



## IGA ACTIVITIES

### Message from the Vice President

**Ruggero Bertani**

It is a pleasure to write this short note about some of the most important current IGA activities, taking the floor on behalf of the President, who could not be available for this issue of IGA News.

WGC 2010 is very well on track. More than 1200 abstracts have been submitted, and the process of reviewing and accepting is under way. If your paper is to be presented at the conference, either orally or as a poster, it will be very important for you to be present at the WGC. Even if your paper is not accepted, it will in any case be an opportunity for discussing your ideas and your work with the most important players in the worldwide geothermal community. Even if you have not submitted a paper, do not hesitate to start planning a visit to the WGC conference and exhibition, with all the most up-to-date state of the art in terms of technologies and information.

Let me remind you of important dates:

- 1<sup>st</sup> April 2009: acceptance of the paper
- 31<sup>st</sup> May 2009: draft technical paper submission
- 30<sup>th</sup> October 2009: final technical paper submission
- 25-30 April 2010, in the astonishing BALI, Indonesia: the WGC2010 event:

#### “Geothermal: the Energy to Change the World”

Exhibition booths are still available: an early booking will give a substantial discount! Visit the website: [www.wgc2010.org](http://www.wgc2010.org).

One of the most important recent IGA events has been the workshop supported by the World Bank GeoFund/IFC through the EuroBranch and the International Summer School. As the workshop was hosted in Istanbul, Turkey, on 16-19 February, there were several Turkish businesses who had recently bid on privatized geothermal sites in Turkey and were seeking partners to help develop these sites. Many of these companies had kiosks to display their geothermal project initiatives and potential. This workshop brought together geothermal experts and decision-makers from both private and public sectors, reaching the unexpected value of 170 attendees! The goal of the workshop was to help initiate and implement geothermal projects in Turkey. In addition,

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to complement the workshop, an exhibit hall of kiosks highlighted business “best practices” and developers of geothermal energy, both for electricity and district heating. The long term goal was to provide geothermal stakeholders in Europe and Central Asia (ECA) with on-going technical and logistical assistance to help develop best-practice geothermal initiatives.

Three major sessions were organized:

- Geothermal projects: successful case studies;
- Geothermal demand and securing financing;
- Course on economic evaluation and modelling.

The goal of the World Bank's GeoFund - IGA Geothermal Workshop was to promote systematically the use of geothermal energy in the ECA countries by removing barriers to the development of geothermal renewable energy, leading to greater use of, and increased demand for, geothermal energy projects. The workshop was targeted directly at GeoFund countries, with a particular focus on Turkey, and at high-level energy officials, developers and financiers. The workshop aimed to enable geothermal development by bringing together decision-makers with leaders in geothermal industry and finance.

To this end, the World Bank (WB) GeoFund is the first region-wide program of its kind; it is implemented jointly with the International Finance Corporation (IFC) to promote private sector investments. Our Workshop is part of phase 1 of 3 phases designed to enable geothermal development in the ECA region. The GeoFund overall assistance phases are as follows:

- 1) Technical Assistance:** Through the Geothermal Workshop our goal was to present the attendees with information on how to develop a project, carry out financial analysis and economic modelling, prepare winning proposals to the GeoFund for exploration and drilling, and secure international financial resources.
- 2) Direct Investment:** GeoFund, via the World Bank, will support selected project developers by providing low cost loans, contingent grants and outright grants which would cover part of the project cost through monetization of external benefits. Likewise, via the IFC, the GeoFund will help improve the performance of existing geothermal installations through renovation of existing facilities, and will also support bankable business plans for "greenfield" facilities where the resources are promising.
- 3) Geological Risk Insurance:** GeoFund will partially insure project developers/investors against the short-term and medium-term geological risks. This insurance will help mitigate the risks associated with geothermal energy exploration and operation that are considered key barriers to geothermal energy investments.

## UPCOMING EVENTS

**RENEXPO Central Europe**, Budapest, Hungary, 16-18 April 2009. Website: [www.renexpo-budapest.com](http://www.renexpo-budapest.com)

**Canadian Geothermal Energy Association Conference and AGM**, Vancouver, Canada, 22-24 April 2009. Website: [www.cangea.ca/events/](http://www.cangea.ca/events/)

**International Symposium on Convective Heat and Mass Transfer in Sustainable Energy**, Yasmine Hammamet, Tunisia, 26 April-01 May 2009. Website: [www.ichmt.org/conv-09/](http://www.ichmt.org/conv-09/)

**5th International Geothermal Energy Conference (IGC)**, Freiburg, Germany, 28 April 2009. Website: [www.geothermiekonferenz.de/](http://www.geothermiekonferenz.de/)

IEA Geothermal Implementing Agreement - IGA Workshop "Geothermal Energy - Its Global Development Potential & Contribution to the Mitigation of Climate Change", Madrid, Spain, 5-6 May 2009. Contacts: [mongillom@reap.org.nz](mailto:mongillom@reap.org.nz), [rybach@geowatt.ch](mailto:rybach@geowatt.ch)

**Clean Technology Conference & Expo, Session on Geothermal**, Houston, TX, USA. Website: [www.csievents.org/cleantech2009/](http://www.csievents.org/cleantech2009/)

**AAPG 2009 - Sessions on "Geothermal Energy Systems" and "How do Fluids Really Move through Rocks?"**, Denver, CO, USA, 7-11 June 2009. Website: [www2.aapg.org/denver/index.cfm](http://www2.aapg.org/denver/index.cfm)

**RENEXPO 2009**, Augburg, Germany, 24-27 September 2009. Website: [www.renexpo.de](http://www.renexpo.de)

**GRC 2009 Annual Meeting**, Reno, NV, USA, 4-7 October 2009. Website: [www.geothermal.org](http://www.geothermal.org)

**New Zealand Geothermal Workshop**, Auckland, New Zealand, 16-17 November 2009. Website: [www.science.auckland.ac.nz/uoa7science/about/research/gei/workshop.cfm](http://www.science.auckland.ac.nz/uoa7science/about/research/gei/workshop.cfm)

**World Geothermal Congress 2010**, Bali, Indonesia, 25-29 April 2010. Website: [www.wgc2010.org](http://www.wgc2010.org)



ELSEVIER

## GEO THERMICS

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The countries eligible for GeoFund assistance are: Albania, Armenia, Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Croatia, Georgia, Kazakhstan, Kirgizstan, Macedonia, Moldova, Montenegro, Romania, Russia, Serbia, Ukraine, Tajikistan, Turkey, Turkmenistan, and Uzbekistan.

For more information visit the website: [www.worldbank.org](http://www.worldbank.org).

