Geothermal ERA-NET

Report on the state-of-the-art and needs in regarding geothermal data and existing tools to manage them

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Executive summary

A description of the state-of-the-art concerning geothermal data and tools used for the management and sharing them is a sine qua non for the key task of 3.2 within Work Package 3 - *Towards a European Geothermal Platform* - in the framework of the Geothermal ERA-NET. This is line with the objective of WP3 is to complete the preliminary work required for the creation of a European Geothermal Platform with the purpose of sharing harmonized and systematic information on legal and regulatory aspects, policies, measures, institutions, research projects and datasets.

As such this report in line with task 3.2 with in Work Package 3, provides an overview of the available state-of-the-art, the needs with regards to geothermal data and existing tools to manage them and will be the a backbone and cornerstone for the feasibility study.

For the analysis of the state-of-the-art, a questionnaire was proposed to the Geothermal ERA-NET partners. The main results have been reported and discussed in order to develop the feasibility study, aimed at the implementation of the European Geothermal Information Platform (EGIP).

This report also provides a brief description extracted from the compiled questionnaire of each country, and a first analysis of the current status of the geothermal data. The compiled questionnaires has been attached as an appendix of this report.

As a part of the report the WP3 questionnaire can be regarded as an effective tool to define the actual situation for surveying the geothermal information and data management systems running and used among the Geothermal ERA-NET countries. One of the fruits of the report is a list of the organizations that compiled questionnaires, and also all the organizations related to the geothermal data use and management which are now available for each country and have been listed out in the report. Furthermore, the report bring together a list of the Geothermal Management Systems actually running which is an important outcome at its own right.

The last part of the questionnaire is relevant for the implementation of the European Geothermal Information Platform. Each country has given its own contribution on the majority of the crucial issues and on what should be considered important to make EGIP useful and efficient, the main retrieved hints are: to elaborate a common database gathering info from various sources (wells, plants,...), to define tools to manage the exploited aquifers and to assess the possibility of new operations, to harmonize services and data management, to conform to INSPIRE and at last to provide tools helping to select potentially interesting areas taking into account other factors besides geothermal potential, e.g., energy demand, potential coverage of different kind of energy demand with respect to geothermal heat and power potential supply, social aspects.

The overview of the results of WP3 questionnaire and the discussed issues in the report can in turn be considered a potential starting point to elaborate following ERA-NET WP3 task, the feasibility study of EGIP. The state-of-the-art gives an important point of view on the actual situation on all issues related to geothermal energy. As such based on this report the feasibility

study can be developed using the list of information proposed, the list of references (both documents and websites) and the main common issues suggested by the ERA-NET partners.

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Introduction

In the framework of the Geothermal ERA-NET project, the task 3.2 of WP3 -Towards a European Geothermal Database - requires a description of the state-of-the-art concerning geothermal data and the tools used to manage and share them.

This report gives an overview of the available the state-of-the-art, needs and existing tools related to geothermal data and will be the cornerstone for the feasibility study.

To analyse the state-of-the-art, a questionnaire was proposed to the Geothermal ERA-NET partners. The main results are here reported and discussed in order to develop the feasibility study due for task 3.3, aimed at the implementation of the European Geothermal Information Platform (EGIP).

Nowadays many geothermal databases (GDB) are developed on national (local, regional and national GDB) or international scale (e.g., GDB in projects such as GEOELEC, GEIS within EERA JPGE, TransEnergy, the IGA GDB of geothermal uses in the world). They mostly refer to management of underground data and to resource features (e.g., well data, heat flow, geophysical and geochemical data), or to exploitation parameters (e.g., installed capacity).

However, exploitation and management of geothermal energy require not only the knowledge of the underground conditions and the technologies, but also other issues such as regulatory, economical and social (including environmental) aspects, research roadmaps and training, energy demand and market request. Data availability, needs and gaps in many fields provide a variety of information, partly connected, depicting a complex picture. These data are often available on-line but spread in different databases, platforms or web pages without constituting a complete set of information.

The need to manage a large quantity of data of different kinds (e.g., well data, regulatory documents, monitoring data, list of training courses) and store them in different ways requires, beside a structured data organisation, information analysis and recovery systems able to answer in a quick and efficient way. Thanks to the technological evolution of data management system tools, data integration and analysis may be performed through information platforms managing both structured and unstructured data, which can be analysed in an aggregated way

2. Questionnaire

The questionnaire is conceived to establish state-of-the-art, needs and gaps of geothermal data organisation. It is structured in 4 parts describing:

i) ***Context***,

ii) ***Data***,

iii) ***Application***,

iv) ***Management of the European Geothermal Platform***, (see the questionnaire model attached in Appendix 1 of this report).

In the first part, named General Database Context Information, a description of the government body that manage geothermal information and an overview of the role of the involved stakeholders (e.g., administrators, users, providers) is requested. Once defined the body institution/s answering the questionnaire (1.1), a description on the role of the body institution, with respect to geothermal data, is required (1.2). 1.3 is focussed on the data management system, requesting if it is present in the answering body institution (1.3) and how it is managed (1.4), or if there are management system in the country (1.5), with a references (e.g. links to website, scientific paper, documentation). The final point of this part (1.6) is used to understand issues and gaps regarding the functionalities of the actual geothermal management system.

Part 2 of the questionnaire, named Master Data list, is more structured as the responder has to consider if listed data exist, if they are public and how they are organised. **Existence** and **public** status can be checked by empty (meaning no) or marked (meaning yes) boxes; partial is therefore assumed when both boxes are left. For the **organisation** status, three different ways have been considered: by **database** (DB) meaning a tool for archiving and managing structured data within a relational database management system, which may be queried for retrieving the required information; by **platform** (PF) meaning a tool that adds to the DB a business intelligence functionality able to process structured and unstructured data and to provide them in form of graphs, reports and maps defined a priori in order to facilitate access and analysis in an aggregated way; by **Web Page** (WP) referring to places on the world wide web where data in the form of maps, reports, tables, documents are listed and may be accessed.

The list of data includes all the aspects related to geothermal energy, not only underground data but also information on the economical, regulations, national energy policies, energy production, energy demand, market requests, social issues. All the issues are referred to geothermal represent the concept of geothermal knowledge, as drawn in figure 1 (Fig. 1)

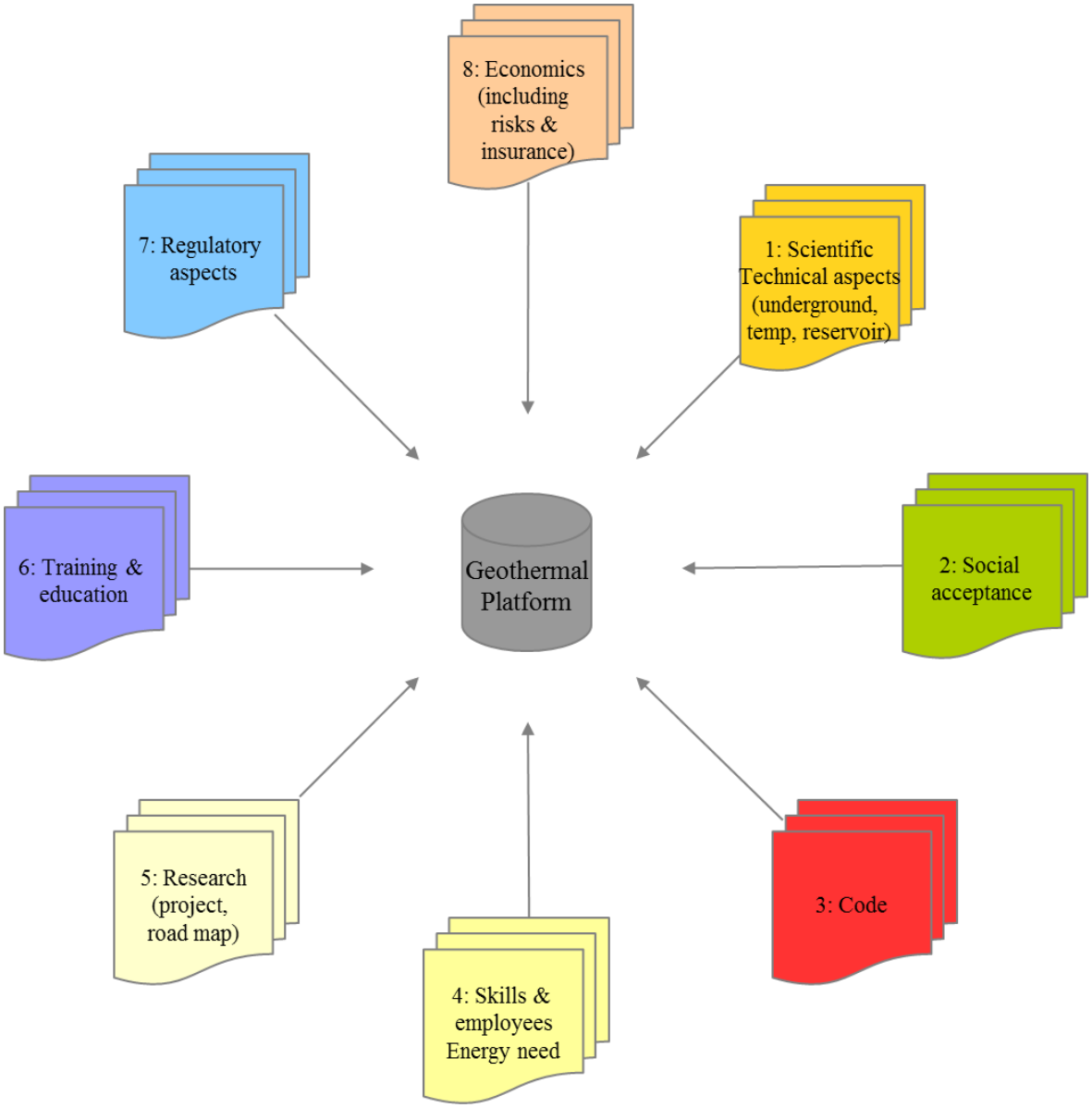

Figure 1 The data list covers the issues of the 8 boxes.

