Information and dissemination of knowledge in the field of geothermal energy

Adele Manzella
Italian National Research Council - Institute of Geosciences and Earth Resources, Pisa, Italy

Keywords: information, dissemination

Abstract

Dissemination plays a main role in the integration phase of the Engine Co-ordination Action. It will take the form of sharing information among the partners and stakeholders, toward the definition of the state-of-the-art, and in particular a review of case histories, in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology. Another important part of dissemination is the promotion of the geothermal energy. The knowledge will be disseminated and made available through the information and publication systems, and should arise the interest of other potential scientific and industrial partners. Scientific and technical know-how and practices is planned to be disseminated through scientific publications and on-line through the Web site. Also general scientific documents are foreseen, as multimedia programmes, articles and information brochures. These less specialised publications aimed at a wider audience will contribute to the promotion of geothermal energy in terms of policy makers and public opinion.

In order to start working on this subject, a review of the geothermal energy dissemination and information available at the moment will be given, as well as a discussion of possible improvements and new ideas.

1. Introduction

An overall discussion about actual tools of geothermal energy dissemination and how to organise and improve them can be considered a first step toward one of the goals of Engine Coordination Action (CA), summarised in the name of Workpackage 2: Information and Dissemination System. WP2 will play a major role in the exchange and dissemination of data, good practises and standards.

Dissemination in geothermal is performed both at local level, mainly thanks to Geothermal Associations, and at international level by the International Geothermal Association (IGA) with its European Branch, the Geothermal Research Council (GRC), the European Geothermal Energy Council (EGEC). International geothermal projects, such as those funded by European Union (e.g., “Soulz-sous-forêts”) or local authorities (e.g. “Swiss Energy” at Basel and Geneva, “Geodynamics Ltd.” in Australia and “Bund and EnBW” at Bad Urach in Germany) also provide information on their WebPages and/or through other means. Another valuable source of information about geothermal for general public is the Geothermal Education Office, offering a slide show about geothermal (http://geothermal.marin.org/). The Geo-Heat Center (http://geoheat.oit.edu/index.htm), by the Oregon Institute of Technology, provides information regarding direct uses of geothermal energy.

Information regarding geothermal is often scattered, is mostly in English language although sometime local information is provided in local languages, while most information remains in specialised scientific papers. In order to begin the organisation of the large amount of geothermal data and information available at the moment it is necessary to overview the main information tools already available and collect data. The following step will be to collaborate with international organisation already working to this end.

The collection of the information that will be given in this paper does not pretend to be exhaustive, but represents the beginning of a road where all the partners of Engine CA will walk in these following 33 months.

2. Main tools of dissemination

Here I give a list of ways geothermal data are provided to public. It is impossible to give priorities, and the order of the list is almost casual.

2.1 WebPages

Most organisations, associations and projects have now their own WebPages, which have become the main information vehicle. Here visitors can find information on the organisation or project. A comprehensive list is reported in Table 1.

On many of these web-sites general information regarding geothermal energy, its distribution worldwide, its various forms of utilisation may be found; language is English, but on IGA a general description of geothermal is provided also in Italian, Japanese, Spanish, Greek, Korean languages.

Associations usually use their local language, but some of them provide information also in English beside their own.

Engine CA already has its own web-site (http://engine.brgm.fr) and information will be driven mainly through it.

Organization	**Brief description**	**Web-site**
Center for Renewable Energy and Sustainable Technology (CREST) Primer on Geothermal Energy	An introduction to geothermal energy and its benefits	*www.solstice.crest.org/renewables/geothermal/*
Deep Heat Mining	Hot dry rock geothermal energy program in Switzerland. About the technology and the ongoing development program, including photos, maps, and diagrams	*www.dhm.ch/*
Department of Energy -Geothermal Energy Program	Describes the U.S. DOE Geothermal Energy Program and provides information and news on geothermal energy.	*www.eere.energy.gov/geothermal/*
Department of Energy - Geothermal Energy Technical Site	Maintained by Idaho National Engineering and Environmental Laboratory. Information about use of geothermal energy, U.S. laws and standards, calendar of events, FAQ, links and other.	*www.geothermal.id.doe.gov/*
Energy Commission Geothermal Program in California	Funding opportunities, contacts, related web sites and overview of geothermal energy in California.	*www.energy.ca.gov/geothermal/*
Geo-Heat Center	Center for dissemination of geothermal information and technology transfer, by the Oregon Institute of Technology. Information on geothermal energy, its utilization, and United States's geothermal resources. Dedicated to direct uses.	*www.geoheat.oit.edu/*
Geothermal Education Office	Provides public information	*geothermal.marin.org*

