# IGA NEWS

Newsletter of the International Geothermal Association

Quarterly No. 103



# IGA ACTIVITIES

## Message from the President

The first quarter of 2016 has been an action-packed few months, geothermally speaking.

In January, I attended the IRENA General Assembly in Abu Dhabi. Many events and meetings were offered, but the Ministerial Meeting on Renewable Energy and Climate Change in Africa stood out, titled, *The Implications of COP21 for Africa: Challenges and Opportunities*. Geothermal energy is playing a large role in achieving access to electricity across the region. Much of the potential remains to be developed, both in terms of geothermal electrical and direct uses. The meeting emphasized the need for coordination, collaboration and cooperation across Sub-Saharan Africa between energy initiatives, governments, development partners and international institutions.

Another outstanding experience was listening to the inspiring presentation of Christiana Figueres, the Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC). Ms. Figueres spokes about the COP21 Paris agreement, saying, "The World has said we have drawn the boundary around how much we are going to emit for the rest of the history of mankind on this planet". Strong words.

In February the North Rhine-Westphalia Climate and Environment Minister, Johannes Remmel, announced project funding for continued support of the IGA Secretariat in Bochum through December 2018. The IGA is hosted by the International Geothermal Centre Bochum (GZB) at the University of Applied Sciences in Bochum. The project is Phase 2 of the original project, which made possible the IGA Secretariat to stay at Bochum since 2011.

Minister Remmel said, "Geothermal energy is baseload energy and can play a key role in energy transition for densely populated metropolitan areas. The federal state has a significant heating demand that also can be met by geothermal energy. Our study on geothermal potential shows more than 50% of the heat demand in NRW could be covered by low-enthalpy geothermal applications, like borehole heat exchangers. The GZB is a competent partner in exploring and making use of these resources."

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On behalf of the IGA, I want to thank Minister Remmel, the federal state of North Rhine-Westphalia, and the EU for supporting geothermal energy research and use for Europe and the world.

In June, the IGA holds elections for a new Board of Directors. The IGA Secretariat and the Nominating Committee, led by Mr Paolo Romagnoli of ENEL Green Power, have been hard at work organizing the elections, which will be held online. There are many new faces (and some familiar ones) among the candidates. The profiles of each candidate will be available soon on the IGA website.

*Dr Nina Rman, Geological Survey of Slovenia, and her daughter, Pika; Dr Juliet Newson, IGA President; and Dr Ana Vranjes, Geothermal Researcher, University of Belgrade. Photo taken at Laboratory for Geothermal Energy and Energy Efficiency, University of Belgrade.*

For myself, I have been working on behalf of the IGA. I addressed the 2016 Energy Efficiency and Renewable Energy conference in Sofia, Bulgaria, which was supported by the Bulgarian Ministry of Economy, the Ministry of Environment and Water, and the Sofia Municipality. I travelled to Serbia and met with Professor Dr Dejan Milenić and Dr Ana Vranjes of the Laboratory for Geothermal Energy and Energy Efficiency, Department of Hydrogeology, Faculty of Mining and Geology, University of Belgrade. Serbia has many geothermal springs, and encompasses the southern part of the Pannonian Basin, a well-known geothermal resource throughout Eastern Europe. On behalf of the IGA, I expressed the hope we can look forward to the establishment of a Serbian national geothermal association. The meeting with Dr Vranjes and Professor Dr Milenić was facilitated by my friend, colleague and geothermal researcher from the Geological Survey of Slovenia, Dr Nina Rman.


From Serbia, I travelled to Iceland to participate in the ESMAP Global Geothermal Development Roundtable, and then in succession: the Iceland Geothermal Conference, IGA Board meetings and the preliminary meetings for organizing the next World Geothermal Congress in Iceland in 2020.

For the people in the Northern Hemisphere, I wish you well for the coming spring and summer; for southerners like myself, I hope geothermal energy is keeping you warm this winter!

Regards,

**Juliet Newson, President**
**International Geothermal Association**

# IGA Headquarters Will Remain Three more Years in Bochum, Germany

The Minister of the German federal state of North Rhine-Westphalia's (NRW) Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection (MKULNV), Johannes Remmel, visited the headquarters of the International Geothermal Association (IGA) on February 17. He officially kick-started Phase 2 of the Association at its host institution, the International Geothermal Centre of Bochum (GZB) at the University of Applied Sciences of Bochum. The GZB is an institute for research, education, communication and networking with a regional to global focus. Many institutions for these different tasks are based at the GZB.

The IGA and the offices of its Secretariat have been hosted in Bochum since 2011, and now will remain there up to December 2018.

During his visit, Minister Remmel officially handed over the note of project funding for the extension of the IGA's headquarters in Germany. The project extension cost of around €1 million is partly funded by the federal state and partly by the European Union (EU). It is expected that the IGA will continue enhancing the scientific and technology transfer between NRW companies/institutions and international entities and thereby open up new markets.

Dr. Juliet Newson, the President of the IGA, appreciated the support by the federal state, sent a message stating: "On behalf of the International Geothermal Association (IGA), I want to thank the federal state of North Rhine-Westphalia, and the EU for the continuing support of the IGA Secretariat in Bochum. The IGA is pleased to be associated with the strong renewable energy focus of North Rhine-Westphalia. We appreciate the opportunity to encourage use of geothermal as a clean energy option for Europe and for the world."

Prof. Dr. Rolf Bracke, the Director of the GZB, said: "The new knowledge and transfer platform for geothermal climate protection technologies provides a win-win situation for the IGA and the GZB. The research institute GZB provides the IGA and the nearby industry with an excellent framework setting and is at the same time strengthened through the international networks and contacts of the IGA."

Prof. Dr. Martin Sternberg, President of the University of Applied Sciences in Bochum, stated: "The International Geothermal Association significantly assisted the GZB as well as German companies and research entities in its international projects and in becoming more prominent globally. We appreciate the recognition by the federal state, the EU and the IGA Board of Directors that the IGA continues to steer its operations from Bochum."

*Prof. Dr. Rolf Bracke, left, and Minister Johannes Remmel.*

Source:
http://www.energieagentur.nrw/geothermie/meldungen/geothermie_ist_wichtiger_faktor_fuer_die_gelungene_energiewende_in_unseren_ballungsraeumen

# 23rd Congress of the Mexican Geothermal Association

## *Luis C.A. Gutiérrez-Negrín, Chair of the Information Committe*

During the second week of March, the Mexican Geothermal Association (AGM: Asociación Geotérmica Mexicana) held its 23rd annual congress and annual general assembly in Morelia, state of Michoacán, Mexico. The congress gathered around 130 persons from the geothermal divisions of the Comisión Federal de Electricidad (CFE) and the Instituto de Investigaciones Eléctricas (IIE: Electric Research Institute), as well as from the universities of Mexico (UNAM: National Autonomous University of Mexico) and Michoacán (UMSNH) and other institutions, like the Mexican Center for Innovation in Geothermal Energy (CeMIE-Geo: Centro Mexicano de Innovación en Energía Geotérmica), students, the Energy Ministry (SENER), Lawrence Berkeley National Laboratory (LBNL) and private companies. The general breakdown of participants appears in the following table.

| Sector | Number | % |
|---|---|---|
| CFE | 17 | 13.0 |
| IIE | 10 | 7.6 |
| UMSNH-INICIT-CeMIE-Geo | 30 | 22.9 |

| | | |
|---|---|---|
| UNAM-II-CeMIE-Geo | 11 | 8.4 |
| CICESE-CeMIE-Geo | 4 | 3.1 |
| Students (ESIA, UNAM) | 23 | 17.6 |
| SENER | 3 | 2.3 |
| Private companies* | 23 | 17.6 |
| Other (International, retired) | 10 | 7.6 |
| **Total** | **131** | **100.0** |

**(ChemTreat, Energy Forever Exergy, ENAL, Enel Green Power Mexico, GEA, Geocónsul, Grupo Dragón, Nalco-Ecolab, Permex, Spectramex, and other).*

During the congress, 29 technical papers were presented orally and 11 as posters, some of which were also presented orally. There was one invited conference given by Patrick Dobson, from the US LBNL. Almost three quarters (72%) of the technical papers (23) were related to exploration (geology, geochemistry, geophysics); other topics covered were field management (3), direct uses (3), power plants (2), heat flow and potential (2) and modeling (2).

On March 9, there was a pre-congress, eight-hour workshop on "Introduction to Isotopic in Hydrothermal Systems" and "Introduction to Geothermal Heat Pumps", conducted by IIE researchers Mahendra Pal Verma and Alfoso García-Gutiérrez, respectively. There were 28 attendees mostly from UNAM, UMSNH and ESIA (Escuela Superior de Ingeniería y Arquitectura). Others were from CICESE (Center of Scientific Research and High Education of Ensenada), private companies and the Energy Ministry (SENER).

It is worth mentioning that the current AGM's Board of Directors decided to organize a parallel commercial exhibition during the congress, for the first time in 23 years. Thus, the organizing committee offered 12 booths that were quickly taken by private companies and public institutions to exhibit their products and services. Exhibitors were: CeMIE-Geo, ChemTreat Mexico, Exergy SpA, Industrias Falcón, Instituto de Geofísica de la UNAM, IIE, Instrumentos Científicos, Kuster, and Servicio Geológico Mexicano. One special sponsor of the congress was Ormat Technologies.

Magaly Flores-Armenta, head of the geothermal division of CFE opened the congress in the morning of March 10. She was accompanied by José Manuel Romo-Jones, technical leader of CeMIE-Geo, Michelle Ramírez-Bueno, director of Geothermal Energy of SENER, and Georgina Izquierdo-Montalvo, President of the AGM, all of them were introduced by Luis C.A. Gutiérrez-Negrín, former AGM's president.

At the evening of March 10, after concluding the technical presentations, Georgina Izquierdo presented the Pathé Award to Jorge Guiza-Lambarri, acknowledging his contribution to the early developing

*Participants in the AGM's 2016 Annual Congress*

of geothermal in Mexico. Guiza-Lambarri, currently 92, is a chemical engineer that was in charge of the geothermal office of CFE between 1948 and 1971, and after his retirement in 1978 he was responsible of the IIE facilities in the Cerro Prieto geothermal field up to 1985. The 2016 Pathé Award was delivered by José Luis Hernández-Galán, recipient of the 2015 award. After that ceremony, participants to the congress attended an opening reception in the colonial Municipal Palace in the historic downtown of Morelia, enhanced by the Folkloric Ballet of Michoacán that performed several typical dances.

On March 11 after the closing ceremony of the congress, the AGM held its 23rd Annual Ordinary Assembly in the same facilities, which was restricted to its current members. Georgina Izquierdo-Montalvo who presided the meeting, called to order, read the minutes of the past annual meeting and informed on the status of the Association, and the AGM's treasurer presented the current finance situation as of February 29th. Minutes and reports were approved, and the general assembly concluded around 20:30 hours.

