European Geothermal Information Platform EGIP

An overview to prepare the implementation
EGIP Expert Group Report

September, 2016

European Geothermal Information Platform EGIP

An overview to prepare the implementation
EGIP Expert Group Report

Report

Philippe Calcagno, Thorvaldur Bragason, Christian Minnig, László Sőrés, Eugenio Trumpy

BRGM- France; OS- Iceland, Swisstopo- Switzerland, MFGI- Hungary, CNR- Italy

September 2016

Executive summary

The FP7 European [Geothermal ERA-NET](#) project (2012-2016) was dedicated to the coordination of geothermal R&D and the development of Joint Activities among the countries members of the consortium: Iceland (coordinator), The Netherlands, Switzerland, Italy, Germany, France, Turkey, Slovakia, Hungary, Portugal, and Slovenia.

Working towards a European Geothermal Database was a target of the Geothermal ERA-NET proposal that led to the EGIP concept (European Geothermal Information Platform). The goal of EGIP is to facilitate the access to geothermal information at the European level. This will be an important step to structure the geothermal sector and help scientists, stakeholders, investors and geothermal developers. EGIP is envisaged as a Web tool gathering data and knowledge from national providers following the European INSPIRE directive (INSPIRE, 2007) to harmonize the geothermal sector at EU level and to improve INSPIRE contents.

A comprehensive and solid background has been prepared for EGIP during the Geothermal ERA-NET project by the EGIP working group. This document is based on the major steps regarding EGIP achieved in the course of the Geothermal ERA-NET project. The group started with a state of the art report (2013) and a feasibility study report (2013). Then, a pilot (2014) was set up to demonstrate the EGIP concept feasibility. The pilot was tested and evaluated by stakeholders; the results of this survey along with propositions for enhancement are described in the "Tuning EGIP Joint Action report" (2016). On top of that, the EGIP approach was published in a scientific journal (Trumpy et al., 2015). Full references and Web links related to these major achievements are available in the references chapter of this document.

This document offers an overview of EGIP to prepare its implementation. After a presentation of the EGIP concept, it proposes a vision for its intended architecture and implementation. This vision is completed at the end of the document by some open issues and recommendations, plus as an annex, a detailed list of relevant geothermal data themes linked with related INSPIRE guidelines and previous Geothermal ERA-NET works.

EGIP has not been implemented so far but a pilot has been set up. The following is dedicated to whom such implementation may concern. It is not a ready-to-use procedure but contains the main insights identified by the EGIP Expert Group to be considered and adapted to the context where EGIP will be implemented.

Table of Contents

List of Tables

List of Figures

Acknowledgements

Abstract

This document focuses on the European Geothermal Information Platform (EGIP). This platform intends to help stakeholders of the geothermal sector for accessing geothermal information and data at the European level. Such an information platform does not exist yet but a pilot has been created to demonstrate the feasibility. The report is dedicated to whom will take part in the implementation of EGIP.

Firstly, the concept of EGIP is introduced to define the framework of the information platform. Then, the foreseen architecture and key outlines for the implementation of EGIP are discussed in compliance with the INSPIRE European directive. As a complement, some recommendations and open issues are presented to draw the attention on important specific topics. Finally, the geothermal data themes recommended by the Expert Group for populating EGIP are presented in the annex of the report.

1 Introduction to the EGIP concept

Through all the work performed under Geothermal ERA-NET, the EGIP working group developed a clear vision of the EGIP concept exposed in this chapter.

The envisaged EGIP must act as a Web portal, where European geothermal information can be accessed, retrieved and queried using modern information and communications technology (ICT). EGIP goes beyond pure data sharing: it also defines the way information and data are displayed, examined, and compared. In reality, it is a virtual entity, created through harmonized information.

The information included in the EGIP covers all the aspects related to geothermal energy, not only underground data but also information on the economics, regulations, national energy policies, energy production, energy demand, market requests, and social issues.

The sum of these aspects represents the concept of geothermal knowledge, as outlined in Figure 1.
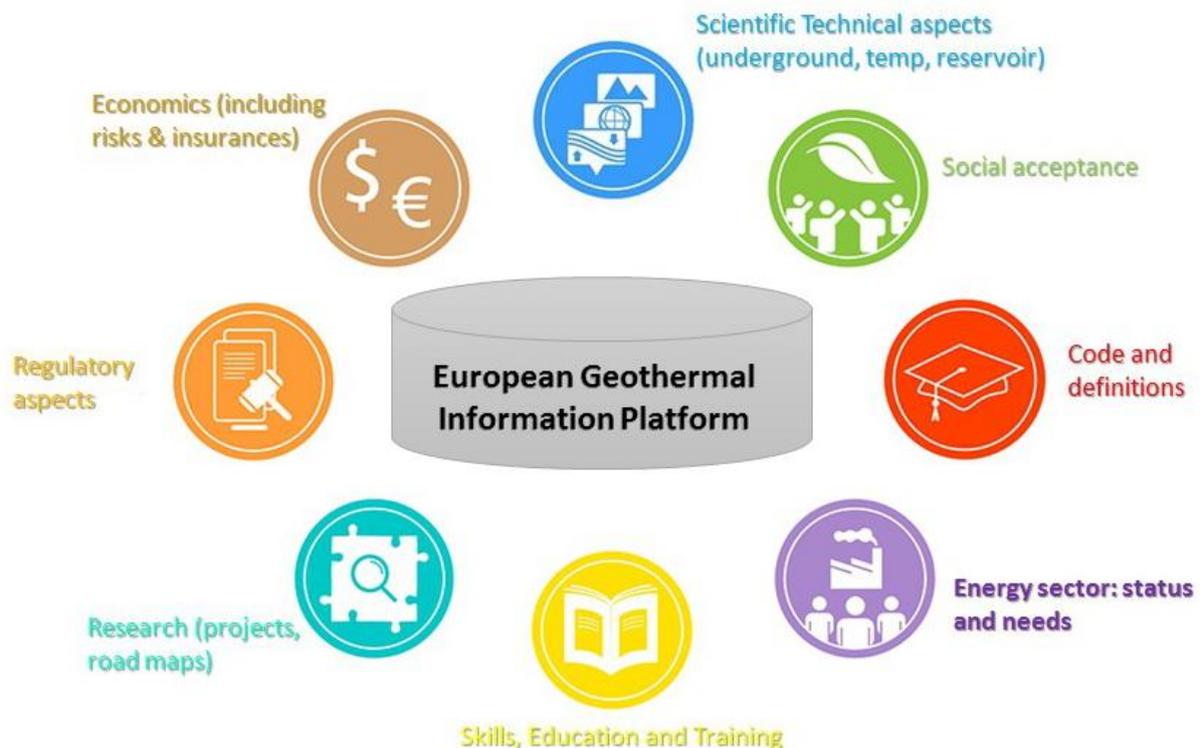
Figure 1 The topics intended for EGIP.

