Geothermal ERA-NET

Feasibility Study for a European Geothermal Information Platform

October, 2013

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October, 2013

Publisher:

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Email: os@os.is

Website: http://www.geothermaleranet.is/

ISBN: 978-9979-68-362-9

The Geothermal ERA NET is supported by the European Union's Seventh programme for research, technological development and demonstration under grant agreement No 291866

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Abstract

This document describes our proposal for the joint implementation of a European Geothermal Information Platform (EGIP). EGIP's target is to increase the share of potential geothermal energy users - primarily international operators, and surveyors - primarily European bodies. Two appendicies are included in the document. Appendix 1 reports the collect references and links organized by category resulting from the questionnaire set up in task 3.2 and 2.1. Appendix 2 describes the most important technical aspects for EGIP implementation following INSPIRE implementing rules.

Executive summary

As a key element and fundamental task (D3.2) within Work Package 3 - ***Towards a European Geothermal Platform***- in the framework of the Geothermal ERA-NET, it is sine qua non to propose a possible path for the joint implementation of a European Geothermal Information Platform (EGIP). This is in line with the objective of WP3 that 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 data.

This report provides a description of the authors proposal for the joint implementation of a European Geothermal Information Platform (EGIP). EGIP's target is to increase the share of potential geothermal energy users - primarily international operators, and surveyors - primarily European bodies. EGIP's improved knowledge and data sharing service to retrieve the basic information to establish geothermal projects and to survey the geothermal sector meet this target.

According to the work of this report the envisaged EGIP acts as a portal, where European geothermal information can be accessed, retrieved and queried using modern ICT technologies. In reality, it is a virtual entity, created through harmonized information. It is noted that, EGIP goes beyond pure data sharing: it also involves the way information and data are displayed, examined, and compared. 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 initial part of this report provides the rationale behind the portal and describes the current situation (Framework), EGIP's challenges and the primary EGIP customers.

Consequently EGIP formulation and requirements are described and basic functions of EGIP are indicated by their authors. The platform would not be limited to statistically accessing and organizing information: the EGIP structure also aggregates and compares information. In addition, architecture and technical requirements are outlined and a desription of the way that the priciples of a distributed architecture should be implemented for the EGIP are provided both at national and European level. With regards to data format the geothermal information organized by the EGIP may be both structured (i.e., databases, spreadsheets, vector feature maps, raster coverage maps) and unstructured (documents). Since structing of all the information is a huge dast the emphasize and focus will be only on most useful data to be structured.

The current report suggests a possible work plan and a potential implementation strategy is outlined. A step-by-step plan, ensuring a gradual evolution from the present situation to the whole implementation is suggested wherby EGIP firstly executes a strategic setting with few extra-resources by highlighting information requiring few resources but the highest potential performance gains. A four-step planning process is described, to build strategic data and to set immediate, short-, medium- and long-term targets.

The first step is to map the links and documents where geothermal information is currently provided at a national level, and to organize this information on the GEO ERANET website. This stage is implemented immediately, by simply using the information mapping already performed in WP2 and WP3. Although the core documents and links represent an important reference for EGIP, this list is not optimal for information retrieval: the true platform still needs to be designed.

EGIP planning then proceeds by grouping geothermal information into three lists, which represent the short- (Stage 1), medium- (Stage 2) and long-term (Stage 3) data involvement phases.

The aim of the early stage as a so called Pilot Project with in GEO ERA-NET, which is proposed and suggested by authors as a Joint Activity, is to prove the effectiveness and efficiency of a European Geothermal Information Platform in Europe. The initial development of the pilot project involves setting up a geothermal common data model and the management and optimization of services. It is designed to fully satisfy the end-user by providing easy and useful data retrieval and cost containment, in compliance with INSPIRE rules for building a (spatial) Data Infrastructure. The three lists to be developed and implemented over time have increasing levels of detail. Each list of information is subdivided into the main information categories already defined in Report D3.1.

The further implementation of the EGIP will involve Stages 2 and 3 of the EGIP described in the report. Besides the national activities, EGIP will need some central coordination, management and maintenance. A central server, providing caching services, would be advisable.

There are two appendices deliverd with this report. Appendix 1 (Dissemination of the State-of-the-Art: Stage ‘0’ catalogue) reports the collect references and links organized by category resulting from the questionnaire set up in task D3.2 and D2.1. Appendix 2 (Technical Document For EGIP Implementation) describes the most important technical aspects for the implementation of EGIP following INSPIRE implementing rules.

1 Introduction

Of the strategies GEO ERA-NET partner countries set up to foster geothermal energy development in Europe, the organization and sharing of geothermal data play an important role, and was specifically mentioned in the EU Commission Call [Topic ENERGY.2011.10.2-2, FP7-ERANET-2011-RTD] which led to the current GEO ERA-NET Project.

This document describes our proposal for the joint implementation of a **European Geothermal Information Platform (EGIP)**. EGIP's target is to increase the share of potential geothermal energy users - primarily international operators, and surveyors - primarily European bodies. EGIP's improved knowledge and data sharing service to retrieve the basic information to establish geothermal projects and to survey the geothermal sector meet this target. The EGIP envisaged here is a portal where a broad selection of European geothermal information can be accessed, retrieved and queried. EGIP is designed as a distributed system through the harmonization of national data models and services as well as documents.

This introduction outlines the rationale behind the portal and describes the current situation (Framework), EGIP's challenges and the primary EGIP customers.

1.1 Framework

To understand what EGIP can achieve, let us consider the current situation for geothermal data sharing, which was analysed and detailed in the report "State-of-the-art and needs regarding geothermal data and existing tools to manage them", GEO ERA-NET project Deliverable 3.1 (referred to in the following as Report D3.1).

Providers of a geothermal information system based on ICT (information and communication technologies) tend to differ in their conception of ideal data sharing and services, and hence each designs and builds its own information system independently. Scientists, operators and consultants organize and use geothermal databases, which contain underground data, provide maps (e.g., temperature and heat flow distribution) and are seldom accessible to the public. Regional, national and European administrations produce, collect and organize regulations, documents, descriptions and maps of geothermal leases and permits, and energy production values. Information providers publish general information (e.g. definitions, terms) in the form of texts and figures. Manufacturers have their own advertising, none of which are included in

a comprehensive picture of the geothermal world. Funding and insurance agencies require and organize all the information aimed at creating risk management and economic analyses of all proposed projects.

When available, these various databases and data-sharing systems are mostly based at a national level, provided in the local language, and are suitable for local or specialized applications.

1.2 The impact of creating EGIP

The increasing need for energy, both for electricity and thermal uses, has improved the potential market for geothermal energy applications. The trend toward globalization compounds the situation. As trade barriers between nations and regions are dismantled, information on resources, opportunities, regulations, prices and demand should become instantly and globally available.

The differences in data organization among different branches and languages described in 1.1 are currently taken for granted.

EGIP challenges this practice.

It looks at the different segments as parts that can be aggregated into a unique higher-performing, less-fragmented geothermal information system. Having local and specialized geothermal information systems in different branches is of course useful. What we are doing is to challenge the existing, taken-for-granted situation. We want to create desegmentation opportunities by formulating a new information strategy.

EGIP's overall target is to increase the share of potential geothermal energy users at an international level by improving knowledge and facilitating the retrieval of the basic information needed to establish geothermal projects.

The main aims behind the EGIP are to: i) reduce information fragmentation, ii) simplify data provision, iii) reduce project risks (economic aspects), iv) raise awareness about geothermal energy by providing an overview of its application at the European scale, and v) increase the focus on and investments in geothermal energy.

The primary EGIP customers are potential international energy users, such as international operators and funding agencies interested in launching new geothermal projects. However, the EGIP would be beneficial to any geothermal stakeholder and to respond to the increasing

concerns of non-geothermal-sector stakeholders that geothermal applications are too confusing and difficult to manage.

The EGIP is designed as a distributed system: each (national) data provider delivers its data according to a common standard data model and common services. Its development exploits INSPIRE[1] directives, thus ensuring a coordinated effort at a minimum cost since each EU country will have to be INSPIRE compliant within the next few years. Creating an EGIP now that INSPIRE directives are being implemented has several benefits:

- Guaranteed data interoperability: retrieval, viewing and access of information from partners and other providers (via WMS, e.g. protected areas)
- Harmonized geothermal domain at a European level
- Efficiency, thanks to the non-multiplicity of data sources, the latter being directly related to national databases
- Guaranteed ownership: data belong to and stay in the country they are related to. Each country decides what to share and what to keep private
- Durability and maintainability, since this is information is directly related to national data sources
- Economically viable, requiring only coordination with respect to what each country would need to develop independently
- Productivity, by covering all published data in the long term.

Having explained why and for whom, let's see how EGIP would work.

[1] The INSPIRE directive (2007/2/CE) came into force in May 2007. INSPIRE, stands for Infrastructure for Spatial Information in Europe. It aims to create a European Union (EU) spatial data infrastructure. This will enable environmental spatial information to be made available to the public sector and will facilitate public access to spatial information across Europe. For details: **http://inspire.jrc.ec.europa.eu/**

2 FORMULATING EGIP

2.1 Basic Functions

The envisaged EGIP acts as a portal, where European geothermal information can be accessed, retrieved and queried using modern ICT technologies. In reality, it is a virtual entity, created through harmonized information. Indeed, the EGIP goes beyond pure data sharing: it also involves the way information and data are displayed, examined, and compared.

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. All these issues represent the concept of geothermal knowledge, as outlined in Figure 1.

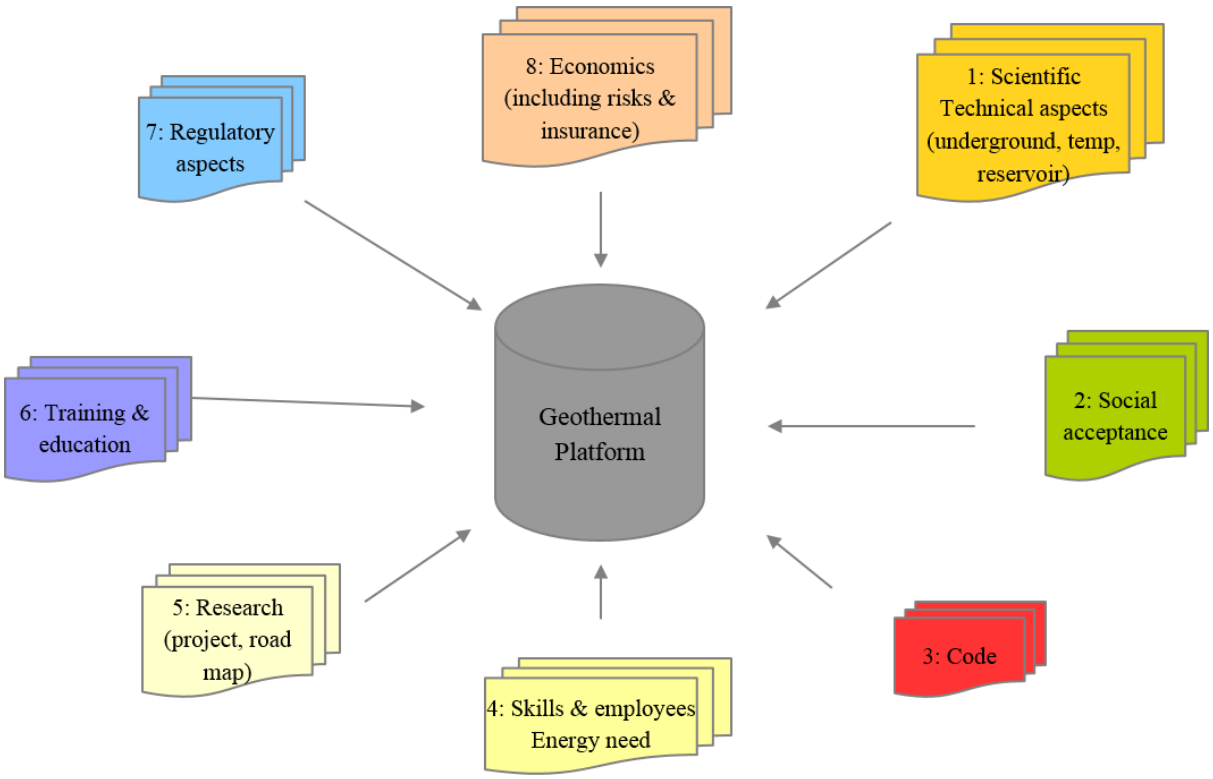

Figure 1 The eight topics covered in the information list that represent geothermal knowledge.

The platform would not be limited to statistically accessing and organizing information: the EGIP structure also aggregates and compares information. To be able to conduct in-depth surveys of geothermal knowledge, EGIP tools have to ensure, for example, browsing from a catalogue to a document and from a document to a table or map (see Figure 2).

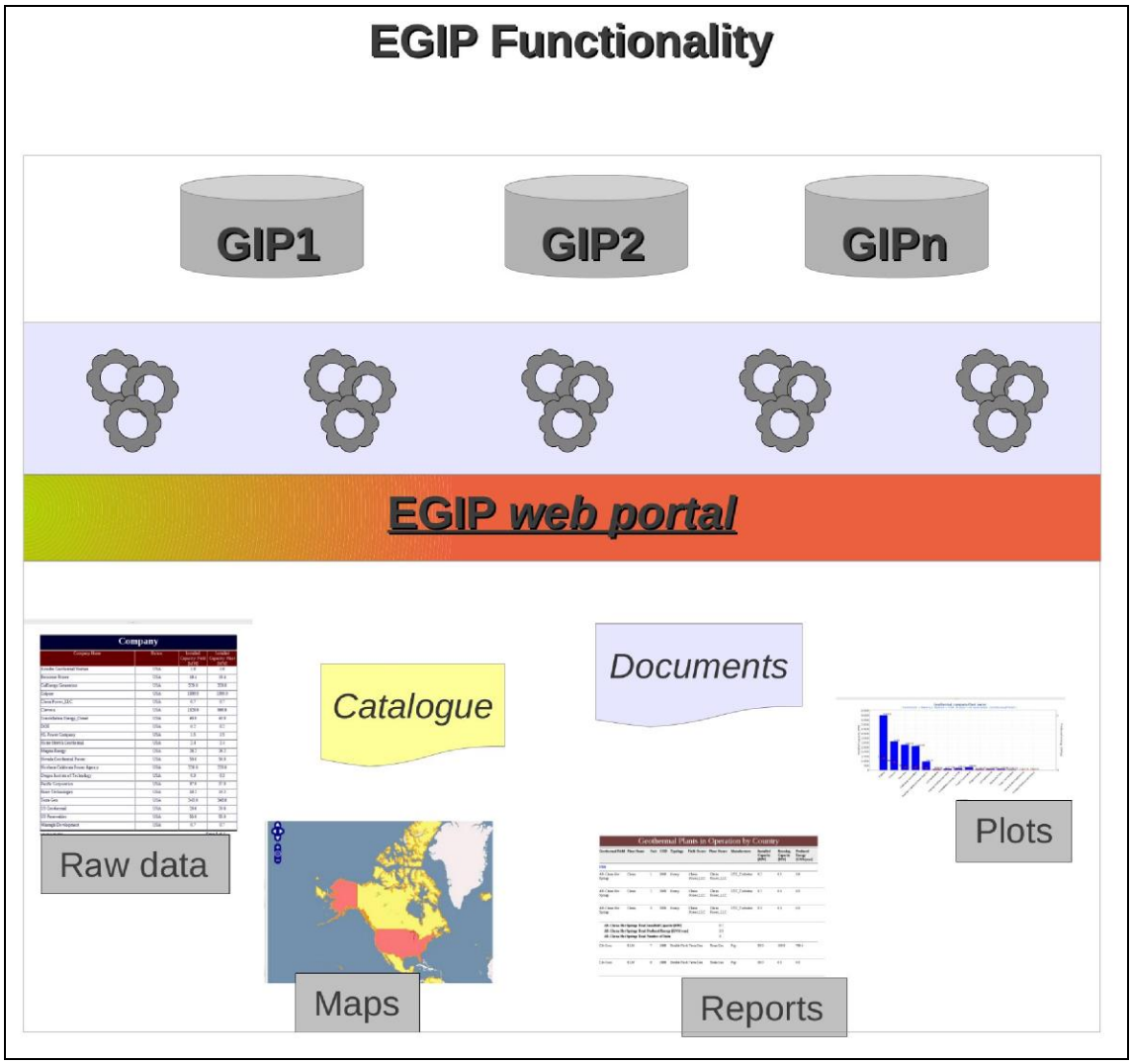

Figure 2 EGIP functionalities

EGIP makes it possible not only to browse or query maps (e.g., depth temperatures for the whole of Europe or for the chosen areas) but also to obtain information in various aggregate forms such as charts, reports or tables that enable the geothermal information available in its database to be quickly surveyed and compared. Finally, through a catalogue tool (i.e., a search system based on keywords, countries and categories), the proposed EGIP provides all the electronic documents of geothermal interest.

2.2 Architecture and technical requirements

Figure 3 describes how the principles of a distributed architecture should be implemented for the EGIP. At a national level, each data provider shares data and documents (managed by its own information system) with the EGIP portal according to common rules adopted by the

EGIP and which are compliant with INSPIRE principles. These rules are related to the common data model for the EGIP, the metadata to describe the datasets, and the web services to deliver data and metadata.

With the metadata registered in the catalogue, the EGIP portal finds the services and then processes the data (view, download, or any other process such as computing statistics). The portal then puts all national pieces together to make an end European product. Dedicated services could be also developed for this aggregation and be used by the EGIP portal.