## Bulgaria Could Use more Geothermal Energy: Juliet Newson

In an interview prior the conference "Energy Efficiency & Renewable Energy" held in Sofia, Bulgaria on 5-7 April, Juliet Newson, IGA's President, was asked what she would recommend to change the low usage per capita of geothermal energy in Bulgaria, in spite of the country's high geothermal potential. She said: "We are aware of a number of geothermal resource uses in Bulgaria. The town of Velingrad for example is known for its hot and cold mineral springs that are used for heating and balneology. As the temperature of geothermal wells in the country ranges between 20°C - 100°C direct use applications are most appropriate. North-East Bulgaria (Moesian plate) and South Bulgaria (Rila-Rhodopes massif) host most of the geothermal resources. Direct thermal water use in Bulgaria concentrates on balneology (largest share with 60%), space heating, air-conditioning, greenhouses, ground source heat pumps, direct thermal water supply, bottling of potable water and soft drinks and for some technological processes.

"Bulgaria's energy mix traditionally consists of coal (about 50%) and nuclear (36%). There is a window of opportunities for geothermal energy in the country, particularly in use of heat. As far as we are aware no governmental incentives are provided to geothermal developers. In terms of the regulatory environment, support for the municipalities to build capacity in geothermal resource assessment and management would increase the confidence of investors. Also, awareness raising for decision makers, potential investors and the public would improve the situation."

Responding other questions, Juliet Newson added: "The legislative and regulatory framework for geothermal energy is very diverse within the EU member states, and in some cases is a real barrier to geothermal energy use. There are countries with barriers of fiscal nature (i.e. mining royalty, sewage penalty, groundwater use fee, environmental tax). Challenges include for example royalties e.g. in France, Hungary, Poland, Romania. Geothermal resources often are subject to Mining Law whereas the production of geothermal fluids from the shallow subsurface is generally regulated by Water use legislation… Geothermal energy plays an important role in the energy transition due to its diverse uses for heating/cooling, electricity generation, agricultural drying processes, balneology, etc."

Source: http://viaexpo.com/en/press/there-is-a-window-of-opportunities-for-geothermal-energy-in-bulgaria

## From the IGA Secretariat Desk

### *Note & photos by Marietta Sander, IGA Executive Director*

**IGA in Klima Forum 2016 -** The IGA Executive Director attended the 'KlimaForum2016' in Düsseldorf, Germany on 29 February. High-level German industry

and governmental representatives discussed the structural challenges of energy transition and the climate

change mitigation targets in the state of Northrhine-Westphalia, and particularly the Ruhr area where the IGA Secretariat is located. Further information is available in German online: https://www.klimadiskurs-nrw.de/.

**IGA in GeoTHERM2016 -** On 25-26 February, IGA attended the GeoTHERM 2016 in Offenburg, Germany. The IGA was also represented with a booth in the exhibition area. A total number of 200 exhibitors demonstrated their services and products in the two exhibition halls. GeoTHERM is a large German-European geothermal exhibition plus congress held annually. The next GeoTHERM will take place on 15-16 February 2017 also in Offenburg. For more info visit the GeoTHERM website: http://www.geotherm-germany.com/.

**New IGA Poster Available -** IGA recently launched a new IGA poster: 'Geothermal Support Programs in the framework of International Development Cooperation'. The map shows projects by financial and technical support agencies that assist geothermal development worldwide. If you wish to print the map in the original format feel free to contact the IGA Secretariat (iga@hs-bochum.de) to obtain the file.

**Lecturer Opportunity -** The IGA Academy is starting its teaching and training activities and has therefore launched an online application in early April. The IGA Academy is currently looking for geothermal specialists who would like to offer academic or technical geothermal courses on behalf of the IGA Academy. Applications will be reviewed by the IGA Education Committee and the IGA Secretariat to ensure that the IGA Academy will only offer courses led by highly qualified lecturers. We hope to receive many good applications in order to be able to offer a diverse course program in the near future. The pool of lectures and their fields of expertise will be the basis for upcoming IGA courses. Some courses will be offered in cooperation with international universities and shall be evaluated for future certification and accreditation.

If you would like to apply to become a lecturer on behalf of the IGA Academy, please feel free to apply via the following website: http://www.geothermal-energy.org/iga_academy/geothermal_experts.html.

**The IGA at the Berlin Energy Transition Dialogue -** On 17-18 March, the IGA Executive Director attended the second Berlin Energy Transition Dialogue in Berlin, Germany. Via this dialogue platform, the German Federal Government continues sharing experiences on the energy transition (*Energiewende*). Foreign Minister Frank-Walter Steinmeier and Federal Minister for Economic Affairs and Energy Sigmar Gabriel opened the Energy Transition Dialogue at the Federal Foreign Office. Ministers from numerous countries, including Norway, South Africa, Saudi Arabia and Tunisia attended the event, as well as high-level representatives and guests from 74 countries.

To invite the world to the 2016 Dialogue and to promote the international dialogue on the energy transition, a GREEN ENERGIEWENDE SOFA (https://www.energiewende2016.com/the-green-energiewende-sofa/) travels around the world initiating discussions at several international meetings and conferences before ending its "tour" in Berlin at the start of the next dialogue. Further information is available online: www.energiewende2016.com. An online livestream is also available.


At the event, IRENA launched its 2nd edition of the REmap in Berlin. The report provides an in-depth perspective on the energy transition in 40 countries, representing 80% of carbon emitters. To download the report visit: http://ow.ly/Zi5U8.

On 17 March, the physicist and environmental activist Amory Lovins, co-founder and director of the Rocky Mountain Institute was awarded the Officer's Cross of the Order of Merit of the Federal Republic of Germany (*Bundesverdienstkreuz*). His outstanding achievements on shaping the renewable energy pathway led to this distinguished honor.

# AFRICA

## Ethiopia: Geothermal Potential for 10,000 MW, Says the Geological Survey

The Geological Survey of Ethiopia (GSE) said the country could generate over 10,000 megawatt (MW) from geothermal energy. The Public Relations and Communication Director at GSE, Tamiru Mersha, made that remark based on the study his institution conducted in the rift valley region, an area endowed with high subsurface temperatures. The study identified 22 potential areas for geothermal energy production.

In addition, the 70 MW project in Aluto-Langano continues to show progress. A total of four wells will be drilled in collaboration with the Japanese Government (*see* IGA News 102, pp. 8-9). Two of these wells, with depths of 1920 and 1953 meters have already been completed. According to Tamiru, the GSE would hand over the remaining two wells to the Ethiopian Electric Power this year. He further said preparations are underway to begin work on another project that could generate 100 MW around the Tendaho area, Afar regional state. The GSE would work with the Ethiopian Electric Power to identify potential areas and drill wells as various stakeholders have expressed interest to take part in the work.

Source:
http://www.fanabc.com/english/index.php/news/item/4953-ethiopia-capable-to-generate-over-10,000mw-geothermal-energy-study

## Kenya: Developments in Olkaria, Grant for Akiira

**KenGen to develop Olkaria V and VI –** Kenya and Japan signed a 46 billion yen (US$408 million) loan agreement for the construction of the Olkaria V geothermal power station that is expected to be operational within the next two years. Kenya Electricity Generating Co. (KenGen) announced it will receive the loan from the Japan International Cooperation Agency (JICA) for the construction of the plant, composed of two units each with an installed capacity of 140 MW. KenGen plans to tender for the construction of the facility, located about 70 km (44 miles) northwest of the capital, Nairobi. Construction is expected to begin in the third quarter of 2016, and power from the plant would be added to the national grid by 2018. In early April, the japan Deputy Embassador to Kenya, Mikio Mori, confirmed that the procurement phase of the Olkaria V project was complete. "Bids have been sent to three applicants who were successful in the request for proposal stage. We expect construction works on the power plant to start in five months," said Mori, but did not disclose the three applicants.

It was also unveiled that KenGen has agreed to invest US$650 million in the construction and development of project Olkaria VI, which will have a total installed capacity of 180 MW. Thus, the investment per MW will be US$3.61 million. The company may partner with US, Chinese or Indian investors to finance and develop geothermal power plants, including that of Olkaria VI. The company will probably take a minority stake in the Olkaria VI geothermal power plant. The construction of the power plant is expected to start in 2018.

KenGen plans to more than double its generation capacity to 4270 MW by 2025 at a cost of US$8.1 billion.

Sources: http://www.4-traders.com/KENYA-ELECTRICITY-GENERAT-9295413/news/Kenya-Electricity-Generating-to-Invest-USD650-Million-in-Olkaria-VI-Geothermal-Power-Plant-in-Keny-21731245/, http://www.theafricareport.com/East-Horn-Africa/energy-kenya-signs-408-million-loan-with-japan-for-140-mw-geothermal-plant.html, http://www.bloomberg.com/news/articles/2016-01-28/kengen-of-kenya-secures-387-2m-from-jica-for-geothermal-plant, http://www.standardmedia.co.ke/business/article/2000196774/olkaria-v-ground-breaking-expected-in-august

**Olkaria III Reaches 140 MW –** Ormat Technologies, Inc. announced in early February that it reached

## UPCOMING EVENTS

**3rd Iceland Geothermal Conference (IGC)**
26-29 April 2015, Reykjavik, Iceland

**International 100% Renewable Energy Conference (IRENEC)**
26-28 May 2016, Istambul, Turkey

**4th Indonesia International Geothermal Convention & Exhibition (IIGCE 2016)**
10-12 August 2016, Jakarta Indonesia
(Special fee for IGA Members: US$400)

**European Geothermal Congress (EGEC 2016)**
19-24 September 2016, Strasbourg, France

**40th GRC Annual Meeting & GEA Geothermal Energy Expo**
23-26 October 2016, Sacramento, CA, US

**6th African Rift Geothermal Conference (ARGeo-C6)**
31 Oct-6 Nov 2016, Asmara, Eritrea

**German Geothermal Congress (DGK 2016)**
29 Nov-1 Dec 2016, Essen, Germany

**Note**: Please check the IGA website for more events.

commercial operation of Plant 4 in the Olkaria III complex in Kenya, increasing the complex's total generating capacity by 29 MW to 139 MW. Plant 4 will sell its electricity to Kenya Power and Lighting Company Limited (KPLC) under a 20-year Power Purchase Agreement (PPA). In October 2015, Ormat signed an amendment to the PPA that enables the increase the capacity of Plant 4 in phases, to an aggregate of 100 MW.

Ormat has implemented a multi-phased development strategy in Olkaria III. The first phase of Plant 1 commenced operation in 2000 and the second one in 2009. Plant 2 began commercial operation in 2013 and plant 3 in 2014. Ormat financed the first three plants of the complex with a US$310 million debt facility provided by the Overseas Private Investment Corporation (OPIC), the U.S. Government's development finance institution. Plant 4 was financed by Ormat equity which is covered under an insurance policy from MIGA (a member of the World Bank Group) to cover its exposure to certain political risks involved in operating in developing countries.

"Now that we have the commercial terms in place, we will continue to evaluate the feasibility of future expansions of the Olkaria III complex as well as other prospects to support our growth in Kenya," noted Isaac Angel, Ormat's Chief Executive Officer.