I would like to highlight another task still ongoing, in which I am personally involved: IGA will contribute to some chapters (Knowledge Modules) of the Global Energy Assessment Report (GEA), which will be one of the major inputs and sources of data for the coming World Energy Conference of 2010. The organization responsible for this task is the International Institute for Applied Systems Analysis (IIASA, Vienna): it is very important to be present in such a high level task and to be the voice of geothermal energy as one of the important renewables. It is even more important to present data and information outside the “closed loop” of our IGA community, extending our presence among all the energies, both renewables and otherwise.

More information on websites : [www.iiasa.ac.at](http://www.iiasa.ac.at) and [www.globalenergyassessment.org](http://www.globalenergyassessment.org).

The IEA Geothermal Implementing Agreement (GIA) is an active entity to promote international cooperation in the development of geothermal energy. In view of the planned IPPC Special Report, the coming IGA BoD meeting in Madrid (May 2009) will be held in conjunction with the IEA-GIA workshop (on the GIA website [www.iea-gia.org](http://www.iea-gia.org)). Our inputs to the IPPC report will be discussed and approved at the joint meeting. A brief summary of the major outcome of these activities will be published in the next IGA News.

The IGA Executive Committee has passed a motion from the Education Committee to accept a grant application from the International Centre for Science and High Technology of the United Nations Industrial Development Organization (ICS-UNIDO), Trieste, Italy, proposing to conduct a 2-week “School on Geothermics” at the ICTP, Trieste, Italy in 2009. The grant agreement was signed by both partners in Istanbul in February. UNIDO is also keen to co-sponsor this programme. The main objectives of this school will be as follows:

- To provide basic knowledge about geothermal energy resource exploration and its application for power generation and direct use;
- To provide advanced technical knowledge, methods and implementation tools for the application of geothermal energy for power generation and direct use through lectures and tutorials and case studies/histories;
- To provide knowledge about the economic and environmental aspects of geothermal energy;

There will also be a field visit to the Larderello geothermal area and other direct application sites in Italy.

The main target groups of the programme are University teachers, post-graduate students, decision-makers, independent power producers and mid-career professionals and technologists from the public and private sector organizations involved in exploitation of renewable energy resources from developing countries like Africa, Indonesia, Arab peninsula, India and selected East European countries. Duration: from 26th October to 6th November 2009 at ICTP, Trieste, Italy.

For further information and for participation, contact <http://www.ics.trieste.it>.

The IGA Executive Committee has approved the addition of Philippe Dumas, manager of the Brussels office of the European Geothermal Resources Council, to the Information Committee.

I look forward to continuing to work with you in our joint effort to promote geothermal, and thank you all for your support.

## EUROPE

### A European research agenda for geothermal energy: Strategy 2008 to 2030

#### *Philippe Dumas, EGEC Delegate*

The European Geothermal Energy Council (EGEC) published in January 2009 the first European research agenda for geothermal energy, proposing a R&D strategy to decrease costs and reach the targets fixed by the geothermal sector for 2030.

Firstly EGEC prepared a list of priorities for Research and Development (R&D) in the geothermal sector. The paper was discussed during the workshop organized in Brussels (Belgium) on 5 September 2008.

A list of main priorities was selected, and proposed in a first consultation document issued in October 2008.

The conclusions have now been presented in the final version of the Research Agenda, integrating the inputs received both from inside and outside Europe.

The objective is to decrease geothermal costs:

- by 5% for geothermal district heating: target 40 €/MWh<sub>th</sub>
- by 10% for geothermal heat pumps: target 15 €/MWh<sub>th</sub>
- by 30% for conventional geothermal power (flash and dry steam): target 20 €/MWh<sub>el</sub>
- by 50% for low enthalpy electricity production: target 50 €/MWh<sub>el</sub>
- by more than 50% for EGS: target 50 €/MWh<sub>el</sub>

The main R&D priorities presented in the geothermal research agenda are:

- drilling improvement for EGS and conventional geothermal resources

## Summary of targeted costs

Heating and cooling	Cost 2007	Average (€/MWh)	Costs red. by 2030 (% 2005 costs)
Deep geothermal	2 to 40	7.2	11
Geothermal district heating <sup>1</sup>	40 to 80	50	-5
Shallow geothermal heating only	10.8 to 320	19	-9
Shallow heating and cooling	7.2 to 270	61	-8

Geothermal Electricity	Cost 2007	Average	Costs 2030
	Range(€/MWh)	(€/MWh)	Average (€/MWh)
Electricity conventional	50 to 90	70	20
Low temperature	80 to 150	115	50
Enhanced geothermal systems	200 to 300	250	70

<sup>1</sup>The figures for deep and shallow geothermal are from the IEA report 2007: *Renewables for heating & cooling*. The data on District Heating are EGEC projections for geothermal DH in Europe. European Union: EU- 27 represents : Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom



### RESEARCH AGENDA FOR GEOTHERMAL ENERGY Strategy 2008 to 2030



- resource identification: increasing knowledge of the geothermal potential in Europe,
- prove the sustainability of Enhanced Geothermal System (EGS) technology
- develop enabling technologies and demonstrators for microgeneration and co-generation with low temperature water (<120°C), also in hybrid plants (e.g. biomass and geothermal).
- improve geothermal plant efficiency,
- geothermal heat pumps: decrease installation cost, and increase Seasonal Performance Factor (SPF), optimize the entire system (ground heat source/heat pump/distribution)

The next step will be to implement this research agenda. The creation of a European Technology Platform for renewable heating and cooling, with a special panel on geothermal energy, will help to detail these research topics and to adopt the actions required to achieve these costs reductions.

The R&D work should be accompanied by strong educational/training activities and measures to solve non-technical issues, like quality certification, guidelines, regulation, infrastructure, etc..

**The Long Term goal (2030) of the geothermal sector is to contribute 5% of total electricity production in Europe, and 3.5 % of total heat generation.**

## Targets for all of Europe (EU-27 and the rest)

Geothermal energy heating	2007	2010	2020	2030
Installed capacity (MW <sub>th</sub> )	14,100	20,000	50,000	80,000
Heat delivered (mtoe/y)	3.8	5.5	13.7	22

## Iceland

### 30th Anniversary of UNU-GTP in Iceland

**Ingvar Birgir Fridleifsson, Director UNU-GTP**

The 30th anniversary of the United Nations University Geothermal Training Programme (UNU-GTP) was celebrated with a two day Anniversary Workshop in Reykjavík on 26-27 August 2008. Thirty three former UNU Fellows from 23 countries attended the Workshop, in addition to 22 current UNU Fellows from 15 countries and 8 MSc Fellows from 5 countries. The Foreign Minister of Iceland, Mrs. Ingibjorg Solrun Gísladóttir, gave a speech at the opening of the Workshop, as did UNU Vice-Rector Janos J. Bogardi, Prof. Cornel Antal, the Rector of Oradea University in Romania (who spoke on behalf of the UNU-GTP alumni), and the Ambassador of the People's Republic of China, Mr. Zhang Keyuan. Over forty papers were presented at the Workshop (available on [www.unugtp.is](http://www.unugtp.is)). Over one hundred guests from the geothermal and academic community in Iceland participated in the Anniversary Workshop, amongst them many of the key teachers and supervisors as well as former staff members of the UNU-GTP. It was a great experience to see so many of the UNU-GTP alumni and supervisors share their research results as well as meeting friends and colleagues from various parts of the world, reminiscing

about the past, and planning for the future. These are the pillars of the network of UNU-GTP Fellows worldwide.

