GEORG

GEOthermal Research Group

Annual Report

RAN090326-1303

Centres of Excellence and Research Clusters
Strategic Research Programme

Year 2, 2010-2011

May 24th 2011

GEORG
GEOTHERMAL RESEARCH GROUP

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SUMMARY

- The second General Assembly was held on the 21st of May 2010. In connection to the General Assembly an Open Conference was held with the general theme of Geothermal Energy Research. The venue was Reykjavik Energy headquarters.
- Status of supported projects. 19 projects have already been supported by GEORG during these 24 months of practice. All of the projects have been running smoothly with minor delays in few cases.
- WP – leader workshop. As a preparation for the third call of proposals a WP leader workshop was held in August. Based on the results of this workshop the board published a list of focus points for GEORG's third call. Another strategy workshop was held in January 2011 and strategy work is continuing with WP leader analysis and a special attention 2011 Annual Meeting.
- The third call for proposals was published on the September 22nd, 2010, with a deadline November 30th. The call was open in all WP's but with certain focus on selected tasks. It was also decided that WP3 and WP8 should be continuously open for proposals and shall not be subjected to certain calls. The evaluation of the proposals resulted in selection of 4 projects.
- GEORG implemented two series of seminars in the spring of 2011, seven seminars were held on Roots of Geothermal Systems (relates to WP4) and six on Innovation in the field of Geothermal Energy (relates to WP3). The seminars were held approximately once a week from mid February till May.
- European Geothermal PhD day. GEORG's BoD supported EGPD 2011, initiated by the EERA - JPGE and organised by a group of Icelandic graduate students studying topics related to geothermal energy. The event was held in Iceland 1st -4th of March 2011 and in total around 60 participants from 20 countries attended the event.
- GEORG is taking part in a Nordic-German-Polish Cluster Excellence Project on Benchmarking of clusters. Two of members of the board participated in an interview conducted by Dr. Gerd Meier zu Köcker, Managing Director of the Agency Competence Networks Germany. The project is conducting a conference/workshop in Copenhagen in May 2011 on best practices in cluster management and GEORG's Operational Manager will attend.
- The conference Iceland Geothermal was held on November 1st 2010. The conference was a milestone in a project managed by Gekon and with the objective of mapping the "Icelandic Geothermal Cluster". Following the conference the Ministry of Industry invited a group of stakeholder to a meeting to discuss further the formulation of a geothermal cluster. GEORG was one of the invitees at the meeting and GEORG is participating in exploring the possibilities of further and broader cooperation in the field and Edda Lilja Sveinsdóttir, Board Member, was appointed as GEROG representative in the preparation expert panel.
- Iceland took initiative to lead an EU - ERA NET proposal in the field of geothermal energy. The ERA NET is coordinated by Orkustofnun and GEORG participated in a very active way in the preparation by coordinating the proposal writing, but nine EU countries are participating. The proposal was submitted on February 22nd 2011 and the evaluation is ongoing, results are expected soon.
- GEORG submitted, together with Iceland Innovation Centre, Gekon, INNOVA ÉSZAK-AFÖLD (Hungary) and BUNDESVERBAND GEOTEHERMIE (Germany) a Concept Note on Geothermal Cluster in the EU CIP call - 3/G/ENT/CIP/11/C/N04C011. This action aims at fostering European cluster cooperation in view of internationalisation strategies outside Europe,

MANAGEMENT

General Assembly (GA) was held in Reykjavik Energy headquarters on the 21st of May. Seventeen participants attended from 9 organisations. The agenda for the meeting and the minutes from the can be found in Appendix I and II

Board of Directors (BoD) are the representative Nominated Managers of GEORG responsible for the management of administrative issues of the Consortium. The board meets regularly and during the 24 months of GEORG operation the BoD has met 46 times in total, thereof 16 times during the second year of operation. The BoD elected by the last GA consists of the following members:

- Sigurður Magnús Garðarsson University of Iceland Chairman

- Auður Andrésdóttir Mannvit
- Edda Lilja Sveinsdóttir Reykjavík Energy
- Ernst Huenges GFZ, Potsdam, Germany
- Guðrún Sævarsdóttir Reykjavík University
- Ólafur G Flóvenz ISOR
- Rúnar Unnþórsson Keilir
- Sigrún Hreinsdóttir University of Iceland

Science Academy (SA) is responsible for setting the scientific direction, and proposing the funding procedures to be employed by the BoD on annual basis. The individuals appointed on the Science Academy are selected by voting by the GA. The SA is lead by Sveinbjörn Björnsson and the members for the second operational year are:

- Árný Erla Sveinbjörnsdóttir Institute of Earth Sciences, University of Iceland
- Brynhildur Davíðsdóttir University of Iceland
- David Brunh GFZ
- David Mainprice Geosciences Montpellier (CNRS)
- Einar Gunnlaugsson OR
- Guðni Axelsson Iceland GeoSurvey
- Guðni A Jóhannesson OS
- Halldór Pálsson University of Iceland
- Hrefna Kristmannsdóttir RES
- Ingólfur Örn Þorbjörnsson Innovation Center Iceland
- Kristinn Ingason Mannvit
- María S. Guðjónsdóttir Reykjavik University

Work Package leaders (WPL) are responsible for coordinating all activities within a given work package, and ensure proper interactions via the sub-activity groupings and the integrating WPs with the other work packages. The WPL are responsible for ensuring that the deliverables from their work packages are completed according to the global GEORG project work plan and achieve the necessary levels of quality. One change was made in the WPL group whereas Brynhildur Davíðsdóttir resigned as leader of WP 7 and Sveinn Agnarsson took over. After the change the WPL are:

• WP1	Sigurður Magnús Garðarsson	University of Iceland
• WP2	Edda Lilja Sveinsdóttir	REYST
• WP3	Ágúst Valfells	Reykjavik University
• WP4	Ólafur G Flóvenz	ISOR
• WP5	Halldór Pálsson	University of Iceland
• WP6	Guðni Axelsson	ISOR
• WP7	Sveinn Agnarsson	University of Iceland
• WP8	Sigurður G Bogason	MarkMar

New members. Islensk Matorka ehf. and Vatnaskil Consulting Engineers have requested to join GEORG. The BoD will recommend that the GA confirm them as new members at the next General Assembly.

PROJECTS SUPPORTED BY GEORG

GEORG has already supported 19 projects in its two years of operation (including projects from the third call). The projects have touched upon various aspects of geothermal research but the strongest focus has been on reservoir science. The projects have encouraged broad collaboration, both within GEORG as well as collaboration with outside partners. Figure 1 shows the collaboration patterns of supported projects within GEORG. The dotted line determines the Geothermal Research Group; those inside the line are members of GEORG.

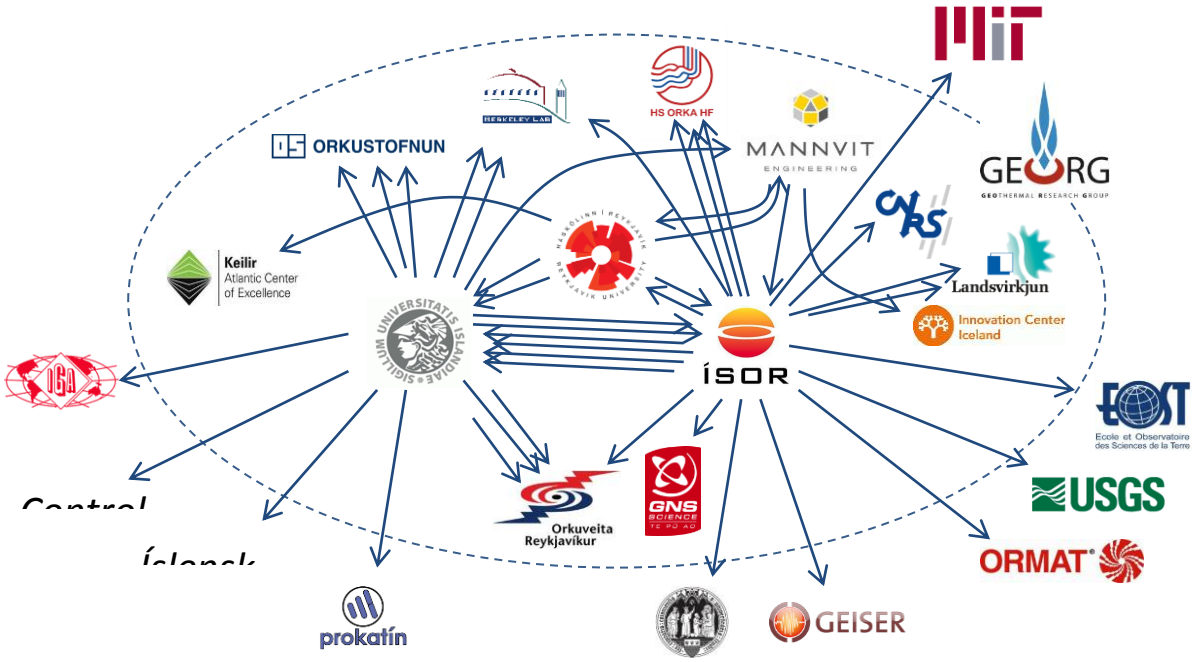


Figure 1 Collaboration pattern of supported project

The progress of supported projects has in general been excellent. Most of the projects have been on time with few exceptions, where delays have mainly been due to technical problems or personal reasons of key participants (e.g. maternity leaves). One of the projects is finished and seven other

have submitted annual reports. The annual reports of supported projects are attached to the report in Annex V.

THIRD CALL FOR PROPOSALS

The third call for proposals was published on September 22nd with a deadline on November 30th. The call was open for all WPs but the BoD announced the following topics as focus points for this call, the task number relate to the numbers in the WP description.

- Task 4.3: Effects of tectonic movements and volcanic activity on geothermal systems
  - Subtask a), b) and d)
- Task 4.6: Development of methods for exploitation of deep geothermal systems
  - Subtask c)
- Task 5.2: Direct use of geothermal heat for industrial processes
- Task 5.6: Maintenance procedures in geothermal utilization
- Task 5.7: Offshore drilling and utilization
- Task 6.2: Environment and health impacts of geothermal energy utilization
- Task 6.4: Geothermal sustainability assessment protocol
- Task 7.4: Macroeconomic effects
- Task 7.6: Cost-benefit analysis and environmental impact
- Task 7.3: Regional development and local capacity building

The BoD also announced that topics of WP3 and WP8 will be continuously open for proposals and shall not be subjected to certain calls.

GEORG received a total of 13 proposals in this call, 8 of the proposals were lead by the University of Iceland, 4 by ISOR and 1 by Reykjavík Energy. As before most of the projects were for three years or 7 projects, and 3 projects are for 1 and 2 years. The requested grant amounted to 174 MISK and the total costs of the projects estimated to be just over 520MISK.

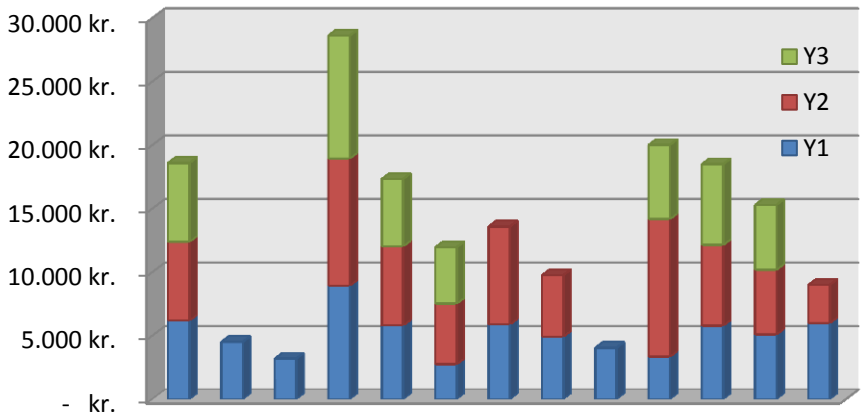


Figure 2: The total requested grant of the 13 projects in the third call.

