GEORG

GEOthermal Research Group

Annual Report

RAN090326-1303

Centres of Excellence and Research Clusters
Strategic Research Programme

Year 1, 2009-2010

May 20th 2010

GEORG
GEOTHERMAL RESEARCH GROUP

rannís
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SUMMARY

GEORG, GEOthermal Research Group, has now been operating for a full year and a significant progress has been achieved. The main milestones are:

- The Grant formerly awarded to the group February 13th, 2009 and the cluster was formally established April 1st, 2009.
- Hjalti Páll Ingólfsson was hired as an Operational Manager April 20th. Hjalti Páll has joined the Icelandic delegation in EU 7th Framework Program Committee for Energy, appointed as an expert.
- April 29th the first call for proposals was published, with a deadline on June 2nd, 2009. The call was open for proposals in all WP's and 33 proposals were received asking for a support of more than 400 MISK. The evaluation process was successful with 9 qualified reviewers from different sectors within GEORG, as well as an outside reviewer. On July 3rd, 10 proposals were offered to negotiate for funds, which resulted in the awarding them with total grant of 117 MISK.
- The second call for proposals was published on October 15th, with a deadline of November 30th. The call was open for proposals in all WP's. 22 proposals were received and the total amount of requested grant was 267 MIS. 5 projects were awarded with a total grant of 65 MISK.
- In mid June partners gathered for a Kick-Off meeting and the first General Assembly (GA). In connection with these two meetings an Open Conference was held with the general theme of Geothermal Energy Research. The venue was Reykjavik Energy headquarters.
- In mid October GEORG took part in a symposium on sustainability of the geothermal energy resources. The symposium was held in cooperation with Samorka, the Icelandic Ministry of Industry, the Geothermal Association of Iceland, ÍSOR and Orkustofnun.
- The creation of an EEIG around the operation of GEORG was not possible. The GA decided to go for a conventional Consortium Agreement instead, at least for the first operational year.
- In February 2010 GEORG supported eight graduate students from Iceland to go and take part in a PhD day in Potsdam Germany. The support was a 50.000 ISK travelling grant per student. GEORG did also support BEST Reykjavik (Board of European Students of Technology) by 120.000 ISK to host European seminar on geothermal utilization
- GEORG launched a new and improved website in October, www.georg.hi.is. It provides an easy access to all relevant information on GEORG and its operation as well as other geothermal related issues and events.
- GEORG was presented at four different conference or meeting over the first year of operation. Three of these conferences were in Iceland and one in USA.
- GEORG is constantly searching for opportunities in further cooperation or funding. In the first year GEORG was in touch with US DoE for possible cooperation in proposal evaluation and that discussion is ongoing. GEORG is also looking into the possibility to take part in a proposal for an ERA NET within FP7 WP 2011. The WP 2011 will be published in July with an application deadline in October – November 2010.

THE GRANT

The grant was awarded to the group February 13th, 2009 at a news conference at Þjóðmenningarhús. The grant is part of the Strategic Research programme for Centres of Excellence and Research Clusters awarded by Icelandic Science and Technology Policy Council and is administrated by Rannis. It amounts to 70 MISK per year for 7 years.

The cluster was established April 1st, 2009, by a formal contract with Rannís.

ORGANISATIONAL STRUCTURE

GEORG operates as a Research Joint Venture for many diverse actors in the geothermal resources field, and the collaboration is mainly visible through the structured individual multidisciplinary research projects of which GEORG supports financially. Each project is managed by a competent project manager and adheres to the project management procedures adopted within GEORG, and they manage project based budgets as normal in research projects.

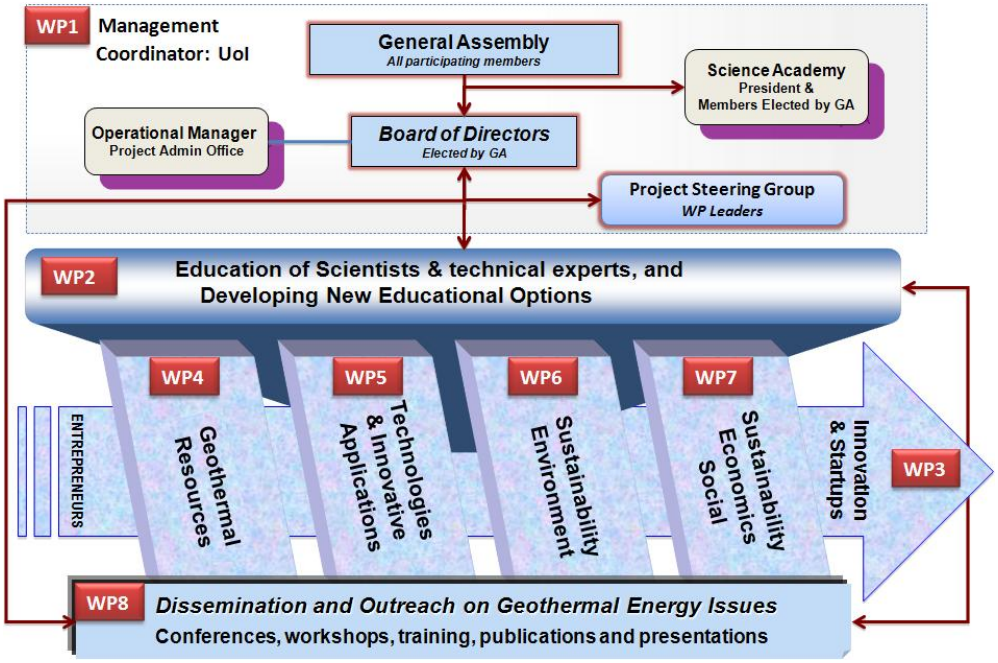


Figure 1: The organisational chart of the GEORG consortium

The operational structure of GEORG is shown in Figure 1 and the structure of GEORG comprises the following organisational bodies:

General Assembly (GA) as the ultimate decision-making body of the Consortium and is made up of one member from each partner.

Board of Directors (BoD) are the representative Nominated Managers of GEORG responsible for the management of administrative issues of the Consortium. The BoD is elected by the GA. The Operational Manager and other personnel employed by the Consortium report to the Chairman of the BoD. In the first operation year the board met 30 times and minutes of those meetings are available. The board members are:

• Sigurður Magnús Garðarsson	University of Iceland	Chairman
• Andri Stefánsson	University of Iceland	
• Bjarni Pálsson	Landsvirkjun	
• Edda Lilja Sveinsdóttir	REYST	
• Ernst Huenges	GFZ, Potsdam, Germany	
• Guðrún Sævarsdóttir	Reykjavík University	
• Oddur B Björnsson	Verkís	
• Ólafur G Flóvenz	ISOR	

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 other members are:

• Brynhildur Davíðsdóttir	University of Iceland
• Freysteinn Sigmundsson	Institute of Earth Sciences, University of Iceland
• Guðni Axelsson	Iceland GeoSurvey
• Halldór Pálsson	University of Iceland
• David Mainprice	Geosciences Montpellier (CNRS)
• Ingólfur Örn Þorbjörnsson	Innovation Center Iceland
• William Harvey	Reykjavik University
• Guðni A Jóhannesson	OS
• Einar Gunnlaugsson	OR
• Kristinn Ingason	Mannvit
• David Brunh	GFZ

Work Package leaders (WPL) is 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. 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	Brynhildur Davíðsdóttir	University of Iceland
• WP8	Sigurður G Bogason	MarkMar

OPERATIONAL MANAGER HIRED

Hjalti Páll Ingólfsson was hired as an operational manager in April and his first day was Monday, April 20th. Hjalti Páll holds an MSc degree in industrial engineering from University of Iceland, with emphasis on energy management. Before joining GEORG he worked as a production manager for Icelandic Hydrogen and prior to that as project manager in hydrogen research with Icelandic New Energy. Hjalti Páll has a good experience in managing large multinational research projects which is a good quality for operating GEORG. GEORG rents an office space at Orkugarður, Grensásvegi 9 where Hjalti Páll has his workstation.

In October Hjalti Páll was appointed as one of three experts in the Icelandic delegation of the 7th Framework Program Committee for Energy. There he joins Ólafur Flóvenz from ISOR and Þorsteinn Ingi Sigfússon from the Icelandic Innovation Centre as experts and Benedikt Steingrímsson who is "Iceland's PC".