	materials about geothermal energy.	
Geothermal Resource Information Clearinghouse	National Renewable Energy Laboratory provides links to geothermal energy information resources on internet.	*www.rredc.nrel.gov/geothermal/*
Geothermal Resources Council	Encourages worldwide research and development on geothermal energy resources and utilization. Calendar of events, workshops, membership information, publications, related links and other information.	*www.geothermal.org/*
GEOTHERMIE	Information in French, Italian and German for planners, contractors and costumers about practical use of geothermal energy.	*www.geothermal-energy.ch/*
GEOTHERNET - Geothermal Informations for Europe	Directories of geothermal energy development and research around Europe, journals, and worldwide conferences and events. Some internet links. Includes basic information on geothermal energy technology. English or German.	*www.geothermie.de/egec_geothernet/menu/frameset.htm*
International Geothermal Association	Information on geothermal energy in use around the world, Proceedings of world conferences on geothermal and links to related web sites.	*www.geothermal-energy.org/*
National Renewable Energy Laboratory Geothermal Technologies Program	Information organised by topics such as technology description, program summary, research and development projects, and publications.	*www.nrel.gov/geothermal/*
New Energy and Industrial Technology Development Organization - Geothermal Energy Development Department	Information about Japanese research and development activities in this area.	*www.nedo.go.jp/english/activities/newenergy/geothermal.pdf*
Office of Scientific and Technical Information — Geothermal Energy Technology	Online document database, updated bimonthly, of hypertext bibliographic citations of current worldwide geothermal information.	*www.osti.gov/get/gethome.html*
Sandia National Laboratories: Geothermal Research Department	Research in drilling and associated well-bore technologies, environmental drilling, industry partnerships, and laboratory and field-testing to evaluate new concepts.	*www.sandia.gov/geothermal/*
Virginia Tech Geothermal Data	Geothermal resource data for the southeastern U.S. through the Regional Geophysics Laboratory; summary of geothermal resources, technology, and potential of geothermal heat pumps in the southeastern U.S.	*geothermal.geol.vt.edu*
Electricity From Earth's Core	News article about a concept for a long, self-contained turbine shaft called a Power Tube that could tap	*http://www.wired.com/news/technology/0,1282,48947,00.html*

	subterranean heat without relying on geysers and steam vents. (December 14, 2001)	
The World Bank Group	General Information about geothermal energy, principally about its applications.	*www.worldbank.org/html/fpd/energy/geothermal/*
U.S. Geological Survey's Cascades Volcano Observatory	Multi-disciplinary science organization that provide scientific information to describe and understand the volcanic phenomena and related natural hazard. In this web site it is listed much of information about geothermal and hydrothermal activity in USA, Canada and New Zealand.	*vulcan.wr.usgs.gov/Glossary/ThermalActivity/framework.html*
WEC	General outline about geothermic energy and its use's spreading in the world.	*http://www.worldenergy.org/wec-geis/publications/reports/ser/geo/geo.asp*
Geothermal Energy Curriculum	In this web-site the geothermal energy is described in six sections in PDF format in the context of the world's energy needs.	*www.bpa.gov/Corporate/KR/ed/geothermal/homepage.htm*

Table 1: Major organizations providing general information

Name	**Brief description**	**Web-site**
CGEA-Canadian Geothermal Energy Association	A non-profit association that is interested in the utilization, protection and understanding of geothermal resources.	*http://www.geothermal.ca*
DBEDT- State of Hawaii	Factsheet on geothermal energy in Hawaii, with links to other information.	*www.state.hi.us/dbedt/ert/geo_hi.html*
GEA-Geothermal Energy Association	This site provides a full listing of geothermal plants by state and includes data, contact information, and a photo of each plant	*www.geo-energy.org/information/plants.asp*
EGI- The Energy & Geoscience Institute at the University of Utah	The Geothermal Energy Unit, formerly UURI (University of Utah Research Institute) performs basic and applied research in geothermal exploration, reservoir delineation, drilling and logging, and production.	*http://egi-geothermal.org/*

Table 2: web-sites of National Associations and Institutions. To be completed. Many links can be found on IGA webpage (http://iga.igg.cnr.it/geoworld/geoworld.php?sub=links)

2.2 Newsletters

Their aim is to provide timely general information on geothermal matters to the geothermal community and general public. IGA News (4 issues per year) and GRC Bulletin (6 issues per year) include feature articles, announcement, and news about geothermal energy development around the world. The Bulletin is provided to GRC members and is available to non-members by subscription, whereas IGA News is provided to IGA members but is also available on IGA web-site. Other newsletters are: "The Heat of the Earth: A Clean and Sustainable Energy for All" from SwissEnergy; EGEC Newsletter

2.3 Scientific papers, special reports

Scientific papers regarding geothermal may be found in specialized Journals, mainly Geothermics and Journal of Volcanology and Geothermal Research, both from Elsevier Ltd, or in many other earth sciences and engineering journals.

