Danube Region Geothermal Information Platform (DRGIP)

User's Manual

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User's Manual

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Authors:

Jernej Bavdek, Maks Šinigoj, Špela Kumelj [all GeoZS]

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CONTENTS

System requirements:

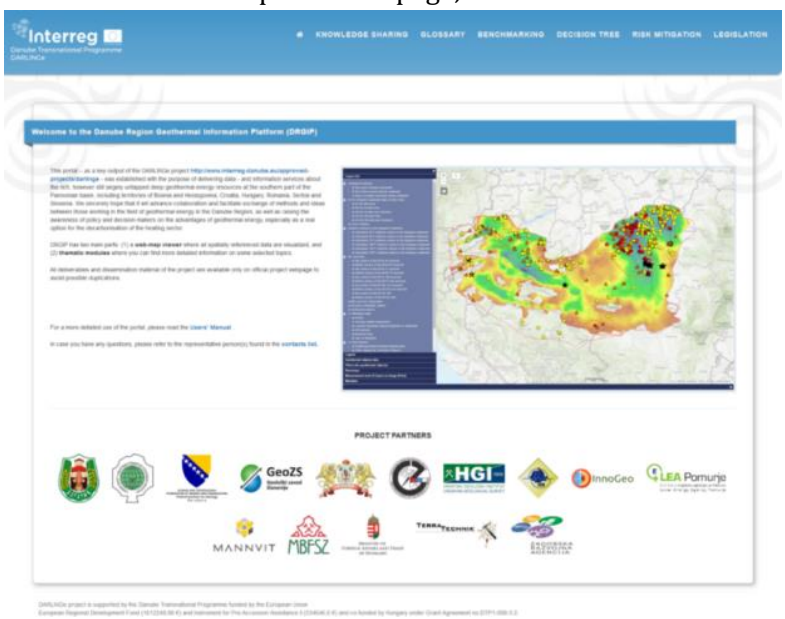
Modern browser (Firefox, Chrome, Internet Explorer, Safari, Opera)

1. Home page

When navigating to the page https://www.darlinge.eu/ we get to the home page of the DRGIP portal. The home page is composed of five sections:

1. Navigation bar – in the uppermost part. It consists of project logo, home icon and names of specific modules:
   - Knowledge sharing
   - Glossary
   - Benchmarking
   - Decision tree
   - Risk mitigation
   - Legislation

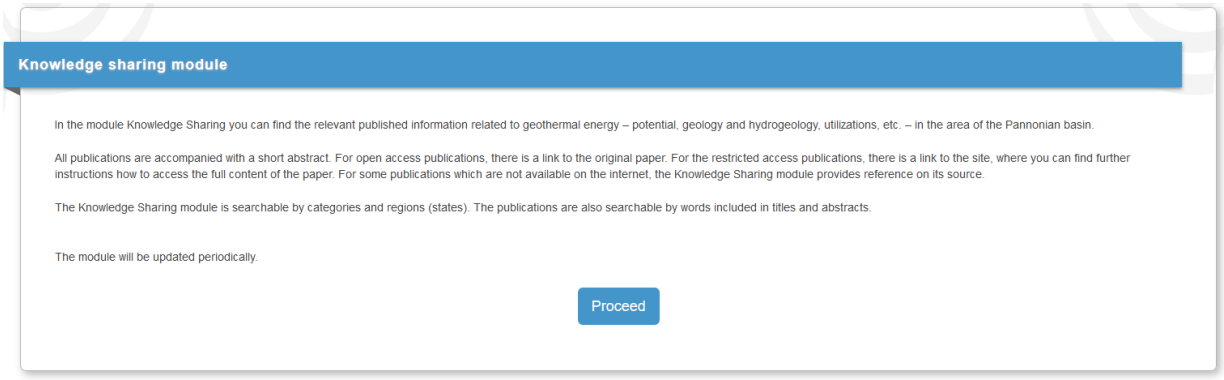
   Clicking on each of these module names in navigation takes us to the **intro page of the specific module** with description and explanation of the module.
2. Description of the portal and its purpose with additional links to web page of the project, user manual and contact list of people that contributed to portal's content, or its technical derivation.
3. Image of the Map viewer of DRGIP portal, which holds the visualization of spatially referenced data. Clicking on this image gets us to the map viewer.
4. Logos of the project partners - clicking on specific logo gets us to the home page of the project partner.
5. Disclaimer text in the bottom part of the page, in the footer.



PART I. - MODULES

I.1. Knowledge sharing

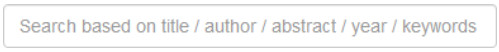
After navigating to the Knowledge sharing module in the navigation bar, we get to the intro page of the module.

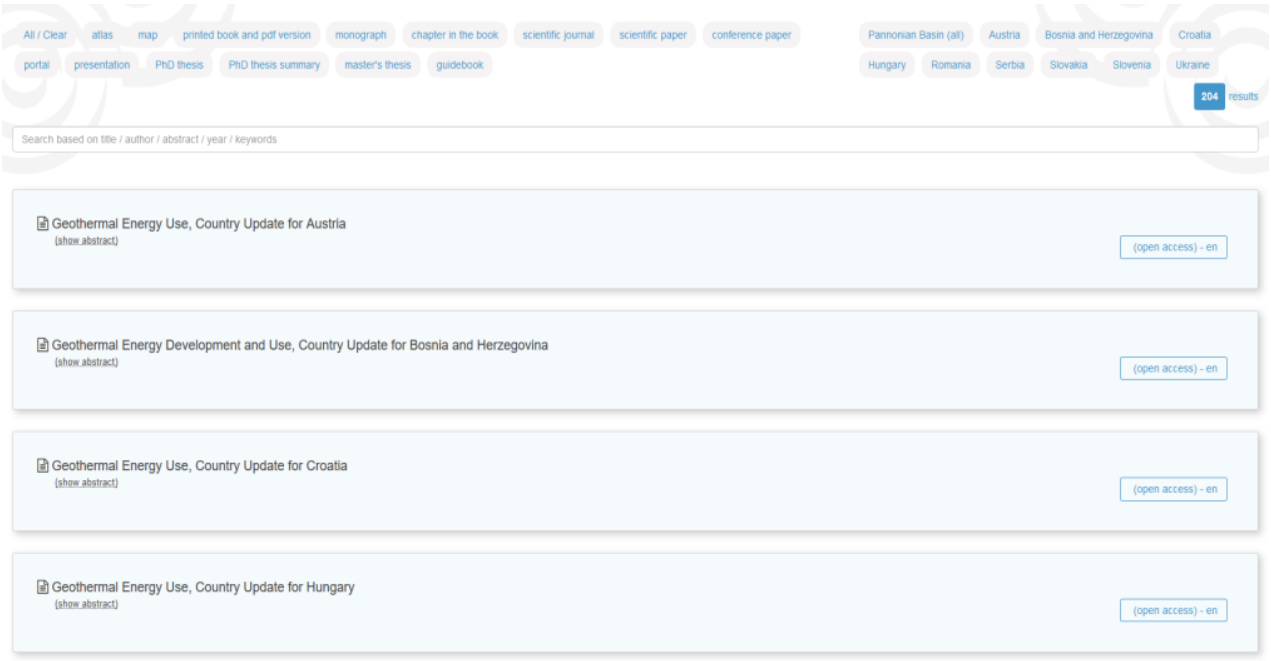


If we click **Proceed**, we get to the module itself.

This page consists of more than two hundred scientific publications which can be **filtered** by:

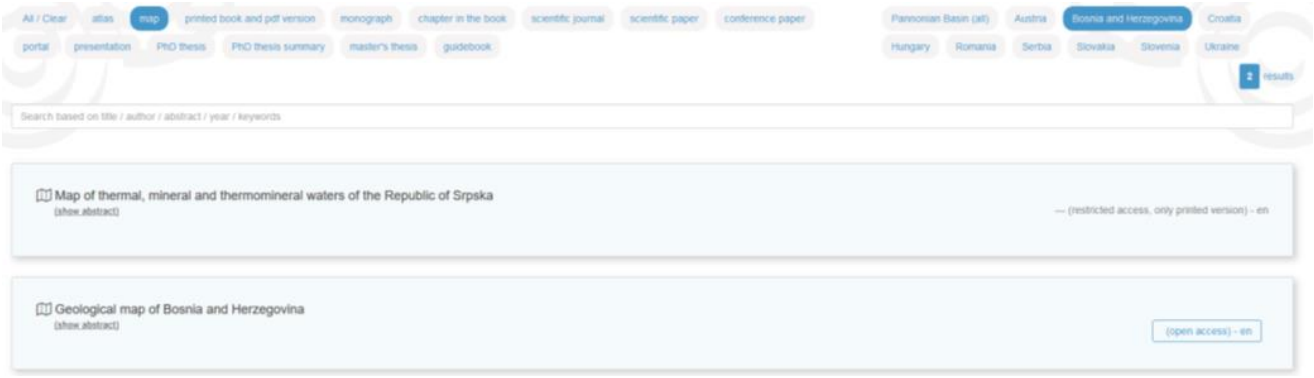
- Category of knowledge resource (atlas, map, printed book, monograph, chapter in the book, scientific journal, scientific paper, conference paper, portal, presentation, PhD thesis, PhD thesis summary, master's thesis, guidebook)
- Region (Pannonian Basin – all, Austria, Bosnia and Herzegovina, Croatia, Hungary, Romania, Serbia, Slovakia, Slovenia, Ukraine)
- Title, author, abstract, year, keyword



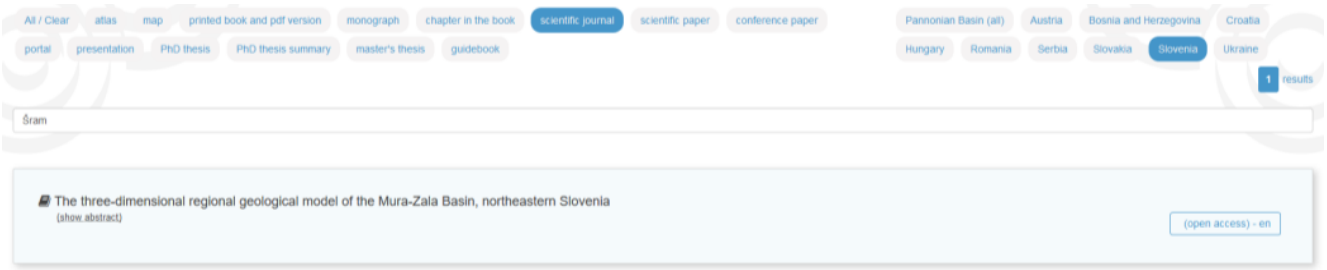


Categorical and region filtering can be done with buttons at the top, we can also **combine** the filter buttons from different types of filtering and filtering with input field.