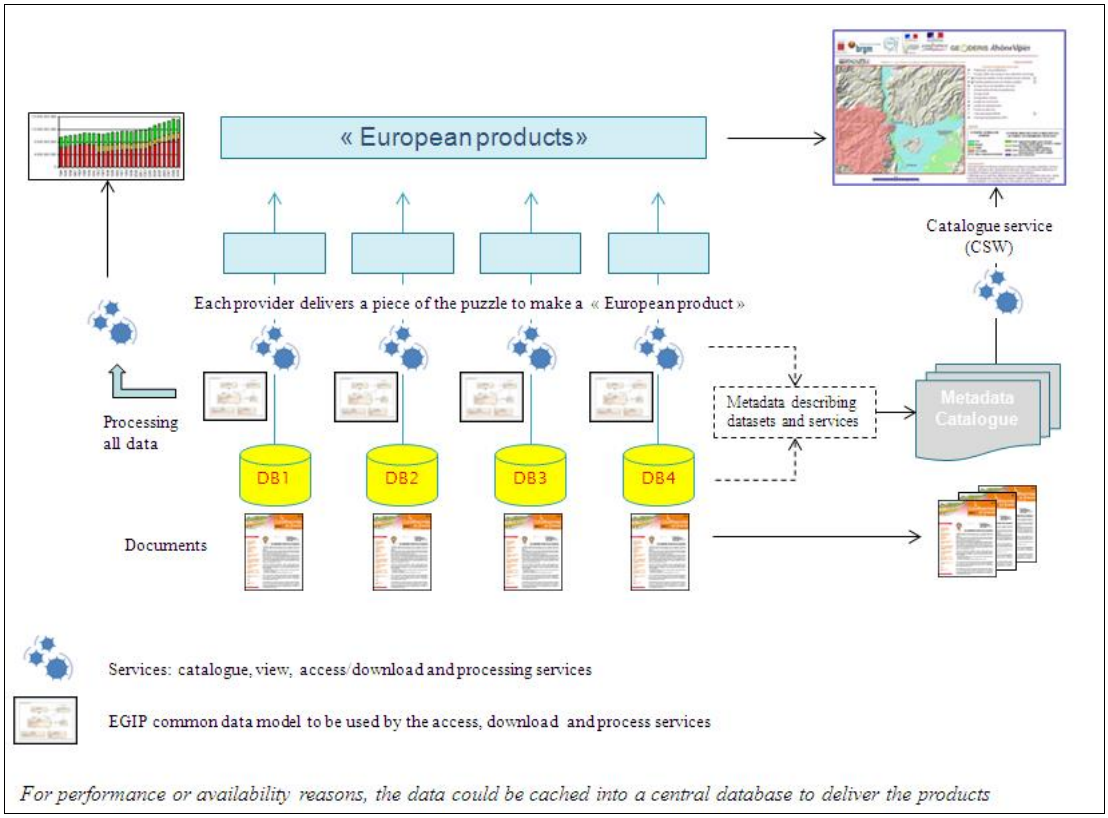

Figure 3 EGIP architecture

At a national level, each provider will need to:

- set up web services to view and access their own data according to EGIP rules (OGC/INSPIRE web services, display rules for maps, common data model and code-list (or vocabularies) for the data);
- specify and map their own data model onto the EGIP common data model;
- specify and map their own code-list (or vocabulary) values onto the common EGIP values;
- Describe the available documents, datasets and services by metadata registered in a catalogue.

At a European level:

- a portal will request all 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.

To be able to participate in EGIP implementation, the following data management is required for the participating countries:

- Existence of data
- Data finding
- ICT skills
- Equipment (e.g. servers, network bandwidth).

2.3 Data format

The geothermal information organized by the EGIP may be both *structured* (i.e., databases, spreadsheets, vector feature maps, raster coverage maps) and *un-structured* (documents).

For the *structured information* the entities, attributes, domains and relations, both for spatial and non-spatial datasets, will be identified. Documents will be treated as *un-structured information* and hence inserted into a catalogue system.

Since structuring all the information contained in documents would require a huge effort, only the most useful data will be structured, i.e., included in the conceptual model as harmonized data (Figure 4).

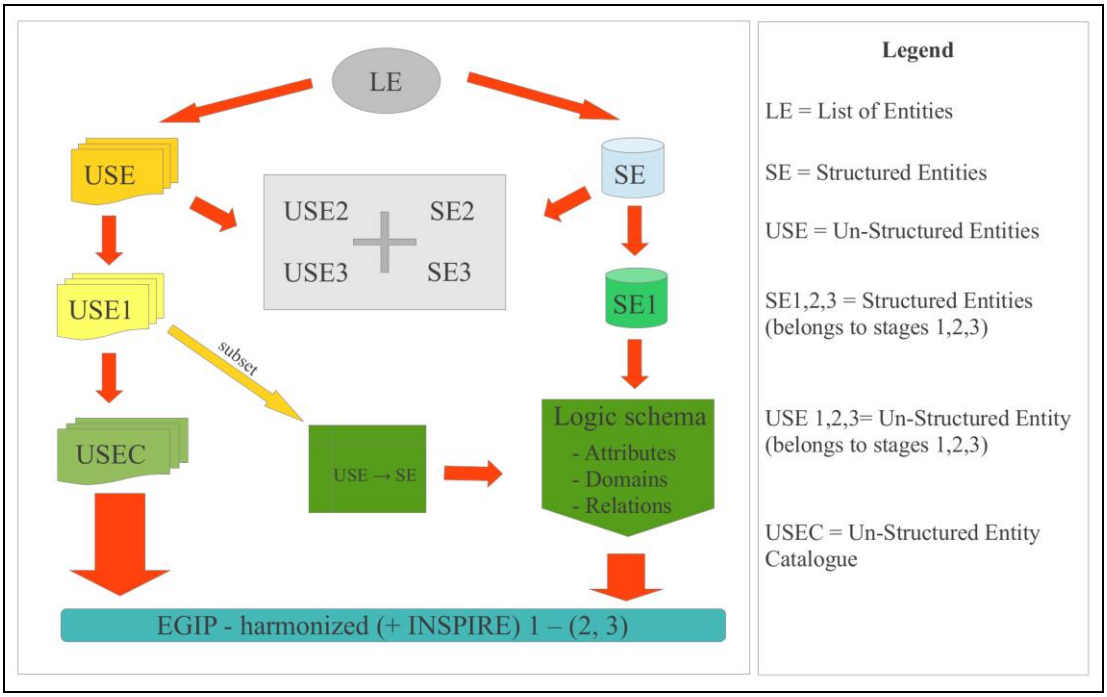

Figure 4 EGIP data implementation

Having described the main services and data types the EGIP would provide, we now define its content.

3 Work plan

3.1 The strategy

Organizing the whole EGIP from scratch would be lengthy, costly, and complex. It would also be inefficient considering the length of time already spent in many countries in building effective, although fragmented, geothermal information systems.

We propose, instead, a step-by-step plan, ensuring a gradual evolution from the present situation to the whole implementation. The EGIP firstly executes a strategic setting with few extra-resources by highlighting information requiring few resources but the highest potential performance gains. A four-step planning process is described below, to build strategic data and to set immediate, short-, medium- and long-term targets.

Since the core function of the EGIP is to organize geothermal data and information at a European scale, the *first step* (***Stage 0***) in the implementation is to map the links and documents where geothermal information is currently provided at a national level, and to organize this information on the GEO ERA-NET website. This stage is implemented immediately, within the framework of the GEO ERA-NET Project, by simply using the information mapping already performed in WP2 and WP3.

Although the core documents and links represent an important reference for EGIP, this list is not optimal for information retrieval: the true platform still needs to be designed. EGIP planning then proceeds by grouping geothermal information into three lists, which represent the *short-* (***Stage 1***), *medium-* (***Stage 2***) and *long-term* (***Stage 3***) data involvement phases. The three lists to be developed and implemented over time have increasing levels of detail. Each list of information is subdivided into the main information categories already defined in Report D3.1 and covering the topics outlined in Figure 1.

3.2 Stage 0: Geothermal information 'state-of-the-art'

The first step (***Stage 0***) handles information related to the current management of geothermal data in the GEO ERA-NET partner countries. These National Geothermal Management Systems (from D3.1) are listed in Table 1.

The information, in the form of references and links, is organized by category and was collected in the questionnaires set up by the WP3 leaders in Task 3.2 (see Appendix 1 – part

A for the complete list) and WP2 leaders in Task 2.1 (see Appendix 1 – part B for the complete list).

Table 1 Links to National Geothermal Management Systems

Country	Name	Link
FRANCE	Geothermie Perspectives	www.geothermie-perspectives.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
HUNGARY	Hungarian Office for Mining and Geology	www.mbfh.hu
HUNGARY	National Institute for Environment	www.neki.hu
ICELAND	Orkustofnun site	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

Country	Name	Link
ITALY	MISE	http://unmig.sviluppoeconomico.gov.it
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

* *The IGA Global Geothermal Energy DB is not exactly a National Geothermal Management System: it is managed by the Italian National Research Council and includes information from all geothermal countries in the world regarding power production and the direct use of heat.*

3.3 From Stage 1 to Stage 3

To subdivide the geothermal information into the lists corresponding to the different stages of development, we considered three factors: 1) data availability in the EU countries, 2) data importance for operators and 3) the time required for data organization. Factor 1) was easily obtained from the state-of-the-art mapping described in Report D3.1, whereas the other two factors were based on the experience of the GEO ERA-NET consortium. Indeed, the GEO ERA-NET partners were asked to participate in the ranking, by identifying the main information to be organized and their urgency. This identification and ranking resulted in the two following groups (note that within each group there is no particular ranking):

Top priorities

- Local and regional government list
- Industry list
- Education and research centres list
- Funding organizations list
- Information on existing production/exploitation for geothermal purposes
- Information on potential (e.g., temperature distribution at defined depths)
- Energy market structure
- Energy demand and supply
- National energy strategy (2020 goals)

Lower priorities

- Project list with key figures (possible lower limit)
- Future projects
- Research projects
- Details of education and training activities

On the basis of all the above, the data lists for the three stages of EGIP data involvement were defined, as shown in Tables 2, 3, 4. In these tables the left-hand column defines the main groups of information, i.e., the EGIP information category, and the right-hand column lists the specific information to be organized at each stage. When a table cell is empty, it means that no information for a certain category is included in that specific stage.

Table 2 – List of data and documents for Stage 1. Note: names of categories appear as in the WP3 questionnaire

Category	Information
Scientific and technical aspects	Temperature maps at various depths (e.g., 1 / 2 / 3 km) Surface heat flow measurements and map Exploration and production licenses and (projected) power production
Social acceptance (including environmental issues)	Environmental impact laws
Code	-
Skills & employees, energy needs	-
R&D	Geothermal national roadmap
Training and education	List of education and research centres
Regulatory aspects	Licensing regulations (exploration/exploitation) Legal conditions for grid access

Support schemes	Insurance covering the geothermal project risks (e.g. deep drilling wells) Royalties & taxes, support schemes (e.g. feed-in tariffs, grants)
Other	Industry list

Table 3 List of data and documents for Stage 2. Note: names of categories appear as in the WP3 questionnaire

Category	Information
Scientific and technical aspects	• Geothermal reservoir temperature in high enthalpy geothermal fields • Fault mapping, Tertiary and Quaternary fault systems • Recorded seismicity • Exploration and production licenses and (projected) power production • Geothermal plant location, installed capacity (MW), running capacity (MW), and energy produced in one year (MWh/year), typology, status, plant owner, manufacturer, geothermal field. • Direct use of heat: location, typology, installed capacity (MWt) and energy produced in one year (TJ/year)
Social acceptance (including environmental issues)	Environmental pressure factor list
Code	-
Skills & employees, energy needs	Surveys on energy needs and coverage by geothermal uses (e.g. maps)
R&D	On-going geothermal projects, completed and planned

Training and education	Geothermal training courses available
Regulatory aspects	-
Support schemes	-
Other	Services provided by each industry

Table 4 List of data and documents for Stage 3. Note: names of categories appear as in the WP3 questionnaire

Category	Information
Scientific and technical aspects	• Temperature data in the subsurface (e.g. oil and gas borehole BHT/DST). • Heat flow maps • Thermal spring analyses (physical and chemical, e.g., temperatures, pH, chemical elements, geothermometers) • Any other reservoir information (e.g. pressure, production level depth, flow range, fluid characteristic, enthalpy). • Published temperature model interpretation (e.g. regional heat flow, local effects due to meteoric effects) • Basin layout and sediment-basement interface depth • Outlines of granite formations • Geothermal and oil & gas wells masterlog (including litho-stratigraphy, wells technical aspects, geophysics logs) • Geophysical survey (e.g. seismic cross-sections, MT survey, geoelectrical survey) • Information regarding geographical restricted areas for geothermal energy (including mining, oil exploration and/or exploitation, CCS, nuclear storage, spas, interference with drinking water, population density, natural parks, high seismicity areas, etc.)

	• Raster maps of transmissivity (percentage map coverage of country/region) • Porosity – Permeability measurements or poro-perm relationships and poro/depth relationship • Exploration data on prospective resources
Social acceptance (including environmental issues)	• Studies and reports on the social acceptance of geothermal energy • Monitoring network data • Environmentally tracked parameters
Code	Geothermal code and/or thesaurus and/or a glossary in country
Skills & employees, energy needs	• Official number of people employed in geothermal energy (e.g. institutional bodies, private companies) • List of skills required in the field of geothermal energy • Surveys on energy needs and coverage by geothermal uses (e.g. maps)
R&D	Geothermal projects considered necessary on specific topics
Training and education	• Details of training courses (e.g., location, schedule) • Average attendance of training courses
Regulatory aspects	-
Support schemes	-
Other	-

Having defined the work plan, we will now describe how we propose to build the EGIP.

4 IMPLEMENTING the EGIP

We have already mentioned the preliminary phase (Stage 0), focused on the organization and dissemination of geothermal data collected by the WP3 and WP2 questionnaires and related to the state-of-the-art. This dissemination will be achieved in the present GEO ERA-NET Project, through the project's website. Our information and suggestions are described in Section 4.1. After this, however, EGIP still needs implementing - therefore what actions and activities are required?

In designing the EGIP, we decided not to focus initially on delivering (Stage 1) the most sophisticated information system, but to deliver key information that could be organized quickly through joint actions, performed within the Geothermal ERA-NET timeframe. Sophisticated and overcomplicated first steps would lack the key commonalities valued by most people. This first-level EGIP, although very small, needs to be developed by skilled people. The aim is to provide potential customers with the most urgent information in order to decide where and how they could be involved. It will also demonstrate the usefulness of the EGIP concepts, taking into account top priority information and data (Table 2). This Stage 1 will be implemented by a pilot project jointly performed by interested national groups and is described in Section 4.2.

This pilot will provide only the nucleus of the EGIP. In fact, a complete EGIP is beyond the skills of the GEO ERA-NET consortium and the activity of the project itself, however its creation is one of the aims of the GEO ERA-NET Project. This requires time, a budget and the expertise of those who manage geothermal databases. It should be developed in synergy with on-going national activities, and jointly with the EERA-JPGE coordination of geothermal data.

What are the added values and hurdles in creating a fully developed EGIP and how can the values be enhanced and the hurdles reduced? We discuss these issues in Section 4.4, after describing the work involved in the implementation of Stages 2 and 3 in Section 4.3. Finally, we provide a time frame estimation in Section 4.5.

4.1 Dissemination of the State-of-the-Art: Stage 0

All the links to web pages and documents presented in Appendix 1 (parts A and B) will be sorted by topic and country, and then published on the GEO ERA-NET web site. “Stage 0” will be completed by mid 2014 and managed by the coordinator as part of WP1. Two different approaches are possible:

1. Insert the collection of links and documents on the ERA-NET web pages. Technically this entails creating one or more web HTML pages where the listed links and documents can be found
2. Set up a search tool within the GEO ERA-NET website that allows users to retrieve documents and links using their topic categories and/or countries of origin.

The first solution is easy and quick to implement but less effective, whereas the second one requires a greater implementation effort.

4.2 Pilot project within GEO ERA-NET

The aim of this early stage, which we propose as a joint activity, is to prove the effectiveness and efficiency of a European Geothermal Information Platform in Europe. The initial development of the pilot project involves setting up a geothermal common data model and the management and optimization of services. It is designed to fully satisfy the end-user by providing easy and useful data retrieval and cost containment, in compliance with INSPIRE rules for building a (spatial) Data Infrastructure.

The pilot project consists mainly in:

- creating a catalogue of the metadata for the information included in Stage 1 (Table 2) as described in Subsection 4.2.1;
- mapping the information for Stage 1 (Table 2), as described in Subsection 4.2.2, using the EGIP conceptual data model (Appendix 2);
- implementing the web portal;
- implementing discovery, view, download and process services at a national level;
- carrying out intelligent searches among the documents collected in Stage 1;
- setting up the portal on web services retrieved from the confederate national portal (Appendix 2 Chapter 2);

4.2.1 Metadata

Metadata operations are one of the main tasks in data organization, which entails describing and cataloguing the information collected. Metadata operations can follow different descriptive schemas and usually refer to i) documents, ii) services, iii) software and iv) datasets.

For EGIP purposes, the INSPIRE Metadata Implementing Rules, which are based on EN ISO 19115 and EN ISO 19119 (see Appendix 2 Chapter 3 for more technical details) are required in order to register Stage 1 datasets and services in the catalogue.

Table 5 shows the INSPIRE themes membership and how they are sorted according to INSPIRE metadata topic categories.

Table 5 Stage 1 information

Information	Format	Spatial	Typology Definition	INSPIRE topic category	INSPIRE theme category
Temperature map	Structured	YES	Map (vector or coverage)	Geoscientific information	Energy Resources
Surface Heat Flow	Structured	YES	Map (vector or coverage)	Geoscientific information	Energy Resources
Exploration and production licenses and (projected) power production	Structured	YES	Map (vector)	*Exploration and production licenses*	Area management / restriction / regulation zones
Environmental impact law	Un-Structured	NO Country	Document	Environment	-
Licencing regulations	Un-Structured	NO	Document	Planning cadastre	-

(exploration/exploitation)		Country			
Legal condition for grid access	Un-Structured	NO Country	Document	Structure	-
Geothermal roadmap	Un-Structured	NO Country	Document	Economy	-
Insurance	Un-Structured	NO Country	Document	Economy	-
Royalties & taxes, support scheme (feed-in tariffs, grants, …)	Un-Structured	NO Country	Document	Economy	-
List of education & research institutes	List	YES	Map (vector)	Structure	-
List of Industries	List	YES	Map (vector)	Structure	*Production and industrial facilities*

4.2.2 Entities and attributes description

This section outlines firstly the already structured information and then the data required from the unstructured information (documents), for the technical description of the data model, rendered in the Unified Modelling Language (UML), including the INSPIRE implications and specifications, see Appendix 2 Chapter 3.