For more details on datasets, their priority, and the mentioned category belonging, please refer to the Annex of this document.

The EGIP platform shall allow an easy and quick access to datasets, including data and documents, both for visualization and download (Figure 2).

To such aim, the platform has a central catalogue providing and disseminating information regarding what geothermal data are available, how to access and who is maintaining them, and their access level. The entries have to be accessible in two main ways: i) as catalogue allowing alphanumeric search operation which relies on (metadata) attributes (e.g., keywords, countries and categories), and ii) as Web-map allowing a spatial search of information/data sets.
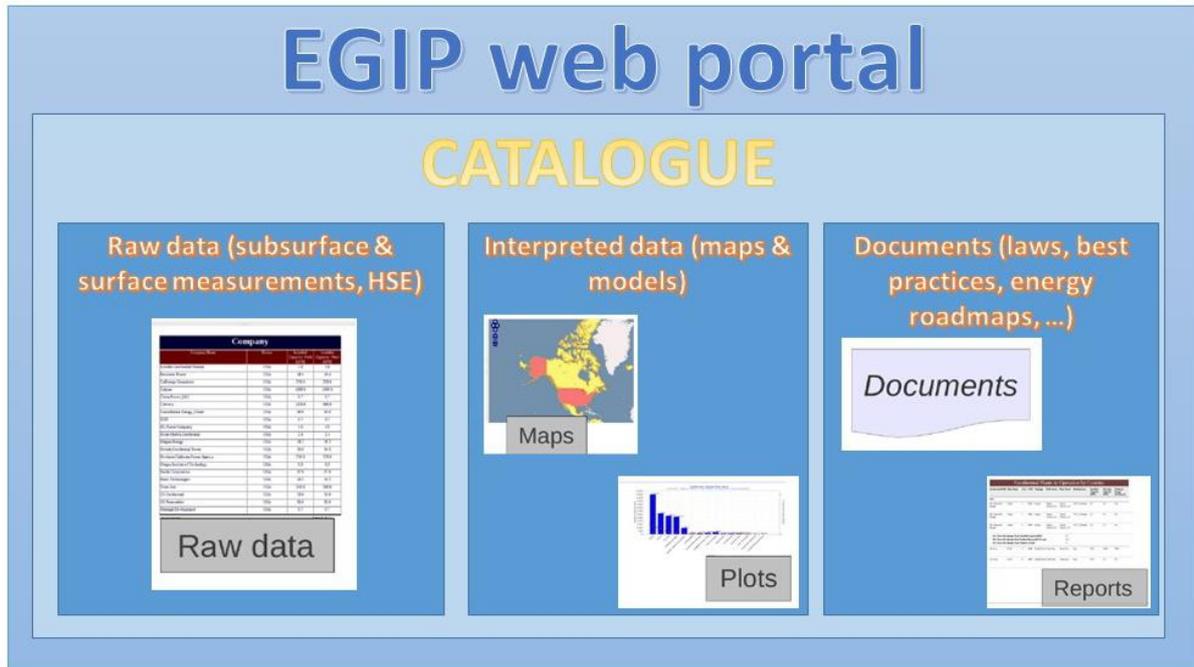
Figure 2 EGIP: proposed data typologies.

Furthermore, EGIP should allow visualizing, browse, and query interpreted datasets in the form of maps (e.g., subsurface temperatures for the whole of Europe or for the chosen areas) covering the areas of the participating countries.

The datasets/documents not covered by any kind of restriction and on the base of their own licence are available for download.

According to the stakeholder survey (Tuning EGIP Joint Action report, 2016), statistical tools or charts on contained information/datasets, although important, are considered 'nice to have' but have a lesser priority.

