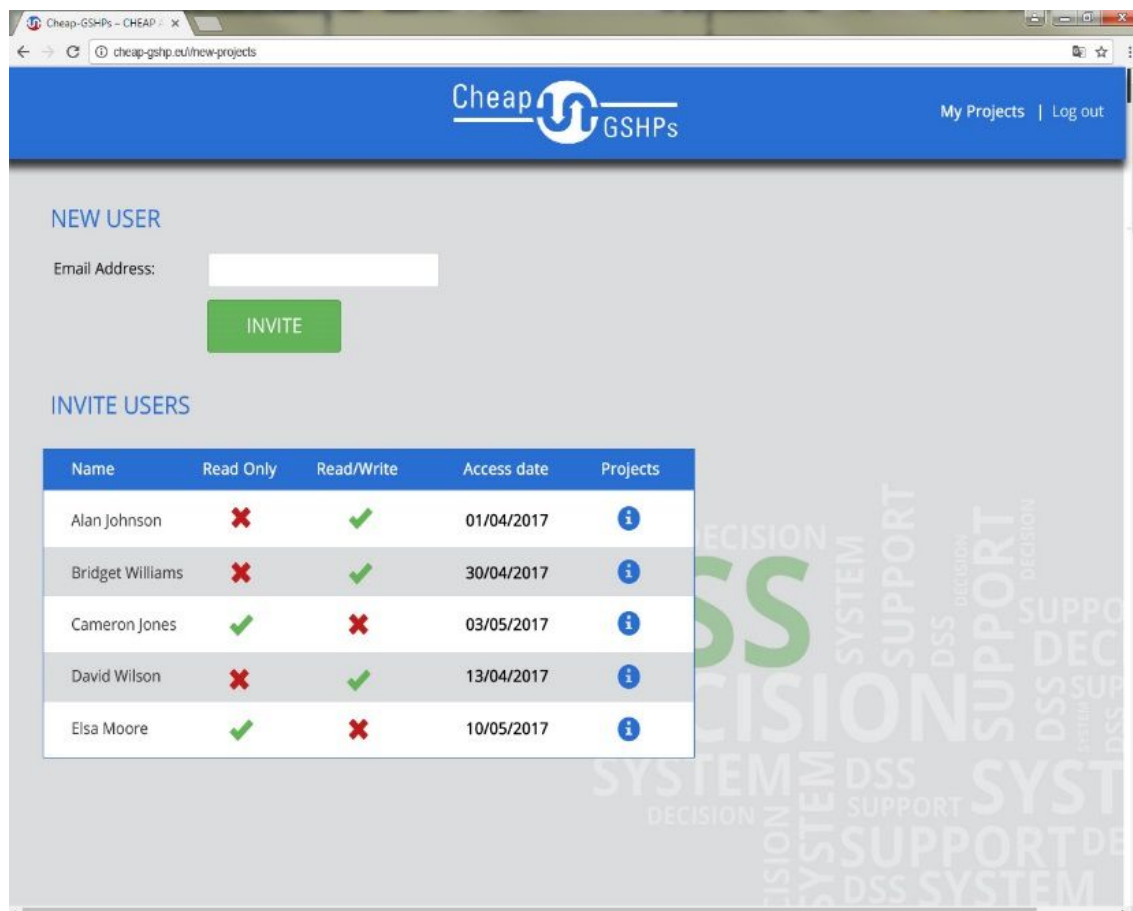


Figure 7. DSS Website – Project Users

## Step 6: My Projects

At any moment, the logged-in users can access the “My Projects” link, view their current list of projects (with the creation date, project name and description) and create new ones.