Temperature maps

Temperature maps show the temperature trend at a certain depth below the ground or sea level and are the most common type of information used in Europe. Usually temperature values are represented as isolines or polygons, and occasionally as raster coverage.

If the temperature maps are available as polygon vector data, the attributes needed are: i) a unique ID referring to each geometry, ii) an upper and lower polygon temperature limit (expressed in °C), and iii) a label attribute that can be used for styling the maps.

If the vector data are polylines (isolines) as well as unique ID attributes for the geometry and the label, the isoline temperature value and its typology are also needed, i.e., whether the line has been inferred, is certain or uncertain) (see Appendix 2).

Surface Heat Flow

Since the 1980s, heat flow maps have been released and periodically updated in the European Geothermal Resource Atlas. The heat flow is generally represented at the surface either as vector polylines (but also as vector polygons) or as raster coverage. Like temperature maps, both vector polylines and polygons include the ID and label, and the areas are completed with the lower and upper heat flow limit values (expressed in mW/m^2). The isolines are described with the heat flow value and its typology (see Appendix 2).

Licencing

Information on licencing is collected by ministries, energy agencies or local authorities and generally consists of collections of reports, maps, underground surveys, well logs and analyses, etc. Licensing areas are often stored as polylines, representing boundaries, or as polygons highlighting the licence areas.

For the EGIP the following attributes are fundamental i) a unique ID for each area, ii) typologies (defined in a coded vocabulary), iii) a name, iv) a position (on-shore or off-shore), v) the area in m^2 (only for polygons), vi) the perimeter length, vii) the date the licence started and viii) when it expires, ix) at least one link to available documents (see Appendix 2, also for the 'type' of vocabulary).

Geothermal roadmap

National roadmaps, if any, tend to be documents, and in most cases are related to energy in general. Information may be included on geothermal energy and its current and planned exploitation according to the national energy strategy. Thus, in addition to storing the road-map in the collection of un-structured information under R&D, it is possible to mine some of the useful data, which can then be organized into a query table.

Each roadmap needs a unique ID. A table can then include the name of the entity that developed the road-map, the emission date, the validity date, a link to the relevant website, the current energy produced (power and heat), and the expected target.

Insurance

Insurance tools cover the possible financial losses of the investors if the project fails and are thus very important in promoting geothermal projects. Not all EU countries provide insurance for geothermal projects. However such information (e.g. whether insurance is provided by a public or private organization, as contracts that can be viewed on the web) can help countries without insurance to promote the development and the delivery of these tools.

Insurance is a contract, hence a document, and thus is included within the un-structured document collection in the 'Economy'. Also for this kind of data, useful information can be retrieved to produce an information table, such as who handles the insurance, whether it is provided by a public or private organization, if a document (a contract for instance) is available on the web as well as the refunding amount (if it is known and publically available).

Royalties & taxes, support schemes

Energy production is usually regulated by royalties and taxes or supported by specific feed-in tariffs or grants. This information is collected in specific documents that can be related to an economic category of information.

In order to collect the economic data in a dataset, a 'type' attribute is required to select, in a vocabulary, the items that the data refer to (e.g., royalties, taxes, support scheme) and a link to a web reference as well a name code.

Regulations

Many laws regulate geothermal issues, related to licencing procedures, grid access, and the environment. These laws are available mainly as documents, and are often on the web. For each law, a unique ID is necessary as well as the 'type' attribute that defines the scope (once again from a vocabulary), the law code, the date of emission, a brief description, and any links to resources.

List of education and research centres

Although the WP3 questionnaire did not contain a survey on universities and research centres that deal with geothermal courses and activities, this information is important for Stage 1 of the EGIP.

The list will be in a table format, and includes a unique ID, the type (i.e. university or research centre), the name, the location (if possible in latitude and longitude coordinates to enable this data to be shown as a map) and a link to web pages, see Appendix 2.

List of Industries

Industries involved in geothermal activities refer to all companies that produce components both for power production and the direct use of heat. Again, the WP3 questionnaire did not contain a survey on the industries involved, but this will be covered in the EGIP by producing national lists containing the same criteria as the universities and research centres (see previous subsection): an ID to identify each industry, a 'type' of industry, chosen from a pre-built vocabulary, the name and location may also be required together with the coordinates (latitude and longitude) and a link to their web pages.

The data model in Stage 1 does not have many links between the various entities, since this information covers different topics and only a few attributes are taken into account. In later steps of the EGIP (i.e., when the information in Stages 2 and 3 is introduced into the data model) relations will be set for more complex queries among the data. To date all the considered entities are related to each country.

4.3 Further implementation: Stages 2 and 3

The main work will include:

- Porting the EGIP server from the servers where the pilot is hosted to an official EU server
- Maintenance of the new EU Geothermal Portal
- Definition of the data model for the information in Stage 2 (Table 3)
- Definition of the data model for the information in Stage 3 (Table 4)
- Collection of information required in Stages 2 and 3 (Tables 3 and 4)
- Mapping of the structure and the code-lists for Stages 2 and 3

- Registration of the services and datasets in the metadata catalogue
- Extraction of information from the main documents to produce structured data (table data)
- Translation of the most useful documents into English for international use
- Implementation of a cache server to improve the performance of the EGIP

4.4 Enhancing values and overcoming organizational hurdles of EGIP implementation

For countries where national GIPs have been partly developed or not defined yet, the current EGIP proposal is clearly an advantage: less or no time for the *design*, since it is already embedded in EGIP, and the only cost is for the implementation. But what is the advantage for countries where geothermal databases and information systems are already well established? For any country, the advantage is that EGIP would gain access to information from other branches and countries in a click, at the same cost as setting up the system at a national level and following the INSPIRE Directive.

How long would it take to update the answers to the WP2 and WP3 questionnaires on geothermal and data organization for each country? Or to retrieve the necessary information to decide whether a geothermal project is worth setting up in a certain place and to prepare a business plan? How long would it take to collect the information required for a report regarding an updated geothermal status in Europe with respect to your country, covering resources, different geothermal energy uses, energy needs and geothermal energy provision, regulations, needs and gaps, social and political aspects, training and education? The longer the time required, the more sense it makes to have an EGIP.

Is geothermal a static sector that does not need information updates so often? Is it a sector that does not raise such questions so often? The aim of GEO ERA-NET is to help change this situation.

Once the above mentioned values are shared and the community agrees on the proposed strategy, then the EGIP needs to be set up. The challenge is that the strategy represents a significant departure from the status quo. Many hurdles need to be overcome to put the proposed strategy into action.

One hurdle is the limited resources. Since we are going to be moving in a new direction, it might appear that more resources would be needed. However, with our strategy, resources would actually be cut in the long run, if we provide coordinated actions.

Another hurdle to adoption is the resistance of the scientific community that has already developed geothermal databases: why is their model less important than others? For this reason, the EGIP must be developed from the coordination of different groups already skilled in this task. Through joint activities, the EGIP can incorporate the most efficient model of each part that makes up tools have already been developed. With the support of people skilled in different fields and focused on their own area, EGIP will be able to streamline operations.

To obtain a complete EGIP it will be necessary to set up a joint call and/or a European call, to fund this activity. A technical team will be necessary to include the information from Stage 2 and 3 data lists (Tables 3 and 4) in the EGIP and to follow this implementation within the GEO ERA-NET Project. GEO ERA-NET is expected to go beyond the level of cooperation and integration already achieved, not only by broadening partnerships and/or by integrating relevant new partners with a good geographical distribution but also by complementing ongoing EERA-JPGE activities. The most appropriate instrument to support its development will be decided through WP4 and WP7, after which WP3 will follow up with the implementation of the European Geothermal Platform.

4.5 Timing

In line with the scheduling for the GEO ERA-NET project and with the actions defined in this work plan, the proposed milestones are:

- "Pilot implementation" proposal as joint activities - March 2014 [M23] – WP4 Task1
- "Pilot implementation" definition of possible schemas and barriers August 2014 [M26] – WP4 Task2
- Preparation for the calls from March 2014 to December 2014
- Implementation of the EGIP from January 2015 to January 2016
- Analysis of joint experiences in February 2016
- The report on "Pilot implementation" March 2016
- Proposal for future collaboration in developing "EGIP Further implementation" April 2016

Table 6 WP3 Towards EGIP

WP3 – towards EGIP	Year 2			Year 3											Year4															
	2013			2014											2015												2016			
	Oct	Nov	Dec	Jen	Feb	Mar	Apr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dec	Jen	Feb	Mar	Apr	May	Jun	Jul	Ago	Sep	Oct	Nov	Dec	Jen	Feb	Mar	Apr
"Pilot implementation " proposal as joint activities																														
"Pilot implementation " definition of possible schemas and barriers																														
Call preparation																														
Implementation of the EGIP																														
Analysis of experiences of joint activities																														
Report on implementation																														
Proposal for future collaboration in develop " EGIP further implementation "																														

5 Budget

This chapter outlines the budget for the dissemination of the state-of-the-art, for the pilot project within the GEO ERA-NET, and for further EGIP implementations.

The cost of implementing EGIP is mainly related to the time spent on activities in each country. It is impossible to give a budget in terms of currency, since the personnel cost is very variable in different EU countries. Here we provide the budget in terms of days foreseen for activities at a national level, and each country can translate this estimate into their own currency. Please note that the budget in Sections 5.2 and 5.3 assumes the technical skills described in Section 2.2.

Other costs for setting up a centralized portal are mentioned in Section 5.3.

5.1 Dissemination of the State-of-the-Art

Orkustofnun and CNR will be in charge of disseminating the state-of-the-art. In Appendix 1 (parts A and B) CNR will provide all the references collected in the WP2 and WP3 questionnaires. Orkustofnun will make these references public on the GEO ERA-NET website.

According to the work plan, two dissemination options are proposed.

- a budget for uploading the list of references (solution A)
- a budget for search tools (solution B)

Table 7 EGIP Stage 0: Dissemination solution A

Activities for further implementation	Time spent (days/person)
Create HTML pages for the collection of references	2
Upload in GEO ERA-NET and test link	2
TOTAL	**4**

Table 8 EGIP Stage 0: Dissemination solution B

Activities for further implementation	Time spent (days/person)
Setting up a search tool	5
Preparing the collection in terms of categories and countries of origin	2
Testing the tool	3
TOTAL	**10**

5.2 Pilot project within GEO ERA-NET

In the pilot implementation the participants will be responsible for national activities (NAs). Their role is to make their own data accessible through appropriate services, in accordance with the EGIP architecture and hence INSPIRE compliant (Section 2.2).

Appendix 2 outlines the technical details. In brief, each country has to:

1) Map the structure: i.e. define to what extent the properties of their national database correspond the EGIP data model elements; map the vocabularies (i.e. define the correspondence between the controlled values of national vocabularies and the EGIP common vocabularies or code-lists)
2) Set up a server to provide the INSPIRE-compliant OGC services (such as CS-W, WMS, WFS, WPS)
3) Register the services and datasets in the metadata catalogue
4) Extract info from the main documents and convert this information into table data (e.g. lists of universities and research centres, companies)

The CNR will be responsible for building the web portal that will retrieve all the information and services supplied by each national provider.

Each of these activities is reported in Table 7 in days/person.

Table 9 EGIP Stage 1 implementation for participating countries– N.B. see requirements in Section 3

Activities for further implementation	Time spent (days/person)
Information collection	TBD – depends on Country
Mapping the structure and vocabularies	5
Setting up OGC services and testing	5
Registration of documents, datasets and services in the metadata catalogue	5
Information extraction from main documents and conversion into table data (e.g. lists of universities and research centres or lists of companies)	5
COUNTRY TOTAL	**20**

5.3 Further implementation

The further implementation of the EGIP will involve Stages 2 and 3 of the EGIP described above. Besides the national activities, EGIP will need some central coordination, management and maintenance. A central server, providing caching services, would be advisable. The cost consists of the setting-up and management time, listed in Table 10, and the dedicated hardware and software, amounting about 6/7k €.

Table 10 EGIP further implementation, coordination activities. – N.B. see requirements in Section 3

Centralized activities for further implementation	Time spent (days/person)
Porting the EGIP server from the server(s) hosting the pilot to an official EU server	***6***
Maintenance of the new EU Geothermal Portal	***24/year (2/month)***

Table 11 shows the times required by each country.

Table 11 EGIP further implementation, national activities. – N.B. see requirements in Section 3

Activities for further implementation	Time spent (days/person)
Information collection for Stages 2 and 3 (Tables 3 and 4)	TBD – depends on Country
Data model of Stage 2 (Table 3) information	10
Data model of Stage 3 (Table 4) information	30
Mapping of the structure and code-lists for Stages 2 and 3	50
Registration of documents, datasets, services in the metadata catalogue	10
Information extraction from main documents and conversion into table data	40
Translation into English of the most useful documents for use throughout the EU	50
Implementation of the cache server to improve the performance	10

In agreement with the GEO ERA-NET project plan and with the timing proposed in Section 4.5, the further implementation of the EGIP may be completed in one year, working in parallel at a national level. Beside the 200 working days mentioned in Table 11, the budget also needs to include the time required for data collection. This time will depend on the data quantity and organization already available for each country.

Appendix 1

STAGE 0

D 3.2 Appendix 1

CNR

October 2013

Publisher:

Coordination Office, Geothermal ERA NET

Orkustofnun, Grensásvegi 9, 108 Reykjavík

Tel: +-354-569 6000,

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The Geothermal ERA NET is supported by the European Union's Seventh programme for research, technological development and demonstration under grant agreement No 291866

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APPENDIX I – part A

References from WP3 questionnaire

Part two of the WP3 questionnaire surveys the existence, the availability and the data organization of the information on geothermal knowledge splitted up in eight categories.

Here all the references collected are included in eight tables, one for each category.

Table 12 List of documents or web pages inherent sub-sections - Scientific and technical aspects

Country	Category	Link
GERMANY	Scientific and technical aspects	http://www.geotis.de/homepage/impressum.php?loc=en_US
HUNGARY	Scientific and technical aspects	Temperature maps at depth: Dövényi, L., Drahos, D., Lenkey, L. (2001): Geothermal potential assessment of Hungary – subsurface temperature conditions. Manuscript. Dept. of Geophysics, Eötvös Loránd University, Budapest
HUNGARY	Scientific and technical aspects	Surface heat flow measurements and map: http://geophysics.elte.hu/projektek/geodinamikai_atlasz.htm
HUNGARY	Scientific and technical aspects	Heat flow measurements and map at depth: Dövényi, P., Horváth, F.: A review of temperature, thermal conductivity and heat flow data form the Pannonian Basin, in: Royden, L.H., Horváth, F. (Eds): The Pannonian Basin a Study in Basin Evolution. *American Association of Petroleum Geologist memoirs*, Tulsa, Oklahoma, **45**, (1988), 195-233. Lenkey, L., Dövényi, P., Horváth, F. & Cloetingh, P.L. 2002: Geothermics of the Pannonian basin and its bearing on the neotectonics. EGU Stephan Muller Special Publication Series, 3: 29-40
HUNGARY	Scientific and technical aspects	Thermal spring analyses: www.vizeink.hu
HUNGARY	Scientific and technical aspects	Basin layout and sediment-basement interface depth: Geological and Geophysical Institute of Hungary, www.mfgi.hu

Country	Category	Link
HUNGARY	Scientific and technical aspects	Geophysical survey: Geological and Geophysical Institute of Hungary, www.mfgi.hu
HUNGARY	Scientific and technical aspects	Fault mapping, Tertiary and Quaternary fault systems: Geological and Geophysical Institute of Hungary, www.mfgi.hu Eötvos Loránd University, http://geophysics.elte.hu/projektek/geodinamikai_atlasz.htm
HUNGARY	Scientific and technical aspects	Recorded seismicity: Geological and Geophysical Institute of Hungary, www.mfgi.hu Eötvos Loránd University, http://geophysics.elte.hu/projektek/geodinamikai_atlasz.htm
HUNGARY	Scientific and technical aspects	Information regarding geographical restricted areas for geothermal: Hungrian Office for Mining and Geology www.mbfh.hu National Institute for Environment (www.neki.hu)
HUNGARY	Scientific and technical aspects	Exploration and production licenses and (projected) power production: Hungrian Office for Mining and Geology www.mbfh.hu
HUNGARY	Scientific and technical aspects	Raster maps of transmissivity: Geological and Geophysical Institute of Hungary, www.mfgi.hu
HUNGARY	Scientific and technical aspects	Porosity – Permeability measurements or poro-perm relationships and poro/depth relationship Geological and Geophysical Institute of Hungary, www.mfgi.hu
HUNGARY	Scientific and technical aspects	Direct use of heat: location, typology, installed capacity (MWt) and produced energy in one year (TJ/year): These systems operate according to the Act on District Heating and their relevant data are managed by the Hungarian Energy Office (www.eh.gov.hu)