2 Intended architecture (INSPIRE compliant)

EGIP intends to upscale national data and information at European level. Compliant with the INSPIRE directive (INSPIRE, 2007), EGIP has to be connected with the national data providers through Web services. European products will be obtained by accessing, sharing, and processing the national geothermal information (Figure 3).
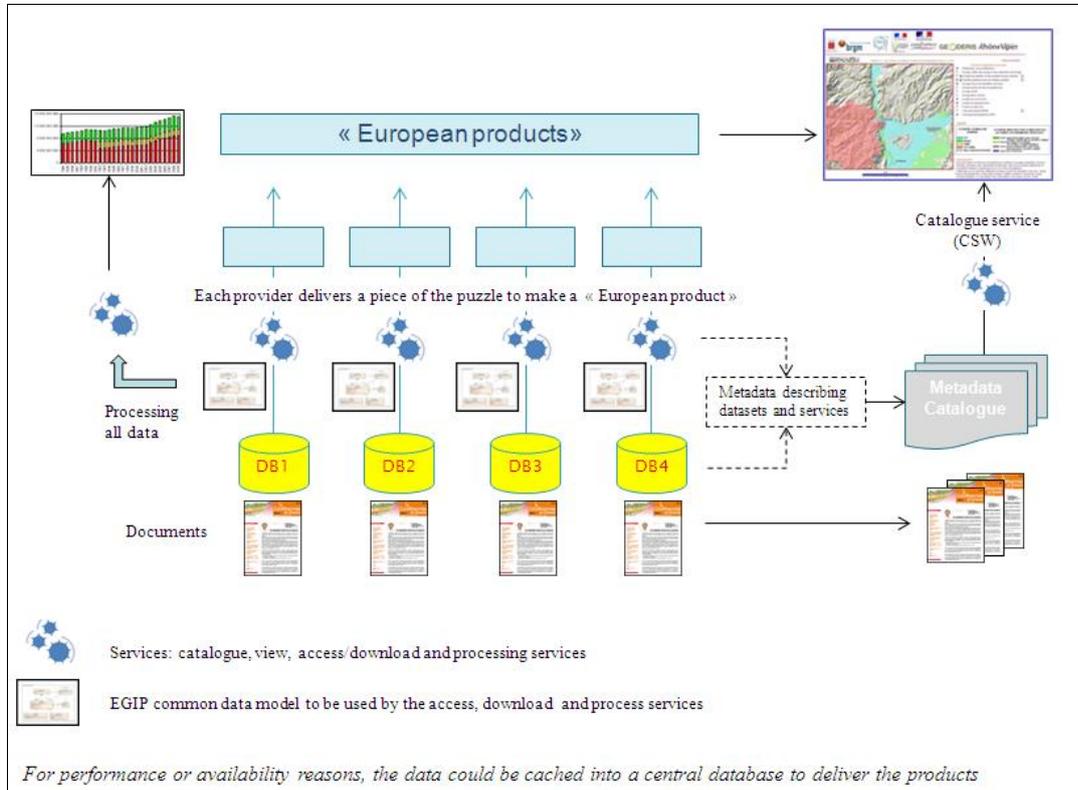
Figure 3 EGIP architecture.

According to the architecture shown in Figure 3, the EGIP structure will include the following main components:

- A portal will request the national service providers to deliver their part of the European puzzle to be incorporated into the final European product (e.g., a temperature map).

- A catalogue will register all resources (e.g., Web services, datasets, documents) made available by the national providers. This catalogue is used by the portal to search for these resources, but it can also be exploited by other users.

- One or more processing services will obtain the data from the providers and process them in order to deliver a European product (e.g., statistical information).

- Service/data providers will be requested to regularly update their databases, though such databases will always remain under their control.

Consequently, the national geothermal data will remain the property of the national providers who will host them. The national providers will be in charge of maintaining their data up-to-date and ensuring their compatibility with the EGIP data model. Insights regarding the intended EGIP data model are described in the next chapter and in the Annex of this document.

3 Intended implementation (INSPIRE compliant)

This chapter describes the main steps required to implement EGIP, from the data model to the services to be deployed.

3.1 Data model

To make datasets harmonized and fully exploitable by automated services the INSPIRE core schema and especially code lists for Energy Resources needs to be extended. Extended code lists should be mutually accepted and used by the geothermal community. This task is ideally done by the project group in charge of implementing EGIP.

To represent the distribution of geothermal parameters the core INSPIRE scheme offers the RenewableAndWastePotentialCoverage feature type. It is recommended to extend the profile so that Observation metadata can be accompanied with the coverage results. (see: the INSPIRE cross-thematic "Guidelines for the use of Observations & Measurements and Sensor Web Enablement-related standards in INSPIRE Annex II and III data specification development")

3.2 Metadata

Metadata system should describe datasets and services. It is also recommended that metadata explains the hierarchy so that local (national) datasets contributing to a specific INSPIRE layer can be identified by CS-W (Catalogue Service for the Web) queries and rendered into a harmonized European layer. To achieve this, it is proposed that:

- For each official INSPIRE layer, one European level master metadata record should exist. A master metadata record should contain sufficient information about content to make it findable in any search where the layer is supposed to be relevant. A master metadata record also has to contain the official name of the layer as defined in the INSPIRE technical guidelines.

- Parent identifier of local metadata records should refer to the master record and contain connection parameters of the related view and download services in the distribution information section. The official name of the layer should also be contained in a uniform way.

A CS-W query against a European level metadata catalogue may result in a large number of records. Using dataset hierarchy irrelevant results can efficiently be filtered out.

3.3 Services

EGIP should have an open architecture and use the standards recommended by INSPIRE and the Open Geospatial Consortium (OGC) as much as possible. In particular, the five following topics will have to be handled.

Discovery Services defined as CS-W (Catalogue Service for the Web) that enable metadata to be searched for and accessed.

The portal must provide efficiently and user-friendly search facilities that are based on metadata maintained and periodically updated by national geothermal metadata providers. Duplication of metadata should be avoided as much as possible. National CS-W services should be considered as a primary source for harvesting or federated search. The EGIP platform also has to operate CS-W from

a single endpoint URL and serve European level metadata to users from other communities or automated systems.

View Services defined as WMS (Web Map Service) that guarantee view access to spatial *data*.

The portal should be able to provide harmonized European level thematic maps based on INSPIRE datasets and services made available by national data providers. INSPIRE conformant spatial information is organized into thematic layers nominated in the technical guidelines.

To implement view services of INSPIRE GML coverages (underground temperature map as RenewableAndWasteResourceCoverage) running simple feature WFS and WMS services on the national side seems to be a good option. In order to implement a harmonized set of national services a common transaction scheme shall be developed. Building on those services the portal should be able to serve coverage data as contour line or coloured polygon maps.