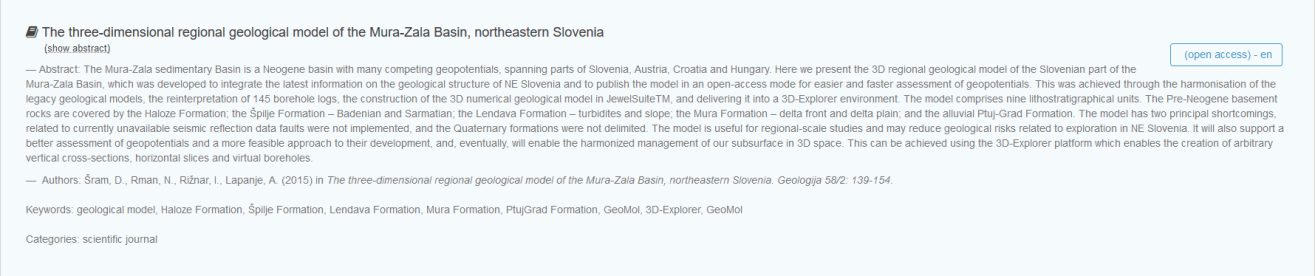
E.g. 1: Knowledge resources filtered for *map* category and *Bosnia and Herzegovina* region gives us 2 results:



E.g. 2: knowledge resources filtered for *scientific journal* category, *Slovenia* region and "*Šram*" in input field as author gives us 1 result:



If we click on the **show abstract** under the title of the knowledge resource, the panel expands:



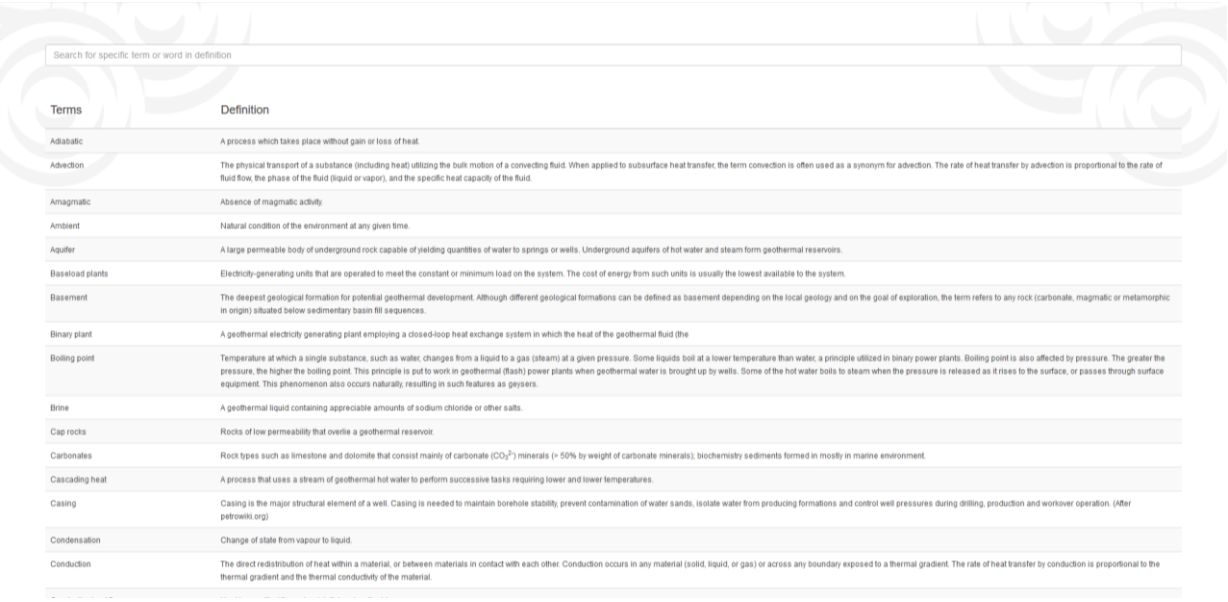
which shows us additional information about the knowledge resource:

- Title
- Abstract
- Authors
- Keywords
- Categories
- Type of access (in the top right side of the panel), language of resource

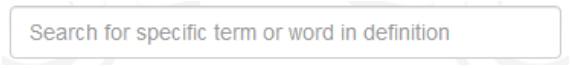
The input field mentioned above can filter data based on information from each of these data fields. And if we click on the button with type of access, it navigates us to the original page of the resource.

I.2. Glossary

After navigating to the Glossary module in the navigation bar, we get to the intro page of the module and if we click Proceed, we get to the module itself.



This module consists of a list of terms and their definitions often used related to geothermal energy. We can filter through terms and/or definitions by using the input field, similarly to knowledge resource module.

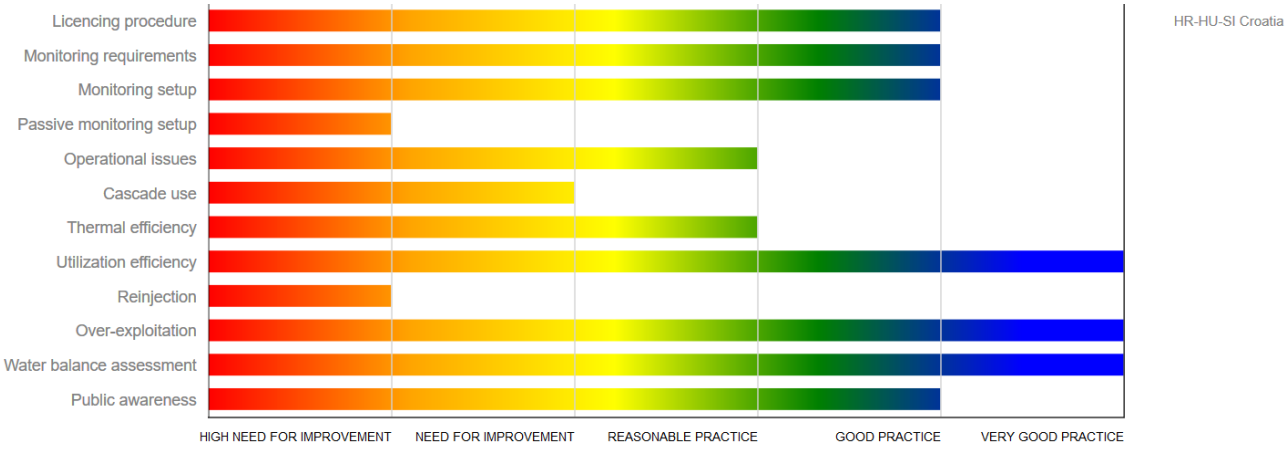


I.3. Benchmarking

After navigating to the Benchmarking module in the navigation bar, we get to the intro page of the module and if we click Proceed, we get to the module itself.

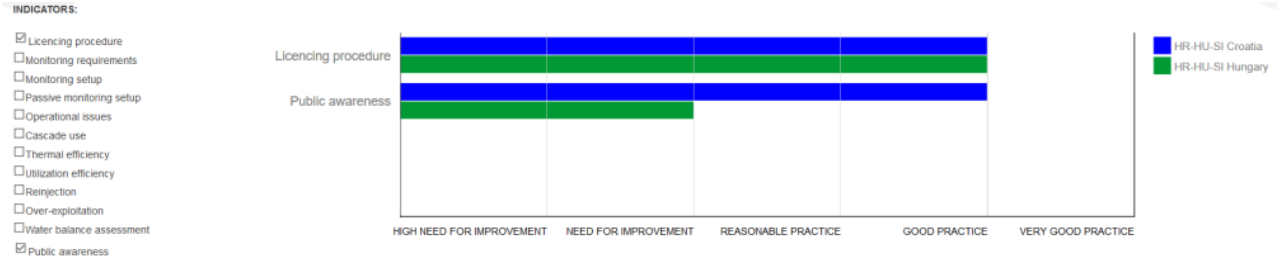
In the upper part of the page we have countries grouped by the pilot area they belong to (3 cross-border pilot areas). We can check the Map viewer of DRGIP to look at the boundaries of each pilot area. By clicking the checkboxes next to the country labels, we can select which pilot area/country benchmarking results are to be shown.

If we choose a specific country, the benchmarking tool provides us with the benchmarking results that are drawn as a bar chart.



If we select an additional country, it gives us legend for each country and a section of **indicators** by which we can compare countries. If we select/deselect these indicators, the bar charts redraw themselves accordingly.

E.g.: here we can see comparison of countries *Croatia* and *Hungary* in *Croatia – Hungary – Slovenia pilot area* by two indicators: *licencing procedure*, *public awareness*:



When we click on a country inside the specific pilot area it also pops up detailed information about the specific pilot area below the bar chart.

E.g.: BA-RS pilot area:

BA-RS pilot area

In Bosnia and Hercegovina, two geothermal wells were evaluated. In Serbia two wells were also evaluated, but only one produces thermal water. All four wells tap carbonate rocks. As the number of wells is very low in both cases, it is necessary to point out that the results can be treated as rather biased, or better, too dependent on practice of a single user.

The evaluation shows that regulations and monitoring requirements are reasonable in both countries, but some improvements has to be be made in implementation of the monitoring requirements. Moreover, no national monitoring network of geothermal aquifers exists. Despite, the knowledge on the status of water balance is regarded as sufficient to evaluate the quality and quantity status of these aquifers as good. There is a difference in applied technology for exploitation of thermal water between the countries. Is seems to be more effective in Bosnia and Hercegovina as cascade use is properly applied and no operational issues are critical. However, both countries show that improvements are needed in the direction of increasing thermal efficiency; this means that more cascades need to be applied to extract more thermal energy from thermal water. Also, the quantities of exploited water are rather below the allowed in the permits. It is also obvious that injection of thermally depleted water is not yet sufficiently applied and there as a great need for its improvement in general. Last but not least, some public information on thermal water occurrence, properties and use does exist, however, more effort will be put in this, more geothermal development we can expect.

In the bottom of the page we can see the descriptions of the indicators by which the benchmarking has been done. When we click the **more info** link, it gets us to a pdf file with explanations to the formulas of indicator calculation and detailed explanation of the specific parameter.

LICENCING PROCEDURE: HOW SYSTEMATIC IS THE PROCEDURE OF GRANTING PERMITS FOR EXPLOITATION?

This indicator describes the transparency and simplicity of a national or regional legislation. It takes into account, for example, whether licencing is required to use thermal water or not, if at least 80% of active (producing) objects have a licence granted, or if only one type of concession fee has to be paid annually to produce thermal water by a licence, etc. (more info...)

OPERATIONAL ISSUES: ARE TECHNOLOGICAL CHALLENGES SUCCESSFULLY ADDRESSED AND WELL DOCUMENTED?

This indicator shows whether appropriate technical requirements are met at wells' installations, if problems during operation are successfully mitigated (e.g. scaling, free gases....), how efficiently is the water usage implemented, and it also describes the overall status of archives of documentation at a site. (more info...)

REINJECTION: CAN WASTE THERMAL WATER BE REINJECTED AND IS IT AND WHERE?

This indicator is calculated based on the ratio of the volume of reinjected and produced thermal water which is used only for geothermal energy (heat) production as water used in swimming pools should not be reinjected. It considers whether the reinjection is implemented into the same aquifer from where the water is abstracted or not. (more info...)

MONITORING REQUIREMENTS: WHAT SHOULD PERMIT HOLDERS MONITOR AND REPORT TO AUTHORITIES?

This indicator describes what the licence owners are obliged to monitor and report to an authority in a region or a country. It checks if hydraulic and chemical properties of the aquifer and water are regularly observed, e.g.: groundwater levels, temperature, produced quantity, chemical composition of thermal water, hydraulic tests etc. It also checks if interpretation of these results is performed and reported to an authority or not. (more info...)

CASCADE USE: IS THERMAL WATER USED FOR MULTIPLE PURPOSES AND SEQUENTIALLY?

This indicator is related to a site's (it may have multiple wells used) practice in energy abstraction, denoting if thermal water is used in more than one sequential application. For example, first for hotel space heating, then for sanitary water heating, later for pool heating and at the last stage for greenhouse heating etc. (more info...)

