ANNEX I
Project Plan

Geothermal economic impact data base

Project ID:	**09-02-017**
Coordinator:	Sveinn Agnarsson / University of Iceland
Start date:	March / 2010
Duration:	41 month
Partners:	Faculty of Economics, University of Iceland National Energy Authority of Iceland Institute of Economic Studies, University of Iceland

1 Project description

1.1 General description

Like all other types of energy, the utilisation of geothermal energy can have a substantial impact on society and play an important role in sustainable development. These effects can, however, vary both through time and over regions. In Iceland, for example, geothermal energy has for centuries been used for washing and bathing, but in the first half of the 20th century its use expanded to include space heating, swimming pools and spas and greenhouses. More recently, geothermal energy has also been utilised for fish-farming, various industries, snow melting, and electricity generation.

Although the economic and social effects of geothermal energy may at first seem obvious and easily assessed, it is essential to map these impacts thoroughly and analyse at both regional and national levels how the utilisation of geothermal energy affects households and firms, as well as inter- and intra-industry links. In order to accomplish this in a satisfactory manner it is imperative to compile a data-base that makes it possible to pinpoint how geothermal energy is utilised throughout the country and the development of this usage through time. The data compiled will then be used together with data from Statistic Iceland to construct dynamic input-output accounts that allow us to trace the utilisation of geothermal energy through the economy and analyse in depth its importance for households and firms. Further, assembling such a data-base is a prerequisite for all further analysis of the economic and social effects geothermal energy has had on Icelandic society, and an invaluable tool for studying what effect changes in energy use will have on the economy.

Input-output (I-O) accounts provide detailed statistics on economic processes and relationships and allow users to study changes in the structure of the economy and assess the impact of specified events on economic activity. Generally speaking, there are two broad applications of the I-O accounts; as an economic accounting model and as an analytical model. The former shows the relationship between the producing sectors, final demand, and income by industry. More precisely, it shows industry purchases of goods and services, including geothermal energy, that are used to produce commodities (including services). In turn, these commodities may serve as inputs for other industries or as purchases by final users (firms or consumers). The model also accounts for the income origination from each industry as a result of its production. This income is in the form of compensation (wages), taxes on production and imports less subsidies, and gross operating surplus (profits).

The analytical model is derived from the accounting model and is used to show the relationship between final demand and industry production. Industry production is usually measured in terms of gross output, income, or employment. The model may be used to evaluate the interrelationships among industries and the relationships between industries and the commodities they use and produce.

1.1.1 Objectives

The general objective of this project is to gather data necessary to estimate the social and economic impact geothermal energy has had on Icelandic society, in addition to set the framework and evaluate comprehensive social-economic IO accounts. This pivotal study will then serve as a

blueprint for other studies elsewhere e.g. for other energy sources and will facilitate a comprehensive assessment of the economic implications for utilizing domestic renewable energy sources in Iceland.

Specific objectives are:

1. Compile time-series data from all geothermal energy utilities in Iceland, which show the number of customers (households and firms), how these customers have used the energy, prices and quantities.

2. Gather data from Statistics Iceland that can be used for input-output accounts.

3. Merge the compiled data set with data from Statistics Iceland to create geothermal input-output accounts, which maps how geothermal energy is used in Icelandic society.

1.1.2 Future use

Once the input-output accounts have been compiled the model can be complemented with the social impact data which will be assembled in Task 7.2 of WP7. This will allow users to quantify the social and economic effects geothermal energy utilisation has on Icelandic society.

The resultant social-economic input-output accounts will be invaluable for analysing the effects geothermal utilisation has on regional development and local capacity building (Task 7.3 in WP7). The data base will also be utilised to analyse the macroeconomic effects of geothermal energy use (Task 7.4) and be a useful tool in understanding the build-up of geothermal know-how in the economy.

Finally, the input-output accounts can be complemented with data from the LCA framework in WP6.2 for a thorough cost-benefit analysis and LCC analysis.

It should be clear, that building this data-base is therefore an absolute prerequisite for all other work undertaken in WP7, and is vital for assessment of the sustainability protocol in WP6.

1.2 Scientific – and/or Technical Merit

This study will obtain valuable and necessary information on the actual economic impacts of harnessing geothermal energy based on a proper Icelandic setting. The derived conclusions will be presented both to decision makers at all levels of decision-making, as both the industry and energy authorities directly participate in or are connected to the project. This also secures continual flow of information and results to these key actors within the geothermal energy arena.

Furthermore, at a time when concerns have been voiced regarding the continued harnessing of geothermal and hydropower in Iceland, conclusions from this project will provide sound arguments within this ongoing debate as well as guide future geothermal harnessing strategies towards sectors that provide both economic and societal value, and thereby contributing to the sustainable development of Icelandic society.

To our knowledge, this will be the first time that such comprehensive data has been gathered on the utilisation of a specific energy source for a whole economy . The intent is to be able to assemble a data-base that makes it possible to pinpoint precisely how many households and firms use geothermal energy in every community in Iceland, and how this energy is used. The I-O analysis will

then enable us to trace the various inter- and intra-industry links. The data gathered will be used to build more advanced models, that is a dynamic IO Model, as opposed to the conventional static I-O models. Since Iceland is touted as a possible model for other nations with regard to increased use of low-carbon energy, a comprehensive understanding of the economic and social dynamics of the utilization of the resource is of utmost importance.

Furthermore, it must be kept in mind that building this data-base is a necessary prerequisite for all the work to be undertaken in the entire WP7 as described in the GEORG project.