Country	Category	Link
ICELAND	Scientific and technical aspects	Surface heat flow measurements and map: OS, http://www.os.is/gogn/Skyrslur/OS-1985/OS-85076.pdf
ICELAND	Scientific and technical aspects	Geothermal and oil&gas wells masterlog: OS, http://www.os.is/borholuleit
ICELAND	Scientific and technical aspects	Recorded seismicity: Icelandic Met Office, http://en.vedur.is/#tab=skjalftar
ICELAND	Scientific and technical aspects	Information regarding geographical restricted areas for geothermal: Master Plan for hydro and geothermal energy resources in iceland http://www.rammaaaetlun.is/english
ICELAND	Scientific and technical aspects	Exploration and production licenses and (projected) power production OS, http://www.os.is/orkustofnun/leyfisveitingar/utgefin-leyfi/
ICELAND	Scientific and technical aspects	Raster maps of transmissivity OS; http://orkuvefsja.is/vefsja/orkuvefsja.html
ICELAND	Scientific and technical aspects	Exploration data on particular data prospective resources OS, http://www.os.is/borholuleit
ICELAND	Scientific and technical aspects	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 OS; http://orkuvefsja.is/vefsja/orkuvefsja.html
ICELAND	Scientific and technical aspects	Direct use of heat: location, typology, installed capacity (MWt) and produced energy in one year (TJ/year) OS; http://orkuvefsja.is/vefsja/orkuvefsja.html
ITALY	Scientific and technical aspects	Temperature data in the subsurface: MiSE-UNMIG Inventory of the National Geothermal Resources on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/inventario/inventario.asp - pdf format, MiSE-UNMIG VIDEPI project, partially available on http://unmig.sviluppoeconomico.gov.it/videpi/default.htm - pdf format CNR national geothermal database on http://geothopica.igg.cnr.it, partially available

Country	Category	Link
ITALY	Scientific and technical aspects	Temperature maps at depth: MiSE-UNMIG Isolines from Inventory of the National Geothermal Resources on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/inventario/inventario.asp - pdf format CNR national geothermal database on http://geothopica.igg.cnr.it
ITALY	Scientific and technical aspects	Surface heat flow measurements and map: MiSE-UNMIG Inventory of the National Geothermal Resources on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/inventario/inventario.asp - pdf format CNR national geothermal database on http://geothopica.igg.cnr.it
ITALY	Scientific and technical aspects	Geothermal reservoir temperature in high enthalpy geothermal fields MiSE-UNMIG Inventory of the National Geothermal Resources on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/inventario/inventario.asp - pdf format CNR national geothermal database on http://geothopica.igg.cnr.it
ITALY	Scientific and technical aspects	Any other reservoir information: MiSE-UNMIG Inventory of the National Geothermal Resources on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/inventario/inventario.asp - pdf format CNR national geothermal database on http://geothopica.igg.cnr.it
ITALY	Scientific and technical aspects	Published temperature model interpretation: MiSE-UNMIG Inventory of the National Geothermal Resources on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/inventario/inventario.asp - pdf format

Country	Category	Link
ITALY	Scientific and technical aspects	Geothermal and oil&gas wells masterlog: MiSE-UNMIG VIDEPI project, partially available on http://unmig.sviluppoeconomico.gov.it/videpi/default.htm – pdf format
ITALY	Scientific and technical aspects	Geophysical survey: MiSE-UNMIG VIDEPI project, partially available on http://unmig.sviluppoeconomico.gov.it/videpi/default.htm – pdf format
ITALY	Scientific and technical aspects	Fault mapping, Tertiary and Quaternary fault systems: ISPRA (Institute for Protection and Environmental Research) on http://sgi1.isprambiente.it/geoportal/catalog/content/project/ithaca.page - wms service
ITALY	Scientific and technical aspects	Recorded seismicity: INGV (National Institute of Geophysics and Volcanology) ISIDe - Italian Seismological Instrumental and Parametric Database on http://iside.rm.ingv.it/iside/standard/index.jsp (data starting from 1900) – table format INGV (National Institute of Geophysics and Volcanology) CPTI11 – Italian Earthquake Parametric catalogue on http://emidius.mi.ingv.it/CPTI11/ (December 2011) events from 1000 to 2006
ITALY	Scientific and technical aspects	Information regarding geographical restricted areas for geothermal: MiSE-UNMIG Hydrocarbon and Geothermal exploitation licences on http://unmig.sviluppoeconomico.gov.it/ - pdf format. INGV Database of Individual Seismogenetic Sources on http://diss.rm.ingv.it/diss/- shp format PCN (Cartographic National Portal) available layers on areas covered by environmental constraints on http://www.pcn.minambiente.it/GN/index.php?lan=en - WMS and WFS
ITALY	Scientific and technical aspects	Exploration and production licenses and (projected) power production: MiSE-UNMIG Geothermal exploitation licences on http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/titoli/titoli.asp - pdf format

Country	Category	Link
ITALY	Scientific and technical aspects	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: ENEA collects and provides geothermal, among other renewable energies, data and statics in http://www.enea.it/it/produzione-scientifica/rapporto-energia-e-ambiente-1/rapporto-energia-e-ambiente-2009-2010/i-dati-2009-2010/statistiche-delle-fonti-rinnovabili - xls and pdf formats Global Geothermal Energy World Database on http://vmigg.iit.cnr.it/SpagoBI (from IGA website, http://www.geothermal-energy.org-), available for visitor users – web platform, pdf, jpg, xls format
ITALY	Scientific and technical aspects	2.1 Direct use of heat: location, typology, installed capacity (MWt) and produced energy in one year (TJ/year): ENEA collects and provides geothermal, among other renewable energies, data and statics in http://www.enea.it/it/produzione-scientifica/rapporto-energia-e-ambiente-1/rapporto-energia-e-ambiente-2009-2010/i-dati-2009-2010/statistiche-delle-fonti-rinnovabili - xls and pdf formats Global Geothermal Energy World Database on http://vmigg.iit.cnr.it/SpagoBI (from IGA website, http://www.geothermal-energy.org-), available for visitor users – web platform, pdf, jpg, xls format
NETHERLANDS	Scientific and technical aspects	Temperature data in the subsurface: TNO (geological survey); www.nlog.nl Interactive maps with calculation of doublet www.thermogis.nl
NETHERLANDS	Scientific and technical aspects	Temperature maps at depth : TNO (geological survey) 1. 2000 m depth http://www.nlog.nl/resources/Geothermie/aardwarmte.pdf 2. 3D interactive maps with calculation of doublet www.thermoGIS.nl

Country	Category	Link
NETHERLANDS	Scientific and technical aspects	Geothermal reservoir temperature in high enthalpy geothermal fields: information on the best known low enthalpy reservoirs www.thermogis.nl
NETHERLANDS	Scientific and technical aspects	Any other reservoir information: www.nlog.nl e.g. also provides information on oil and gas reservoirs
NETHERLANDS	Scientific and technical aspects	Basin layout and sediment-basement interface depth: 3D model from the subsurface exists, which is very deep in the north see basin. www.nlog.nl www.thermogis.nl Reference: Hans Doornebal, TNO contact details: http://www.tno.nl/content.cfm?context=thema&content=prop_case&laag1=895&laag2=911&laag3=98&item_id=1574&Taal=2
NETHERLANDS	Scientific and technical aspects	Geothermal and oil&gas wells masterlog: www.nlog.nl They are available after 5 years after drilling of the well, according to the Mining Law
NETHERLANDS	Scientific and technical aspects	Geophysical survey: TNO (geological survey); www.nlog.nl
NETHERLANDS	Scientific and technical aspects	Fault mapping, Tertiary and Quaternary fault systems: TNO, www.nlog.nl There is a 3D model of the Dutch subsurface
NETHERLANDS	Scientific and technical aspects	Recorded seismicity: KNMI (Royal Netherlands Meteorological Institute) (Ministry of Infrastructure and the Environment) http://www.knmi.nl/seismologie/aardbevingen-nederland.html http://www.knmi.nl/research/seismology/ (english)

Country	Category	Link
NETHERLANDS	Scientific and technical aspects	Information regarding geographical restricted areas for geothermal: Permitting data www.nlog.nl Health and safety http://www.sodm.nl/english Relevant is the ongoing work on the "Structuurvisie ondergrond" by the Ministry of Infrastructure and the Environment, on the "spacial planning'' of the subsurface (expected 2013): http://www.rijksoverheid.nl/onderwerpen/bodem-en-ondergrond/structuurvisie-ondergrond
NETHERLANDS	Scientific and technical aspects	Exploration and production licenses and (projected) power production: Information can be found at www.nlog.nl
NETHERLANDS	Scientific and technical aspects	Raster maps of transmissivity: 100% www.thermogis.nl until a depth of 4500 m for the best known aquifers
NETHERLANDS	Scientific and technical aspects	Porosity – Permeability measurements or poro-perm relationships and poro/depth relationship: In some cases, these measurements/relations are existing. In these cases, they can be found via www.nlog.nl.
NETHERLANDS	Scientific and technical aspects	Exploration data on particular data prospective resources: Permit data monitoring and reporting by TNO, through www.nlog.nl Actual availability of exploration data by TNO, through www.nlog.nl after 5 years
NETHERLANDS	Scientific and technical aspects	Direct use of heat: location, typology, installed capacity (MWt) and produced energy in one year (TJ/year): Aggregated numbers on produced energy are available via Statistics Netherlands (www.cbs.nl). To date, the geothermal association www.geothermie.nl in the Netherlands describes all projects in operation and a number of planned projects, providing some rough indication of flow and temperature
SLOVAKIA	Scientific and technical aspects	Temperature data in the subsurface: SGUDS: http://mapserver.geology.sk/atlasge/mapviewer.jsf?width=1608&height=871

Country	Category	Link
SLOVAKIA	Scientific and technical aspects	Temperature maps at depth: SGUDS: http://mapserver.geology.sk/atlasge/mapviewer.jsf?width=1608&height=871
SLOVAKIA	Scientific and technical aspects	Surface heat flow measurements and map: SGUDS: http://mapserver.geology.sk/atlasge/mapviewer.jsf?width=1608&height=871
SLOVAKIA	Scientific and technical aspects	Any other reservoir information: Transenergy project: http://www.arcgis.com/home/webmap/viewer.html?webmap=f82fe0f737174219a354f4209ea7448a&extent=12.1518,45.3238,20.2487,49.1158
SLOVAKIA	Scientific and technical aspects	Basin layout and sediment-basement interface depth: SGUDS: http://mapserver.geology.sk/atlasge/mapviewer.jsf?width=1608&height=871
SLOVAKIA	Scientific and technical aspects	Geophysical survey: SGUDS: http://mapserver.geology.sk/atlasge/mapviewer.jsf?width=1608&height=871
SLOVAKIA	Scientific and technical aspects	Recorded seismicity: SGUDS: http://www.geology.sk/new/en
SLOVAKIA	Scientific and technical aspects	Direct use of heat: location, typology, installed capacity (MWt) and produced energy in one year (TJ/year): Slovgeoterm, a.s. http://www.slovgeoterm.sk/index.cfm?s=projects
SWITZERLAND	Scientific and technical aspects	www.geologieviewer.ch / map.geo.admin.ch www.geomol.eu

Table 13 List of documents or web pages inherent sub-sections – Social Aspects

Country	Category	link
GERMANY	Social Aspects	http://www.bmu.de/bmu/parlamentarische-vorgaenge/detailansicht/artikel/laufende-forschungsvorhaben-des-bmu-im-bereich-erneuerbare-energien/
GERMANY	Social Aspects	http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/ee_forschung_vorhaben_bf.pdf
HUNGARY	Social Aspects	Hungarian Geothermal Association www.mgte.hu
HUNGARY	Social Aspects	Hungarian Thermal Energy Association www.termalenergia.hu
HUNGARY	Social Aspects	Ministry of Rural Development www.vm.gov.hu
HUNGARY	Social Aspects	National Institute for Environment www.neki.hu
HUNGARY	Social Aspects	River Basin Management Plans: www.vizeink.hu
ICELAND	Social Aspects	All laws in Icelandic accessible on www.althingi.is. Regulations on www.reglugerdir.is. On websites of ministries translations can sometimes be found.
ITALY	Social Aspects	http://www.unionegeotermica.it/amici-della-terra-risorsa-geotermica.asp
ITALY	Social Aspects	www.normattiva.it
ITALY	Social Aspects	http://www.va.minambiente.it/condivisione/normativa/normativanazionale.aspx
ITALY	Social Aspects	http://rinnova.gse.it/pages/normativa.aspx.
ITALY	Social Aspects	*http://www.arpat.toscana.it/temi-ambientali/aria/aree-geotermiche/geotermia/progetto-geotermia#pressioni*
ITALY	Social Aspects	http://www.ars.toscana.it/files/aree_intervento/ambiente/geotermia/studio_geotermia/1_sez_a_ambiente_%20pp_1-38.pdf
ITALY	Social Aspects	http://www.enel.com/it-IT/doc/report2011/Rapporto_ambientale2011.pdf

Country	Category	link
NETHERLANDS	Social Aspects	Some reports can be found through http://www.energiek2020.nu/aardwarmte/
NETHERLANDS	Social Aspects	In the future, additional reports may become available through www.agentschapnl.nl/aardwarmte
NETHERLANDS	Social Aspects	www.overheid.nl makes available Dutch legislation. This includes laws and granted permits.
NETHERLANDS	Social Aspects	http://www.infomil.nl/onderwerpen/integrale/omgevingsvergunning provides guidance concerning the environmental impact permits, including access to laws and forms.
NETHERLANDS	Social Aspects	Monitoring statistics for european renewable energy directive www.cbsstatline.nl
SLOVAKIA	Social Aspects	Ministry of Environment: http://www.minzp.sk/en/
SWITZERLAND	Social Aspects	map.bafu.admin.ch
TURKEY	Social Aspects	Republic of Turkey Ministry of Environment and Urbans (http://www.csb.gov.tr)

Table 14 List of documents or web pages inherent sub-sections – Geothermal code

Country	Category	Link
ICELAND	Geothermal code	See Report Ketilsson et al. (2011) accessible in Icelandic here; http://www.os.is/gogn/Skyrslur/OS-2010/OS-2010-05.pdf
NETHERLANDS	Geothermal code	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)

Table 15 List of documents or web pages inherent sub-sections 2.4 – Skills & employees, energy needs

Country	Category	Link
GERMANY	Skills & employees, energy needs	http://www.erneuerbare-energien.de/en/topics/data-service/renewable-energy-in-figures
ICELAND	Skills & employees, energy needs	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	Skills & employees, energy needs	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).
ITALY	Skills & employees, energy needs	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	Skills & employees, energy needs	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
NETHERLANDS	Skills & employees, energy needs	List of skills required in the field of geothermal http://www.nlog.nl/resources/procedures/Opzet_eisen_operators_web_1.pdf
NETHERLANDS	Skills & employees, energy needs	Surveys on energy needs and coverage by geothermal uses? (e.g. maps, …) http://www.warmteatlas.nl
NETHERLANDS	Skills & employees, energy needs	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

Table 16 List of documents or web pages inherent sub-sections – Research R&D

Country	Category	Link
GERMANY	Research R&D	http://www.bmu.de/bmu/parlamentarische-vorgaenge/detailansicht/artikel/laufende-forschungsvorhaben-des-bmu-im-bereich-erneuerbare-energien/
GERMANY	Research R&D	http://www.bmu.de/fileadmin/bmu-import/files/pdfs/allgemein/application/pdf/ee_forschung_vorhaben_bf.pdf
ICELAND	Research R&D	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
ITALY	Research R&D	http://www.assoknowledge.org/AlleanzeTecnologicheItaliane.pdf
ITALY	Research R&D	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
NETHERLANDS	Research R&D	Publicly funded RD&D projects www.agentschapnl.nl/energie-innovatie
NETHERLANDS	Research R&D	Specific focus on geothermal projects www.agentschapnl.nl/aardwarmte
NETHERLANDS	Research R&D	Action plan geothermal energy (national roadmap): http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2011/04/21/actieplan-aardwarmte.html
SLOVAKIA	Research R&D	http://www.geothermalanywhere.com/en/asfeu-project-qapplied-research-and-development-of-innovative-drilling-technology-for-ultra-deep-geothermal-wellsq.html
TURKEY	Research R&D	http://www.tubitak.gov.tr

Table 17 List of documents or web pages inherent sub-sections – Training and Education

Country	Category	Link
ICELAND	Training and Education	See www.unugtp.is (postgrad diploma), www.reyst.is (MS programme), www.hi.is (BS,MS,PhD), http://www.keilir.net/ (BS),
NETHERLANDS	Training and Education	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/

Table 18 List of documents or web pages inherent sub-sections Regulatory aspects

Country	Category	Link
HUNGARY	Regulatory aspects	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	Regulatory aspects	A list of issued licenses can be accessed here: http://www.os.is/orkustofnun/leyfisveitingar/utgefin-leyfi/
ITALY	Regulatory aspects	http://unmig.sviluppoeconomico.gov.it/unmig/norme/norme.asp
NETHERLANDS	Regulatory aspects	The procedure is explained in English here http://www.nlog.nl/en/procs/procedures_licences.html
NETHERLANDS	Regulatory aspects	Assuming it is comparable to wind – see http://www.windbarriers.eu/fileadmin/WB_docs/documents/WindBarriers_report.pdf
TURKEY	Regulatory aspects	http://www.epdk.gov.tr/

Table 19 List of documents or web pages inherent sub-sections Economics

Country	Category	link
GERMANY	Economics	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	Economics	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
ICELAND	Economics	http://www.os.is/orkustofnun/rad-og-nefndir/orkusjodur/
ITALY	Economics	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
ITALY	Economics	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	Economics	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	Economics	Insurance covering the geothermal project risks (e.g. deep drilling wells) http://www.agentschapnl.nl/programmas-regelingen/regeling-sei-risicos-dekken-voor-aardwarmte
NETHERLANDS	Economics	Royalties & taxes, support scheme (feed-in tariffs, grants, …) http://www.agentschapnl.nl/programmas-regelingen/geothermie-sde-2013

Country	Category	link
SLOVAKIA	Economics	http://www.urso.gov.sk/doc/legislativa/z_309-2009_sk.pdf (in Slovak)

APPENDIX I - part B

References from WP2 questionnaire

The WP2 questionnaire on country information was intended to get an overview of the status of geothermal energy in the GEO ERA-NET consortium country partner, the relevant RD&D and other policy programmes and support scheme.

The questionnaire was divided in four parts on: i) general country info, ii) national energy programmes aimed at geothermal energy, iii) public support and funding schemas and iv) the appendices.

In the table 1 all the references are collected per country and questionnaire part.