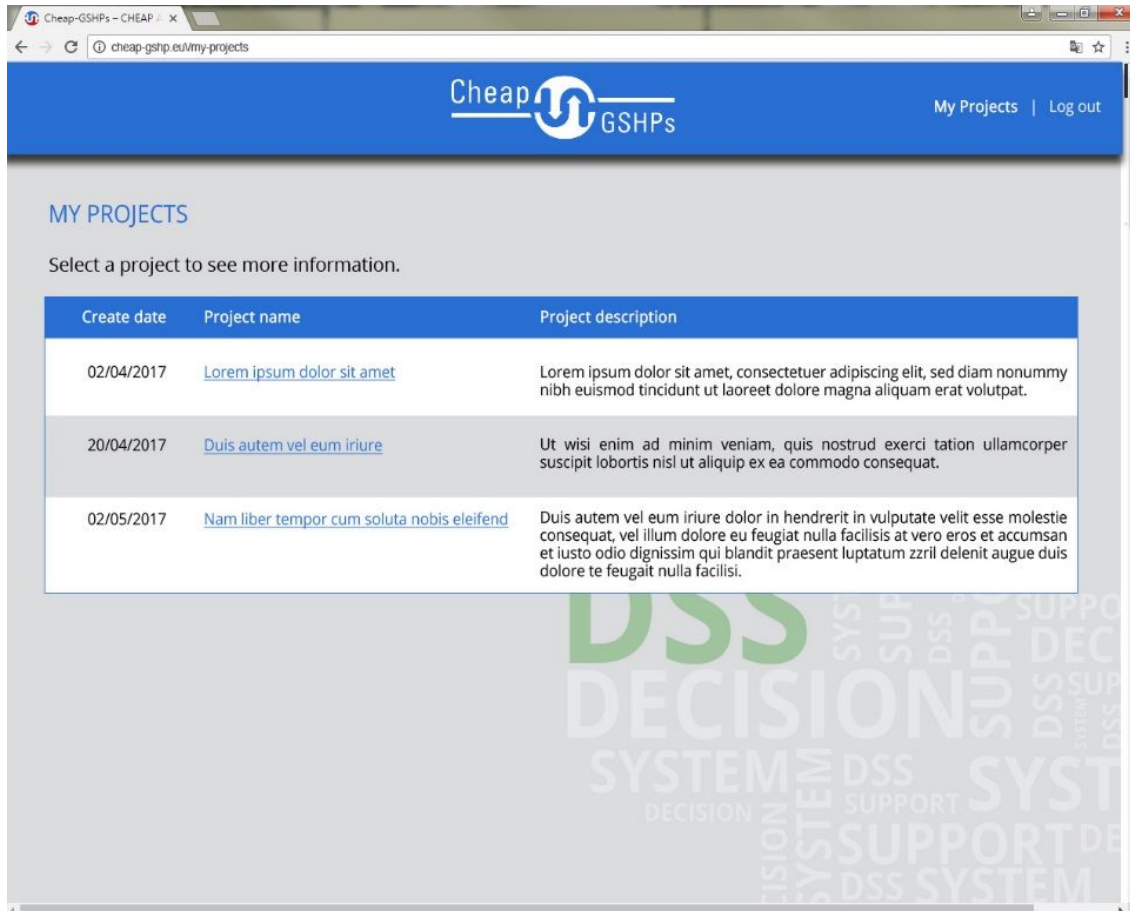


Figure 8. DSS Website – “My Projects” area

### 3.2 SCENARIO 1: BASIC FACILITY DESCRIPTION

In this scenario the end-users (building owners and technical offices) are capable to define the facilities of a building, according to basic information. The application allows the user to define the building type, insulation level of the building, information regarding the current systems installed, the sizing of the facilities and information of the location of the building.

