Interreg North-West Europe
DGE-ROLLOUT

EUROPEAN UNION

WP T1 Deliverable D1.6 Easy to use end-user application

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1/8/2023

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Introduction

This report provides an overview of the Easy to use end-user application devlopped in the framework of the WPT1 aiming to make the main datasets of the WPT1 publically available for stakeholders. This application will significantly contribute to raise knowledge and awareness of Deep Geothermal Energy in North-West Europe. The webGIS tool is hosted on EGDI (European Geological Data Infrastructure) to ensure a high visibility of the project results, the respect of European standards and the long-term maintenance and update. EGDI guarantees Findable, Accessible, Interoperable, Reusable (FAIR) data, which perfectly corresponds to DGE-ROLLOUT vision on datasets created during the project.

 In this application, an overall view through an interactive online map was developed merging the baseline sources to identify potential geothermal hotspot regions within the project area. The basis for this categorization comprises harmonized geological knowledge, DGE resource potential and the market/investor correlation (socio-economic potential).

EGDI

EGDI is EuroGeoSurveys' (EGS) European Geological Data Infrastructure. It provides access to Pan-European and national geological datasets and services from the Geological Survey Organizations of Europe. EGDI is a central element in EGS' ambition about establishing a Geological Service for Europe. EGDI gives access to more than 800 map layers as well as a large number of documents (reports, images, spreadsheets,etc.). There is also a database for 3D geological models. The layers can be shown on maps and all the information can be searched in a free text search system. A number of scientific terms are documented in a vocabulary and there is also a multilingual keyword thesaurus which is used in the search system and to find layers in a connected metadata catalogue.

EGDI contains results of projects covering a broad range of geoscientific themes. ***The Geoenergy theme (see Figures 1 and 2) is well represented: a*** number of European and regional projects have been carried out during the last decades in order to address energy-related issues related to fossil fuel resources, Carbon capture and storage (CCS) capacity, geothermal energy potential, shale gas and shale oil plays etc.
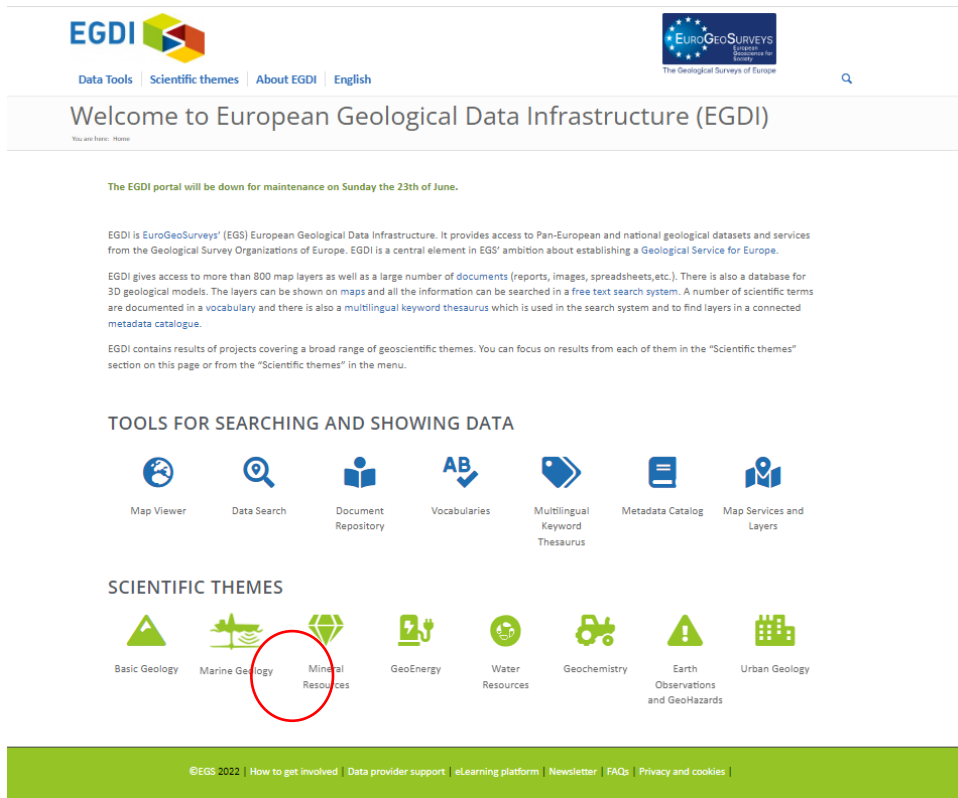
Figure 1: Welcome page of EGDI, the GeoEnergy section is accessible through the icon in the red circle or through the Scientific Themes tab.
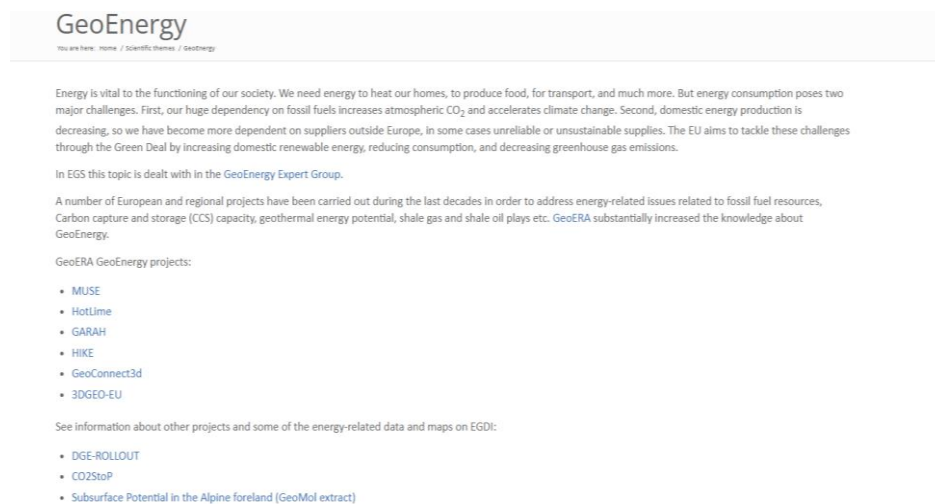