The UNU-GTP ([www.unugtp.is](http://www.unugtp.is)) is operated at Orkustofnun, the National Energy Authority of Iceland (NEA), which has been an Associated Institution of the UNU since 1978. The main goal of the UNU-GTP is capacity building in the sustainable use of geothermal energy resources. The aim is to assist developing countries with significant geothermal potential to build up groups of specialists to cover most aspects of geothermal exploration and development. Since the foundation of the UNU-GTP, 402 scientists and engineers from 43 countries have completed the annual six-month courses. Of these, 44% have come from countries in Asia, 26% from Africa, 15% from Central and Eastern Europe, and 15% from Latin America. The trademark of the UNU-GTP is to give university graduates engaged in geothermal work intensive on-the-job training in their chosen fields of specialization. The trainees work side by side with geothermal professionals in Iceland (the majority with ISOR - Iceland GeoSurvey). Specialized training is offered in geological exploration, borehole geology, geophysical exploration, borehole geophysics, reservoir engineering, chemistry of thermal fluids, environmental studies, geothermal utilization, and drilling technology. In 2000, an MSc programme was started in cooperation with the University of Iceland. Sixteen have graduated, 6 of them in 2008. The first PhD candidate on a UNU Fellowship started at the University of Iceland in 2008.

### Joint GIA-IGA Workshop

#### Geothermal Energy - Its Global Development Potential and Contribution to the Mitigation of Climate Change

The International Energy Agency Geothermal Implementing Agreement (IEA-GIA) and the IGA are holding a joint 2-day workshop in Madrid, Spain, on 5-6 May 2009, to discuss the global potential of geothermal energy and its possible contribution to the mitigation of climate change. The results will contribute to the geothermal chapter of the Intergovernmental Panel on Climate Change (IPCC) Special Report on Renewable Energy and Climate Change to be published in 2010.

Though still in the planning stages, the current draft Workshop discussion topics includes: Definitions of Geothermal Potential; Geothermal Potential for Power Generation and for Direct Use; Challenges and Barriers to Attaining Geothermal Potentials; and the Potential Contribution to Mitigation of Climate Change. The plan is to have a limited number of experts from the GIA and IGA, and possibly other invited experts, make short presentations on these topics based upon their current work and/or published (peer reviewed) papers, to be followed by in-depth discussions. A "wrap-up session" will firm up conclusions, assign actions and set deadlines for completion of outputs, which are expected to include: a formal "Madrid" statement on geothermal's potential contribution to climate change and final reviewed summary documents presenting the participants' agreed conclusions.

For the IEA GIA: Mike Mongillo, Secretary. Contact: [mongillom@reap.org.nz](mailto:mongillom@reap.org.nz)

For IGA: Ladislaus Rybach, President. Contact: [rybach@geowatt.ch](mailto:rybach@geowatt.ch)



*Thirty three former UNU Fellows from 23 countries attended the 30th Anniversary Workshop (alumni from 1979, 1982, 1983, 1985, 1988, 1990, 1991, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007), in addition to 22 current (2008) UNU Fellows from 15 countries and 8 MSc Fellows from 5 countries. All the alumni presented papers. Together with the UNU Fellows in the photo are the staff and Studies Board of the UNU-GTP.*

## **UNU-GTP Workshops and Short Courses as a contribution to UN Millennium Development Goals**

**Ingvar Birgir Fridleifsson, Director UNU-GTP**

The UNU-GTP has organized annual Workshops/Short Courses in geothermal development for African countries (2005, 2006, 2007 and 2008), and for Central American countries (2006 and 2007). The first Workshop for Asian countries was held in China in May 2008. The courses/workshops are set up in cooperation with the energy agencies/utilities and earth science institutions responsible for exploration, development and operation of geothermal energy power stations and/or district heating utilities in the respective countries/regions. A part of the objective is to increase the cooperation between specialists in the respective countries in the field of sustainable use of geothermal resources. Proceedings of the Millennium Workshops/Short Courses of the UNU-GTP are available on: [www.unugtp.is](http://www.unugtp.is). The courses may in the future develop into sustainable regional geothermal training centres. The

core funding for the Workshops/Short Courses is a contribution by the Government of Iceland towards the Millennium Development Goals of the UN.

The first UNU-GTP Millennium event in Asia (“Workshop for Decision Makers on Direct Use of Geothermal Resources in Asia”) was held in Tianjin on 11-18 May, 2008. High ranking decision makers and leading geothermal experts were invited from the People’s Republic of China as well as from Asian countries with significant geothermal resources, plans and markets for space heating (replacement for coal). There were about 120 participants on the opening day. The aim of the workshop was to give high level decision makers from energy ministries and leading geothermal agencies in the region an overview of some of the key issues in the development of geothermal resources for direct use for space heating, with special focus on sustainability, CO<sub>2</sub> emission reduction and reinjection.

Geothermal water replaces coal as a heat source in many cities in China. China is presently at the top of the world list for direct use of geothermal resources for heating, and has the potential to make a significant contribution to the mitigation of climate change by making full and sustainable use of its widespread

geothermal resources. The criteria for a country to be invited to the Workshop were (a) that there is a need for space heating for a few months of the year, and (b) that there are known geothermal resources near densely populated areas (towns, villages). Participants in the Workshop came from China, India, Iran, Jordan, Mongolia, the Democratic People's Republic of Korea, and the Republic of Korea. In addition, lecturers came from Iceland, Germany, Japan, Poland and Switzerland, as well as the United Nations Framework Convention on Climate Change (UNFCCC). In total, there were about 120 participants.

The Workshop in China was co-hosted by the UNU-GTP, the Tianjin Bureau of Land, Resources and Real Estate Management, and the Tianjin Bureau of Geology and Mineral Exploration and Development, in cooperation with the Ministry of Land and Resources of P.R. China, as well as the Municipality of Tianjin. Fifty two papers were presented and distributed in the conference proceedings (available on [www.unugtp.is](http://www.unugtp.is) under Workshops/Short Courses). Among the lecturers were several former UNU-GTP Fellows from Asian Countries. The agenda included papers on geothermal resources and their utilization in the Indian Himalayas and Tibet, at the highest altitude on Earth, and from Jordan, situated by the Dead Sea, at the lowest altitude on Earth.