Source: http://www.ormat.com/news/latest-items/ormat-announces-commercial-operation-plant-4-olkaria-iii-kenya-expanding-complex-c

*Drilling in Akiira.*

**Grant for Exploratory Drilling in Akiira -** Akiira Geothermal Limited has received a Sh138 million (US$1.36 million) grant from the African Union Commission (AUC) to fund exploratory drilling which it is currently undertaking in Naivasha. The grant by AUC is part of the Geothermal Risk Mitigation Facility and is aimed at mitigating financial risks at early stages of geothermal exploration. The firm started exploratory drilling in August 2015 in a bid to construct a 70 MW geothermal power plant. According to Akiira Geothermal's Chief Executive Robert Bunyi, two wells have been drilled and a third one will be drilled in April 2016. In August 2015, the company signed a PPA with Kenya Power at a cost of 9.23 US cents per kWh. The project is composed of three 70 MW stages each, with the first one scheduled for December 2018. The company received a Sh86 million (US$ 850,000) grant from the Overseas Private Investment Corporation (OPIC) in October 2014 as part of President Obama's Power Africa program that facilitated to pay for the technical and legal work needed before drilling. Akiira Geothermal Ltd. is owned by Centum Investments in conjunction with other three entities that include Ram Energy and Marine Power from the US and Frontier Investments Management ApS from Denmark.

Source:
http://www.capitalfm.co.ke/business/2016/03/akiira-geothermal-limited-gets-sh138mn-for-exploration-works-2/

## Tanzania: Support for Geothermal Exploration and Drilling in Lake Ngozi by Next June

The Ministry of Energy and Minerals of Tanzania signed a cooperation agreement to support geothermal development in the country, under the joint Nordic Development Fund (NDF) and Icelandic International Development Agency (ICEIDA) regional Geothermal Exploration Project. The main objective of this regional project is to assist countries in the East Africa Rift Valley to enhance geothermal knowledge and capacity in order to enable further actions on geothermal utilization and complete the exploratory phase of geothermal development. The Geothermal Exploration Project is the initial phase of the Geothermal Compact partnership program, initiated jointly by ICEIDA and the World Bank. This includes active support during the exploration phase.

The implementing agency in Tanzania is the Tanzania Geothermal Development Company (TGDC). TGDC was incorporated in December 2013 as a 100% state-owned company with the mandate of spearheading geothermal resources development in the country. The objective of the sub-project is to enhance knowledge of selected geothermal areas of the country, including Luhoi, Ngozi and Kiejo-Mbaka, and to identify potential sites for exploration drilling and improved capacity to advance geothermal energy production. The sub-project places particular emphasis on building the capacity of Tanzanian experts through hands-on training during surface exploration and lectures on methods and data interpretation.

Sources: http://www.ndf.fi/news/supporting-geothermal-development-tanzania, http://www.ndf.fi/project/geothermal-exploration-project-ndf-c48

*Geothermal fieldwork in Tanzania. Photo: ICEIDA.*

In other news, the Minister of Energy and Minerals, Prof. Sospeter Muhongo, has directed TGDC that it must begin drilling three wells in the area of Lake Ngozi by June 2016. "We cannot continue waiting due to the elevated shortage of power the country experiences while Tanzania is where the Rift Valley covers huge area compared to other countries within a region," he said. The Minister explained that according to a research conducted in the field, the expected subsurface temperature is between 230 and 250°C.

Prof. Muhongo advised the company to continue with a significant exploration in other areas that show similar indicators, including the Mbaka area in the Rungwe district. He said three foreign companies, including Symbion Tanzania, have already shown interest to invest in geothermal in collaboration with the Tanzania Petroleum Development Corporation (TPDC).

Source: http://allafrica.com/stories/201602081329.html

## Uganda: Geothermal Exploration at Buranga Prospect

The Government of Uganda is promoting the use of renewable energy sources as alternatives or supplements to other traditional sources like hydropower, and fossil fuels (oil and gas). Among the renewable sources of energy being considered is geothermal energy. Pre-feasibility studies at the Buranga geothermal prospect indicate subsurface temperatures of approximately 150 - 200°C. The temperatures are suitable for electricity production and direct use in industry and agriculture.

GIDS Consult Limited is currently carrying out geothermal exploration and evaluation studies with an aim of installing an at least 100 MW geothermal power plant at the Buranga prospect. The company is planning to drill three deep exploration/production wells at the prospect and install a 30 MW wellhead unit at each successful well.

Source: http://africastopover.com/shop/public-sector/geothermal-exploration-and-development-at-buranga-prospect/

# AMERICAS

## Caribbean: Activities in Nevis and St. Vincent and the Grenadines

**St. Kitts and Nevis -** The tiny volcanic island of Nevis is located in the northern region of the Lesser Antilles. With a population of 12,000, it currently imports 4.2 million gallons (15.9 million liters) of diesel fuel annually at a cost of US$ 12 million. Nevis consumes a maximum of 10 MW of energy. Nevis is the smaller island of a pair, known as the Federation of St. Kitts and Nevis. It is home to active hot springs and a large geothermal reservoir. Seven volcanic centers have been identified on Nevis, and drilling at three sites has indicated that the geothermal reservoir is capable of producing all the electric energy the island demands.


Deputy Premier and Minister of Tourism of Nevis, and Minister of Foreign Affairs of St. Kitts and Nevis Mark Brantley said: "About 10 years ago we discovered that we have geothermal energy here. It has taken a while but we are now at a stage where all the exploration work has been done and we have been assured that geothermal goes live in December of 2017. What that means is that when that plant switches on in December of 2017, fully 100 per cent of Nevis' electricity will be

supplied by renewables. Nowhere else in the world can boast that and so it will make us the greenest place on planet earth. That's the new tagline – the greenest place on planet earth."

The Nevis project is developed by Nevis Renewable Energy International (NREI, which is an affiliate of Texas based Thermal Energy Partners LLC (TEP). NREI said in late March that the Italian company Turboden has been selected through a competitive bid process, to provide ORC turbines and to serve as the engineering, procurement and construction (EPC) contractor for its 9 MW geothermal project in Nevis. As the equipment provider and the lead company providing EPC services, Turboden will provide high efficiency binary cycle generation equipment that maximizes the available energy from the Nevis geothermal reservoir, informed NREI.

Sources: http://www.caribbean360.com/news/nevis-has-a-date-with-geothermal-energy#ixzz3yV3mUbEC, http://antiguaobserver.com/nevis-envisages-selling-power-to-antigua-barbuda/, http://www.thinkgeoenergy.com/nevis-geothermal-project-chooses-turbine-supplier-and-epc-contractor/?utm_source=ThinkGeoEnergy+List&utm_campaign=e7f265fafe-TGE_Newsletter_RSS1_12_2015&utm_medium=email&utm_term=0_657e42f767-e7f265fafe-415210497

**Loan to Construct a 15 MW Power Plant -** The Abu Dhabi Fund for Development (ADFD) will loan St. Vincent and the Grenadines Dh55 million (US$15 million) to install a geothermal power station in this volcanic island country. Working with the International Renewable Energy Agency (IRENA), the project is being funded as part of the Dh1.285 billion (US$350 million) project facility, set up in 2012 to provide finance for renewable energy projects in developing IRENA member countries. The geothermal power plant is planned to generate 15 MW. When finished, the plant will cut the cost of electricity generation by 25 per cent, and make the grid more resilient to power cuts.

St. Vincent Prime Minister Ralph Gonsalves said: "The proposed geothermal power plant will give a strong boost to the energy sector in our country, supporting its economic growth and development programs." As a volcanic island, geothermal energy is in abundance in the Caribbean country and the project will help drive the wider energy sector and help support sustainable economic development across the country's 32 islands.

"ADFD has paid particular attention to the renewable energy sector, given the essential role of the sustainable energy in meeting the growing needs of developing countries, and supporting their social and economic development," said Mohammed Al Suwaidi, director general of ADFD. He added that despite the potential of renewable energy in sustainable development across the world, funding for costly sustainable projects remains one of the biggest barriers to enabling universal energy access.

Source:
http://www.thenational.ae/uae/environment/abu-dhabis-dh55m-loan-to-st-vincent-for-geothermal-power

## Chile: Generators for Cerro Pabellón Are under Construction in England

Located on an Andean plateau 4500 m above sea level in the north of Chile at Cerro Pabellón, the first geothermal plant in South America is under construction following a US$320 million investment, financed through resources provided by Enel Green Power. Cerro Pabellón is thought to be the first binary geothermal plant in the world to be built at such a high altitude. It is due to be completed in 2017.

Brush, an English manufacturer of power generation equipment including turbogenerators and switchgear, based in Loughborough, England, is supplying the generators for the Cerro Pabellón project. They are two specially-modified, 27.6 MW, four-pole, 1500 rpm generators to the site with a rated voltage of 9500 V and a power output of 32,471 kVA. The generators will be powered by 15 MW turbines and have been designed to withstand the challenges presented by extracting geothermal energy in high altitude conditions.

Brush said its generators are suitable for corrosive environments and are extra protected against hydrogen sulfide ($H_2S$) and sulfur dioxide ($SO_2$), which pose a substantial operational hazard. The company said its four-pole generators have specialist anti-corrosive paint layers to protect against long-term damage.

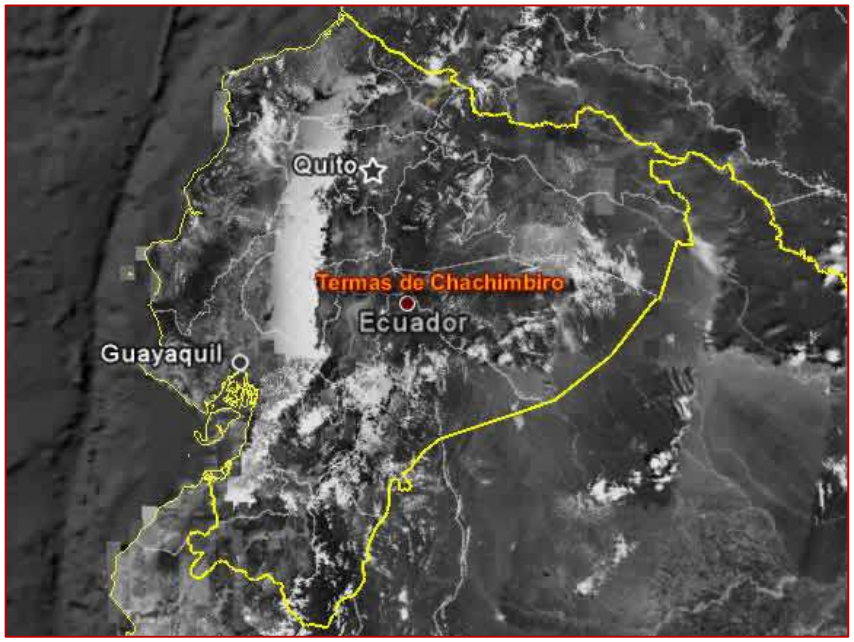
*A Brush generator for Cerro Pabellón. Photo by Brush.*

Brush, also informed that at high altitudes the air is much thinner. Due to this effect, all high voltage electrical clearances need to be much greater to reduce the potential for any damaging partial discharge activity in the stator windings. Erwin van Campen, project manager for Brush, said, "Because of the pressures put on the electrical insulation at 4500 m, we have de-rated the voltage of the generators from the usual 13.8 to 9.5 kV to counteract any potential energy-loss scenarios… We also had to re-evaluate our approach to cooling the generators due to the thinner air that circulates inside the cooling circuit. However, at such heights ambient temperatures can reach extremes of -31°C, which poses significant challenges…"

Van Campean concluded, "Cerro Pabellón is not only pushing the boundaries of geothermal energy, it is testing the limits of generator capacity in the harshest of climates."