Taking into account also the questionnaire prepared in the frame of the GEOELEC Project (www.geoelec.eu WP2), a list of the most relevant data has been proposed by ERA-NET WP3 questionnaire in 2.1 sub-section. Information required are those usually used in geothermal databases, e.g., temperature data, temperature maps, surface heat flow, thermal springs, reservoir info, fault mapping, porosity data, permeability measurements, seismicity recorded, geothermal plant energy production.

To complete this part also the reference system used for geo-referencing data is required.

Sub-section 2.2 is related to social acceptance, querying on the existence of studies or report on the social acceptance for geothermal energy, on the existence of laws on the environmental impact, on the presence of environmental impact factor list, if a monitoring network data is present and if there are some tracked parameters.

Sub-section 2.3 verifies the existence of a geothermal code at national level, whereas 2.4 survey is related to data regarding employees, skills required for geothermal and on geothermal energy needs and supply.

Sub-section 2.5 concerns running, completed and foreseen geothermal projects and national geothermal roadmaps. **Sub-section** 2.6 is focussed on geothermal training and education, considering University courses, PhD, Master, specialisation.

The following **sub-section, 2.7**, the rules of licencing and the legal condition for grid access are investigated, and in 2.8 some specific issues on insurance covering the geothermal project risks or royalties, taxes and support scheme matters are treated.

The questionnaire provides also the possibility to add, in the 2.9 sub-section, information not covered by the proposed survey.

Part 3 of the questionnaire, called Database Application to Develop, refers to the available data defined in the previous section, and it intends to verify how data have been already processed, what are the operations considered important to perform with the data list (maps, charts, statistics,…), and the general feeling with INSPIRE directives.

In 3.1 and 3.2 it is asked to explain how geothermal data and information are retrieved and how the geothermal spatial data is used.

The awareness of INSPIRE directives have been assessed in 3.3, 3.4, 3.5, in order to understand if the INSPIRE data specifications and services are well known and used in providing geothermal data.

The point of the sub-section 3.6 is focussed on issues and gaps regarding the functionalities in geothermal management systems, to provide critical point that can be avoided and optimised hints for future actions in EGIP.

Part 4, Procedures for data update and data management, is meant to collect hints for optimising management and updating capabilities for the future EGIP.

To have a complete idea of questionnaire frame, its structure, and the complete list of the covered topics, the original from is attached in Appendix 1

3. Review of collected information

Here we present a brief description extracted from the compiled questionnaire of each country, and a first analysis of the current status of the geothermal data. The compiled questionnaires can be found in the Appendix 2 of this report.

3.1 France

ADEME compiled the questionnaire. ADEME manages some databases linked to its activity on renewable energy, including geothermal energy. ADEME also funds studies or R&D projects to produce and enhance the management of geothermal data. ADEME and BRGM, which works in a strong partnership with ADEME on renewable energy, implement a website, www.geothermie-perspectives.fr, which represents the reference website for information on geothermal energy in France, and contains articles written for public, for industry, for R&D stakeholders or public authorities. It includes also information on shallow aquifers with coverage of 80% of the country. Soultz sous forest EGS project is presented within the website www.geothermie-soultz.net.

ADEME is now working on a database, SINOE EnR, which collects information on operations subsidised by the renewable heat fund managed by ADEME. BRGM is developing Aquapac, a non-public database on shallow geothermal operations.

A website, named Thermo2pro, is under development by BRGM, and aims to display the available information about deep geothermal resources.

Table 1 Analysis of compiled questionnaire for France

Owner/Developer	Reference	Description	Status
ADEME/BRGM	www.geothermie-perspectives.fr	1. Geothermal energy in general and shallow aquifers	running
GEIE	www.geothermie-soultz.net	EGS project	running
ADEME	SINOE EnR	Operation subsidised by renewable heat fund	running
BRGM	Aquapac	Shallow aquifers	running
BRGM	Thermo2pro	Geothermal deep resources	In progress

France has a wide Master Data List, considering the Scientific and Technical aspects, and the questionnaire shows a high value of data existence, valued in 90%. The existing data are for 71% public, most of them are organised in a DB (52%) and PF (48%) and for the 43% they are organized in WP. In France the social acceptance is described by reports and studies since

environmental impact laws and a monitoring network exist, no environmental pressure factor list is present. A geothermal code is still absent but there is a mining law framework that covers geothermal energy and strategic roadmap. Documents on skills and employees, research R&D and training and/or education are existing and public. The rules of licencing (exploration/exploitation) are available on WP as well as the legal condition for grid access. France has insurance covering the geothermal project risks, which is published on WP. The royalties, taxes and support schemes are available on the web.

ADEME for France is the main organisation that funds geothermal energy, so it knows the produced knowledge on exploration, and also manages the main public funds and risk mitigation schemes, so has the access to the risk mitigation data and subsidies. BRGM by law gives the information of the underground to the public authorities, so it is possible to have access even to the yearly production and others elements on exploitation.

INSPIRE directives in France are well known but they still require to be implemented.

While in France the data availability is good, the general feeling is that data are too scattered, therefore a better and centralised data structuring is suggested.

ADEME also indicates, as short-term priority, the improvement and the updating of the working geothermal facilities e.g., geothermal-perspective website and Thermo2Pro web application, the development of tools in relation of regulatory framework for very low enthalpy geothermal operations. On the other hand, as mid-term objectives ADEME indicates the working out of a common database gathering the various sources of information on geothermal operation (wells and plants), and the development of the characterisation of the French geothermal resources and of the tools to manage the exploited aquifer.

3.2 Germany

The Project Management Jülich (Projekträger Jülich- PTJ) compiled the questionnaire. PTJ implements research and innovation funding programmes on behalf of public authorities. It also offers advice on national research and innovation funding programmes, for which it is commissioned by the responsible German federal ministries and federal states. Moreover, it serves as the National Contact Point for advising applicants from Germany with respect to FP7. The division EEN (Renewable Energy) of PTJ coordinates substantial parts of energy research funding in the area of renewable energy, including geothermal. PTJ finances the National Geothermal Data System named Geotis (www.geotis.de).

Geotis information system, developed and managed by the Leibniz Institute for Applied Geophysics (LIAG), is composed by two modules: the "Geothermal Potential" offering a compilation of data and information about deep aquifers in Germany for hydrothermal use, and the other one, "Geothermal Installations", provides an overview of geothermal installations in Germany that are under construction or in operation.

Regarding the data list proposed in the questionnaire at 2.1, the 81% of information are existing and public in Germany. 76% of these data are organised as DB, PF and WP and refers mainly to Geotis web application. Environmental Impact laws and documents on geothermal energy

acceptance are present, but there is no monitoring network and related list of factors. Official number of employees, energy needs are known and included in official document available on the network by German Environmental Ministry that set up the "Working group on Renewable Energy – Statistics (AGEE-Stat)". The geothermal project list (running, completed, foreseen and also the needed) are listed and known by the BMU (The Federal Ministry for the Environment, Nature Conservation and Nuclear Safety), which also manage the geothermal national roadmap. The information on training and education are not available and a geothermal code in Germany does not exist. No answer for the regulatory aspects. Documents on Market incentives programme that supports risk insurance and drilling subsidies exists, dated 2012, and the regulation for feed-in tariff are available.

For PTJ, as funding agency, no application of Geotis in the daily work is needed. PTJ knows the INSPIRE Directives but those are not yet applied to Geotis. Geotis information system platform supply most of the useful data needed for geothermal application, it started in September 2005 and it is continuously improved and updated.

3.3 Hungary

Geological and Geophysical Institute of Hungary (GGIH) compiled the questionnaire. GGIH is the Hungarian Geological survey and is in charge of managing Hungarian geological and geophysical data, including also temperature borehole database and many thematic maps. The first Hungarian geothermal database was created in the late 1990 by Dept. of Geophysics, Eötvös Lórand University in Budapest. It contained more than 4666 temperature data (T > 30°C and depth > 200m), mostly drilled for hydrocarbon. The National Geothermal Energy register, maintained by Hungarian Office for Mining and Geology, deals with the production data, which are based on users self-declaration due for paying mining royalties. The thermal water production register, related to the National Institute for Environment, manages data related to all water production well in operation, including details on their utilisation.

The GGIH's geothermal information management system includes the borehole database and webmap services, used for specific activities, i.e., EU-funded projects such as TRANSENERGY (geothermal project on western Pannonian Basin) or Geo-DH (geothermal district heating potential in Europe). Since a unique geothermal information management system does not exist in Hungary, the various thematics are covered by various databases, as described above, partly available through websites. In most of cases production data are confidential. For complete references see Table 3.

The main gap indicated by GGIH is the fragmentation of geothermal data in Hungary, where the information are collected by water and mining authorities belonging to different ministries. Since the mining royalties and water resource fees are paid on self-declaration, the official data are often understated.

In Hungary 100% of the data proposed in questionnaire 2.1 list exists, but only 10% of those are completely public and 33% are partial public. Data are mainly organised in DB (100%) and only 19% are published in WP; no PF is implemented yet.

Public documents concerning the social acceptance exist in Hungary. Although a precise WP is not indicated, they are referred to Hungarians thermal energy and geothermal associations or to public organizations such as Ministry of Rural Development or National Institute for Environment. A geothermal code and info on skills, employees and energy need are not present at the moment. Geothermal projects (questionnaire Research R&D topic 2.5) and training courses are described within the country update and will be presented at the next European Geothermal Congress (EGC 2013 Proceedings). Regarding the Rules of Licencing (questionnaire 2.7), the completed TRANSENERGY project produced a document on legislation related to geothermal energy, see Table 7 for link details, and a summary is included in the country update for EGC. Although royalties, taxes and feed in tariff exist, no references are provided.