OPERATIONAL FORM

In the original plans for GEORG the goal was to form a so-called European Economic Interest Group (EEIG) around the partnership. EEIG is one type of a non profit legal entity where all partners are jointly responsible for the operation of the grouping. In other words the EEIG form has a "several and joint liability" clause. EEIG statues were written and sent to partners for signing. However, unfortunately, the creation of an EEIG around GEORG did not materialise. The reasons for that was mainly the strict policy of joint and several liabilities. Some of the partners wouldn't or even couldn't sign such a binding liabilities under the difficult economic circumstances of 2008. As an alternative the GA agreed to run GEORG under a conventional Consortium Agreement.

CONSORTIUM AGREEMENT

The Consortium Agreement is based on a conventional EU consortium. The partners are:

- University of Iceland
- Iceland GeoSurvey
- Reykjavík University
- National Energy Authority
- Keilir, Atlantic Center of Excellence
- Reykjavik Energy Graduate School of Sustainable Systems
- RES | the School for Renewable Energy Science
- Carbon Recycling International
- HS-Orka
- Landsvirkjun
- United Nations University Geothermal Training Programme
- Reykjavik Energy
- MarkMar
- Mannvit Engineering
- Verkís
- Iceland Innovation Center
- Bureau de Recherches Géologiques et Minières
- Deutsches GeoForschungs Zentrum
- The Centre National de la Recherche Scientifique
- GNS Science
- Lawrence Berkeley National Laboratory

GENERAL ASSEMBLY

Partners were convened for GEORGs first General Assembly in June 2009. The minutes of the meeting are annexed to this report. About 20 people attended the assembly representing most of the partners in GEORG.

The second General Assembly will be held on May 21st 2010, in Reykjavik Energy headquarters.

CALLS FOR PROPOSALS

As explained in the chapter on organisational structure the collaboration of GEORG is mainly visible through the structured individual multidisciplinary research projects. In return these projects seek funding to GEORG through call for proposals, on a competitive basis.

GEORG´s main objective is to support financially collaborative research projects in the field of geothermal energy. In general the proposals are evaluated with a target of the GEORG grant contribution to be no more than 50% of the total eligible project cost, unless otherwise identified in the Call.

The goal, however, is to obtain up 75% co-financing over the total duration of GEORG. The maximum size of the GEORG funded portion of an individual grant is 10 million ISK per year for up to three years, unless indicated differently in the Call. In general the goal is to allocate approximately 1/3 of the available funding to one year projects, 1/3 to two year projects and 1/3 in three year projects.

GEORG has put a great effort in making transparent and fair grant evaluation process. Figure 1 shows a diagram of the evaluation process as well as the responsibilities of different players. First, proposals are registered by the Operational Manager and all relevant information stored in a database. The Operational Manager also prepares a summary of the applied proposals to be introduced to the Science Academy (SA). Based on this summary the SA appoints the Review Committee (RC). The Operational Manager assigns proposals to reviewers based on the SA recommendations. Now the proposals are reviewed by individual reviews and consensus score is developed by the RC. Each proposal is reviewed by 2-3 reviewers. The reviewing steps are listed below:

- ✓ Reviewers review the proposals already selected for them
- ✓ Reviewers meet at the review meetings to discuss the scoring.
- ✓ 1st reviewer will present a short introduction on the proposals selected for him/her as a 1st reviewer and defends his/her evaluation to the meeting.
- ✓ 1st reviewer is responsible for filling out the score sheet and delivering it to the operational manager. The reviewer should keep in mind that the score sheet will eventually end at the table of the applicant. This should ensure a professional evaluation and comments.
- ✓ The 2-3 reviewers are co-responsible for the evaluation of the proposals towards the BoD.

When the reviewing is concluded the Operational Manager compiles the scoring using the algorithm developed by the SA and presents the results to the SA. In the second call for proposals the AHP method was used to compare the scoring sheets and rank the proposals. Based on the results of the ranking the SA recommends to the BoD which projects to support. Finally the BoD decides which projects will be supported and the Operational Manager informs the applicants about the results of

the evaluation and the BoD decision. The application forms and evaluation guidelines are published at the GEORG website.

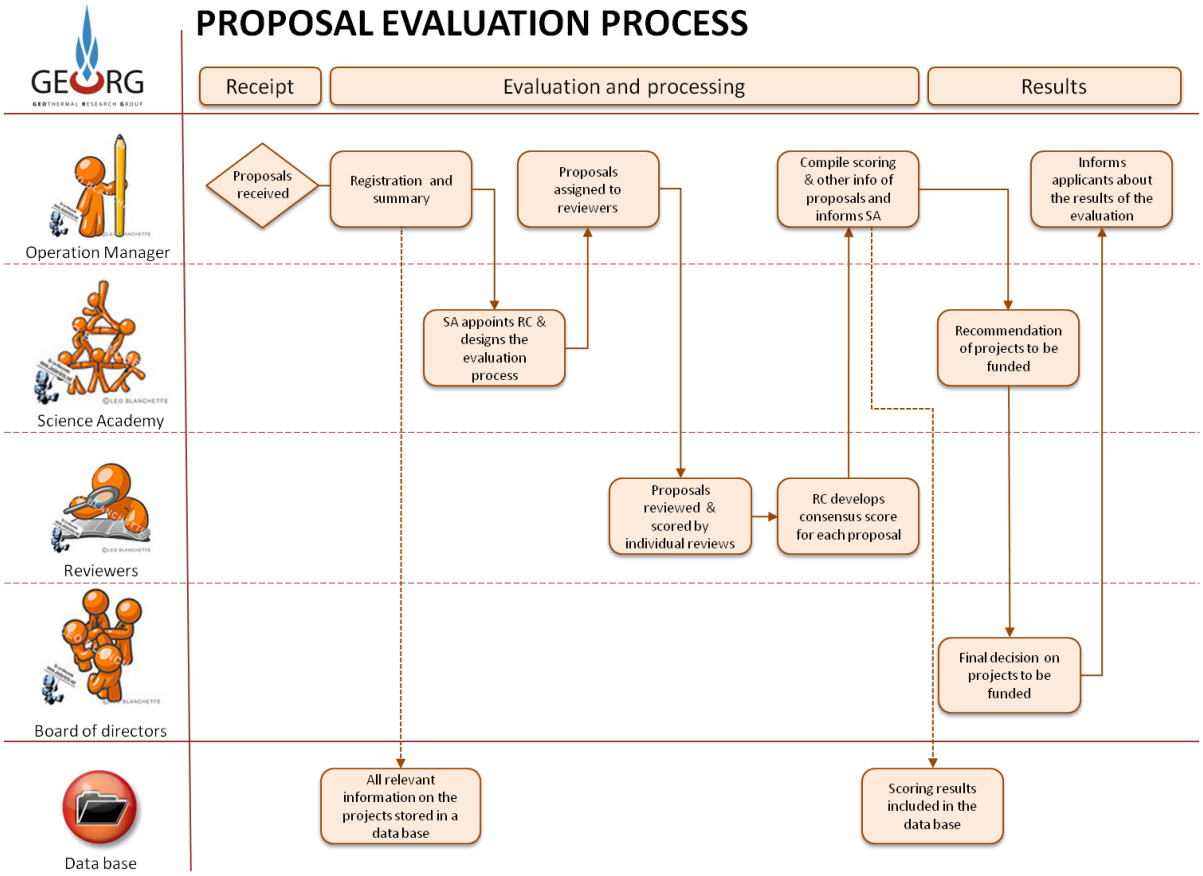


Figure 1: The proposal evaluation process diagram.

FIRST CALL FOR PROPOSALS

The first call for proposals was published on April 29th and had a deadline on June 2nd. The call was open for all WPs. GEORG Science Academy composed a guideline for the application and evaluation process and these guidelines were published on the GEORG website. The Science Academy also designed the evaluation process and evaluation criteria.

GEORG received a total of 33 proposals in its first call, requesting grants of some 420MISK where the overall project cost was 1.093MISK. Figure 2 shows the deviation of costs and requested funds between years.