Harmonization of styles should be supported by centrally developed public SLD files for each thematic layer.

The EGIP platform also has to operate WMS service from a single endpoint URL and serve harmonized, European level maps to users from other communities or automated systems.

Download Services defined as WFS (Web Feature Service) or WCS (Web Coverage Service) to download spatial feature collections and grid coverages.

Download services harvested by EGIP must be able to provide INSPIRE features that are validated against the XSD[1] (XML Schema Definition), and if specified, additional schematron[2] rules. Validation rules (XSD and optionally schematron) must be public.

The portal should be able to exploit WFS 2.0 services in order to make rich content stored in complex features available. It also has to provide facilities to render complex features in a user-friendly way and make embedded reference links accessible. Features validated by INSPIRE core and future extension schemas (and optional schematron rules) should be harvestable regardless of the national service implementation or application being used.

Transform Services using a WCTS (Web Coordinates Transformation Service) that re-project spatial datasets onto a different coordinates system

Web Coordinate Transformation Server (WCTS) allows transforming data from a spatial reference system to another. The EGIP portal will have to provide these services to ensure the coherence of information aggregated from data provided in different coordinate systems. These types of transformations include both simple transformations and inverse transformations.

Processes services, defined as WPS (Web Process Service), provides a robust, interoperable, and versatile protocol for process execution on Web services

The EGIP portal should be able to invoke Spatial Data Service defined as WPSs (Web Processing Services) to operate actions on data. WPS provides a standard interface that simplifies the task of using data for simple or complex computations via Web services.

---

[1] *An XSD schema contains structural description of XML documents. During validation XML is compared to the schema to check if names, formats, order of embedded elements and substructures etc. are coincident with the description. If the test succeeds, the XML is considered as valid.*

[2] *A Schematron contains constraints on XML content. On top of XSD validation, the content of an XML document can be checked using schematron's rules.*

As an example, we reported in Table 1 possible INSPIRE services referred to the information identified as stage 1 priority in the EGIP Feasibility Study (2013) and collected in the framework of the EGIP pilot implementation (2014).

Table 1 INSPIRE services identified as Stage 1 priority in the EGIP Feasibility Study (2013) and used for the EGIP Pilot (2014).

Information	INSPIRE Services
Temperature map	WMS: Colour map based on temperature values CS-W: Find and access the map in the catalogue
Surface Heat Flow	WMS: Colour map based on temperature values CS-W: Find and access the map in the catalogue
Exploration and production licenses and (projected) power production	WMS: Colour map based on typology of the licence CS-W: Find and access the map in the catalogue WPS: Chart for licencing expiration WPS: Chart for licencing start WPS: Chart for licencing area
Environmental impact law	CS-W: Find and access the map in the catalogue
Rules of licencing (exploration/exploitation)	CS-W: Find and access the map in the catalogue
Legal condition for grid access	CS-W: Find and access the map in the catalogue
Geothermal Roadmap	CS-W: Find and access the map in the catalogue WPS: Statistic: Chart for the start date WPS: Statistic: Chart for the expiry date (also coupled with the starting date) WPS: Statistic: Chart for current and expected geothermal production in the roadmap target
Insurance	CS-W: Find and access the map in the catalogue WPS: Report (or table) on who deals with insurance for each country WPS: Statistic: Report (or table or chart) on a number of insurance premiums
Royalties & taxes, support scheme (feed-in tariffs, grants, …)	Unstructured

	CS-W: Find and access the map in the catalogue
List of Education & Research	WMS: Symbol map based on typology (university or research centre)
	WPS: Report (or table or chart) on number of centres
List of Industries	CS-W: Find and access the map in the catalogue
	WMS: Symbol map based on typology
	WPS: Chart on number of each type per country

4 Open issues and recommendations

The EGIP Expert Group recommends paying attention to the following considerations related to the intended EGIP implementation.

4.1 Recommended geothermal data themes and relevant INSPIRE guidelines

To prepare the EGIP implementation, a detailed catalogue of relevant geothermal data themes is presented in the Annex along with the related INSPIRE guidelines and previous work from the Geothermal ERA-NET project. It has been prepared by the EGIP Expert Group to facilitate the intended implementation of EGIP. This catalogue will have to be updated and adapted to the context where the implementation will take place.

4.2 Geodata and non-geodata

EGIP deals with geodata that is spatial data (e.g. subsurface temperature) usually managed by geological surveys, and non-geodata that are unstructured data and documents (e.g. national incentives for geothermal energy) usually managed by program and funding agencies. The Annex gives a comprehensive overview of the geothermal data themes for geodata and non-geodata.

Knowing the (estimated) subsurface temperature is crucial for the development of a geothermal project but knowing the country incentives for geothermal energy is as much crucial for the developer. Consequently, the EGIP Expert Group strongly recommends considering at the same level geodata and non-geodata in the EGIP implementation.

4.3 European harmonization

The EGIP Expert Group estimates that the geothermal sector suffers from a lack of harmonization at the European level. Common and coherent initiatives are needed to gather experts for the coordination of the geothermal actors and the definition of shared ways of working.

Two main aspects of such a harmonization are related on one hand to a European code for reporting geothermal resources and reserves, and on the other hand to the harmonization of geothermal data in the scope of the INSPIRE directive. In that sense, implementing EGIP is an opportunity to assist the harmonization the geothermal European sector at the European level.

4.4 Stakeholders' involvement

It seems important to the EGIP Expert Group to involve a representative group of users since the beginning of the EGIP implementation. Scientists, investors, developers, decision makers dealing with geothermal energy should be taken on board as soon as possible to ensure that the propositions fit their needs. This would also facilitate progressive appropriation of EGIP by the identified stakeholders.