OVER-EXPLOITATION: ARE THERE ANY CHANGES IN QUANTITY AND QUALITY STATE OF GEOTHERMAL AQUIFERS NOTICED?

This indicator highlights whether obvious changes in piezometric groundwater levels, water temperatures, groundwater availability and water quality or groundwater dependent ecosystems have been observed. In the DARLINGe project area, the subsidence is not relevant issue and was therefore not included in this indicator. (more info...)

MONITORING SETUP: WHAT DO PERMIT HOLDERS MONITOR AND REPORT IN REALITY?

This indicator is linked to monitoring requirements and it identifies which parameters are observed at an individual geothermal well or a spring. These can be quite simple (eg. only water level) or varying up to complex monitoring with numerous parameters recorded, both, at production and monitoring wells. Inactive production wells with licences are also included in this calculation. (more info...)

THERMAL EFFICIENCY: HOW MUCH AVAILABLE ENERGY DO USERS EXPLOIT IN REALITY?

This indicator is determined as a ratio between the used and available heat energy on an annual scale, where the mean annual air temperature of 12 °C is used as a treshold value for 100%. It means that all temperatures above the latter are available to the user as available geothermal energy (heat). (more info...)

STATUS OF WATER BALANCE ASSESSMENT: HOW RELIABLE IS THE INFORMATION ON THE EXISTING WATER BALANCE ASSESSMENT?

This indicator is a measure of the availability and reliability of information used to evaluate the quantity and quality status of a geothermal aquifer. (more info...)

PASSIVE MONITORING SETUP: WHAT KIND OF INDEPENDENT MONITORING SYSTEMS EXIST?

This is a region or country specific indicator highlighting whether there is/are geothermal observation wells monitored and their state interpreted by a national or regional environmental agency or similar organization. (more info...)

UTILIZATION EFFICIENCY: HOW MUCH LICENCED WATER QUANTITY DO USERS EXPLOIT IN REALITY?

This indicator is a ratio between the actual annual water production and the maximum permitted annual production rate. If this data is not available, the theoretical capacity of the well can be applied as the latter. (more info...)

PUBLIC AWARENESS: WHICH AND HOW MUCH PUBLIC INFORMATION IS PROVIDED BY THE USERS THEMSELVES?

This indicator highlights how much and which type of information is publicly available at websites and easy-accessible promotional publications for an individual geothermal resource and practice of its use. Scientific articles and expert reports are not relevant for general public, and therefore, are neglected in this indicator. (more info...)

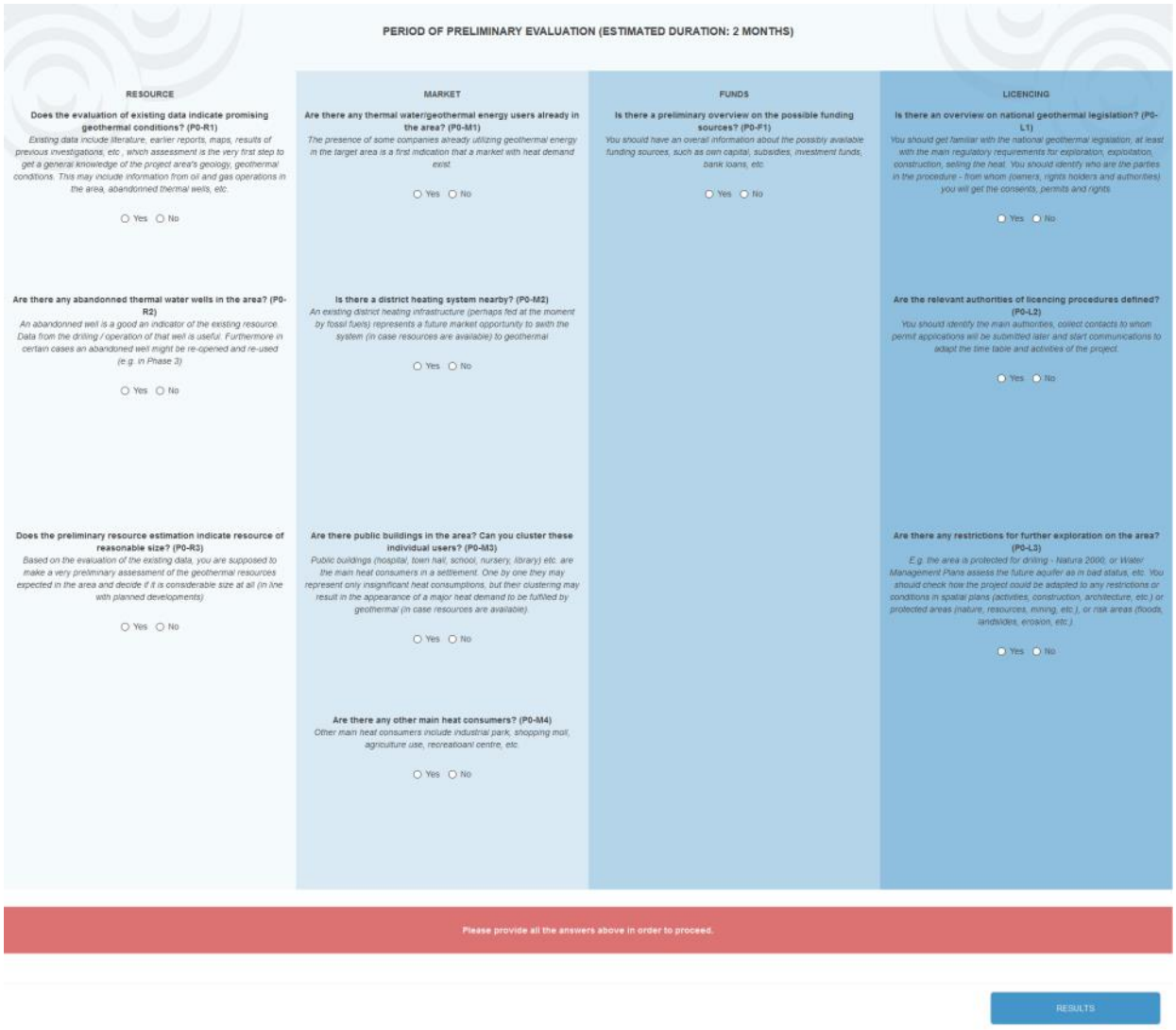
I.4. Decision tree

After navigating to the Decision tree module in the navigation bar, we get to the intro page of the module and if we click Proceed, we get to the module itself.

The opening page welcomes us with a list of questions according to 4 key areas of project development (Resource, Market, Funds, Licensing) that are grouped by corresponding phases of project development:

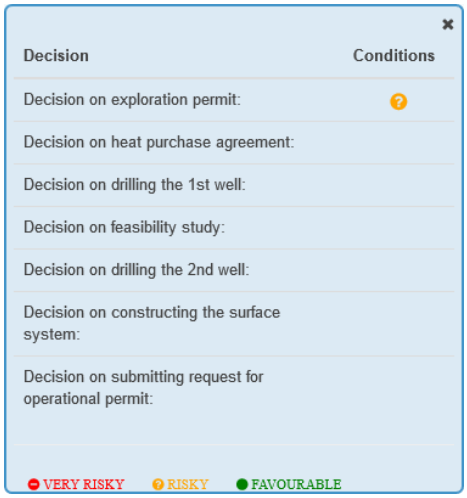
- Period of preliminary evaluation
- Period of preparatory work
- Period of construction of wells
- Period of construction of surface system

and are separated by columns.



On each question we answer either Yes or No. We must answer all questions in order to be able to proceed. Until we answer to all the questions, we see the alert: "Please provide all the answers above in order to proceed." When you answer to all questions in the section, the sign disappears and changes to:

After clicking on the icon, our answers are evaluated and the **Results window** pops up in the downright corner of the screen:



Here it shows us the condition of the specific decision we are going to make. It evaluates according to three levels: very risky, risky and favourable.

We can minimize this window by clicking at the cross in the upper right part of the window. This minimizes the window to this button, and if we click back on it, it toggles it back on.

After the evaluation we also get a pair of new icons:

This gives us two options:

- Back – it slides us back to the questions section and in case we change an answer to some of the questions, we **must re-evaluate** results again by clicking on evaluate icon, to have the updated condition.
- Continue – it slides us down to the next series of questions. That corresponds e.g. to "You've decided to procure the exploration permit," which now also shows in the results window.

Basic flow is such that sometimes we just have to click "Continue" to proceed to a new section of questions, because there is no evaluation at the time of process to be made, and when the decision is to be made, we have to evaluate results first.

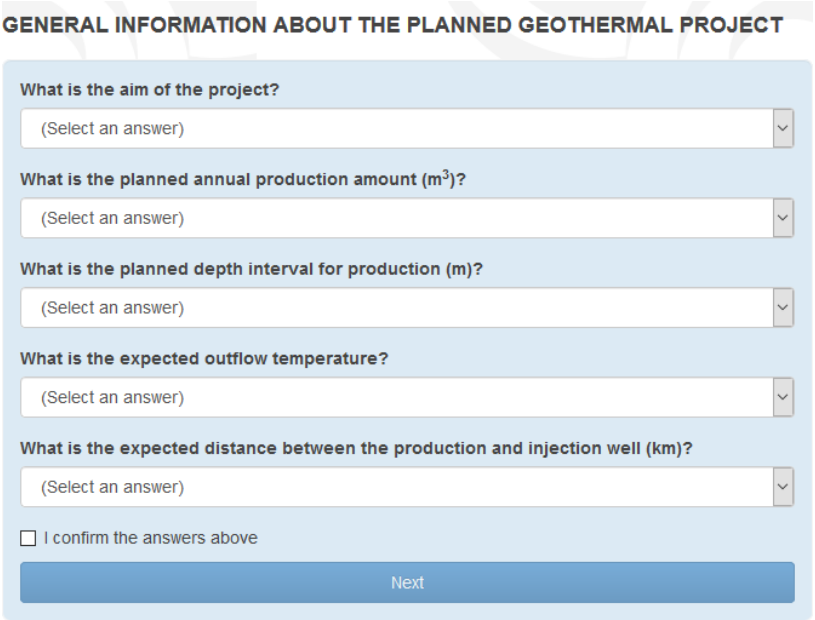
Flow is intuitive and gets us from one section to the other in separated steps. When we've answered all the questions, we get to the final table that summarizes conditions on all decisions.

Decision	Conditions
Decision on exploration permit:	●
Decision on heat purchase agreement:	⛔
Decision on drilling the 1st well:	●
Decision on feasibility study:	⛔
Decision on drilling the 2nd well:	⛔
Decision on constructing the surface system:	●
Decision on submitting request for operational permit:	⛔

I.5. Risk mitigation

After navigating to the Risk mitigation module in the navigation bar, we get to the intro page of the module and if we click Proceed, we get to the module itself.

At first the module welcomes us with the form of *General information about the planned geothermal project*.



We have to answer to all the questions in order to proceed. We also have to tick the "I confirm the answers above" checkbox. This enables the button "Next" and after clicking it gets us to the next topic of questions. There are four sets of questions:

- General information about the planned geothermal project
- Information on level of exploration and on operating wells

- Information on properties of targeted reservoir
- Information on properties of the geothermal fluid

By filling in the forms one after the other, we get to the final form where we select the relevant phase of the planned geothermal project. When we select it, the list of risk mitigation measures pop ups, suggesting us which mitigation measures one should take in the given project phase to avoid possible damages.