As before applicants were asked to determine to which WP's their project were most relevant to. This gave an overview of the distribution between WP's, see Figure 3, green column. The other

column shows the WP relevance in previous calls. It can be seen that there has been a slide shift in the emphasis of proposed project, mainly towards WP 6, Sustainability - Environment

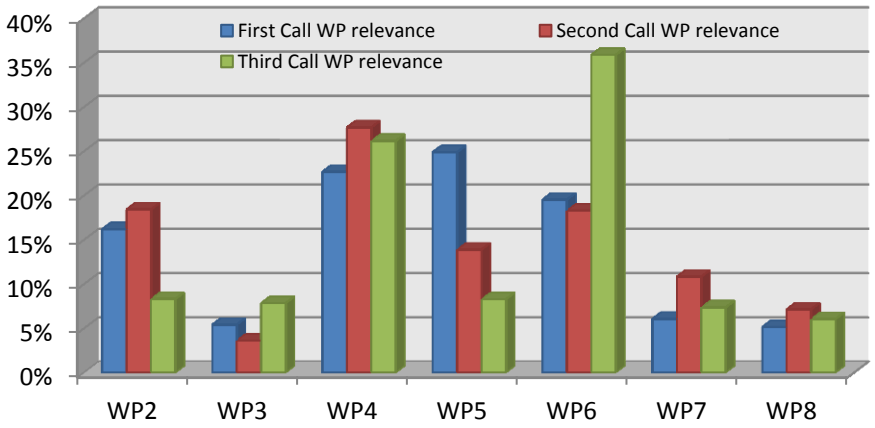


Figure 3: Comparison of WP relevance between 1st, 2nd and 3rd call.

Figure 3 shows the relationship between partners in the proposed projects of the third call. Even though most of the projects are coordinated by UNI and ISOR there are still a significant cooperation between partners and surprisingly many participants from outside of GEORG.

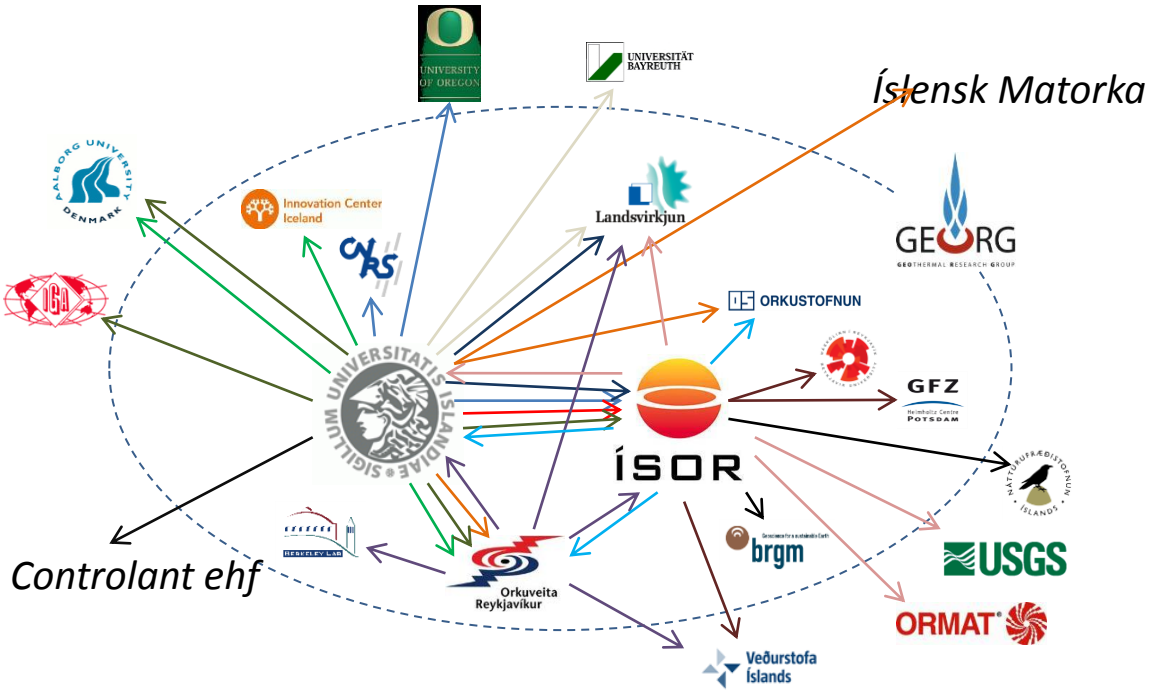


Figure 4: The relationship between partners in all proposed projects of the third call

As before the proposals were evaluated by at least 2 reviewers and consensus meetings were held to determine the final score for each project. The evaluation process, with date, is shown in figure 5.

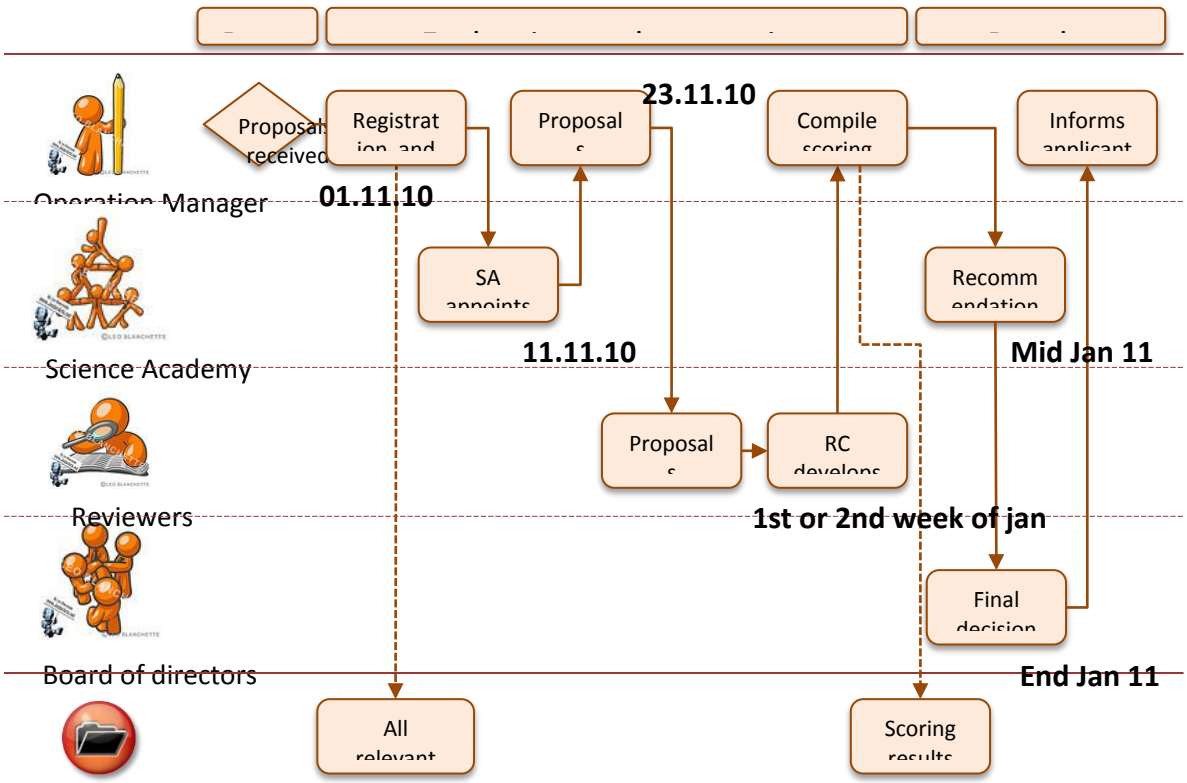


Figure 5: The evaluation process for the third call, with date

Out of the total 13 proposals that were submitted, 4 proposals are offered to negotiate for funding or about 31% (by number). The proposals were evaluated by 15 competent and skilled reviewers and each proposal were reviewed by at least two reviewers. Based on the outcomes of the evaluation and the overall goals of GEORG, the Science Academy made recommendations to the Board of Directors, which then made the final decision on offered support. The supported projects are listed below, (see Annex III for abstracts).

Project Name	Coordinator	Other Participants
Mapping interaction between magmatic and hydrothermal system with fluid inclusion analysis	Anette K. Mortensen	Landsvirkjun, USGS, ORMAT
Sustainability Assessment Protocol for Geothermal Utilization	Brynhildur Davíðsdóttir	Orkuveita Reykjavíkur, ÍSOR, ORKUSTOFNUN
GeoChem	Bernhard Örn Pálsson	Controlant ehf
Green Geothermal Growth	Sjöfn Sigurgísladóttir	Íslensk Matorka; ORKUSTOFNUN

INTERNAL STRATEGY WORK

During the last year special attention has been given to internal strategy work to define the progress of GEORG. Two workshops were held, one in August 2010 and another in January 2011. In the August workshop the focus was on GEORG achievements and where to head with the third call of

proposals. WP leader gave a short presentation on their WP and how well their tasks had been tackled in the previous call and if something was missing. The workshop was very successful and based on the results from this meeting the BoD decided to focus on specific tasks within each WP for the third call, as described before.

The second workshop was in held January 2011 with larger participation and broader discussions. The main outcomes of that workshop was that GEORG partners would like to

- see simplified funding procedures,
- make GEORG more visible and
- nurture internal growth and infrastructure.

The minutes from the strategy meeting are annexed in Annex IV. Following the workshop the BoD engaged the WP leader to analyse the status of their WP in order to identify potential gaps in the research agenda and define the next steps in terms of project support and project work. The WP leader of the main project WP called the principle stake holder for a meeting to discuss the status and returned a short report or memo on the results to the BoD. These reports are also annexed in Annex IV.

EU ACTIVITIES

GEORG is actively looking for opportunity to strengthening the connection with EU community and funding processes in the geothermal field. The following projects are ongoing.

PARTICIPATION IN THE 7TH FRAMEWORK PROGRAM COMMITTEE FOR ENERGY

Hjalti Páll Ingólfsson, Operational Manager of GEORG has been participating as one of three experts in the Icelandic delegation of the 7th Framework Program Committee for Energy since October 2009. He has attended five meetings in Brussels, since April 2010. Participating in the FP7 Program Committee for Energy, gives GEORG a great advantage to explore and facilitated the opportunities for geothermal energy within the EU Framework Program as well as a change to promote geothermal as an important energy source within the renewable energy portfolio.

ERA NET IN GEOTHERMAL ENERGY

Iceland took the initiative of writing a proposal in the EU call "FP7-ERANET-2011-RTD". The proposal is lead by Orkustofnun and GEORG participates by coordinating the proposal writing. Rannís is also participating in the proposal on behalf of Iceland and other countries are Germany, France, Italy, The Netherlands, Switzerland, Hungary, Turkey and Slovakia.

In the call text it says *"The objective of the ERA-NET scheme is to step up the cooperation and coordination of research programmes in the field of geothermal energy at national level in the Member or Associated States through the networking of research and other geological programmes. This is aimed at the development and implementation of joint programming and opening of joint calls. Objectives will be to create an EU geothermal database for geothermal resource assessments and co-ordination of national activities and databases in geology, geochemistry and geophysics".*

Participating in this ERA NET gives a golden opportunity to deepen the cooperation of national program owners and administrators and thus be an enabler for the integration of national research and development agendas into a coherent European geothermal R&D program.

The duration of the ERA NET is 4 years and the support for the EU amounts to 2M€. ERA NET is a coordination action and is 100% financed by the EU Commission.

The ERA NET is divided into 7 work packages as shown in figure 6, Iceland (Orkustofnun) is the coordinator and WP leadership is divided between countries as indicated in the figure. The evaluation is ongoing and results are expected soon.