## Switzerland

### Implementation of the BDFGeotherm database (geothermal fluids of Switzerland) on Google Earth

**Romain Sonney, François-D. Vuataz & Stéphane Cattin**

**Centre for Geothermal Research - CREGE, University of Neuchâtel, Switzerland ([www.crege.ch](http://www.crege.ch)), [romain.sonney@crege.ch](mailto:romain.sonney@crege.ch)**

The database BDFGeotherm, containing physical, chemical and hydrogeological information on more than 200 deep fluids from 84 sites in Switzerland and some neighbouring regions, was compiled in ACCESS code and then modified to improve its availability and attractiveness by using Google Earth free software and the CREGE website ([www.crege.ch/BDFGeotherm/](http://www.crege.ch/BDFGeotherm/)). BDFGeotherm is a functional tool for various phases of a geothermal project such as exploration, production or fluid re-injection. This database allows existing geothermal data, generally widely dispersed and often difficult to reach, to be gathered into a user friendly tool. Downloading the file "BDFGeotherm.kmz" from the CREGE website makes possible visualization of the 84 geothermal sites, each one represented with a pinpoint of different colour for different temperature ranges.



FIGURE: Participants in the first UNU-GTP Millennium Workshop for Asian countries (held in Tianjin, China, 11-18 May 2008) were high-level decision makers and geothermal professionals from China, India, Iran, Jordan, Mongolia, the Democratic People's Republic of Korea, the Republic of Korea, as well as lecturers from Iceland, Germany, Japan, Poland and Switzerland, and the UNFCCC.

## BDFGeotherm – General information on Lavey-les-Bains

## Site description

Country	Switzerland
Canton/Province	Vaud
Primary use	Thermal usage
Secondary use	Building heating

## Geology

Surface formation	Alluvial deposits
Age of surface formation	Quaternary
Reservoir formation	Gneiss
Age of reservoir formation	Hercynian
Geological setting	Aiguilles Rouges Massif



Lavey-les-Bains has 13 sampling points and 7 geological logs are available (\*)

P600 (LAVEY-P600)\*  
 P201 (LAVEY-P201)\*  
 P205 (LAVEY-P205)\*  
 P11 (LAVEY-P11)\*  
 P12 (LAVEY-P12)\*  
 P13 (LAVEY-P13)\*  
 P14 (LAVEY-P14)\*  
 S7 (LAVEY-S7)  
 S8 (LAVEY-S8)  
 S9 (LAVEY-S9)  
 Q8 (LAVEY-Q8)  
 AP (LAVEY-AP)  
 S10 (LAVEY-S10)

Search another site  
 in BDFGeotherm web database

Site: Lavey-les-Bains  
 Sampling point: P600  
 Sample name: LAVEY-P600

## Description

Sampling point type: Borehole  
 X-coord: 568'080  
 Y-coord: 116'482  
 Elevation: 431.75 m amsl  
 Depth: 517 m

## Hydrochemistry

Sampling date: 12.09.2006  
 Geochemical type: Na-SO<sub>4</sub>-Cl  
 Temperature: 64.0 °C  
 Electrical conductivity: 1767 µS/cm  
 pH: 7.7

## Cations (mg/l)

Li: 3.7  
 Na: 376  
 K: 11.5  
 Mg: 1.51  
 Ca: 56.7  
 Sr: no data

## Anions (mg/l)

F: 6.1  
 Cl: 242  
 S-O<sub>4</sub>: 577  
 HCO<sub>3</sub>: 87.4

## Undissociated (mg/l)

SiO<sub>2</sub>: 65.7

TDS: 1435 mg/l  
 Ionic balance: -1.23 %

## Hydraulics

Flow rate: 20.00 l/s  
 Surface temperature: 65.0 °C  
 Max. measured temp.: 72.0 °C  
 Hydraul. conduct.: 1.0 x 10<sup>-3</sup> m/s  
 Exploitation mode: Pumping

## Isotopes

Sampling date: 12.09.2006  
<sup>18</sup>O: -13.15 ‰  
 D: -97.10 ‰  
<sup>2</sup>H: 1.0 TU  
<sup>14</sup>C: no data  
 Resid. time: no data  
 Infiltration area: 1050 m amsl

## Geothermal parameters

Min. reservoir temp.: 100 °C  
 Max. reservoir temp.: 110 °C  
 Reservoir depth: -2500 m amsl  
 Geoth. gradient: no data  
 Geoth. potential: 4600 kWh<sub>th</sub>

## Geological log

Figure 2: View of the main information page for an example: the Lavey-les-Bains geothermal site.

A large majority of sites are located in the northern part of the Jura Mountains and in the upper Rhone Valley (Fig. 1). General information about water use, geology, flow rate, temperature and mineralization are given in a small window by clicking on the desired pinpoint. Moreover, two links to Internet addresses are available for each site in each window, allowing the user to return to the CREGE website and providing more details on each sampling point such as: geographical description, reservoir geology, hydraulics, hydrochemistry, isotopes and geothermal parameters (Fig. 2). For a limited number of

sites, photos and a geological log can be viewed and exported.