All spatial datasets provided by Geological and Geophysical Institute of Hungary have INSPIRE compatible metadata.

3.4 Iceland

Orkustofnun compiled the questionnaire. Orkustofnun (OS) is a regulatory body to which operators are obliged to submit data on resources and their utilisation. OS contracts researchers to conduct measurements and stores the results in its internal database. The operators submit information in various forms depending on their capabilities. OS makes available a webmap/portal application concerning energy base maps, electricity power plants and geothermal direct uses (www.orkuvefsja.is). Search for information on wells in Iceland is available on OS website http://www.os.is/borholuleit

All OS reports published since 1947 can be accessed at http://www.os.is/orkustofnun/skyrslur-OS, while technical reports since 1980 are also accessible electronically from www.gegnir.is. Beside gathering data and maintaining the database, OS manages also geographical datasets and the electronic energy library. In Iceland also the Icelandic GeoSurvey (ISOR) operates an extensive database on all measurements that the institution has conducted, as well as geological maps and data on GIS format.

In Iceland the 86% of the proposed data (questionnaire 2.1) belongs to the master data list, the 57% of those are public and the 14% are partially public. For the 57% of cases, information is stored in DB, 43% is managed in PF and 48% with WP.

Environmental impact laws can be retrieved at www.althingi.is , while www.gegnir.is publishes studies and reports on the social acceptance of geothermal energy. The environmental pressure factor list exists now but is not accessible online yet, it belongs to the Water Framework Directive defined within Icelandic Legal Framework.

A code partially exists (page 85-89) in the report, by Ketilsson et al. (2010), accessible at http://www.os.is/gogn/Skyrslur/OS-2010/OS-2010-05.pdf .

Regarding skills, employees and energy need, documents exist and are public via IGA Iceland Country Report, published every 5 years or via Energy Forecasts for electricity, heat uses and

fuel, although the reports are in Icelandic language and translation is available only for the figures.

In Iceland a broad set of documents related to geothermal running, completed and foreseen projects are available, as well as a Master Plan for the protection and development of geothermal areas. In particular, it is possible to know whether wells are drilled for heat extraction, steam extraction for power generation, reinjection, research or temperature gradient. In the Master Plan the resources have been quantified, also defining whether they need to be protected, further researched or utilised for power generation (available at www.rammaaaetlun.is).

Training and education information are available and detailed in some WP, e.g., www.unugtp.is (for postgrad diploma), www.reyst.is (for MS programme), www.hi.is (for BS,MS,PhD), http://www.keilir.net/ (for BS).

The legal conditions to connect a power plant to the transmission system required a Power Plant License from OS. A list of issued licenses can be accessed at http://www.os.is/orkustofnun/leyfisveitingar/utgefin-leyfi/.

In Iceland the Energy Fund, operated by OS on behalf of the state, can cover the geothermal project risks, ensuring a grant if the drilling is unsuccessful for house heating in areas where geothermal energy is not used today. The tax frame can be accessed at www.althingi.is, although royalties are not available online. Feed-in-tariffs for geothermal are not set in Iceland since geothermal energy is competitive with other energy sources.

OS is the main collector of the most important Icelandic geothermal information, it provides information both from industries and researchers. Lots of maps and GIS material are available as web services useful for daily OS affairs, managing licences, conducting official monitoring. The policy for the spatial data is under revision to be INSPIRE compliant, while the directives are not completely yet applied although they are known.

The main suggested gap is the lack of a synchronised European well identification for geothermal energy and cold water. OS considers such a harmonisation as a prerequisite for a joint platform and pan European Geothermal Dataset, able to link also to Eurostat (or other organisations) for the interoperability of geothermal energy statistics data.

3.5 Italy

CNR compiled the questionnaire. CNR carries out geothermal activities in the field of R&D. In the frame of these activities, it provides, collects, and it manages geothermal data (e.g., underground data, monitoring, regulative, social, economic data). CNR also contributes to IGA geothermal data (production) management. In particular, two main datasets are maintained, one is the Italian National Geothermal Database, containing the information covering the whole Italian territory, and the other one is the IGA Global Geothermal Energy World Database (GGEWD), consisting of the geothermal energy production and direct use all over the world. CNR manage also data and reports produced in project coordinated for CNR (VIGOR and Atlante).

Table 2 Analysis of compiled projects for Italy

Project	Reference	Status
Italian National Geothermal database	http://geothopica.igg.cnr.it	In operations
Global Geothermal Energy World Database	http://vmigg.iit.cnr.it/SpagoBI	In operations
VIGOR Project	http://www.vigor-geotermia.it	In the final stage
Atlante Project	in construction	in construction

In Italy also the MiSE (Ministry of Economic Development) – UNMIG (Directorate-general for mineral and energy resources): http://unmig.sviluppoeconomico.gov.it/home.asp manages and administers the web portal where the data related to geothermal leases and concessions, regulations, Geothermal Inventory data, geothermal well locations are organized in a web platform.

Of the data proposed in the list of the 2.1 sub-section of the questionnaire, 86% of them exists in Italy, 43% are public and 43% are partially public. The information are mainly published in WP (81%) whereas 62% are stored in a DB and only the 19% are organized and used in a PF.

Information on social acceptance in Italy are few. These have been mainly done for University theses, stages or private studies. Documents related to power use is provided by Italian Geothermal Union (UGI) website. The VIGOR project will publish a report on geothermal social acceptance in the Italian southern regions. In Italy a wide set of environmental laws exists and are published into web pages and are often organized and can be retrieved from databases. The Environmental Protection Agency of Tuscany region (ARPAT) releases the lists of the main environmental pressure factors and carries out the environmental monitoring of the tuscan geothermal area. ARPAT, ARS and ENEL GreenPower (the Italian geothermal operator) produce and public the results of environmental monitoring of geothermal areas as downloadable documents in web page. The monitoring networks track parameters related to i) air quality, ii) gas emission from geothermal power plant, iii) wastes, iv) water quality and v) heavy metal concentrations in soil.

A new and complete geothermal code does not exist in Italy, but the Italian National Geothermal Database comprises a glossary where the main topics and data contained in the database are explained. In the framework of the Geothermal Atlas project a new thesaurus will be produced.

The number of employees in geothermal field has been counted in some occasion. For example, one of the last survey was performed in the frame of GEOELEC project, and another one is published in the proceeding of the World Geothermal Congress WGC (Bertani, 2010 – Italy

country update). A list of skills required in the field of geothermal exists but is not public: it is present within a document produced, under request of the European Commission, by European countries with also the Italian contribution. Data regarding energy needs and the geothermal energy supply and share are collected in documents for IEA-GIA or WGC.

Regarding geothermal projects, usually in Italy the information exist. A comprehensive collection of info and links is not available, apart the leases and concessions info organised by MISE, information is usually published in each project web page (for more details refer to WP2 questionnaire). The Italian Geothermal Technological Platform has issued a document on the identified priorities for geothermal R&D

(see: http://www.assoknowledge.org/AlleanzeTecnologicheItaliane.pdf), whilst a proper geothermal national roadmap does not exist, the National Strategic Energy (SEN) is present, some references for renewable energy could be retrieved in the European Project REPAP2020 in the National renewable Energy Source Industry Roadmap.

Some training and education information are present, mainly published on web pages but those are not well organized, and info on the courses attendance is absent. Education is mainly carried out as University degree, both bachelor and master as well as PhD training; other courses are available at professional level, and are mainly focused on shallow geothermal energy system.

The information on regulation, laws, directives or authorization forms can be obtained from the website of the Ministry of Economic Development, whereas the condition for grid access can be found on Terna (the society that manages energy transmission in Italy, guarantees its safety, ensures equal access conditions to all grid users) web pages

http://www.terna.it/default/home_en/electric_system/grid_code.aspx

In Italy, there is no Insurance covering the geothermal project risks. Feed-in-tariff are explained in the Ministry Decree of 6 July 2012, others information are available at GSE, (the state-owned company which promotes and supports renewable energy sources (RES) in Italy) web pages http://www.gse.it/ where references to tariff, incentives and decrees are provided.

At CNR geothermal data related to technical aspects mainly comes from the Italian National Geothermal Database that is updated when new analyses or surveys or when a significant scientific dataset from literature are retrieved. Data on geothermal energy produced by power plants or by direct uses of the heat are organised on IGA GGEWD. Results of the VIGOR project, either spatial data or un-spatial data, can be obtained in the VIGOR web pages.

Usually the spatial data are managed in a desktop frame by the common desktop GIS software, hence the produced maps are provided on the web using the OGC services. INSPIRE directives are known but they are applied only partially in the managed dataset.

The Italian geothermal data management tools include many kind of useful applications such as RDBMS, webGIS, data catalogue and business intelligence platform but those are not completely integrated: what is missing is a tool that can ensure a complete and effective data browsing.

CNR suggests that in a European context, as should be EGIP in the future, the information coming from each country should be mainly managed and updated by each National GIP, while the information has to pass through an harmonization process determined by a defined protocol on data content and format.

3.6 Netherlands

The NL Agency compiled the questionnaire. NL Agency mentioned themselves, the Ministry of Economic Affairs (MEA), TNO (NL Geological Survey), and State Supervision of Mines (SSM) (Governmental organisation under the responsibility of the Ministry of Economic Affairs) as organisations involved in providing data relevant for geothermal energy.