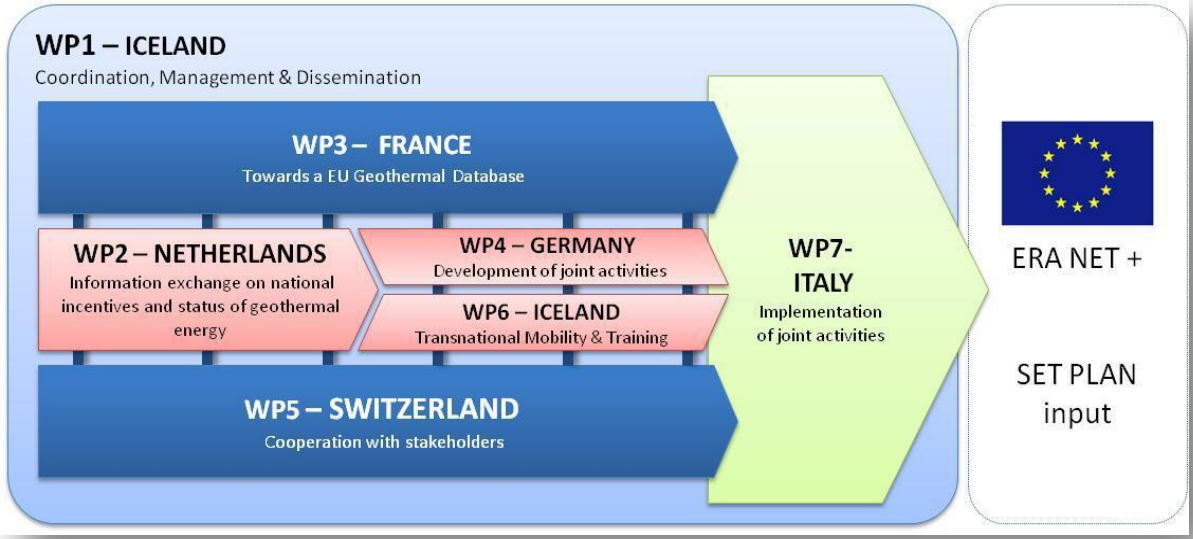


Figure 6: A schematic figure of the work packages in the Geothermal ERA NET.

EERA JPGE

EUROPEAN ENERGY RESEARCH ALLIANCE - Joint Programme on Geothermal Energy aims at providing an outstanding contribution bringing together the 14 leading European geothermal research institutions in a single strategically oriented Joint R&D Programme. The EERA JPGE participants are BRGM, CEGL, CNR, CNRS, CRES, ETH-Zürich, KIT, GFZ, ISES-VUA, ISOR, LIAG and TNO, the underlined participants are GEORG partners

The goal of the JPGE is to contribute to the achievement of the SET Plan objectives, streamlining and coordinating national R&D programmes, accelerating the targeted development and maturing of next generation geothermal technology in order to provide industry with all the elements required for its large-scale and cost-effective deployment.

The JPGE will be developed over 10 years and divided into 5 sub-programmes:

- SP 1. Resource Assessment
- SP 2. Accessing and Engineering of the Reservoir
- SP 3. Process Engineering and Design of power systems
- SP 4. Operation and Management of Geothermal Systems
- SP 5. Sustainability, Environment and Regulatory Framework

The EERA JPGE activities are closely linked to GEORG as four of its participants are also GEORG partners and formal connections will be made between the EERA JPGE and the Geothermal ERA NET.

EU CIP CALL: STRAND 1 – PROMOTING INTERNATIONAL CLUSTER ACTIVITIES IN THE CIP PARTICIPATING COUNTRIES

GEORG submitted, together with Iceland Innovation Centre, Gekon, INNOVA ÉSZAK-AFÖLD (Hungary) and BUNDESVERBAND GEOTEHERMIE (Germany) a Concept Note on Geothermal Cluster in the EU CIP call - 3/G/ENT/CIP/11/C/N04C011. This action aims at fostering European cluster cooperation in view of internationalisation strategies outside Europe, by building upon and further developing successful support schemes already implemented in some Member States. There is a two-stage submission process is used in this call with a deadline for a submission of a concept note as 10/05/2011. The date for submission of the full proposal will be specified later and will allow at least two months for the preparation of the full proposal.

EVENTS / CONFERENCES

ANNUAL MEETING – OPEN CONFERENCE

In a connection with the General Assembly GEORG organised an open conference with the general topic of Geothermal Energy Research. A number of respected experts and scientists addressed the conference with interesting presentations. The agenda for the open conference is listed in Annex I.

FRÁ GUFU TIL GJALDEYRIS, SERIES OF INNOVATION SEMINARS IN GEOTHERMAL ENERGY

Activities for WP-3 commenced in the beginning of the year 2011. It was decided to implement a series of seminars concerning means of generating value from the geothermal resource, other than for district heating and electrical power generation.

Each seminar was built around a specific theme, and the format was that 2 – 3 speakers gave talks on a special topic related to the theme. These talks were followed by the speakers joining a panel and taking part in an open discussion session. Six seminars, with the following themes were held approximately once a week, from mid February till May. The themes were:

10. mars 2011 Jarðhiti og matvælaframleiðsla, Háskólanum í Reykjavík

***Ylræktarver*,**
Sigurður Kiernan, GeoGreenhouse
Samkeppnisstaða íslensks fiskeldis með notkun jarðhita
Dr. Ragnheiður Inga Þórarinsdóttir, Íslensk Matorka ehf.

16. mars 2011Jarðhiti og ferðaþjónusta, Háskólanum í Reykjavík

Virkjun, víðerni og ferðavaran

Edward H. Huijbens, Rannsóknarmiðstöð ferðamála

Jarðvarmi –nýtt og vannýtt auðlind í ferðaþjónustu

Anna G. Sverrisdóttir, Laugarvatn Fontana

Gufar gjaldeyrir upp?

Auður Björg, Orkusýn

23. mars 2011 Jarðhiti og iðnaður, Háskólanum í Reykjavík

Nýting jarðhita við framleiðslu endurnýjanlegs eldsneytis,

Ómar F. Sigurbjörnsson, framkvæmdastjóri rannsókna- og þróunar, CRI.

Þörungaverksmiðjan og óhefðbundin tækifæri í orkuiðnaði,

Atli Georg Ágústsson, framkvæmdastjóri Þörungaverksmiðjunnar á Reykhólum.

***Varmahagfræði -hvað er það?*,**

Páll Valdimarsson, prófessor í vélaverkfræði við Háskóla Íslands

6. apríl 2011 Jarðhiti og ráðgjafastarfsemi, Orkuveitu Reykjavíkur

Frá gufu til gjaldeyris –jarðhitaráðgjöf

Eyjólfur Árni Rafnsson, forstjóri Mannvit

Fjármálaráðgjöf fyrir orkugeirann

Gunnar Tryggvason, Senior Manager, Fyrirtækjasvið KPMG

13. apríl 2011 Jarðhiti, menntun, mannauður, Orkuveitu Reykjavíkur

Jarðhitamenntun á Íslandi

Edda Lilja Sveinsdóttir, REYST/ Orkuveitu Reykjavíkur

Jarðhitamenntun erlendis

Guðrún Sævarsdóttir, Háskólanum í Reykjavík

Starfsemi Jarðhitaskólans á Íslandi og erlendis

Ingvar Birgir Friðleifsson, Jarðhitaskóla Sameinuðu Þjóðanna

5. maí 2011 Jarðhiti og vöruþróun, Orkuveitu Reykjavíkur

Vöruþróun mælitækja við háhita

Ragnar Ásmundsson, eðlisfræðingur hjá ÍSOR,

Nýsköpun og tækniþróun hjá Marel.

Kristinn Andersen, rannsóknarstjóri hjá Marel,

Frá verkviti til vöru - Af framgangi og fyrirstöðum

Rögnvaldur J Sæmundsson, verkfræðingur hjá Össuri og dósent við HR

All of the seminars entailed lively discussions, and the first two seminars were filmed and videos can be found at GEORG website http://georg.hi.is/node/174. The slides from most of the other lectures can also be downloaded from this website.

ROOTS OF GEOTHERMAL SYSTEMS

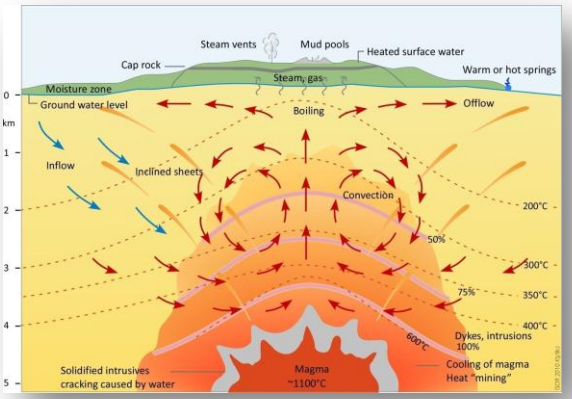


Illustration: Kristján Sæmundsson

A group of our best geothermal reservoir scientists organized, together with GEORG, a series of seminars on the roots of geothermal systems this spring. The seminars were held approximately once a week from mid February till April, total of seven seminars. The seminars started with an intensive lecture on the topic in question each time with a following a discussions among meeting participants. The events were well attended with up to 50 participants per meeting. The topics and lecturers are listed below and the slides can be downloaded at GEORG website: www.georg.hi.is/node/139

- 15.02.11 ***Volcanic Roots of Krafla and Hengill,***
  Lecturer: Sveinbjörn Björnsson
- 24.02.11 ***Properties of intrusives,***
  Lecturer: Hjalti Franzson

- 03.03.11 *Use of Magneto-Telluric prospecting*,
  Lecturer: Knútur Árnason
- 09.03.11 *Pressure and temperature of volcanic geothermal systems and their roots*
  Lecturer: Stefán Arnórsson
- 17.03.11 *Energy transfer to the deep roots The conceptual model for central volcano fields* Lecturer: Jónas Elíasson
- 24.03.11 *Heat Sources – Fluid Interactions*
  Lecturer: Guðmundur Ómar Friðleifsson
- 07.04.11 *Heat extraction in the roots*
  Lecturer: Guðni Axelsson

The "Deep Root Physics Group" as they have chosen to call themselves is now planning a follow-up conference in late August this year, in cooperation with GEORG and NORDVULK on "*Rock Mechanics, associated rock parameters and thermal properties".* Thomas Kohl, Steve Hickman and Ernst Huenges, all world leading experts on rock mechanics, have already been invited to present at the conference and they have all shown interest in participating.

Short Course on Inverse Modeling and Optimization

In connection to the supported project 09-01-028 "Evaluation and Improvements of Geothermal Models using Inverse Analysis" GEORG took part in the organization of a short course on Inverse Modeling. The course was held in early August 2010 at the University of Iceland. The core was conducted in close cooperation of Magnús Þór Jónsson, University of Iceland, Stefan Finsterle and Yingqi Zhang, Lawrence Berkeley National Laboratory. 13 graduate students participated in the course and it gave 2 ECTS. The syllabus of the course can be found in Annex V together with the annual report of the project 09-01-028 and other supported projects.

The second European Geothermal PhD day - EGPD 2011

GEORG supported the EGPD 2011, initiated by the EERA - JPGE and organised by a group of Icelandic graduate students studying topics related to geothermal energy. The aim of the event is to bring together young scientists working in the field of geothermal energy and offer them the opportunity to share ideas and build up a network between them. In total around 60 participants from 20 countries attended the event.

The event was held in Iceland on the 1st -4th of March 2011. GEORG supported the event by funding venue and publication cost. GEORG also assisted in managing the accounting of the event. The EGPD 2011 was the second event in the series and was the first in Potsdam, Germany, in 2010 and GEORG supported 8 graduate students to attend.

CLUSTERS COOPERATION

THE "ICELANDIC GEOTHERMAL CLUSTER – PORTER STYLE"

The conference Iceland Geothermal was held on November 1st 2010. The conference was a milestone in a project managed by Gekon and with the objective of mapping the "Icelandic Geothermal Cluster". Following the conference the Ministry of Industry invited a group of stakeholder to a meeting to discuss further the formulation of a geothermal cluster. GEORG was one of the invitees at the meeting and GEORG is willing to explore the possibilities of further and broader cooperation in this field.

The work continued into 2011 with invested interest of Landsvirkjun and Mannvit. An expert panel was established and Edda Lilja Sveinsdóttir was appointed as GEORG representative along with; Albert Albertsson - HS-Orka; Árni Magnússon – Íslandsbanki; Eyjólfur Árni Rafnsson, -Mannvit; Hörður Arnarson – Landsvirkjun; Stefán Pétursson – Arionbanki and Davíð Lúðvíksson - Samtök iðnaðarins. A plan was set up to have a decision on whether to formally establish a large geothermal cluster in mid June, see below.