Source: http://www.dieselgasturbine.com/March-2016/Unlocking-The-Power-Of-Geothermal-Energy/#.VvtOjuJ9601

## Ecuador: Pre-feasibility Study at the Chachimbiro Geothermal Project




In April, Ecuador will launch a detailed pre-feasibility study at the Chachimbiro geothermal project funded by a US$7 million grant from the Japan International Cooperation Agency (JICA). The project is located in Urcuqui, Imbabura province (*see* IGA News No. 102, pp. 12-136). The study will be conducted by the state-owned power company Corporación Eléctrica del Ecuador (Celec), through its Termopichincha unit. Chachimbiro is part of the Ecuadorian-Japanese cooperation in renewable energy and energy efficiency amounting to almost US$20 million.

Source: http://renewables.seenews.com/news/to-the-point-japan-supports-new-geothermal-studies-in-ecuador-513662

## El Salvador: Expectations to Increase the Share of Geothermal to 40% by 2019

The Government of El Salvador has announced its ambition to raise the share of geothermal energy in the country's electricity supply by 15%. According to the plans, geothermal energy would represent a 40% share in the energy mix, so said Eugenio Chicas, the Secretary of Communications of the Presidency of El Salvador.

In a statement, he indicated that these plans are part of a "best effort" that seeks to change the energy supply of El Salvador to renewable energy sources. There were no comments on any possible investment or how many geothermal projects would be developed and who would help achieve the objective for geothermal energy development.

"The expectation is that at the end of the mandate we will depend 40% on geothermal energy, but also to grow even more in hydropower," said the Government's spokesman, adding that "also is betting on energy production based on gas, solar and wind power."

He explained that this transition will help improve the economic dynamics "that the country has begun to walk" which, he said, has led to a growth rate between 2.4% and 2.6% in 2015.

Source: http://www.thinkgeoenergy.com/el-salvador-plans-to-reach-a-40-share-of-geothermal-in-energy-mix-by-2019/?utm_source=ThinkGeoEnergy+List&utm_campaign=d70cf9da42-TGE_Newsletter_RSS1_12_2015&utm_medium=email&utm_term=0_657e42f767-d70cf9da42-415210497

In other news, the Transactions Unit (Unidad de Transacciones), in charge of managing the transmission grid and the wholesale electricity market of El Salvador, informed that geothermal energy produced 22% of the total power generated in the country in 2015, which was 6310.4 GWh. In other words, geothermal power plants produced around 1380 GWh, being the main source of renewable energy.

Source: http://www.laprensagrafica.com/2016/02/01/demanda-de-energia-crecio-4-en-2015

## Honduras: Construction at Platanares Begins

Ormat Technologies, Inc. announced in January that its indirect, wholly-owned subsidiary has commenced construction of the 35 MW Platanares geothermal project. The project was acquired by Ormat in December 2013 via a Build, Operate, and Transfer (BOT) contract with ELCOSA, for approximately 15 years from the commercial operation date (COD). In December 2015, Ormat concluded the drilling activity as well as extensive tests that support the decision to construct a 35 MW project, which is larger than initially estimated.

Geotérmica Platanares will sell its power, mainly under 30-year power purchase agreements with the national utility of Honduras, ENEE. The project expects to reach commercial operation by the end of 2017 and generate an average annual revenue of approximately US$33 million. Isaac Angel, Ormat's Chief Executive Officer stated that "Following a prudent process of field assessment and development, and in line with our continued focus on plant optimization, we were able to increase the projected capacity of the Platanares plant to 35 MW and improve the expected returns… The Platanares project will be the first geothermal project in Honduras and will further expand Ormat's global presence."

The Platanares geothermal project is regulated by the Law to Promote the Generation of Electric Energy by Renewable Resources, which was enacted in 2007. Under this law, the project may benefits from an income tax exemption during the first 10 years of operation.

Source: http://www.ormat.com/news/latest-items/ormat-announces-start-construction-35-mw-platanares-geothermal-project-honduras

## México: In Memoriam Víctor Manuel Arellano Gómez (19.09.1955 – 30.01.2016)

### *Eduardo R. Iglesias, IGA Information Committe*

Víctor Manuel Arellano Gómez, Manager of the Geothermal Department of the Instituto de Investigaciones Eléctricas (IIE), Full Member of the National Academy of Engineering (Mexico), Member of the Mexican National System of Researchers and outstanding researcher in the fields of geothermal reservoir engineering, geochemistry and software development for geothermal applications passed away on 30 January 2016.

Víctor graduated from Mexico's Universidad Autónoma Metropolitana (UAM) as Energy Engineer in 1978 and joined the Geothermal Department of IIE (the Mexican Electrical Research Institute, where he started his long career in geothermal engineering. He had training in reservoir engineering at Stanford University in 1980 and in reservoir simulation at Intercomp (Houston, USA) in1981-82.

A great deal of his work focused on developing mathematical models and other techniques for reliable characterization, evaluation and monitoring the evolution of geothermal reservoirs. His work included studies on the Los Azufres, Cerro Prieto, Las Tres Vírgenes and Los Humeros Mexican geothermal fields, as well as in the Chipilapa (El Salvador), Macizo Volcánico del Ruiz (Colombia) and Platanares (Honduras) fields. In 1992, he was promoted to Manager of the Geothermal Department, a job he held successfully until his untimely death. His tenure was characterized by his affability, optimism and contributions to the development of geothermal energy in Mexico.

In 1987, he received a Master's Degree in Engineering with mention of honor from the Universidad Autónoma del Estado de Morelos, developing (under my supervision) the first expert system in the world

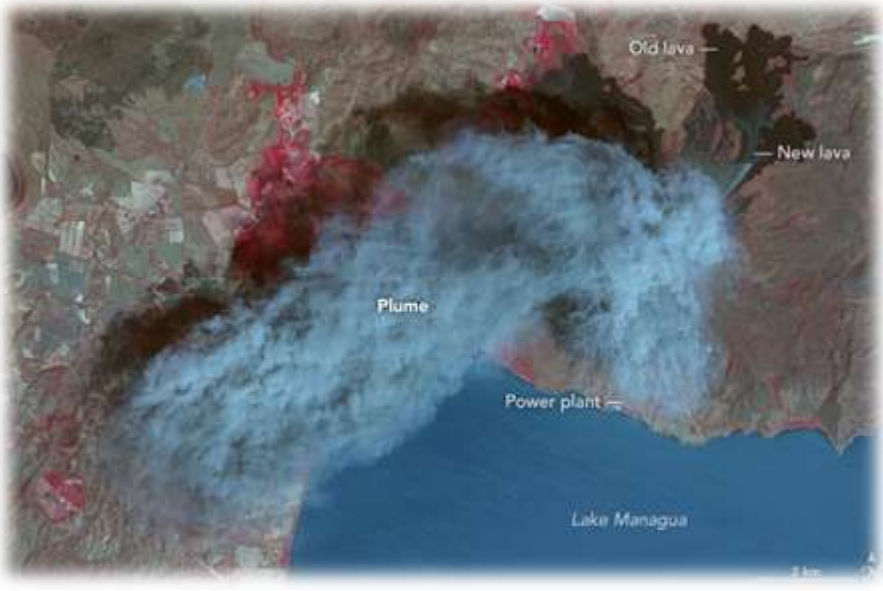
(ANAPRESS) to automatically analyze pressure tests in wells.

Víctor was a founding member of the Mexican Geothermal Association (AGM) created in 1992, was its President during the 1994-1995 period and remained an active member until the end. He received the 2012 Pathé Distinction, the more important recognition in Mexico from the AGM. He was also a veteran member of the International Geothermal Association. Víctor was a member of editorial board of *Geothermics* (1994-1997); he was recognized by Renewable Energy Global Innovations in 2011 when he developed an original methodology to study the response to exploitation of geothermal reservoirs. Among his other many recognitions, he received Best Paper Award from the Geothermal Resources Council (2006 and 2007). He had more than 200 publications on geothermal energy, including articles, proceedings, book chapters and reports. He also gave training in geothermal energy in Mexico and abroad.

Victor is survived by his wife, Dr. Rosa María Barragán Reyes, a well-known geothermalist and former member of the IGA Board of Directors (2004-2010). Rest in peace Víctor, his many friends and colleagues will miss him. A website in his honor can be found at: www.victorarellanogomez.org.mx.

## Nicaragua: Eruption of the Momotombo Volcano

The Momotombo volcano began erupting in December, for the first time in a hundred years, throwing gas and ash into the air. The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) recently passed overhead and took an incredible picture of the volcano. The image clearly shows how lava flows in the community of El Papalonal came near the 22 MW Momotombo geothermal plant to the SW of the volcano owned by Empresa Nicaraguense de Electricidad (ENEL). Momotombo is an iconic stratovolcano in Nicaragua, and is located near Leon, the country's second-largest city. Notable eruptions have forced evacuations in the past; e.g., the city had to be moved 30 miles away in 1610 following a major eruption and its remains, León Viejo, is now a World Heritage Site.




Source: http://www.gizmodo.in/science/Nicaraguas-Momotombo-Volcano-Is-Glorious-In-False-Color-Satellite-Imagery/articleshow/51283578.cms

## US: Ormat's Projects, Generation in California and Climate Plan on Hold

**Ormat to Add up to 190 MW of Geothermal Capacity to its Portfolio by 2018 -** Nevada-based Ormat Technologies plans to add between 160 MW and 190 MW of geothermal generation capacity globally to its portfolio by the end of 2018, Ormat CEO Isaac Angel said on late February. Of that total, 21 MW will be added this year from the 7 MW expansion of the Bouillante facility in Guadeloupe and completion of the 14 MW first phase at the Sarulla project in Indonesia. The company's expansion plans will include bringing new plants online, expanding existing plants and adding capacity through acquisition. Angel said Ormat has begun development efforts at two U.S. projects in Nevada —Tungsten Mountain and Dixie Meadows. Each project should have an installed capacity of 25 to 35 MW when complete. He added that the company plans to complete construction of Tungsten Mountain in 2017 and Dixie Meadows in 2018. It has drilled several exploration wells and is currently working to secure power purchase agreements for both facilities.

With respect to the Bouillante power plant, in mid March Ormat announced that it has signed an Investment Agreement and Shareholders Agreement with Sageos holding, a fully owned subsidiary of Bureau de Recherches Géologiques et Minières (BRGM), the French governmental geological survey, to gradually acquire 85% of Geothermie Bouillante SA. This company owns and operates the Bouillante geothermal power plant that currently generates approximately 10 MW, and owns two exploration licenses with a total additional potential capacity of up to 30 MW, all located in Guadeloupe Island, a French territory in the Caribbean. Ormat expects to optimize the use of the resource at the

existing facilities and recover its current production to its design capacity of 14.75 MW by mid-2017. Additionally, Ormat plans modifications to the existing equipment, as well as to further develop the asset with a potential of reaching 45 MW in phased development, by 2021. Under the Investment Agreement, Ormat will pay Sageos an additional amount of up to €16 million (US$17.8 million) subject to the achievement of agreed production thresholds and capacity expansion within a defined timeframe.