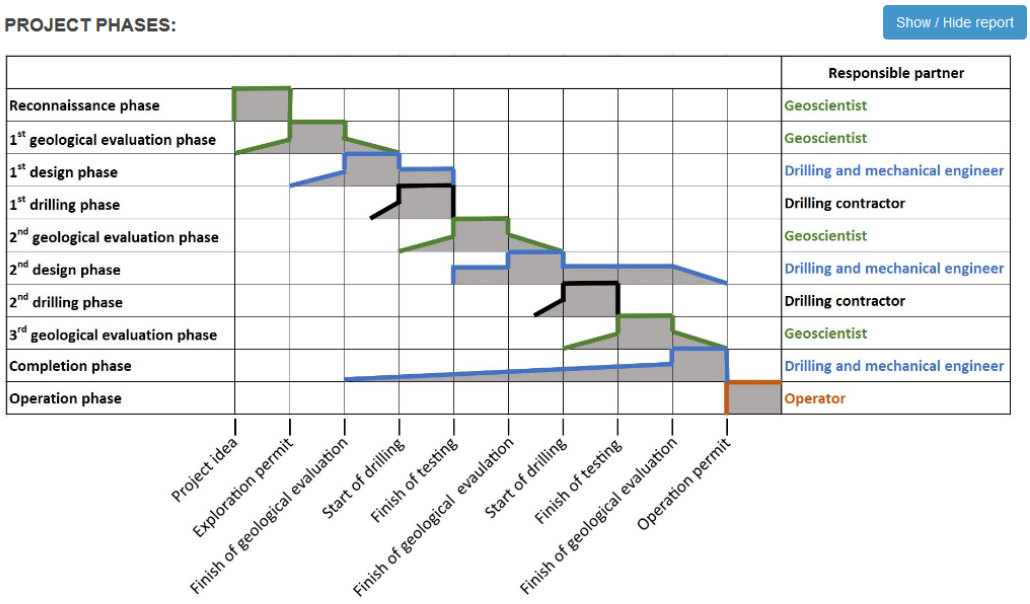
PERFORM A MITIGATION MEASURE:

Level of recommendation	Measure	If the measure is not applied, the following damage might occur with higher probability
Highly recommended	Designing the production section of the well with 8 1/2" diameter.	The amount of energy is low, because of low yield.
Recommended	Accurate hydrogeological modelling including data collection and interpretation.	Pending of operation, because significant induced pressure change is observed at a waterwork nearby.

PREPARE A MITIGATION MEASURE:

Level of recommendation	Measure	By the use of the measure the next damage(s) could be avoided
Highly recommended	Use of external casing packer between the loose formation and productive layer.	1) The amount of energy is low, because of low yield. 2) Cost increase in operation because of pressure increase at reinjection.
Highly recommended	Professional service provider and supervised cementing activites for appropriate isolation.	1) The amount of energy is low, because of low temperature. 2) Pending of operation, because significant induced pressure change is observed at a waterwork nearby.
Recommended	Use of cement with increased heat insulation properties for cementing of casings of production well.	The amount of energy is low, because of low temperature.
Worth to consider	Try to drill long enough production section for securing the expected yield.	The amount of energy is low, because of low yield.
Worth to consider	Use of clay minerals-free drilling mud in the production section, which is properly treated in the mud system by removal of cutting particles.	The amount of energy is low, because of low yield.
Worth to consider	Performing adequate chemical sampling and analysis of produced fluid.	Cost increase in operation because of increased scaling activity of produced fluid.
Worth to consider	Performing adequate chemical sampling and analysis of produced fluid.	Cost increase in operation because of increased corrosion activity of produced fluid.

A separate section also explains the specific project phases and there duration.



EXPLANATION:

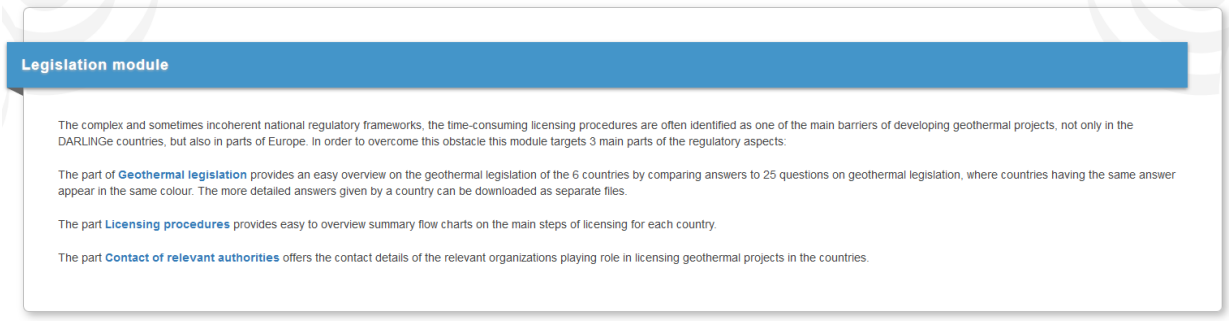
Reconnaissance phase - Reconnaissance phase starts from the project idea and lasts until the decision to obtain an exploration permit or not
1st geological evaluation phase - This phase theoretically starts in the reconnaissance phase and last until the drilling, but the main activity is made between the approved exploration permit and the start of the design phase.
1st design phase - The main activity o this phase is between the geological evaluation and drilling
1st drilling phase - The drilling phase starts from the mobilization of the rig and lasts until the finish of operation of end of drilling (OED), which period (OED) covers the testing activities in general.
2nd geological evaluation phase - This phase theoretically starts together with the 1st drilling phase and last until the 2nd drilling, but the main activity is made between the finish of testing and the start of the 2nd design phase.
2nd design phase - The main activity o this phase is between the geological evaluation and drilling
2nd drilling phase - The drilling phase starts from the mobilization of the rig and lasts until the finish of operation of end of drilling (OED), which period (OED) covers the testing activities in general.
3rd geological evaluation phase - The 3rd geological evaluation is based on the data collected during the completion of second drilling.
Completion phase - The completion phase covers the activities of surface works excluding drilling activities
Operation phase - The operation phase is when the construction is finished, and the plant is working continuously according to the approved operational permit.

The show / hide report button toggles visibility of the previously selected answers to questions, if we choose to print the whole page.

I.6. Legislation

After navigating to the Legislation module in the navigation bar, we get to the intro page of the module, where there is a description of the different sub-modules:

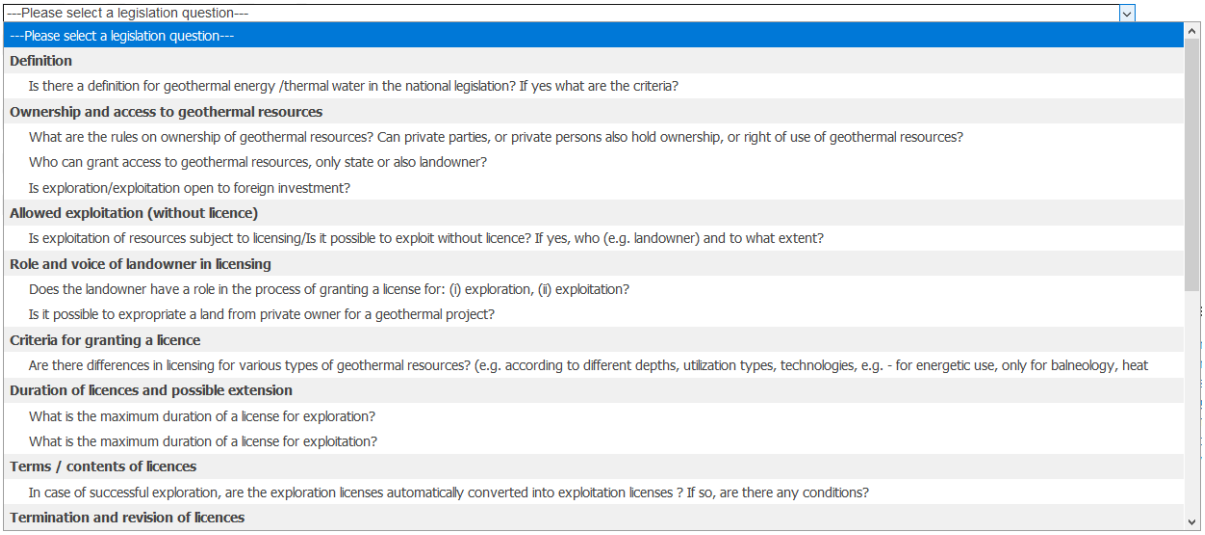
- Geothermal legislation
- Licensing procedures
- Contacts of relevant authorities



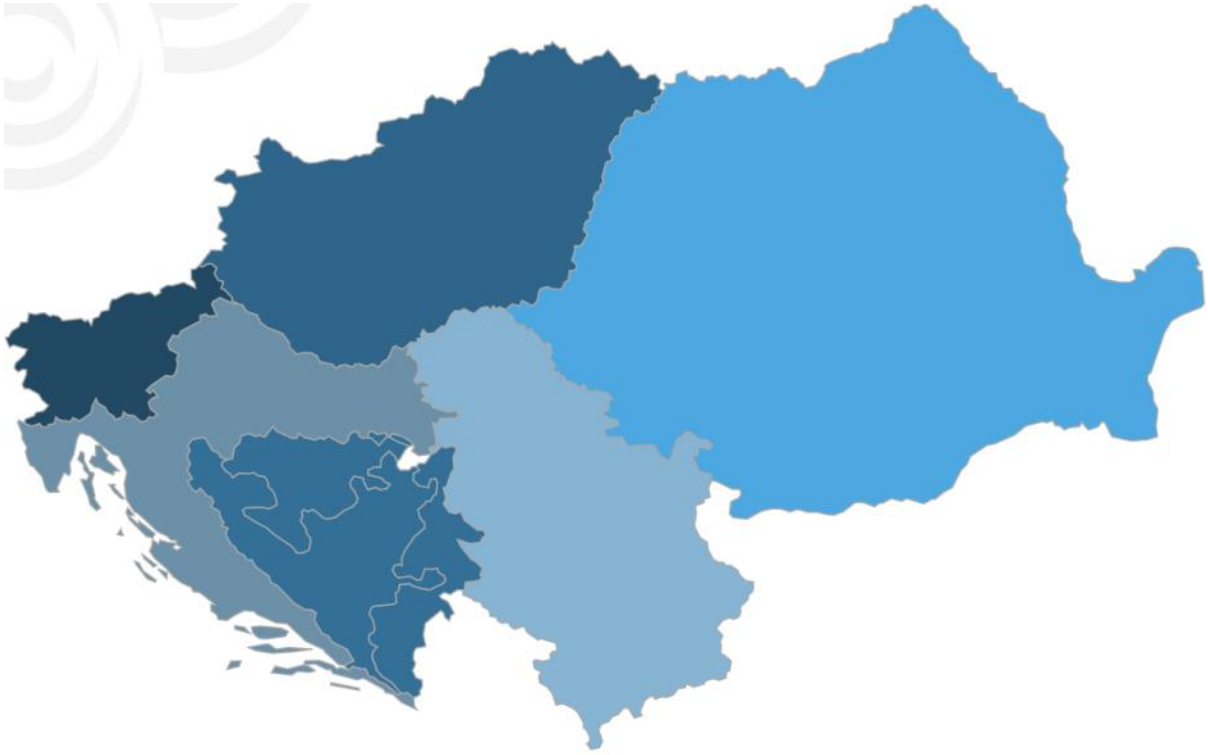
If we click on one of the sub-module links, we get to the specific sub-module.