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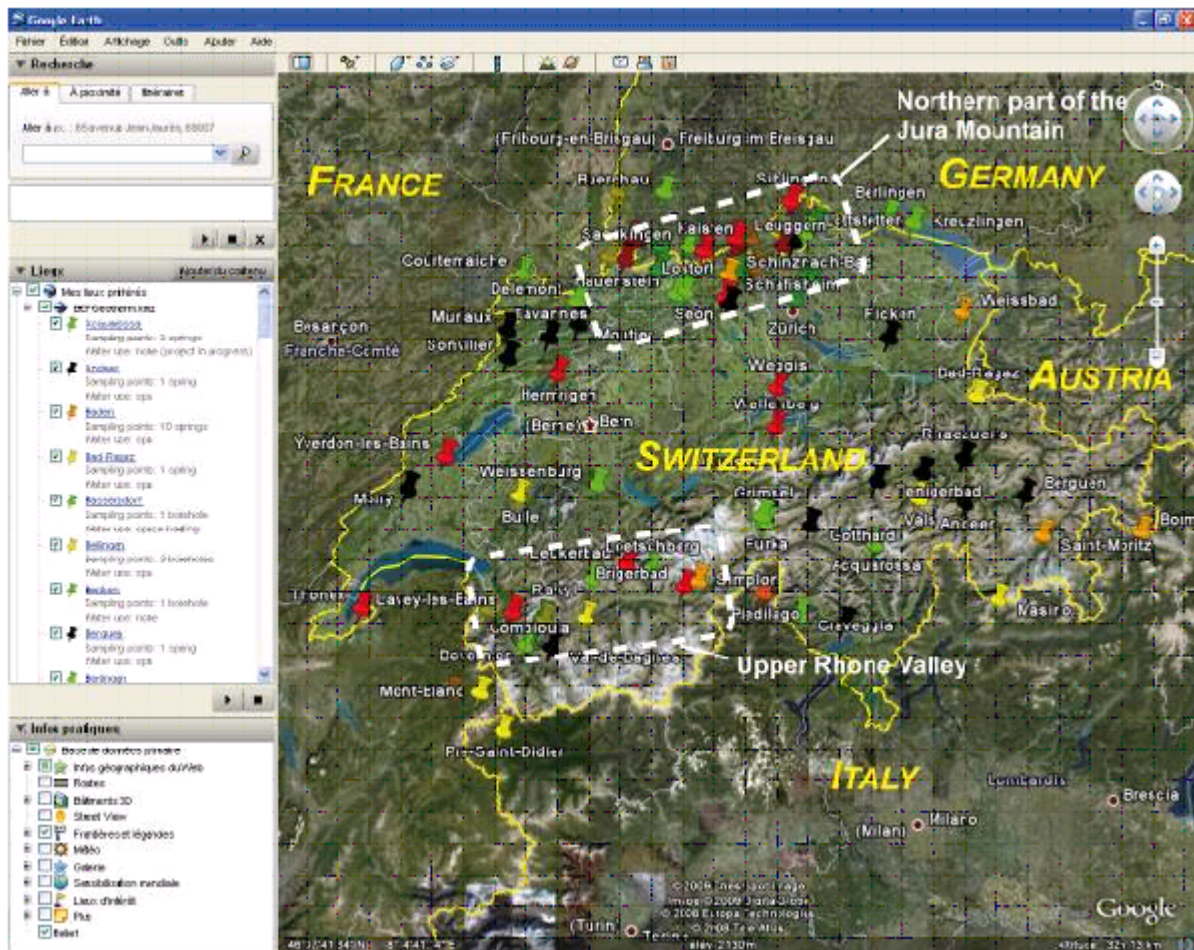


Figure 1: View of geothermal sites implemented in the Google Earth free software. Colours assigned to the pinpoints correspond to ranges of maximum measured temperatures:  $>50^{\circ}\text{C}$  (red),  $40\text{-}50^{\circ}\text{C}$  (orange)  $30\text{-}40^{\circ}\text{C}$  (yellow),  $20\text{-}30^{\circ}\text{C}$  (green), and  $<20^{\circ}\text{C}$  (black)

## AMERICAS

### Mexico

## Mexico-Environmental study on Cerritos Colorados geothermal field finally approved

**Luis C.A. Gutiérrez-Negrín**

The environmental impact study (MIA by its Spanish acronym) for the Cerritos Colorados geothermal project, Jalisco, Mexico, consisting of a first phase with a 25-MW condensing unit and the construction of a transmission electric line at 60 kV, was approved early in January 2009.

This field is located in western-central Mexico, on the outskirts of Guadalajara City, the second largest city in the country. It is inside a Quaternary volcanic caldera, with geothermal fluids contained in andesites. The field has been explored since the 1970s by the Comisión Federal de Electricidad (CFE, the governmental agency in charge of generation, transmission and distribution of electricity in Mexico). Thirteen exploration and development wells have been drilled, at depths between 689 and 2900 meters. Six of them were assessed with a combined production of 200 tons per hour (t/h) of steam and 430 t/h of brine at 8 bars of separation pressure. A preliminary potential of 75 MW was also assessed.

In March 1989 CFE had to suspend all of its development activities in the field due to the environmental impacts on the pine-oak forest where the geothermal field lies. Over the next five years, CFE developed an intensive and comprehensive program to mitigate the impacts and restore the 0.6 km<sup>2</sup> area affected. More than 0.4 km<sup>2</sup> were covered with compost material and then local grass to stabilize slopes, 170,000 pine-trees were transplanted over 1 km<sup>2</sup>, all the access roads were covered with asphalt, 196 filtering-dams were installed to intercept the run-off and retain sediments, and many civil works were constructed. The program was concluded in 1995. Since then, CFE has carried out the necessary maintenance of these works, but it had not been possible to get the proper licences to continue working in the field. In 2007 an initial MIA was submitted to the environmental authorities, but it was rejected by the end of the year. In April 2008 a new, corrected and modified MIA was submitted, which was finally approved.

Cerritos Colorados will be the fifth geothermal field in Mexico, along with Cerro Prieto, Los Azufres, Los Humeros and Las Tres Vírgenes - all of them currently under production. CFE is planning to restart work in 2009 and intends to start the project in 2010.



Photo 1. Arturo González (right) delivers the 2008 Patbé Award to Bernardo Domínguez.

## XVI Congress of the Mexican Geothermal Association

**Luis C.A. Gutiérrez-Negrín, Editor Geotermia**

As planned, the XVI Annual Congress of the Mexican Geothermal Association (AGM: Asociación Geotérmica Mexicana) was held on November 14, 2008, along with the XVI General Ordinary Assembly, which is part of the International Geothermal Association (IGA). Both meetings were carried out at the facilities of the Comisión Federal de Electricidad (CFE) in Morelia City, State of Michoacán. At this city is located the headquarters of the geothermal division of the CFE.

The congress gathered 32 attendees from the CFE, the Mexican electric research institute (IIE, Instituto de Investigaciones Eléctricas), the nuclear research institute (ININ, Instituto Nacional de Investigaciones Nucleares), the universities of Mexico (UNAM, Centro de Geociencias) and Michoacán (UMSNH, Universidad Michoacana de San Nicolás de Hidalgo), the scientific research center of Ensenada (CICESE), and Geocónsul and Alstom, a couple of private companies involved in geothermics.

Participants were welcomed by the AGM President and Vice-President, José Luis Quijano and Raúl Maya.

Ten technical papers were discussed during the congress. Four of those papers dealt with the Los Azufres geothermal field, near Morelia, presenting relevant geochemical, isotopic, production and injection characteristics from this field, including a simulation of the performance of the steam pipelines. Two papers presented different aspects of the recently drilled well H-43 in the Los Humeros geothermal field. One paper showed the evolution of the oldest production sector of the Cerro Prieto field and another the geothermal manifestations and potential of the Santorini caldera in Greece. Two more papers dealt with estimation of initial temperatures in geothermal reservoirs and natural seismicity on faults.

All of the complete papers were included in a compact disc that was given to attendees. Most will be published in following issues of the Mexican magazine Geotermia, whose previous issues can be consulted at the AGM (<http://www.geotermia.org.mx>) and Geothermal Resources Council (GRC) (<http://geothermal.org>) public websites.

After the congress, the AGM annual assembly was



Photo 2. Participants at the 2008 Annual Congress of the AGM.

conducted by its President under the following agenda:

1. Approval of the Minutes from the 2007 General Ordinary Assembly.
2. Report of the 2007-2008 Board of Directors.
3. Report of the 2007-2008 Treasurer.
4. Delivery of the 2008 Pathé Award.
5. Election of the 2009-2010 Board of Directors.
6. Swearing-in of the 2009-2010 Board of Directors.
7. General issues.