NL Agency is responsible for the implementation of the national policies on sustainability, innovation and economic development, it deals with financial support for geothermal energy, including the Guarantee fund for the geological risk, and has an important networking and knowledge-sharing function. The Ministry of Economic Affairs is responsible for geothermal permitting and national energy programmes, while a separate independent group at TNO (AGE) advices the permitting department of the Ministry of Economic Affairs in matter of geothermal, geological, geophysical and geo-reservoirs. TNO (NL Geological Survey) manages all well description data, and SSM gives health and safety advices for the permitting department of the MEA.

Through its website, NL Agency provides documents on support schemes, such as the risk guarantee fund and the feed-inn premium (SDE+), and information on geothermal energy in general and on specific projects. Moreover, the "warmteatlas" (Heat Atlas), a webGIS application organized by NL Agency allows to view the location map of energy demand and the energy supplied. The stakeholders interacting with NL Agency's geothermal management system are mainly engineering companies, consultants and researchers.

NL Agency indicates the Ministry of Economic Affairs together with TNO (NL Geological Survey) as the main subsoil information provider, especially for geothermal reservoir data and exploration data. Their NL Oil and Gas Portal site www.nlog.nl provides information about oil, gas and geothermal energy exploration and production in the Netherlands and the Dutch sector of the North Sea continental shelf. They also make available data on permitting procedures and permits as collected at:

http://www.nlog.nl/en/geothermalEnergy/geothermalEnergy.html

In the Netherlands, official publications such as permits and subsidy schemes are available through one central governmental Internet site, see

https://zoek.officielebekendmakingen.nl/zoeken/staatscourant

The following table 3 shows a list of relevant websites.

Table 3 List of relevant website in Netherlands

Description	Link
Agentschap NL – information and data on geothermal energy including the Guarantee Fund	www.agentschapnl.nl/aardwarmte
Agentschap NL "NL Heat Atlas" – GIS application for detailed spatial data on heat demand and availability of a.o. geothermal energy in NL	www.warmteatlas.nl
Ministry of Economic Affairs / TNO – exploration and production data on oil, gas and geothermal energy	www.nlog.nl
TNO – GIS application for geothermal energy potential at specific locations	www.thermogis.nl

The data listed in 2.1 in Netherlands are covered for 71%, and publicly available. Among the available data, 67% of them are organized in a DB, 29% in a PF and the majority (71%) are available through Internet.

Concerning social acceptance, some documents (in Dutch), are available on web at www.energiek2020.nl. Concerning environmental impact, environmental impact laws are available through the central government at www.overheid.nl (all Dutch legislation) or at http://www.infomil.nl/onderwerpen/integrale/omgevingsvergunning, where the guidelines concerning the environmental impact permits are provided.

Netherlands has one relevant code available on the web, namely the Renewable Energy Protocol Monitoring. This document defines rules for calculating the contribution of various type of renewable energy to the Dutch energy production (http://www.agentschapnl.nl/content/protocol-monitoring-hernieuwbare-energie-update-2010-den).

There is no an official estimation of the number of employees in the field of geothermal, but a document, available at

http://www.nlog.nl/resources/procedures/Opzet_eisen_operators_web_1.pdf gives the list of skills required for working in the field of geothermal. The web application at www.warmteatlas.nl is used to discover the energy need and the coverage by geothermal uses.

NL Agency has also a complete list, available in web pages, including all the running, completed and foreseen geothermal projects and an index of the specific focus on geothermal projects. A geothermal national roadmap is also available.

On the training and education questionnaire topic (2.6), Netherland has information of the available courses, which are mainly related to the University (bachelor's and master's degrees)

and as post-academic education (3-day course). The scheduling of national congress/symposia and (post)academic courses are provided via internet.

Rules for licencing both exploration and exploitation and the applicable procedures are explained (also in English) at http://www.nlog.nl/en/procs/procedures_licences.html.

The INSPIRE directive is known, NL Agency is responsible for renewable potential while TNO is focussed on fossil fuel and geothermal energy.

NL Agency points out some relevant issues related to EGIP feasibility study: underlining the importance for EGIP to conform to INSPIRE, to consider adding data for producing more accurate maps (e.g., permeability, temperature); and to facilitate selecting potentially interesting areas for geothermal energy production and utilisation (e.i., demand vs. geothermal potential). Another suggestion is that EGIP could be coupled with a (national/European) guarantee fund for geothermal energy.

3.7 Slovakia

AGEO compiled the questionnaire. AGEO is an Agency for Geothermal Power Engineering composed by a scientific-technological coordination group. Its main aim related to the development of geothermal energy is to ensure its commercial utilization and sustainable growth. AGEO itself uses geothermal data mainly from the geothermal energy Atlas realised by the State Geological Survey of Dionyz Stur and available also as a webGIS application at http://mapserver.geology.sk/atlasge/mapviewer.jsf?width=1608&height=871, because there isn't a Geothermal Information Management System in Slovakia.

AGEO for Slovakia retrieved the 33% of the master data list proposed in 2.1 of the WP3 questionnaire. Only the 19% is public and the 10% of the existing are partially public. In most cases data are published in WP (29%), the 19% of them are organized in DB and 14% are used in a PF.

The Ministry of Environment provides environmental impact laws available at the Ministry web pages. Other references on legislations related to royalties, taxes and feed-in-tariff can be downloaded at http://www.urso.gov.sk/doc/legislativa/z_309-2009_sk.pdf. In Slovakia a public list of running, completed and foreseen geothermal projects exists, as well as the index of geothermal projects considered necessary on specific topic, an example being the new technology on drilling system reported at http://www.geothermalanywhere.com/en/asfeu-project-qapplied-research-and-development-of-innovative-drilling-technology-for-ultra-deep-geothermal-wellsq.html. No other information and data are referred by AGEO on topics as social acceptance, presence of geothermal code, training and education, skills & employees and energy needs, research R&D and regulatory aspects.

AGEO uses geothermal info and data provided by National Geologic Survey of Dionyz Stur for the basic recommendation and instructions within their publications and reviews.

In Slovakia the INSPIRE directives are not known, hence they are not implemented yet.

No issues and gaps on the geothermal management system are reported in the questionnaire.

3.8 Switzerland

Federal Office of Topography (SwissTopo) compiled the questionnaire. SwissTopo is responsible for geographical referenced data for Swiss Confederation. Geothermal Energy is one of the main target and will be highly supported in the next future. SwissTopo's role lies in handling, storing and providing geothermal data. Switzerland has not an officially recognised Geothermal Information System, it may have one but the author of this section does not know it.

Among the proposed list of data in subsection 2.1, in Switzerland all the geothermal data are present (100%), but only 33% is public and 48% is partially public. Swiss data are mainly offered in WP (48%) and only 14% are organized as DB and PF. Most of them are available thanks to the GeoMol project and available at the SwissTopo web mapping tool (www.geologieviewer.ch).

Cantonal administrations or Federal offices are the maintainers of the Environmental impact laws and environmental impact factor list. In the questionnaire all items regarding geothermal code, issues on skills, employees and energy need are marked as existent and organised in DB, PF and WP, but no further information or link are available.

A list of running, completed and foreseen projects considered strategic for geothermal R&D in Switzerland and a geothermal national roadmap are defined (given reference: Project of the City of St. Gallen).

Geothermal training courses exist at University of Neuchatel (MSc), at CAS (Certificate of Advance Studies at University of Neuchatel), at ETH Zurich, and SVG (Swiss Association on Geothemics www.geothermie.ch) provides courses for professionals and administrations.

Information on regulatory aspects and economics exist but no reference is suggested within the questionnaire.

Part 3 and 4 of the questionnaire were not compiled for Switzerland.

3.9 Turkey

For Turkey three body organisations jointly compiled the questionnaire: Ministry of Energy and National Resources, Energy Market Regulatory Authority and The Scientific and Technological Research Council of Turkey. The latter gathered information and finalised the questionnaire.

The Ministry of Energy and National Resources deals with the implementation of energy regulations, the Energy Market Regulatory Authority is involved in balancing the energy market and The Scientific and Technological Research Council of Turkey mainly supports the geothermal projects.

The Scientific and Technological Research Council of Turkey as well as in the others Authorities have not a geothermal information system.

No data related to the list proposed in 2.1 WP3 questionnaire are reported (0%).

The Ministry of Environment and Urbans (http://www.csb.gov.tr) deals with the environmental impact laws, whereas no information exist on geothermal code, skills&employees and energy need. Tubitak is the referent institution for running, completed and forseen geothermal projects. A list of projects considered necessary on specific geothermal topics and a not-public geothermal roadmap are present in Turkey.

University courses dealing with geothermal energy topics, including PhD and Master, are known and published in WP.

The rules of licencing for both exploration and exploitation are managed by Republic of Turkey Energy Market Regulatory Authority (http://www.epdk.gov.tr/).

An insurance covering geothermal exploration risks, incentive schemes, taxes and royalties are well defined in Turkey.

Regarding Part 3 of the questionnaire, Tubitak indicates custom issues for retrieving geothermal data and information, specifying also that they do not work with spatial data. No suggestion for future geothermal management system (questionnaire Part 4) and has been provided.

4. Discussion

The WP3 questionnaire is an effective tool to define the actual situation for surveying the geothermal information and data management systems running and used among the Geothermal ERANET countries.

A list of the organisations that compiled questionnaire (Table 4), and also all the organisations related to the geothermal data use and management (Table 5) are now available for each country.