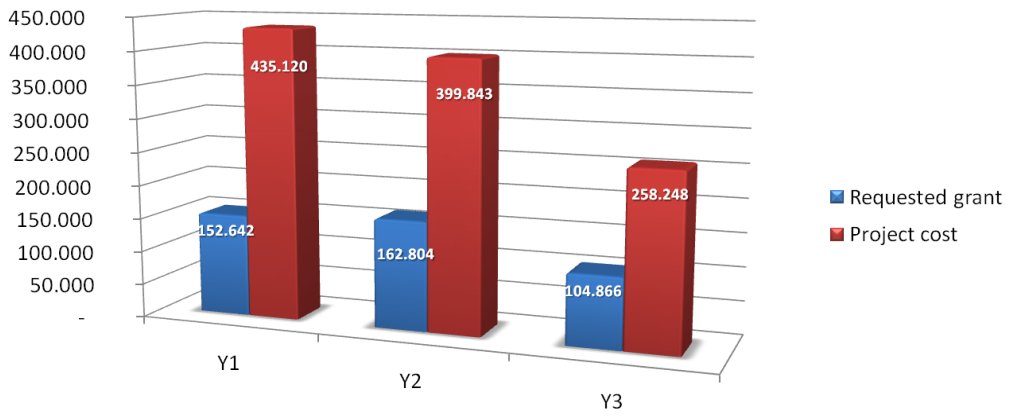


Figure 2: The total requested grant vs. Project cost of projects in the first call.

Applicants were asked to determine to which WP's their project were most relevant to. This gave an overview of the deviation between WP's. In the first call the main emphasis was on WP4 "Geothermal Resources", WP5 "Technologies and Innovative Applications" and WP6 "Sustainability – Environment". Since most of the proposed project involved a significant student work WP2 "Education and Training" was also important.

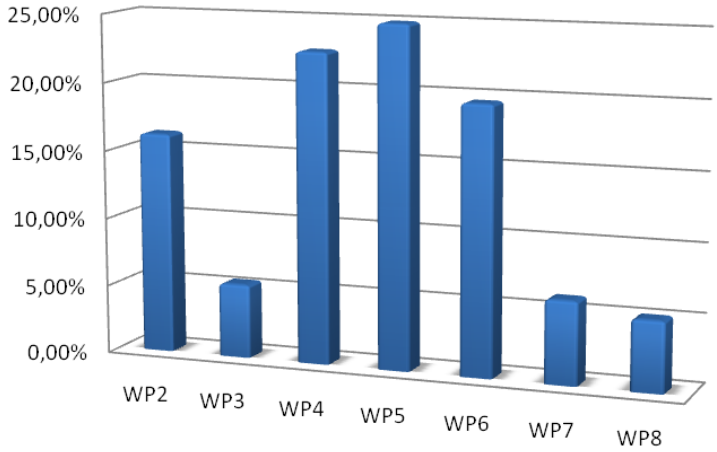


Figure 3: WP relevance of the all proposals in the first call.

First Call - Evaluation results

Out of the 33 proposals, in the first call, 10 proposals were offered to negotiate for funding or 30% (by number). Since a large majority of the 33 proposals were for three years or 21 proposal and only 8 proposals were for two years and 4 proposals for one year it was impossible to achieve the goal of allocating the available funding evenly between one, two and three year projects. Therefore it was decided to make the scoring of the Review Committee a top priority in the selection process. As a result from that the board selected 7 three year proposals (30% by number of 3 year proposals), 1 two year proposal (12,5% by number of 2 year proposals) and 2 one year proposals (50% by number of 1 year proposals).

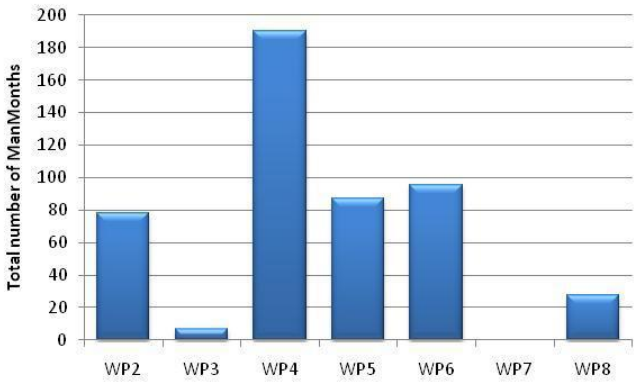


Figure 4: WP relevance of the selected project in the first call.

Figure 4 shows the total workload assigned for each WP. These figures are based on the "WP relevance" indicated by the applicants and the total number of man months assigned for the project. One can see that the largest effort is put to WP 4 or nearly 200 man months, compared to less than 100 for all the other WP's. Figure 4 also shows that the there is no emphasis on WP7 and very little on WP3.

Six of the selected projects deal with simulation, modelling or surveying of geothermal reservoirs, one deals with grouts for cementing steel casings in geothermal wells, one involves collection of data with new highly detailed seismic tomography of the Kleifarvatn-Fagradalsfjall area of the Reykjanes, one focuses on biological utilisation of geothermal gases and finally one project is seeking funds to cover the Icelandic participation in an EU supported project. A list of the selected proposals can be found in Table 1. As can be seen in the table the 10 selected projects involve 9-10 PhD students and 4-6 MSc students. A short description on the selected projects is annexed to the report.

Table 1: List of the selected projects in the first call

Project name	Coordinator	Students	Duration	Note
Evaluation and Improvements of Geothermal Models using Inverse Analysis	Magnus Thor Jonsson, professor	2 PhD	3 Y	Simulation, modelling or surveying of geothermal reservoirs
Development of coupled reactive fluid flow models	Hannes Jónsson	1-2 PhD	3 Y	Simulation, modelling or surveying of geothermal reservoirs
Mathematical modelling of energy flow in a geothermal reservoir	Halldór Pálsson	1 MSc	1 Y	Simulation, modelling or surveying of geothermal reservoirs
Properties of two phase flow of water and steam in geothermal reservoirs	Guðrún Sævarsdóttir	1 PhD & 1-2 MSc	3 Y	Simulation, modelling or surveying of geothermal reservoirs
Resistivity survey of Grímsvötn	Knútur Árnason	1 PhD	3 Y	Simulation, modelling or surveying of geothermal reservoirs
RENEWABILITY OF GEOTHERMAL RESOURCES	Guðni Axelsson	1 PhD & 1-2 MSc	3 Y	Simulation, modelling or surveying of geothermal reservoirs
Biological Utilization of Geothermal Gas	Dr. Guðmundur Óli Hreggviðsson	1 MSc	2 Y	Focuses on biological utilisation of geothermal gases
HYDRORIFT	Ólafur G. Flóvenz	2 PhD	3 Y	Seismic tomography of the Kleifarvatn-Fagradalsfjall area of the Reykjanes,
The Icelandic participation in the EU supported project Geothermal Engineering Integrating Mitigation of Induced Seismicity in Reservoir	Kristján Ágústsson	1 PhD	3 Y	Seeking funds to cover the Icelandic participation in an EU supported
High pressure and high temperature geothermal grouts	Gísli Guðmundsson	No student	1 Y	R&D on grouts for cementing steel casings in geothermal wells

The requested funds and total cost of the 10 selected projects is shown in Table 1. Due to the uneven distribution of proposals, by years, the budget for the first year is relatively low. This allows the board to reserve about 10-12MISK to be allocated later. The "overshoot" in the third year is "corrected" by negotiation with the project asking for close to 10MISK on the third year to reduce the cost of that year.

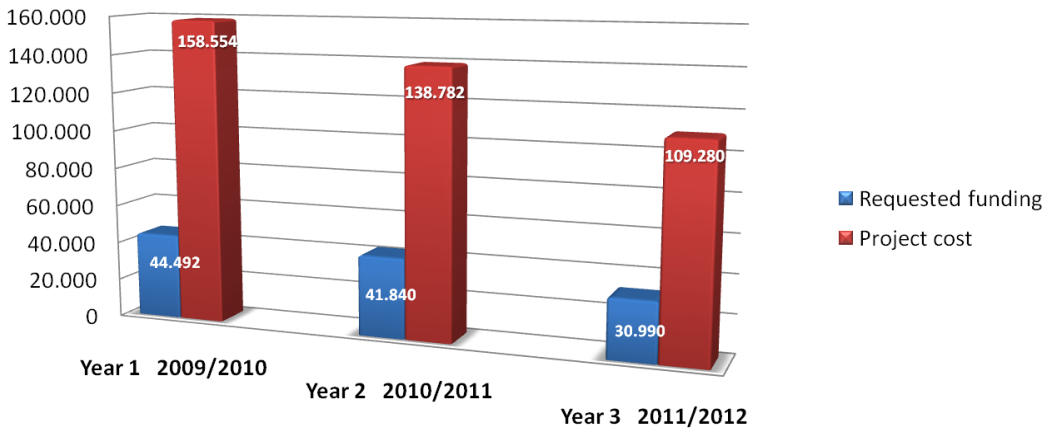


Figure 5: Requested grant vs. project cost of 10 selected projects in the first call.

