



IGA NEWS

Newsletter of the International Geothermal Association

IGA ACTIVITIES

Message from the President

John W. Lund, President

The President was an invited speaker at the Italian Geothermal Union closing ceremony for the celebration of the centenary of the world geothermal-electric industry (1906-2004) in Pisa, Italy, on 10 December 2005. The President presented a talk on the “Present Utilization and Future Prospects of Geothermal Energy Worldwide -2005” and Dr. Ladsy Rybach, former Vice President of IGA, presented an invited paper on “Present and Future Development of Geothermal in Europe.” The IGA received an award “...for their successful activity in joining the efforts of the international community to foster geothermal development worldwide.” The award plaque will be kept at the IGA Secretariat in Iceland. The President and Dr. Rybach also received individual awards for their pioneering work in geothermal energy. My thanks to Dr. Giancarlo Passaleva, President of the Italian Geothermal Union, and to Dr. Raffaele Cataldi (one of the founding members of IGA and former board member) for hosting the conference. Dr. Cataldi published a volume on the *History of Geothermal Energy in Italy* (in Italian) that was presented at the conference. Dr. Cataldi’s report can be found elsewhere in this News.

There have been some changes at the Secretariat. Valgardur Stefansson, the Executive Director, has been diagnosed with cancer and is undergoing treatment. He is therefore on very limited duty at the Secretariat. Arni Ragnarsson has stepped in to take over the major responsibilities together with Gestur Gislason, who has taken over the responsibility of coordinating the publishing and distribution of IGA News. We thank the two Icelanders for stepping in to keep the organization going, and wish Valgardur a speedy recovery.

The IGA Board of Directors met in Brussels, Belgium, on 3-4 April 2006 with a field trip on 5 April. The meeting was organized by Dr. Burkhard Sanner and held at

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the recently dedicated Renewable Energy House, which is heated with geothermal heat pumps. Major topics that were discussed were:

- The formation of the Steering Committee for the World Geothermal Congress 2010 to be held in Bali, Indonesia. The Steering Committee has the primary role of the technical program, educational events, publications, awarding the fellowships and fund raising. The Indonesians will form the Organizing Committee for the event. The membership of the Steering Committee as approved by the Board is: Gordon Bloomquist, chair; Roland Horne, technical program; Beata Kepinska, education; Jim Lawless, fund raising; Eduardo Iglesias, publications; Jim Koenig, and Mahmut Parlaktuna, fellowships.
- Several Bylaw changes were proposed and approved, mainly concerning the formation and operation of Regional Branches. These changes will now be submitted to the membership for ratification.
- The Western Pacific Regional Branch was approved and Jim Lawless of New Zealand elected as the chair. The following countries have already shown interested in joining this regional branch: New Zealand, Indonesia, Philippines, Japan and China. Other countries in the region are also being extended an invitation to join.
- The International Summer School activity in Ukraine for 2006 has been cancelled due to difficulties with communications and finance.
- Two new countries, El Salvador and Iran, have been approved for affiliate memberships with IGA. A second geothermal organization in Hungary (Hungarian Thermal Energy Association) was also approved for affiliation.
- The Nominations Committee is preparing for the 2007 Board of Directors election to be held from April to July of 2007. The new board will take office in October 2007. Nominations will be solicited in late 2006 and early 2007.
- The next IGA Annual General Meeting will be held in Chiba, Japan in early October, 2006 in conjunction with the next Board of Directors meeting (7-8 October) prior to the Renewable Energy 2006 conference.
- The IGA Board of Directors was presented with a proposal to join the International Renewable Energy Alliance (IREA) consisting of the World Wind Energy Association, the International Solar Energy Society and the International Hydropower Association. The issue will be voted on at our next board meeting.
- Alimin Ginting presented an update on the progress of WGC2010 in Bali.
- Presentations were made on the status of the activities of the European Geothermal Energy Council and the research and demonstration actions in FP7 (7th framework program) for the geothermal sector of the European Union.

At the conclusion of the Board of Directors meeting, a field trip of geothermal projects was organized by Burkhard Sanner. These were to Antwerp, Belgium, for a tour of a geothermal heat pump project at a hospital; to Heerlen, Netherlands to a minewater drilling project; and to Aachen, Germany to view a drilling project for a single deep bore-hole heat exchanger at the university.

Western Pacific Regional Branch of IGA Formed

Chairman: Jim Lawless

I am very pleased to announce that the second Regional Branch of the IGA has now been established to cover the Western Pacific Region. This will complement the existing European Forum.

The intention of a Regional Branch of IGA is to provide a close regional focus for members with common interests not only geographically but also in terms of similar types of geothermal resources and technical applications. In the case of the Western Pacific Branch there will be a strong focus on electricity generation and higher enthalpy resources. The individual affiliated country Associations of New Zealand, Indonesia, the Philippines, Japan and China have agreed that a Regional Branch should be formed. Those countries in total comprise about 530 members of IGA (though not all of them would necessarily want to join the Regional Branch, see below).

The Board of the IGA at its last meeting in Brussels in April agreed to the formation of the Western Pacific Regional Branch and I have been appointed as the first Chairman and have been tasked by the Board to set up the Branch. The founding members of the Western Pacific Regional Branch for IGA will be those members of the affiliated national Geothermal Associations of Indonesia, Japan, the Philippines, China and New Zealand who opt to join the Regional

Branch, plus other member of IGA living or working within the geographical area defined who wish to join. Because the Regional Branch will levy a fee, and more generally because some members of IGA in the region may not wish to participate in the Regional Branch, membership of the Regional Branch will be voluntary rather than automatically including all members of the IGA in the geographical area concerned.

The geographical coverage of the Western Pacific Regional Branch is the area outlined by joining the national boundaries of: Thailand, China, Japan, Samoa, New Zealand, Australia and Indonesia, and all other countries within that area.

There is a strong tradition of co-operation between several of the countries in the region for geothermal development. For example during the period of rapid geothermal development in the 1980s and 1990s, there was a high degree of participation by New Zealand and Japan in geothermal research and development in Indonesia and the Philippines. With the maturing of the geothermal industries in those countries it is now much more of a partnership role, but strong linkages remain.

As well as the five core countries named, formation of a Regional Branch will permit individual members of IGA in countries where there is an interest in geothermal but which do yet have a geothermal association to join. Countries in that category include Papua New Guinea, Fiji, the Solomons, Vanuatu, Taiwan, Thailand, Vietnam and Australia. I understand that Korea and Malaysia do have geothermal associations, but they are not yet affiliated to IGA. People from other countries within the proposed region, such as Cambodia or Samoa are also welcome to join if they have an interest in geothermal.

Currently, all of the five core countries concerned individually hold at least annual geothermal conferences or seminars. It is proposed that, under the aegis of the Regional Branch, one of those conference be named as the Regional Branch Conference for that year, on a rotating basis. That will foster closer relationships and give a boost to international participation in the conferences.