Table 4 WP3 Questionnaire Reference Organisation

Country	Organization Compiling Questionnaires
FRANCE	ADEME
GERMANY	Project Management Jülich
HUNGARY	Geological and Geophysical Institute of Hungary
ICELAND	Orkustofnun
ITALY	CNR
NETHERLANDS	NL Agency
SLOVAKIA	AGEO
SWITZERLAND	SwissTopo
TURKEY	Tubitak

Table 5 Organisations related to geothermal

Country	Reference Organization
FRANCE	ADEME
FRANCE	BRGM
GERMANY	Project Management Jülich
GERMANY	LIAG
HUNGARY	Geological and Geophysical Institute of Hungary
HUNGARY	Dept. of geophysics, Eötvös Lórand University, Budapest
HUNGARY	Hungarian Office for Mining and Geology

Country	Reference Organization
HUNGARY	National Institute for Environment
ICELAND	Orkustofnun
ICELAND	ISOR
ITALY	CNR
ITALY	MISE
NETHERLANDS	NL Agency
NETHERLANDS	TNO
NETHERLANDS	Ministry of Economic Affairs
NETHERLANDS	SSM
SLOVAKIA	AGEO
SWITZERLAND	SwissTopo
TURKEY	Tubitak
TURKEY	Ministry of Energy and National Resources
TURKEY	Energy Market Regulatory Authority

The WP3 questionnaire survey produced a list of the Geothermal Management Systems actually running (Table 6). Web pages on generic geographical web tool have been excluded from the table.

Table 6 Ongoing Geothermal Management Systems and links

Country	Name	Link
FRANCE	Geotermie Perspective	www.geotermie-perspective.fr
FRANCE	Thermo2Pro	www.thermo2pro.fr
GERMANY	Geotis	www.geotis.de
HUNGARY	Geological and Geophysical Institute of Hungary	www.mfgi.hu
HUNGARY	Dept. of geophysics, Eötvös Lórand University, Budapest	www.elte.geophysics.hu

Country	Name	Link
HUNGARY	Hungarian Office for Mining and Geology	www.mbfh.hu
HUNGARY	National Institute for Environment	www.neki.hu
ICELAND	Orkustofnun Portal	www.orkuvefsja.is
ICELAND	Orkustofnun site	http://www.os.is/borholuleit
ICELAND	Orkustofnun site	http://www.os.is/orkustofnun/bokasafn/skyrslur-OS/
ITALY	Geothopica	http://geothopica.igg.cnr.it
ITALY	IGA Global Geothermal Energy DB	http://vmigg.iit.cnr.it/SpagoBI
ITALY	MISE	http://unmig.sviluppoeconomico.gov.it/home.as
NETHERLANDS	NL Agency Geothermal Energy	www.agentschapnl.nl/aardwarmte
NETHERLANDS	NL Agency "NL Heat Atlas"	www.warmteatlas.nl
NETHERLANDS	ThermoGIS	www.thermogis.nl
NETHERLANDS	NL Oil & Gas Portal	www.nlog.nl
SLOVAKIA	-	-
SWITZERLAND	-	-
TURKEY	-	-

A detailed data survey has been conducted in the second part of the questionnaire, taking into account the proposed list of data. All information are summarised in tables Table 7, Table 8, Table 9 and shown in Figure 2 and Figure 3.

Apart Slovakia and Turkey (and Hungary since no info is available yet) the ERANET partners have a large quantity of data, over 70% of those proposed in 2.1.

In most cases, data are organised in web pages and databases, whereas the web platform tool is less popular. Utilised spatial systems are different among Geothermal ERANET countries, see Table 6.

Table 7 Underground data list - Questionnaire 2.1 subsection (8/9 countries)

Country	% Existence	% Public	% Partially Public
FRANCE	90	71	0
GERMANY	81	0	81
HUNGARY	100	10	33
ICELAND	86	57	14
ITALY	86	43	43
NETHERLANDS	71	71	0
SLOVAKIA	33	19	10
SWITZERLAND	100	33	48
TURKEY	0	0	0

Table 8 Underground data Organization - Questionnaire 2.1 subsection (8/9 countries)

Country	% DB	% PF	% WP
FRANCE	52	48	43
GERMANY	76	76	76
HUNGARY	100	0	19
ICELAND	57	43	48
ITALY	62	19	81
NETHERLANDS	67	29	71
SLOVAKIA	19	14	29
SWITZERLAND	14	14	48
TURKEY	0	0	0

Table 9 Spatial Data reference system - Questionnaire 2.1 subsection (8/9 countries)

FRANCE	Lambert for continental France, specific UTM for overseas territories
GERMANY	WGS
HUNGARY	UTM
ICELAND	ISN93
ITALY	WGS84UTM32 / WGS84UTM33 / WGS84UTM34 Gauss-Boaga east fuse / Gauss-Boaga west fuse ED50UTM32 / ED50UTM33 / ED50UTM34
NETHERLANDS	RD new amersfoort (permitting). TNO uses UTM
SLOVAKIA	-
SWITZERLAND	-
TURKEY	-

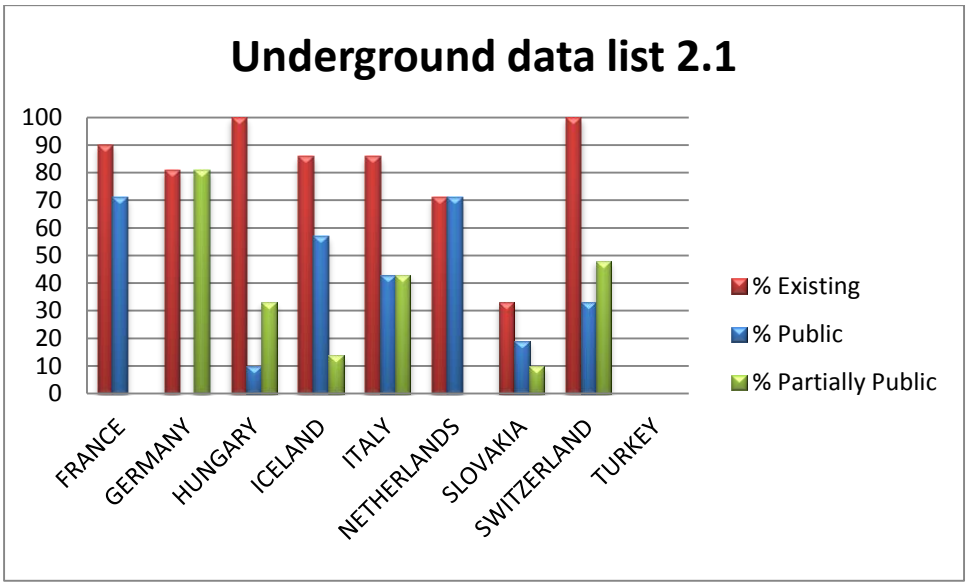

Figure 2 Data availability, based on underground data list proposed in questionnaire section 2.1 (Hungary still pending)

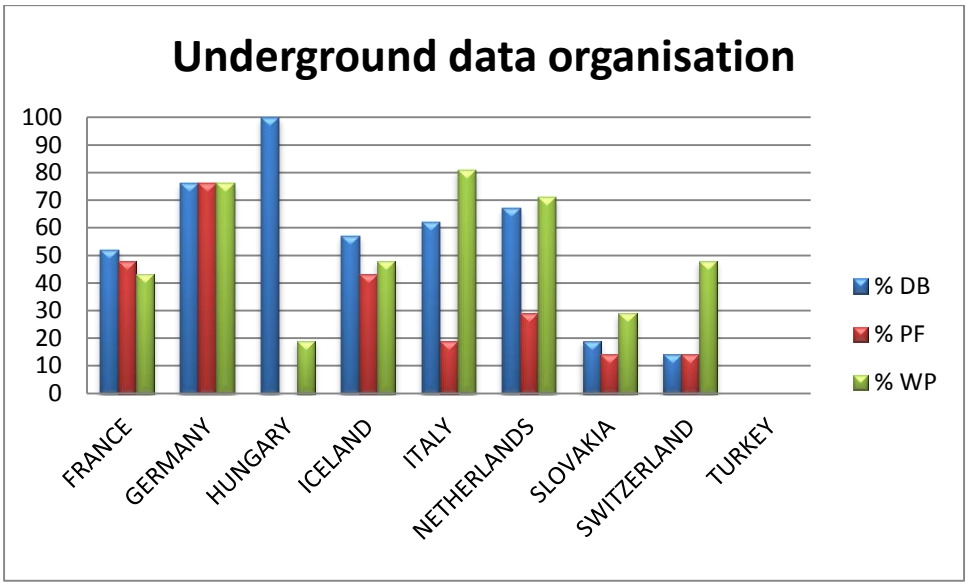

Figure 3 Underground data organisation of the data list proposed in questionnaire section 2.1 (Hungary still pending).

**Countries can have different kind of data*

Only in Iceland, France and Netherlands a sort of geothermal code (2.3 sub-section) exists, whilst in Italy it is in progress.

Social Acceptance information (question 2.2 of the questionnaire), as well as Skill & employees and energy need information (question 2.4) are well or partially covered in France, Germany, Hungary, Iceland, Italy, Netherlands and Switzerland. All countries (Hungary still pending) have given answers for the Research R&D topics (2.5), often including a reference web site or documents. Regarding the Training and education issue (2.6), all ERANET countries excluding Slovakia declare the presence of geothermal courses mainly as University curriculum (BSc, MSc, PhD). Only Germany and Switzerland have public information about course attendance, although partial.

In most cases the documents on regulatory aspects (2.7) are available as WP, with the exception of Slovakia where the rules of licencing are not available, whereas regarding grid access only France, Germany, Iceland, Italy and Slovakia have information regarding the legal conditions available in WP.

The insurance covering the geothermal project risks (2.8) is available in France, Germany, Iceland, Netherlands and Switzerland. Still in 2.8 topics and regarding Economic aspects, all the ERANET countries have royalties, taxes and support schemes, and these information can be retrieved through WP (excluding Turkey), see table 7.