Figure 2: The GeoEnergy section of EGDI, with DGE-ROLLOUT page listed

DGE-ROLLOUT page on EGDI

The DGE-Rollout webpage on EGDI belongs to the GeoEnergy section (see figure below). The project is referenced on the GeoEnergy page.

The webpage is currently available in English. The French, Dutch and German versions are ready to be uploaded in August 2023.

It is accessible through this link: https://www.europe-geology.eu/scientific-themes/geoenergy/dge-rollout/

Figure 3: Access tot he DGE-ROLLOUT page

Figure 4: DGE-Rollout page: Abstract and Project Facts

The DGE-ROLLOUT webpage starts with an Abstract of the project, then the project Facts section allows to find main project webpage and contact point.

The next section presents the Decision-making tool (D1.1.4) devlopped in the framework of the WPT1, more details are available in the report of the deliverable D1.1.4.

Decision-making tool

The decision-making tool reveals step by step which questions (in blue boxes) a potential DGE investor is recommended to answer before the drilling of a deep geothermal well, following three main axes: Economics, Geology/Technical, and Regulatory framework/Public acceptance. A positive answer leads to the next question. If the answer is "no", actions are suggested (green boxes) or tools and helpful reports are provided, which have been developed within the DGE-ROLLOUT project (light green boxes).
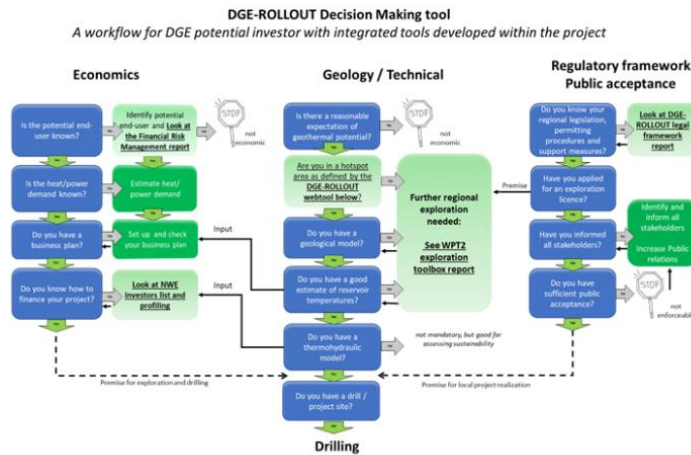

Figure 5: the decision making tool

The section following is dedicated to the webtool DGE-ROLLOUT webtool and Disclaimer. The direct link for the webtool is : https://data.geus.dk/egdi/?mapname=dgerolloutwebtool

Figure 6: The Webtool window on DGE-ROLLOUT page

Figure 7: the Disclaimer

Webtool structure

The DGE-ROLLOUT web application combines surface data (e.g. heat demand, socio-economic potential) and subsurface data (boreholes, seismic lines, harmonized top and thickness maps, heat in place) to assess the geothermal potential. The application illustrates the expectedly most promising areas (called hotspots) to launch investigations on building up a DGE project in the Dinantian reservoir in Belgium, northern France, the Netherlands, the state of North Rhine-Westphalia in Germany (2D maps) or in some parts of the northern Upper-Rhine Graben in Germany (3D Viewer available).