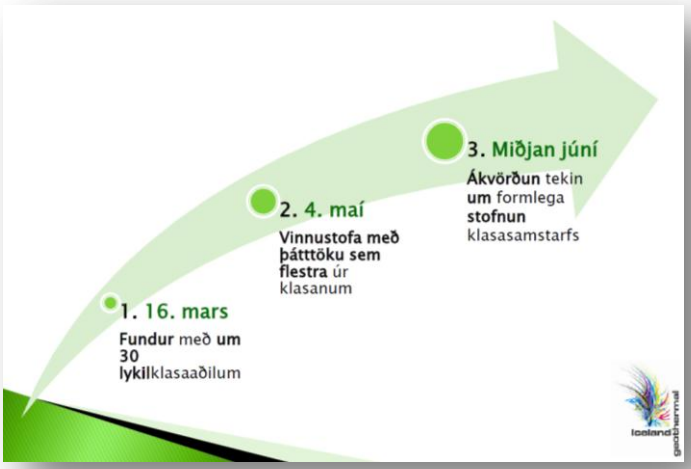


Figure 6: Timeline provided by GEKON

NORDIC-GERMAN-POLISH CLUSTER EXCELLENCE PROJECT

GEORG is taking part in a Nordic-German-Polish Cluster Excellence Project on Benchmarking of clusters in cooperation with Rannís. Two members of the board participated in an interview conducted by Dr. Gerd Meier zu Köcker, Managing Director of the Agency Competence Networks

Germany, who is managing the project on behalf of the project group. The project has organized an intensive cluster conference Copenhagen late May and Hjalti Páll will attend on behalf of GEORG.

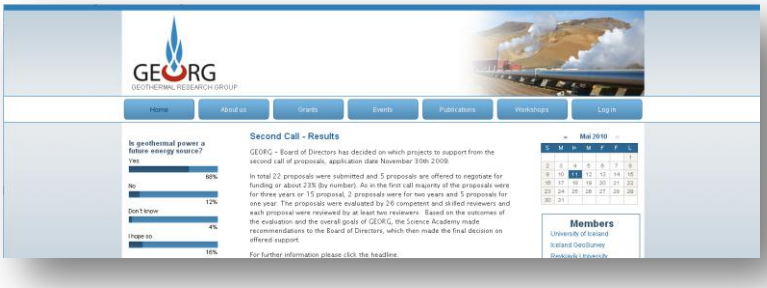
DISSEMINATION

PRESENTATIONS AT CONFERENCES AND MEETINGS

GEORG and University of Iceland organized a half-day conference April 19th, 2011: Orkuráðstefnan: Jarðhiti í brennidepli, where several lectures on various issues in the field were given, including a short introduction on GEORG. GEORG was also introduced at Engineering and Natural Sciences Research Symposium 2010 at University of Iceland, October 8th, 2010. Viðskiptablaðið published an article on GEORG, published in connection with the "Iceland Geothermal" conference, held in November 2010. GEORG was also acknowledged, few times, in speeches held by the Minister of Industry, the Rector of the University of Iceland and others.

WEBSITE

GEORG web address is www.georg.hi.is. All relevant information on the cluster is gathered at this website as well as all application documents and evaluation guidelines for the call of GEORG. The website is maintained and updated by the Operational Manager.



GEORG is also active on Facebook. The site can be found under http://www.facebook.com/pages/GEORG-GEOthermal-Research-Group/203518776344624 or simply by looking up GEORG – GEOthermal Research Group.

ANNUAL ACCOUNTS

The annual accounts for the second year are presented below. The operating year is April 1st, 2010 – March 31th, 2011. All amounts are in thousand ISK.

GEORG - Cost and financing account

		Year 1			Year 2		
Cost	**Note**	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
Grants	1	10.958	31.731	42.689	53.452	218.921	272.373
Contracted services	2	957	0	957	537		537
Travel expenses	3	0	0	0	433		433
Conferences, dissem. & outreach	4	724	845	1.569	308	3.500	3.808
Overhead total	5	6.505	8.700	15.205	8.829	6.200	15.029
Total operation cost		**19.144**	**41.276**	**60.420**	**63.559**	**228.621**	**292.180**
Financing							
Partner Co-financing			41.276	40.931	400	228.621	229.021
Funding from Rannis	6	50.000		50.000	76.000		76.000
Total financing		**50.000**	**41.276**	**90.931**	**76.400**	**228.621**	**305.021**
Results of operational acivities		**30.856**	**0**	**30.856**	**12.841**	**0**	**12.841**

GEORG - Balance sheet

Assets	**Note**	**31. March 2011**
Cash and cash equivalents	7	43. 697
Unpayed funding fom Rannís	6	14.000
Unaccounted co-financing of R&D projects	1	61.289
Total assets		**118.985**
Debts and liabilities		
Unpayed grants for projects	1	26.844
Unaccounted co-financing of R&D projects	1	61.289
Total debts and liabilities		**88.133**
Total assets		**30.853**

ANNUAL ACCOUNTS - NOTES

1. Grants

GEORG has supported 19 projects as well as supporting student activity. Negotiation with 3 of the 4 supported projects in call three is ongoing so no payments have been made so far. In the table below the amounts of grants are listed according to type. The partners co-financing is estimated according to the projects status.

	Year 1 April 2009- April 2010			Year 2 April 2010- April 2011		
Grants	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
RTD Projects first call						
09-01-003				*2.580*	*5.645*	*8.225*
09-01-005	*1350*	*3.538*	*4.888*	*2.700*	*7.075*	*9.775*
09-01-007	*1100*	*7.525*	*8.625*	*3.400*	*22.575*	*25.975*
09-01-011	*750*	*10.170*	*10.920*	*0*	*3.390*	*3.390*
09-01-012	*2200*	*2.175*	*4.375*	*4.300*	*9.400*	*13.700*
09-01-013	*1863*	*2.275*	*4.138*	*5.589*	*6.825*	*12.414*
09-01-016	*2475*	*3.475*	*5.950*	*4.950*	*6.950*	*11.900*
09-01-017	*350*	*2.018*	*2.368*	*900*	*6.054*	*6.954*
09-01-028				*5.920*	*14.020*	*19.940*
09-01-029	*350*	*555*	*905*	*650*	*1.110*	*1.760*
RTD Projects second call						
09-02-001				*6.000*	*18.281*	*24.281*
09-02-003				*7.500*	*83.609*	*91.109*
09-01-005				*3.375*	*25.013*	*28.388*
09-02-010				*1.000*	*2.550*	*3.550*
09-02-017				*1.900*	*2.072*	*3.972*
RTD Projects third call						
10-03-004				*2.000*	*4.352*	*6.352*
10-03-005				*0*	*0*	*0*
10-03-012				*0*	*0*	*0*
10-03-013				*0*	*0*	*0*
PhD day travel grants	*400*		*400*			
BEST Reykjavik	*120*		*120*			
European PhD day 2011				*488*	*200*	*688*
Grants Total	**10.958**	**31.731**	**42.689**	**53.252**	**219.121**	**272.373**

The cash flow is somewhat slower than planned because of unexpected postponement of project start-ups. GEORG is however liable to pay the planned amount, given that the projects deliver according to the grant agreements. The project partners are also liable to provide the planned co-financing accordingly.

2. Contracted services

Considerable less service was bought during the second year of operation, then the year before.

	Year 1 April 2009- April 2010			Year 2 April 2010- April 2011		
Contracted services	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
Printing & publishing etc.						
Advertisements	*267*		*267*	*164*		*164*
Website	*121*		*121*	*11*		*11*
Logo	*187*		*187*			
Legal & audits				*56*		*56*
Legal consult - EEIG	*82*		*82*			
Subcontracted other						
MarkMar-consult.	*300*		*300*			
SA chair				*306*		*306*
Contracted services Total	**957**	**0**	**957**	**537**	**0**	**537**

3. Travel expenses

During the preparation of the ERA NET proposal, two trips were made to Europe, one to Utrecht in The Netherlands and one to Paris, France.

	Year 1 April 2009- April 2010			Year 2 April 2010- April 2011		
Travel expenses	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
Outside of RTD projects						
ERA NET meeting in Utrecht			*0*	*218*		*218*
ERA NET meeting in Paris				*215*		*215*
Total	**0**	**0**	**0**	**433**	**0**	**433**

4. Other costs

Largest part of conference and dissemination costs this year is covered by the partners themselves and involves cost of setting up and hosting the seminar series on Roots of Geothermal systems and the innovation workshop “Frá gufu til gjaldeyris”.

	Year 1 April 2009- April 2010			Year 2 April 2010- April 2011		
Conferences, dissem. & outreach	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
GEORG - Open Conferences	*251*	*345*	*596*	*282*		*282*
Samorka, Sustainability conference	*126*		*126*			*0*
Reservoir workhop	*33*	*500*	*533*			*0*
Roots of Geothermal Systems				*26*	*1.500*	*1.526*
Frá gufu til gjaldeyris					*2.000*	*2.000*
Total	**410**	**845**	**1.255**	**308**	**3.500**	**3.808**

5. Overhead

The largest part of GEORG overhead goes in to operating the office and paying the salaries of the Operational Manager. A large part is also involved in the participation of partners in committees as BoD, SA and RC. The cost of these participations is paid by the partners themselves and is accounted as partner co-financing. Note that the cost of office rental in Year 1 is included in Year 2 accounts.

	Year 1 April 2009- April 2010			Year 2 April 2010- April 2011		
Overhead for GEORG	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
Operational Manager & secretariat	*6.223*		*6.223*	*6.894*		*6.894*
Office operation	*229*		*229*	*1.930*		*1.930*
Other general operational costs	*52*	*8.700*	*8.752*	*5*	*6.200*	*6.205*
	6.504	**8.700**	**15.204**	**8.829**	**6.200**	**15.029**

6. Funding from Rannís

Rannís has paid out 56MISK out of the 70 MISK agreed for this year. Included in this year payment are the last two payments from Year 1, 12MISK and 8MISK. The payments for the second year are paid out according to the Grant Agreement between GEORG and Rannís, see table below.

Payments upon:	**Date**	**Amounts in ISK thousand**
Signature of the contract	June 2010	28.000
A Progress report	Dec 2010	28.000
An Annual report	April 2011	14.000
Total amount for the 2st year		70.000

Rannís shall pay the final payment (14MISK) for the second year at the delivery and acceptance of this annual report.

7. Cash and cash equivalents

On the 31st of March 2010 the status of GEORG accounts was 43.697 thousand ISK.

SUMMARY

A summary is provided at page 3.

ANNEX I-V

GEORG
GEOTHERMAL RESEARCH GROUP

Aðalfundur,
"General Assembly"
er æðsta stjórnvald GEORG
og er haldinn einu sinni á ári.

Aðalfundur er eingöngu
ætlaður meðlimum klasans
og eru þátttakendur beðnir
um að skrá sig með því að
senda tölvupóst á:
georg@orkugardur.is
eða með því að samþykkja
fundarboðs em á þá er sent.

GEORG - GENERAL ASSEMBLY

Reykjavík Energy headquarters, Bæjarháls 1, Reykjavík
Friday 21. May , 9:30 - 12:00

09:30-10:00	*Coffee and refreshments*
10:00-10:05	*Welcome note by the Chairman of the Board* *Sigurður Magnús Garðarsson*
10:05-11:15	*Annual Report Presentation* *- Report of the Board* *Sigurður Magnús Garðarsson, Chairman of the board* *- Annual Accounts for 2009/2010* *- Financial plan for 2010/2011* *Hjalti Páll Ingólfsson, Operational Manager* *- Discussions*
11:15-11:30	*Elections* *- Election of Board of Directors* *- Election of Science Academy*
11:15-11:30	*Regulations on New Member Admission*
11:30-12:00	*Other matters*
12:00-13:10	*Lunch break*

www.georg.hi.is

GEORG

MÁLÞING UM RANNSÓKNIR Í JARÐHITA

í húsakynnum Orkuveitu Reykjavíkur
föstudaginn 21. maí, kl. 13:10 - 16:00
Málþingið mun fara fram á ensku og er öllum opið

Í tengslum við ársfund GEORG, alþjóðlegs rannsóknaklasa í jarðhita, er efnt til opins málþings um jarðhitarannsóknir og nýtingu jarðhita.

Markmið rannsóknaklasans er að leiða saman aðila á jarðhitasviðinu og mynda sterkt afl til skjótra framfara í jarðhitarannsóknum, verkfræði og hönnun.