Sources:
http://www.renewableenergyworld.com/articles/2016/02/ormat-to-add-up-to-190-mw-of-geothermal-capacity-to-portfolio-by-2018.html,
http://www.ormat.com/news/latest-items/ormat-signs-definitive-agreements-acquire-geothermal-power-plant-island-guadeloupe

**Good Start for Geothermal in California -** On 3 January 2016, geothermal energy was the biggest provider of electricity from renewable sources to the California Independent System Operator (CAISO) grid, with over 26,000 MWh (see the attached graph). Solar energy (PV and thermal) peaked at noon and supplied 21,079 MWh. Wind provided 17,555 MWh.

**24-Hour Renewables Production**

| Renewable Resources | Peak Production Time | Peak Production (MW) | Daily Production (MWh) |
|---|---|---|---|
| Solar Thermal | 0:00 | 0 | 0 |
| Solar | 11:24 | 3,758 | 21,079 |
| Wind | 12:02 | 1,400 | 17,555 |
| Small Hydro | 18:43 | 313 | 4,182 |
| Biogas | 16:36 | 202 | 4,763 |
| Biomass | 7:08 | 261 | 5,812 |
| Geothermal | 16:00 | 1,096 | 26,201 |
| **Total Renewables** | | | **79,591** |
| *Total 24-Hour System Demand (MWh):* | | | *551,871* |

Geothermal energy in California supplies a steady average of about 1000 MW, 24 hours a day, 365 days a year. On 3 January the hour-average was 1091.7 MW and the peak was 1096 MW. Taking into account that renewables supplied 14.4% of the total electric demand that day, geothermal represented 4.74% of that total in the region operated by CAISO.

Source:
http://geothermalresourcescouncil.blogspot.mx/2016/01/usa-california-geothermal-is-1.html?utm_source=feedburner&utm_medium=email&utm_campaign=Feed:+GlobalGeothermalNews+(Global+Geothermal+News)

**The Supreme Court Puts Obama's Clean Power Plan on Hold -** A divided US Supreme Court agreed to halt enforcement of President Barack Obama's sweeping plan to address climate change (see IGA News 102, pp. 13-14) until after legal challenges are resolved. The surprising move is a blow to the administration and a victory for the coalition of 27 mostly Republican-led states and industry opponents that call the regulations "an unprecedented power grab."

By temporarily freezing the rule the high court's order signals that opponents have made a strong argument against the plan, which aims to stave off the worst predicted impacts of climate change by reducing carbon dioxide emissions at existing power plants by about one-third by 2030. A federal appeals court last month refused to put it on hold.

The appeals court is not likely to issue a ruling on the plan until months after it hears oral arguments begin on 2nd June. But any decision likely would be appealed to the Supreme Court, meaning resolution of the legal fight is not likely to happen until Obama leaves office.

Compliance with the new rules is not required until 2022, but states must submit their plans to the Environmental Protection Administration (EPA) by September or seek an extension. Implementation of the rules is considered essential to the US meeting emission-reduction targets in a global climate agreement signed in Paris in December 2015. The Obama administration and environmental groups also say the plan will spur new clean-energy jobs.

The US is still on course to sign the Paris agreement in a New York ceremony organized by UN secretary-general Ban Ki-moon this April, the White House has signaled. And its emissions target of at least a 26% cut on 2005 levels by 2025 may be conservative, environmentalists argue. The US could reach the Clean Power Plan's 2030 target five years in advance as coal power stations are retired in greater numbers.

Sources:
http://www.pennenergy.com/articles/pennenergy/2016/02/supreme-court-puts-obama-s-clean-power-plan-on-hold.html?cmpid=EnlDailyPowerFebruary102016&eid=291021978&bid=1306429,

http://www.climatechangenews.com/2016/02/12/us-green-groups-this-is-not-kyoto-mark-two/

**250 MW Geothermal Project Could Be Developed in the Salton Sea –** California'a Imperial Irrigation District (IID) recently approved a 1900-acre (526 hectares) lease for the Australian company Controlled Thermal Resources to develop a 250 MW geothermal plant in one of the state's most geothermal-rich areas, the Salton Sea. The project will help California to meet

the new 50% renewables-by-2050 mandate by bringing down costs through economies of scale and delivering price-competitiveness baseload generation, necessary to balance the intermittency of renewables.

The project has still a few hurdles ahead of it, such as securing a buyer for its electrical output and garnering approval by the California Energy Commission. The developer will pay IID about US$40,000 per year for the next three years, about $200,000 per year after construction begins and royalties on its electrical output. The Salton Sea area already hosts 11 small geothermal plants, but the geothermal development is estimated to have 1.05 to 1.81 GW of generation capacity by 2030, according to a recent study from the National Renewable Energy Laboratory (NREL).

Source: http://www.utilitydive.com/news/australian-company-unveils-major-250-mw-geothermal-project-in-californias/415798/

**Formal Inauguration of Hybrid Plant in Nevada -** Italian Prime Minister Matteo Renzi, Enel CEO Francesco Starace, Enel Green Power CEO Francesco Venturini and Nevada Governor Brian Sandoval, attended on late March the inauguration of Enel Green Power's Stillwater renewable hybrid facility in Fallon, Nevada. Stillwater is the world's first power plant to combine medium enthalpy, binary cycle geothermal, solar thermal and solar photovoltaic technologies at the same site. The Director of the National Renewable Energy Laboratory (NREL), Dr. Martin Keller, US Senator Dean Heller, US Representative Mark Amodei and other US national, state and local dignitaries also attended the event.

By combining generation technologies of different profiles at one production site, energy availability is increased and energy intermittency reduced. Geothermal and solar (thermal and photovoltaic) are complementary, meaning that production from solar is higher during the sunniest and hottest days of the year, when the thermal efficiency of the geothermal plant is lower. In addition, research findings between March and December 2015 confirm that the combination of 2 MW of a solar thermal facility with 33.1 MW of the geothermal plant increased overall output at Stillwater by 3.6% compared with production from geothermal only.

The Stillwater plant began operation in 2009 with the completion of the geothermal plant. Since then, the site has served as a hub of innovation for EGP. In 2012, the company added a 26.4 MW solar PV unit to the geothermal plant –at the time one of the largest PV systems of its kind in the United States. In 2015, the company developed a solar thermal system to operate in conjunction with the existing Stillwater geothermal power station.

*Stillwater hybrid geothermal-solar plant (source: EGP).*

Source: http://www.thinkgeoenergy.com/italian-prime-minister-inaugurates-geothermal-solar-hybrid-plant-in-nevada/?utm_source=ThinkGeoEnergy+List&utm_campaign=3ea41e220d-TGE_Newsletter_RSS1_12_2015&utm_medium=email&utm_term=0_657e42f767-3ea41e220d-415210497

# ASIA/PACIFIC RIM

## India: The Government to Invest in Kenya's Geothermal Projects

The Government of India is planning to invest US$200 million in geothermal power production in Kenya's Nakuru and Baringo counties through the Line Credit Initiative, one of the Government of India development assistance instruments.

During a recent visit to Nakuru County, Suchitra Durai, India High Commissioner to Kenya talked about India's investments in many projects in Africa. "GDC (the state-owned Geothermal Development Company) has geothermal projects in Suswa (Nakuru) and Baringo (Silali-Bogoria), we are planning to invest in this and we are at the moment in discussions with GDC. Studies have been done by Indian companies and these have been examined by our Ministry of External Affairs in New Delhi. There were some clarifications that we wanted and that is why I have come to see the projects in Menengai and Olkaria geothermal complexes', said Suchitra. She added they have been in discussion with GDC for more than a year and now that the Indian Prime Minister Narendra Modi has announced a line of credit for projects all over Africa they would like to take

it forwards as they would like Kenya to benefit with some projects.

The high commissioner also noted that through the Indian Technical and Economic Cooperation Program they have 250 capacity building courses for government employees and asked the County Government of Nakuru employees to take advantage of them. These courses are in numerous fields, and take three weeks to six months and are fully funded by the Indian Government, each year Kenya is given 75-100 slots.

The acting managing director and chief executive GDC Paul Ngugi said the financing by the Indian Government will facilitate drilling in Suswa and Silali-Bogoria. "The financing will mainly provide drilling materials such as casings, rock bits and valves for well head equipment. Part of Suswa is in Nakuru and Silali-Bogoria is in Baringo County', said Ngugi.

Regarding direct geothermal uses at Menengai Geothermal Complex, Ngugi mentioned that soon GDC will seek the cooperation of the County Government of Nakuru in the creation of industrial parks as they are better suited to utilize opportunities available from steam direct use. Also GDC is seeking partnerships with local communities because using of steam to heat fish ponds and greenhouses can be applied by people on the ground.

Source:
http://www.hivisasa.com/nakuru/business/116251

## Indonesia: Recent Developments, Prices, Probable New Company and Cooperation Activities

**More Than 1700 MW to Be Added in 2016-2019 -** According to the Indonesian Ministry of Energy and Mineral Resources (MEMR), 1716 MW of geothermal power will be added to the grid between 2016 and 2019:

| Year | Project Name (and capacity in MW) |
|---|---|
| **2016** | Lumut Balai (55), Karaha (30), Sarulla (114), Lahendong (20), and Ulubelu (55). Total: 274 |
| **2017** | Ulubelu (55), Sarulla (118.5), Lahendong (20), and Liki Pinawangan Muaralaboh (70). Total: 263.5 |
| **2018** | Sarulla (118.5), Lumut Balai (55), Hululais (55), Tulehu (20), Rantau Dedap (220), Gn. Rajabasa (110) and Dieng (55). Total: 633.5. |
| **2019** | Gn. Rajabasa (165), Dieng (165), Karaha (60), Cisolok-Cisukarame (45) and Pangalengan (110). Total: 545 |

The MEMR explained that "Geothermal development within the next five years will be focused on the development of geothermal potency having a high enthalpy, while geothermal potency having a medium-low enthalpy will be developed within the next 10 years and also the small scale geothermal development."

If all of those new projects are installed as planned, geothermal power in Indonesia will be doubled in just four years, from the current 1438.5 MW reported by the end of 2015. The Government faces several challenges, and the MEMR will develop five strategic steps for regulation production bonus, direct and in-direct utilization, among other issues. The Government will develop Geothermal Opened Areas through Geothermal Preliminary Survey Assignments (PSP) or Preliminary Survey Assignments plus Exploration (PSPE) and the Policy on Geothermal electricity sale prices by using Feed-in Tariffs (FIT) and State Capital Participation (PMN) in geothermal projects.

In addition, the Government of Indonesia will offer 21 geothermal blocks to investors over the next two years. Combined these 21 blocks, which are estimated to require US$4.2 billion in investment, have a power generation capacity of 1065 MW. An official of Indonesia's MEMR said that 16 blocks will be offered through an open auction, eight in 2016 and eight in 2017. For the remaining five geothermal blocks the Government will select the operator (a state-owned company) through direct appointment. Most likely the Government will appoint Pertamina Geothermal Energy (PGE), subsidiary of energy company Pertamina, to operate these blocks. The first open auction is reported in the next note.