4.5 Sustainable governance

The Information Platform needs sustainable governance operating even after the end of the EGIP implementation project to guarantee the accessibility and the update of the data, and to allow the evolution of the platform for fitting the user's demand.

4.6 Border harmonization, cross-border discontinuity and interpolation issue

Creating fully harmonized European level cross-border coverages requires transnational cooperation and great effort as demonstrated by the rare international projects dedicated to harmonization issues.

Sharing data through the EGIP platform can help in solving such problems. Common transnational datasets are required to create 2D surfaces that are free of interpolation errors at state borders. Interpolations carried out with combined datasets will be free of border zone discontinuities.

Publishing background data as "Renewable and Waste Resource Coverage" with multipoint geometry is fully in line with the INSPIRE directives and provide exactly the kind of information that is needed to solve such issues.

For example: to create a European coverage of underground temperature at 1000 m depth each partner must provide the proper temperature values at the borehole locations as a "Renewable And Waste Resource Coverage" with multipoint geometry. This dataset should be used to create the required surface by interpolation. The result will be published as another "Renewable and Waste Resource Coverage" with surface geometry and used to present coloured contour line maps. Both coverages will contain the following INSPIRE attributes:

- typeOfResource: geothermal

- potentialType: temperature

- VerticalExtent/scalar: 1000 m

5 References

EGIP - State of the art report (04/2013)

Trumpy, E., Manzella, A., Nardini, I., 2013. Report on the state-of-the-art and needs in regardinggeothermal data and existing tools to manage them. Publisher: Coordination Office, Geothermal ERA NET, ISBN: 978-9979-68-361-2.

Link: http://www.geothermaleranet.is/media/publications-2015/Geothermal-ERA-NET-D3_1_Report-on-the-state-of-the-art-and-needs-in-regarding-geothermal-data-and-existing-tools-to-manage-them-NT.pdf

EGIP - Feasibility study report (10/2013)

Manzella, A., Trumpy, E., Calcagno, P., 2013. Feasibility Study for a European Geothermal Information Platform. Publisher: Coordination Office, Geothermal ERA NET, ISBN: 978-9979-68-362-9.

Link: http://www.geothermaleranet.is/media/publications-2015/Geothermal-ERA-NET-D3_2-Feasibility-Study-for-a-European-Geothermal-Information-Platform-NT.pdf

EGIP - Pilot (2014)

Trumpy, E., Manzella, A., Calcagno, P., 2014. EGIP pilot implementation Game's rules.

Link: http://egip.igg.cnr.it/index.php/join-egip/328-games-rules)

Grellet, S., Calcagno, P., Alcanié, M., Manzella, A., Trumpy, E., 2014. EGIP Pilot – Data model.

Links: http://egip.igg.cnr.it/index.php/join-egip/327-egip-data-model

http://egip.igg.cnr.it/index.php/join-egip/329-egip-xsd

EGIP - Scientific publication (2015)

Trumpy, E., Coro, G., Manzella, A., Pagano, P., Castelli, D., Calcagno, P., Nador, A., Bragason, T., Grellet, S., Siddiqi, G., 2015. Building a European geothermal information network using a distributed e-Infrastructure. International Journal of Digital Earth, Volume 9, Issue 5, 499-519, DOI: 10.1080/17538947.2015.1073378.

Link: http://www.tandfonline.com/doi/full/10.1080/17538947.2015.1073378

Tuning EGIP Joint Action report (inc. Web survey) (01/2016)

Trumpy, E., Minnig, C., Bragason, T., Calcagno, P., Grellet, S., Ingolfsson, H.P., Jamshidnia, H.R., Nador, A., Lapange, A., Manzella, A., Petursson, B., 2016. Geothermal ERA NET Joint Activity - Tuning EGIP for Target Users - EGIP Web Survey Results. Publisher: Coordination Office, Geothermal ERA NET, ISBN: 978-9979-68-389-6.

Link: http://www.geothermaleranet.is/media/publications/Geothermal-ERA-NET-JA-REPORT-EGIP.pdf

INSPIRE

INSPIRE Directive, 2007. "2/ EC of the European Parliament and of the Council of 14 March 2007 Establishing an Infrastructure for Spatial Information in the European Community (inspire)." Official Journal of European Union. 25th April 2007.

INSPIRE Data Specifications; http://inspire.ec.europa.eu/document-tags/data-specifications.

Appendix

Recommended geothermal data themes and relevant INSPIRE guidelines

Introduction

Primary Geothermal Features

- The INSPIRE guideline for Energy Resources nominates three groups of obligatory layers to be provided by geothermal portal view services such as EGIP (See chapter 11.1, Layers to be provided by INSPIRE view Services). These are:
- Renewable And Waste Resource
- Renewable And Waste Resource Coverage
- Energy Statistical Unit

It is recommended, that these features are used whenever it is possible.

RenewableAndWasteResource is used to describe confirmed and operationally confined energy resources (for example producing geothermal wells).

RenewableAndWastePotentialCoverage is used for vector or grid coverages representing energy potential (for example underground temperature distribution). Types of such layers are categorized by the "potential type" attribute linked to code list called GeothermalPotentialValue. At present this code list contains only two items: "Geothermal gradient" and „Temperature". To make this feature type more generic it should be extended according to community requirements (e.g. surface heat flow). EnergyStatisticalUnit is used to present energy statistics linked to vector geometry.

Adding Observation Metadata to Geothermal Features

To be able to provide supplementary information on details of measurements or applied procedures (time, observed properties, operator, quality) the "Observations And Measurements" standard shall be used. The standard way of coupling observation metadata and data to spatial features is using the "Sampling Feature" schema, as described in the Observations & Measurements_D2.9 cross-thematic guideline.