Framtíðarsýn klasans er að verða leiðandi afl í alþjóðlegum jarðhitarannsóknum.

13:10-13:20	***Welcome Address*** *Sigurður Magnús Garðarsson, Chairman of the Board*
13:20-13:40	***International Partnership of Geothermal Technology (IPGT)*** *Ólafur G. Flóvenz, IPGT board member, ÍSOR*
13:40-14:00	***The IEA Geothermal Implementing Agreement (GIA)*** *Jónas Ketilsson, GIA - Vice Chairman* *The National Energy Authority*
14:00-14:20	***International Operation of Mannvit Engineering*** *Tryggvi Jónsson, Mannvit*
14:20-14:45	***Kaffihlé***
14:45-15:00	***Geothermal Models Using Inverse Analysis, Iceland / US Cooperation*** *Magnús Þór Jónsson, University of Iceland*
15:00-15:15	***Biological Utilization of Geothermal Gas*** *Guðmundur Óli Hreggviðsson, University of Iceland*
15:15-15:30	***High Pressure and High Temperature Geothermal Grouts*** *Gísli Guðmundsson, Mannvit*
15:30-15:45	***Resistivity Survey of Grímsvötn*** *Arnar Már Vilhjálmsson, ÍSOR*
15:45-16:00	***How should GEORG proceed?*** *Almennar umræður*

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ANNEX II,

GENERAL ASSEMBLY. #2.

Meeting Minutes

Date: 2010-05-21

Present: See Appendix 1; Registration sheet
Voters: See Appendix 2; Voters

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1. ***Welcome note by the Chairman of the Board*.**

a. The Chairman of the board (Sigurður Magnús Garðarsson) welcomes the participants and goes through the agenda of the General Assembly as well as the open conference in the afternoon. Then he proposes Guðrún Sævarsdóttir as chair of the meeting and Hjalti Páll Ingólfsson to take the minutes. Approved by the meeting.

2. ***Annual Report Presentation***

Report of the Board

a. Sigurður Magnús Garðarsson presented the annual report and explained the progress of the first year.

Annual Accounts

b. Hjalti Páll Ingólfsson presented the annual accounts for the first year, account period 1. April 2009- 31. March 2010. He presented also the budget plan for 2010-2011.

Discussion

c. The report and accounts discussed and approved by the meeting. In addition there were some discussion on the general operation and strategy of GEORG.

Operational form

Hallgrímur Jónasson asks whether the different operational form (Consortium Agreement in state of EEIG) makes any difference regarding the overall operation. Sigurður Magnús Garðarsson stated that the operational arrangement would in fact not change the daily operation and at the moment there are no plans of change it. The reason that the EEIG form did not work was the joint and several liability clause the EEIG operational form requires. Some of the partners could not take on such liability.

Future plans

Magnús Þór Jónsson asks about future plans of GEORG, where to go and how the cluster should develop. Sigurður Magnús Garðarsson answers and emphasizes that the cluster should constantly be in development and the participants can influence on how it evolves. He points out increased interest of different parties to join GEORG or work closely with the cluster. One example of that is the consultant company Gekon which is working on a project of mapping the Icelandic Geothermal Cluster and would like to cooperate with GEORG.

Evaluation Process

There were also some discussion about the evaluation process; Jónas Ketilsson expressed his concern about a difference between evaluators and how some evaluators seemed to be giving relatively high scores when others were more critical and gave lower score, based on his experience as an evaluator. The BoD and the

Operational Manager is well aware of this thread and this is a common problem within evaluation processed like this. However everything is done to prevent uneven evaluation and in addition the AHP method is used in processing the scores which also evens out possible difference in individual evaluations. Magnús Þór Jónsson proposes the possibility of applying unanimous evaluations on some parts of the application texts, for example the scientific and technical merits. This will be considered but might be difficult because of how small the group is and it might also be pretty transparent how the leader of some of the proposed projects is. Another effective way is to increase the role of outside reviewers and continued effort will be put in ensuring outside reviewers for the next call.

3. *Elections*

Board of Directors (BoD)

a. At the last BoD meeting board members were either elected for one year or two years. This means that for the coming years only part of the board is elected at each General Assembly and all new member are elected for two years. The outgoing Board of Directors proposed the following changes in the Board of Directors for this election.

Outgoing member		***New member***	***Representing***
Andri Stefánsson	->	Sigrún Hreinsdóttir	*Icelandic Universities, research institutions and governmental agencies*
Edda Lilja Sveinsdóttir	->	Rúnar Unnþórsson	
Bjarni Pálsson	->	Edda Lilja Sveinsdóttir	*Energy companies*
Oddur B Björnsson	->	Auður Andrésdóttir	*Private companies*

This proposal was approved with all votes in favour.

The BoD will therefore consist of the following individuals. The numbers in the brackets indicate the number of years left.

Icelandic Universities, research institutions and governmental agencies – 5 BoD seats	***Energy companies – 1 BoD seat***	***Private companies– 1 BoD seat***	***Other EEA based participating collaborators and Associate members – 1 BoD seat***
Sigurður Magnús Garðarsson (1) Sigrún Hreinsdóttir (2) Guðrún Sævarsdóttir (1) Rúnar Unnþórsson (2) Ólafur G Flóvenz (1)	Edda Lilja Sveinsdóttir (2)	Auður Andrésdóttir (2)	Ernst Huenges (1)

Science Academy

b. Most of the former SA members wanted to continue working in the committee.

Only two SA members could not continue for the next year, these are William Harvay and Freysteinn Sigmundsson.
The outgoing BoD therefore proposed the following individuals for the Science Academy. The green names indicate new members, other members are continuing from last year.

Name	*Position*	*Name*	*Position*
Sveinbjörn Björnsson	**Chair**		
Brynhildur Davíðsdóttir	University of Iceland	María S Guðjónsdóttir	Reykjavik University
Árný Erla Sveinbjörnsdóttir	University of Iceland	Guðni A Jóhannesson	OS
Guðni Axelsson	Iceland GeoSurvey	Einar Gunnlaugsson	OR
Halldór Pálsson	University of Iceland	Kristinn Ingason	Mannvit
David Mainprice	CNRS	David Bruhn	GFZ
Hrefna Kristmannsdóttir	RES	Ingólfur Örn Þorbjörnsson	Innovation Centre Iceland

The new SA members were elected with all votes in favour.

4. ***Regulations on New Member Admission***

The outgoing BoD proposed to apply the following rules regarding the accession of new members:

- ✓ *Additional members of GEORG should be companies or institutions that conduct research and/or development in the field of geothermal science, technology and utilization and can contribute to the overall objectives of GEORG.*
- ✓ *The admission of a new member is subject to the payment of an admission fee, decided by the BoD.*
- ✓ *Indicative admission fee for 2010 is $2.000*
- ✓ *Admission of a new member must be approved by 2/3 of votes at General Assembly.*

The rules were discussed, especially the admission fee. In general the payment of an admission fees was thought to be acceptable but the indicative number should not be included in the rules, this should be the decision of the Board at any given time.

The conclusion was to vote on bullets points #1, 2 and 4 and exclude the bullet point on indicative admission fee. - Approved with all votes in favour.

5. ***Other matters***

a. No other conclusions made and meeting adjourned

Appendix 1; Registration sheet

GEORG

2nd GENERAL ASSEMBLY, 2010
REGISTRATION SHEET

NAME	ORGANISTAION	E-MAIL
Edda Lilja Sveinsd.	REYST	els@reyst.is
Bjarni Pálsson	landsvirkjun	bjarnip@lvp.is
Jakob K. Kristjánsson	Prokatin ehf.	jakob@arkea.is
Guðm. Ó. Friðleifsson	HS orka hf	gof@hs.is
Ólafur G. Flóvenz	ISOR	ogf@isor.is
Kristinn Ingason	Mannvit hf.	kristinn@mannvit.is
Jónas Ketilsson	OS	JONAS.KETILSSON@OS.IS
WILLIAM HARVEY	HR	HARVEY@RU.IS
Hallgrímur Jónasson	Rannís	hallgrimur@rannis.is
Sigurður Björnsson	Rannís	sigurdur@rannis.is
Árni Stefánsson	Jarðvísindast. HÍ	as@hi.is
[illegible]	IVT - HÍ	[illegible]@hi.is
Magnús Þór Jónsson	IVT - HÍ	magnusj@hi.is
Ingólfur Jakobsson	NMI	Ingo@NMI.IS
María S. Guðjónsd.	HR	msg@ru.is
Sigmundur M. Einarsson	HÍ	sigmg@hi.is
Halldór Pálmar Halldórsson	GEORG	halldor.p.ingolfsson@orkugardur.is

Appendix 2; Voters

REYST	Edda Lilja Sveinsdóttir
OR	Edda Lilja Sveinsdóttir
Landsvirkjun	Bjarni Pálsson
ÍSOR	Ólafur G. Flóvenz
HSOrka	Guðmundur Ó. Friðleifsson
Mannvit	Kristinn Ingason
National Energy Authority	Jónas Ketilsson
Reykjavik University	William Harvay
University of Iceland	Ólafur P. Pálsson
Innovation Center Iceland	Ingólfur Örn Þorbjörnsson

ANNEX III

ABSTRACTS OF THE SUPPORTED PROJECTS FROM THE THIRD CALL

Application Number	10-03-004
Project Title	GREEN GEOTHERMAL GROWTH - Use of geothermal heat for warm water ecoculture
Coordinator (company /name)	UNI / Sjöfn Sigurgísladóttir

Project Abstract (copy from proposal)

The aim of the project is to implement sustainable warm water aquaculture in Iceland utilizing local resources, building an ecological food park based on integrated systems with polyculture, aquaponics, tailored feed from local raw materials and added value food production with focus on healthy and safe food for export. Natural green production circles optimize the utilization of energy, water, organic waste material, land and other local resources. This will provide conditions favorable for the sustainable growth of Icelandic food production with focus on utilization of geothermal heat, ensuring both adequate supplies of seafood and vegetables and protection of the environment.

Application Number	10-03-005
Project Title	GeoChem
Coordinator (company /name)	Center for Systems Biology – University of Iceland / Bernhard Örn Pálsson

Project Abstract (copy from proposal)

The overall goal of this project is to design and build a photobioreactor-based algae factory that utilizes geothermal energy in an efficient manner to fix CO2 into valuable chemicals that are produced from algae. We propose a new photobioreactor (PBR) design that combines light-emitting diode (LED) technology and algal biotechnology to produce algae from electrical energy and CO2 emitted from geothermal wells in Iceland. Many of the fundamental design parameters of such a factory have already been determined through experimentation with a fully functional prototype operated at the Center for Systems Biology at the University of Iceland.

Application Number	10-03-012
Project Title	Sustainability Assessment Protocol for Geothermal Utilization
Coordinator (company /name)	UNI / Brynhildur Davísdóttir

Project Abstract (copy from proposal)

Sustainable development calls for the use of sustainable energy systems. However the way in which a geothermal resource is utilized will ultimately determine whether or not it is sustainable. Sustainable utilization of geothermal energy means that it is produced and used in such a way that it is compatible with the well-being of current and future generations.

The objective of this project is to develop a Sustainability Assessment Protocol for Geothermal Utilization (GSAP), tailored especially for geothermal energy development projects. This protocol will be tested and implemented for projects in countries at various stages of development, Including Iceland.

Application Number	10-03-013
Project Title	Mapping interaction between magmatic and hydrothermal system with fluid inclusion analysis
Coordinator (company /name)	ISOR / Anette K. Mortensen

Project Abstract (copy from proposal)

Through analyses of hydrothermal alteration and chemical analysis of fluid inclusions (major, trace, gasses and isotopes) of cuttings from wells that have reached parts of a geothermal reservoir impacted by magmatic gasses the project seek to constrain the chemical processes and model the magmatic fluxes at the transition zone between the magmatic and hydrothermal system

ANNEX IV

INTERNAL STRATEGY WORK.

Main recommendation from WP leaders at the WP-leader meeting in August 2010

- WP 2:
  - High emphasis on student involvement until now
  - Lack in fulfilling promised deliverables, what should be done?