Journal Title	N.ber of published papers regarding geothermal in the last 10 years
AAPG Bulletin	12
Acta Petrologica Sinica	16
Annals Of Glaciology	8
Applied And Environmental Microbiology	20
Applied Geochemistry	56
Applied Thermal Engineering	16
Australian Journal Of Earth Sciences	17
Bioinorganic Chemistry And Applications	1
Biological Conservation	2
Biometals	1
Bollettino Società Geologica Italiana	19
Bulletin Of The Seismological Society Of America	32
Bulletin of Volcanology	19
Canadian Geotechnical Journal	6
Chemical Geology	70
Chinese Journal Of Geophysics – Chinese Edition	17
Chinese Science Bulletin	20
Clays And Clay Minerals	34
Colloids And Surfaces A-Physicochemical And Engineering Aspects	2
Computers & Geosciences	13
Contributions To Mineralogy And Petrology	21
Desalination	26
Earth Surface Processes And Landforms	3
Economic Geology	7
Energy Conversion And Management	31
Energy Sources	63
Extremophiles	10
Geochemical Journal	31
Geochimica et Cosmochimica Acta	116
Geofluids	13
Geological Society Of America Bulletin	24
Geology	43
Geo-Marine Letters	4

Geophysical Journal International	58
Geophysical Prospecting	6
Geophysical Research Letters	83
Geophysics	35
Geothermics	412
Global And Planetary Change	31
Heat Recovery Systems & CHP	20
International Journal Of Green Energy	1
Izvestiya – Physics Of The Solid Earth	14
Journal Of Agricultural And Food Chemistry	1
Journal of Fluid Mechanics	7
Journal Of Geology	11
Journal Of Geophysical Research – Section B – Earth Sciences	131
Journal Of Geophysics And Engineering	7
Journal Of Glaciology	14
Journal Of Hydrology	10
Journal Of Metamorphic Geology	38
Journal Of Mining Science	3
Journal Of Oceanography	1
Journal Of Petrology	15
Journal Of The Geological Society	26
Journal of Volcanology And Geothermal Research	203
Lithology And Mineral Resources	1
Marine And Petroleum Geology	26
New Zealand Journal Of Geology And Geophysics	12
Oceanology	14
Ore Geology Reviews	12
Organic Geochemistry	23
Petroleum Geoscience	8
Physics Of The Earth And Planetary Interiors	27
Precambrian Research	18
Proceedings Of The Institution Of Civil Engineers – Civil Engineering	1
Proceedings Of The Japan Academy Series B-Physical And Biological Sciences	1
Progress In Natural Science	2
Pure And Applied Geophysics	30
Remote Sensing Of Environment	1
Renewable & Sustainable Energy Reviews	11
Renewable Energy	49
Resource Geology	17
Revista Mexicana De Ciencias Geologicas	2
Science In China Series D- Earth Sciences	14
Sedimentary Geology	10
Sedimentology	8
Stochastic Environmental Research And Risk Assessment	1
Surveys In Geophysics	6
Tectonics	24
Terra Nova	15
Water Resources Research	19

Table 3: Number of articles directly related to geothermal published in the main Journals in the last 20 years. In red color are highlited numbers over 40, in blue the numbers in the range 20-40.

Special reports have been prepared and sponsored in various occasions in the past.

Atlases of Geothermal Resources has been published periodically and contain geothermal information worldwide.

Many geothermal libraries have been built where necessary. The Geothermal Resources Council offers thousands of citations for individual articles from GRC and other geothermal publications, which can be accessed by simple keyword searches. GRC members have free access to downloadable PDFs, with hard copy available for a nominal fee. The geothermal library of CNR-IGG in Italy also offers thousands of citations for individual geothermal articles and books, but can be accessed at the moment only on-site.

2.4 Congresses and workshops

A World Geothermal Congress (WGC), sponsored by IGA, is held every five years. The most recent WGC was held in Turkey in May 2005, and attended by 2000 participants. In 1995 the WGC took place in Florence, with 1451 participants, while in 2000 it took place in Japan, with 1800 participants. The next WGC is scheduled to be held in Indonesia in 2010.