I.6.1. Legislation – Geothermal legislation

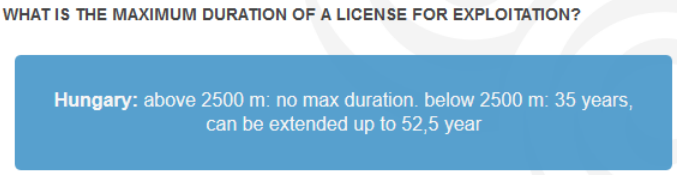
At first we have to select a specific legislation question from a set of questions assessing various aspects of the geothermal regulatory framework in the DARLINGe countries.



When we select one question, the **responsive image** with DARLINGe countries pops-up, coloured in accordance to similarity of the legislation answers between countries. When there are the same legislation directives, the countries will have the same colours.



When we click over a specific country, the question and summed up answer to that question for that country pops-up.



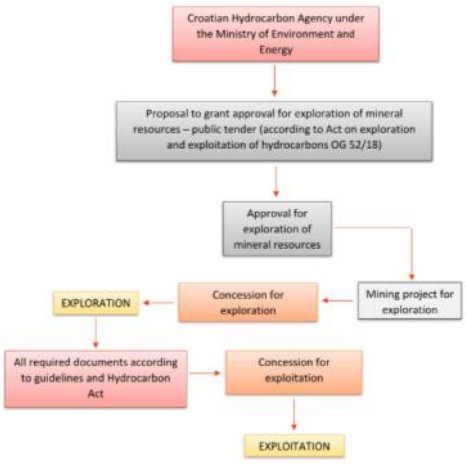
We can also download the pdf file for a specific country with detailed answers to all the legislation questions, if we choose from this list:

MORE DETAILED ANSWERS BY COUNTRIES IN THE LIST BELOW:

Bosnia and Herzegovina - Federation of Bosnia and Herzegovina
Bosnia and Herzegovina - Republika Srpska
Croatia
Hungary
Romania
Serbia
Slovenia

I.6.2. Legislation – Licensing procedures

There is a collection of diagrams, one for each country showing the main steps of licensing a geothermal project. If we click on the image, the full resolution image fills up the screen that can be closed by cross tick at the top right corner of the screen. E.g. for Croatia:

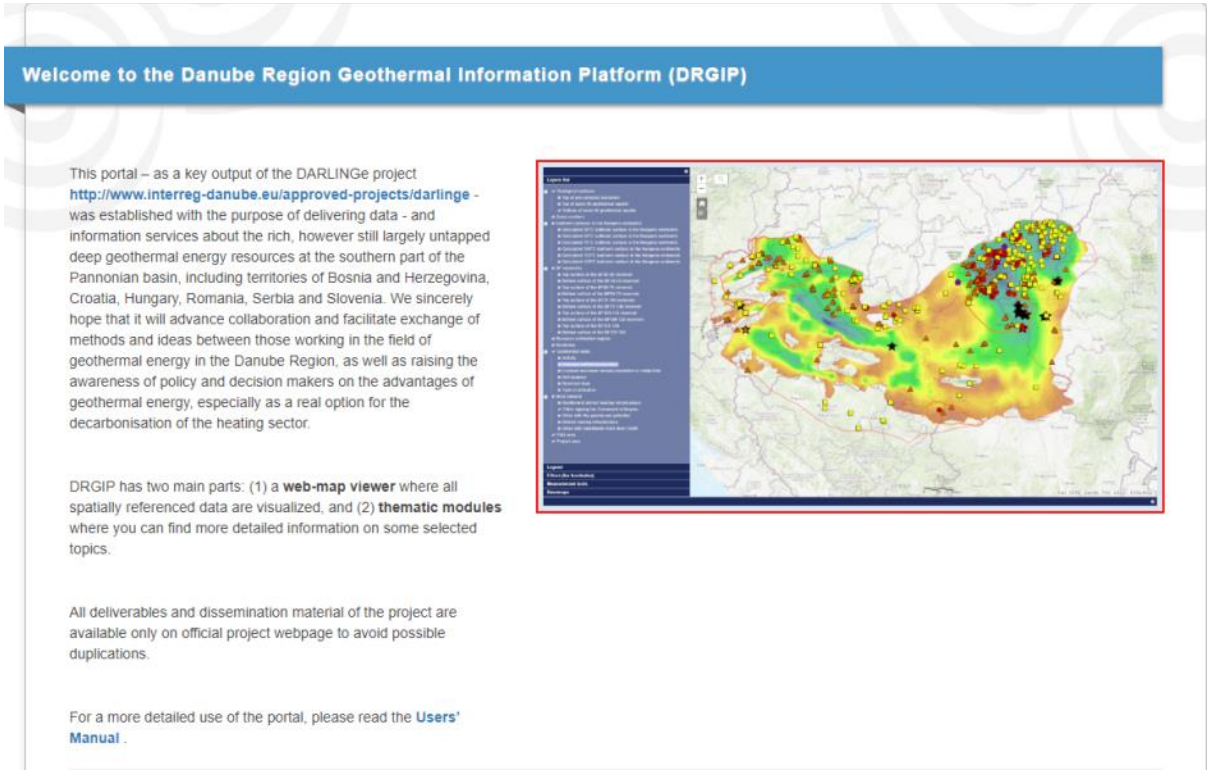


I.6.3. Legislation – Contact of relevant authorities

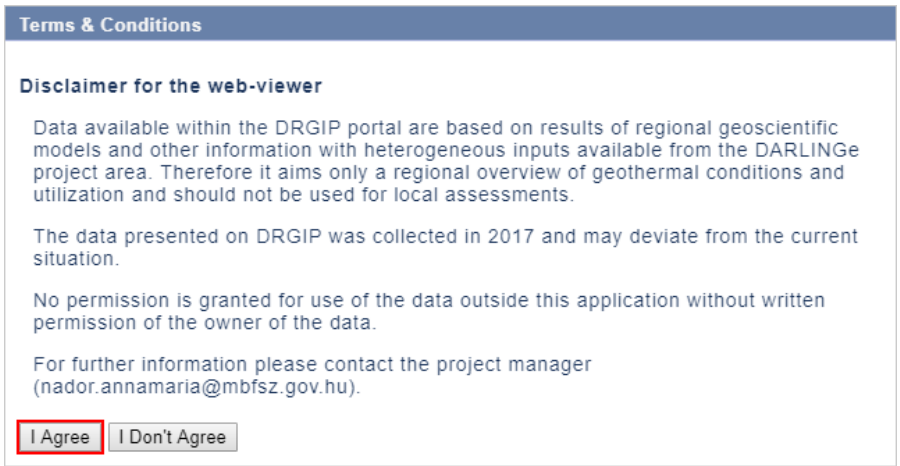
There is a list of contacts of relevant authorities for each country. We can filter by each country by selecting buttons with the country name at the top.

PART II. - MAP VIEWER

To access the **Map viewer**, click on its image on the front page *(highlighted with red in the screenshot)*.



The Terms & Conditions window pops up. If you agree with them, click on the **I Agree** button *(highlighted with red in the screenshot)* to proceed to the Map viewer.

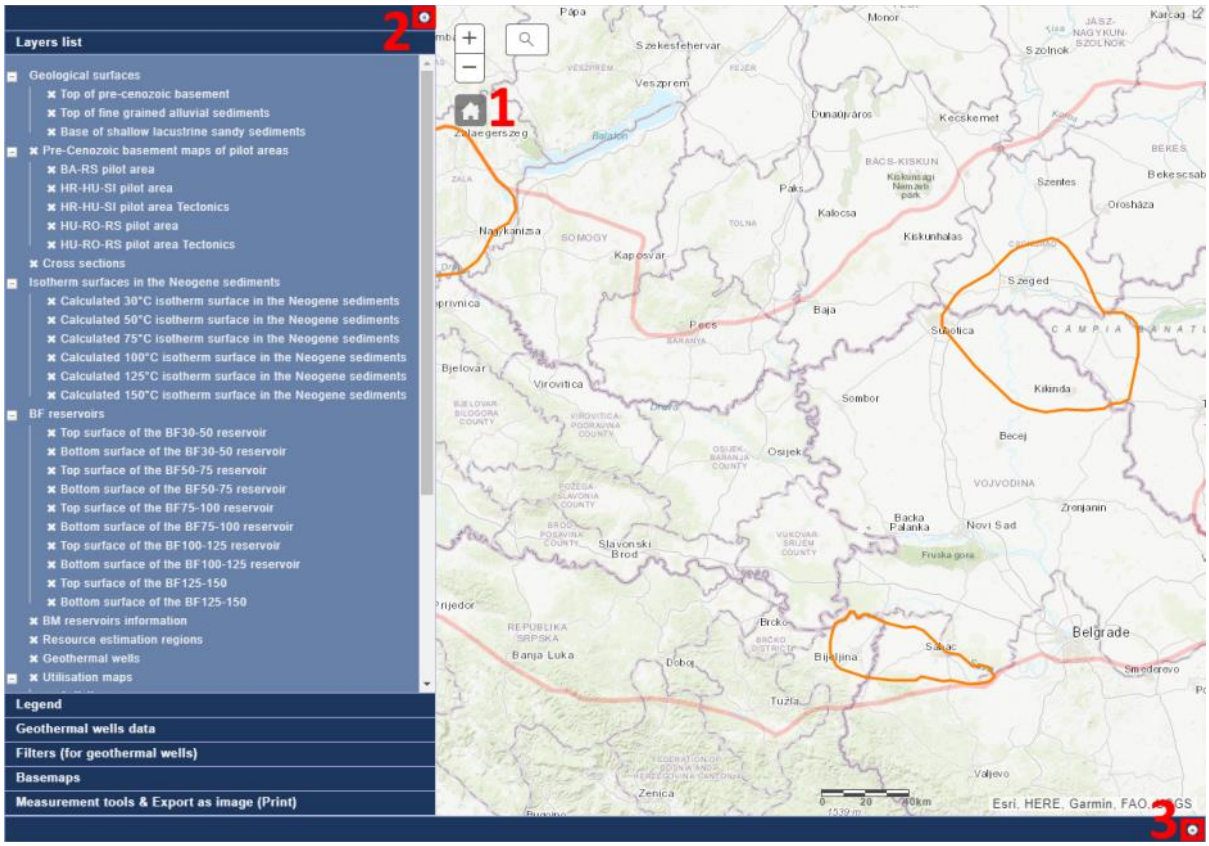


II.1 General overview

In general the viewer can be divided into three sections, all of which will be explained further down.

- **Map** itself is *marked with a red 1*
- **Sidebar** with **layers, geothermal objects data, filters, measurement tools, basemaps, measurement tools** is *marked with a red 2*
- **Tables menu**, which can be expanded by clicking the button *marked with a red 3,* shows us different attribute tables

The arrow buttons *highlighted with red* allow you to **collapse** or **expand** either the entire layer or table menu.



II.2. Map

Basic map viewer functionality:

Zoom in (**+**) or **Zoom out** (**-**) *you can zoom in or zoom out by clicking on these buttons*.