- WP 3:
  - Low emphasis until now, lack in fulfilling deliverables, seminars needed and innovation workshop planned in Oct.
  - Discussed to offer support to innovative angles on existing projects, add on...

- WP 4:
  - WP-4 has had the highest success rate until now
  - Majority of the proposed topics in WP-4 are already covered

- WP 5:
  - Fairly good distribution till now, but lack technical
  - Next call highlights
    - 2. To investigate possibilities of direct industrial utilization of geothermal heat.
    - 6. To develop new methods for maintenance procedures in geothermal machinery.
    - 7. To investigate technical aspects of offshore drilling and utilization.

- WP 6:
  - Overwhelming emphasis on of the nature of geothermal resources – goal a)
  - Next call highlights
    - b) Improve the understanding of environmental and health impacts of geothermal utilization
    - e) Create a global protocol for sustainable utilization of geothermal resources, following the principles of sustainable development
    - d) Promote multiple integrated use of geothermal resources

- WP 7:
  - Only ONE project has been supported so far.
  - Necessary prerequisite for most others in the package. Also applied for extended cost-benefit analysis and sustainability assessment but not successful.
    - Solution: Allow cohesive buildup of package – put focus on WP 7 topic in the 3rd call

- WP 8:
  - WP Leaders will have budget for internal work.
  - The next call for proposals would include a call for a Regional mini-conference (as. D8.3) with a budget of c.a. 1MISK
  - To make the open conferences of GEORG more visible internationally by inviting key note speaker from the EU Commission. Involve the foreign partners of GEORG to

increase the visibility even more. Budget of 0,5MISK should be set aside for this activity.

– Set aside budget for lobbying for GEORG as part of WP 8 activates, 0,25-0,5MISK

Strategy meeting - Meeting Minutes

Date: 5. January 2011

Participants: Sigurður Magnús Garðarsson (HÍ/GEORG BoD), Hjalti Páll Ingólfsson (GEORG OM); Ólafur Flóvenz (ISOR/GOERG BoD) Auður Andrésdóttir (Mannvit/GEORG BoD), Sigrún Hreinsdóttir (HI/GEORG BoD), Rúnar Unnþórsson (Keilir/GEORG BoD), Guðrún Sævarsdóttir (HR/GEORG BoD), Edda Lilja Sveinsdóttir (OR/GEORG BoD), Sigurður Bogason (Mark Mar/GEORG WP8); Björn Víkingur Ágústsson (RANNÍS); Brynhildur Davíðsdóttir (HÍ/GEORG WP7); Guðni A Jóhannesson (OS); Sigurður Björnsson (RANNÍS); Guðni Axelsson (ISOR/GEORG WP6); Ágúst Valfells (HR/GEORG WP3).

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1. **Opening by the Chairman**

Sigurður Magnús welcomes the participants and begins with a roundtable introduction.

2. **Funding procedures**

Hjalti Páll Ingólfsson gives an overview on Calls 1-3. He went through the development of sought and supported projects and experiences of project follow-up, the slides are annexed.

a. Most of the project activity involves only a number of a few key partners.
b. Involvement of others is limited or none.
c. Project follow-up procedures are inefficient and it's difficult to get the required reports submitted. The idea of simplifying the follow – up discussed, for example to have an Open GEORG day, ones or twice every year, where ongoing projects would be presented as a replacement for summary reports.

Auður Andrésdóttir and Edda Lilja Sveinsdóttir shared the experience of Mannvit and Orkuveitan in taking part in GEORG calls. The slides Auður presented are annexed.

d. Auður reminded us on few of the objectives of GEORG, e.g. *"to break through existing scientific and technical barriers to innovation"* and to *"Increase significantly the number of qualified experts in geothermal research, engineering, design and technical exploitation of the resource"*. To achieve these goals we would need broader cooperation of academia and "industry" and to increase the weight of practical projects in the evaluation process.
e. She also explained that the preparation of project proposals is thought to be complicated and time consuming and even too expensive to participate.
f. There is often a lack of experience within the industry to write and prepare a good scientific proposal.
g. Edda Lilja did agree with Auður on these basic issues

Discussion: Are changes needed?

Fruitful discussion followed the presentations, here are few discussion points

h. GEORG might slowly be developing into "just another research fund", this was not the intent in the beginning and actions are needed to prevent this.
i. GEORG needs to be more visible, introduction really needed, both internally and externally.
j. The funding procedure of GEORG is complicated and "heavy" and changes might be needed, not to exclude scientific projects but rather to introduce something else on the side, e.g.
    i. Special calls for "practical projects"
    ii. Support internship and mobility of researches, experts and students
    iii. Indentify un-tackled tasks and target it directly as GEORG project.
    iv. To set up a "Think tank" where group of well selected experts would brainstorm on needed research topics and based on the results, action would be implemented
k. Increased active cooperation needed,
    i. Technology platform on geothermal?
l. RANNÍS external review on GEORG is planned next year.
    i. The review is based on the objectives of the "STRATEGIC RESEARCH PROGRAMME - CENTRES OF EXCELLENCE AND RESEARCH CLUSTERS"
    ii. The group needs to be prepared and make sure that we have done what we can to fulfil the tasks as we have promised

3. WP3: Innovation and entrepreneurship (Discussion leader: Ágúst Valfells)

Ágúst Valfells discusses issues related to WP3 innovation and entrepreneurship. He presented his view on the products of geothermal; Electricity, Heat, Materials (chemicals) & Environment and the need for players of different fields to cooperate on innovation. How can we make better use of low enthalpy resources, what is most often thrown away today? He proposed that GEORG should organize a series of workshops on innovation to discuss this;

- Geothermal + Chemical
- Geothermal + Tourism
- Geothermal + Food Production
- Etc...

How can we create scalable products? Consultancy is not a scalable product...

He talked about the necessity of coordination in energy related education in Iceland; the effort is too spread out in his opinion. Lot of money put in but limited output and achievements. Maybe GEORG should support mobility, training and even internship, not only focus on higher education?

Ágúst also discussed the possibility of GEORG being a platform for stakeholders to discuss the overall strategy of geothermal energy utilisation, what is the best way of utilising the resources.

Discussion: How can GEORG stimulate innovation and entrepreneurship within GEORG?

Discussion points:

- Patents: Some discussion about lack of patent in the geothermal field; GEORG should help stimulating new patents
  - Get someone to introduce what steps to take towards a patent (workshop-introduction meeting)
  - Could GEORG take a patent as a group?
  - 5-7 patents promised in the proposal to Rannís, something to think about.
- "Ár nýsköpunar" hjá Samtökum Iðnaðarins - "Year of innovation" at the Federation of Icelandic Industries.
  - Seek ways to make use of that
- Revenue opportunities for GEORG
  - How can we continue in 7 years?
  - GEORG needs to proof itself, convince the group on its right for existence.
  - Royalty - through patents?
  - Membership fees – maybe not enough.
  - "Bolt on Projects"

4. Cooperation with GEKON and others on Geothermal Cluster – Porter style

Hjalti Páll Ingólfsson & Edda Lilja Sveinsdóttir gave a short briefing on the background and the next steps.

a. The conference „Iceland Geothermal 2010" was held in Iceland November 1st 2010 where Dr. Michael Porter introduced his analysis on the Icelandic Geothermal Cluster.
b. Following the conference The Ministry of Industry wanted to seek ways to take this to the next level and create "the Icelandic Geothermal Cluster".
c. Two meeting been held so far in a small group of key participants, GEORG among them, and other meetings planed early 2011 as well as a larger workshop on possible opportunities and cooperation.
d. What role GEORG will play depends a bit on the outcomes of these next meetings and workshop.

Discussion: Meeting agreed that GEORG should continue to be involved in these discussions and formulation of an Icelandic Geothermal Cluster. The clear goal of GEORG in that participation is to increase the value of geothermal utilization – be it education, knowledge transfer to other countries, products, etc. We should use the work of WP-3 in achieving that goal.

5. How can CEORG further stimulate cooperation between members

a. Discussion
   i. See above.

6. Other items

a. ERA NET
   i. Hjalti Páll and Guðni A Jóhannesson inform that Iceland has taken the initiative to send in a proposal in the call FP7-ERANET-2011-RTD on ERA NET in Geothermal Energy. GEORG is managing the proposal preperation but the ERA NET will be lead by Orkustofnun. Iceland, France, The Netherlands, Germany, Swiss, Italy and Hungry are confirmed partners and in addition

Slovakia, Slovenia and Turkey have shown interest in participating. The deadline of the call is February 22. 2011.

ii. The objective of the ERA-NET scheme is to step up the cooperation and coordination of research programmes in the field of geothermal energy at national level in the Member or Associated States through the networking of research and other geological programmes.

iii. Participating in this ERA NET gives a golden opportunity to deepen the cooperation of national program owners and administrators and thus be an enabler for the integration of national research and development agendas into a coherent European geothermal R&D program.

iv. The expected duration of the ERA NET is 4 years and the indicative budget is 2M€. ERA NET is a coordination action and is 100% financed by the EU Commission.

b. NEXT STEPS

i. GEORG BoD will be briefed about the outcome of this meeting.

ii. The BoD will set up an action plan based on the discussion today and inform the participants of this meeting.

c. No other items discussed

04.04.2011/ELS

PROPOSAL FOR WP-2 EDUCATION ACTIONS 2011-2015 – DRAFT 1

- **Partners:**
- David Bruhn, GFZ Potsdam
- Edda Lilja Sveinsdottir, OR (WP-2 leader)
- Guðmundur Ómar Friðleifsson, HS
- Guðrún Sævarsdóttir, Reykjavik University
- Hjalti Páll Ingólfsson, GEORG manager
- Ingólfur Þorbjörnsson, Innovation Center Iceland
- Ingvar Birgir Friðleifsson, UNU-GTP
- Magnús Þór Jónsson, University of Iceland
- Ólafur G. Flóvenz, ISOR
- Rúnar Unnþórsson, Keilir
- Sanjuan Bernard, BRGM

1. Background
Decision of the BoD is to review the status of the WP´s status and make suggestions on how to proceed in order to fulfil the objectives of the work package.

The BoD plans to present a thorough review of the status of all the GEORG deliverables at third General Assembly, May 19th, 2011. This review will be used to determine the direction for GEORG during the third year of operation and to prepare for the end of 3rd year review. Therefore, BoD requests that the WP leaders to gather views and information from all GEORG partners involved in their WP´s.

They must deliver the results in a short report that will include information and opinions on the status of the deliverables, a proposal on how to achieve the objectives and deliverables – or if some objectives or deliverables should be changed or deleted and if a special contract should be made for any special task or deliverable.

WP-2 Objectives:

- Promote education and research in the diverse knowledge areas involved in geothermal utilization and increase the number of young scientists and technical experts by 20% in the fields.
- Attract leading scientists and technical experts from around the world to contribute to the development of the education and training within this programme.
- Involve local experts, both from academia and industry, in the various research projects with the goal of advancing the local knowledge base.

2. Suggestion to GEORG BoD on plan for WP-2

The following was agreed at a meeting of several WP-2 partners 30.03., 2011.

Deliverables:

D2.1 Annual output of BSc students in science and engineering increased significantly from the participating universities; From 2011 a benchmark of an addition of 15 students annually, Undergraduate Benchmark Reports (months 12, 24, 36, 48, 60, 72, & 84)
This annual report shall be made by the GEORG operational manager, all information drawn from the annual reports of the projects funded by GEORG.

D2.2 Increase number of graduate students in disciplines focusing on geothermal sciences annually within 2 years; Benchmark of at least 30 MSc students enrolled by 2011, and at least 20 PhD graduates by 2015. Graduate Benchmark Reports (months 12, 24, 36, 48, 60, 72, & 84)
Based on a review of the WP-relevance, (as suggested by the project applicants), WP-2 is well covered in general, but only in terms of student´s participation in the research projects.

There is need for analysis on the number of students involved in the projects supported by GEORG, and how many graduate per year (BSc, MSc and PhD). This annual report shall be made by the GEORG operational manager, all information drawn from the annual reports of the projects funded by GEORG.

A special emphasis should be on attracting young people to the field of geothermal sciences. The following suggestions were made:

- Open days at the universities – special invitation to high school students
- Visits for groups of high school students between countries
- Summer schools.

GEORG partners shall report to the operational manager the extent of these activities in their country.