The Pathé Award was instituted by the AGM in 2005 to honor people involved in the development of geothermics in Mexico for a minimum of 15 years. The 2008 Pathé Award was delivered to Bernardo Domínguez Aguirre by Arturo González Salazar, who had received the award in 2007. Bernardo Domínguez Aguirre, 79, is a petroleum engineer with 54 years of professional experience. Between 1954 and 1964 he worked for the national oil company PEMEX, the Mining Promotion Commission, and for private companies. He joined the former Geothermal Energy Commission in 1964, supervising geothermal wells in the Cerro Prieto field. Through 1965-1970 he worked for private drilling companies at the same geothermal field, and then joined the CFE in 1971, being appointed as Exploitation Manager of Cerro Prieto. He remained in CFE up to his retirement in 1997, where he was responsible for the Studies area of Cerro Prieto, the Drilling Department in the geothermal division of CFE (GPG, Gerencia de Proyectos Geotermoelectrónicos), technical advisor of the GPG and regional coordinator of the CFE's Energy Saving Program in the State of Jalisco. Since 1998 he is an independent consultant. Bernardo Domínguez Aguirre has been professor at the Baja California University and has conducted several technical short courses in Mexico and other Latin American countries. He was the President of the Mexican Geothermal Association in 1995-1996.

As point 5 of the agenda, the new 2009-2010 Board of Directors was elected. The former Vice-President, Raúl Maya González, was sworn-in as the new President. The Board of Directors is as follows

- President: Raúl Maya-González
- Vice-President: Magaly Flores-Armenta
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## ASIA/PACIFIC RIM

### Japan

## Statement by Geothermal Research Society of Japan

### *Kasumi Yasukawa, IGA Information Committee*

To encourage geothermal developments in the country, in October 2008 the Geothermal Research Society of Japan, a mother society of IGA-Japan, published a statement on

geothermal energy use in Japan. Copies were distributed to relevant authorities and organizations. The messages in the statement are as follows:

“Global warming is a matter of great concern for every sector on earth. Its acceleration may defeat our lives if we continue present energy-consuming activities. On the other hand, rising oil prices cause economic damage to all kinds of industries including transportation and agriculture. Furthermore, the peaking of petroleum production may limit its supply in the near future.

“These problems of earth's environmental and energy security should be considered as a most urgent matter, which may be solved by efforts of long-term and global scale. However, measures for such problems in Japan are further behind those of other developed countries, such as those in Europe.

“Developments of renewable energies need legal support because their production cost is still higher than thermal or nuclear power plants, so that power suppliers need other incentives. However, except for recent policy on photovoltaic power generation, Japanese policies on renewable energies are generally not in effect. In particular, geothermal energy, which has high potential in the country and shares with hydropower the highest power production rates among renewables, is almost out of the focus of government policy. Geothermal development in Japan has been stopped for a decade because of high development cost, untouchable national parks, and lack of communication with the local residents. All these problems may be solved by new rules from the government.

“Thus delayed development of geothermal energy is a significant loss for Japanese citizens. Living in the country with the third highest geothermal potential after Indonesia and USA, our mission is to advertise and promote geothermal energy to the government, private sectors, and citizens. The Geothermal Research Society of Japan will make any effort to achieve this mission.”

### Vietnam

## Report of the 8th Asian Geothermal Symposium

*Kasumi Yasukawa, AIST, Japan*

*Tran Tan Van, VIGMR, Vietnam*

The 8th Asian Geothermal Symposium was held in Hanoi City, Vietnam, on 9-12 December 2008, sponsored by the National Institute of Advanced Industrial Science and Technology (AIST), the Vietnam Institute of Geosciences and Mineral Resources (VIGMR) and the Korean Institute of Geoscience and Mineral Resources (KIGAM). The theme of the Symposium was “Geothermal Energy: emerging issues and its role in energy security and environmental protection for Asia”. Over fifty participants from nine countries attended this Symposium.

The Symposium was held on 9-10 December at VIGMR. After an opening note by Dr. Yusaku Yano, Director of the Institute for Geo-Resources and Environment



*Swimming pool of Tam Hop geothermal site*

(GREEN), AIST, and a welcome note by Dr. Tran Tan Van, Vice-Director VIGMR, twenty-two technical papers, including invited ones, were presented by speakers from seven Asian countries (China, Indonesia, Japan, Philippines, South Korea, Thailand, and Vietnam) and two European countries (Germany and Iceland). The first technical session focused on the theme “energy security and environmental issues”, which discussed economical aspects of geothermal energy. Subsequent sessions were mainly on topics of country updates, recent surveys and developments, and new technologies. Among them, four local speakers presented geothermal researches in Vietnam, showing intensive interest in geothermal energy in this country.



*Cruise at Ha Long Bay*

A two-day excursion to Ha Long Bay, a beautiful coastal area of World Natural Heritage, with stops at two geothermal direct-use sites, followed the Symposium. The participants enjoyed an afternoon cruise in Ha Long Bay on day-1, exploring caves in a limestone island and visiting a floating fish and fruit market. On day-2, they visited Quang Hanh and Tam Hop geothermal sites. At each site, geothermal fluid is used for health therapy at some forty individual treatment rooms and two big pools. Through this symposium, we firmly believe that this forum for information exchange will contribute to further development of geothermal energy in Asia.



*Participants of the 8th Asian Geothermal Symposium at VIGMR, 10 December, 2008*

## AFRICA

### Kenya

# Kenya plans to develop 1260 MWe of geothermal power by 2018

**Silas M. Simiyu and Peter A. Omenda, Kenya Electricity Generating Company Limited, pomenda@kengen.co.ke**

### Introduction

Kenya currently has an interconnected installed electric power capacity of about 1338 MWe, comprised of a mix of hydro, geothermal, thermal, wind, gas turbine and diesel power generators. Of this, the Kenya Electricity Generating Company (KenGen) currently produces about 1005 MWe while the balance is produced by independent power producers (IPP). Kenya currently has an annual demand growth of about 8%, driven by increased consumption from existing customers (5%) and connection of new customers (3%). However, installed capacity has not increased to match the demand growth, so emergency power generators have been procured to satisfy peak demand. The Least Cost Power Development Plan (2008-2028) prepared by the Government of Kenya indicates that geothermal plants, having the lowest unit cost and being suitable for base load, are thus recommended for additional expansion.