The uncertainty maps are key elements to understand the level of confidence of the various layers available in this tool.
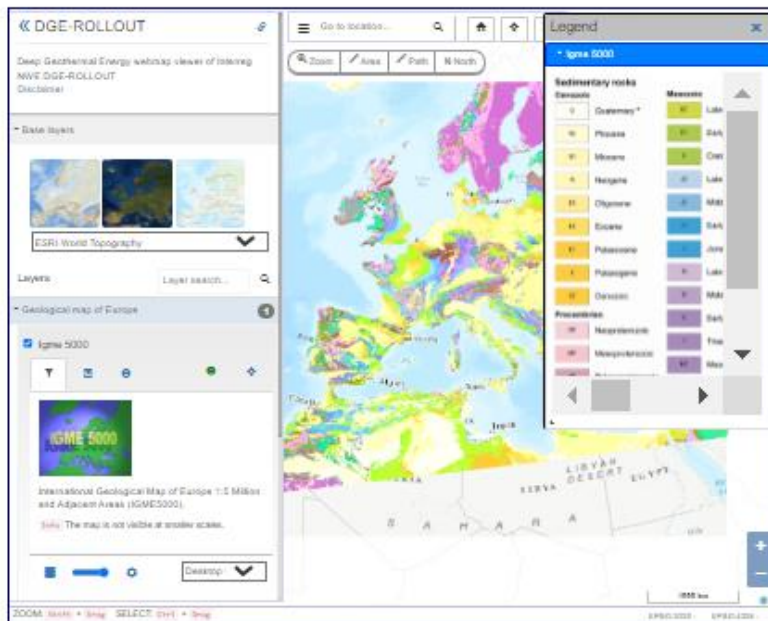
All the datasets published on this Web-GIS are listed below in the Figure 8.

Existing and Future DGE installations

This layer was produced in the scope of the D1.1.7 and gathered the Deep Geothermal Energy (District heating and Power Plant) installations that are in operation in NWE, as well as the main DGE projects that are under investigation or under devlopment in June 2023. The data were compiled from different sources: the National Geological Surveys (FR, NDLS, BE), regional Geological survey (GD-NRW), National Geothermal associations and EGEC (European Geothermal Energy Council) databases.

- Geological map of Europe

- Existing and future geothermal installations in NWE

- Surface data for NWE
    - Socio-eco index for NEW (link to DGE-ROLLOUT report)
    - Population density (link to DGE-ROLLOUT report)
    - Gross Economic product (link to DGE-ROLLOUT report) j
    - EU social progress index (link to DGE-ROLLOUT report)
    - Heat demand (link to DGE-ROLLOUT report)
    - Greenhouse gas emission per capital (link to DGE-ROLLOUT report)
    - Total installed DH capacity (link to DGE-ROLLOUT report)
    - Nature conservation areas (link to DGE-ROLLOUT report)
    - Socio-eco index per country (FI-Wal-FR-GER-NDL)

- Subsurface data

    - 2D Dinantian
        - Facies map (short description "report"e)
        - Seismic lines in NEW
        - Dinantian boreholes database
        - Top and thickness maps ((link to DGE-ROLLOUT report)
        - Presence or absence of Dinantian (short description "report")
        - Heat in place (short description "report")

    - 2D Upper Rhine Graben
        - Seismic lines
        - Boreholes database
        - Heat In place

    - Uncertainty maps

    - Uncertainty map (short description "report")
        - Distance to data (short description "report")
        - Structural complexity (short description "report")

    - 3D Upper Rhine Graben ((link to URG report)

- Hot spots
    - Heat in place + socio eco index
    - Heat in place+ heat demand

Figure 8: Structure and list of datasets/layers uploaded in the DGE-ROLLOUT web-GIS

Surface data

The surface data were produced in the Activity 2 of the WPT1:

- The deliverable D1.2.1 the heat demand maps (residential, commercial and total Heat demand), a link towards the D1.2.1 report is availbale in the webGIS
- The D1.2.3 socio-economic index provided a series of maps for NWE (cf. report available in the webGIS): population density, Gross Economic product, EU social progress index, Greenhouse gas emissions per capital, Total installed DH capacity…
- All these data were combined and harmonised to obtain the socio-eco index at NWE level
- The socio-economic index for each region of the project area (calucated with more local datasets) are also browsable in the application.