GRC convene an annual workshop usually in Nevada, and in California—with alternate cities chosen by the Board of Directors to enhance domestic and international relations. The companion (U.S.) Geothermal Energy Association Trade Show offers the opportunity to learn about the latest in geothermal equipment and services while forming important business contacts. GRC Transactions offers most technical papers presented at GRC Annual Meetings and are available to GRC members and GRC Annual Meeting attendance.

Other annual workshops have fixed location and provide proceedings that are available on-line through IGA website (http://iga.igg.cnr.it/iga_pub.php) and provided by Stanford (http://geothermal.stanford.edu/standard/). They include: Stanford, New Zealand, Philippines (PNOC-EDC) workshops and the European Geothermal Congress (EGC).

2.5 Presentations for general public

A famous series of slides regarding generalities about geothermal is available on Geothermal Education Office web-site (see Table 1).

A PowerPoint presentation of the various aspects of geothermal energy is available on CD from Swiss Energy.

Other information is provided through web-sites, as listed in Tables 1 and 2.

2.6 On-line information system: Geothermal databases

GREAT BASINS CENTER for Geothermal Energy	
Producer	University of Nevada, Reno
Content	Research towards the establishment of geothermal energy as an economically viable energy source within the Great Basin. The Center specializes in collecting and synthesizing geologic, geochemical, geodetic, geophysical, and tectonic data, and using Geographic Information System (GIS) technology to view and analyze this data and to produce favorability maps of geothermal potential
Coverage	Great Basin (USA)
Dissemination	Online
Target Audience	Public

Cost	Free of charge
Information format	
Contact	www.unr.edu/geothermal/

NM-Geo-database	
Producer	The Oregon Institute of Technology GeoHeat Center (OIT) administers the program and the University of Utah Earth Sciences and Resources Institute (ESRI)
Content	It is a part of a larger congressional-funded national effort to encourage and assist geothermal direct-use. In 1991, the U. S. Department of Energy, Geothermal Division (DOE/GD) began a Low-Temperature Geothermal Resources and Technology Transfer Program. Phase 1 of this program includes updating the inventory of wells and springs of ten western states and placing these data into a digital format that is universally accessible to the PC.
Coverage	USA
Dissemination	Online
Target Audience	Public
Cost	Free of charge
Information format	Full text (PDF)
Contact	http://www.nmsu.edu/Research/tdi/public_html/Geothermal-Energy/NMgeo-databases/NM-Geo-Databases.html

Geothermal Energy Technology	
Producer	States Dept. of Energy Office of Scientific and Technology Information
Content	Geothermal energy is derived from resources below the Earth's surface (geo) as well as from heat (thermal). Resources range from shallow ground to hot water and rock several miles below Earth's surface. Earth's energy can be converted into heat and electricity, and other related subjects. Hard copy ordering is also available.
Coverage	Worldwide
Dissemination	Online
Target Audience	Public
Cost	
Information format	Search, browse, and retrieve hypertext
Contact	http://www.library.dal.ca/dmsearch/dmsearch.php?q=1&keyword=physics&field=subject&rows_per_page=25&type=databases

Geothermie	
Producer	Databases on STN International, STN International Europe, Help Desk, P.O. Box 2465, D-76012 Karlsruhe
Content	A bibliographic database on geothermal energy (about 42,000 records from the STN database ENERGY) an exemplary search for geothermal energy in the PATDPA database of the German Patent Office. STN International provides a wide range of databases in science and technology that offer fast and direct access to literature, patents, and catalogs of your interest. Special guides such as STNGUIDE and

	NUMERIGUIDE or the STN Free Search Preview help you find the database containing the information relevant to your search question. In addition you may use the alphabetical Database List or the Database List by Category to identify databases of interest.
Coverage	National (Germany)
Dissemination	Online
Target Audience	Public
Cost	Free of charge
Information format	Full text, searchable
Contact	http://www.fiz-informationsdienste.de/en/DP/cdrom/geoth.html

Geothermal Congress Proceedings Database	
Producer	Stanford University for IGA
Content	Proceedings of World Geothermal Congresses, European Geothermal Congresses, Stanford Workshops, PNOC workshops, New Zealand Workshops. Search by author, keywords, title, congress
Coverage	Worldwide
Dissemination	Online
Target Audience	Public
Cost	Free of charge
Information format	PDF
Contact	http://

GRC Bulletin Database	
Producer	GRC
Content	Bibliographic information of articles and announcements included in the GRC's Bulletin
Coverage	Worldwide
Dissemination	Online
Target Audience	Public
Cost	
Information format	Bibliographic (GRC citations and publications preview only, no PDF's)
Contact	http://www.geothermal.org/bulletin-db.html