As a group with over 500 members the Regional Branch will be in a better position to attract funding from regional and international agencies than can the individual member associations.

How do you join the Regional Branch ?

If you are in one of the five core founding countries, that have affiliated Geothermal Organisations, you can expect to be contacted by your appointed representative, or send an Email to the following::

China:	Dr. Tingshan Tian:	taints@mail.cigem.gov.cn
New Zealand:	Jim Lawless:	jlawless@skm.co.nz
Japan:	Toshihiro Uchida :	uchida-toshihiro@aist.go.jp
Indonesia:	Alimin Ginting:	aliming@unocal.com
Philippines:	Tony Yee:	ayee@unocal.com.

If you are an IGA member who lives or works within the Western Pacific region, but who is not within one of the above five countries, or have any questions, please send an Email directly to me at the address above.

EUROPE

ENGINE co-ordination action (ENhanced Geothermal Innovative Network for Europe)

P. Ledru, A. Genter, BRGM, France

1. Context

The development of renewable and sustainable energy will have a major impact on world economics and its sustainable development. The challenge defined in the EU's 6th framework programme is to reverse the present pattern of development in order to achieve a truly sustainable energy system, one that preserves the equilibrium of ecosystems and encourages economic development. In line with the Kyoto protocol implementation, an EU directive has been established that aims, by year 2010, to double the contribution of renewable energy to total energy consumption from 6 to 12% and to reduce greenhouse gases and pollutant emission by 15%. Finally, the Green Paper "Towards a European strategy for the security of energy supply," published in 2001, underlines that the EU will become increasingly dependent on external

energy sources (70% in 2030) and that at present it is not in a position to respond to the challenge of climate change and meet its commitments, notably under the Kyoto Protocol. It is also noted that the development of certain renewable energy sources calls for major efforts in terms of research and technological development.

2. Objectives of the ENGINE project (ENhanced Geothermal Innovative Network for Europe)

The contribution of geothermal energy is a key factor to the successful achievement of the objectives of the European Commission concerning the development of renewable and sustainable energy. The concept of Unconventional Geothermal Resources and in particular Enhanced Geothermal Systems examines ways of increasing the potential of geothermal power generation through (i) exploring new types of reservoirs for heat exchange (Hot Dry Rock, supercritical fluids..), (ii) enlarging the extent of productive geothermal fields by stimulating permeability, (iii) enhancing the viability of current and potential hydrothermal areas by stimulation technology and improving thermodynamic cycles.

The ENGINE project (ENhanced Geothermal Innovative Network for Europe) is a co-ordination action supported by the 6th Research and Development framework of the European Union. Its main objective is the co-ordination of the present R&D initiatives for Unconventional Geothermal Resources and Enhanced Geothermal Systems, from resource investigation and assessment stage through to exploitation monitoring. The Co-ordination Action will provide (1) an updated framework of activities concerning geothermal energy in Europe, including the integration of scientific and technical know-how and practices, and the evaluation of socio-economic and environmental impacts; (2) the definition of innovative concepts for investigation and use of Unconventional Geothermal Resources and Enhanced Geothermal Systems; groups of experts will present a “Best Practice Handbook”; (3) a scientific and technical “European Reference Manual” including the information and dissemination systems developed during the Co-ordination Action.

The links established between research and development teams, national development programmes, industrial partners and international agencies will be used to promote geothermal energy as a major renewable and sustainable source of energy and to propose innovative high-level medium- to longer-term research projects

3. Organisation of the ENGINE co-ordination action

To promote an efficient network of geothermal activities, the Co-ordination Action will define, organise and manage joint and common initiatives through :

- an Integration Phase, i.e. a bottom-up and federative strategy aimed at providing an updated framework of activities concerning geothermal energy in Europe and developing motivation within the scientific and technical community by exchanging experiences and sharing practices;
- a Synthesis Phase; i.e. an expertise strategy for defining the best practices and priorities for research investment. The expert groups will perform specific studies and strengthen links between the geothermal community and financial and political institutions.

The breakdown structure of the project is presented (Fig. 1). Its duration is estimated to 30 months and it has been funded with € 2 million. Among the main actions, 3 general conferences (launching, mid-term and final) will be organised and 7 specialised workshops will present the most innovative concepts, review the best practices, identify gaps and barriers and define new projects on the following items:

- *Defining, exploring, imaging and assessing reservoirs for potential heat exchange*
- *Exploring Supercritical fluid reservoir: a new challenge for geothermal energy*
- *Stimulation of reservoir and induced microseismicity*
- *Drilling cost effectiveness and feasibility of high-temperature drilling*
- *Electricity generation, combined heat and power*
- *Increasing policy makers awareness and the public acceptance*
- *Risk analysis for development of geothermal energy*

All information collected during the preparation and realisation of these meetings will be available on the web site of the co-ordination action at <http://engine.brgm.fr/> .

BRGM, represented by P. Ledru and A. Genter, is the coordinator of the project. The management of the project will involve an Executive Group, chaired by C. Fouillac, Research Director (BRGM), and composed of S. Cloetingh (VUA), E. Elewaut (TNO), R Emmermann (GFZ), O. Flovenz (ISOR), E. Huenges (GFZ), P. Ledru (BRGM), A. Manzella(CNR-IGG), J. Maas (Shell), L. Rybach (GEOWATT AG). J. Schuppers (EC DG Research) is an invited participant as a representative of the European Commission. A Steering Committee, in charge of the organisation of the main conferences and workshops, is composed of the work package leaders, chaired by E. Huenges (GFZ) with the assistance of

A. Manzella (CNR-IGG), and composed of P. Calcagno (BRGM), A. Genter (BRGM), M. Kaltschmitt (IE), C. Karytsas (CRES), T. Kohl (GEOWATT), P. Ledru (BRGM), A. Lokhorst (TNO), S. Thorhallsson (ISOR)

The ENGINE co-ordination action is composed of 31 partners representing 16 European countries and including 6 private companies. The first group of partner has a broad knowledge covering large aspects of the geothermal energy. It comprises **BRGM** (France), co-ordinator of the ENGINE project, **CFG SERVICES** (France), **GeoForschungsZentrum Potsdam** (GFZ, Germany), **ISlenskar ORkurannsóknir** (ISOR, Iceland GeoSurvey), **Centre for Renewable Energy Source** (CRES, Greece), **the Geological Survey of Denmark and Greenland** (GEUS, Denmark), **Shell International Exploration and Production B.V.** (SIEP B.V., Netherlands).