SECOND CALL FOR PROPOSALS

The second call for proposals was published on October 15th with November 30th as a deadline and was open for all WP's.

GEORG received 22 proposals in its second call. As in the first call large majority of the proposed projects were for three year or 15 projects. 3 proposals were for 2 year projects and 4 for 1 year. The total cost of these projects is around 1.276 million ISK and the requested grant is 276 million ISK, this means that the co-financing of these projects is over 78%. The evaluation process was completed in the beginning of February and 5 projects were offered to negotiate with GEORG.

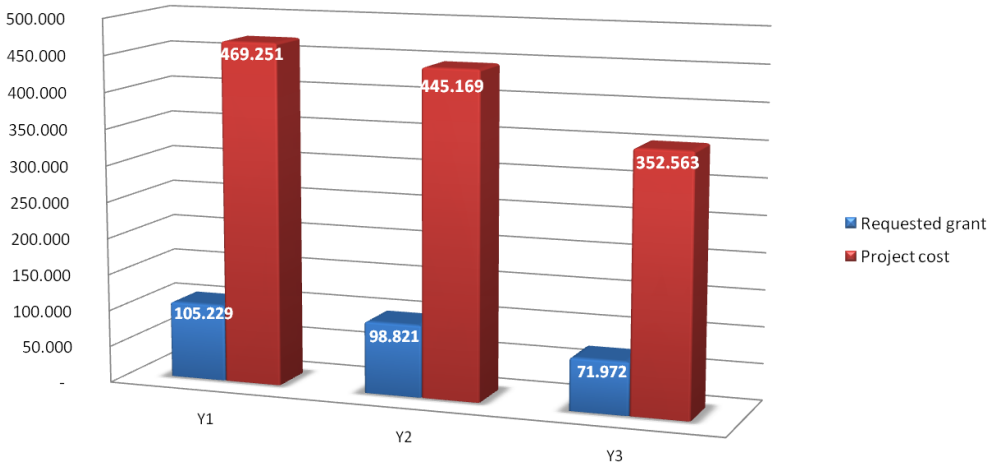


Figure 6: The total requested grant vs. project cost of projects in the second call.

SUPPORTED PROJECTS IN SECOND CALL

Out of the 22 proposals that were submitted 5 proposals were offered to negotiate for funding or about 23% (by number). As in the first call majority of the proposals were for three years or 15 proposal, 2 proposals were for two years and 5 proposals for one year. The proposals were evaluated by 26 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.

Table 2 The following projects are offered to negotiate for funding in the second call

Project name	Coordinator	Institute	Duration
Advanced 3D Geophysical Imaging Technologies for Geothermal Resource Characterization	*Knútur Árnason*	*ISOR*	*3 years*
The Hengill geothermal reservoir. Evaluation of subsurface geological data	*Hjalti Fransson*	*ISOR*	*1 year*
CarbFix project	*Sigurður Reynir Gíslason*	*UNI*	*3 years*
Utilization of Supercritical Geothermal Fluid	*Guðrún Sævarsdóttir*	*RU*	*1 year*
Geothermal economic impact data base	*Sveinn Agnarsson*	*UNI*	*3 years*

The total requested grant was just over 276MISK and the offered grant to the 5 selected projects is just over 65MISK or about 24% (by amount). The average amount of requested grant is about 5,3MISK per year, ranging from a full grant of 10 MISK per year, for three year, down to just less then 3MISK per year.

EVENTS / CONFERENCES

GEORG was formally launched at a kick off meeting held in Reykjavik Energy headquarters on June 18th. In a connection with the meeting GEORG organised an open conference with the general topic of Geothermal Energy Research. A number of respected experts and scientists addressed the conference following an opening address by the Icelandic minister of industry. The agenda for the kick-off meeting and open conference is listed in Annex I.

Figure 2: Guests at the Open Conference on Geothermal Energy Research

GEORG co-sponsored a symposium discussing the Sustainability of Geothermal Energy with Samorka, the Icelandic Ministry of Industry, the Geothermal Association of Iceland, ÍSOR and Orkustofnun. The symposium was held at Hilton Nordica on the 12th of October. It was very successful with nearly 200 participants and fruitful discussions. The symposium was aimed for the public as well as experts and scientists.

Figure 3: **Participants of the meeting took part in a two hour discussion session in where the topics were discussed. The meeting was divided in eight groups and group leaders introduced the conclusions in a panel afterwards.**

On March 4th, 2010 GEORG organized symposium on the topic of Geothermal Reservoir Science, in cooperation with IPGT *(International Partnership for Geothermal Technology*). The workshop was very successful with over 50 participants and fruitful discussions.

The goal of this interactive workshop was to bring together engineers and scientists involved in geothermal reservoir studies in Iceland to exchange ideas and increase understanding on geothermal resources. Evaluate ongoing research: What works? What doesn't? What has been accomplished over the past years?

Web streams of the lectures are available at GEORG website.

Figure 4: Few of the Icelandic participants at the poster session of the PhD day

In February 2010 GEORG supported eight graduate students from Iceland to go and take part in a PhD day in Potsdam Germany. The support was a 50.000 ISK travelling grant per student. This was the first European Geothermal PhD-day (EGPD2010) ever held and the venue for the event was at the Helmholtz Centre Potsdam GFZ - German Research Centre for Geosciences. The PhD day was an initiative of the EERA joint program in geothermal energy. The goal of the PhD day was to bring together young scientists working in the field of geothermal energy research and offer them the opportunity to share ideas and build up a network between them, leading to synergies and collaborations. The next European Geothermal will be held in 2011 in Reykjavik, Iceland and GEORG will participate and help in any way possible.

GEORG did also support BEST Reykjavik (Board of European Students of Technology) by 120.000 ISK to host European seminar on geothermal utilization. The seminar was held in Reykjavík March 9th-17th 2010. The seminar was very successful with over 20 participants from universities all around Europe.

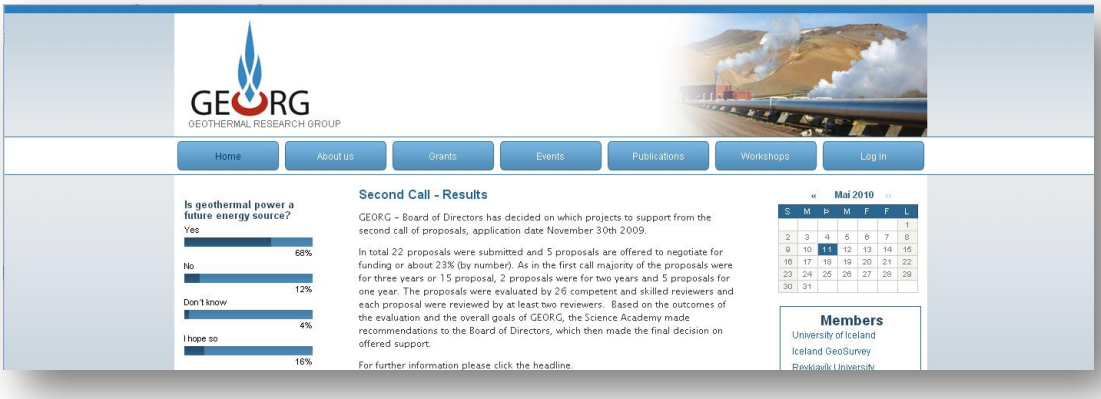
PUBLICATIONS AND DISSEMINATIONS

PRESENTATIONS AT CONFERENCES AND MEETINGS

GEORG was presented at four conferences and meetings on the first operational year. The first presentation was at the annual meeting of the Icelandic Geothermal Association (Jarðhitafélag Íslands) in April 2009. GEORG was then presented at the ASI Symposium "Atvinnumál á krepputímum" in January 2010. GEORG was also presented at the Second CSM Geothermal Symposium held in Colorado School of Mines, USA on January 18th, 2010. Finally the group took part in a conference held by Iceland Innovation Centre in connection with the European Union, Sustainable Energy Week, 22 – 26. March 2010. The conference was held at Grand Hotel Reykjavík on March 25th.