Sources: http://www.esdm.go.id/index-en/50-geothermal/8070-the-government-targeted-pltp-installed-capacity-for-1751-mw-for-five-years.html, http://www.indonesia-investments.com/news/todays-headlines/government-of-indonesia-to-auction-geothermal-power-blocks/item6391

**Government Assigns 11 Geothermal Work Areas -** The Ministry of Energy and Mineral Resources will assign state-owned enterprises (SOEs) to manage 11 geothermal working areas this year. "A number of SOEs have submitted their applications," said Saefulhak Yunus, director of geothermal energy. According to Yunus, Pertamina is proposing to work on five geothermal areas, PLN applies for four work areas, while PT Geo Dipa Energi (Persero) asks for two. The Energy Ministry has not revealed which 11 geothermal working will be assigned to the three SOEs, because is still reviewing their proposals. The government's plan to assign SOEs to manage the 11 geothermal working areas is part of the Energy Ministry's target to offer 27 geothermal areas with a total capacity of 1535 MW until 2017. The paperwork for the management of the other

16 work areas is being prepared. Of the 27 work areas offered, five have been offered to the public.

Source:
http://en.tempo.co/read/news/2016/04/01/056758955/Govt-Assigns-11-Geothermal-Work-Areas-to-SOEs

*Photo: Reuters Photo/Beawiharta.*

**Solved Disagreement over Geothermal Steam Pricing -** Issues have arisen over an attempted negotiation for steam price sales between Pertamina Geothermal Energy (PGE), the geothermal division of Indonesian state energy firm Pertamina, and the electricity firm Perusahaan Listrik Negara (PLN). PGE was prepared to cease sales of steam for the Kamojang geothermal power plant in West Java after the two parties failed to agree on a lower steam price.

The disagreement casts a negative light on the future of geothermal development in Indonesia, whose competitiveness is in peril due to constantly low global oil and coal prices. PGE officials stated that they need a fair price to make investing in geothermal projects worthwhile. There is a struggle to balance the price for customers with the need for sufficient funding.

Fortunately, after intervention of the State-Owned Enterprise (SOE) Minister Rini Soemarno, PLN and PGE reached an agreement in renewing their power purchase deal for electricity from the Kamojang and Lahendong plants. PLN has agreed to purchase steam for its Kamojang 1, 2 and 3 plants in West Java, at six cents per kW/h and purchase power at 9.4 cents per kWh for the Kamojang 4 plant. The utility firm will buy at six cents per kWh for Lahendong in North Sulawesi. The prices have lowered since the previous contracts, but are significantly higher than PLN offered.

Kamojang and Lahendong plants have a combined capacity of 300 MW, accounting for 20 percent of Indonesia's current geothermal production capacity.

The eight new contracts were officially signed in a ceremony on 12 February in the presence of Vice President Jusuf Kalla and Energy and Mineral Resources Minister Sudirman Said. The signatories include President Director of PT Pertamina Geothermal Energy Irfan Zainuddin, President Director of PT PLN (Persero) Sofyan Basir, President Director of PT Indonesia Power Antonius Resep Tyas, President Director of PT Supreme Energy Muara Laboh Supramu Santosa, and President Director of Star Energy Geothermal Wayang Windu Ltd Rudy Suparman.

Sources:
http://jakartaglobe.beritasatu.com/business/pln-pge-solve-geothermal-quarrel-govt-intervention/,
http://www.antaranews.com/en/news/103074/eight-contracts-signed-for-geothermal-power-and-steam-prices, GEA Weekly No. 50.

**Government to Set Up Company to Use Renewable Energy Only -** The Government plans to establish an electricity company that would use only renewable power sources, in an effort to boost the development of renewable energy, Indonesian Energy and Mineral Resources Minister Sudirman Said said in Jakarta in early January. The minister mentioned that the accelerated development of renewable energy would contribute to the country's energy security in the long run. According to the minister, the Government is preparing policies, funding, technology and human resources capacity building to accelerate renewable energy development. He added: "Such a company would bridge [state electricity firm] PLN's limitations in terms of upstream development budget and it could support the Government's ambitious target of achieving a national energy mix with renewable energy."

Since the beginning of 2015, Sudirman said, the Government had made various efforts to boost renewable energy development, as covered in Law No. 30/2007 on energy and Government Regulation No. 79 /2014 on National Energy Policy (KEN). KEN has targeted the portion of renewable energy in the national mix to hit 23 percent by 2025, almost four times the achievement so far. "That's why renewable energy development is certain," he told. To achieve 25 percent renewable energy from 35,000 MW power plants, equivalent to 8750 MW in the next four years, several power plants have been built.

Source:
http://www.thejakartapost.com/news/2016/01/07/govt-set-renewable-only-power-firm.html#sthash.nUMbIIpu.dpuf

**Pertamina-BPPT Teaming up to Build Geothermal Power Plant –** The Kamojang Unit of PT Pertamina Geothermal Energy is cooperating with the Technological Study and Application Center (BPPT) in

an experiment to build a geothermal power plant with a capacity of 3 MW. BPPT designed the plant, and the components are produced by PT Nusantara Turbin & Propulsi (NTP), PT Barata Indonesia, and PT Pindad. Under the cooperation scheme, the Kamojang unit of PGE will supply geothermal steam to the mini generating plant that is being built and to be operated by BPPT. It is located in the working area of the Kamojang power plant; trial operations are planned for May.

The Kamojang geothermal field that Pertamina has operated since 1983 holds one of the world's best geothermal reserves in quality. The reservoir produces dry geothermal steam, which can enter the turbine directly without the need of chemical treatment. Currently the Kamojang Unit of PGE has two units; i.e., Unit 4 (60 MW) and Unit 5 (35 MW). There are other three units operated by PT Indonesia Power, and so the field has an installed capacity of 235 MW.

BPPT is also cooperating with the PGE's Lahendong Unit in North Sulawesi, with a 0.5 MW binary plant. Abadi Purnomo, Chairman of the Indonesia Geothermal Association, said the cooperation between PGE and BPPT is very positive to promote technological mastery. BPPT and PGE began cooperation in Kamojang in 2010.

Source: http://en.republika.co.id/berita/en/jakarta-region-others/16/02/21/o2w4ak317-pertaminabppt-teaming-up-to-build-geothermal-power-plant

## Japan: Starts Construction of a New Binary Power Plant

Idemitsu Kosan Co., Ltd. has begun construction of a 5 MW binary power plant at the Takigami (Geothermal) Office of its wholly owned subsidiary Idemitsu Oita Geothermal Co., Ltd. Since the start of operation of the Geothermal Power Station of Kyushu Electric Power Company, Inc., the Takigami Office has supplied steam used to generate a power equivalent of 25 MW. Since then, it has contributed to the maintenance of one of the top utilization rates in Japan for 19 years, including adaptation to Kyushu Electric's 27.5 MW output expansion in June 2010.

Presently, it has begun the construction of a binary power plant on the same site, scheduled to be commissioned in March 2017. After its completion, this will be one of the largest binary power plants in Japan, with a generating capacity of 5050 kW.

Source:
http://www.idemitsu.com/company/news/2015/160301.html


*Conceptual drawing of completed facility. Source: Idemitsu.*

## Pakistan: Huge Geothermal Potential

According to Pakistani scientist Javed Ahmad, the geothermal potential of Pakistan could be up to 100 GW, and the prices of geothermal electricity could be as low as 5-10 US$ cents per kWh, depending upon the location of the power plants. He claims that the US has offered Pakistan US$7-8 billion for equipment to explore and exploit those geothermal resources. The funding would become available to all four federating units of the country. Pakistan's Minister for Water and Power, Khawaja Muhammad Asif, has included geothermal energy in the policy for development of renewable energy for power generation. This decision will unfold a series of opportunities for investors to exploit the geothermal resources in the country for electricity production.

Javed Ahmad also mentioned that: "US experts have acknowledged my research according to which the presence of hot water and steam, springs, fumaroles and geysers have been found in the Northern Himalayas". Field surveys identified mud volcanoes and hot geothermal fluids in Balochistan province and dormant volcanoes, 150°C magmatic waters in the Chagai volcanic Arc in the same province. The research has also pinpointed hydrocarbon basins in Sinch where co-produced geothermal waters have 80-170°C temperatures. In addition, there are some 300 dry, depleted and abandoned oil and gas wells, which can be used for geothermal energy development.

Source:
http://www.thenews.com.pk/print/107521-Pak-geothermal-energy-resources-can-generate-100000MW-power

## Philippines: Mabini, Maibarara, Transmission Line and Low Enthalpy Project

**Development of the Mabini Project -** Drilling will start in the Mabini geothermal project, Batangas province in next May, said an official of the Basic Energy Corp. This company and partners Trans-Asia Oil and Energy Development Corp. signed a joint operating agreement for the Mabini geothermal power project in November 2015, after the approval by the Energy Department of the deed of assignment for the Mabini geothermal service contract number 8 of Basic Energy to Trans-Asia. Basic Energy now owns 75 percent of the service contract, while Trans-Asia holds the remaining 25 percent. The approved arrangement calls for a 75-25 equity and project cost participation between Basic Energy and Trans-Asia. According to previous prospective estimates, the project could generate between 20 and 60 MW.

Source:
http://thestandard.com.ph/business/196055/basic-energy-to-start-geothermal-drilling-in-batangas.html

*Discharge of the first well, Mai6D on Maibarara project site (source: Maibarara Geothermal Inc.; taken from ThinkGeoEnergy).*

**Expansion of the Maibarara Project -** Maibarara Geothermal Inc. said it started the 12 MW geothermal power plant expansion in Batangas province, as it prepares for full commercial operation in 2017. The company operates the existing 20 MW Maibarara geothermal power project in Sto. Tomas, under a joint venture with Trans-Asia Oil and Energy Development Corp. and PNOC Renewables Corp. The Energy Department awarded the Maibarara service contract in February 2010 following an open and competitive selection process in October 2009. It became the newest geothermal power facility in the country and the first under the President Aquino Administration, when it started commercial operation on February 8, 2014. The Maibarara expansion project involves the installation of a new 12 MW unit adjacent to the existing 20 MW Maibarara-1 geothermal project and is expected to add at least 95,000 MWh to the plant's annual generation.

Francisco Delfin Jr., Maibarara Geothermal President, said: "We opted to increase Maibarara-2's gross capacity from 10 MW to 12 MW after the successful flow-test of well MB-15RD and the release of an independent resource validation by California-based Geothermal Science, Inc., which confirmed more than sufficient reserves for combined M1 and M2 power generation for 25 years". He added: "We aim for M2 unit to be on-line by the third quarter of 2017".

Source:
http://thestandard.com.ph/business/195778/maibarara-expands-geothermal-project.html

**EDC Seeks Approval for Transmission Line -** Energy Development Corp. (EDC) is seeking regulatory approval to construct a P130-million (US$2.54 million) facility that will connect the Bac-Man 3 geothermal expansion project to the Luzon grid. The EDC's 31 MW Bac-Man 3 geothermal power plant in Sorsogon province is expected to be operational by December 2017. Once on line, it would help satisfy Luzon's the increasing energy demand. In order to supply the energy to be generated by the Bac-Man 3 project to the public, EDC must connect the plant to the Luzon grid. For this purpose, the EDC intends to construct a connection asset for its exclusive use, which shall connect the plant directly to the Palayan Bayan switchyard.