The second group of partners has knowledge covering mainly exploration, drilling and reservoir assessment: the **Instituto di Geoscienze e Georisorse** (IGG, Italy), the **Department of Geophysics of the Eotvos University** (ELTE, Hungary), the Institute of Earth Sciences, Dept. of Tectonics, of the **Vrije Universiteit Amsterdam** (VUA, Netherlands), the **Groupement Européen d'Intérêt Economique "Exploitation Minière de la Chaleur"** (GEIE "EMC", an international consortium operating on the site of Soultz-sous-Forêts, France), the **Panstwowy Instytut Geologiczny** (PGI, Polish Geological Institute, Poland), **Tsentr geoelektromagnitnykh issledovaniy Instituta fiziki zemli Rossijskoi akademii nauk** (GEMRC IPE RAS, GEoelectromagnetic Research Center of the Institute of the Physics of the Earth, Russian Academy of Sciences, Russian Federation), the **Geologijos Ir Geografijos Institutas** (IGGL, Institute of Geology and Geography, Lithuania).

A further group of partners has a large experience in drilling and reservoir assessment, exploitation and impact of the geothermal energy. It is composed of the

Netherlands Organisation For Applied Scientific Research (TNO, Netherlands), ten laboratories of the French **CNRS** (France) involved in the HDR Soultz experiment, **Geoproduction Consultants** (GPC, France), the Chemical Process Engineering Research Institute (CPERI) of the **Center for Research and Technology-Hellas** (CERTH), the Environmental Research Laboratory of the **National Centre for Scientific Research "Demokritos"** (NCSR, Greece), the **Institutt for Energiteknikk** (IFE, Institute for Energy Technology, Norway), the **Deep Heat Mining Association** (DHMA, International Consortium), The company **Geowatt AG**, the **Instituto Geológico y Minero de España** (IGME Geological and Mining Institute of Spain, Spain), the **Leibniz Institute for Applied Geosciences** (GGA-Institute, Germany), the **University of Oradea** (UOR, University of Oradea, Romania).

Another group of partners are mainly involved in the development and management of exploitation and in impact studies of the geothermal energy: the **Institut für Energetik und Umwelt GmbH** (IE, Institute for Energy and Environment, Germany), the **Institut vysokikh temperatur Rossijskoi akademii nauk** (IVTRAN, Institute for high temperatures, Russian Academy of Sciences, Russian Federation), the **Institute for Geothermal Research of the Daghestan Scientific Centre of Russian Academy of Sciences** (IGR DSC RAS, Russian Federation) and 3 private firms, **ORME JEOTERMAL A.S.**, operating in Turkey, **Intergeotherm-M Stock Company** (Intergeotherm-M SC, Russian Federation), involved in the construction of geothermal plants worldwide and **MeSy GeoMessSysteme GmbH** (MeSy, Germany) partner of the European HDR Soultz-sous-Forêts project.

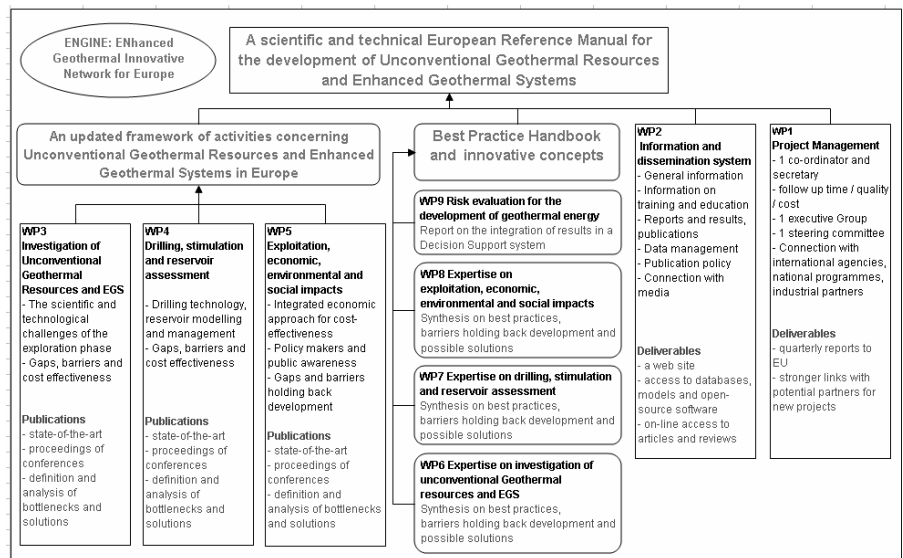


Figure 1. Breakdown of the ENGINE structure, brief description of Workpackages

Efficient Low Temperature Geothermal Binary Power (Low-Bin) DG-TREN Funded Strep Programme

Karytsas Constantine and Mendrinou Dimitrios

Summary

The “Efficient Low Temperature Geothermal Binary power” project (Acronym: LOW-BIN) aims at improving cost-effectiveness, competitiveness and market penetration of geothermal electricity generation schemes, targeting both hydrothermal resources for immediate market penetration and future hot dry rock systems, by:

1. Widening market perspectives of geothermal Rankine Cycle power generation, by developing a unit that can generate electricity from low temperature geothermal resources, with a temperature threshold for profitable operation below 80°C, compared with 90-100°C for existing units.
2. Developing a Rankine Cycle machine for cogeneration of heat and power by heat recovery from the cooling water circuit. This will lead to cogeneration of heat and power from Rankine Cycle units in present and future geothermal district heating schemes with overall **energy efficiency of 98-99%**, compared with 7-15% for existing units producing only electricity and 35-60% for existing geothermal cogeneration schemes.

The project will involve theoretical research, laboratory experimentation, pre-prototype development, technology evaluation of the pre-prototype in terms of technology breakthrough achievement, energy efficiency, electricity generation costs and market potential, manufacturing and demonstration of successful prototypes, monitoring and technology validation, as well as dissemination of the technology and other innovation related activities.

The LOW-BIN project consortium consists of 9 partners from 8 countries:

CRES (Greece-Coordinator), TURBODEN (Italy), GFZ-Potsdam (Germany), GEOTEAM (Austria), University of Oradea (Romania), ESTSetubal (Portugal), Politecnico di Milano (Italy), BRGM (France) and ISOR (Iceland). The total budget of the LOW-BIN project is in the order of € 4 million, 47.7% of which is the EU contribution

Project objectives

The objectives of the LOW-BIN project are:

- The development and demonstration of technology for electricity generation from even lower temperature geothermal resources
- The development of technology and demonstration of innovative solutions to geothermal heat and power