1.3 Innovation / Entrepreneurship

Direct and indirect project partners come from a range of different sectors, resulting in a strong network of actors in Iceland. The data-base assembled can be utilised to analyse the effects changes in various parameters, e.g. macroeconomic variables, will have on geothermal utilisation. As such it is of interest to a wide network of actors, ranging from policy makers, the industry (Landsvirkjun, HS Orka, Reykjavik Energy and smaller utilities) to consumers.

As the project during the first year is mostly inward looking, collaboration with scientists and organizations abroad will not commence until in year 2 and 3, as the modeling process begins. Collaboration will be sought at MIT, but members of the project team will spend the spring of 2010 at MIT facilitating such collaboration. Collaboration has already been facilitated at NREL as well as at Berkeley.

Due to the novelty of focusing specifically on energy in dynamic IO accounts, the Icelandic research arena within this field will be greatly enhanced within the international research community. Icelandic experience and expertise will lead internationally in quantifying and illustrating the societal implications of geothermal utilisation and assessment.

The conclusions will illustrate the economic importance of geopower in Icelandic society – and illustrate areas where large societal benefits are to be expected. This can present exciting entrepreneurial opportunities domestically and abroad, benefiting the Icelandic economy.

1.4 Education / Dissemination

The project will tie together people from the University of Iceland, the National Energy Authority, Statistics Iceland and industry such as Landsvirkun, Reykjavik Energy and smaller industrial actors. As both the industry, the energy authorities as well as academia participate in the project the continued flow of information between important actors is secured.

The study will facilitate the involvement of students as well as enhancing the interaction between students and the industry. One doctoral student and three masters students (one per year) are expected to participate.

Both the methodologies and the specific conclusions of the project will be published and disseminated through all the different pathways of GEORG (public website, publications, conferences and events, regional “mini” conferences and at the World Geothermal Congress 2015). However, special emphasis will be given to publishing in highly regarded academic journal such as the Energy Journal.

1.5 Objectives and GEORG WP relevance

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.

2 Work plan and time schedule:

The data on geothermal energy utilisation will be gathered using the following methods:

1. Data available from Statistics Iceland.

2. Data available from National Energy Institute.

3. Data available from each geothermal utility, in cooperation with Landsvirkjun, Orkuveita Reykjavíkur, HS Orka and other much smaller geothermal utilities e.g. Hitaveituveitufélag Þverárhlíðar which have been fundamentally important in regional development and enhanced quality of life all over the country.

4. Data available from regional municipalities to complement data from statistics Iceland.

5. Surveys/interviews with individual communities, firms and households will be conducted should the data otherwise obtained prove unsatisfactory.

Subtask	Start	Finish	Deliverable/Milestone
Compile data base	1. March 2010	31. Agust 2011	Data base
Create national I-O accounts	1. September 2011	31. August 2012	National I-O accounts
Create regional I-O accounts	1. September 2012	31. Agust 2013	Regional I-O accounts

3 Project Management

In recent years the Institute of Economic Studies (IoES), University of Iceland, has been developing models based on input-output accounts. These models have mostly been used to analyse the importance of various branches of economic activity, both at regional and national level. This project can be regarded as a direct continuation of that work. The project team will include two economists from the IoES, and either a graduate student or student with a masters degree, and a PhD student. In addition the project will have a four person steering committee with 2 members from IoES and Energy and natural resources at the University of Iceland (Sveinn Agnarsson, Brynhildur Daidsdottir), Energy Authority (Jonas Ketilsson) and one representative from the geothermal industry (a representative from either HS Orka, Reykjavik Energy or Landsvirkjun). The steering committee will meet once a semester to facilitate proper continuation of the project.

The masters' student will compile the data, in close cooperation with industry and energy authority representatives, while IoES staff will primarily be responsible for designing the input-output accounts. The PhD student will be involved in the data gathering, but is mostly intended to take part in developing the input-output accounts and subsequent modelling work. The PhD student should ideally also be engaged in other tasks in WP7.

All the tools needed are readily available, and access to relevant industry specific data is secured with participation of industry representatives and the energy authority.

4 Budget overview

Consortium: **GEORG**

Name of Project: **Geothermal economic impact data base**

ISK '000	Year		Year 1 2010/2011		Year 2 2011/2012		Year 3 2012/2013				Grand Total	
Salaries including overhead		Unit cost	Man-months	Total	Man-months	Total	Man-months	Total				
Meistaranemi	NN	210	7	1.470	8	1.680	8	1.680			4.830	
PhD nemi	NN	265	4	1.060	8	2.120	8	2.120			5.300	
Sveinn Agnarsson	SA	425	3	1.275	4	1.700	4	1.700			4.675	
Brynhildur Davíðsdótti	BD	425	1	425	2	850	2	850			2.125	
Sigurður Jóhannesson	SJ	425	2	850	2	850	2	850			2.550	
Jónas Ketilsson	JK	425	1	213	1	213	1	213			638	
Total			18	5.293	25	7.413	25	7.413			20.118	
Operational exp.												
a											0	
b											0	
c											0	
Total				0		0		0			0	
Travel expenses												
a											0	
b											0	
c											0	
Total				0		0		0			0	
Total cost				5.293		7.413		7.413			20.118	
Financing												
University of Iceland				2.550		3.400		3.400			9.350	
University of Iceland PHD Scholarship (to be applied for)						795		795			1.590	
National Energy Institute				213		213		213			638	
Total other financing				2.763	52%	4.408	59%	4.408	59%		11.578	58%
Requested funding from GEORG				2.530	48%	3.005	41%	3.005	41%		8.540	42%
Total financing				5.293		7.413		7.413			20.118	100%

4.1 Explanation of cost:

Funding is sought for one PhD student, and three masters students – one per each year.