Using other INSPIRE Themes

For most geodata features required by the geothermal theme, alternatives are available in Annex II - Geology, Annex III – Monitoring Facilities, Annex III - Area Management/Restrictions/Regulation, Annex III - Production and Industrial Facilities, Generic Conceptual Model, and the general Base Models–Coverage Types INSPIRE themes. These features are referenced in the table below either as an alternative way of describing a geothermal theme or as the only available way whenever no dedicated geothermal feature types exist. The first choice should, however, be the primary geothermal feature types.

Boreholes

Description of borehole data is essential in geoscientific domains. Depending on the nature of information to be shared there are three main ways to use the existing standards:

- INSPIRE core Borehole model
- GeoSciML Borehole model (INSPIRE extension)

- Geophysical Borehole Logging model

The INSPIRE core model is restricted to basic borehole properties and geologic description of layers. GeoSciML and the Geophysics model are based on the Sampling Feature model, so adding observation metadata, geophysical and technical logs are also possible. Duplication of data can be avoided as these three types of features may share the same geometry and observation links (Figure 1).
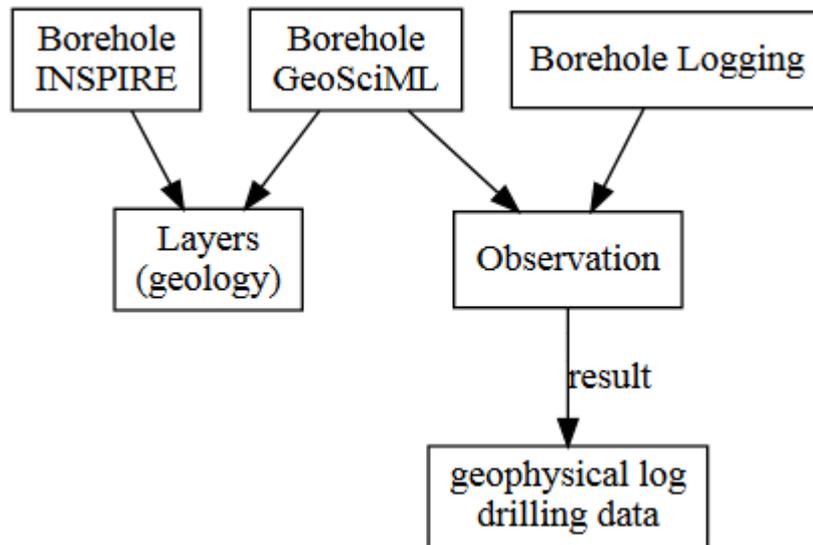

Figure 1 Schematic relationship between INSPIRE guidelines and data.

Table

Geothermal data theme:

This column displays data topics that bear some relevance to the field of geothermal energy. The data doesn't necessarily have to come from geothermal projects or data providers, if available, the publication of data e.g. from oil and gas wells can be very useful for the development of geothermal energy. The relevance should be focused towards various stakeholders, e.g. project developers, industry, researchers, legislators, or NGOs. The data topics are described rather loosely and are not defined in complete detail. The necessary level of detail and quality of the data integration will have to be agreed upon by the eventual project team implementing the final EGIP. Without a common understanding and agreement thereupon, we cannot predefine that within the scope of work of this expert group.

INSPIRE (with sub-columns):

The INSPIRE columns suggest existing INSPIRE guidelines which can be used to describe the respective data theme. The leftmost column „Data Specification DS & Guidelines GL" gives the name (with a direct link) of the INSPIRE document. The second column „Application Schema" goes one level deeper into the document by indicating what application schema of the linked document is suggested to describe the data theme. For easier finding the page number is indicated as well. The third column „Feature Type" goes even one more level deeper by making a reference to what feature type of the corresponding application schema is suggested. Referenced names are coincident with official feature type names used in the data model. The column „comments" allows pointing out other important aspects.

Where several possibilities of describing a data theme in an INSPIRE conform way were identified, all were included.

It is important to note that the indicated INSPIRE guideline, application schemes, and feature types are in a lot of cases not fitting to be utilised just as they are as of today! In many cases, more work is needed to make them fit for the topic of geothermal energy. For example, if we look at the feature type BoreholePurposeValue on page 174 in the Data Specification on Geology, we notice that in the code list we can only assign it as "geothermalEnergy". To properly describe the purpose of a geothermal borehole, subcategories are needed where one can define e.g. geothermalProduction, geothermalInjection, and geothermalExploration.

EGIP WG3 - Feasibility study D 3.2 (link)

This document was created in the framework of Geothermal ERA-NET WP3 in 2013 and describes a proposal for the joint implementation of a European Geothermal Information Platform (EGIP). In the document, several data themes are suggested and tagged with a priority by suggesting in what stage of development the according to data theme should be included in EGIP. Stage 1 has the highest priority and stage 3 the lowest. Three factors influenced the prioritisation: 1) data availability in the EU countries, 2) data importance for operators, and 3) the time required for data organization.

➔ Where a data theme in the table below also gets mentioned in the feasibility study D 3.2, its priority therein is stated in this column.

Appendix 2 of the feasibility study D 3.2 describes the most important technical aspects of EGIP implementation following INSPIRE implementing rules. There the authors indicated relevant INSPIRE documentation for some data themes.

➔ Where a data theme gets mentioned in Appendix 2 the respective reference is also given in this column of the table below.

EGIP Pilot

In the framework of Geothermal ERA-NET WP3, a pilot EGIP was developed. In this pilot, a small set of data from a few countries is harmonized, collected and published on a Web platform. The data stays in the respective countries, the EGIP pilot only harvests them to display them all centrally. This pilot proved the technical feasibility of such a system but is by no means to be considered as an end product. While its data management can serve as a good start for a full implementation of EGIP, the Web-interface needs strong development. Also, the data themes it can incorporate must be extended substantially.