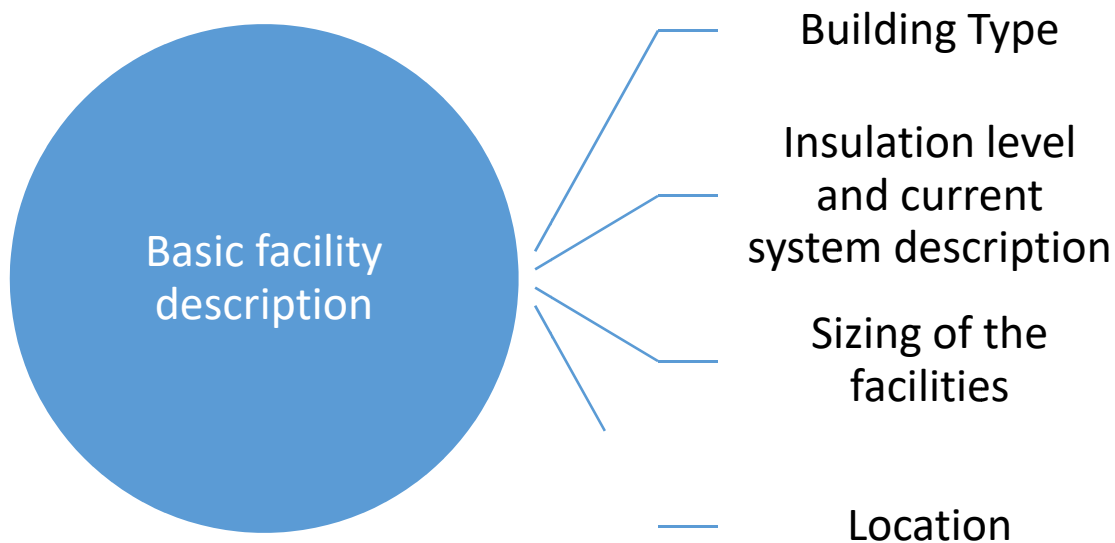


Figure 9. DSS Website – Basic facility description steps

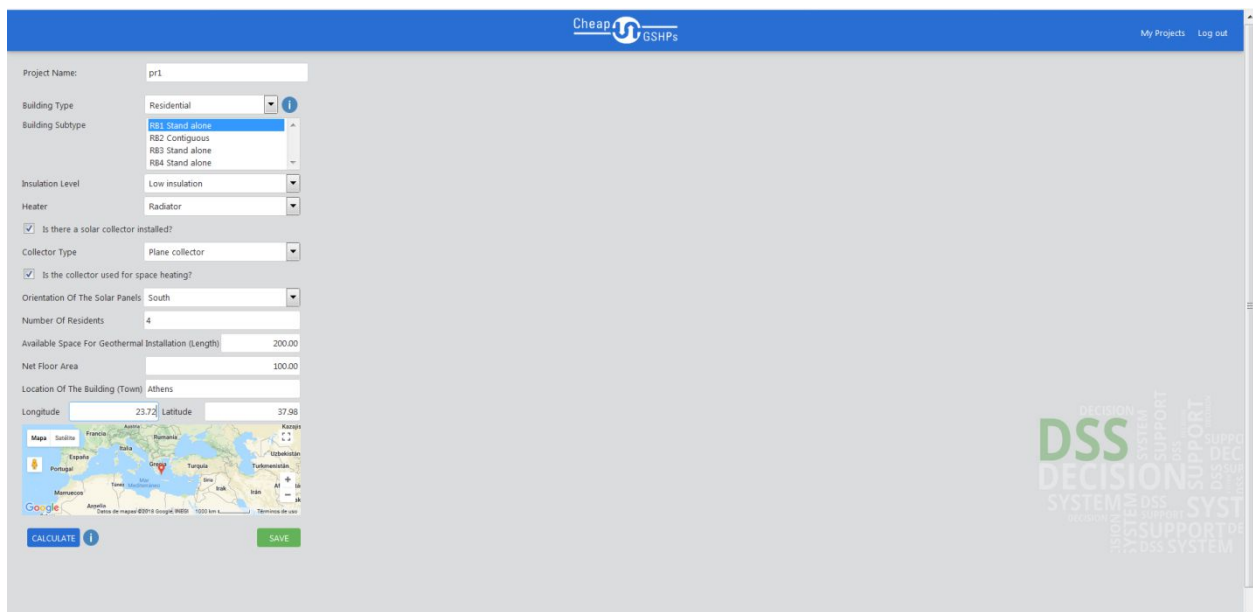


Figure 10. DSS Website - Facility description page



**Step 1: Building Type**

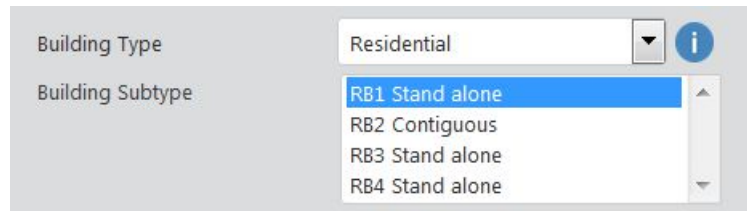


Figure 11 - DSS website - building type definition

The user must define the building type. Information requested:

- Building type: Choose between Residential or Non – residential buildings.
- Building Subtype

The subtypes of building are defined in the following tables:

**Residential Building**

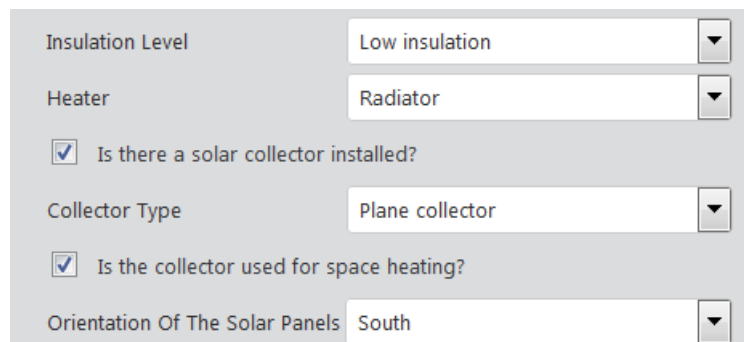
	RB 1	RB 2	RB 3	RB 4
External view				
S/V <sub>gross</sub> ratio	0.86	0.40	0.35	0.43
Net area (m <sup>2</sup> )	210	126	1330	681
% glazed area	14%	12%	25%	14%
No. storeys	2	4	6	6
No. dwellings	1	1	20	10
Urban structure	stand alone	contiguous	stand alone	stand alone