Subsurface data

2D Dinantian

- <u>The facies map</u>: The facies map represents the main sedimentary environment deposit of the Dinantian (Lower Carboniferous) in NWE. It was compiled after the palaeogeographic maps of Van Hulten (2012) https://popups.uliege.be/1374-8505/index.php?id=3778), Smit et al. (2018) https://doi.org/10.1016/j.marpetgeo.2018.01.004), and Arndt et al. (2020) https://www.gd.nrw.de/zip/scriptumonline-16_2020-09.pdf
- <u>Seismic lines</u> layer displays the public seismic profiles in the DGE-ROLLOUT project area. The raw data are accessible on request to national Geological Surveys of France (BRGM), Netherlands (TNO), Germany (GD-NRW), Belgium (GSB) or to Technical University of Darmstadt for the Upper Rhine Grabben.
- <u>Dinantian boreholes database:</u> The dataset contains all known boreholes that drilled the Dinantian limestones within the Interreg NWE area, compiled from national databases in the Netherlands, North Rhine Westphalia, Belgium and France. The dataset contains information about (a.o.) location, borehole name, source organisation, country, original projection and local coordinates, elevation reference level, elevation, type of borehole, total depth, type of rock at total depth, depth of the top of the Dinantian and URL of the original data – if available.
- <u>Harmonised top and Thickness maps (D1.1.5)</u> see report of this deliverable
- <u>Presence or absence of Dinantian:</u> this layer aims to explain why the Dinantian reservoir is not mappedin some areas: because of the absence of the geological layer, because of the reservoir is too deep for DGE (> 6km of depth), because of the lack of data/unknown areas…
- <u>Heat in place</u>: The heat in place is the maximum theoretically extractable heat energy of the Dinantian reservoir (in GJ.m² at 50 grC). The static and volumetric evaluation method used to calculate the map derived from "Muffler & Cataldi 1978".

2D Upper Rhine Graben (URG)

- URG Seismic lines
- URG Boreholes database
- URG Heat in place

3D Upper Rhine Graben (URG)

The 3D viewer of the URG is accessible through the "3D Model" link (see figure XX) or via this link:

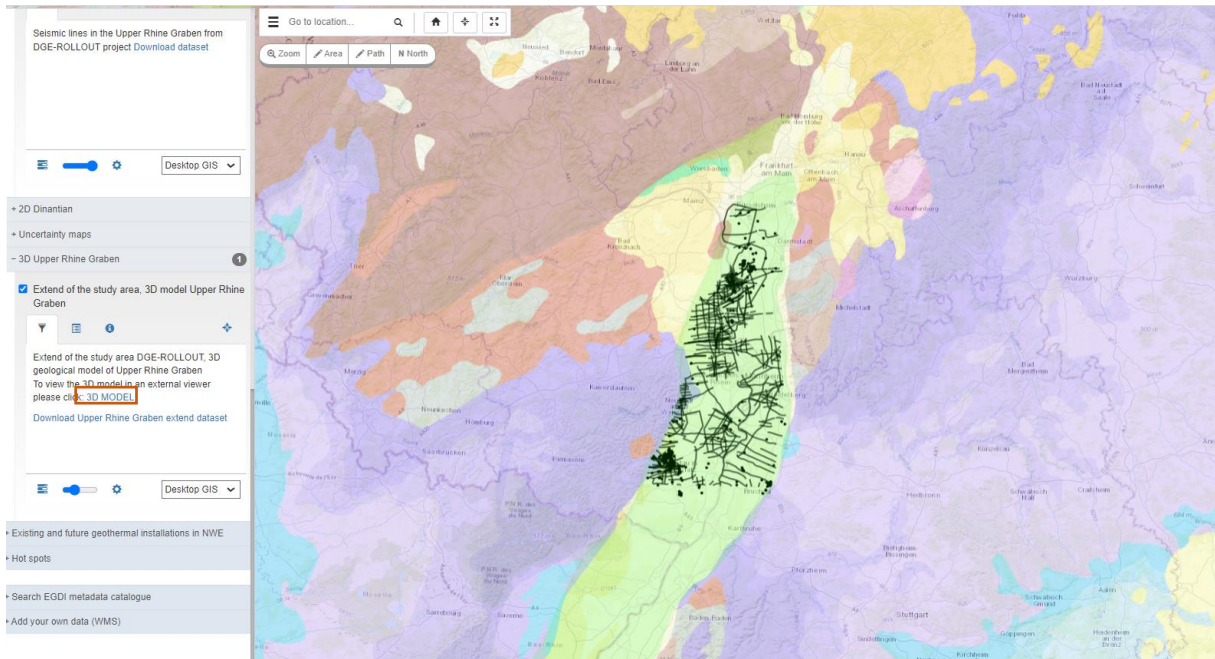https://geusegdi01.geus.dk/dge_rollout/

Figure 9: In the red square, the link allows a direct access to the 3D viewer, a new window will open.
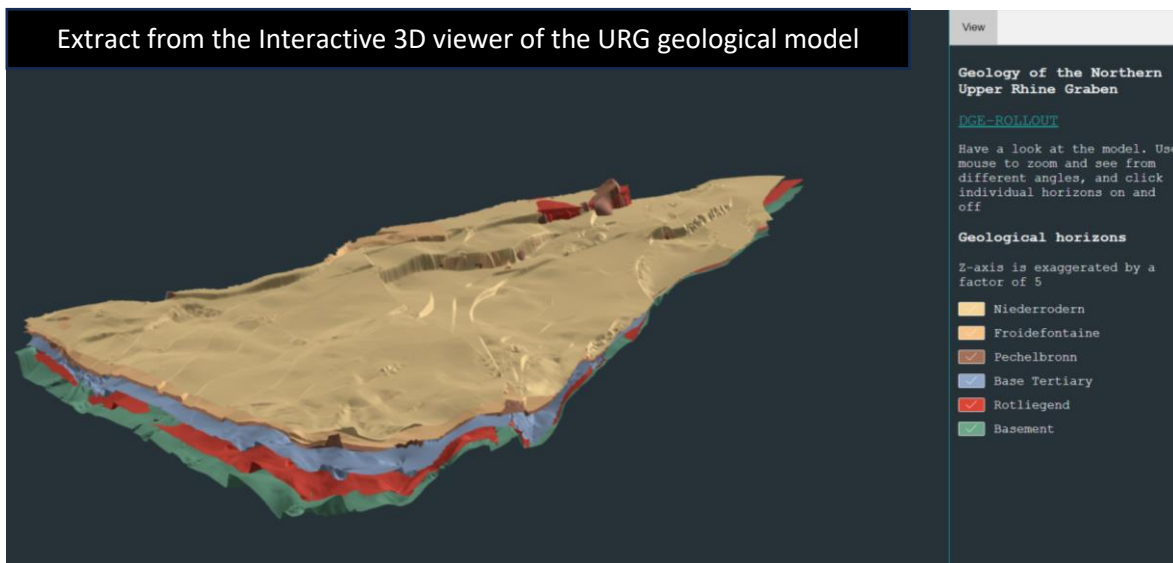

Figure 10: Extract from the interactive 3D model oft he URG

It appears essential to draw a map giving to the end-user the level of confidence of data used in the top and thickness maps. The 3 main parameters used to evaluated the level of uncertainty are:

- the distance to data: this map gives the areas closed to direct observation data (boreholes, wells, seismic lines) and the areas where extrapolation between observation points was made.
- the geological/structural complexity: in NWE the structural complexity differs from the North to the South. The maximum of structural complexity is observed in Wallonia and Northern France where the uncertainty even close to observation data points can be high due tot he context of fold-and thrust belt.
- the depth of the Dinantian: the deeper the Dinantian layer is the more uncertain are his top and thickness due to the limited data at important depths.

This 3 parameters were combined to obtain an uncertainty map

Hot spot mapping

- The Hotspot 1 map combines the Heat in Place map and the socio-economic index map. It provides areas where the socio-economic potential at the surface and the geothermal reservoir conditions are the most promising.
- The Hotspot 2 map combines the Heat in Place map and the Heat demand map. It provides areas where the heat demand at the surface is high and have a significant heat in place available.

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