➔ Where a data theme in the table below is already incorporated in the EGIP pilot, it was marked with an "X" in the EGIP pilot column.

The following links lead to more information on the EGIP pilot:
- The EGIP pilot gateway: http://egip.igg.cnr.it/
- Document "Implementation game rules": http://egip.igg.cnr.it/index.php/join-egip/328-games-rules
- Data model – document: http://egip.igg.cnr.it/index.php/join-egip/327-egip-data-model
- Data model – XSD file: http://egip.igg.cnr.it/index.php/join-egip/329-egip-xsd
- Paper: http://www.tandfonline.com/doi/full/10.1080/17538947.2015.1073378

EGIP - Web survey 2015 (link)

In order to focus more on the potential users of EGIP, a Web survey in the form of a questionnaire has been set up in 2015 to identify and assess the needs of the stakeholders and the requirements for a potential EGIP. The answers from this survey allowed a prioritisation of the possible EGIP functionalities and contents. Where a data theme of the table below was part of the survey, its priority according to the survey answers was indicated in the column EGIP – Web survey 2015.

IRENA Global Renewable Energy Atlas (link)

The International Renewable Energy Agency produced a Web-based information platform on renewable energies. Besides wind, solar, hydro, bioenergy and marine, it has also a topic of geothermal energy. In the table below, data themes relevant for IRENA were marked with an "X" (see IRENA's "Geothermal strategy for the Global Renewable Energy Atlas" document, p.9).

Table 1
Recommended INSPIRE guidelines for relevant data themes

Nr.	Geothermal data theme	INSPIRE				EGIP WG3 Feasibility study D 3.2	EGIP Pilot	EGIP - Web survey 2015	IRENA Global Renewable Energy Atlas
		Data Specification DS & Guidelines GL	Application Schema	Feature Type	comments				
GEODATA – Maps and Models									
1	Temperature maps at depth (1, 2, 3 …)	DS_Energy Resources_D.2.8.III.20	Energy Resource Coverage, p.40	RenewableAndWaste PotentialCoverage, p.41-46, 91	Codelist „GeothermalPotentialValue"	Stage 1 (Appendix 2 p.11) (Appendix 2 p.18)	x	Priority 1	x
		GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	result is grid coverage – may also be RenewableAndWastePotential Coverage				
		DS Base Models– Coverage Types D2.10.2							
2	Surface heat-flow density	DS_Energy Resources_D.2.8.III.20	Energy Resource Coverage, p.40	RenewableAndWaste PotentialCoverage, p.41-46, 91	Not yet in open Codelist „GeothermalPotentialValue"	Stage 1 (Appendix 2 p.11)	x	Priority 1	x
		GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	result is grid coverage, may also be RenewableAndWastePotential Coverage				
		DS Base Models– Coverage Types D2.10.2							
3	Heat flow map at depth	DS_Energy Resources_D.2.8.III.20	Energy Resource Coverage, p.40	RenewableAndWaste PotentialCoverage, p.41-46, 91	Not yet in open Codelist „GeothermalPotentialValue"	Stage 3 (Appendix 2 p.11)			
		GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	result is grid coverage, may also be RenewableAndWastePotential Coverage				
		DS Base Models– Coverage Types D2.10.2							
4	Geological maps, cross sections, also depth maps (e.g. top basement, granite bodies)	DS_Geology_D2.8.II.4	Geology, p.21			Stage 3		Priority 1	
5	Geological fault mapping	DS_Geology_D2.8.II.4	Geology p. 21	ShearDisplacementSt ructure	spatial objects MappedFeature →	Stage 2		Priority 1	

#	Description	Data Spec	Reference	Feature Class	Notes	Stage		Priority	
				p. 25	GeologicFeature → GeologicStructure → ShearDisplacementStructure				
6	Geological 3D models	DS_Geology_D2.8.II.4	Geology p. 21	MappedFeature	3D geometric model			Priority 1	
				GeologicFeature or GeologicUnit	3D property model				
7	Raster map of transmissivity	GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	the result is grid coverage	Stage 3			
8	Geothermal areas (provinces)	DS_Area Management/Restrictions/Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	Management Restriction Or Regulation Zone					x
9	Geothermal reservoir characterization (reservoir type, e.g. petrothermal, hydrothermal (porous or fractured)	DS_Geology_D2.8.II.4	Geology p. 21	MappedFeature	spatial objects which are classified according to same thematic classification (no open code list value yet)	Stage 3			
				GeologicUnit p.22, 24, 33 ThematicClassification p. 22, 36 – 39	May be used together for reservoir characterization. Empty code list: http://inspire.ec.europa.eu/codelist/ThematicClassificationValue				
10	Geothermal reservoir temperature in high enthalpy geothermal systems (measurements?)	GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	sampling feature subtype is dependent on measurement geometry	Stage 2		Priority 1	
		DS_Geology_D2.8.II.4	Geophysics, p. 63,	GeophMeasurement, p.66 ff	GeophProfile boreholeLogging				
11	Geothermal power and heat plant and R&D project location with production data etc.	DS_Energy Resources_D.2.8.III.20	RenewableAnd WasteResource		Needs probably input from several guidelines	Stage 2 (Appendix 2 p.18)		Priority 1	
		GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes		Stage 2 (Appendix 2 p.18)		Priority 1	
		DS Production and Industrial Facilities D2.8.III.8			Contains location, description, categorization of production sites, installations and buildings. Very generic, mainly used for administrative purposes and localization. Codelists are empty. Relevant for geothermal power plants, but not much use for boreholes.				