Table 20 List of documents or web pages inherent WP2 Questionnaire

Country	Questionnaire part	link
FRANCE	1. General country info	France country report for the 2011 GIA annual report, IEA, 2013 (to be published): Boissier F., Desplan A., Laplaige P. (2010) – France Country Update. World Geothermal Congress 2010 in Bali Strategic geothermal roadmap, ADEME, 2011 National renewable energies action plan, Period 2009-2020, France. MEEDM, 2010
FRANCE	2. Description of national energy programmes aimed at geothermal energy	Appel à Manifestation d'Interet (AMI) "Géothermie": http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=24707 http://investissement-avenir.gouvernement.fr/ http://www2.ademe.fr/servlet/getDoc?id=79542&cid=96&m=3&p1=1
FRANCE	2. Description of national energy programmes aimed at geothermal energy	Renewable Heat Fund – Geothermal applications: http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=25162

FRANCE	3. Public support and funding scheme	"Investments for the future" program: http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=24707 http://investissement-avenir.gouvernement.fr/ http://www2.ademe.fr/servlet/getDoc?id=79542&cid=96&m=3&p1=1
FRANCE	3. Public support and funding scheme	Renewable heat fund: http://www2.ademe.fr/servlet/KBaseShow?sort=-1&cid=96&m=3&catid=25162
FRANCE	3. Public support and funding scheme	Tax reduction for heating networks: http://www11.minefi.gouv.fr/boi/boi2007/3capub/textes/3c107/3c107.pdf http://www.cete-ouest.developpement-durable.gouv.fr/IMG/pdf/2013-02-18_ENQUETE_NATIONALE_2011_SNCU_cle5587a6.pdf
FRANCE	3. Public support and funding scheme	Risk mitigation scheme for deep geothermal: http://www2.ademe.fr/servlet/getDoc?sort=-1&cid=96&m=3&id=84916&ref=&nocache=yes&p1=111 Internal documents (ADEME)
FRANCE	3. Public support and funding scheme	Feed in tariff: http://www.ademe.fr/midi-pyrenees/a_2_15.html http://www.actu-environnement.com/ae/news/tarif-achat-electricite-geothermie-10759.php4 Internal documents (ADEME)
GERMANY	1. General country info	Geotis.de Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat) Federal Republic of Germany: National Renewable Energy Action Plan in accordance with Directive 2009/28/EC on the promotion of the use of energy from renewable sources Bundesministerium für Wirtschaft und Technologie: Stromerzeugungskapazitäten und Bruttostromerzeugung nach Energieträgern (2011)

GERMANY	1. General country info	Legal basis for the use of renewable energies for electricity generation in Germany is the Renewable Energy Sources Act (EEG). It first came into force on 1 April 2000 and has been evaluated at regular intervals in the form of progress reports, after which appropriate adjustments have been made. The last amended Renewable Energy Sources Act was adopted on 8. July 2011 and the new provisions were taken into force since January 2012. http://www.bmu.de/en/service/publications/downloads/details/artikel/renewable-energy-sources-act-eeg-2012/
GERMANY	1. General country info	Statistics: In collaboration with the Federal Ministry of Economics and the Federal Agricultural Ministry, the German Environment Ministry has set up the Working Group on Renewable Energy - Statistics (AGEE-Stat) to ensure that all statistics and data relating to renewable energy sources are part of a comprehensive, up-to-date and coordinated system. Statistics about geothermal energy is part of their work. The newest data sets of the last year are being available regularly in March or April. http://www.erneuerbare-energien.de/en/topics/data-service/agee-stat/ http://www.erneuerbare-energien.de/en/topics/data-service/renewable-energy-in-figures/
GERMANY	2. Description of national energy programmes aimed at geothermal energy	Description of national energy programmes aimed at geothermal energy: http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/broschuere_innovation_forschung_2011_en_bf.pdf
GERMANY	3. Public support and funding schemes	http://www.ptj.de/antragstellung http://www.ptj.de/geothermie http://www.verwaltungsvorschriften-im-internet.de/bsvwvbund_13122011_KIIII54603022.htm#Seitenanfang http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2006:323:0001:0026:de:PDF http://foerderportal.bund.de/easy/easy_index.php?auswahl=easy
GERMANY	4. Appendices	Text of research programmes for geothermal energy: http://www.bmwi.de/BMWi/Redaktion/PDF/Publikationen/6-energieforschungsprogramm-der-bundesregierung-en,property=pdf,bereich=bmwi2012,sprache=de,rwb=true.pdf

HUNGARY	1. General country info	Boldizsár, T. 1958: New terrestrial heat flow values from Hungary. Geophisica Pura Applicata, Milano, Italy, vol. 39, 120-5. Tóth, A. 2010: Hungary Country Update 2005-2009. Proceedings, World Geothermal Congress 2010. Bali, Indonesia., 25-29 April 2010. Abstracts Kujbus, A., 2005: Complex approach of establishing a geothermal power plant in Hungary. V: R. Horne & E. Okandan (ed.), Proceedings, World Geothermal Congress 2005, Antalya, Turkey, 4p. National Energy Strategy of Hungary 2011-2030 (Ministry of National Development) Ministry of National Development 2010: Magyarország megújuló energia hasznosítási cselekvési terve a 2020-ig terjedő megújuló energiahordozó felhasználás alakulásáról http://www.kormany.hu/download/2/88/20000/NCsT_20110106) Gondárné Sőregi K., Simonffy Z. (2009). Felszín alatti vizek mennyiségi állapotának meghatározása. Zárótanulmány a „Vízgyűjtő-gazdálkodási tervek készítése” c. KEOP-2.5.0. projekt keretében. Kézirat, 47 pp. Barcza, M., Bálint, A., Kiss, S., Szanyi, J., Kovács, B. (2011). A Szentes térségi hévíztározó épződmények hidrodinamikai viszonyai szivattyú tesztek kiértékelése alapján. A Miskolci Egyetem Közleménye, A sorozat, Bányászat, vol. 81, p. 245-254 Bálint, A., Barcza, M., Szanyi, J., Kovács, B., Kóbor, B., Medgyes, T. (2010). Investigation of thermal water injection into porous aquifers. 1st Knowbridge Conference on Renewables. September 27-28, 2010. Miskolc, Hungary. Abstracts Szanyi, J., Kovács, B. (2010). Utilization of geothermal systems in South-East Hungary. Geothermics, vol. 39, p. 357-364 Dövényi, P., Horváth, F. (1988). A review of temperature, thermal conductivity and heat flow data form the Pannonian Basin. In: Royden, L.H., Horváth, F. (eds): The Pannonian Basin a Study in Basin Evolution. American Association of Petroleum Geologist memoirs, vol.45, p. 195-233. Tulsa, Oklahoma Horváth and Royden 1981

HUNGARY	1. General country info	Magyar, I., Geary, D.H., Müller, P. (1999). Paleogeographic evolution of the Late Miocene Lake Pannon in Central Europe. Palaeogeography, Palaeoclimatology, Palaeoecology, vol. 147, p. 151-167. Bérczi, I., Phillips, R.L. (1985). Processes and depositional environments within deltaic-lacustrine sediments, Pannonian Basin, Southeast Hungary. Geophysical Transactions, vol. 31, p. 55-74. Dövényi, P., Homola, V., Horváth, F., Kohl, T., Rybach. L. 2005: European HDR/EGS resources: Future potential development in Hungary. Final report, Manuscript Order no. G109/05-22.13, pp. 41 Rezessy, G., Szanyi, J., Hámor, T. (2005). Progress report on the the geothermal potential assessment of Hungary. Manuscript. Hungarian Geological Survey. 82 pp.
ICELAND	1. General country info	www.os.is
ICELAND	2. Description of national energy programmes aimed at geothermal energy	www.georg.hi.is http://www.landsvirkjun.com/ResearchDevelopment/EnergyResearchFund/ www.unugtp.is
ICELAND	3 Public support and funding schemes	http://www.althingi.is/dba-bin/prentaloguti.pl?lnr=2003087&utg=nuna&pdf=PDF http://www.os.is/orkustofnun/rad-og-nefndir/orkusjodur/
ITALY	1. General country info	UGI, 2011: Previsioni di crescita della geotermia in Italia fino al 2030 http://www.unionegeotermica.it/pdfiles/stime-sommario.pdf Ministry of Economic Development, 2010: Piano di Azione Nazionale per le energie rinnovabili (direttiva 2009/28/CE) VIGOR project, 2013: Quadro normativo e iter autorizzativo per la ricerca e la coltivazione di risorse geotermiche http://www.vigor-geotermia.it/images/download/iter_31gennaio2013.pdf UNMIG (National Mining Office for Hydrocarbons and Georesources of the Ministry of Economic Development) http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/titoli/titoli.asp

ITALY	1. General country info	Becheri et al. 2012: Rapporto sul sistema termale in Italia 2012, Franco Angeli Edizioni. National Geothermal Database and webGIS service http://geothopica.igg.cnr.it ENEA technical reports and data may be found in the website http://www.enea.it and the document http://www.enea.it/it/produzione-scientifica/rapporto-energia-e-ambiente-1/rapporto-energia-e-ambiente-2009-2010 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 Cash flow methodology is largely based on dutch economic models and spreadsheets developed by Energie Centrum Netherland (ECN,www.ecn.nl)
ITALY	2. Description of national energy programmes aimed at geothermal energy	http://www.mezzogiorno.cnr.it/ POI programme http://www.poienergia.it
ITALY	3. Public support and funding schemes	http://www.sviluppoeconomico.gov.it http://www.gse.it/en/Pages/default.aspx Ministry of EconomicDevelopment “Ministero dello Sviluppo Economico” Decreto Ministeriale 6 Luglio 2012 http://www.sviluppoeconomico.gov.it http://unmig.sviluppoeconomico.gov.it/unmig/geotermia/info/geotermia.asp http://unmig.sviluppoeconomico.gov.it/unmig/info/impianti_pilota.asp http://www.gse.it/en/Pages/default.aspx
ITALY	4. Projects	http://www.mezzogiorno.cnr.it/index.php?option=com_content&view=article&id=17&Itemid=65 VIGOR project http://www.vigor-geotermia.it https://sites.google.com/site/cfddpproject/ http://unicabox.vodu.it/download/pdf_comitato/Geotermia_Grado.pdf Notiziario dell’Unione Geotermica Italiana, Anno VII, Agosto 2008, n.21http://www.unionegeotermica.it/notiziari/UgiNotiziario21.pdf http://www.geologiabruzzo.it/files/download/materiale_didattico/corso_geotermia_2012/della_vedova_cng_geotermia_27_11_12.pdf

ITALY	4. Projects	Della Vedova et al., 2008 "IL POZZO ESPLORATIVO GRADO-1 PER LA VALUTAZIONE DELLA RISORSA GEOTERMICA NEI CARBONATI SEPOLTI DEL LITORALE NORD-ADRIATICO" http://www2.ogs.trieste.it/gngts/gngts/convegniprecedenti/2008/riassunti/3.2/32-dell.pdf Congresso Internazionale "La Geotermia in Italia e in Europa. Quale futuro?Teleriscaldamento di Grado: a che punto siamo? " http://www.unionegeotermica.it/pdfiles/geotherm-expo-09/Presentazioni/Sessione3-DellaVedova.pdf
NETHERLANDS	1. General country info	Rapport nationaal actieplan voor energie uit hernieuwbare bronnen (NREAP), 23-06-2010, http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2010/06/23/rapport-nationaal-actieplan-voor-energie-uit-hernieuwbare-bronnen.html Actieplan aardwarmte (Action plan geothermal energy), 21 April 2011, http://www.rijksoverheid.nl/documenten-en-publicaties/rapporten/2011/04/21/actieplan-aardwarmte.html "Visie diepe geothermie" (Outlook deep geothermal energy), IF Technology/Ecofys/TNO, March 2011, http://geothermie.nl/fileadmin/user_upload/documents/reports/IF_Ecofys_TNO_-_Visie_diepe_geothermie.pdf "Nederlands Olie en Gasportaal" (Dutch oil and gas portal) NLOG: www.nlog.nl – specific for geothermal energy and in English http://www.nlog.nl/en/geothermalEnergy/geothermalEnergy.htm www.cbs.nl, see statline (also available in English) Basisbedragen in de SDE+ 2013 eindadvies (Base cost in SDE 2013, final advice), ECN, September 2012, http://www.ecn.nl/docs/library/report/2012/e12038.pdf Aanvullend advies geothermie in SDE+ in 2013 (Additional advice geothermal energy in SDE+ in 2013), ECN, 11-12-2012, http://www.ecn.nl/docs/library/report/2012/n12025.pdf
NETHERLANDS	2. Description of national energy programmes aimed at geothermal energy	http://www.agentschapnl.nl/en/onderwerpen/onderwerpenlijst/Energie provides a description in English of some highlights of the subprogramme's activities http://www.kasalsenergiebron.nl/ http://www.tuinbouw.nl/thema/energie-co2 http://www.energiek2020.nu/

NETHERLANDS	2. Description of national energy programmes aimed at geothermal energy	Additional comments: NWO (Netherlands organisation for scientific research) www.nwo.nl operates general mobility and training programmes, which may serve mobility of scientists working on geothermal energy as well. http://www.studned.nl/1490/wetenschap/nwo-stuurt-jong-wetenschappelijk-talent-de-wijde-wereld-in NWO also has a programme for international collaboration in earth and life sciences, and a "white" programme: http://www.nwo.nl/financiering/onze-financieringsinstrumenten/nwo/vrije-competitie/alw/open-programma.html internationalising earth and life sciences: http://www.nwo.nl/financiering/onze-financieringsinstrumenten/alw/internationalisering-aard--en-levenswetenschappen/internationalisering-aard--en-levenswetenschappen.html "meer met minder" http://www.nwo.nl/financiering/onze-financieringsinstrumenten/alw/meer-met-minder/meer-met-minder.html Foreseen public-private collaboration on "computational sciences for energy research" by FOM (institute for fundamental research of matter): http://www.fom.nl/live/nieuws/archief_persberichten/persberichten2013/artikel.pag?objectnumber=213869
NETHERLANDS	3. Public support and funding schemes	Energy Innovation Subsidies: http://www.rijksoverheid.nl/onderwerpen/ondernemersklimaat-en-innovatie/investeren-in-topsectoren/energie
NETHERLANDS	3. Public support and funding schemes	Guarantee Fund Geothermal Energy : www.agentschapnl.nl/aardwarmte
NETHERLANDS	3. Public support and funding schemes	SDE – Stimulation Renewable Energy production: www.agentschapnl.nl/sde
SLOVAKIA	1. General country info	EGEC Market Report 2012 Andrej Lapanje and Joerg Prestor: Legal aspect of transboundary aquifer management, TRANSENERGY project, 31.12.2011 Atlas of geothermal energy in Slovakia available at http://mapserver.geology.sk/atlasge/
SLOVAKIA	3.Public support and funding schemes	http://portal.gov.sk/Portal/sk/Default.aspx?CatID=42&NewsID=2115

SWITZERLAND	1. General country info	Die Energieperspektiven für die Schweiz bis 2050 Energienachfrage und Elektrizitätsangebot in der Schweiz 2000 – 2050 http://www.bfe.admin.ch/php/modules/publikationen/stream.php?extlang=de&name=de_564869151.pdf http://www.geothermie.ch/data/dokumente/miscellanusPDF/Publikationen/Geothermiestatistik%20Schweiz%202011.pdf www.geothermie.ch www.fws.ch
SWITZERLAND	2. Description of national energy programmes aimed at geothermal energy	Geothermal Energy Research Program: The program pursues activities within each of the 6 topical and 3 transverse focus areas. Each focus area comprises a set of measures with clear targets. http://www.energieschweiz.ch/pub/p5415/de-ch (in German with a summary in French)
SWITZERLAND	3. Public support and funding schemes	Pilot- and Demonstration Program: http://www.bfe.admin.ch/forschunggeothermie/index.html?lang=en
SWITZERLAND	3. Public support and funding schemes	Mathematics, Science and Engineering: http://map.geo.admin.ch/?selectedNode=node_ch.bfe.energieforschung2&Y=660000&X=190000&zoom=1&bgLayer=ch.swisstopo.pixelkarte-farbe&layers=ch.bfe.energieforschung&layers_opacity=1&layers_visibility=true&lang=de
SWITZERLAND	3. Public support and funding schemes	Feed-in tariff for geothermal power generation: http://www.admin.ch/ch/d/sr/7/730.01.de.pdf (see in particular Appendix 1.4 – part of legal basis) and http://www.swissgrid.ch/content/swissgrid/de/home/experts/topics/renewable_energies/crf.html for details regarding the functionaliy and http://www.stiftung-kev.ch/foerdermittel/kev.html for annual reporting.

SWITZERLAND	3. Public support and funding schemes	Geothermal (Risk) Guarantee: http://www.admin.ch/ch/d/sr/7/730.01.de.pdf Annex 1.6 for legal text. http://www.stiftung-kev.ch/foerdermittel/buergschaften-geothermie.html for website of the Foundation KEV and http://www.swissgrid.ch/content/swissgrid/de/home/experts/topics/renewable_energies/risk_guarantees_geothermal_facilities.html for details on the process.
TURKEY	All is referred to	Republic of Turkey Ministry of Energy and National Resources and Republic of Turkey Energy Market Regulatory The Scientific and Technological Research Council of Turkey (TÜBİTAK)

APPENDIX 2
Technical Document for EGIP implementation

D 3.2 Appendix 2

BRGM

October, 2013

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The Geothermal ERA NET is supported by the European Union's Seventh programme for research, technological development and demonstration under grant agreement No 291866

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APPENDIX II

1 Introduction

This appendix contains the description of the technical aspects of the EGIP Implementation as a distributed system and it is aimed at data providers.

Based on the experience of the **OneGeology-Europe project**, chapter 2 describes the main steps involved in the implementation of distributed services including various technical recommendations (to be updated according to the current technology at the moment of implementation), in accordance with the INSPIRE principles.