The proposed interconnection project consists of a 230-kilovolt (kV) connection asset, composed of transmission wires, steel towers, steel poles and other related facilities. EDC is asking that "the commission provisionally authorize the development, ownership and operation of the connection project, considering that the impending power crisis projected by the DOE warrants the issuance of a provisional authority," according to its 13-page application.

The Bac-Man 3 project costs P7.6 billion (US$160.6 million). EDC said it has sufficient funds on hand to undertake the project, including the interconnection project. In September 2015, EDC signed a design and equipment supply contract with Hyundai Engineering Co. Ltd. and a construction services contract with Galing Power and Energy Construction Co. Inc., for the engineering, procurement and construction of the Bac-Man 3.

Source: http://www.businessmirror.com.ph/edc-awaits-erc-okay-to-build-p130-million-facility-to-connect-geothermal-project-to-luzon-grid-2/

**Low Enthalpy Geothermal Project in Camiguin -** A Low Enthalpy Geothermal Project (LEGP) will be undertaken in the island province of Camiguin, which is known for its seven volcanoes and several volcanic domes. Using binary technology and other direct-use applications, the LEGP could produce enough to provide electric power to the more than 100,000 inhabitants of the province. The geothermal resource was discovered by officials and technicians of the Renewable Energy Management Bureau (REMB) of the Department of Energy (DOE).

The Department's officials identified Camiguin as one of the potential areas for locally funded LEGPs. The DOE-REMB will check the rock types, structures, volcanic history and geohydrology of Camiguin through imageries interpretation and geological surveys, including measurements of temperature and chemistry of the underground reservoir fluids from the water and gas samples. DOE envisions to formulate policy and guidelines for the development of low-to-medium enthalpy geothermal energy resources for small-scale power generation, agro-industrial and direct application. The agency also plans to offer potential geothermal areas to investors for energy exploration, development, and utilization

Source: http://www.mb.com.ph/geothermal-plant-to-provide-ample-electricity-in-camiguin/#QPBL3I8Qe19CYFwT.99

# EUROPE

## England: Probable EGS Project in Cornwall

The cabinet of the Cornwall Council has agreed to invest £1.5 million (US$2.12 million) into geothermal hot rocks energy, to unlock cash from the EU. Councilors backed a report that says the cash is needed to unlock more money from the European Union. The report says a geothermal project generating 15 MW could power 25,000 homes and create up to 260 jobs. Knowledge of the resource dates back more than 40 years to the Camborne School of Mines Hot Dry Rocks project at Rosemanowes Quarry, between Falmouth and Helston. The Eden project, in partnership with Cornwall-based EGS Energy, has planning permission for a 3-4 MW geothermal power plant at its site in a former china clay pit, near St Austell, taking energy from the heat in underground granite rocks. On a site the size of a football pitch, the geothermal power plant would produce enough heat to meet Eden's s heating needs, and enough electricity to power around 4000 houses.

Source: http://www.plymouthherald.co.uk/Cornwall-Council-invest-1-5m-hot-rocks-geothermal/story-28904681-detail/story.html#ixzz431sWXacZ

## Finland: Drilling to Begin in a New Geothermal District Heating Project

A Finnish geothermal district heating project is advancing in Otaniemi, Espoo. There, the company St1 Deep Heat Oy has invested in the construction a geothermal heat pilot plant, planning to initiate well drilling to a depth of seven km in late March or early April 2016. One of the goals of this pilot project is to increase Finnish expertise in geothermal. The project is considered to be one of the most important research and product development investments in the field of energy in the country.

Through competitive tendering, St1 Deep Heat has joined Strada Energy as its partner in drilling deep-rock wells. The British company is specialized in geothermal drilling and utilizes patented technology that makes deep drilling in Finland's hard granite bedrock feasible. Strada Energy CEO Glenn Baldwin expressed that his company's "…unique patented fluid hammer operating system combined with water-based percussion techniques enables a cost-efficient and quick way to drill over 7000 meters total measured depth wells in granite."

It is expected that the well drilling phase will take around six months. The heat pilot plant is scheduled to be completed in 2017. The heat generated will be sold to Fortum's district heating network and will cover a maximum of 10% of Espoo's district heating needs.

Source: http://www.thinkgeoenergy.com/finland-pushing-ahead-with-innovative-geothermal-heating-project/

*Winter view, Espoo, Finland (source: flickr/ Antti T. Nissinen, creative commons).*

## Germany: New Power Plant and New Player in the Geothermal Market

**New 5.5 MW Power Plant on Line in Bavaria -** Last January, the Italian firm Turboden informed that its 5.5 MW Organic Rankine Cycle (ORC) power plant was connected to the grid in Bavaria. The customer is Geothermische Kraftwerkgesellschaft Traunreut GmbH (GKT), a company that operates a geothermal well producing from a low-temperature (118°C) resource. The ORC plant will also supply up to 12 MW of heat to the municipality of Traunreut. The 5.5 MW Traunreut plant is Turboden's fourth geothermal unit installed in Germany, where now has a portfolio of 20 MW installed geothermal power generation capacity.

Source:
http://www.turboden.eu/en/news/news.php?categoria=news#247

**EGP Started Activities in the Geothermal Market -** Enel Green Power (EGP) has acquired 78.6% stake in Erdwärme Oberland GmbH (EO) from Erdwärme Bayern GmbH & Co. (EB), a company specialized in the development of geothermal projects in the Bavarian region. The acquisition was carried out through the issue of new shares in EO for a total of €22 million, covering the initial investment requirements for the project. With this transaction, EGP entered the German geothermal market. EO has recently developed a project for the construction of a geothermal plant with a maximum expected capacity of about 26 MW. The project, located near the town of Weilheim, about 50 km southwest of Munich, will be developed under a mineral exploration concession granted by the Bavarian Ministry for Economic Affairs, Media, Energy and Technology valid for three years that started last December and in consultation with local communities. EO will begin with geological exploration this year.

Source:
https://www.enelgreenpower.com/en-GB/media_investor/press_releases/release.aspx?iddoc=1665163

**Drilling Started at Trebur -** Drilling has commenced at the Geothermie-Projekt Groß-Gerau in Trebur, a community in Groß-Gerau district in Hessen, near Frankfurt in Germany. The planned depth of the well is 3,500 to 4,000 meters to an expected water temperature of 160 degrees Celsius. The power plant will deliver 3 MW of electrical power and 6 MW of thermal power (feeding into district heating network for the supply of industrial enterprises and residential areas). The investment amounts to 40 to 50 million euros.

Source: GRC's Global Geothermal News, 18 March 2016.

## Iceland: IDDP Receives EU Grant for Drilling of New Deep Well

Partners of the International Deep Drilling Project (IDDP) participated in a proposal (DEEPEGS) to the European Union research program called Horizon 2020 and secured a Research Grant for participation in the IDDP-2 well at Reykjanes. The DEEPEGS project is a four-year project led by HS Orka, Iceland, in cooperation with other partners from Iceland, France, Germany, Italy, and Norway. About €20 million research grant has been awarded to the DEEPEGS. Approximately 45% of this grant is allocated to various research projects related to the drilling and testing operation at the demonstration site in Reykjanes.

The acronym DEEPEGS stands for: Deployment of Deep Enhanced Geothermal Systems for Sustainable Energy Business. The DEEPEGS partners are HS Orka, Fonroche Géothermie of France, Statoil of Norway, ENEL Green Power of Italy, and Landsvirkjun (Iceland), all operating energy companies, Herrenkneckt Vertical and Karlsruhe Institute of Technology in Germany, BRGM of France, and ISOR and GEORG from Iceland.

*Flow test of the IDDP-1 well at Krafla, Iceland (source: Kristján Einarsson; taken from ThinkGeoEnergy).*

The DEEPEGS project will be testing stimulating technologies for deep EGS development, and intends to deliver new innovative solutions and models for wider deployments of EGS reservoirs for significant amounts of geothermal power across Europe. The project will demonstrate the capabilities of EGS for widespread exploitation of high-enthalpy systems, by testing the deep roots beneath the existing hydrothermal field at Reykjanes, with temperature up to 550°C, and in very deep hydrothermal reservoirs in sedimentary basins at Valence and Vistrenque in France with temperatures up to 220°C.

The deep well at Reykjanes, IDDP-2, is expected to be completed in 2016. A 2.5 km deep production well will be deepened to 5 km by HS Orka, Statoil and IDDP. After drilling the well it will be extensively tested for injectivity and connection to the overlying conventional hydrothermal field, and subsequently flow tested for fluid chemistry and production properties.

Source: http://iddp.is/wp-content/uploads/2015/12/ENSKA-Fr%C3%A9ttatilkynning_-des-2015-1.pdf

## Italy: EGP to Be Integrated into ENEL

Enel Green Power (EGP) is to be fully integrated into ENEL under plans almost unanimously approved by EGP shareholders on early January. ENEL shareholders also approved the move, which will see the parent company take its stake in EGP from 63% currently to 100%. The move is in line with the direction outlined by CEO Francesco Starace after he took over the leadership of the company in 2014. Recently he described the integration of EGP as being about placing renewables at the core of the group's growth and business models.

Under his plans, green energy will account for 52% of ENEL's power capacity by 2019, up from 38% when he took over in 2004. Increased wind and solar power will account for the bulk of the increase. The company has also announced plans to close 23 fossil fuel power plants in Italy by 2019, scrapped plans for new facilities in Italy and Chile and is seeking to offload assets worth six billion euros, particularly in Eastern Europe.

The change of direction was welcomed by Greenpeace Italy director Giuseppe Onufrio, whose campaign group has a long history of clashes with ENEL, many of which have ended in court. "In two cases, we were suing them for environmental damages and in seven cases they were suing us for our activities around their plants or because of our campaign against them," Onufrio declared. "Now our relationship has dramatically changed, positively," he said.

Source: http://www.thelocal.it/20160111/eenpeace-back-italian-giants-tilt-to-renewable-energy

## Poland: New Government Prefers Geothermal over Wind Energy

Barely sworn into the office, Jan Szyszko, Poland's new minister of Environment, said that the Law and Justice Party, which he represents, is against further expansion of wind power facilities in the country. According to some Polish media, he stated: "Geothermal energy, not wind energy, will definitely be the priority of this government…In the first we see a possibility to meet the air quality norms in urbanized parts of the country. The situation is completely different with wind farms. Wind farms destroy the landscape arrangement and are alien to the Polish cultural heritage and harmful to natural reserves."