The LOW-BIN project aims to move thermal applications from the outlet geo-

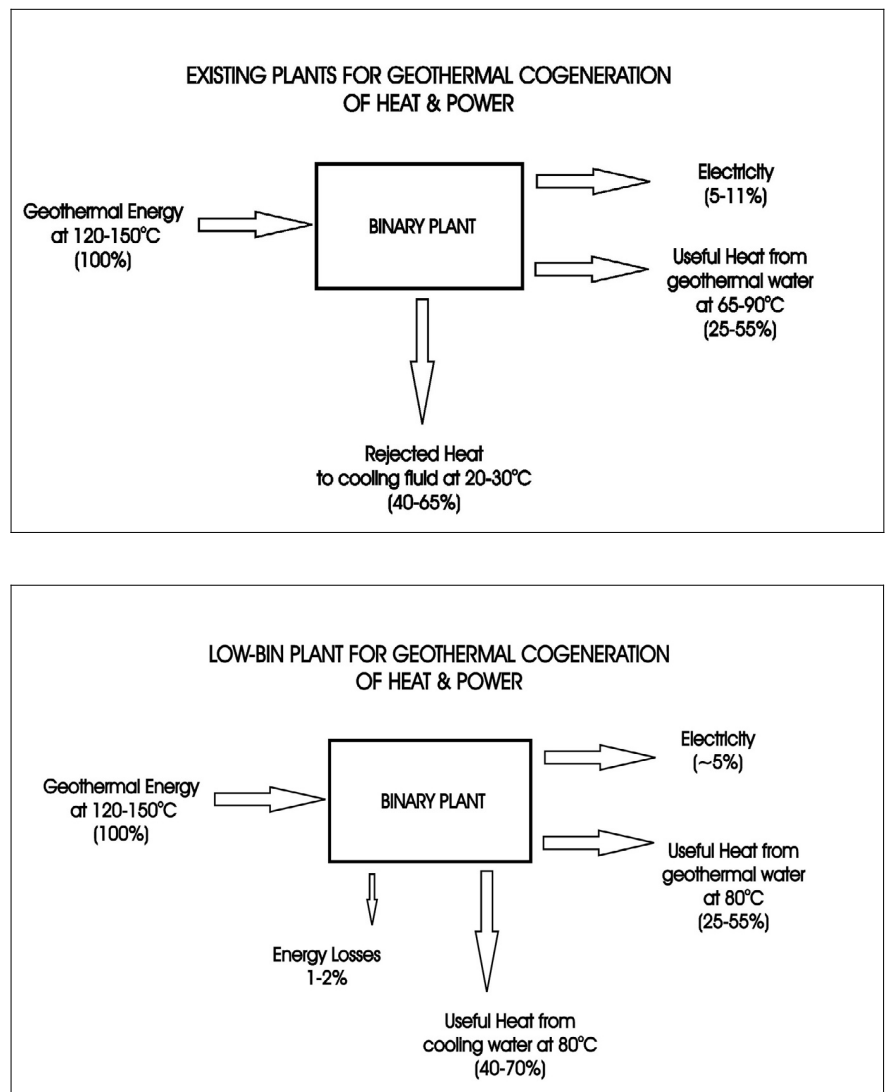


Figure 1: Energy flow chart of existing geothermal binary plants (left) for heat and power cogeneration and proposed modification during the LOW-BIN project (right).

thermal line to the cooling water line as shown in figure 1. That way, almost 100% of the waste thermal energy of a binary plant can be recovered by its utilization in a district heating scheme (or in any other direct thermal application) increasing the overall energy efficiency of the system to 98-99%. This will also result in additional reduction of geothermal energy costs.

The project will demonstrate, on the one hand, cost reductions associated with low temperature geothermal electricity (both prototypes) and, on the other, how the integration, under full-scale operating conditions, of innovative technological solutions for geothermal cogeneration of heat and power (2nd prototype) can lead to improving both energy efficiency and costs.

Both machines, after the demonstration period of the prototypes, where the final operation tuning and technology improvements will be made, will be available to the market.

Both machines that will be developed and demonstrated during the LOW-BIN project involve new technology, with the use of new materials of lower cost, tailor-made not only for immediate market penetration targeting hydrothermal resources but also for long term sustainable development via the exploitation of the vast hot dry rock geothermal resources as well.

Reduction of greenhouse gases and pollutants emissions (Kyoto)

The LOW-BIN project will lead in the development of two geothermal power generating machines, which target new geothermal markets, one of low temperature resources and the other of cogeneration of heat and power. Geothermal binary power generation is a pollution-free technology leading to effective reduction of emissions to the atmosphere of greenhouse gas resulting from power generation by fossil fuels.

The CO₂ emissions reduction expected from the implementation of the LOW-BIN project are significant, being estimated to be around 4.0 million tonnes of CO₂ by 2010 and considerably larger in the long term due to:

- the large energy potential of low temperature hydrothermal resources of Europe, which exceeds 10,000 MWe.
- the cost reductions for geothermal heat and power cogeneration schemes arising from the second prototype, which will facilitate the exploitation of the vast amounts of hot dry rock geothermal resources (estimated as having the potential to cover 70% of energy use in EU).

Improving energy efficiency

Energy conversion efficiency from geothermal heat to electricity is increased from 7-15% for existing electricity generating geothermal plants, or from 35-60% for existing geothermal cogeneration schemes, to around 98-99% for the second LOW-BIN prototype. That way geothermal resources are exploited with the highest possible efficiency.

In addition, both LOW-BIN prototypes can be used in **industrial waste heat recovery systems**, resulting in additional power to be generated from waste heat, especially in electricity intensive industries (which need electricity and not heat), further improving energy efficiency in the European Union.

Increasing the use of renewable energy

The LOW-BIN project will result effectively in increasing the use of geothermal energy, a renewable energy form, by the addition of more than 10,000 MWe to the low temperature geothermal electricity resource base, and by dramatic cost reductions to geothermal cogeneration (short term) and hot dry rock (long term) exploitation schemes.

Moreover, the low temperature LOW-BIN machine will find new applications in **solar electricity conversion**, where hot water of temperature under 80-90°C is delivered by **standard solar water heaters**, which will further increase the share of renewable energy in the European energy market.

Geothermal energy research and demonstration funding in the European Union

Jeroen Schuppers, European Commission, DG Research

Collaborative energy research at the European level is essential to support Europe's transition to a more sustainable energy policy, the fight against global climate change and air pollution, ensure security and diversity of Europe's energy supply, and improve industrial competitiveness. European Commission support for geothermal energy research has

been part of all six framework programmes. EU co-ordinated research in the field of Enhanced Geothermal Systems (EGS) started in FP3. EGS technology could permit significant levels of electricity generation in many countries that are not currently considered as geothermal, though continued technological research is required before pilot plants can provide convincing demonstration of the practical and economic aspects of EGS systems. EGS technology has been developed to a large extent in the EU co-funded EGS Project at Soultz-sous-Forêts, and Europe is presently the world leader in this technology. The verification of the technical feasibility and cost-effectiveness of electricity production from EGS is one of the strategically important research areas in the medium to longer term part of the Sustainable Energy Work Programme of the current (6th) Framework Programme. In addition, international co-operation takes place through the Commission participation in the IEA Geothermal Implementing Agreement.