Chapter 3 details the INSPIRE Directive requirements to be applied to all national public data providers in the geothermal domain. The EGIP covers more than the INSPIRE requirements, however the goal is to understand the INSPIRE requirements and concepts (distributed system, interoperability …) before defining the EGIP data model.

Finally, in Section 3.4, the EGIP conceptual data model is described with UML and taking advantage as much as possible from INSPIRE classes in order to facilitate the data providers' work in delivering geothermal data according to Energy Resources data specifications.

2 Overview of EGIP implementation

EGIP is a distributed and open architecture and uses the standards recommended by INSPIRE and OGC as much as possible.

There are standards for three types of EGIP components:

1. The metadata to describe datasets and services: INSPIRE recommends a set of metadata elements based on the OGC/ISO metadata standards ISO19115 and ISO19119. All information is provided in the INSPIRE Metadata technical guidelines:

   http://inspire.jrc.ec.europa.eu/documents/Metadata/INSPIRE_MD_IR_and_ISO_v1_2_20100616.pdf

2. The services: to search and access metadata, a discovery service based on the OGC CS-W standard – Catalogue Service for the Web has to be implemented. The view service is based on the ISO/OGC WMS (Web Map Service), and the downloaded service can be implemented by an ISO/OGC WFS (Web Feature Service). For details, see the INSPIRE services technical guidelines:

   http://inspire.jrc.ec.europa.eu/index.cfm/pageid/5

3. The data specifications: based on common principles defined in the Generic Conceptual Model, INSPIRE has defined data specifications for several data themes. The following chapters suggest how to use them for the EGIP.

The data specifications include how to portray data on the maps to get a harmonized European map.

Three main steps are required to implement EGIP: i) dataset preparation, ii) service implementation and iii) datasets and services description with metadata.

2.1 Preparation of the datasets

In a distributed system each data provider has its own database structure. The idea is map the structure of the national databases onto the common standard data model promoted by EGIP. Clearly if the national database already uses the standard data model, mapping is very easy.

The mapping has two tasks:

1. Mapping the structure: to define how properties in the national databases should correspond to the EGIP data model elements:

For example if for the temperature map the national database has a field named "lower_values" in the table "temp_map", and for the EGIP data model there is "lowerTemperature" in the TemperatureUnit class, the mapping should have this form (the syntax depends on the tool used)

Temp_map.lower_V = TemperatureUnit.lowerTemperature

This link is stored in a file and used by the WFS to deliver the data according to the common structure (various tools are possible but the principle is the same)

2. Mapping the vocabularies: to define how the controlled values of the national dictionaries should correspond to the common vocabularies (or code-lists):

It is assumed that European code-lists have been defined and agreed. Some already exist in INSPIRE, and others may exist in other geothermal international organizations.

For example: the value "1080 survey permit" of the type of license in the national database must be mapped to the common European code-list value (possibly "surveypermit")

If the national database structure is quite different from the common data model then the data may need to be reorganized to simplify this mapping.

2.2 Implementation of the services

This process consists of several steps:

1. Setting up a WMS and WFS (using for instance ESRI ArcGis Server or the opensource software MapServer, or GeoServer)
2. Installing a connector to manage multilingualism and to provide data according to the EGIP data model (this software component is to transform an XML provided by a classical W*S into an XML according to EGIP (and INSPIRE) recommendations
3. Using the future EGIP portal to check that the service is correct
4. Registering the services and datasets in the metadata catalogue

To setup a WMS, OneGeology provides participants with some cookbooks:

http://onegeology.org/wmsCookbook/home.html

2.3 Description of datasets and services with metadata

Each EGIP dataset and service must be described by the metadata and registered in the metadata catalogue. This process is already operational nationally for the INSPIRE data themes.

3 Implementing INSPIRE Directives in the EGIP

The INSPIRE Directive requires European countries to publish data related to several themes in order to address environmental issues in Europe. Energy Resources is one of these data themes, and includes geothermal energy. Each theme is described by data specifications containing a data model.

EGIP needs to comply as much as possible with INSPIRE recommendations, the main ones being:

- An open and distributed architecture
- Data sets and services must be described by metadata registered in catalogues
- 3 Network services need to be implemented: a catalogue service to give access to metadata, a view service for the data, a download service to allow users to obtain the data according to the specified data model and a process service to handle the information.

The EGIP will manage more information and data than is required by INSPIRE, the EGIP data model will thus be richer than the INSPIRE model. To develop the EGIP data model, we will adhere to the following recommendations:

- We will provide a conceptual model using the UML language
- As far as possible we will use INSPIRE classes to describe the same classes
- When it is not possible to use INSPIRE classes, we will ensure that it is easier to provide data in accordance with the INSPIRE data specifications
- An implementation model will be later created from the conceptual model in order to define the database structure

3.1 INSPIRE metadata

The INSPIRE regulations require the datasets and services to be described with the following metadata elements:

http://inspire.jrc.ec.europa.eu/documents/Metadata/INSPIRE_MD_IR_and_ISO_v1_2_20100616.pdf

The technical guidelines, retrievable trough the above web link, provide a definition of each element, the multiplicity and the condition.

Table 21 INSPIRE metadata for datasets and services

Section	Metadata element	Multiplicity	Condition
1.1	Resource title	1	
1.2	Resource abstract	1	
1.3	Resource type	1	
1.4	Resource locator	0..*	Mandatory if an URL is available to obtain more information on the resource, and/or access related services.
1.5	Unique resource identifier	1..*	
1.7	Resource language	0..*	Mandatory if the resource includes textual information.
2.1	Topic category	1..*	
3	Keyword	1..*	
4.1	Geographical bounding box	1..*	
5	Temporal reference	1..*	
6.1	Lineage	1	
6.2	Spatial resolution	0..*	Mandatory for data sets and data set series if an equivalent scale or a resolution distance is specified.
7	Conformity	1..*	
8.1	Conditions for access and use	1..*	
8.2	Limitations on public access	1..*	
9	Organisation responsible	1..*	
10.1	Metadata point of contact	1..*	
10.2	Metadata date	1	
10.3	Metadata language	1	

N.B. Section 1.6. ‘Coupled resource’ and 2.2. ‘Spatial data service type’, in this table missing, they are two more elements to describe services

These metadata are recorded in a catalogue, and a catalogue service provides portals or applications with functions to find and display the metadata, and thus the dataset.

3.2 INSPIRE data models

This section describes what the countries should provide for INSPIRE regulations related to Energy Resources. The EGIP data model should take into account these data structures including other attributes if necessary, but the EGIP must at least find the easiest way to provide geothermal data in accordance with INSPIRE specifications.

As INSPIRE covers a large number of data themes, some objects relevant for EGIP are described in specifications other than Energy Resources (such as licenses, used by several themes, and described in the area management theme). Some common classes (such as coverage or document citations) used by several themes are described in a common document to all data themes: the Generic Conceptual Model.

Section 3.3 presents the INSPIRE classes that are relevant for EGIP.

The INSPIRE classes can be used to describe "Scientific and technical aspects" data of EGIP. Most of the other groups of data (Social acceptance, code, skills employees and energy need, R&D, training and education, regulatory aspects and support schemes) are not within the scope of INSPIRE. However EGIP could use:

- The INSPIRE method of describing documents (see below),
- When there is a spatial aspect, it should be possible to use the GML object to describe the geometry (type of geometry – point, line, …; coordinate system; coordinates and the bounding box)

3.3 Energy Resources

Geothermal energy is a part of the Energy Resources data theme. Some classes are described in the Technical Guidelines:

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_ER_v3.0rc3.pdf

For Geothermal energy, the Energy Resources data specification provides 3 packages:

- Energy resources (vector)
- Energy resources coverage (grid)

- Energy Statistics (as an extension to the requested data model)

Renewable and Waste Resources (**vector**), with the type of resource = geothermal.

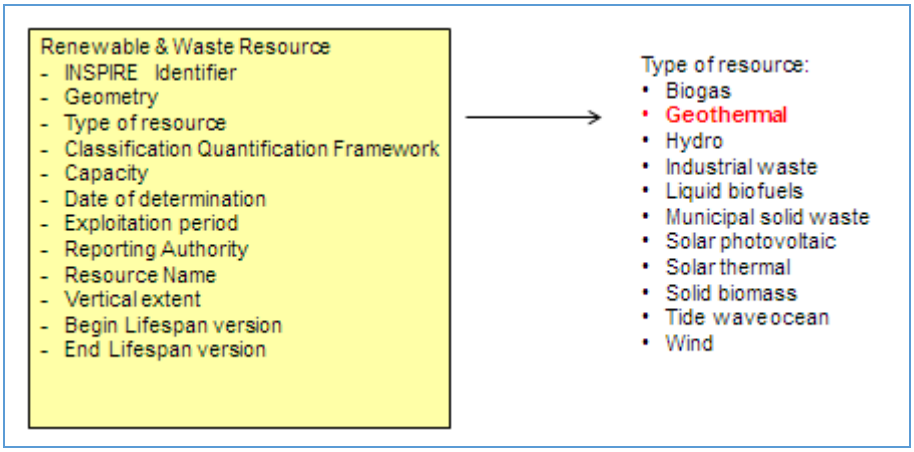


Figure 5 renewable and Waste Resources vector

Geothermal energy is defined by INSPIRE as: "Energy available as heat emitted from within the Earth's crust, usually in the form of hot water or steam. This energy production is the difference between the enthalpy of the fluid produced in the production borehole and that of the fluid eventually disposed of. It is exploited at suitable sites for electricity generation or directly as heat".

The data specification diagram for vector:

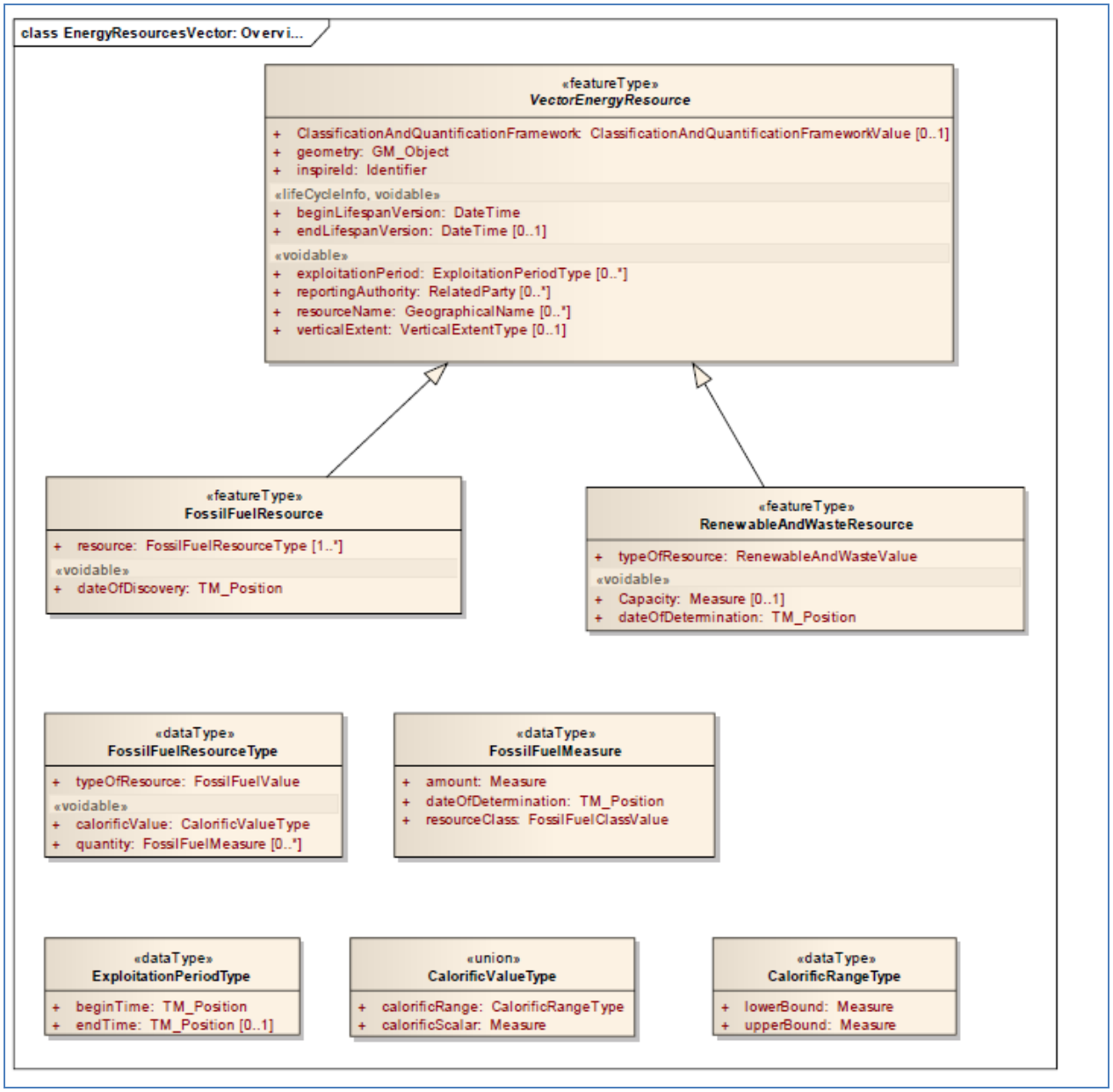


Figure 6 UML class diagram: Overview of the components of the Energy Resources Vector application schema

Renewable and Waste Potential Coverage (**grid**), with a 'potential type' is geothermal potential with two possible properties: geothermal gradient and temperature

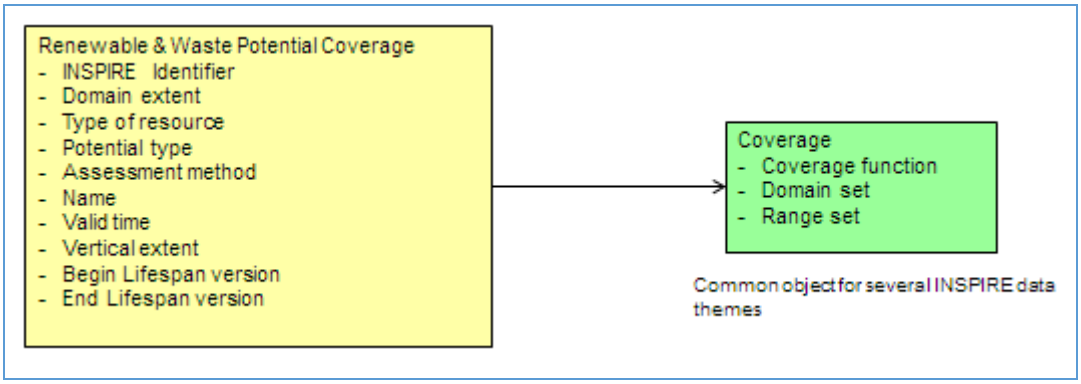


Figure 7 Renewable and Waste Potential Coverage (grid)

The data specification diagram:

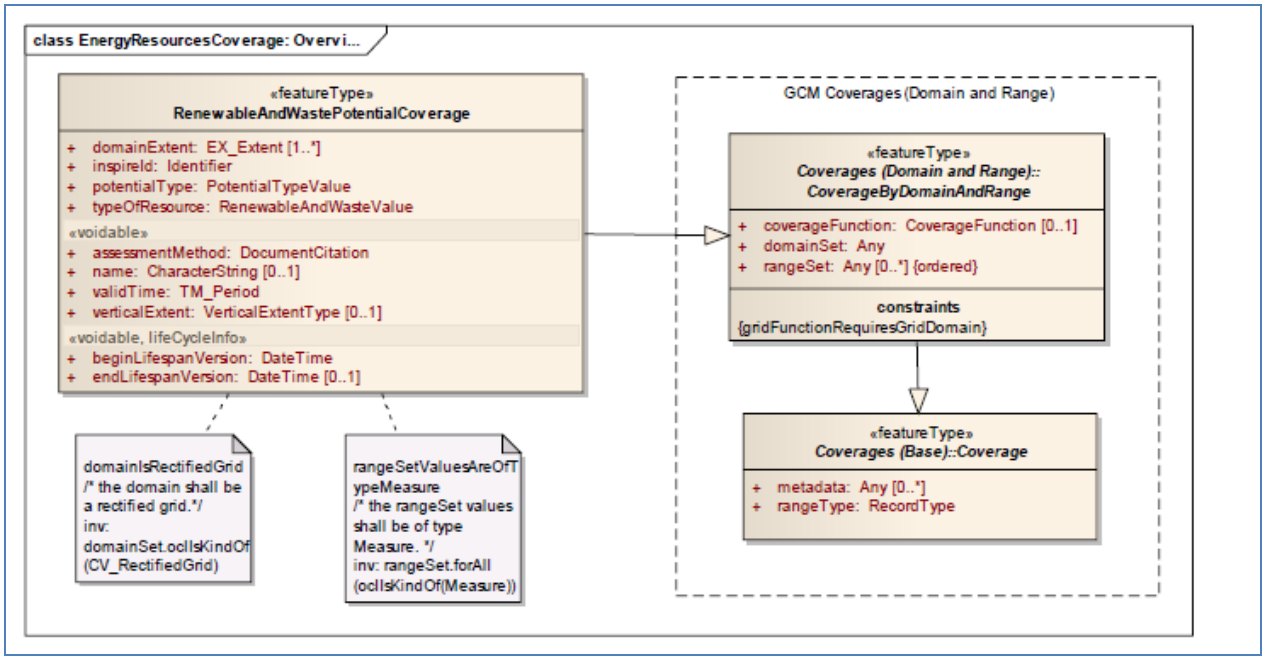


Figure 8 UML class diagram: Overview of the key components of the Energy Resources Coverage application schema

D2.10.2 INSPIRE Data Specifications – Base models – Coverage types (version 1.0rc3)

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/D2.10.2_CoverageTypes_v1.0rc3.pdf

Energy statistics (optional):