### Geothermal Potential in Kenya

Kenya is endowed with vast geothermal potential along the world famous East African Rift valley that transects the country from north to south (Figure 1). Exploration reveals that geothermal potential exceeds 4,000 MW and is capable of meeting all of Kenya's electricity needs over the next 20 years. Out of this potential, 163 MWe is currently exploited at the Olkaria geothermal field. A

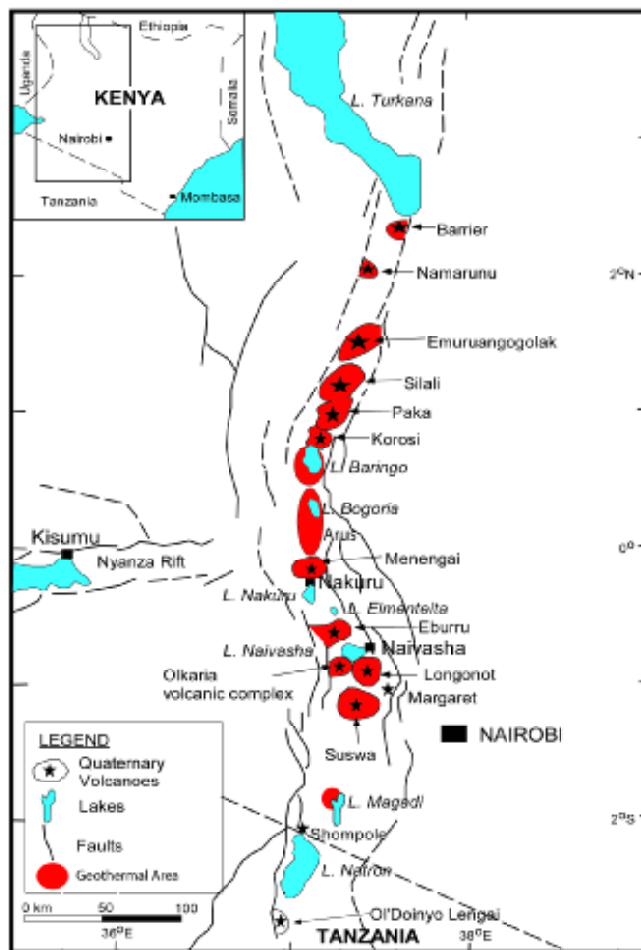


Figure 1: Geothermal areas in the East African Rift Valley in Kenya

horticultural farm at Olkaria also generates about 4 MWe from two small geothermal plants for private use.

KenGen is currently undertaking production drilling of the Olkaria Domes field to the east of the current production field. This development is earmarked for the 140 MWe Olkaria IV power plant. Six appraisal and four production wells have so far been drilled in the Domes field, bringing the total number of wells in the field to

Power Plant	Capacity (MW <sub>e</sub> )	Year commissioning	Status
Olkaria II 3rd Unit	35	2010	Construction in progress
Eburru Pilot Plant	2.5	2010	Construction to commence in 2009
Olkaria I, 4th Unit/I and II Optimization	140	2012	Production drilling in progress
Olkaria IV	140	2012	Production drilling in progress
Menengai I	140	2013	EIA complete, drilling to start in 2010
Menengai II	140	2014	Drilling to start after Menengai I
Menengai III	140	2015	
Menengai IV	140	2016	
Menengai V	140	2017	
Menengai VI	140	2018	
Longonot I	140	2019	

Table 1. Summary of KenGen's planned power plant developments

thirteen. The wells are both directional and vertical and drilled to depths of between 2200m and 3000m. The wells show high temperatures and good permeability, and productivity varies from 3-8MWe. Recent studies completed in the Menengai and Longonot prospects reveal that substantial geothermal resources exist in each of the fields and KenGen now plans to drill deep exploration wells in the prospects from 2010.

### Geothermal Expansion strategy

KenGen has embarked on an ambitious generation expansion plan to install an additional 1260 MW of electric power from geothermal sources by 2018. The planned geothermal developments require 300 production and 60 re-injection wells to be drilled in the next ten (10) years and about 10 large power stations of about 140 MWe each to be built. The developments are planned to be undertaken in the four identified high geothermal potential areas in the Kenya Rift, namely, Olkaria, Menengai, Longonot and Eburru (Figure 1). In order for the plans to be achieved, the key milestones in Table 1 will need to be met.

### Financing

To allow for power stations to be planted on schedule, the envisaged enhanced activities will require more than US\$ 5 billion over the next ten years to cover the following costs: 6 new drilling rigs, drilling materials, drilling contractor services, supply of other drilling equipment and spares, feasibility and EIA studies, engineering and other consultancy services, construction of power plants and steam field development, construction of substations and transmission lines and laboratory and well test equipment. In order to meet the set targets, KenGen is open to discussions on funding with potential financiers, manufacturers, suppliers and those interested in joint ventures in the renewable energy sector.



*Olkaria II, Unit 3 (35MW) construction works in progress*

## Progress on Olkaria II Unit 3 Geothermal Power Project

**Moses Nthiga, KenGen Resident Engineer, Olkaria Geothermal Project, P.O. Box 785, Naivasha, Kenya**

Olkaria II Power plant currently has two similar generating units each with a capacity of 35MW. The total output is 70MW. After commissioning the power station in 2003, there was excess steam of about 28 MW in Olkaria II field and another 25 MW in the adjacent Olkaria I field, about 3 km away. It was then decided that Olkaria I and II borefields should be connected with a pipeline in order to tap the combined excess steam to run an additional 35MW as Olkaria II Unit 3.

Tenders for the Olkaria II Unit 3 extension project were invited through international competitive bidding. The contract was awarded in August 2007 to a consortium of Mitsubishi Heavy Industries and Mitsubishi Corporation (MHI/MC). The consultant is Sinclair Knight Merz from New Zealand. However, the contract, which will run for 27 months, became effective on 12th February 2008 with a commissioning date of 12th May 2010. The contractor mobilized to site immediately. Design and manufacturing of the power station equipment also commenced immediately after signing the contract. The project is financed by IDA, EIB, AFD and KenGen.

Permanent works at site commenced in October 2008 and the contractor has already completed piling works as scheduled. Deep excavation works at the hot-well area are complete and concreting of the U-seal pit is in progress ahead of schedule.

Design and manufacturing of the main plant equipment has been completed. Most of the components are being tested in readiness for shipment to Kenya. Steam pipes have already been delivered and the cooling water system pipes have also been received on site.

All site challenges have been overcome and the plant is expected to be commissioned as scheduled.

### Uganda

## The Second African Rift Geothermal Conference (ARGeoC2)

**Godfrey Bahati, Organizing committee, ARGeoC2**

### Introduction

The Second African Rift Geothermal Conference (ARGeoC2) was held at the Imperial Resort Beach Hotel in Entebbe, Uganda, on 24-28 November, 2008. The theme of the conference was "Geothermal Energy for Sustainable Development".