In addition to the above mentioned EGS project at Soultz-sous-Forêts, four geothermal RTD projects are ongoing with the support of European Commission: I-GET *Integrated Geophysical Exploration Technologies for deep fractured geothermal systems*, <http://www.i-get.it/>; LOW-BIN *Efficient Low Temperature Geothermal Binary Power*; GROUNDHIT *Ground coupled heat pumps of High Technology*: <http://www.geothermie.de/groundhit/>; ENGINE *Enhanced Geothermal Innovative Network for Europe*: <http://engine.brgm.fr/>

The I-GET and ENGINE projects, launched 2005 and supported by EC DG Research, are of strategic importance for the verification of the technical feasibility and cost-effectiveness of electricity production from EGS, and are expected to make a significant contribution in this field.

Renewable electricity generation will be an important research topic in the Energy theme of the upcoming 7th Framework Programme, and the Commission will continue to support research into geothermal technologies: http://europa.eu.int/comm/research/future/index_en.cfm.

Italy

THE CELEBRATION OF THE CENTENARY OF THE GEOTHERMAL-ELECTRIC INDUSTRY WAS CONCLUDED IN FLORENCE ON DECEMBER 10th, 2005

Giancarlo Passaleva, President, and Raffaele Cataldi, Vice President, of UGI/Italian Geothermal Union

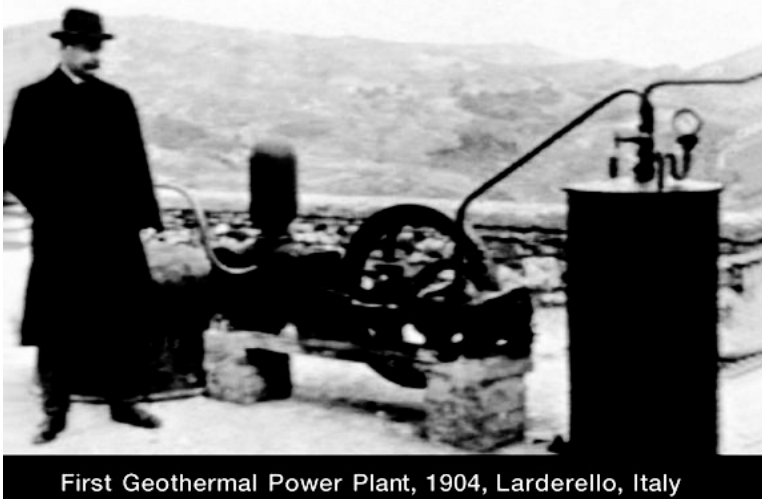
The 1904 experiment, by which P. Ginori Conti proved that geothermal fluids can be utilized to generate electric energy, has a relevance that goes beyond the simple technological innovation in the use of the Earth's heat. The centenary of the geothermal-electric industry is thus an event representing the legacy of the world geothermal community.

With this in mind, the parties interested to support the celebration program agreed that the centenary in question should be considered as an opportunity to revive the interest for geothermal energy, starting from the age-old geothermal tradition formed in Italy, and then devising the future development of this form of energy in the frame of a historical continuity with the achievements obtained in this field in the past centuries. Moreover, it was deemed necessary to take the occasion of the centenary to stress the future role that geothermal energy could play in meeting the Italian energy needs.

Thus, it was decided to implement a celebration program wide in scope, with a number of linked events capable of raising interest in as many parties involved in energy matters as possible, including institutions, politicians, energy decision-makers, industries

and companies operating in the geothermal sector, scientific, environmental and cultural organizations, and people in general. It was also decided that the program should include some events intended to rejuvenate the interest of people in their geothermal traditions with a view to improving the basic conditions for the social acceptance of the geothermal development in their territory.

In short, the Italian geothermal family devised an integrated celebration program aimed not only at recalling the birth of the geothermal-electric technology, but also at paving the way for a new geothermal century. Consequently, a multi-faceted group of events was established for execution from Autumn 2003 to December 2005.



First Geothermal Power Plant, 1904, Larderello, Italy



The world-class **Lihir Gold Limited** operation is located on the tropical island of Lihir in Papua New Guinea and provides residents with a peaceful and secure lifestyle. Facilities include a modern medical centre, well appointed housing, an international standard primary school, as well as a variety of recreational and sporting amenities. This position will be offered on a residential or Fly-in Fly-out basis. We are currently seeking suitably qualified and highly motivated candidates focused on development and career path progression to work in a unique and challenging mine environment. This is an excellent opportunity for a professional to gain exceptional experience in the role of:

Geothermal Scientist

The position reports to the Superintendent Geothermal & Dewatering and is responsible for the mitigation of geothermal risks, technical support to geothermal power station and consideration of pit de-watering programs to ensure safe, efficient and cost effective mine operations.

You will also be involved in transferring technical skills to Papua New Guinean employees and be accountable for Lihir Gold Occupational, Health, Safety and Environment compliance.

Key elements required for the role include:

- Geothermal field experience
- Pump operations exposure
- Exposure to drilling in geothermal, oil or gas environments
- Project management
- Understanding of hydro-geology

Selection Criteria:

- Tertiary qualification in an engineering related discipline.
- At least 10 years experience working within geothermal, oil or gas operations.
- A track record of working with multi-disciplinary teams.
- A working knowledge of MS Office software suite.
- An effective communicator of complex issues, both through written reports and presentations in English.

This position represents an outstanding career opportunity. The remuneration package will be discussed at interview.

Persons interested in applying for this role are invited to forward details to:

The Recruitment Coordinator
Email: RecruitLGL@lihir.com.pg
Lihir Gold Limited, GPO Box 905, BRISBANE, 4001
Telephone: +675 9865 477, Fax: +675 9865 424

www.lihir.com.pg

In IGA News 60, Raffaele Cataldi described the first events organized in Italy to celebrate the centenary of the geothermal electric industry: the *Opening Ceremony* and *First conference on history of geothermal energy in Italy*, the *International conference* on “Geothermal Energy and the Territory: After Johannesburg, the contribution of geothermal energy to sustainable development”, the *International workshop* “One hundred years of geothermal energy in the world”, the *Photo exhibition* on “Larderello, the Geothermal festival”, the *Historical review of the Italian geothermal-electric industry*, the *Special geothermal session to celebrate the centenary of the geothermal-electric industry*, and the *Second conference on the history of geothermal energy in Italy*. That brought the story to November 2004, and the success continued.....