D2.3 Staff Exchanges and visiting scientist registry reports (months 12, 24, 36, 48, 60, 72, & 84)
To the knowledge of the meeting partners, this objective has not been achieved. It was decided to suggest to the BoD to set aside a budget for exchange scientists between GEORG partners.

D2.4 Bi-annual report on new educational pathways developments, and new course listings (months 24, 48, 72, & 84)

GEORG should offer grants to a certain number of short courses per year, e.g. one course from each country involved in GEORG (IS, G, F, USA). An example of execution of this is to set aside € 25.000 which would cover cost of 25 students in the four countries. The courses would cover different topics.

Importantly, all activities suggested here would also increase the cooperation of the partners in GEORG.

To summarise the WP-2 suggestions for activities for the next two years, a special budget should be set aside in order to be able to deliver D2.3 and D2.4.

Status of WP-4

WP-4, Geothermal Resources, deals with research related to the geothermal systems, i.e. the source of the energy. It encompasses the geology of the reservoirs and the understanding of the physical processes involved as well as the technology to explore and exploit the resource.

From the beginning, WP-4 projects proposals were quite successful in the open calls. Therefore the possibilities for applying for projects in WP-4 where constricted in the third call.

In the contract with Rannis it was anticipated that 23,3% of the GEORG budget would be used to support WP-4 activities while the support ratio after the first three calls was 31,8%.

WP-4 consists of seven tasks (4.1 to 4.7) and individual task is composed of several subtasks. The following table show the numbers of subtasks within individual tasks and how many of them are already addressed in the on-going projects.

Task	Number of subtasks	Subtasks supported in projects through calls 1-3
4.1	5	3
4.2	5	2
4.3	6	4
4.4	2	2
4.5	3	2
4.6	4	2
4.7	1	1
Total	26	16

Task 4.7 is not yet started. Since it includes making of research strategy for siting of deep geothermal wells the work will rely on the outcome of the projects covering the other tasks. Therefore it is naturally to be dealt with in the second half of the first 7 years of Georg activities. To cover this task some other measures than open call for proposals are recommended.

In the following years it is foreseen that other important tasks of WP-4 that still are not covered will be open for future project calls. Some might however been covered by other means like workshops.

The deliverables of WP-4 are number of publications in scientific journals and conference papers like the World Geothermal Congress. As a consequence the deliverables will appear at the end of the projects, the first are to be expected in 2012 but a large number in 2013 to 2015.

GEORG
WP5 status report

Halldór Pálsson

April, 2011

1 Introduction

The purpose of this report is to summarize the current status of the main deliverables of Work Package 5 (WP5) with respect to the original application of the GEOthermal Research Group (GEORG) to the Icelandic Centre for Research (RANNÍS) in year 2009. The report is divided into two main parts, where in the first part each deliverable is discussed with respect to how well it has been fulfilled and what is mainly missing in fulfilling the proposed description in the original application. In the second part recommendations are presented for each deliverable, pointing out in detail what would be the necessary and appropriate steps to fulfill the description. The report is then concluded with some general remarks about the GEORG progress as a whole, pointing out if and how changes should be made to GEORG in the long run.

The main reference for the description of deliverables is a document provided by the Operational Manager of GEORG, Hjalti Páll Ingólfsson, titled *Strategic Research Programme, Attachment 1* containing description of the work packages in the GEORG application to RANNÍS.

2 Current status of tasks related to deliverables

The title of WP5 is *Technologies and Innovative Applications* and it is mainly focused on research and innovative work involving current and new technologies used in geothermal exploration and utilization. Eight sub-tasks of WP5 were identified in the project application and their individual status is reviewed below, mostly in conjunction with the projects that have been funded

until now, but also related to other projects that GEORG's participants have been working on.

2.1 Drilling and using geothermal wells, design improvements and new challenges

Project 09-01-013 *High pressure and high temperature geothermal grouts*, addresses one of the main issues in geothermal well design, namely the cementing of the well casings with different grouts. Corrosion in well casings is also partly addressed in 09-02-010 (see section 2.5 below) where fluid from deep drilling wells is under consideration.

Several other projects are undergoing by GEORG partners, e.g. between the University of Iceland (Magnús Þór Jónsson and Halldór Pálsson) and Innovation Center Iceland (Ingólfur Þorbjörnsson and Sigrún Nanna Karlsdóttir), regarding structural analysis of well-bores, well casings and wellhead devices. These projects are supported by other funds, but can be included here because

This task has been fulfilled quite well if other projects coordinated by GEORG partners are included, with the most notably missing issues being the drilling process itself.

2.2 Direct use of geothermal heat for industrial processes

Project 10-03-004 *Green geothermal growth*, involves the use of low temperature geothermal fluid for fish farming of a particular type of fish which requires relatively high water temperatures. The purpose is to utilize the low temperature source for both heating of water as well as space heating.

The project above only covers part of the task and the most notable missing topics are drying processes (freeze drying or directly with heat) and absorption cooling. More projects would definitely be appreciated in this task.

2.3 Two phase flow of steam and water

A part of project 09-01-28 *Evaluation and Improvements of Geothermal Models using Inverse Analysis*, involves studies of two phase flow in wells, with the focus on the boiling process and its effects on the structural integrity of the wells. Also two phase flow in the reservoirs is the topic of 09-01-011 *Properties of two phase flow of water and steam in geothermal reservoirs*, which

is related to flow in wells and mentioned in the task description. Several other projects exists, funded by other means, but coordinated by GEORG participants. They involve e.g. measurement of pressure drop involving two phase flow in gathering pipelines (Guðrún Sævarsdóttir and Halldór Pálsson, coordinators) as well as flow behavior in steam separators (Magnús Þór Jónsson and Halldór Pálsson, coordinators).

Here it is clear that by taking into account related projects of GEORG participants, the topics of this task are currently well covered.

2.4 Materials and gases included in the geothermal fluid

Project 09-01-028 *Biological Utilization of Geothermal Gas*, addresses the possible utilization of gases in the geothermal fluid for growing bacteria, but the main goal is large scale production of biomass, using mainly carbon dioxide, hydrogen and hydrogen sulfide to enhance growth. Another related project is 10-03-005 *GeoChem*, with a focus on utilizing gases for enhanced growth of biological systems. A project with related purposes is 09-02-001 *CarbFix project*, where the purpose is to pump CO_2 into specific wells and bind the gas in geological formations in the ground, even though this is not directly gas utilization.

It can be concluded that the projects mentioned above fulfill the description of this sub-task in an sufficient manner.

2.5 Geothermal power production

Project 09-02-010 *Utilization of super-critical geothermal fluid*, addresses the case of a deep drilling geothermal well where the fluid has much higher temperature than in conventional well, and different chemicals require special treatment in utilization. The focus in this project is on fluid treatment and possible utilization schemes, thus suiting the task description very well. Low temperature utilization has not been addressed by projects funded by GEORG, but some of the partners have been involved in multiple projects involving geothermal power plant design and optimization (e.g. people at University of Iceland, Reykjavík University, VERKÍS and Mannvit).

The topics in this task are fairly well covered, but projects regarding new methods for power production from low temperature sources would be welcome.

2.6 Maintenance procedures in geothermal utilization

This topic has not been covered in the current list of funded projects and is thus not being fulfilled. However, some of the GEORG participants have been involved in related projects (Magnús Þór Jónsson, UI), but only to limited extent.

2.7 Offshore drilling and utilization

This topic has not been addressed in the projects supported by GEORG, and to the authors knowledge, no GEORG participant has been working on the topic.

2.8 Geothermal well and reservoir stimulation

Well stimulation is an important and widely used process in geothermal utilization, but has not as such been addressed in the projects supported by GEORG. However, many of the GEORG partners are involved in the procedures and project related to this task would be welcomed.

3 Recommendations

The section above gives an overview of what has been done and what is missing in WP5 after two years of operation. In this section, some recommendations are outlined for the board of directions, with the eight tasks in mind. The list of recommendations is numbered according to the subsections above:

2.1 If related projects of GEORG participants are taken into account (not directly supported by GEORG), the objectives of the task are rather well fulfilled.

2.2 The task is partly fulfilled and at least one project involving direct utilization would be welcomed here, but it could be argued that with the currently supported project the task was sufficiently addressed.

2.3 The task is well recovered with the currently supported projects and in relation to other projects coordinated by the GEORG participants.

2.4 The task is very well covered in the current state.

2.5 This task is adequately covered, even though at least one project would be welcomed here.

2.6 The task considerably lacks coverage in the current situation. The subject is important and as such, the task should have some priority in further calls from GEORG.

2.7 Offshore utilization has not yet gained attention in general. The topic is interesting, but probably not important in the near future. The board should consider removing this task from the list, with the argument that it is currently not a viable option in geothermal utilization and should not be given high priority.

2.8 This task is also missing project coverage even though it describes an important subject. The board should consider a prioritization of this tasks in future calls, which would probably be answered by the power companies operating the geothermal fields.

Finally it should be noted that the real deliverables of the different tasks were planned to be various reports as well as international publications. Thus it is important to point out to the project leaders that they specify publications from individual projects and put emphasis of both publications in journals as well as in conference proceedings.

4 Final comments

It is clear from the current status of the projects in WP5 that about 2/3 of the tasks have already been covered, if related work from the participants is included. This inclusion can of course be debated, but since one of the main goals of GEORG is to enhance partner cooperation and general involvement in geothermal research, the inclusion of related projects is well appropriate.

Apparently there are some possibilities for fulfilling all the tasks, as described in the application to RANNÍS:

1. Issue an open call for projects, and hope that they will cover the relevant tasks in WP5.

2. Specify topics related to the uncovered tasks in some of the future calls for projects, similar to what was done in the third call.

3. Form short project descriptions for the missing tasks, which could then be applied for by GEORG participants.

4. Ask relevant GEORG participants to formulate appropriate projects and coordinate the work involved.

The best option is the first one, but with the risk of not being able to fulfill the task deliverables. But in order to secure the coverage of tasks, options two to four should be considered by the board. A particular problem with option four is to choose the participants and also to commit people to the tasks.

GEORG
GEOTHERMAL RESEARCH GROUP

WORK-PACKAGE WP6:
SUSTAINABILITY – ENVIRONMENT

STATUS REPORT
APRIL 2011

Work Package Leader: **Guðni Axelsson – ÍSOR**

WP 6 INTRODUCTION

The third year of the operation of geothermal research group GEORG started on April 1st 2011. The BoD of GEORG plans to present a thorough review of the status of all deliverables in May this year. Therefore the BoD requested that all work package (WP) leaders with work package participants to review the status of the work package, and its deliverables, after two years of operation. This short report presents the results of this review for work package WP6, which focuses on sustainability and the environment.

The key objectives of work package WP6 are to conduct **basic research**, **design protocols** and **develop technologies** aimed at ensuring sustainable long-term utilization of geothermal resources. The goals set forward at the onset of GEORG were the following:

1. Improve understanding of the renewability of geothermal resources to help ensure a long term economically optimal geothermal energy utilization
2. improve the understanding of environmental and health impacts of geothermal utilization
3. minimize adverse and maximize favorable environmental and social effects of geothermal energy production
4. promote multiple integrated use of geothermal resources
5. create a global protocol for sustainable utilization of geothermal resources, following the principles of sustainable development

The main tasks of the work package are, consequently, the following:

Task 6.1 Renewability and long term utilization of geothermal resources, including the following four main study areas: (a) Energy renewability, (b) response to long-term utilization, (c) interference between adjacent well fields and geothermal areas and (d) recovery time.

Task 6.2 Environment and health impacts of geothermal energy utilization, including the following four main study areas: (a) Atmosphere, (b) fresh water, (c) land and (d) life cycle assessment (LCA).

Task 6.3 Mitigation of environmental impact, including the following five main study areas: (a) H_2S disposal, (b) mitigation of seismic risk, (c) bi-product utilization (d) surface manifestations and (e) visual effects.

Task 6.4 Geothermal sustainability assessment protocol.