GEODATA – subsurface measurements									
12	Well / borehole – basic information	DS_Geology_D2.8.II.4	Geology, p.21	Borehole, p.27 & 29		Stage 3		Priority 1	x
13	Well / borehole – geological description	DS_Geology_D2.8.II.4	Geology, p.21	GeologicUnit p. 24 & p.33 GeologicStructure p.25	Borehole → MappedInterval → MappedFeature → GeologicFeature → GeologicUnit & GeologicFeature	Stage 3		Priority 1	
14	Well / borehole – completion (Borehole diameters, casing depths & diameters, cemented sections)	DS_Geology_D2.8.II.4	Geophysics, p. 63,	GeophMeasurement p.66 ff,	GeophProfile, of type boreholeLogging,				
15	Geophysical well logs	DS_Geology_D2.8.II.4	Geophysics, p. 63,	GeophMeasurement p.66 ff,	GeophProfile, of type boreholeLogging,	Stage 3		Priority 1	
			Geophysics Data model extension Annex D p. 286	GeophModel p.289	CurveModel of type compositLog				
16	Geophysical measurements in the subsurface (Temperature, Pressure, Geochemistry)	GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	sampling feature subtype is dependent on measurement geometry	Stage 3		Priority 1	
		DS_Geology_D2.8.II.4	Geophysics, p. 63	GeophMeasurement, p.66 ff	GeophProfile boreholeLogging				
17	Porosity & Permeability measurements on samples	DS_Geology_D2.8.II.4	Sampling p. 10	specimen	CPOR: Application Schema	Stage 3		Priority 1	
18	Heat flow measurements at depth	GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes	sampling feature subtype is dependent on measurement geometry	Stage 3			
GEODATA – Surface measurements									
19	Thermal spring analysis (chemical & physical)	GL_Observations & Measurements_D2.9	Sampling p. 8	SF_SamplingFeature and derived classes, TimeSeries	geometry is point,	Stage 3			
20	Geophysical surface acquisition (Seismic, Gravity, etc)	DS_Geology_D2.8.II.4	Geophysics, p. 63,	GeophMeasurement, p.66 ff,	GeophStation, GeophProfiles, GeophSwath	Stage 3		Priority 1	
			Geophysics Data model extension Annex D p. 286	GeophModel p.289	SurfaceGridModel (seismicLine, seimicTimeSection, seismicDepthSection), SolidGridModel				

		GEODATA – HSE & economics							
21	Recorded seismicity	DS_Geology_D2.8.II.4	Geophysics, p. 63	GeophMeasurement, p.66 ff	GeophStation of type seismologicalStation	Stage 2		Stage 2 (risk governance)	
22	Monitoring network data & environmentally tracked parameters	DS_Environmental Monitoring Facilities_D2.8.II/III.7	Environmental Monitoring Facilities p 21,	EnvironmentalMonitoringFacility		Stage 3			
			EnvironmentalMonitoringNetwork p. 24	EnvironmentalMonitoringNetwork					
23	Areas of potential usage conflicts (e.g. O&G licences, drinking water, nuclear storage area, CCS)	DS_Area Management/Restrictions /Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictionOr RegulationZone (p.32,33)		Stage 3		Priority 2 (risk governance & socio-economic)	
24	Exploration, Power plant and utilisation licenses	DS_Area Management/Restrictions /Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictionOr RegulationZone (p.32,33)		Stage 1 & 2 (Appendix 2 p.14) (Appendix 2 p.20)	x	Priority 2	
25	Exploration activity description	DS_Geology_D2.8.II.4	Geophysics p. 63,	Campaign p. 64,		Stage 3			
			Geophysics Data Model extension Annex D p.286	Project Annex D p.286	A large exploration project may contain several campaigns				
26	Education and training centres					Stage 1 (Appendix 2 p.24)	x	Priority 2	
27	Industry list, research institutes and universities					Stage 1	x	Priority 2	
28	Identified energy (heat) needs	DS_Energy Resources_D2.8.III.20	Energy statistics, p.48			Stage 2			
29	Geothermal - Energy statistics	DS_Energy Resources_D2.8.III.20	Energy statistics, p.48	EnergyStatisticalUnit p. 50 - 52		(Appendix 2 p.12)	x	Priority 2	

		NON GEODATA- unstructured - documents						
30	Environmental impact laws	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 1 (Appendix 2 p.17, 22)	x	Priority 2
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)				
31	Licensing, drilling and production regulations	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 1 (Appendix 2 p.17, 22)	x	Priority 2
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)				
32	Legal conditions for grid access	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 1 (Appendix 2 p.17, 22)	x	Priority 3
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)				
33	Best Practice Documents (e.g. OPERA)	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		(Appendix 2 p.17)		Priority 1
34	Insurance schemes	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 1 (Appendix 2 p.17)	x	Priority 3
35	Royalties & taxes	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 1 (Appendix 2 p.17, 22)	x	Priority 3
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)				
36	Support Schemes, Feed-in tariffs (FIT)	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 1 (Appendix 2 p.17, 23)	x	Priority 3
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)				

37	Socio-economic data							Priority 2	
38	Geothermal R&D Reports – non-site specific					Stage 2		Priority 1	
39	Studies on social acceptance of geothermal energy (e.g. induced seismicity)					Stage 3			
40	National geothermal codes and /or thesaurus or glossaries	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 3			
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)					
41	Official number of people employed in geothermal energy	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		Stage 3			
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)					
42	Geothermal National RoadMap	Generic Conceptual Model D2.5	Base Types 2 p.67	Class Document and legislation citation p.67		(Appendix 2 p.17, 23)	x	Priority 2	
		DS_Area Management/Restrictions/ Regulation_D.2.8.III.11	Area Management Restriction and Regulation Zones (p.25)	ManagementRestrictio nOr RegulationZone (p.32,33)					