All links or web pages related to the 2.2, 2.4, 2.5, 2.6, 2.7 and 2.8 are listed in Table 10

Table 10 List of documents or web pages inherent sub-sections 2.2, 2.4, 2.5, 2.6, 2.7 and 2.8

Country	Sub-section	Link
GERMANY	2.2	http://www.bmu.de/bmu/parlamentarische-vorgaenge/detailansicht/artikel/laufende-forschungsvorhaben-des-bmu-im-bereich-erneuerbare-energien/
GERMANY	2.2	http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/ee_forschung_vorhaben_bf.pdf
GERMANY	2.4	http://www.erneuerbare-energien.de/en/topics/data-service/renewable-energy-in-figures
GERMANY	2.5	http://www.bmu.de/bmu/parlamentarische-vorgaenge/detailansicht/artikel/laufende-forschungsvorhaben-des-bmu-im-bereich-erneuerbare-energien/
GERMANY	2.5	http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/ee_forschung_vorhaben_bf.pdf
GERMANY	2.8	Market Incentive Programme, supports risk insurance and drilling subsidies. http://www.bafa.de/bafa/de/energie/erneuerbare_energien/vorschriften/energie_ee_richtlinie_20_07_2012.pdf
GERMANY	2.8	Feed-in tariff is regulated by EEG (Erneuerbare Energien Gesetz): http://www.erneuerbare-energien.de/fileadmin/ee-import/files/pdfs/allgemein/application/pdf/eeg_2012_bf.pdf In English: http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/eeg_2012_en_bf.pdf
GERMANY	2.9	A complete description of the project starting in 2005 is available: http://www.geotis.de/homepage/Ergebnisse/GeotIS_Endbericht.pdf
HUNGARY	2.2	Hungarian Geothermal Association www.mgte.hu
HUNGARY	2.2	Hungarian Thermal Energy Association www.termalenergia.hu
HUNGARY	2.2	Ministry of Rural Development www.vm.gov.hu

Country	Sub-section	Link
HUNGARY	2.2	National Institute for Environment www.neki.hu
HUNGARY	2.2	River Basin Management Plans: www.vizeink.hu
HUNGARY	2.7	Summary report on Legislation related to geothermal energy in Hungary (also Slovkia, Slovenia and Austira) prepared in the frame of project TRANSENERGY http://transenergy-eu.geologie.ac.at/Downloads/2CE124P3_4PR_WP3%203.3.1_Overview%20of%20EU,%20national%20and%20regional%20legislation.pdf
ICELAND	2.2	All laws in Icelandic accessible on www.althingi.is. Regulations on www.reglugerdir.is. On websites of ministries translations can sometimes be found.
ICELAND	2.3	See Report Ketilsson et al. (2011) accessible in Icelandic here; http://www.os.is/gogn/Skyrslur/OS-2010/OS-2010-05.pdf
ICELAND	2.4	Only via IGA Iceland Country Report published every 5 years. Accessible online in the form of a paper: http://www.geothermal-energy.org/pdf/IGAstandard/WGC/2010/0124.pdf
ICELAND	2.4	Energy Forecasts for electricity, heat uses and fuel are accessible online here: http://os.is/orkustofnun/rad-og-nefndir/orkusparnefnd/ (reports in Icelandic but all figures have also an English translation attached to it in an appendix).
ICELAND	2.5	National Roadmap here defined as equivalent to Icelandic Matser Plan, where resources have been quantified and prioritized to be protected, further researched or to be utilized for power generation. www.rammaaaetlun.is
ICELAND	2.6	See www.unugtp.is (postgrad diploma), www.reyst.is (MS programme), www.hi.is (BS,MS,PhD), http://www.keilir.net/ (BS),
ICELAND	2.7	A list of issued licenses can be accessed here: http://www.os.is/orkustofnun/leyfisveitingar/utgefin-leyfi/
ICELAND	2.8	http://www.os.is/orkustofnun/rad-og-nefndir/orkusjodur/

Country	Sub-section	Link
ITALY	2.2	http://www.unionegeotermica.it/amici-della-terra-risorsa-geotermica.asp
ITALY	2.2	www.normattiva.it
ITALY	2.2	http://www.va.minambiente.it/condivisione/normativa/normativanazionale.aspx
ITALY	2.2	http://rinnova.gse.it/pages/normativa.aspx.
ITALY	2.2	http://www.arpat.toscana.it/temi-ambientali/aria/aree-geotermiche/geotermia/progetto-geotermia#pressioni
ITALY	2.2	http://www.ars.toscana.it/files/aree_intervento/ambiente/geotermia/studio_geotermia/1_sez_a_ambiente_%20pp_1-38.pdf
ITALY	2.2	http://www.enel.com/it-IT/doc/report2011/Rapporto_ambientale2011.pdf
ITALY	2.4	National Renewable Energy Source Industry Roadmap (European Project REPAP2020 – Italian representative is APER) http://www.repap2020.eu/fileadmin/user_upload/Roadmaps/Template_industry_roadmaps_APER_march__2010_english_rev3.pdf
ITALY	2.4	IEA-Data from Annex X National Reports 2010 http://iea-gia.org/wp-content/uploads/2012/08/GIA_TrendsGeothermalApplications-2010_Vs2_1-Ganz-29Aug121.pdf
ITALY	2.5	http://www.assoknowledge.org/AlleanzeTecnologicheItaliane.pdf
ITALY	2.5	National Renewable Energy Source Industry Roadmap (European Project REPAP2020 – Italian representative is APER) http://www.repap2020.eu/fileadmin/user_upload/Roadmaps/Template_industry_roadmaps_APER_march__2010_english_rev3.pdf
ITALY	2.7	http://unmig.sviluppoeconomico.gov.it/unmig/norme/norme.asp
ITALY	2.8	Ministry Decree of 6 July 2012 – “Incentivi per energia da fonti rinnovabili elettriche non fotovoltaiche”, available at link: http://www.sviluppoeconomico.gov.it/images/stories/normativa/DM_6_luglio_2012_sf.pdf

Country	Sub-section	Link
ITALY	2.8	Decree of the President of the Republic of 27 May 1991, no. 395 – "Approvazione del regolamento di attuazione della L.896/86 recante disciplina della ricerca e della coltivazione delle risorse geotermiche", available at link: http://unmig.sviluppoeconomico.gov.it/unmig/norme/geotermia/395dpr91.htm
ITALY	2.8	GSE webpage collects and provides references to Tariffs, incentives and decrees. Links at (partly available in English) http://www.gse.it/en/Pages/default.aspx
NETHERLANDS	2.2	Some reports can be found through http://www.energiek2020.nu/aardwarmte/
NETHERLANDS	2.2	In the future, additional reports may become available through www.agentschapnl.nl/aardwarmte
NETHERLANDS	2.2	www.overheid.nl makes available Dutch legislation. This includes laws and granted permits.
NETHERLANDS	2.2	http://www.infomil.nl/onderwerpen/integrale/omgevingsvergunning provides guidance concerning the environmental impact permits, including access to laws and forms.
NETHERLANDS	2.2	Monitoring statistics for european renewable energy directive www.cbsstatline.nl
NETHERLANDS	2.3	Renewable Energy Protocol Monitoring defines rules for calculating the contribution of various types of renewable energy to the Dutch energy production http://www.agentschapnl.nl/content/protocol-monitoring-hernieuwbare-energie-update-2010-den (also available in English)
NETHERLANDS	2.4	List of skills required in the field of geothermal http://www.nlog.nl/resources/procedures/Opzet_eisen_operators_web_1.pdf
NETHERLANDS	2.4	Surveys on energy needs and coverage by geothermal uses? (e.g. maps, …) http://www.warmteatlas.nl
NETHERLANDS	2.4	http://www.ecorys.nl/contents/uploads/factsheets/85_1.pdf provides an estimation of full-time jobs in 2010, 2020 in geothermal energy and "heat" (district heating??) together

Country	Sub-section	Link
NETHERLANDS	2.5	Publicly funded RD&D projects www.agentschapnl.nl/energie-innovatie
NETHERLANDS	2.5	Specific focus on geothermal projects www.agentschapnl.nl/aardwarmte
NETHERLANDS	2.5	Action plan geothermal energy (national roadmap): http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2011/04/21/actieplan-aardwarmte.html
NETHERLANDS	2.6	PAO (post-academic education) offers 3-day course on geothermal energy http://www.millian.nl/postdoctoraal-en-post-hbo/instituut/postacademisch-onderwijs-(pao)-1328/opleidingen/verdiep-je-in-aardwarmte-geothermie-van-idee-naar-realisatie-25265/beschrijving/
NETHERLANDS	2.7	The procedure is explained in English here http://www.nlog.nl/en/procs/procedures_licences.html
NETHERLANDS	2.7	Assuming it is comparable to wind – see http://www.windbarriers.eu/fileadmin/WB_docs/documents/WindBarriers_report.pdf
NETHERLANDS	2.8	Insurance covering the geothermal project risks (e.g. deep drilling wells) http://www.agentschapnl.nl/programmas-regelingen/regeling-sei-risicos-dekken-voor-aardwarmte
NETHERLANDS	2.8	Royalties & taxes, support scheme (feed-in tariffs, grants, …) http://www.agentschapnl.nl/programmas-regelingen/geothermie-sde-2013
SLOVAKIA	2.2	Ministry of Environment: http://www.minzp.sk/en/
SLOVAKIA	2.5	http://www.geothermalanywhere.com/en/asfeu-project-qapplied-research-and-development-of-innovative-drilling-technology-for-ultra-deep-geothermal-wellsq.html
SLOVAKIA	2.8	http://www.urso.gov.sk/doc/legislativa/z_309-2009_sk.pdf (in Slovak)
SWITZERLAND	2.2	map.bafu.admin.ch
TURKEY	2.2	Republic of Turkey Ministry of Environment and Urbans (http://www.csb.gov.tr)

Country	Sub-section	Link
TURKEY	2.5	http://www.tubitak.gov.tr
TURKEY	2.7	http://www.epdk.gov.tr/

At completion of the questionnaire's second part, the entries of 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8 are plotted as chart in Figure 4, where the Y axis indicates the presence of documents for each topic, except for 2.3 where the value 1 means the existence of the geothermal code. To have a better chart comprehension please note that sub-section 2.2 has 4 different requests, 2.4 has 3 request, 2.5 has 3, 2.6 has 4, 2.7 has 2 and 2.8 has 2.