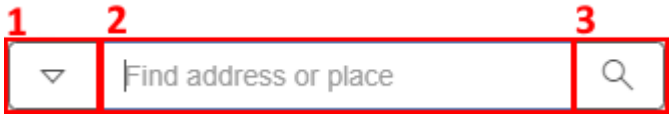
Default extent: *reverts the map back to its default extent.*

Select multiple geothermal objects (only available if you have the layer Geothermal objects enabled) *This allows you to select multiple geothermal objects on the map, by dragging a selection box over their points.*

Deselect geothermal objects*: this deselects previously selected geothermal objects*

Button in top right corner: *opens up a **Map Overview** in the upper right corner.*

Search bar: *by clicking on this button different search options expand:*



The button *marked with a red 1*: You can specify by objects in which layer you can search in (geothermal objects and pilot areas are enabled). The button *marked with a red 2*: The text box, where you can input your **search terms**. The button *marked with a red 3*: By clicking on it, you execute the **search**.

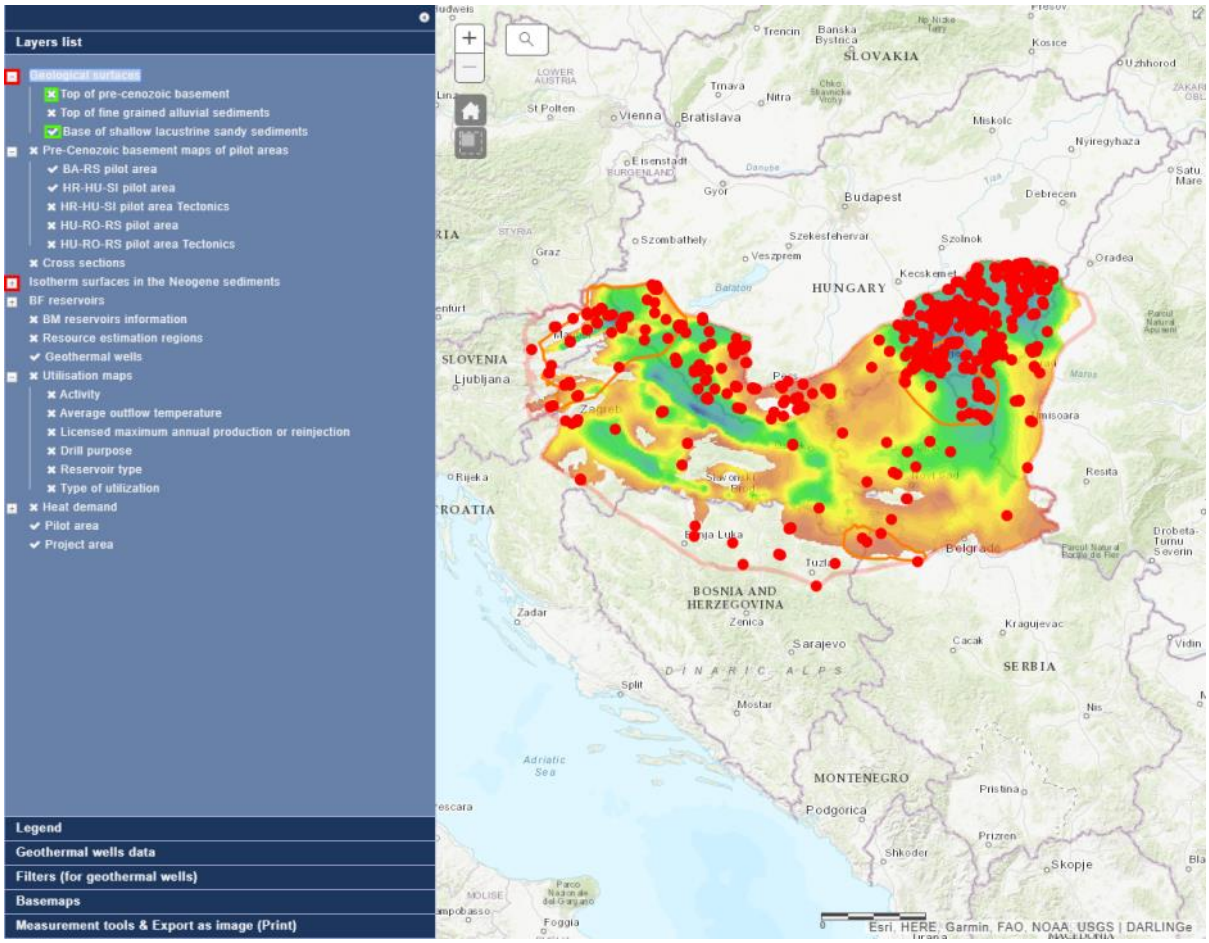
II.3. Sidebar menu

To open a specific submenu with specific functionality, click on its name. Each submenu will now be described.

II.3.1. Layers list

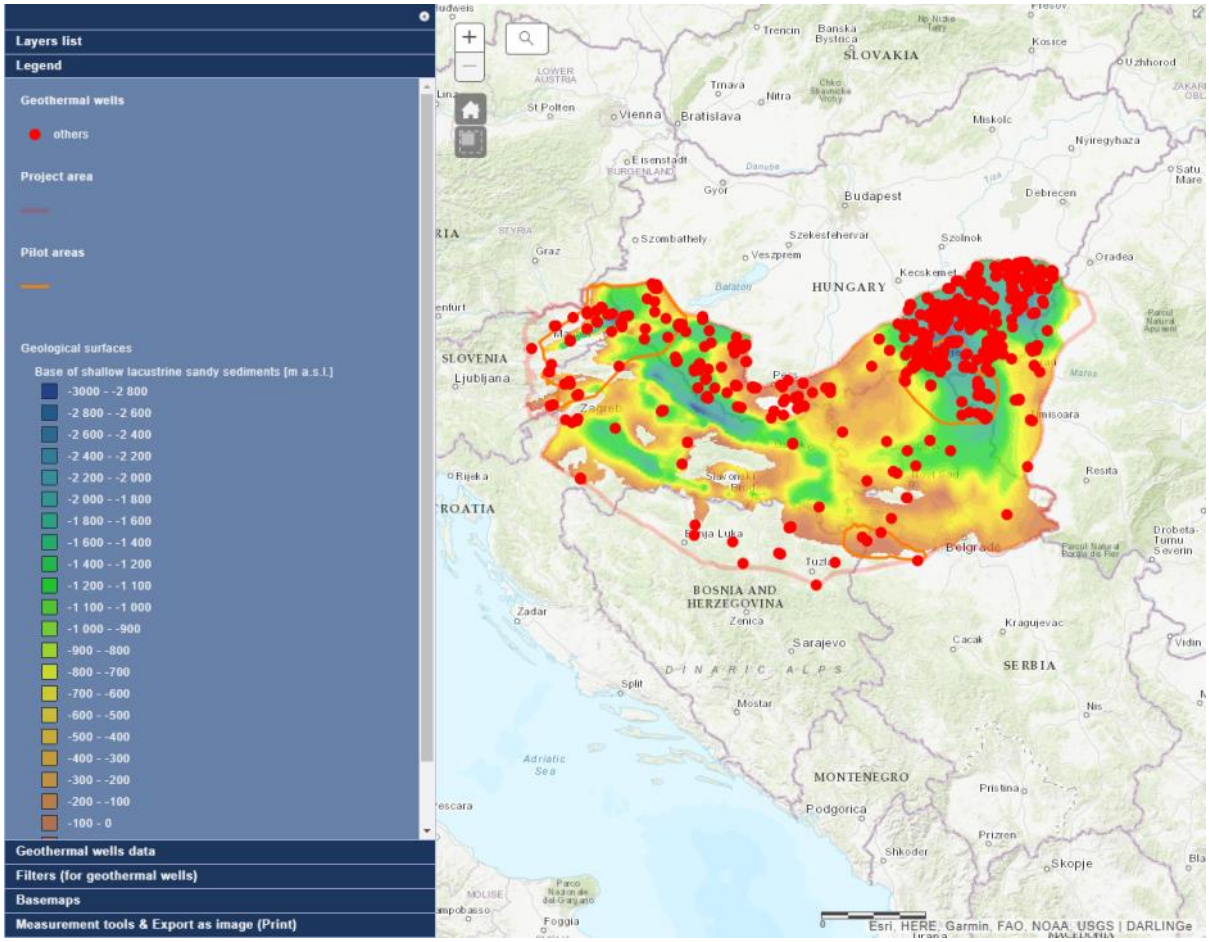
The buttons *highlighted with red* allow you to **collapse** or **expand** different groups of layer types.

The buttons *highlighted with green* allow you to activate specific layers. Certain sub-layers need their main layer activated first.



Only one raster layer can be selected at the time, if you select the second raster layer, previously selected ones get deselected.

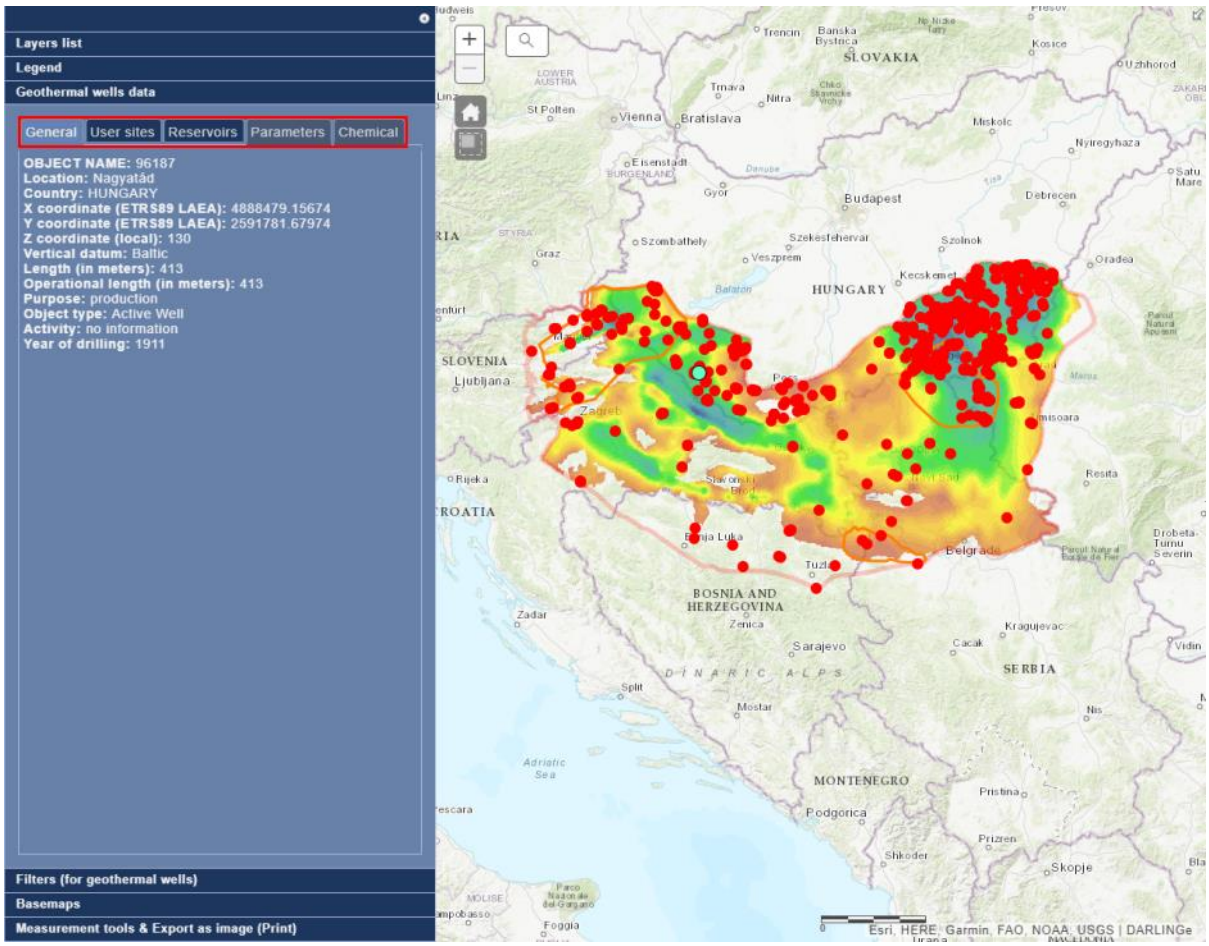
II.3.2. Legend



Legend shows different colored categories of data based on the currently selected layers.