WEBSITE

Right from the beginning GEORG has had the web address 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 first month six months a standard website format was used but in October a new and improved website was designed and published. The website design was done in cooperation with the company Emstrur.is. The transition was very successful and the new website is significantly more "user-friendly" and will provide an easy access to all relevant information on GEORG and its operation as well as other geothermal related issues and events.



OTHER ACTIVITIES

GEORG is constantly searching for opportunities in cooperation and funding. In that means GEORG has been in touch with staff members of the DoE in USA to explore the possibility evaluation exchange that is if DoE experts would participate in the evaluation of GEORG proposals and in return GEORG partners would participate in the evaluation of DoE proposals. DoE has expressed their interest in such cooperation, but unfortunately the time for the evaluation this year was not right so that cooperation could not happen this time.

In the Work Program for 2011 (WP 2011) of EU Seventh Framework Program there will be a call for an ERA NET in Geothermal Energy. GEORG is now exploring the possibility of taking part in an application for an ERA NET in cooperation with Iceland NPC in Energy and Rannís. The WP 2011 will not be published until July 2010, but the necessary perpetrations have started.

ANNUAL ACCOUNTS

The annual accounts for the first year are presented below. The operating year accounted is April 1st 2009 – 31st March 2010.

GEORG - Cost and financing account
Year 1 2009-2010

		Budget plan			Actual Accounts		
Cost	**Note**	**GEORG**	**Partners**	**Total**	**GEORG**	**Partner**	**Total**
Grants	1	33.120	88.067	121.187	10.958	31.731	42.689
Contracted services	2	1.155		1.155	957	0	957
Travel expenses	3	1.000		1.000	0	0	0
Other costs	4	869	165	1.034	724	845	1.569
Overhead	5	7.620	9.000	16.620	6.505	8.700	15.205
Total operation cost		**43.764**	**97.232**	**140.996**	**19.144**	**41.276**	**60.420**
Financing							
Partner Co-financing			97.232	97.232		41.276	41.276
Funding from Rannis	6	70.000		70.000	50.000		50.000
Total financing		**70.000**	**97.232**	**167.232**	**50.000**	**41.276**	**91.276**
Results of operational activities		**26.236**	**0**	**26.236**	**30.856**	**0**	**30.856**

GEORG - Balance sheet
Year 1. 2009-2010

Assets	**Note**	**31. March 2010**
Cash and cash equivalents	7	30.856
Unpaid funding from Rannís	6	20.000
Unaccounted co-financing	1	82.081
Total assets		**132.937**
Debts and liabilities		
Unpaid grants from first call	1	33.014
Unaccounted co-financing	1	82.081
Short term dept and business liabilities	8	711
Total debts and liabilities		**115.806**
Total assets		**17.131**

ANNUAL ACCOUNTS - NOTES

1. Grants

The largest part of GEORG operation is grants to geothermal research. For the first operation year, three types of grant were awarded; R&D project, student travelling grants and finally a support to a European student seminar. In the table below the amounts of grants are listed according to type. The partners co-financing is estimated according to the projects status.

	Budget plan			Actual Accounts		
First call R&D projects	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
09-01-003	*915*	*3.510*	*4.425*	*0*	*0*	*0*
09-01-005	*1.350*	*3.538*	*4.888*	*1350*	*3.538*	*4.888*
09-01-007	*4.500*	*30.100*	*34.600*	*1100*	*7.525*	*8.625*
09-01-011	*750*	*10.170*	*10.920*	*750*	*10.170*	*10.920*
09-01-012	*6.225*	*6.525*	*12.750*	*2200*	*2.175*	*4.375*
09-01-013	*5.927*	*6.825*	*12.752*	*1863*	*2.275*	*4.138*
09-01-016	*7.425*	*10.425*	*17.850*	*2475*	*3.475*	*5.950*
09-01-017	*1.251*	*8.072*	*9.323*	*350*	*2.018*	*2.368*
09-01-028	*4.440*	*8.348*	*12.788*	*0*	*0*	*0*
09-01-029	*338*	*555*	*893*	*350*	*555*	*905*
PhD day travel grants				*400*		*400*
BEST Reykjavik				*120*		*120*
Grants Total	**33.120**	**88.067**	**121.187**	**10.958**	**31.731**	**42.689**

The cash flow is 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

During the first operation year GEORG bought the following services from following contractors and service providers.

	Budget plan			Actual Accounts		
	GEORG	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
Printing & publishing etc.						
Advertisements	*267*		*267*	*267*		*267*
Website	*200*		*200*	*121*		*121*
Logo	*187*		*187*	*187*		*187*
Legal & audits						
Legal consult – EEIG	*81*		*81*	*82*		*82*
Subcontracted other						
MarkMar-consult	*300*		*300*	*300*		*300*
SA chair	*120*		*120*	*0*		*0*
Contracted services Total	**1.155**	**0**	**1.155**	**957**	**0**	**957**

3. Travel expenses

There were no travel costs for the first operation year. All travel costs associated with GEORG dissemination were covered by the conference organizers or by other means.

ANNUAL ACCOUNTS - NOTES

4. Other costs

Other costs mainly involve organisational costs and support for conferences and workshops. The open conference was less expensive than planned and the co financing of partners was higher, especially the participation of Reykjavik Energy. The participation of partners in other events was also greater than planned.

	Budget plan			Actual Accounts		
Conferences, dissem. & outreach	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
GEORG - Open Conferences	*669*	*165*	*834*	*565*	*345*	*910*
Samorka, Sustainability conference				*126*		*126*
Reservoir workhop				*33*	*500*	*533*
Other	*200*		*200*			
Dissemination Total	**869**	**165**	**1.034**	**724**	**845**	**1.569**

5. Overhead

The largest part of GEORG overhead goes in to operating the office and paying the salaries of the operational manager. A very 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 is not included for this year, see note 8.

	Budget plan			Actual Accounts		
Overhead for GEORG	**GEORG**	**Partners**	**Total**	**GEORG**	**Partners**	**Total**
Operational Manager & secretariat	*6.162*		*6.162*	*6.223*		*6.223*
Office operation	*1.237*		*1.237*	*229*		*229*
Other general operational costs	*221*	*9.000*	*9.221*	*52*	*8.700*	*8.752*
Overhead Total	**7.620**	**9.000**	**16.620**	**6.504**	**8.700**	**15.204**

6. Funding from Rannís

Rannís has paid out 50MISK out of the 70 MISK agreed for the first year. The payments 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	April 2009	15.000
Consortium agreement	June 2009	35.000
A Progress report	1/12/2009	12.000
An Annual report	15/4/2010	8.000
Total amount for the 1st year		70.000

A progress report was delivered and accepted by Rannís on the 15th of December 2009. According to the grant agreement Rannís was suppose to pay 12MISK at the receipt of the progress report. Due to some mistake this amount had not been paid on the 31st of March 2010. Rannís shall also pay the final payment (8MISK) for the first 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 30.856 thousand ISK.