**Non Residential Building**

	NRB 1	NRB 2	NRB 3	NRB 4	NRB5
External view					
S/V <sub>net</sub> ratio	0.5	0.5	0.33	0.37	0.26
Net volume (m <sup>3</sup> )	5700	5700	3951	3366	5713
% glazed area	85%	50%	49%	45%	35%
No. storeys	5	5	4	2	2
No. people	100	100	454	201	50
Building Use	Administrative Building	Administrative building	Administrative building	Day care centre	Office building

Figure 12 - DSS website - Types and subtypes of building

## Step 2. Insulation level and current system description



Insulation Level: Low insulation

Heater: Radiator

Is there a solar collector installed?

Collector Type: Plane collector

Is the collector used for space heating?

Orientation Of The Solar Panels: South

Figure 13 - DSS website - Insulation and current systems installed description

As a second step, the user must provide some basic information about the current energy efficiency of the building. Information requested:

- Insulation level: Choose among three levels of insulation (high/low/none).
- Heater type: Describe current heater technology installed. Choose among radiator, radiant panel or fan coils.
- Presence of Solar Collectors
  - Collector type: plane collector / vacuum-heat tube / none
  - If it is being used for heating, also choose the orientation of the solar panels (choose between West, South, East and North).

## Step 3. Sizing of the facilities

Next, the user must provide with some information regarding the sizing of the facilities. Information requested:

- Number of residents: number of people that inhabit the house / apartment.
- Available space for geothermal installation: width and length of the area where it is possible to install the geothermal systems (in meters).
- Net floor area: Net floor area of the house / apartment (in square meters).

#### Step 4. Location Definition

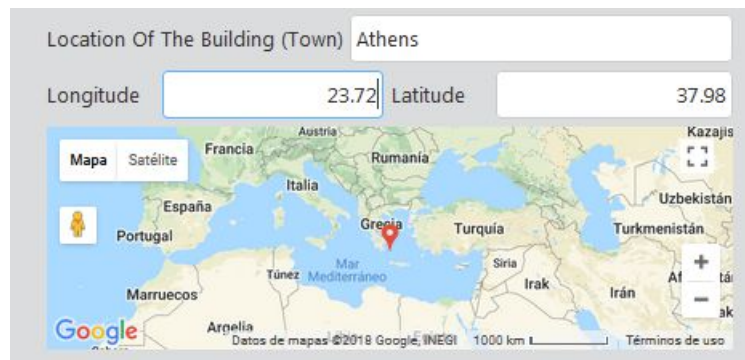


Figure 14. DSS website - Location definition

The user must define the location of the building to be analysed. Information requested:

- City
- Latitude
- Longitude

In case the user does not know the latitude and longitude of the location, a map is shown, where the user can pinpoint the location. The system then obtains the latitude and longitude values from the map.

### 3.3 SCENARIO 2: FEASIBLE ALTERNATIVES RETRIEVAL

Once the information has been introduced, the user must press the button “Calculate”.

Then, the system calculates the energy consumption of the facilities, as well as different combination of geothermal technologies. Thus, based on all the previous inputs, the system calculates feasible solutions based on the energy profile. The compatible alternatives are analysed in terms of:

- Recommended drilling/installation technology
- Type and number of GSHE
- Type of GSHP
- Options to integrate RES
- Installation and operating costs
- Technical feasibility
- Energy saving: in terms of comparison between the project proposed GSHE systems versus conventional heating / cooling systems due to their higher energy utilization efficiency.
- ROI
- Environmental impact

Besides, legislation constraints related to the particular case presented by the user will also be shown.

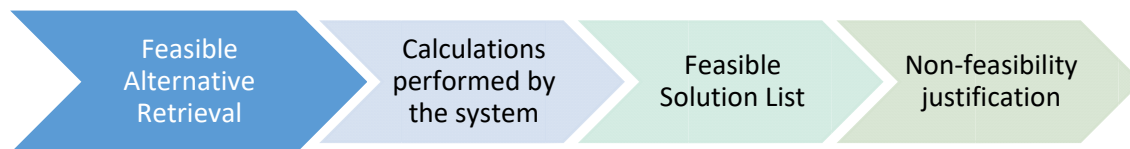


Figure 15. DSS Website – Feasible alternatives retrieval steps

These complex calculations take some time. The user will be informed through different messages of the several steps given by the tool during the process.