II.3.3. Geothermal objects

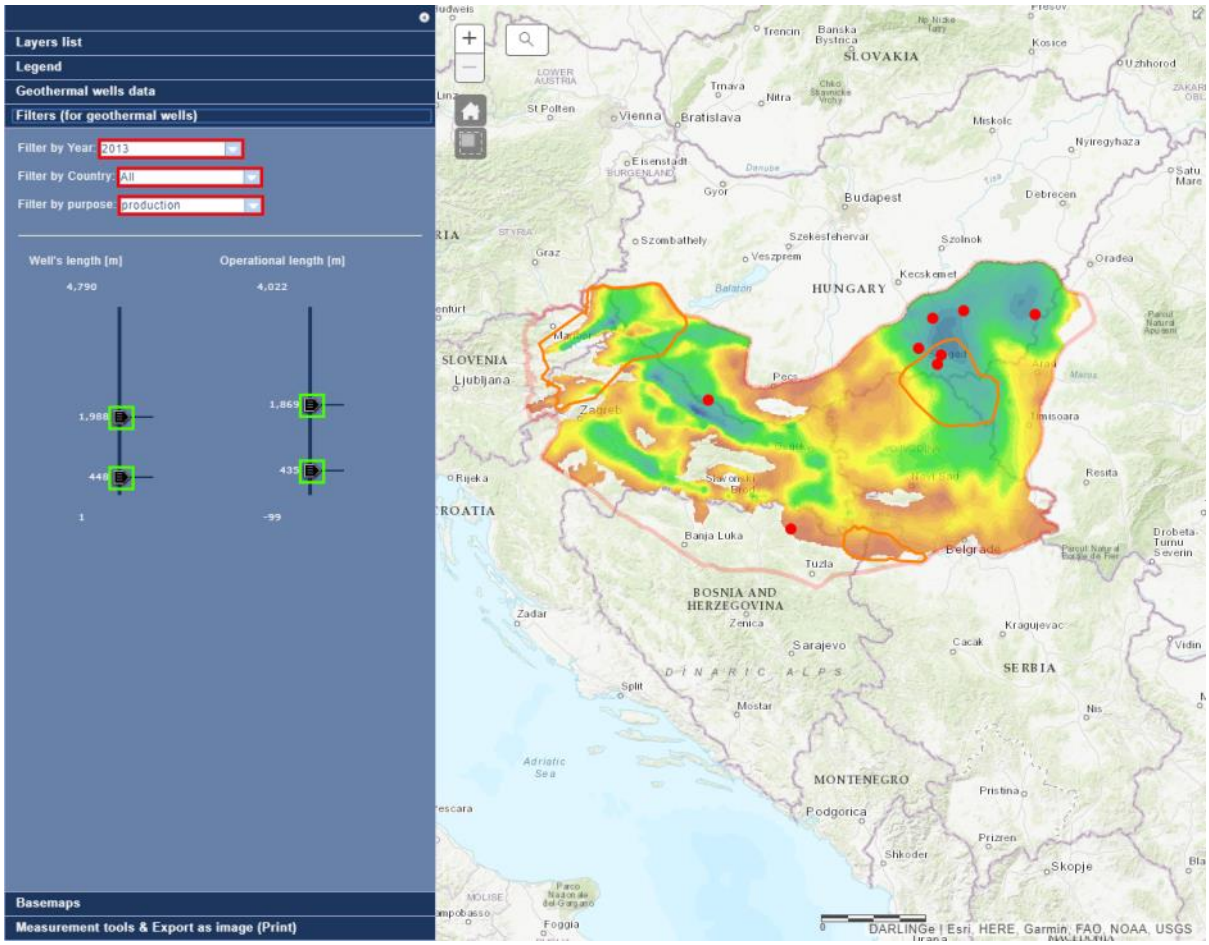
The buttons *highlighted with red* allow you to switch between different types of **information** on the specific geothermal object you've previously selected. A selected geothermal object is shown as a blue circle on the map.



II.3.4. Filters (for geothermal objects)

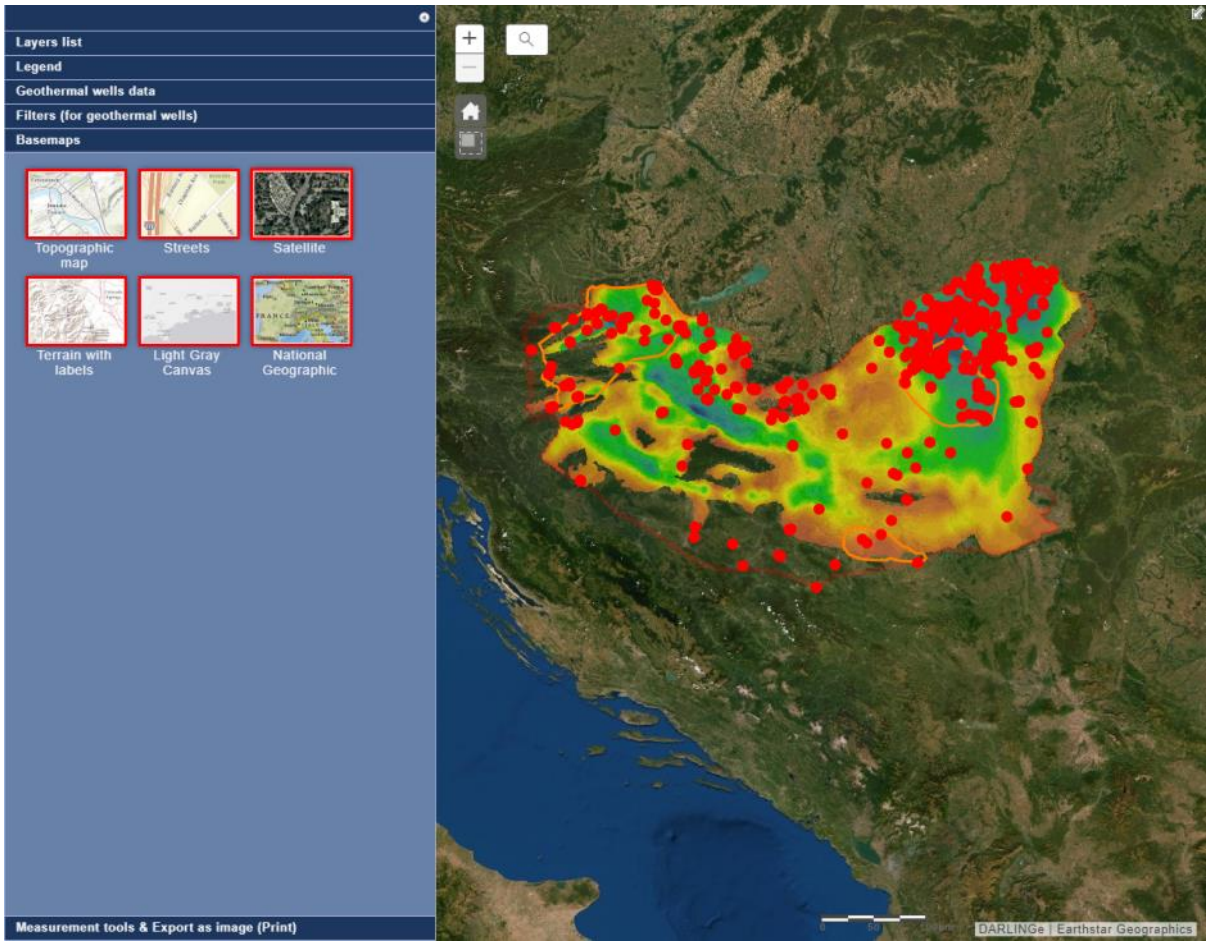
The menus *highlighted with red* allow you **to filter** the displayed geothermal objects by **year**, **country** and **purpose**. You can **combine** these three filters.

The sliders *highlighted with green* allow you **to filter** the displayed geothermal objects depending on their **length** and operational length.



II.3.5. Basemaps

The thumbnail images *highlighted with red* allows you to **change the basemap** of the map.

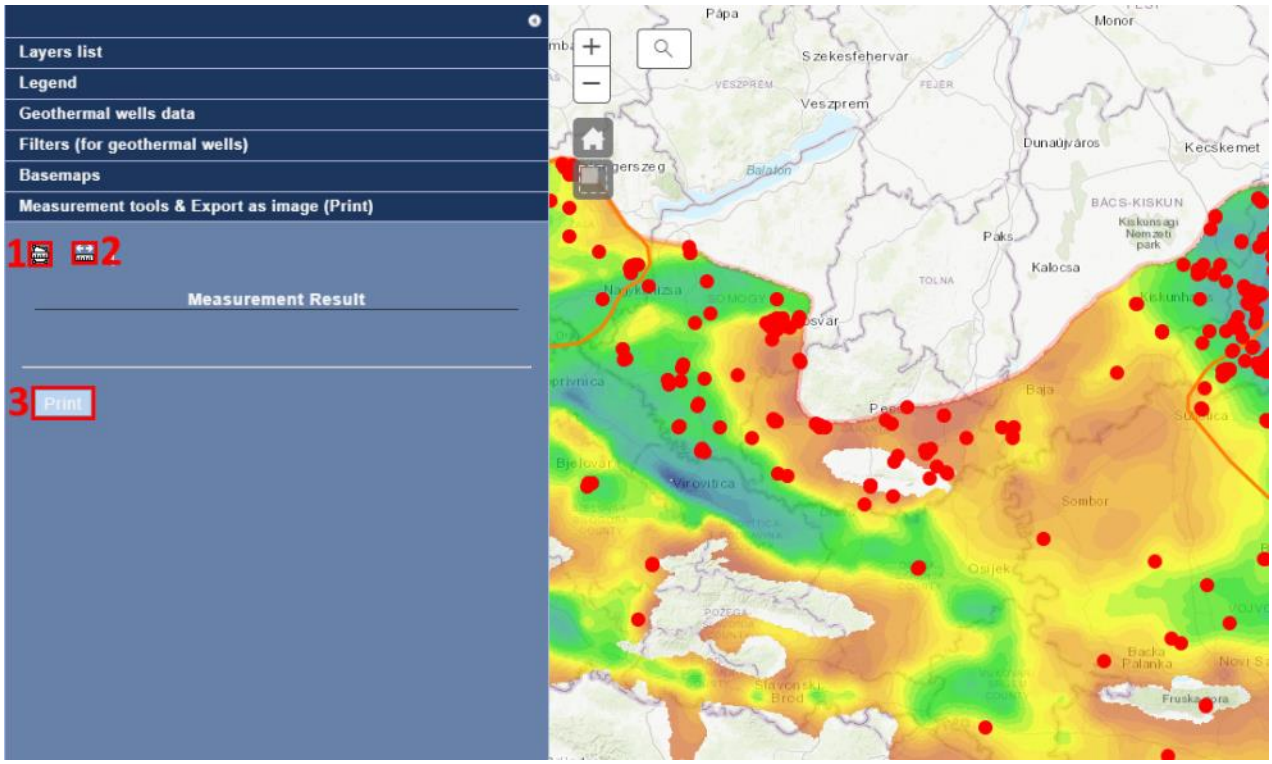


II.3.6. Measurement tools & Export as image (Print) tab:

Button *marked with a red 1*: Allows you to **measure** an **area** on the map.