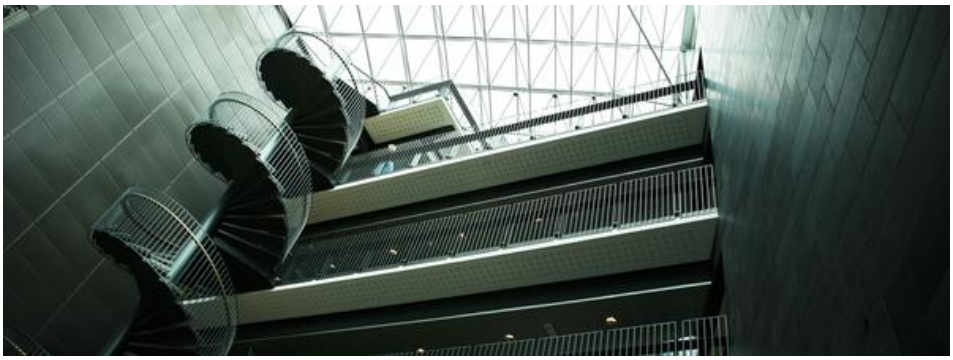
8. Short term dept and business liabilities

At the end of the operational year few invoices had been received but not paid, these are

Office rental from Orkugardur	681 thousand ISK
Video recording and clipping for Reservoir seminar.....	30 thousand ISK
Total	711 thousand ISK

ANNEX I-IV

ANNEX I



GEORG EEIG
KICK OFF / GENERAL ASSEMBLY

JUNE 18 AND JUNE 19, 2009

REYKJAVÍK ENERGY HEADQUARTERS, BÆJARHÁLS 1, REYKJAVÍK

DAY 1 - JUNE 18

08:50-09:00 Welcome note by the Chairman of the Board

09:00-09:45 Introduction of partners

- Two minutes introduction per partner, involving their anticipation of participating in GEORG, main geothermal activities and areas of interest

Coffee break

10:00-10:30 Introduction on GEORG EEIG – formal and practical matters

- Formal approval of statutes and new members included in the partnership

10:30-12:30 General Assembly

- Election of Science Academy
- Election of Board of Directors
- Other matters

Lunch at Reykjavik Energy

13:30-19:00 GEORG - OPEN CONFERENCE

DAY 2 – JUNE 19

09:00-10:00 Work-Package leader's summaries planned activities and specific objectives

Each WP leader presents the objectives of their WP followed by discussions on the WP objectives and future plans

Coffee break

10:30-11:00 Work-Package leader's summary – continued

11:00-11:30 Other matters

11:30-12:00 Wrap up and closing

GEORG

MÁLÞING UM RANNSÓKNIR Í JARÐHITA

í húsakynnum Orkuveitu Reykjavíkur
fimmtudaginn 18. júní, kl. 13:30 - 17:00
Málþingið mun fara fram á ensku og er öllum opið

Í tengslum við formlega stofnun alþjóðlegs rannsóknaklasa í jarðhita, GEORG EEIG, 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.

Þátttakendur eru vinsamlegast beðnir að skrá sig með því að senda tölvupóst á georg@orkugardur.is

13:30-13:40	*Opening address by the Minister of Industry* **Katrín Júlíusdóttir**
13:40-13:50	*Address by GEORG Chairman of the Board* **Sigurður Magnús Garðarsson**
13:50-14:10	*The earth, new challenges and opportunities* **Ólafur G. Flóvenz, ÍSOR**
14:10-14:30	*The role of EGEC (European Geothermal Energy Council) in Europe and the RHC (renewable heating and cooling) technology platform* **Fabrice Boissier, BRGM, Frakklandi**
	Kaffihlé
15:00-15:20	*New Approaches for Enhanced Geothermal Systems Research in Europe* **Ernst Huenges, GFZ, Þýskalandi**
15:20-15:40	*Geothermal energy utilization – technical challenges* **Geir Þórólfsson og Jónas Matthíasson, HS-Orka og Verkís**
15:40-16:00	*Environmental aspects of geothermal utilization* **Einar Gunnlaugsson, Orkuveita Reykjavíkur**
16:00-16:20	*The impact of geothermal utilisation on Icelandic society* **Sveinn Agnarsson, Hákóli Íslands**
16:30-17:00	*Pallborðsumræður*
17:00	*Léttar veitingar*

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ANNEX II,

GENERAL ASSEMBLY #1. MEETING MINUTES

Date: 2009-06-18

Present: See appendix; Registration sheet

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1. Address by the chair of the board.

a. The Chair of the board (Sigurður Magnús Garðarsson) explained the situation regarding the operational form of GEORG. EEIG statutes had not been signed yet and due to unlimited liability clause associated with the operational form of EEIG some important members were not able to sign EEIG statutes at this moment. A consortium agreement would therefore be more appropriate intermediate step; the operational form of GEORG should then be dealt with separately.

b. The Board of Directors proposed that the General Assembly would direct the BoD to finalize the work on the form of GEORG containing the previously described structure and in accordance to the proposal to Rannis. Approved by the meeting.

c. Ólafur G Flóvenz draws the attention to the fact that while the consortium agreement is not signed and the operational form of GEORG is not concluded, the partnership is operated on the basis of the proposal to Rannis.

2. Election of a new Board of Directors

a. The current Board of Directors proposed that the following individuals would be elected as the member of the Board. The board also proposed to elect some members for 2 years and some for 1 year, the numbers in the brackets indicate the number of years.

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 (2) Andri Stefánsson (1) Guðrún Sævarsdóttir (2) Edda Lilja Sveinsdóttir (1) Ólafur G Flóvenz (2)	Bjarni Pálsson (1)	Oddur B Björnsson (1)	Ernst Huenges (2)

The proposal was approved by the meeting

3. Election of a new Science Academy

a. Prior to the GA members of GEORG were offered to nominate persons to join the SA. Number of nominees were received and the following individuals were selected by the Board of Directors to be nominated to the Science Academy

Name	Institution
Brynhildur Davíðsdóttir	University of Iceland
Freysteinn Sigmundsson	Institute of Earth Sciences, University of Iceland
Guðni Axelsson	Iceland GeoSurvey
Halldór Pálsson	University of Iceland
Philippe A. Pezard	Geosciences Montpellier (CNRS)
Ingólfur Örn Þorbjörnsson	Innovation Center Iceland
William Harvey	Reykjavik University
Guðni A Jóhannesson	OS
Einar Gunnlaugsson	OR
Sveinbjörn Björnsson	Professor Emeritus
Kristinn Ingason	Mannvit
David Brunh	GFZ

The lists of nominees were approved by the meeting.

b. In a separate voting session, Sveinbjörn Björnsson was elected as the chair of the Science Academy.

4. Other items

a. Davíð Stefánsson pointed out that there is only one female member in the SA and emphasised on the importance of gender issues. The matter discussed and Magnús Tumi Guðmundsson wanted to book that GEORG has and shall consider those issues in connection with nominations to important seats within GEORG management.

b. Oddur B Björnsson comments that the budget discussion is missing on the agenda of the General Assembly. Sigurður Magnús Garðarsson explains that the budget is missing because the operational form of GEORG is still not concluded and therefore not the budget form. While this has not been concluded the partnership is operated on the basis of the proposal to Rannis. However for the first operational year, GEORG will receive a grant from Rannis to the amount of 70MISK. It is assumed that 60MISK of that grant will be forwarded to the projects of GEORG this year and 10MISK will be reserved for operational expenses. The outlines of the budget framework will be set up in parallel to the work on setting up the operational form of GEORG.

5. No other conclusions made and meeting adjourned

GA meeting: -> Appendix 1; Registration sheet

GEORG

KICK OFF / GENERAL ASSEMBLY
REGISTRATION SHEET

	NAME	ORGANISTAION	E-MAIL
1	Magnús T. Guðmundsson	HI	mtg@hi.is
2	Guðrún Sævarsdóttir	HR	gudrunsa@ru.is
3	Andri Ottesen	CRI	andri@CRI.is
4	Olafur G. Flóvenz	ISOR	ogf@isor.is
5	Fabrice Boissier	BRGM	f.boissier@brgm.fr
6	Oddur Bjarnason	Verkis	obb@verkis.is
7	Haukur Garðarsson	Mannvit	haukurg@mannvit.is
8	Ólafur Pl. Pálsson	HI	opp@hi.is
9	Rúnar Unnþórsson	Keilir	runar@keilir.net
10	WILLIAM HARVEY	HR	harvey@ru.is
11	BJARNI PÁLSSON	Landsvirkjun Power	bjarnip@lvp.is
12	Sigrún N Karlsdóttir	ICI / Nýsköpunarmiðstöð Í.	sigrunkarls@nmi.is
13	Ingólfur Þorbjörnsson	ICI / Nýsköpunarm.	Ingo@nmi.is
14	Magnús Rafnsson	HI	magnusja@hi.is
15	Eiríkur Hjálmarsson	OR and REYST	eirikur.hjalmarsson@or.is
16	DAVÍÐ STEFÁNSSON	RES - SCHOOL FOR RENEWAB.	david.stefansson@res.is ds@sge.is
17	Ernst Huenges	GFZ - Potsdam	huenges@gfz-potsdam.de
18	Hjalti Páll Ingólfsson		hjalti.p.ingolfsson@orkugardur.is
	Sigrún M. [illegible]	HI	sigma@hi.is

ANNEX III

SHORT PROJECT DESCRIPTION ON THE FUNDED PROJECT FROM THE FIRST CALL

BIOLOGICAL UTILIZATION OF GEOTHERMAL GAS

Coordinator: Dr. Guðmundur Óli Hreggviðsson / University of Iceland

The grant proposal aims to connect the GEOGAS project with the GEORG program and seek funding for certain aspects of the GOEGAS projects.