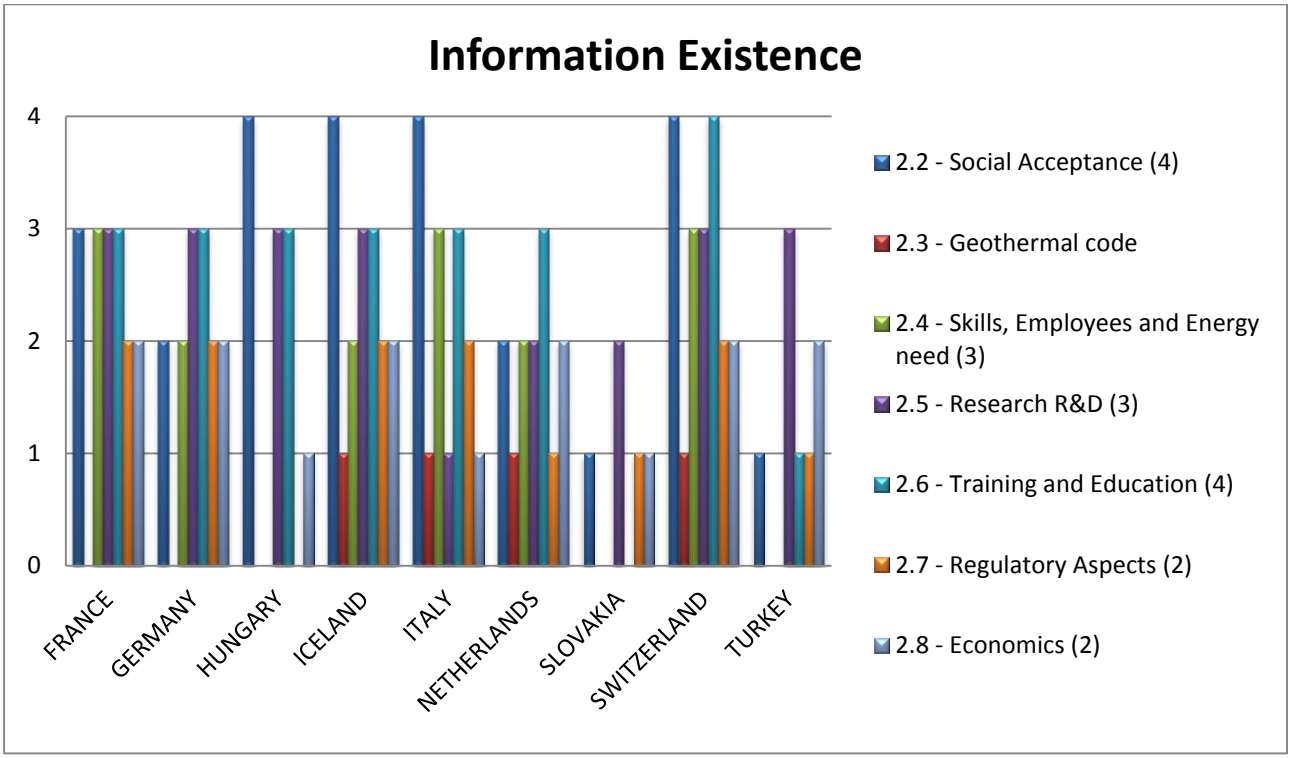

Figure 4 Information existence on Part Two questionnaire topics.

France, Germany, Hungary, Iceland, Italy, Netherlands gave detailed answers in Part 3 of the questionnaire (Database applications to develop). In most cases, the geothermal data are retrieved according to the competences of the answering organisation: Ministries mainly for regulating issues (laws, environmental pressure, royalties, feed-in-tariff, taxes, geothermal roadmap), Agencies mainly for funding and for research and deployment project (running, completed, foreseen), and Scientific Organisations for specific technical geothermal information often referred to reservoirs, resources, i.e., underground technical aspects.

The analysis of 3.3 answers, related to geo-spatial data, shows that there is a wide utilisation of spatial data. In Hungary, Italy and in Iceland geothermal data are produced and provided directly by GGIH, CNR and Orkustofnun, while Netherlands and Germany are provided by TNO and LIAG.

The INSPIRE directives, although known from most ERANET countries, are partially implemented in Hungary, Iceland, Italy and Netherlands whereas France, Germany, Switzerland, Slovakia and Turkey they have not been even considered.

The last part of the questionnaire is particularly relevant for the implementation of the European Geothermal Information Platform. Each country has given its own contribution on the majority of the crucial issues and on what should be considered important to make EGIP useful and efficient, the main retrieved hints being:

- to elaborate a common database gathering info from various sources (wells, plants,)
- to define tools to manage the exploited aquifers and to assess the possibility of new operations
- to harmonize services and data management following a precise protocol, which should also define data content and format
- to be conform to INSPIRE
- to provide tools helping to select potentially interesting areas also taking into account other factors besides geothermal potential, e.g., energy demand, potential coverage of different kind of energy demand with respect to geothermal heat and power potential supply, social aspects.

The results of WP3 questionnaire and the main relevant issues listed above must be considered as the starting point to elaborate the following ERANET WP3 task, the feasibility study of EGIP. The state-of-the-art gives an important point of view on the actual situation on all issues related to geothermal energy. The feasibility study can be developed using the list of information here proposed, the list of references (both documents and websites) and the main common issues suggested by the ERANET partners.

5. APPENDIX I: WP3 Questionnaire; Towards a European Geothermal Database

5.1 Preface

This questionnaire is intended to get an overview of the situation of geothermal energy data organization in the participating countries and for relevant stakeholders (with respect to this issue). Each organization participating to the Geothermal ERA-NET Consortium will be responsible to provide the answers related to its reference country, coordinating, if necessary, the response of others within the country. The Questionnaire will be also sent to stakeholders who are considered of reference for this issue and who will be invited to take part of the round table to be organized in Reykjavik on March 2013.

Nowadays many geothermal database (GDB) are considered on a national (national or even regional and local GDB) or international scale (e.g., GDB in projects such as GEOELEC, GEIS within EERA JPGE, TransEnergy, the IGA GDB of geothermal uses in the world). They mostly refer to management of underground data and to resource features (e.g., well data, geothermal potential), or to exploitation parameters (e.g., installed capacity…).

However, the exploitation and management of geothermal energy requires not only the knowledge of the underground conditions and the technologies, but also other issues are important, e.g., regulatory, economical and social (including environmental) aspects, research roadmaps and training, energy demand and market request. Data availability, needs and gaps in many fields provide a variety of information, partly connected, depicting a complex picture.

The need to manage a large quantity of data of different kinds (e.g., well data, regulatory documents, monitoring data, list of training courses) and stored in different ways requires, beside a structured data organization, information analysis and recovery systems able to answer in a quick and efficient way. Thanks to the technological evolution of data management system tools, data integration and analysis may be managed through information platforms managing both structured and structured data, which can be analysed in an aggregated way.

Geothermal ERA-NET aims to work on setting medium and long term standard on what geothermal information to collect for Europe, proposing and describing the structure of a **European Geothermal Information Platform**, to have a reference that may be followed at national level and to put the base for a common Data Model to share information among European countries.

Within Geothermal ERA-NET we also aim to define the catalogue of data that can be structured by INSPIRE. General rules will be then defined, for managing the catalogued data and services to specify the Data Model of the European Geothermal Information Platform.

In order to establish the state-of-the-art in geothermal data organization and its needs and gaps, this questionnaire is structured in 4 parts describing: i) Context, ii) Data, iii) Application, iv) Management of the European Geothermal Platform.

In this document we refer to different way to organize and provide data: by **database** (DB) we mean a tool for archiving and managing structured data within a Relational management system, which may be queried for retrieving the required information; by **platform** a tool that adds to the DB a business intelligence functionality able to process structured and unstructured data and to provide them in form of graphs, reports and maps, which are defined a priori in order to facilitate access and analysis in an aggregated way; by **webpage** we refer to places on the ***worldwideweb*** where data in the form of maps, reports, tables, documents are listed and may be accessed.

Each partner should coordinate the questionnaire for its country. Please use the flag of your country in the header, erasing the other flags.

5.2 Questionnaire

If the boxes are too small for your answer, don't hesitate to expand them; you can simply drag the bottom line downward.
Please add references, but always provide a (summary) answer in written English text.

Table 11 Questionnaire: Information Part 1

Country	
Name contact person	
Organization contact person	
E-mail	
Phone number	
Others who contributed to the document:	

If others than the primary contact contributed, complete:

Table 12 Questionnaire: Information Part 2

Name contact person	
Organization contact person	
E-mail	
Phone number	

5.3 General Database Context information

Table 13 General Database Context information

1.1 Context Description. Describe the organizations that have been involved to answer this questionnaire and their involvement in geothermal energy.
1.2 Describe the role of the involved organizations with respect to the use of the Geothermal Data (How they produce, provide, manage geothermal data. What is the role (i.e., administrative, provider and user) of those who manage data?).
1.3 Is a Geothermal information management system (i.e., database, platform or webpage[1]) managed or coordinated by your body institution? If yes, please indicate here also the references (e.g. links to website, scientific paper, documentation, ...) and provide to WP3 leader reference documents if they are in English language.
1.4 If yes, what is the role of those who interact with the Geothermal data management system?
1.5 If not in your body institution, is a Geothermal information management system (i.e., database, platform or webpage[2]) present in your country? If yes, please indicate here also the references (e.g. links to website, scientific paper, documentation, ...) and provide to WP3 leader reference documents if they are in English language.
1.6 What are, in your opinion, the most useful issues and gaps regarding the functionalities in geothermal management systems that you or your collaborators have used?