### 3.4 SCENARIO 3: ALTERNATIVES RANKING

Through this final scenario end-users will be able to classify the feasible alternatives identified in the previous scenario so as to select the best one in terms of the next weighting criteria:

- Cost
- Risk
- Life Cycle Cost (LCA)
- Return of Investment (ROI)

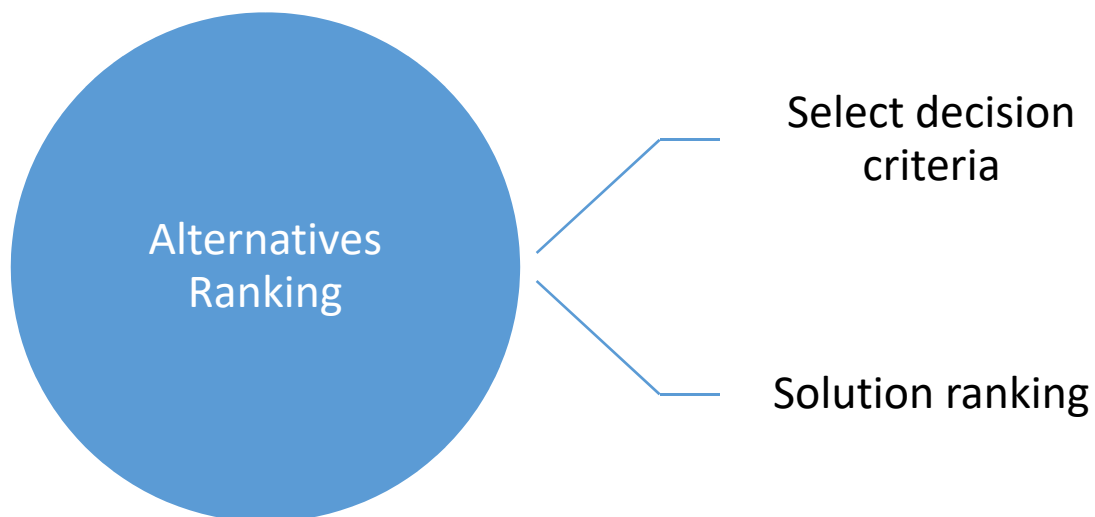


Figure 16. Alternatives Ranking scenario

### Step 1: Select decision criteria

The users define their preferences making pairwise comparison of the decision criteria. The criteria are shown in pairs and the user must select the relative importance of each couple of criteria (risk versus cost, cost versus LCC, etcetera).

The system will use this criteria weight to order the solutions and decide which one fits best the users’ preferences.



Figure 17. DSS Website -Decision Criteria Selection

**Step 2: Results – Ranking of solutions**

As the last step of the process, the ranking of solutions – according to the criteria selected previously - is presented to the user. The solution which best fits the criteria is shown with the greatest weight, followed by the rest of feasible solutions.

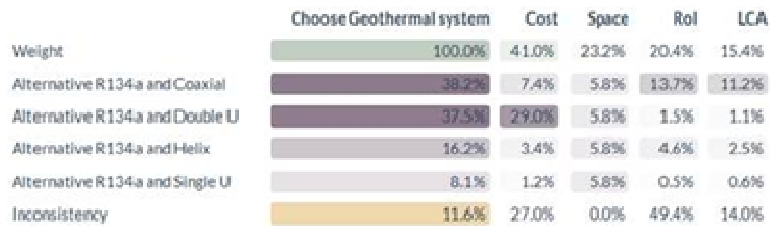


Figure 18. DSS Website – Solutions ranking results

The complete technical details of each of the solutions are also shown, as well as instructions on how to adjust the decision criteria selection.

## **4 Conclusion**

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This document has presented the instructions for the user to be able to use the user-friendly web application developed in the Cheap-GSHPs project. This web application enables users to choose the most suitable geothermal technology – the one that best fits both the energy demand requirements of their facilities and their criteria preferences.

The different steps of the process have been presented, arranged in four scenarios: user login and project creation, energy profile definition, feasible alternatives and ranking of solutions. These scenarios cover the whole process followed by the user from the registering in the website to the obtaining of final results.