1. Celebration events

1.1) The *third conference on the history of geothermal energy in Italy*, organized by UGI, took place at Radicondoli on 18 June



Fig. 2 Some of the audience in the Salon of the Five Hundreds

2005. Seven lectures dealt with the period “From the Renaissance to Modern Times”. Over 200 persons participated.

1.2) The book *Il Calore della Terra. Contributo alla Storia della Geotermia in Italia* (“The Earth’s Heat. Contribution to the History of Geothermal Energy in Italy”) was prepared by UGI with the collaboration of the Institute and Museum of the History of Science, Florence. Edited by R. Cataldi and M. Ciardi, the volume consists of 360 pages with Introduction and Abstracts in Italian and English. All main aspects of the history of science and technology in the geothermal sector in Italy are illustrated,

from Prehistory to 1928, the year of the first international geothermal congress which took place at Larderello. The book is in 3 sections: I) From Prehistory to the Fall of Rome; II) Middle Ages; and III) Modern and Contemporary Ages. Some 2000 copies of book have been distributed *gratis* to institutions, policy-makers, libraries, industries, companies and experts involved in energy matters. In particular, a copy was given to all participants at the closing ceremony described in the following paragraph, and to over 100 selected foreign geothermalists, including all IGA BoD members and more than 70 experts from all main geothermal countries of the world.

1.3) *First-day cancellation stamps*. On the occasion of the events held at Massa Marittima (Nov. 6th, 2004), Radicondoli (June 18th, 2005), and Florence (Dec. 10th, 2005), the first-day cancellation of stamps on special envelopes with Italian and English text was made. A few dozen such envelopes with cancelled stamps are still available at cost. Interested persons can contact UGI Secretary Dr. U. Rossi by e-mail: rossi.umberto@enel.it.

2. Closing ceremony

To conclude the celebration program, a solemn ceremony took place on 10 December 2005 in the prestigious Salon of the Five Hundreds in Palazzo Vecchio in Florence. Organized by UGI with the sponsorship of the Tuscan Region and of the



Fig.3: Presidency table. From left: the UGI President Eng.Passaleva; the Governor Dr. Martini; Moderator Dr. De Felice; and Prince Eng. Ginori Conti



Fig.4: Governor Martini

thermal energy in Italy (see item 3.10) by Prof. Paolo Rossi, outstanding scholar and pioneer of the history of science as a modern discipline (Fig. 7).

Prof. Rossi presented the volume with a learned discourse outlining the history of geothermal energy in the framework of the evolution the Earth, from the Biblical Deluge to the natural history in Antiquity and the different religions in the world, up to the “discovery of Time” in early Modern Ages and the application of geo-chronological methods in the past few decades.

The lecture was welcome by a long ovation.

The UGI President then presented recognition plaques to nine selected Italian and foreign individuals with outstanding geothermal merits and over 40 years work, as well as to eleven Italian and international organizations which in the past 30 years excelled in promoting the use of natural heat, or in realizing geothermal projects for electrical generation and direct use.

All plaques were assigned in the frame of the celebration program in question, but each plaque bears a specific statement of merit. Receivers were:

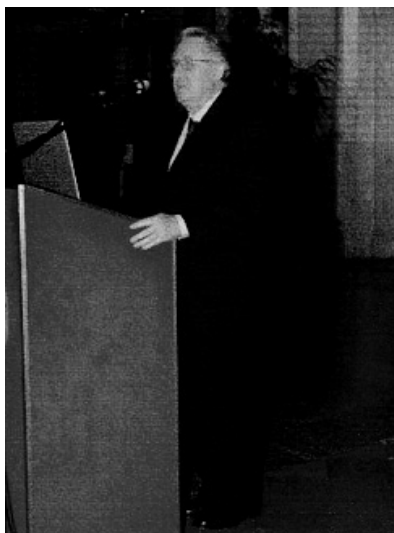


Fig. 6: Prof. L. Rybach

- *Individuals:* Barberi Franco (I), Barbier Enrico (I), Cataldi Raffaele (I), Ginori Conti Ginolo (I) on behalf of the De Larderel and Ginori Conti families, Giovannoni Anselmo (I), Lund John (US), Rossi Paolo (I), Rybach Ladislaus (CH), and Sommaruga Claudio (I);

- *Institutions and Industries:* Ansaldo SpA (I), Comision Federal de Electricidad (MX), Communes of Castelnuovo V.C., Ferrara, Monterotondo M.mo, and Pomarance (I), ENEL (I), IGA / International Geothermal Association, ORMAT Technologies (US-IL), PNOC-EDC (PH), and Tuscan Region (I).

All receivers were greeted by warm applause.

The technical part of the ceremony was then closed with final remarks by the UGI President, who pointed out the “changing trend” of geothermal development in the world, from a dominant position of the high-temperature resources for generation of electric energy in the past century to an increasingly important role for the low- and medium-temperature resources in a variety of direct uses in most countries, especially in Europe. As to Italy, “... considering the notable potential of the Earth’s heat geologically available, we expect that the century under way will see a much more significant share taken by this form of energy in meeting the country’s energy demand...”, the UGI President concluded.

Commune of Florence, it was honoured by the high aegis of the President of Italy. Over 200 invited persons participated (Fig. 2), with representatives from France, Israel, Switzerland, The Philippines, and the USA.

After the introduction by the Moderator and the opening comments by the UGI President, greetings were given by Prince Eng. Ginolo Ginori Conti, grandson of Piero Ginori Conti (Fig. 3).

A far-reaching speech was then made by the Governor of the Tuscan Region, Dr. Claudio Martini (Fig. 4). After recalling the share of geothermal-electric energy in Tuscany (over 25% per year at present), he illustrated the geothermal policy and the notable effort undertaken by his Region to promote development of the direct uses aimed at contributing to meet the objectives of its energy plan 2006-2012.

Two first-class key speeches followed, by Prof. J. Lund and Prof. L. Rybach, to present status and future prospects of geothermal development in the world and in Europe, respectively (Figs. 5 and 6).

Afterwards, the official presentation was made of the volume on the history of geo-

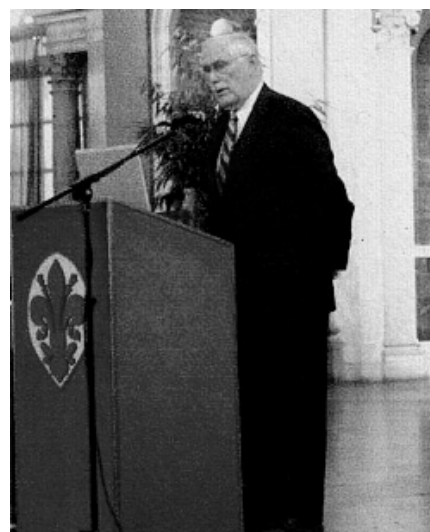


Fig.5: Prof. J. Lund



Fig.7: Prof. P. Rossi

Finally, the ceremony was closed by a symphony concert held by the chamber quintet of the famous Regional Orchestra of Tuscany, with excerpts from Borodin and Mozart. Borodin was chosen because of his link with geothermal energy; in fact, in addition to being a skilled composer Borodin was also a renowned chemist who visited Larderello in 1865 to study the origin of the boric acid and its processing techniques.

3. Sponsorships

Thirty four institutions, industries, organizations, companies, and cultural associations supported or encouraged the events organized by UGI for the centenary in question. Their logo is shown in the first inner page of the volume on the history of geothermal energy in Italy mentioned in para. 2.