*Participants at the Second African Rift Geothermal Conference at Imperial Resort Beach Hotel, Entebbe, November 24-28, 2008.*

ARGeoC2 was the climax of a series of geothermal activities which included (i) a Short Course III on Surface Exploration for Geothermal Resources, at Naivasha, Kenya, 24 October to 18 November, 2008; (ii) a Short Course in Geothermal Project Management at Entebbe, 20-22 November; (iii) a Meeting of the Board of Directors of the International Geothermal Association (IGA BoD) at Entebbe, 22-23 November.

ARGeoC2 attracted over 200 scientists from more than thirty countries around the world. Apart from over 150 participants from Africa, 12 were from Asia, 25 from Europe, 9 from the Americas, and 2 from Canada. The conference facilitated the sharing and dissemination of research information from scientific investigations in the African Rift countries.

Alongside the conference, the Annual General Meeting of the International Geothermal Association (IGA AGM) was held and there was a Post Conference Field trip on 26-28 November to the Katwe-Kikorongo (Katwe) and Buranga geothermal prospects in Western Uganda.

### **ARGeoC2**

ARGeoC2 was officially opened by the Vice President of the Comoro Islands, His Excellency Idi Nadhoim, who also presented a paper on the status of the potential role of geothermal energy in the Comoro Islands. Earlier, the Minister for Energy and Mineral Development of Uganda, Hon. Daudi Migereko, welcomed the participants to Uganda and the fact that the conference would facilitate the sharing and dissemination of research information from scientific investigations relating to continental rifts systems and the African Rift system in particular. He expressed hope that the presentations and discussions

would contribute to the understanding of the various complex phenomena of geothermal systems and the sustainable exploration and development of geothermal resources. The minister was hopeful that the conference would greatly attract new investment in geothermal energy development in the African region.

The opening ceremony was followed by three key note speeches; (i) Status, Development and Prospects of Geothermal Energy Worldwide, by the President of IGA, Professor Ladislav Rybach; (ii) Geothermal Energy and Climate Change, by Dr. Benard Jamet from UNEP, and (iii) Status of Geothermal Energy Exploration and Development in Uganda by the Commissioner of the Department of Geological Survey and Mines, Mr. Joshua Tuhumwire.

A total of 72 papers were presented in 9 sessions that included country updates, papers on geothermal surface exploration, development and utilization. Other papers dealt with economics and financing, institutional frameworks and the environment.

The conference was closed by the President of the Republic of Uganda, His Excellency Yoweri Kaguta Museveni, on 25 November. The President expressed particular interest in the conference due to the increased demand for energy worldwide and in Africa in particular. He added that focusing on development and promotion of alternative and renewable sources, which include geothermal energy, would supplement other traditional sources like hydropower, oil & gas, and nuclear. He noted that sources of energy like oil & gas were finite.

The President recognized that there were big challenges in the development of geothermal energy, including high up-front costs and geological risks associated with



*Some of the Post-Conference field trip participants at Buranga geothermal prospect, West Uganda, November 27, 2008.*

resources determination at the exploration phase. These costs had meant that viable geothermal energy resources in the African Rift, estimated at 14,000 MW, had remained unexploited.

He highlighted the need to encourage the African Rift countries to promote the development of renewable energy sources and their efficient utilization, and the fact that governments need to support upstream scientific investigations, promote private sector participation, set up energy funds to finance important power generation plants and transmission lines, and extend subsidies and incentives to projects that generate power.

The President pledged his government's commitment to develop its geothermal energy resources and support to the African Rift Geothermal Development facility (ARGeo).

### **ARGeoC3**

The Third African Rift Geothermal Conference (ARGeoC3) will be held in Djibouti in 2010. The Republic of Djibouti's acceptance to hold the ARGeoC3 was announced at the closing ceremony.

### **Post conference field trip**

A three day post conference field trip took place on 26-28 November. The participants visited two geothermal areas, namely Katwe-Kikorongo and Buranga located in the Western Rift Valley in Uganda. The field trip attracted 72 local and foreign participants.

### **Acknowledgements**

Thanks are due to the sponsors of the ARGeoC2, namely Heritage Oil Ltd., Icelandic International Development Agency (ICEIDA), International Geothermal Association (IGA), United Nations Geothermal Training Programme (UNU-GTP), Germany Federal Institute for Geosciences and Natural Resources (BGR), Uganda Electricity Transmission Company (UETCL), and Ministry of Energy and Mineral Development of Uganda.

### **Uganda**

### **Short Course on Project Management and Development**

**Ludvik S. Georgsson, Deputy Director UNU-GTP.**

A short course on "Geothermal Project Management and Development" was held on 20-22 November at The Imperial Botanical Beach Hotel in Entebbe, Uganda. This three day event was co-organized by the United Nations University Geothermal Training Programme (UNU-GTP), Kenya Electricity Generating Company, Ltd. (KenGen) and the Ministry of Energy and Mineral Development (DGSM) in Uganda. The 22 African participants came from 10 countries of East Africa. Besides the home



country Uganda with 5 participants, other African participants came from Djibouti (3), Ethiopia (3), Eritrea (1), Tanzania (4), Rwanda (1), Burundi (1), Zambia (2), D.R. Congo (1), and finally Yemen (1), the latter sharing common geological features with East Africa. In addition there were two European participants. The short course was focused on geothermal project management and development of geothermal resources. The aim was to promote and improve focus on planning of geothermal projects in the region and further the development of geothermal resources into the production stage. The timing of the short course was scheduled prior to the ARGeo C-2 conference held in Entebbe, Uganda on 24-25 November. The ARGeo facility and conferences are the main cooperation partnerships of the East African countries with regard to geothermal development.

Lectures and project work covered the status of geothermal energy in the world, with emphasis on East Africa, phases of geothermal development, resource assessment and geothermal project planning and management. Teaching and organization of the short course was in the hands of 5 experts from Iceland (UNU-GTP, ISOR - Iceland GeoSurvey, and Reykjavik Geothermal), 6 experts from Kenya, and one from each of Ethiopia and Uganda, all former UNU Fellows. In addition, two renowned international experts in geothermal utilization and development from El Salvador and the Philippines were lecturing on their experiences. The course was very well received. The lectures and the Power Point presentations are available on [www.unugtp.is](http://www.unugtp.is) under Workshops/Short Courses/Uganda SC 2008.

## IGA News

IGA News is published quarterly by the International Geothermal Association. The function of IGA News is to disseminate timely information about geothermal activities throughout the world. To this end, a group of correspondents has agreed to supply news for each issue. The core of this group consists of the IGA Information Committee:

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The members of this group submit geothermal news from their parts of the world, or relevant to their areas of specialization. If you have some news, a report, or an article for IGA News, you can send it to any of the above individuals, or directly to the IGA Secretariat, whatever is most convenient. Please help us to become essential reading for anyone seeking the latest information on geothermal worldwide.

While the editorial team make every effort to ensure accuracy, the opinions expressed in contributed articles remain those of the authors and are not necessarily those of the IGA.

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