5.4 Data Master List

This section is meant to provide the list of the data already available in your institution/country/project, and how they are organized.

[1] *Refer to Page 1-2 for reference on these terms*
[2] *Refer to Page 1-2 for reference on these terms*

We also ask if there are available or useful although not yet available data that are not listed here.

Instructions:

Please keep the symbol corresponding to your situation, specifying if the listed data exist, if they are public, and if they have been already organized in a **geothermal database (DB), platform (PF) and webpage (WP)**[3].

Symbol explanation:

☐ = no

☒☐= yes

Consider that the data here listed covers the issues of the 8 boxes in the following figure.

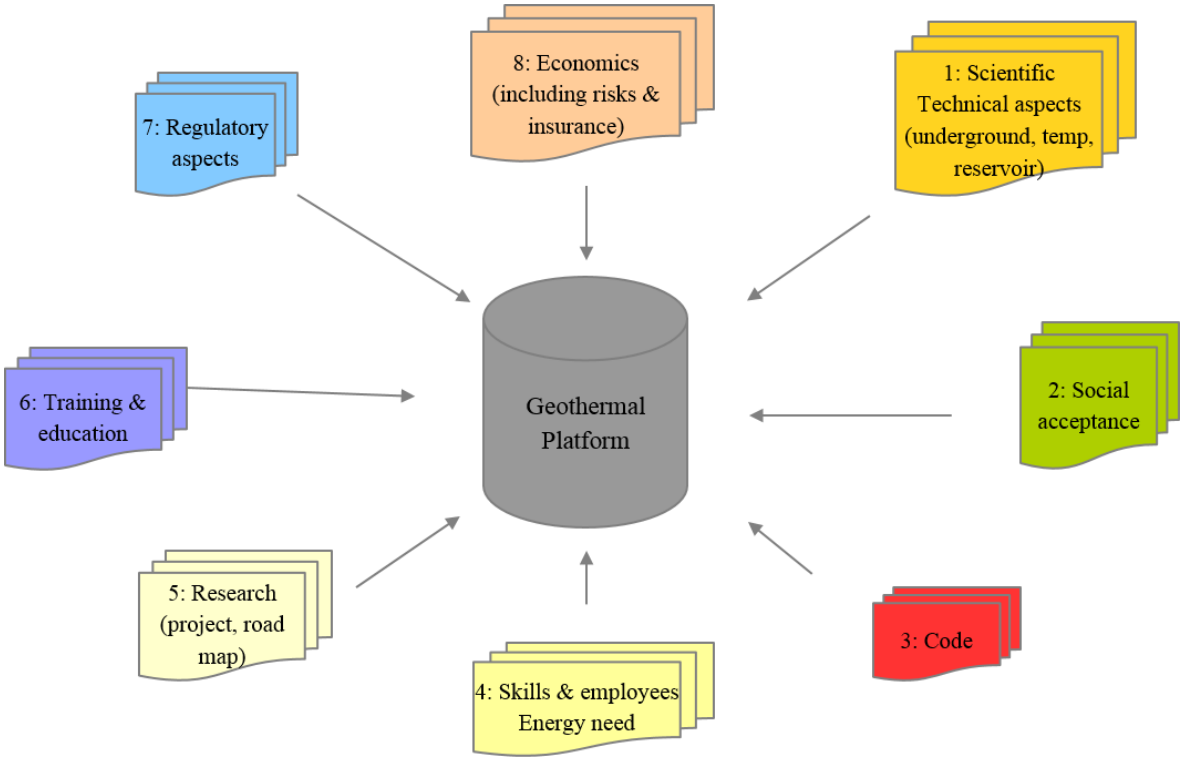

Figure 5 Data Master List

[3] *Refer to Page 1-2 for reference on these terms*

Table 14 Data Master List

2.1 Scientific and technical aspects	Existing	Public	Organized
Temperature data in the subsurface (e.g. oil and gas borehole BHT/DST).	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Temperature maps at depth (Available depth?) ……	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Surface heat flow measurements and map	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Heat flow measurements and map at depth	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Thermal spring analyses (physical and chemical, e.g., temperatures, pH, chemical elements, geothermometers)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP

Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Geothermal reservoir temperature in high enthalpy geothermal fields	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Any other reservoir information (e.g. pressure, production level depth, flow range, fluid characteristic, enthalpy).	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Published temperature model interpretation (e.g. regional heat flow, local effects due to meteoric effects)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Basin layout and sediment-basement interface depth	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Outlines of granitic formations	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP

Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Geothermal and oil & gas wells master log (including litho-stratigraphy, wells technical aspects, geophysics logs)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Geophysical survey (e.g. seismic cross-sections, MT survey, geoelectrical survey)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Fault mapping, Tertiary and Quaternary fault systems	☒ ☐	☒ ☐	☒ ☐ DB ☒ ☐ PF ☒ ☐ WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Recorded seismicity	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Information regarding geographical restricted areas for geothermal (consider mining, oil exploration and/or exploitation, CCS, nuclear storage, spa's, interference with drinking water, population density, natural parks, high seismicity areas, etc.)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP

Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Exploration and production licenses and (projected) power production	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Raster maps of transmissivity (map coverage % of country/region)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Porosity – Permeability measurements or poro-perm relationships and poro/depth relationship	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Exploration data on particular data prospective resources	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Geothermal plant location, installed capacity (MW), running capacity (MW) and produced energy in one year (MWh/year), typology, status, plant owner, manufacturer, geothermal field belonging.	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP

Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Direct use of heat: location, typology, installed capacity (MWt) and produced energy in one year (TJ/year)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
What is the reference system used for georeferencing data (UTM, WGS, or others)?			
2.2 Social acceptance (including environmental issues)	**Existing**	**Public**	**Organized**
Studies and reports on the social acceptance of geothermal energy	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Environmental impact laws	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
Environmental pressure factor list	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide who/which managing organization, and where it can be found, possibly also references /links or further details:			
Monitoring network data	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF

			☐ ☒WP
Please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
If yes, which are the tracked parameters?			
2.3 Code (thesaurus, glossary, lexicon, reporting code, e.g. http://www.pir.sa.gov.au/__data/assets/pdf_file/0005/147875/The_Geothermal_Reporting_Code_Ed_2.pdf, http://www.cangea.ca/reports/attachment/canadiangeothermalcodeforpublicreporting/)	**Existing**	**Public**	**DB/PF/web**
Geothermal code and/or thesaurus and/or a glossary in your body or in your country	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
If yes, please provide who/which managing organization, and where they can be found, possibly also references /links or further details:			
2.4 Skills & employees, energy needs	Existing	Public	Organized
Official number of employees in the field of geothermal? (e.g. institutional body, private company, …)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
List of skills required in the field of geothermal	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Surveys on energy needs and coverage by geothermal uses? (e.g. maps, …)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide comments, references /links or further details:			

2.5 Research R&D	Existing	Public	DB/PF/web
Geothermal projects running, completed and foreseen	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Geothermal projects considered necessary on specific topics	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Geothermal national roadmap	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Please provide references /links or further details:			
2.6 Training and education (training courses lists and related document (data, links, presentations, training manuals)	**Existing**	**Public**	**Organized**
Geothermal training courses present?	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
If yes, which level (e.g. University, PhD, Master, professional bodies, specialization)?			
Training courses details (e.g., location, schedule)	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Training courses average attendance	☐ ☒	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP

What are, in your opinion, the strengths and weaknesses on the course topics, if any?.....
Please provide comments, references /links or further details: …….

2.7 Regulatory aspects (documents regulating geothermal exploitation (laws, directives, authorization document forms) or public documents related to exploration or concession licenses)	**Organized**
Rules of licensing (exploration/exploitation)	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Legal condition for grid access	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Any other issue you consider important to list and retrieve? …….	
Notes: if available, please provide references /links or further details: ……	

2.8 Economics (fund, risks&insurance)	**Existing**	**Organized**
Insurance covering the geothermal project risks (e.g. deep drilling wells)?	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Royalties & taxes, support scheme (feed-in tariffs, grants, …)	☐ ☒	☐ ☒ DB ☐ ☒ PF ☐ ☒WP
Notes: if available, please provide references /links or further details:		

2.9 *Other*
Any other data to be included? You may also add data that are not available, but that you think could be important to include. Please specify if the data you add is something already available in your country/organization/project and if and how it is organized. ……

5.5 Database Application to develop

Starting from the available data defined in the previous section, we want here to verify how data are already processed and what are operations you consider important to perform with the listed data (maps, charts, statistics,…).

Table 15 Database Application to develop

3.1 Describe how you (inside your institutional body or your country or project) retrieve geothermal data and information (e.g., selecting and retrieving data, viewing maps, spatial analysis, or custom issues).	
3.2 Describe how you (inside your institutional body or your country or project) work with geospatial data (including both maps and table with coordinate information or address fields)	
3.3 Are you aware about the requirements of INSPIRE Directive for public organizations to deliver public data concerning Energy Resources, and geothermal energy in particular (mainly the geothermal potential, but also other issues)?	
3.4 If yes, could you please indicate the level of your involvement:	
Do you provide already at the Member state level INSPIRE metadata describing dataset of geothermal resources?	☒ ☐
Do you provide INSPIRE view services to display this data?	☒ ☐
3.5 Do you know the INSPIRE data specifications about Energy Resources (including geothermal energy) that defines the European common data model to deliver energy resources data?	☒ ☐
3.6 What are, in your opinion, the most useful issues and gaps regarding the functionalities in geothermal management systems that you have used?	

5.6 Procedures for data update and data management

Table 16 Procedures for data update and data management

4.1 Describe: What are the future operations of updating and database management that you consider most useful and should be considered to improve the platform capability?

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