The deliverables proposed as associated with work package WP6 are the following:

D6.1 Stronger fundamental knowledge of the renewability, recovery, interactions and response to long-term utilization of the geothermal resource. In bi-annual GEORG Sustainability Review Reports (months 24, 48, & 72+)

D6.2 Operational protocols for optimal long term geothermal energy and bi-product utilization, Summary reports (month 24+, and updated annually)

D6.3 Comprehensive interdisciplinary data- and knowledge base of environmental and health impacts of geothermal utilization in Iceland, data repository available by month 36+

D6.4 Comprehensive Life Cycle Assessment of geothermal power industry in Iceland, reported in GEORG Sustainability Review Reports (months 24, 48, & 72+)

D6.5 Improved general Life Cycle Assessment tools that can be used worldwide (month 24+ annual updates)

D6.6 New technical solutions / alternatives for multi-integrated use of geothermal resources, reported in the GEORG Technical Review Reports (months 24, 48, 60, 72 & 84)

D6.7 New solutions minimizing the visual effects and maintaining hot springs and fumaroles. Reported the bi-annual GEORG Sustainability Review Reports (months 24, 48, & 72+)

D6.8 Geothermal sustainability assessment protocol (month 36, updated by 60 & 84)

D6.9 Scientific publications in ISI journals in the fields of geothermal energy, environmental engineering and science, sustainable development (months 24, 48, 60, 72, & 84)

The principal participants in this work package, according to the original GEORG proposal, are University of Iceland (UoI), Iceland GeoSurvey (ÍSOR), Reykjavík Energy (OR), GeoForschungs Zentrum (GFZ) Potsdam Germany, GNS Science New Zealand, Centre National de la Recherche Scientifique (CNRS) France, Reykjavík University (RU), HS Orka Iceland, Innovation Centre Iceland (ICI), United Nations University Geothermal Training Programme (UNU-GTP) Iceland and Mannvit Iceland.

The work package meeting was held on March 23rd 2011. The following individuals, representing only four of the participants in addition to GEORG, were able to attend the meeting: Hjalti P. Ingólfsson Georg operational manager, Ómar Sigurðsson from HS Orka, Auður Andrésdóttir from Mannvit, Halldór Ármannsson from ÍSOR, Jónas Ketilsson from Orkustofnun and Guðni Axelsson work package leader from ÍSOR.

WORK PACKAGE 6 STATUS APRIL 2010

The activity associated with this work package the first two years has mainly revolved around projects funded following GEORG's three first calls for proposal. The table below lists the projects that are associated with work package WP6, in one way or another:

Project number	Project name	Project leader	Relevance for WP6
09-01-003	Development of coupled reactive fluid flow models	UoI	Limited relevance except for some general relevance for tasks 6.1 – 6.3
09-01-005	The Icelandic participation in GEISER	ÍSOR	Relevance for task 6.3 b) in particular
09-01-012	Renewability of geothermal resources	ÍSOR	Relevance for task 6.1, especially a) and b). Some relevance for 6.1 c).
09-01-017	Biological utilization of geothermal gas	UoI	Relevance for task 6.3 c) in particular
09-02-001	The CarbFix project	UoI	Relevance for task 6.2
10-03-012	Sustainability assessment protocol for geothermal utilization	UoI	Directly addressed at task 6.4

The tasks that have not received limited or no attention yet are tasks 6.1 b) and d), task 6.2 as a whole as well as tasks 6.3 a), d) and e).

The status of the main deliverables listed above is, furthermore, as follows:

Deliverable	Status
D6.1	Stronger fundamental knowledge being accumulated.

	Bi-annual GEORG Sustainability Review Report (GSRR) not published yet.
D6.2	No work on operational protocols yet.
D6.3	Work on environmental data base not started yet.
D6.4	LCA not conducted yet – proposals rejected. Bi-annual GSRR not published yet.
D6.5	Improved LCA-tools not available yet (see D6.4).
D6.6	No work on new technical solutions yet. GEORG Technical Review Report (GTRR) not published yet.
D6.7	No solutions developed yet. No GSRR published yet.
D6.8	Work on protocol starting following 3rd call.
D6.9	Some indirectly linked publications.

This table clearly shows that even though work has started on several of the work package tasks only a limited amount of deliverables have been produced yet. This applies in particular to the specific GSRR and GTRR reports. These are not clearly defined in the GEORG-proposal and it appears that these were foreseen as common to two or more work packages.

How to Proceed with WP6

In general work associated with work package WP6 is progressing according to schedule. Some tasks have received much less attention than others, however. This applies in particular to task 6.2 and to a lesser degree to task 6.3. Only a limited amount of the specific deliverables planned has been produced yet.

This status indicates that the instigation of projects needs to be much more focussed than in the three calls up to the present. The third call may even have been too diffuse. Therefore the following is proposed:

(1) Exclusive calls should be put out for proposals on specific tasks of individual work packages to fill gaps in the tasks proposed by GEORG.
(2) It may also be advisable to request a specific partner to carry out a specific task, which is missing from GEORG's portfolio.
(3) It is also strongly recommended that a mechanism be set up to allow work ongoing by any one of the GEORG partners, or by a GEORG partner in co-operation with others, to be regarded as a contribution to GEORG.
(4) It may be also be advisable for GEORG to collect from all partners a catalogue of all international papers and reports published by the partners, since 2009, which may be counted as a contribution (e.g. deliverables) to any of GEORG's tasks.
(5) Overall GEORG may also need to revise tasks and goals that may not be as desirable as initially.

GEORG also needs to focus more on the production of specific deliverables, which at least in work package WP6 are lacking. Firstly a general review of the need for specific deliverables should be carried out, and on how they may be modified. This applies in particular to the GSRR and GTRR reports mentioned above. Suggestion (4) above may help in adding to the deliverables of the research group.

Guðni Axelsson

WP7 meeting April 13th 2011.

Present: Hjalti Páll Ingólfsson, Georg, Ásdís Hlökk Theodórsdóttir, RU; Brynhildur Davíðsdóttir, UoI and Sveinn Agnarsson, UoI.

Agenda

A. Overview of the purpose of WP7 and progress made so far:

The main aim of WP7 is to analyse in detail the social and economic impact that utilisation of geothermal energy has had on society, and its contribution to sustainable development. In addition, the package also intends to develop methods for transforming the environmental and visual and health effects, utilisation of geothermal energy entails, into monetary values so that improved cost-benefit analysis can be undertaken. The primary objectives are:

1. Analyse the social and economic impact that utilisation of geothermal energy has had on Icelandic society
2. To develop methods for transforming the environmental effects, utilisation of geothermal energy resources entails, into monetary values so that improved cost-benefit analysis can be undertaken.
3. Improved means to the ranking of individual resources utilization projects at the planning stage.
4. Better knowledge of the importance for geothermal energy in shaping modern society.
5. Use the analysis results derived from the Icelandic case for the sustainable, economic and socially responsible resource use as a demonstrator for the rest of the world aiming to tap into their underutilized resources
6. Increased awareness of the role geothermal energy plays in every day life for both industries and individuals, both at regional, national and international level.

Description of work

Task 7.1: Database

Build a database that describes every geothermal utility; size, distribution, number of customers (individuals and firms), etc. over time. The database will also show linkages between industries, so that the effect of geothermal use can be traced through society. This will both be done by utilising inputoutput tables provided by Statistics Iceland and surveys. The database will enable us to map the use of geothermal energy in each region and its inter-industry and societal impacts and will be an important foundation for other analysis.

Progress

Funding was provided for the topic Geothermal economic impact data base, Project ID 09-02-017. Originally, work was to begin in March 2010 but the start was delayed until the beginning of 2011. A masters' student in financial economics was hired to work on the project for four months, and another student will work on the project in the summer and hopefully autumn of 2011.

Work on building the database commenced in January 2011, and detailed information has now been gathered on all public utilities for the period 1994-2006. Information on a number of private utilities has also been gathered. It is hoped that we will be able to update the main data base and cover at least some of the years 2007-2010.

Next steps
Complement the database with information from Statistics Iceland and others.

Task 7.2: Social impact

Analyse the social effects the use of geothermal energy has had on e.g. public health and living standards in countries such as Iceland and Kenya. Special attention will be given to formal social impact assessment, public participation, public health, safety, population displacement, impact on marginal groups, impact on cultural heritage and multiple use benefits. Geothermal energy offers various direct and indirect benefits to the public. In Iceland, the direct benefits include better outdoor air quality, improved space heating and better indoor air quality and health, as well as various spa possibilities.

Geothermal energy is also well suited to large base load heating applications such as swimming pools. The relative abundance of energy also allows houses and business applications especially spas to be heated to higher temperatures than other conventionally heated facilities. This enhances their attraction for swimming and suitability for clinic treatment of various diseases and health problems. The indirect benefits include the reduction of global emission from the combustion of fossil fuels, and the reduction of local atmospheric pollution. Special focus will be given to the impact the use of geothermal power has had on the quality of life of women and how that benefits society as a whole. The outcome of this assessment will directly benefit the assessment of the sustainability protocol proposed in WP6.

Progress
No funding sought and no progress been made.

Task 7.3: Regional development and local capacity building:

Better amenities improve living standards and make it more likely people want to live in respective communities. Here, the intention is to analyse the links between the utilisation of geothermal energy, regional income and resident migrations, and how geothermal energy has contributed to the development of industries such as recreating facilities and tourism, spas, fish farming, greenhouses horticulture and processing industries at the regional level. The outcome of this assessment will directly benefit the assessment of the sustainability protocol proposed in WP6.

Progress
No funding sought and no progress been made.

Task 7.4: Macroeconomic effects

Utilisation of geothermal energy has made Iceland less dependent on imported fossil fuels such as coal, gas and oil. This has both led to a more favourable trade balance and isolated parts of the economy from price shocks on international markets for these fuels. The effects of the use of geothermal power on the national economy will be isolated and analysed. The outcome of this assessment will directly benefit the assessment of the sustainability protocol proposed in WP6.

Progress
This task is partially funded under Project ID 09-02-017 (see above). We intend to build a macroeconomic model with an energy sector that may be used to analyse these effects. Work on this has though not started yet.

Task 7.5: Know-how

Through utilisation of geothermal energy Icelandic firms have acquired impressive technological skills and know-how that they have been able to put to use both at home and abroad. This has given rise to participation in many international ventures and projects. In this section we will analyse the importance of the geothermal industry for science in Iceland and the Icelandic economy at large. Special attention will be paid to linkages between the industry and institutes of higher learning in Iceland and abroad.

Progress
No funding sought and no progress been made.

Task 7.6: Cost-benefit analysis and environmental impact

The environmental impacts of geothermal power are assessed and put into a life cycle analysis (LCA) framework in WP6.2. The LCA framework is then transformed into a life cycle cost (LCC) framework, and thereby transforming the environmental impact into monetary values. As the impact differs between plants, different case studies will be conducted and difference monetizing methods will be tested. In addition methods to assess the visual impact of harnessing geothermal power and monetising that impact, will be developed, in addition to valuation methods of the economic impact of leaving the resource unutilised. Those more comprehensive cost estimates will be incorporated into an enhanced cost-benefit framework enabling better assessment of the “true” social tradeoffs of different geothermal projects. Special attention will be given, at the project level, to social and environmental impact either not or only indirectly accounted for in conventional analysis and economic impact on the local, regional and national economy. The outcome of this assessment will directly benefit the assessment of the sustainability protocol in WP6.

Progress

Funding has been sought but not provided and no progress been made.

B. Future work

Discussed possible cooperation between UoI and RU on various issues related to the tasks outlined in WP7. A meeting between representatives from the two universities will take place in early May.

ANNEX V

ANNUAL REPORTS OF SUPPORTED PROJECTS

ID #	Project Name	Coordinator	
09-01-003	Development of coupled reactive fluid flow models	University of Iceland	Hannes Jónsson
09-01-007	HYDRORIFT	ISOR	Ólafur G. Flóvenz
09-01-012	RENEWABILITY OF GEOTHERMAL RESOURCES	ÍSOR	Guðni Axelsson
09-01-013	High pressure and high temperature geothermal grouts	Mannvit Engineering	Gísli Guðmundsson
09-01-017	Biological Utilization of Geothermal Gas	University of Iceland	Guðmundur Óli Hreggviðsson
09-01-028	Evaluation and Improvements of Geothermal Models using Inverse Analysis	University of Iceland	Magnús Þór Jónsson
09-02-001	CarbFix	University of Iceland	Sigurður Reynir Gíslason