GRC Catalog Database	
Producer	GRC
Content	Bibliographic information of articles from a variety of publications on all aspects of geothermal energy worldwide.
Coverage	Worldwide
Dissemination	Online
Target Audience	Public
Cost	
Information format	Bibliographic (GRC citations and publications preview only, no PDF's)
Contact	http://www.geothermal.org/catalog.html

GRC International Vendors Database	
Producer	GRC
Content	Over 400 listings of companies worldwide that provide

	goods and services to the geothermal industry.
Coverage	Worldwide
Dissemination	Online
Target Audience	Public
Cost	
Information format	Directory
Contact	http://www.geothermal.org/vendors.html

GRC Power Database	
Producer	GRC
Content	Information on geothermal power plants worldwide. Information can be searched by country or by geothermal fields.
Coverage	Worldwide
Dissemination	Online
Target Audience	Public
Cost	
Information format	Directory
Contact	http://www.geothermal.org/grcpower.html

Regional Geothermal Data	
Producer	Southern Methodist University, Geothermal Laboratory
Content	Geographical coordinates, AMS sheet, well depth, elevation, max./min. temp, BHT, gradient(s), thermal conductivity, heat flow, heat production, porosity, date of drilling and logging measurements, water table depth, lithology and references.
Coverage	Regional (U.S.A)
Dissemination	Online
Target Audience	Public
Cost	
Information format	Full text, Fact sheet
Contact	http://www.smu.edu/geothermal/georesou/resource.htm

Italian Geothermal Database	
Producer	National Research Council, Institute of Geosciences and Earth Resources
Content	Geographical coordinates, well depth, elevation, max./min. temp, BHT, gradient(s), thermal conductivity, heat flow, heat production, porosity, date of drilling and logging measurements, water table depth, lithology and references.
Coverage	Regional (Italy)
Dissemination	On a local server (library)
Target Audience	Public
Cost	Free of charge
Information format	Full text, Fact sheet
Contact	Dr. Stefano Bellani, bellani@igg.cnr.it

Western Geothermal Area Database	
Producer	Southern Methodist University, Geothermal Laboratory
Content	Geographical coordinates, AMS sheet, well depth, elevation, max./min. temp, BHT, gradient(s), thermal conductivity, heat flow, heat production, porosity, date

	of drilling and logging measurements, water table depth, lithology and references.
Coverage	Regional (U.S.A. Western Area)
Dissemination	Online
Target Audience	Public
Cost	
Information format	Full text, Fact sheet
Contact	http://www.smu.edu/geothermal/georesou/resource.htm

2.7 Pilot and Demonstration Plants

Demonstration projects are a key for the share of knowledge, to convince general public and decision-maker of geothermal viability, especially in integrated solutions with other locally available energy sources, such as waste incineration and biomass on large scale, or solar on small scale. In Italy an example is the combined geothermal and waste incineration district heating of Ferrara town. Such information and a list of contact persons is required.

2.8 Photos

IGA provides photos related to geothermal in geographical order. GEA provides photos of geothermal plants.

3. Promotion

In order to promote geothermal, many leaflet and brochure are prepared and distributed in congresses, workshops, specialized meetings.

The target audience ranges from the governments to the general public, passing through decision-makers, NGOs, private and public operators, financing agencies, market players, and stakeholders, but only few of them are reached in the few and often too specialized occasions.

4. Conclusions

The main tools of dissemination and information regarding geothermal energy have been reviewed. Although this list is surely incomplete and will require the effort of all Engine partners to complete it at least for what concern Europe, it is clear that geothermal information is not uniformly covering the world and, within it, Europe. Since Engine CA is specifically targeted to Europe, a main target of its WP2 should be to collect as much information as possible and organise it uniformly over Europe.

Geothermal databases should be built or updated for each country, and be available online to at least the partners of the CA, if not to the world community.

A virtual library, accessed through Engine web-site, should be also built, with a public bibliographic search and PDFs of papers available to Engine CA partners. In the occasion, it could be important to update a Thesaurus of geothermal terms for present and future reference, which should become a standard for keyword choice. A link should be established with IGA and Stanford University that manage the geothermal proceedings database.

Demonstration plants should be advertised and linked on a European base.

Geothermal information for general public should be provided in as many European languages as possible, and could be done in conjunction with IGA.

Advertisement by means of brochures, titles in magazines, material for schools and museums, should be prepared for all the countries and languages represented in the CA. Part of this may be prepared for the WebPages, but should also go out of internet and reach the people in the streets.

In conjunction to Education for geothermal, we should also think to train people in this new job: dissemination. Nobody till now has done it as a job by itself. We should take examples from other fields, where this is done professionally.