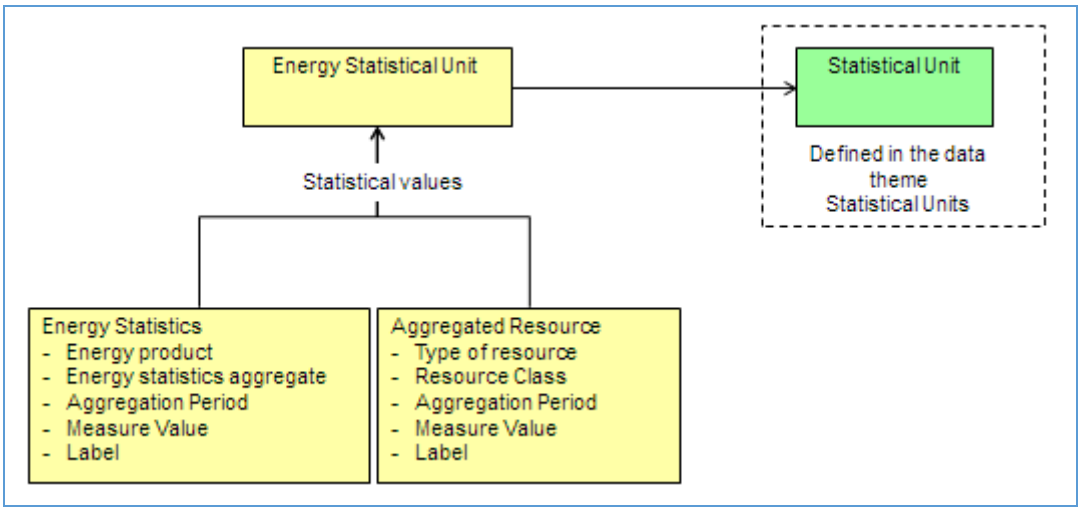


Figure 9 Energy statistics (optional):

The data specification diagram:

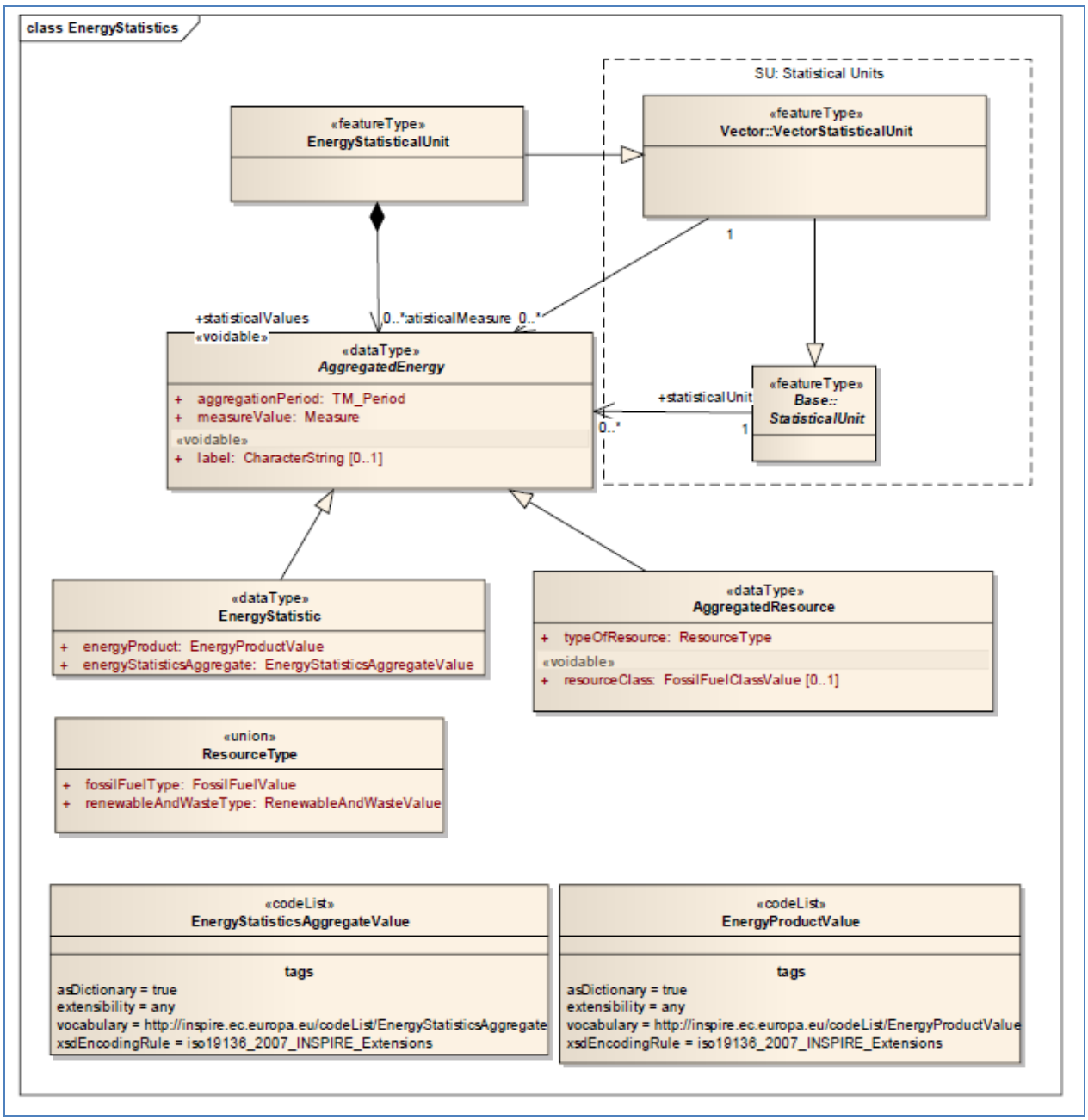


Figure 10 UML class diagram: Overview of the Energy Statistics application schema

3.3.1 Licenses

Licenses/Permits, in which activities are controlled, are used by several INSPIRE themes and are described in the Area management / restriction / regulation zones and reporting units data specification technical guidelines as “ManagementRestrictionOrRegulationZone” (see INSPIRE Specification page 26)

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_AM_v3.0rc3.pdf

Note: This specification uses the common classes to describe Legislation and Documents (see section 3.3.2)

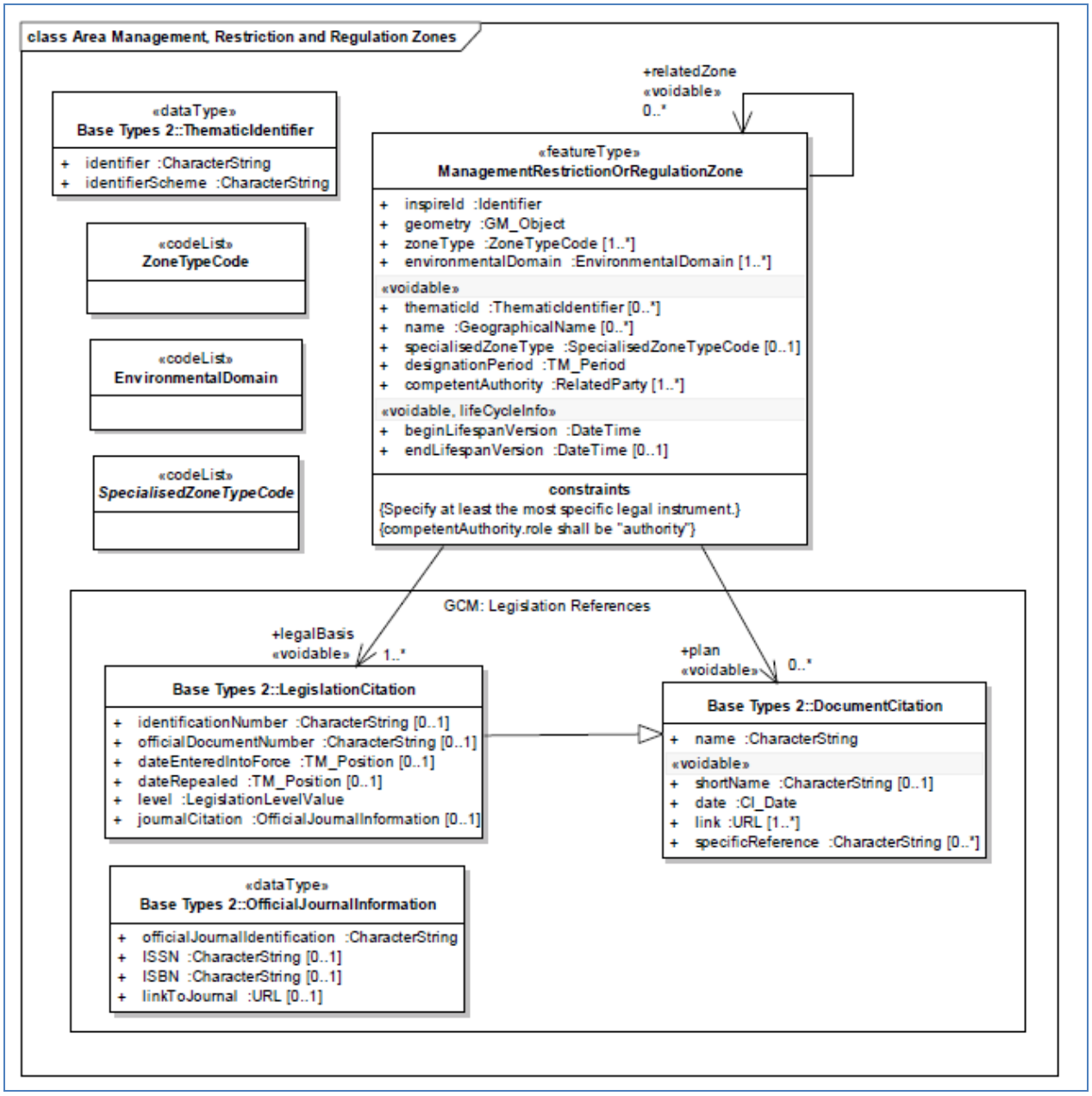
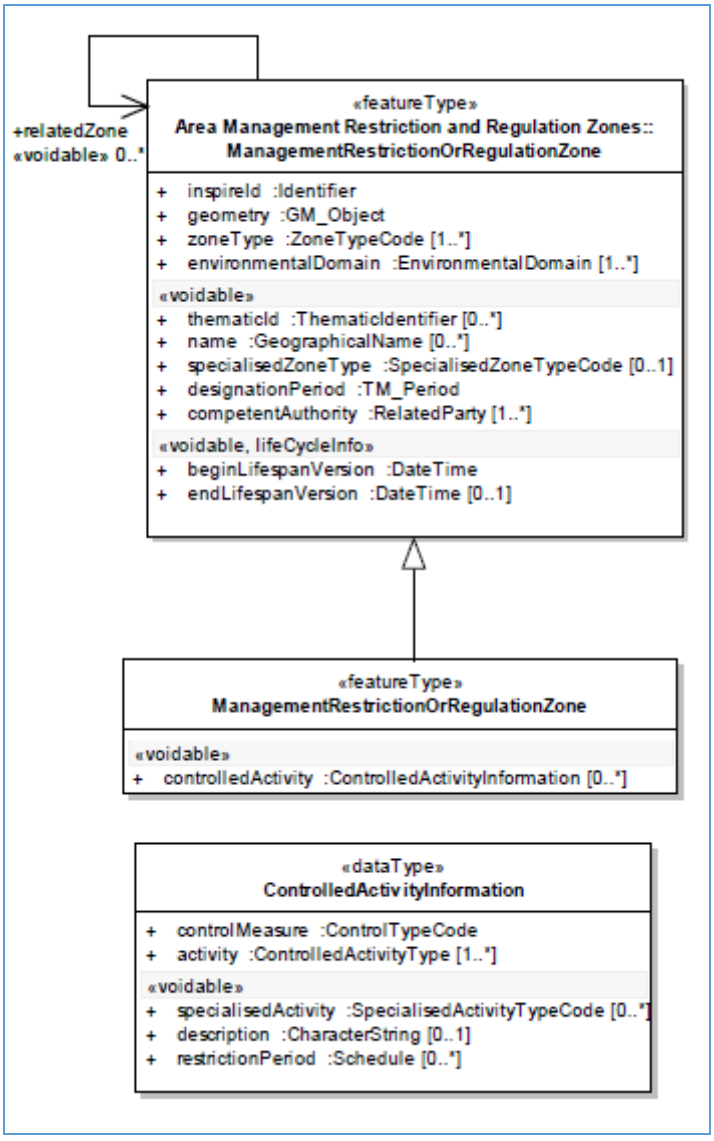


Figure 11 UML class diagram: Overview of the Area Management Restriction and Regulation Zones application schema

If a Management Restriction Or Regulation Zone contains specific activities that are controlled (i.e. permitted, prohibited, promoted or restricted) within the zone, then the **controlled activities** application schema is recommended. These activities may be controlled for a specified time period (see INSPIRE Specifications page 38):



The description of the activities in the regulation zone is defined by the properties “activity” and “specialized activity”, the values of these properties comes from code lists “ControlledActivityType” and “SpecializedActivityTypeCode”

3.3.2 Document and legislation citation

As several data themes need to share some identical objects, their definitions are described in a common document and will be applied to all INSPIRE Data Specifications: the Generic Conceptual Model. One of the common classes is the way to describe document and legislation citations.

(From the Generic Conceptual Model D2.5 v3.4rc3 - page 67):

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/D2.5_v3.4rc3_vs_3.4rc2.pdf

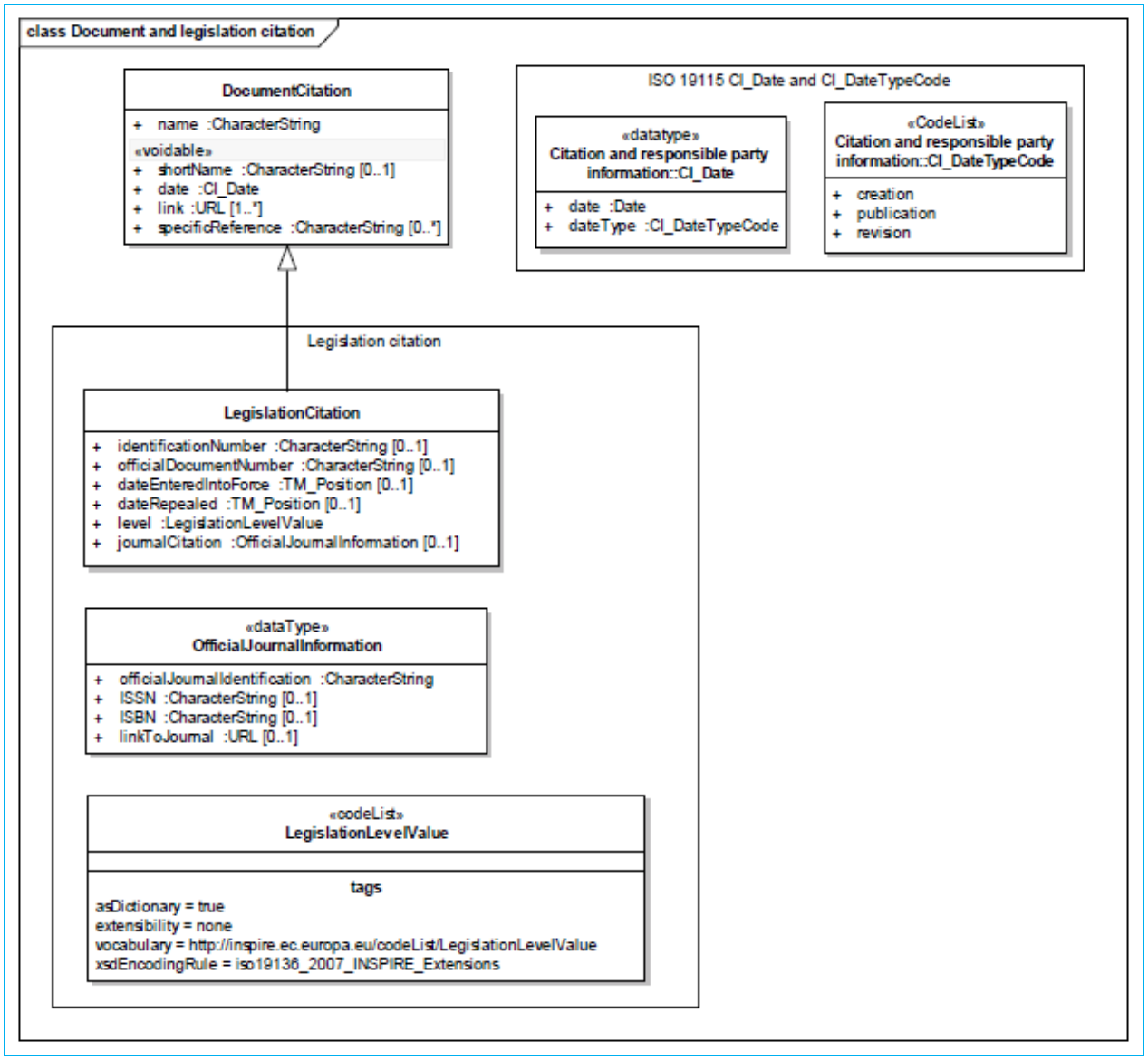


Figure 12 Document and Legislation citation

The possible values for the 'level' attribute of the LegislationCitation class are defined in a Code-List (LegislationLevelValue) as: international, European, national, sub-national

3.3.3 Production and industrial facilities

This data specification describes industrial facilities:

INSPIRE definition: "A Facility represents something designed, built, installed to serve a specific function, including all the equipment or apparatus for a particular process or operation. A facility groups together one or more installations that are operated on the same site by the same natural or legal person and, where present, the land, buildings, and equipment used in carrying on an industrial, business, or other undertaking or service"

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PF_v3.0rc3.pdf

If geothermal installations need to be described, EGIP should adhere to this specification.

3.4 Suggested EGIP conceptual data model

This section uses the data described for stage 1 in the D3.2 Feasibility Study (see table 2).