Button *marked with a red 2*: Allows you to **measure** a **line** on the map.

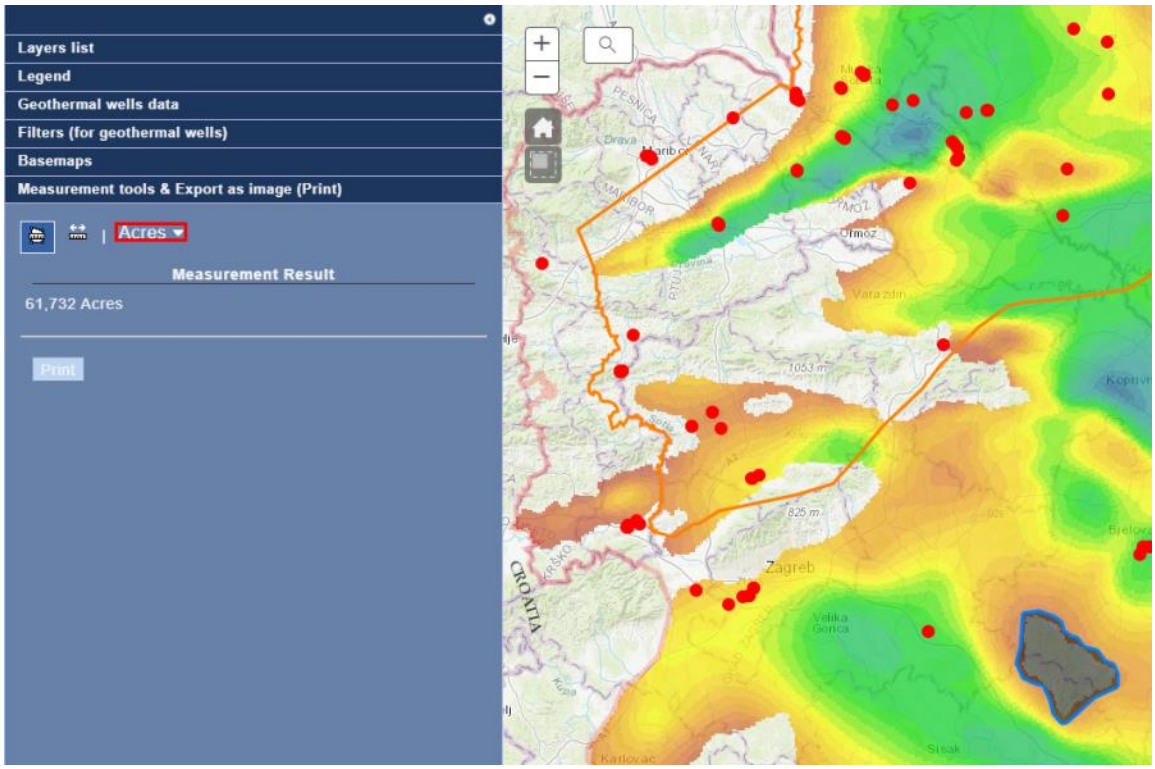
Button *marked with a red 3*: Converts your current map to a PDF and opens it in a separate tab. You can then **save** or **print** the file.



Measuring an area

The button *highlighted in red* changes the unit of measurement.

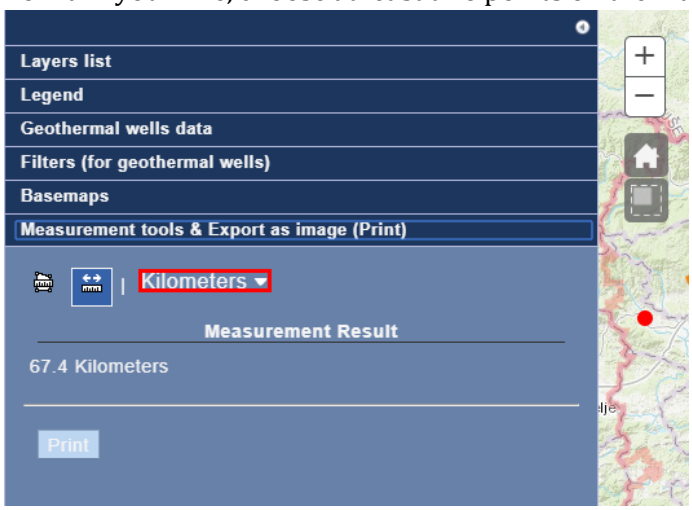
To mark your area, choose at least three points on the map.



Measuring distance

The button *highlighted in red* changes the unit of measurement.

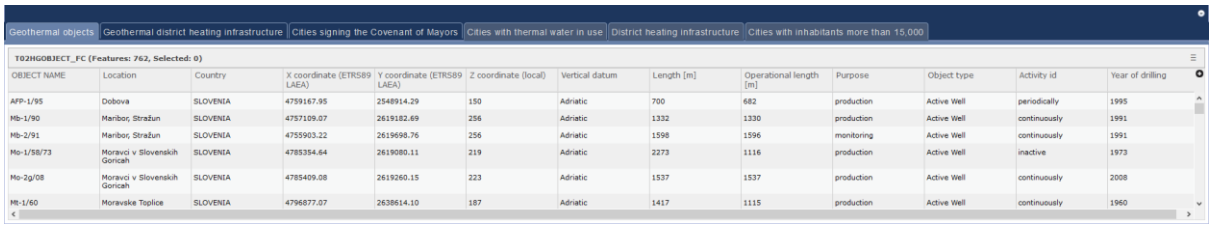
To mark your line, choose at least two points on the map.



The buttons *marked with a red 1*: Switch between different types of **information**.

II.4. Tables menu

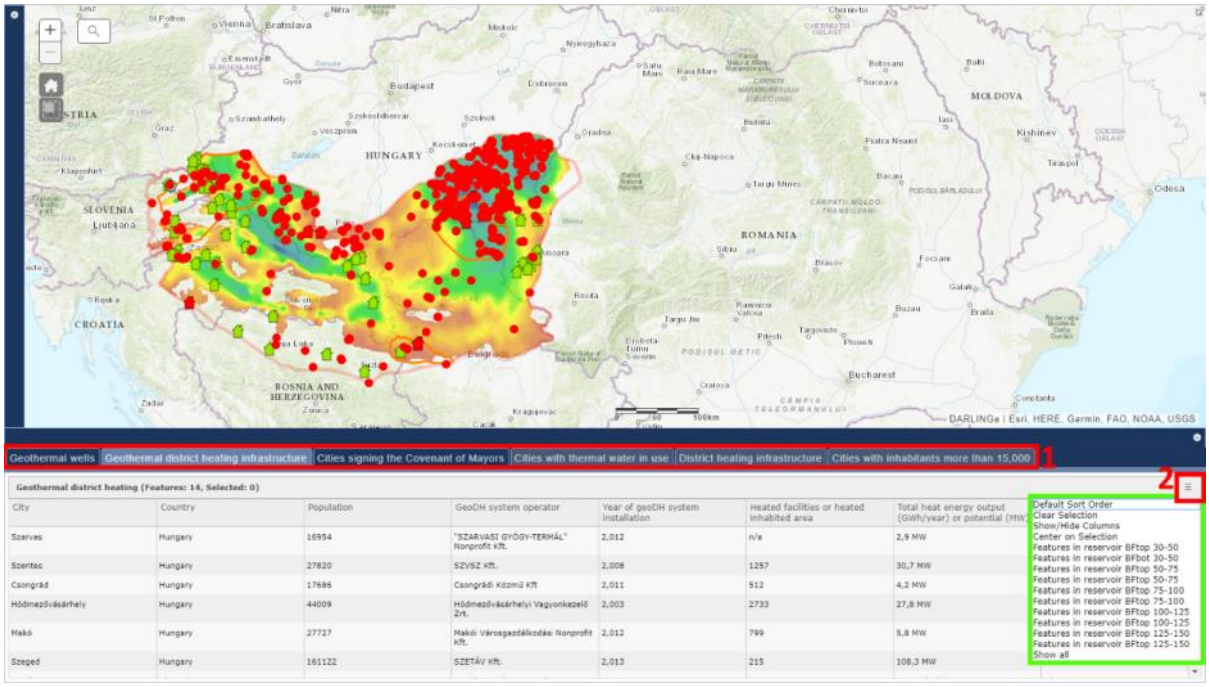
At the top you have different tabs that belong to specific layers, and when you click on the specific tab, attribute table of specific layer with its data shows up.



There are attribute tables for:

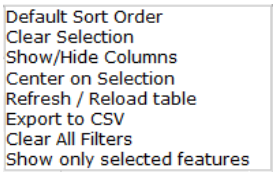
- Geothermal objects
- Geothermal district heating infrastructure
- Cities signing the Covenant of Mayors
- Cities with thermal water in use
- District heating infrastructure
- Cities with inhabitants more than 15000 layer

The button *marked with a red 2*: Opens the **available features** (*highlighted with green)* for specific layer's attribute table.



Geothermal objects attribute table's options

Most of the options are general and allow you to work with the data in the attribute table.

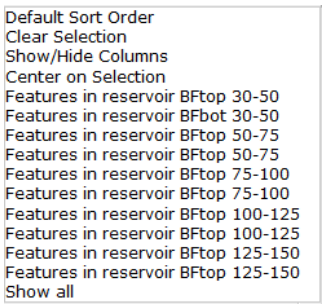


Specific for geothermal objects are:

- Export to CSV, which exports all the attribute table data to the csv file to download
- Show only selected features, which filters and shows in the attribute table just the geothermal objects you've previously selected with the Select multiple geothermal objects tool
- Refresh / Reload table, which does what the name says, used in case data doesn't get filled in the attribute table

Heat demand objects attribute table's options

Most of the options are general to attribute tables and allow you to work with the data in the attribute table.



Specific for Heat demand objects are:

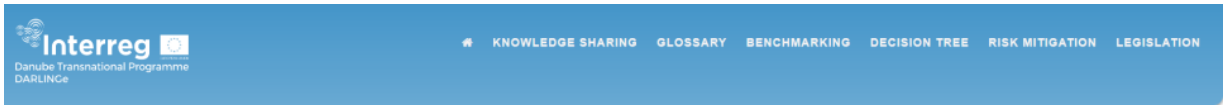
- Features in reservoir BFtop 30-50,
- Features in reservoir BFbot 30-50,
- ...
- Features in reservoir BFtop 125-150

This option should be used in combination with specific BF reservoirs layer. It filters Heat demand objects so that it shows only the ones that overlay (fall onto) with specific BF reservoir layer.

PART III. - GENERAL FUNCTIONALITY

Navigation bar

Clicking on links in the top navigation bar gets us from one module to the next. Clicking on home icon, or the logo takes us to the home page.



Filtering buttons

At modules Knowledge sharing and Contact of relevant authorities we will see the filtering buttons, that filter which content is to be displayed.

Go to the top of the page

At several modules we will also see the blue icon pointing upwards which gets us to the top of the current page.