The aim is to develop a system for large-scale production of microbial biomass using the geothermal gas effluent from geothermal power plants. In one aspect, the system is a bioremediation system for reducing emissions of undesirable gases but on the other hand gives a potential for production of several thousand tonnes of microbial biomass per year. We are currently focusing on bacterial cultivation using hydrogen and hydrogen sulfide as energy sources but the research is a part of the larger GEOGAS research and development plan, with the aim of using both bacteria and, at later stages, also microalgae for complete utilization of all CO2 originating from geothermal power plants..

DEVELOPMENT OF COUPLED REACTIVE FLUID FLOW MODELS

Coordinator: Hannes Jónsson / University of Iceland

TOUGHREACT, a numerical simulation program developed at Lawrence Berkeley National Laboratory (LBNL), will be used for developing coupled reactive fluid flow models of geothermal areas in Iceland. The program was designed to model chemically reactive nonisothermal flows of multiphase fluids in porous and fractured media and it´s applicability to a variety of reactive fluid and geochemical transport systems has already been demonstrated.

These include e.g. mineral alteration and silica scaling in hydrothermal systems under natural and producing conditions and natural groundwater quality evaluation. TOUGHREACT is based on TOUGH2, a multiphase fluid and heat flow simulator.

EVALUATION AND IMPROVEMENTS OF GEOTHERMAL MODELS USING INVERSE ANALYSIS

Coordinator: Magnus Thor Jonsson, professor / University of Iceland

In the project, a method will be put forward in order to choose parameters and verify numerical models that are used to evaluate geothermal systems and to analyze and design geothermal power plants. Emphasis will be placed on bringing in methodology as inverse analysis and using it on three different geothermal power development fields, i.e. analyzing geothermal systems' workloads, stream and boiling in wells and pipelines along with examining functionality of separator stations. In the project, experiments will be performed on pressure drops, temperature changes and quality factors will be used with inverse analysis to adjust models that have been developed for analyzing those factors.

Main objectives:

- Develop a technology to improve usage of geothermal reservoirs and to optimize the placement of wells, steam gathering system and separators.
- Enlarge know-how in this important field of geothermal exploration in Iceland
- Encourage cooperation with a research group in this field at the Berkeley Lab.
- Develop knowledge and a technology that will benefit development of geothermal power production in Iceland.

HIGH PRESSURE AND HIGH TEMPERATURE GEOTHERMAL GROUTS

Coordinator: Gísli Guðmundsson / Mannvit Engineering

This project deals with grouts for cementing steel casings in geothermal wells where high temperature and high pressure are prevailing (geothermal grout). The current status is such that there is negligible knowledge in Iceland about the properties of geothermal grouts, and such knowledge is also very limited globally.

HYDRORIFT

Coordinator: Ólafur G. Flóvenz / ISOR, Iceland GeoSurvey

The aim of the Hydrorift project is twofold:

1) To understand better the mechanical significance of a velocity anomaly known to be in the Kleifarvatn-Fagradalsfjall area. The experiment is a more extended and focused continuation of a seismic experiment carried out in Krísuvík 2005 (Geoffroy &Dorbath 2008).
2) To improve the understanding and knowledge of hydrothermal processes in the crust, especially the processes of heat extraction from hot or even partially molten intrusions at crustal levels.

The proposed project will include a new highly detailed seismic tomography (P, S and Vp/Vs) of the Kleifarvatn-Fagradalsfjall area of the Reykjanes peninsula and a joint interpretation with the recently collected TEM/MT data supported by information from boreholes.

The Hydrorift seismic experiment involves 19 seismic stations from the French GEOSTAR network and 13 Reftek stations from the Icelandic Rannis-supported seismic instrument pool Loki, including three broad band stations. Data from the Icelandic regional seismic network, the SIL-network, will be available. The network was fully deployed on May 27st 2009 and will run to the end of September 2009.

MATHEMATICAL MODELLING OF ENERGY FLOW IN A GEOTHERMAL RESERVOIR

Coordinator: Halldór Pálsson / University of Iceland

The purpose of this project is twofold.

- The first objective is to define a framework for models and software that can be used for solving partial differential equations that are associated with flow in geothermal reservoirs. The framework is the first step of developing an Icelandic reservoir modeling software package that can be used for educational and research purposes. The intention is that this software will be three dimensional and based on the finite volume method or the finite element method. Furthermore it will be designed to simulate decomposed problems on computer clusters if the modeling problems are very big and computations time consuming. A crucial part of software development such as this is the initial design phase before any programming takes place. This project will address that issue.
- The second purpose is to build a relatively simple two dimensional mathematical model of a geothermal system, involving basic Rayleigh-Bernard convection. In this particular case the flow is assumed to follow a pressure gradient in the domain under consideration through the Darcy equation which is dictated by permeability, fluid viscosity and density, as well as gravity. In this model the Darcy equation is accompanied by an equation describing the conservation of energy. The energy equation incorporates three phenomena: flow of energy through convection, flow through diffusion (heat conduction) and changes in energy content over time. In its simplest form the system involves only one parameter which is the dimensionless porous Rayleigh number.

PROPERTIES OF TWO PHASE FLOW OF WATER AND STEAM IN GEOTHERMAL RESERVOIRS

Coordinator: Guðrún Sævarsdóttir / Reykjavík University

The goal of this project is to study two phase flow in geothermal reservoirs, both theoretically using mathematical models and by conducting experiments on such flow situations. The theoretical part involves development of new and improved relations that account for the complex interaction between phases in porous flow. Traditional relation for such flow is the Darcy equation, which relates superficial flow velocity to pressure gradient, through fluid permeability and viscosity. However, phase interaction must be taken into account in the two phase case where effects such as weight difference, friction and surface tension must be included in the known relation. Relations regarding convective and diffusive energy transport will also be coupled to the flow model to include effects of phase changes, especially when the fluid flows in a vertical direction in gravity. The results will be an improved set of relations that describe energy transport in geothermal reservoirs. The equations will be implemented in a simulation tool in order to be able to perform investigations on case studies and comparisons with measurements

RENEWABILITY OF GEOTHERMAL RESOURCES

Coordinator: Guðni Axelsson / ISOR, Iceland GeoSurvey

The purpose of the project proposed here is to develop methods to study the recharge and mass balance and apply them to the Reykjanes-Svartsengi geothermal region in Iceland.

The proposed project aims to join together the results of several different scientific methods or disciplines to address the issue in question, in particular:

(a) High-resolution 3-D surface deformation monitoring (InSAR and GPS monitoring),
(b) micro-gravity monitoring,
(c) repeated TEM resistivity surveying,
(d) reservoir pressure- and temperature monitoring,
(e) chemical content monitoring and
(f) dynamic geothermal reservoir modelling.

Combining surface elevation and gravity data has been used to estimate the mass balance of geothermal systems during production, resistivity surveying has been used for exploration and chemical data has been used to study processes in geothermal systems and their recharge. Detailed numerical modelling of geothermal systems has also been used extensively to simulate the response of geothermal reservoirs to production. The innovative aspect of this proposal involves joining together the results of the different methods through unified modelling of aspects (a) through (e).

RESISTIVITY SURVEY OF GRÍMSVÖTN

Coordinator: Knútur Árnason / ISOR, Iceland GeoSurvey

The main objectives of a LOTEM survey of Grímsvötn are:

(a) To map the spatial extent and depth span of resistivity anomalies in the upper crust under Grímvötn, allowing comparison with other high-temperature geothermal areas.
(b) Map the location and extent of magma bodies in the uppermost 3-5 km of the crust under the volcano.
(c) Use the data and comparisons with other areas to assess the reasons why a pristine geothermal area has heat release similar to that of a large thermal area under full exploitation (e.g. Nesjavellir, Hengill, Krafla).