To all of them thanks are due.

However, regardless of whether they have supported UGI or not, the following must be quoted as the main sponsors: Governments of the Tuscan Region and of the Pisa Province, Commune of Florence, UNEP, IGA, Institute and Museum of History of Science, Institute of Geoscience and Georesources, the De Larderel and Ginori Conti families, ENEL, GE-Oil & Gas/Nuovo Pignone, and ORMAT.

4. Outcome of the celebration program

Seen in the light of their functional objectives (see para. 2), the manifestations held to celebrate the centenary of the geothermal-electric industry have produced so far the following significant results:

- *Participation of people.* Altogether at least 6000 people attended the events in program.
- *Involvement of energy decision-makers.* Many dozens of politicians and public authorities involved in renewable energy sources have been contacted before, during and after each event, to inform them of the advantages of increasing the use of natural heat as much as possible.
- *Dissemination of information on geothermal energy.* Media, newspapers and association journals reported widely on the events carried out to celebrate the centenary in question, and stressed the importance of developing geothermal energy. Moreover, a special issue of the UGI News in Italian and in English will be published soon, for distribution in Italy and abroad.
- *Plan of direct uses in Tuscany.* Following suggestions made by UGI during some of the events described in para. 3), the Tuscan Region has set up a study to bring the assessment up to date, and to evaluate the market conditions for the low-to-moderate temperature resources of the whole territory of Tuscany. The first phase of the study has been completed, and the second phase (consisting of feasibility studies in priority areas) will likely start very soon.
- *Project on the social acceptance of geothermal energy.* As a follow-up of ideas discussed at the first international conference, the University of Pisa is studying the economic feasibility of a project aimed at categorizing the social constraints which hamper the development of high-temperature geothermal resources in Italy and in selected countries of the world, in order to outline an agreed-upon plan of action purported to smooth difficulties arising from such constraints.
- *International Center of Excellence in Geothermal Energy.* Based on discussions started at the conference and on several other occasions in the last few years, an initiative is being studied by the Tuscan Region to create the Center in question, with the support of the Italian Government and of some Italian and international organizations.

Hungary

Birds would say no for re-injection

Gábor Szita, President of HGA, Hungary

In IGA News No. 62, Dr. Burkhard Sanner as President of EGEC reported on the 6th Inter-Parliamentary Meeting held in Edinburgh last October, and mentioned that the Hungarian Geothermal Association (HGA) is trying to cancel the relevant legislation on geothermal. HGA is actually *attempting* to change some of the existing domestic decrees, but always through reasoned arguments in negotiation with the Ministry of Environment. HGA has never *pressed* anybody to change the legislation.

Dr. Sanner suggested that governments should allow transition periods in support of re-injection projects. HGA agrees with that. The problem is that the existing Hungarian legislation provides a very short (practically no) transition period and there is no financial support for re-injection. The fact is, however, that the penalties are 70 times (!) more for those who do not use re-injection. Dr. Sanner thought that HGA was fighting against re-injection. That is not true. HGA is fighting against the general obligation for re-injection that came into force in 2004 in Hungary, which is in contradiction with the Directive 2000/60/EC of the European Parliament on water policy and usually acts as an unnecessary barrier for future developments. Financial support from national or from EU sources may help to develop the technol-

ogy of re-injection into sandstone reservoirs. This is needed *before* drilling hundreds of wells. We have already collected many experiences of unsuccessful re-injections since the first test was carried out in 1978.

It is a fact that there *is* successful re-injection in Hungary, which has been operated for over 13 years – but into fractured limestone.

What about the birds? – the reader may ask. It's an interesting story. One of the biggest geothermal users has a large artificial pool for storing the cooled geothermal water before discharging it into a river. Over the decades, birds have taken to that lake. The 20 year long observation of those birds shows that there are some protected species and two that appear only on that lake. However, due to the existing legislation the lake is sentenced to death. Either the geothermal company will stop exploitation of the waters because of the high rate of penalty, or the water will fully be re-injected. If we asked the birds they would obviously say no to re-injection.

HGA managed to have an executive decree modified

Based on the results of negotiations between HGA and the Ministry of Environment, the Hungarian Government modified its 220/2004 decree. Negotiations started shortly after the “Statement of HGA on the Situation of Harnessing Geothermal Energy in Hungary” was accepted by the Second Workshop of HGA in October 2004. The bilateral talks lasted for almost half a year and the Ministry of Environment drew up its proposal in July 2005. Conciliation with the other ministries consumed another half year.

The modified decree, which became effective at the beginning of 2006, specifies that geothermal users may again apply for individual consideration regarding emission limits if geothermal waters are released to surface receptacles. It makes provision for geothermal companies to apply for individual limits; those users accepted by the local environmental authorities will pay a lower penalty.

The Hungarian Geothermal Association, which has 20 corporate members and represents 70% of Hungarian geothermal utilisation, hopes that the modification is only the first step towards creating a new legal environment that is friendly for geothermal energy in Hungary.

THE AMERICAS

Mexico

Eruptive news: Popocatepetl volcano, Mexico.

N. Segovia, M. Mena, R.M. Barragán

When you approach Mexico City by air you can see two beautiful volcanoes welcoming you to our country. Both of them are more than 5000 m high but their shapes are quite different. The legend says that, once upon a time, an Aztec princess died of sadness while waiting for her beloved warrior. When he returned from the war, he found her resting under a white sheet; he sat close to her and also died of love. God decided to change them into rock and the two mountains, the sleeping lady and the fuming volcano, have lain since then at the eastern end of the Mexico City valley. We know them as Iztaccihuatl and Popocatepetl, the sleeping lady and the warrior. Iztaccihuatl is a very old dormant volcano and Popocatepetl is an active one.

Popocatepetl (19°N 99°W; 5426 m altitude) is a high-risk volcano due essentially to its geographical location in Central Mexico and to its eruptive history. It is located in a region marked by the highest population density in the country, being 60 km from Mexico City, one of the largest cities in the world. The eruptive history of Popocatepetl has been documented since 1347. In 1519 an eruptive stage lasted until 1530. In the 20th century multiple eruptive events occurred between 1920 and 1927, having an explosive character of moderate magnitude. An eruptive phase started in December 1994 and has shown stages of different volcanic activity during the last twelve years. During this period, the volcano has been subject to intensive studies of volcano-tectonic earthquakes, ejecta composition, soil and groundwater radon, water chemistry, glaciers evolution etc.