3.4.1 Temperature map and heat flow map

A map is a way to view data considered as a collection of polygons, polylines, and points associated with various properties stored in a database. This collection is a dataset described by **metadata**. To view these data, a web service (view service for INSPIRE) is set up using portrayal rules (rules to display the data on a map: symbols, colors …). This view service is also described by its metadata.

The data model suggested describes the data used to create the map.

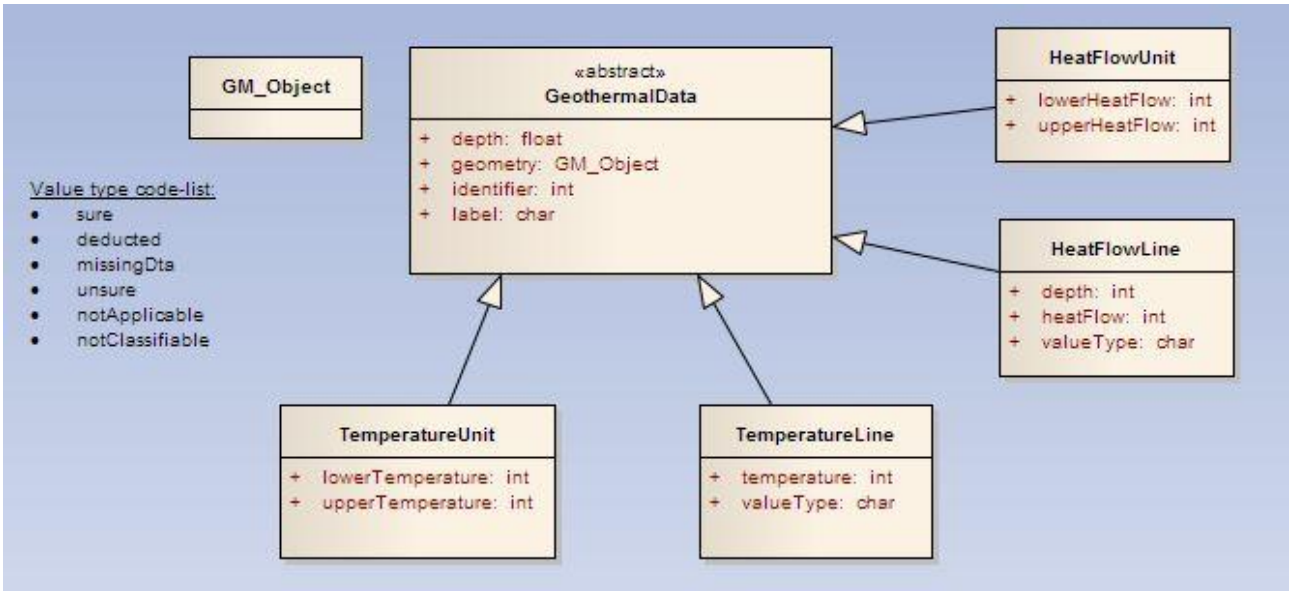


Figure 13 Temperature and Surface Heat flow maps conceptual data model

Unit describes a polygon (a surface with the same value), and lines that represent temperature/heat flow isolines.

The abstract class (GeothermalData) provides three shared properties (geometry, identifier, label) that are common to all other classes.

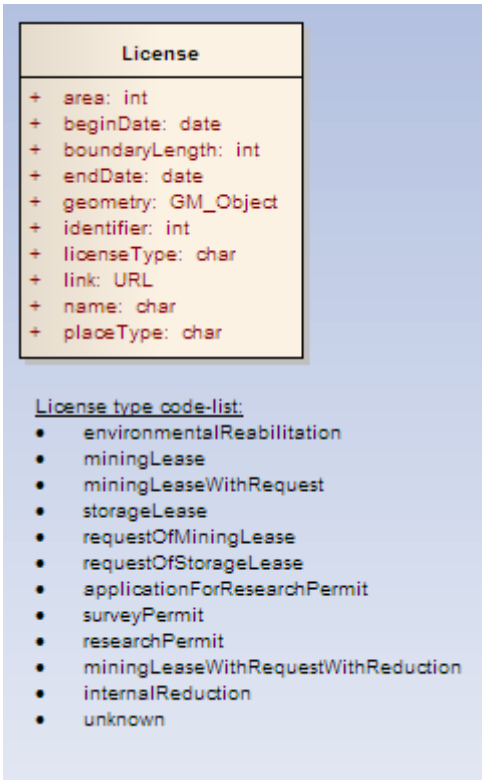
The geometry is defined in a common class (GM_Object) used by all INSPIRE data specifications. This class (from the ISO model) describes any geometry.

The value of the type (valueType) should be selected from a predefined list of values (code-list for INSPIRE). It could be an integer if the current list is kept or a text if it needs to be more significant.

The mapping of EGIP classes to INSPIRE classes will be defined

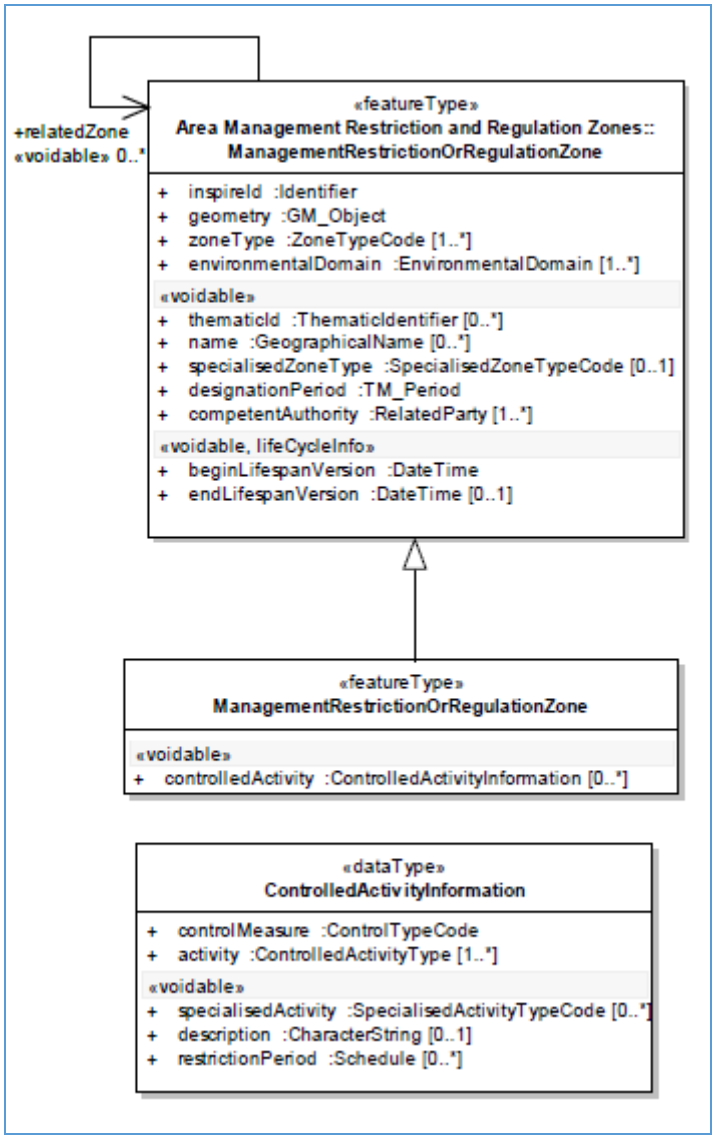
3.4.2 Licenses

For licenses, the suggestion for the EGIP data model is:



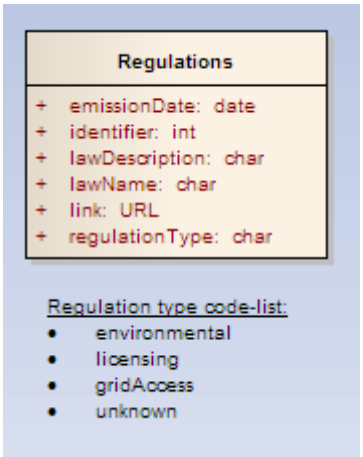
The mapping with the classes of the Area Management data theme of INSPIRE will be defined.

An EGIP license = an INSPIRE ManagementRestrictionOrRegulationZone.



3.4.3 Regulations

The EGIP proposal for Regulations is:



The mapping with INSPIRE classes for Legislation and Document citations are will be defined.

The classes DocumentCitation and LegislationCitation:

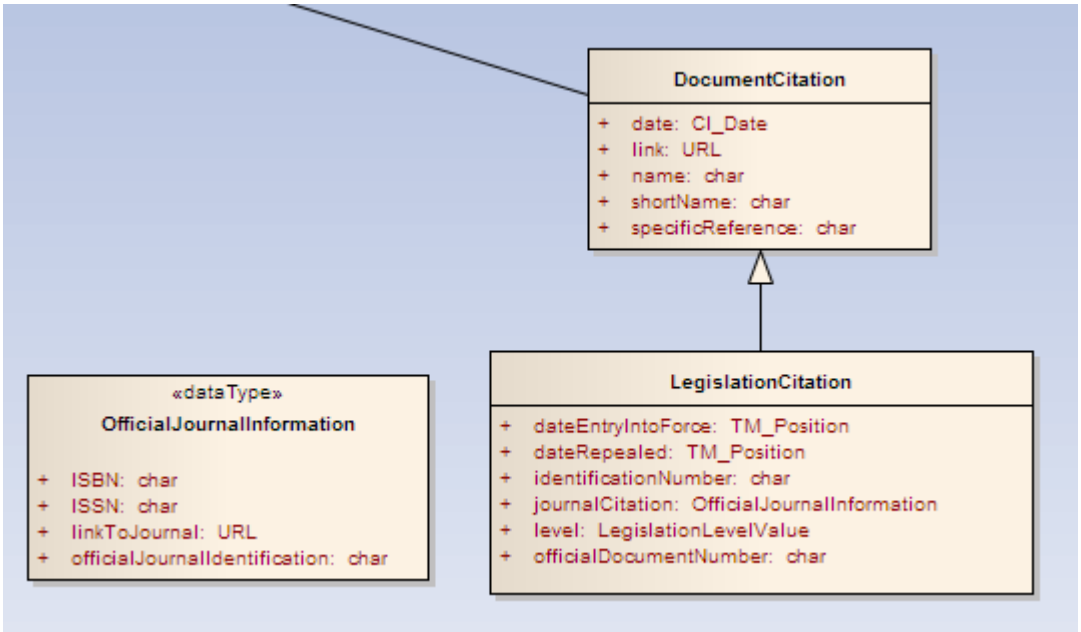
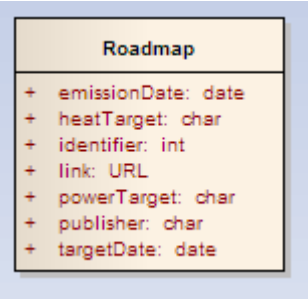


Figure 14 Regulation documents Conceptual model

3.4.4

Roadmap

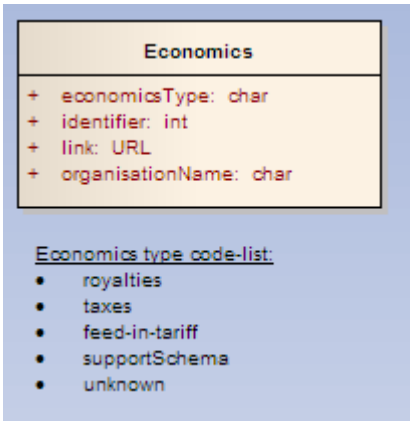
The EGIP proposal for Roadmap is:



The roadmap is a document, so the mapping to INSPIRE classes will be with DocumentCitation and LegislationCitation classes.

3.4.5 Economics (support schemes)

The EGIP proposal for Economics is :



There is no relationship with INSPIRE, thus there are no specific recommendations, except to map if necessary this class to the classes DocumentCitation and LegislationCitation

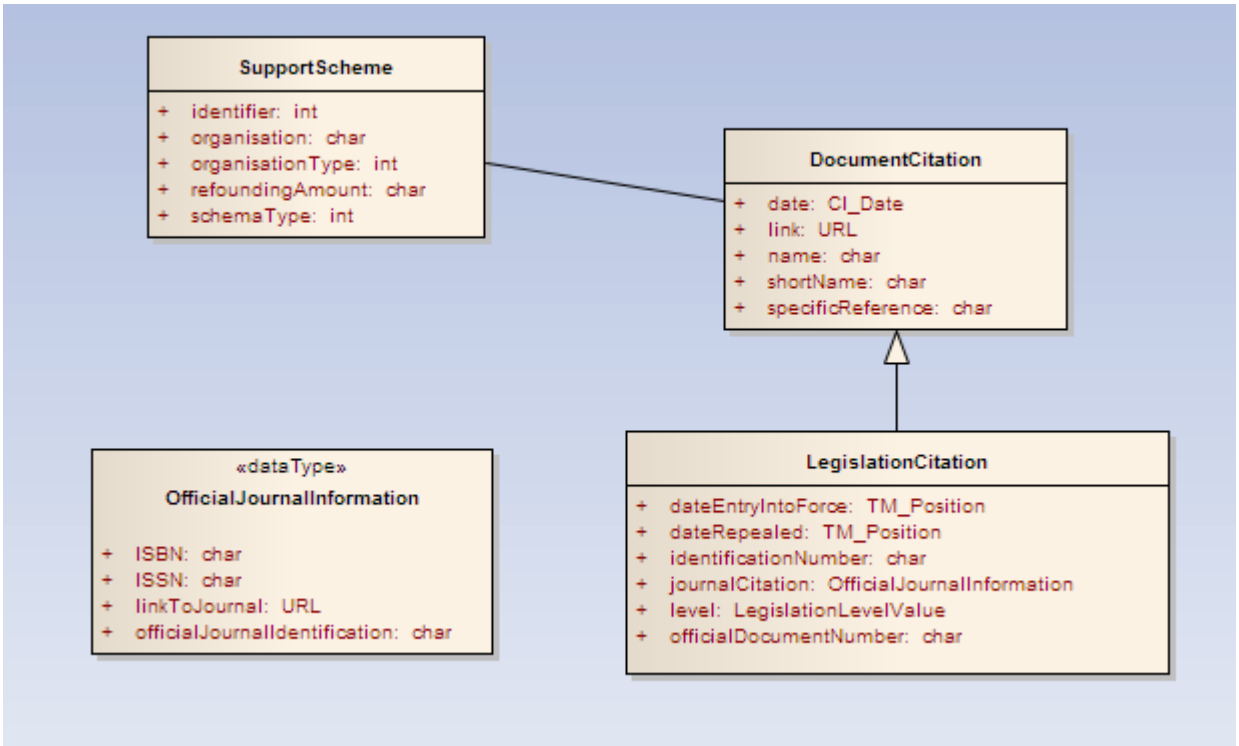


Figure 15 Economics documents Conceptual model

3.4.6 Training & Education

There is no relationship with INSPIRE, but as there is a spatial property the GM_Object should be used:

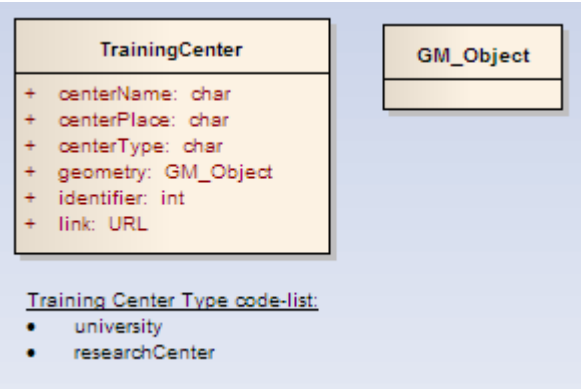


Figure 16 Training & education Conceptual model

4 EGIP web portal capabilities: the functionalities for stage 1

As well as the data description, the functionalities provided by the EGIP platform also need to be described as services in the metadata catalogue. Within the INSPIRE Metadata Implementing guidelines there is a specific metadata scheme for services in which the typology of services have to be fixed see Table 21. The different services have to be implemented on the basis of Open Geospatial Consortium (OGC)[2] standards, herewith introduced:

1. Discovery Services defined as CS-W (Catalogue Service for the Web) that enable metadata to be searched for and accessed
2. View Services defined as WMSs (Web Map Services) that guarantee access to map data
3. Download Services defined as WFSs (Web Feature Services) or WCS (Web Coverage Services) to download vector and grid data
4. Transform Services is a WCTS (Web Coordinates Transformation Service) that re-project spatial datasets onto a different coordinates system
5. Invoke Spatial Data Service defined as WPSs (Web Processing Services) provides the possibility to operate actions on data

For the pilot implementation of the information and data belongs to stage 1 (see Feasibility report D3.2) the services suggested are reported here in table 22:

Table 22 Stage 1 services

Information	INSPIRE Services
Temperature map	WMS: Colour map based on temperature values CSW: discovery the map in the catalogue
Surface Heat Flow	WMS: Colour map based on temperature values CSW: discovery the map in the catalogue

[2] Open Geospatial Consortium (OGC) is an international no-profit organization, based on consensus volunteering, which deals to define the technical guidelines for geospatial and location based. See more www.ogc.org

Exploration and production licenses and (projected) power production	WMS: Colour map based on typology of the licence CSW: discovery the map in the catalogue WPS: Chart for licencing expiration WPS: Chart for licencing start WPS: Chart for licencing expiration WPS: Chart for licencing area
Environmental impact law	CSW: discovery the map in the catalogue
Rules of licencing (exploration/exploitation)	CSW: discovery the map in the catalogue
Legal condition for grid access	CSW: discovery the map in the catalogue
Geothermal Roadmap	CSW: discovery 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	CSW: discovery 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 the amount of insurance premiums
Royalties & taxes, support scheme (feed-in tariffs, grants, …)	Unstructured
List of Education & Research	CSW: discovery the map in the catalogue WMS: Symbol map based on typology (university or research centre) WPS: Report (or table or chart) on number of centres
List of Industries	CSW: discovery the map in the catalogue WMS: Symbol map based on typology WPS: Chart on number of each type per country

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