The project is planned for three years. In the first year the PhD student will study electromagnetic methods in geothermal exploration. He will also carry out model calculations to optimize the survey setup to ensure sufficient depth of exploration and resolution. Two three weeks long field missions for data collection are planned, in June 2010 and June 2011. The field missions will take place in conjunction with the annual missions of the Icelandic Glaciological Society.

After the first field mission, a processing sequence will be set up and inversion (see General description below). From the results, the field strategy will be further developed for the second mission. After the second mission all collected data will be processed and inverted. Finally the resulting 3D resistivity model and other data (gravity and seismic data) will be interpreted jointly to build a conceptual model of the Grímsvötn volcano and its high-temperature geothermal system.

THE ICELANDIC PARTICIPATION IN THE EU SUPPORTED PROJECT GEOTHERMAL ENGINEERING INTEGRATING MITIGATION OF INDUCED SEISMICITY IN RESERVOIR (GEISER)

Coordinator: Kristján Ágústsson/ ISOR, Iceland GeoSurvey

This application is a side application of a large EU-FP7 proposal called GEISER where ISOR,the Icelandic participant, is applying for the cost not covered by the expected EU contribution. This application was originally submitted to EU in 2007 and got very positive evaluation and high ranking (13 out of 15 points) but ended on the reserve list without funding due to EU budgetary limits.

The proposal was revised with respect to the evaluation sheet in 2007 and re-submitted to EU in April 2009 and the decision of funding is expected during the summer 2009. Informal information indicates that the proposal will now be funded. If there will, however, be no-funding from EU the project will not be realized

ANNEX IV

PROGRESS REPORTS

09-01-007 ***HYDRORIFT***

09-01-011 ***PROPERTIES OF TWO PHASE FLOW OF WATER AND STEAM IN GEOTHERMAL RESERVOIRS***

09-01-012 ***RENEWABILITY OF GEOTHERMAL RESOURCES***

09-01-013 ***HIGH PRESSURE AND HIGH TEMPERATURE GEOTHERMAL GROUTS***

ANNEX V

SHORT PROJECT DESCRIPTION ON THE FUNDED PROJECT FROM THE SECOND CALL

CARBFIX PROJECT

PROJECT ABSTRACT

The overall objective of the CarbFix project is to develop an industrial solution for mineral sequestration of CO2 in basalt, and to train young scientist to carry this knowledge into the future. The project consist of field injection of CO2 charged water at the Hellisheidi power plant SW Iceland, laboratory experiments, computer modelling of fluid flow and gas-water-rock interactions, tracer tests, natural analogue- and cost analysis. Here we seek support for 1) CO2 charged seawater-basalt experiments 2) monitoring of CO2 gas and groundwater composition after injection 3) reactive transport computer modelling of water flow and composition before and after injection.

WP – RELEVANCE DESCRIPTION

WP 2.2.Eight PhD students and two MSc students have been and are working on their research within CarbFix, WP 3.1.1 hosting annual workshops, 3.1.2 maintains a webpage (carbfix.com) and organises seminars presenting the progress of the project and the possibilities of utilising its expected outcome. Modelling under WP 4.1. The main essence of CarbFix objective is CO2 sequestration, WP 5.4. WP 6, especially sub-tasks 6.2. and 6.3. Similarly it can be classified within WP7 Sustainability – economics – social, sub-task 7.6. cost-benefit analysis and environmental impact as a part of the CarbFix project is the economic assessment of the sequestration.

ADVANCED 3D GEOPHYSICAL IMAGING TECHNOLOGIES FOR GEOTHERMAL RESOURCE CHARACTERIZATION

PROJECT ABSTRACT

This proposal is the Icelandic part of a comprehensive Icelandic/USA cooperative project under the IPGT agreement. The USA partners are LBL and MIT. The focus is on the development of joint geophysical imaging methodologies using complimentary data for geothermal site characterization and demonstrate their potential in three areas: Krafla, the Reykjanes-Hengill areas and Coso in the USA. The emphasis is on Electro-Magnetic, gravity and earthquake data. The joint inversion will be made in an innovative paradigm of joint geometry rather than parametric correlation. It is divided into four increasingly ambitious stages, from state of the art to fully joint inversion.

WP – RELEVANCE DESCRIPTION

This project has relevance to WP2, mainly Task 2.2. The PhD student will get contacts to many research institutions and universities. The main relevance is to all tasks of WP4. It aims at improving exploration technologies, both applied methods and interpretation. It aims at better understanding the geological/physical processes at work in geothermal systems, both natural (volcanic) and enhanced. It aims at better resolution to decrease drilling risk and help in sustainable resource

development. A strong relevance to all the tasks of WP8. The results will be published in scientific journals and presented at scientific meetings and conferences.

THE HENGILL GEOTHERMAL RESERVOIR. EVALUATION OF SUBSURFACE GEOLOGICAL DATA

PROJECT ABSTRACT

The proposed project aims at defining the character of the Hengill geothermal system with special emphasis on integrating the various geological and geophysical borehole data. This includes a 3D model of geological and hydrothermal alteration structures. The work is mainly done as part of MSc studies of seven students each of whom will in addition focus on specialized subjects which will add further to the characterization of the geothermal system. This will result in the emergence of several highly skilled and motivated new generation scientists in the field of geothermal research. The results will be published in peer-reviewed journals

WP – RELEVANCE DESCRIPTION

WP-2. Seven BSc students will receive a MSc in the field of geothermal sciences by the end of proposed project.

WP-3. Project promotes basic research and helps to realize concepts from basic research.

WP-4. Results will have significant implications for research and technological development of geothermal systems.

WP-6. Results of project will have implications for long-term utilization of geothermal resources.

WP-8. Results will be published in main-stream journals and introduced at domestic and international conferences.

UTILIZATION OF SUPERCRITICAL GEOTHERMAL FLUID

PROJECT ABSTRACT

This project will evaluate appropriate cycle and equipment selections for the utilization of supercritical or high superheat geothermal resources. Two preliminary approaches have been presented in the literature: direct admission to the turbine, and a binary cycle. Both of these approaches have serious challenges due to material limitations. The goal of this work is to develop model-driven comparisons and map operating regions to identify the relative merits of different cycle configurations, and quantify the potential improvements in economy or barriers to be overcome above those present for a more conventional plant.

WP – Relevance Description

The IDDP is an interesting frontier of geothermal development which is prime to attract new young technical experts into the field, as this proposed M.S. project will do in accordance with the objectives of WP2. The main thrust of this work is on the heretofore lightly covered aspect of the above-ground processes and equipment needed to harness high-superheat or supercritical fluids, falling under Task 5.5 of WP5. This is related quite closely with Task 4.6 of WP4 (subsurface aspects), and is intended as a first step towards a longer-term strategic view on how to handle these resources.

GEOTHERMAL ECONOMIC IMPACT DATA BASE

Project Abstract

Although the economic and social effects of geothermal energy may at first seem obvious, it is essential to map these impacts and analyse at both regional and national levels how the utilisation of geothermal energy affects households and firms. This project proposes to assemble a data-base of how geothermal energy is utilised throughout the country and the development of this usage through time. The data compiled will be linked to data from Statistic Iceland to construct dynamic input-output accounts that allow us to trace the utilisation of geothermal energy through the economy, enabling a thorough assessment of its importance in the national economy.

WP – Relevance Description

GWP2: Output 1 Ph.D.s from UoI and 1 masters. Cooperation between faculties of UoI, and the industry, clears new pathways for interdisciplinary education and research in Iceland as it relates to energy resources.

GWP6: complements data from LCA in WP6.2 for a thorough cost-benefit analysis and LCC analysis. Is vital for assessment of sustainability protocol.

GWP7: Effort is a prerequisite for all other work to be undertaken in WP7. IO model will be complemented with the social impact data, assembled in Task 7.2 of WP7, allowing full quantification of social and economic effects geothermal energy utilisation has on Icelandic society. The resultant social-economic IO accounts are also necessary for Task 7.3. It will also be utilised to analyse the macroeconomic effects of geothermal energy use (Task 7.4) as complex intra- and inter-industry relationships must be accounted for to properly evaluate macroeconomic impacts.

GWP8: Parallel to dissemination and outreach strategy.