The volcanic earthquakes and the gravity studies indicate that the magmatic chamber is located around 6 km below sea level, 11000 m from the mountain top. Long period earthquakes associated with the ascending motion of volcanic fluids through cracks or conduits reached maximum values in 1996, 1999, 2000 and 2001. Several of these periods

were followed by small and large volcanic explosions, the larger ones occurring in 1997 and end 2000-beginning 2001. The seismic energy represented by a cumulative measurement of the continuous ground vibration together with the cumulative energy released by the volcano-tectonic earthquakes showed a continuous growth tendency up to the end of 2000, when a large energy step was observed corresponding to the largest volcanic activity since 1994. During this time large and small lava domes were forming and ascending inside the volcano crater. The largest volcanic activity observed at Popocatepetl since 1994 and up to date was observed in December 2000 and January 2001, when the largest lava dome was formed and the most explosive dome destruction occurred. From February 2002 to February 2003, the Popocatepetl activity showed an interesting variation characterized by periods of intense seismic activity of short duration. These were occasionally accompanied by the formation of small lava domes. Dome formation resumed in December 2002, with a dome 40 m tall and 180 m radius. Intense volcanic activity was recorded from February 2003, marking a significant stage of eruptions when 13 volcanic explosions destroyed the domes formed during 2002. Some of these explosions generated ash clouds of more than 4 km in height, which were transported north-east to Florida and detected by the GOES satellite. All these events also generated chemical and radon anomalies in soil and groundwater. Risk maps were generated for the population living in communities on the volcano flanks in order to support eventual evacuation actions, and a continuous survey is maintained.

When you arrive in Mexico City, don't forget to turn to the east and admire our two magnificent volcanoes.

OCEANIA

New Zealand

Tuaropaki Power Company Officially Opens Geothermal Plant Extension at Mokai

Brian White, New Zealand Geothermal Association

On Saturday 25 February 2006, the Tuaropaki Power Company held their official opening ceremony for the Mokai Geothermal Power Station extension. The 39 MWe extension brings the total Mokai output up to 94 MWe. This power station alone will generate almost 2% of New Zealand's total electricity requirements, and will be in the nation's top 15 stations in terms of annual output. Tuaropaki Power Company will now be the 6th largest electricity generator in New Zealand. Geothermal power stations supply a reliable base load of generation that is independent of rainfall or wind.

The station is based around what is known as binary cycle technology. While geothermal steam does pass directly through a steam turbine, geothermal heat from steam and water is passed to a second "organic" working fluid that drives other turbines. Large banks of air-cooled heat exchangers are another feature of the station. The station was designed and built by Ormat of Israel and is similar to the Rotokawa station near Taupo, or to other designs internationally. The overall result is an efficient geothermal power station.

The station has a low profile sitting on farm land surrounded by low-lying hills. The station is not directly visible from main roads out of Taupo. The heat exchanger arrangements around the station mean that there is normally no direct release of geothermal steam at the surface. A small amount of carbon dioxide comes with the geothermal fluid and is vented above the cooling towers. The carbon dioxide emissions are about one sixth of a gas-fired combined cycle power station of the same MWe output. Geothermal water and condensate are reinjected into the Mokai reservoir. The station is normally quiet and is not expected to disturb either the local farm workers or farming operations.

The Tuaropaki Power Company (TPC) was established as an independent generator by, and was wholly owned by the Tuaropaki Trust. The Tuaropaki Trust administers 2,700ha of Maori lands that overlie most of the Mokai geothermal field. The trust runs a successful pastoral farming operation and also has an interest in a large geothermally-heated glass house on its land. An emphasis has always been placed on the need for a sustainable geothermal operation that fits in with the existing farm and adds value. There has been a long term relationship between TPC and state-owned generator Mighty River Power. Mighty River Power has an agreement to operate and manage the Mokai power station, and bought a 25% equity holding in TPC in 2003. The New Zealand Geothermal Association congratulates Tuaropaki Power Company on the official opening of their Mokai geothermal power station extension.

There are many other geothermal fields in New Zealand that are currently untapped or underdeveloped, and that could potentially be developed assuming access and consenting is achieved. There is currently 450 MWe of installed geothermal capacity in New Zealand, and geothermal stations supply 6 – 7% of our electricity demand. Geothermal energy is expected to make an even greater contribution to supplying New Zealand's increasing demand for electricity. Conservative estimates taking account of likely consent restrictions have indicated that more than 600 MWe of new geothermal power stations could be installed. Some developers have spoken of 400 MWe of geothermal power stations over the next 10 years.

UPCOMING EVENTS

Australian Earth Science Convention, Melbourne, Australia, 2-7 July 2006. Contact: <http://www.earth2006.org.au/index.shtml>

The Seventh Asian Geothermal Symposium. Qingdao, China, July 25-26, 2006. Contact: asia7@m.aist.go.jp, <http://unit.aist.go.jp/geoesenv/asia7.html>

International Heat Transfer Conference IHTC-13. Sydney, Australia. August 13-18, 2006. Contact: Graham de Vahl Davis, ihtc-13@unsw.edu.au, <http://ihtc-13.mech.unsw.edu.au/>

World Renewable Energy Congress IX & Exhibition. Florence, Italy, August 19-25, 2006. Contact: Ali Sayigh, asayigh@netcomuk.co.uk, www.wrenuk.co.uk/wrecix.html

2nd Annual Conference Mineral Extraction from Geothermal Brines, Tucson, Arizona, USA, September 6 – 8, 2006. Contact: Dr. Mary M. Poulton mpoulton@email.arizona.edu

Mexican Geothermal Association 2006 Technical Congress, Cerro Prieto, Baja California, Mexico, September 9, 2006. Contact: José Luis Quijano León: luis.quijano@cfe.gob.mx, or Luis C.A. Gutiérrez Negrín: luis.gutierrez03@cfe.gob.mx.

GRC 2006 Annual Meeting. San Diego, California, USA, September 10-13, 2006. Contact: Geothermal Resources Council grc@geothermal.org, www.geothermal.org.

International Conference and Exhibition "Renewable Energy 2006". Makuhari Messe, Chiba, Japan, October 9-13, 2006. www.re2006.org.

Sustainable Energy & Energy Efficiency Expo 2006, London, UK, October 10-12, 2006. Contact: www.energy-expo.info

28th New Zealand Geothermal Workshop and NZ Geothermal Association Seminar, 15-17 November 2006, Auckland University, Auckland, New Zealand. Contact: Jane Brotheridge: j.brotheridge@auckland.ac.nz

3rd BSME-ASME International Conference on Thermal Engineering. Dhaka, Bangladesh, December 20-22, 2006. Contact: www.iutoic-dhaka.edu/bsme_asme_ict2006/index.html

Enertec 2007, Leipzig, Germany, March 13-16, 2007. Contact: www.eventseye.com/fairs/trade_fair_event_711.html

4th International Congress on Numerical Methods in Engineering and Applied Sciences, Morelia, Mexico, January 17-19, 2007. Contact: Dr. César Suárez msuarez@zeus.umich.mx, <http://congress.cimne.upc.es/morelia07>

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 consist of the IGA Information Committee:

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