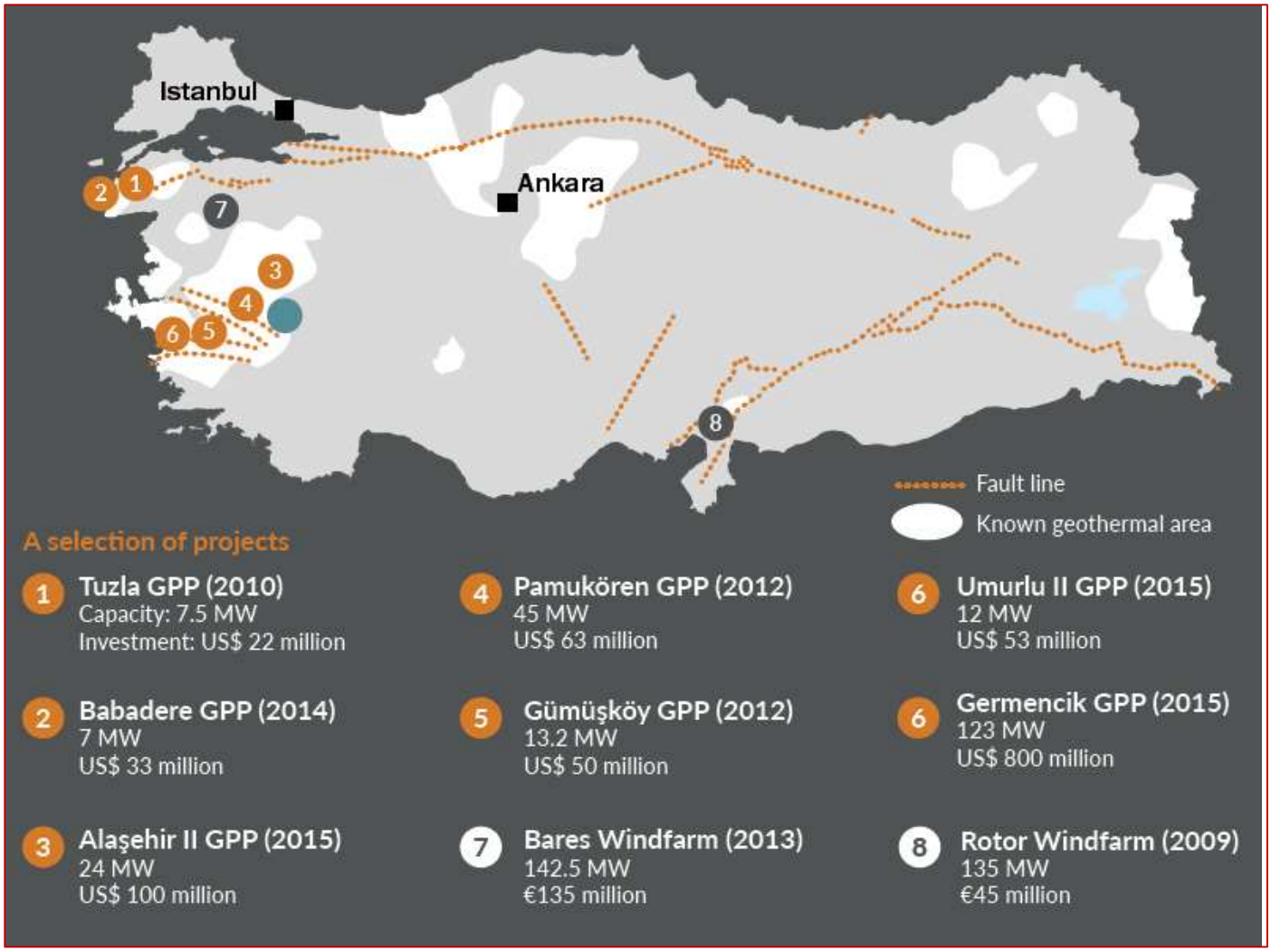
The European Union requires Poland to produce 15% of its electric power from renewables by 2020, up from around 12% currently. Heavily reliant on coal to produce its energy, previous Polish governments have developed biomass energy sources and subsidized the construction of wind farms. In the bill on Wind Investments, drawn up by the Conservative Polish Government in late February, a set of new demands for wind power developers was laid out. Polish wind harnessers fear that the demands, if implemented, will significantly impede or phase out the country's existing wind farms and will make it impossible to launch new ones. Poland's wind market was one of the strongest performers last year, installing a total of 1.3 GW in new capacity.

Joanna Józefiak, the Counselor to minister Jan Szyszko, noted Poland's favorable geothermal conditions. "Around 80% of the country is covered by three geothermal provinces: Central European, Fore-Carpathian and Carpathian," she said, but did not elaborate on the controversial bill. According to the World Energy Council (WEC), Poland possesses substantial resources of geothermal energy, but they are not of high temperatures; the available resources have reservoir temperatures of 30 to 130°C at depths of one to four km.

Source: http://www.renewableenergyworld.com/articles/2016/03/new-polish-government-under-fire-for-crackdown-on-wind-energy-expansion.html

## Turkey: 635 MW Reported by January 2016

Turkey had 21 geothermal power plans in operation with a total installed capacity of 635 MW last January. That places the country eighth worldwide, moving it ahead of Kenya (625 MW). In 2008, Turkey had only one geothermal power plant with 30 MW on line, so its geothermal generating capacity has increased more than 20 times. There are also an additional 96 MW in construction and planned projects of 430 MW. Driven by high energy demand, strong conglomerates developing projects and a favorable energy legislative and policy framework, Turkey has developed a thriving geothermal industry, also with the support by international investors and suppliers.




*Numbers 1-6: Location of geothermal power projects financed by the ERBD in Turkey (Source: ERBD, Infographics).*

The market has also seen strong support efforts by financial institutions such as IFC/World Bank and through a new US$125 million exploration funding mechanism announced by EBRD in cooperation with CTF last January. The European Bank for Reconstruction and Development (EBRD) and the Clean Technology Fund (CTF) launched a program to support exploratory drilling investments in Turkey, named PLUTO, which combines US$ 100 million from the EBRD with US$ 25 million from the CTF, a funding window of the Climate Investment Funds. The program is part of a global push by multilateral development banks to scale up geothermal energy production in two phases. The first one will finance geothermal exploration, drawing on the funds provided by the CTF. If exploration proves successful, during the second phase the EBRD will be available to finance the final stages of drilling and the construction of the power plant. The program aims to develop five new geothermal power plants with a combined capacity of at least 60 MW.

Sources: http://www.thinkgeoenergy.com/turkeys-significant-growth-continues-635-mw-online-today/, http://www.ebrd.com/news/2016/ebrd-and-ctf-give-funding-boost-to-turkeys-geothermal-energy.html

# Oceania

## Australia: Funding to Map Geothermal Resources

The Australian Renewable Energy Agency (ARENA) is providing AUD 450,000 (US$312,660) to the University of Adelaide to map Australia's geothermal resources. Maps of the distribution, orientation and connect-ivity of fractures in four key sedimentary basins will be produced to understand better the structural permeability in these regions. This will be key in developing the country's hot dry rock geothermal resources since geothermal projects in Australia face major headwinds due to the high cost and risk involved with deep drilling.

The University of Adelaide's South Australian Centre for Geothermal Energy Research, part of its Institute for Mineral and Energy Resources, will also develop a "toolkit" to assist developers in identifying permeability

pathways within critical Australian sedimentary basins and reduce the risks associated with drilling operations. This information will be combined with what will be discovered through ARENA-supported geothermal projects and serve as a go-to source for future developments, providing a head start on viability and risk assessments.

This latest project is consistent with the 2014 International Geothermal Expert Group forward looking report that recommended 'rebooting' Australia's geothermal industry. The International Geothermal Expert Group was established by ARENA to investigate and report on the prospects for the commercial development of geothermal energy in Australia.

Source:
http://www.climatecontrolnews.com.au/news/latest/funding-to-map-geothermal-resources-in-australia#2QwWtDPpAwShXiHH.99

## New Zealand: Geothermal Generation & Expansion, University Agreement and Research Project

**Availability of 98% in Mighty River Power Geothermal Plants -** The New Zealand based company Mighty River Power (MRP) released its Quarterly Operational Update corresponding to the last quarter of 2015. Among other information, the company unveiled that had its highest-ever quarter of geothermal generation, up 12% on the prior comparable period (pcp), to 728 GWh. This high geothermal generation reflected 98% availability of the company's geothermal plants during the quarter.

The price MRP received for generation was down 13% on pcp to NZ$67.91/MWh (US$43.85/MWh). MRP stated also that national demand for electricity rose to the highest level for the second quarter on record, up 0.9% compared with the same period last year (adjusted for temperature). This is the sixth consecutive quarter where demand has increased on pcp, with a reduction in demand from urban centers being more than off-set by increases across dairy, irrigation, industrial and rural centers.

Source:
http://www.scoop.co.nz/stories/BU1601/S00278/mighty-river-power-quarterly-operational-update.htm

**Consent for Expansion of geothermal station of Ngawha -** Top Energy's geothermal power generation at Ngawha has received the go-ahead following the withdrawal of challenges to the Environment Court. Top Energy's Chief Executive Russell Shaw said concerns raised by Parahirahi C1 Trust, the kaitiaki of the geothermal field and pools at Ngawha, have been addressed and a joint Consent Order was filed with the Environment Court. The Trust objected when Commissioners in September 2015 granted an extension of consents for Top Energy's existing 25 MW operation and approved new consents for a further 50 MW of generation to be built in two stages. Parahirahi C1 Trust Chair, Dr Te Tuhi Robust, described the agreement with Top Energy as an excellent outcome that provides more gains around technical issues within the consent. As part of the agreement, Top Energy has agreed not to cause or contribute to any adverse effects on the pools. This will require an independent monitoring program to monitor fluids reinjected into the reservoir, including controls on the contents of that fluid to eliminate waste, and to ensure reinjection procedures reflect best practice. Another condition is the appointment of a kaitiaki advisor who will advise an independent peer review panel and who will be consulted as part of Top Energy's cultural indicators monitoring program. In addition, Top Energy will also support the Trust in undertaking an annual independent scientific audit.

Finally, Top Energy will provide funding support for the development of Nga Waiariki pools area, which are a popular tourist destination and a valuable local resource for the community.

Source: http://topenergy.co.nz/power-station-consents-granted/

*Ngawha Geothermal Plant (Courtesy Top Energy).*

**Agreement between Leading Universities in the Pacific –** The University of Auckland recently gave their signature to a Memorandum of Understanding (MoU) with the University of Indonesia that makes official a long tradition of cooperation between the universities. New Zealand has imparted geothermal knowledge to Indonesia since their respective engineers

teamed up to develop Indonesia's first geothermal energy in the 1970s. Over 160 Indonesian engineers have attended the University of Auckland's Geothermal Institute.

In addition, the University works with the Indonesian Ministries of Higher Education and Finance that in turn offer scholarships to allow Indonesian students to study in New Zealand and then return to their home country where they can contribute their newly-learned knowledge while giving back to their communities.

The MoU was made official last year by Professor Ir Muhammad Anis, the University of Indonesia's Rector, and Professor Jennifer Dixon, the University of Auckland's deputy Vice-Chancellor of Strategic Engagement. Founded in 1849, the University of Indonesia is the oldest tertiary-level educational institution in Indonesia, with two campuses: one in Jakarta's central business (Salemba) and one in Depok (West Java). It consists of 12 faculties divided into three clusters, including health science, science and technology, and social science and humanities.

Source: https://www.auckland.ac.nz/en/about/news-events-and-notices/news/news-2016/01/links-strengthened-with-indonesia.html

**Project For Investigate Superhot Fluids -** A new government fund, allocated by the New Zealand Ministry of Business, Innovation and Employment, has put US$450,000 towards an international project to explore magma as a source of electricity generation. The project would investigate whether fluids even hotter than those sourced in current geothermal energy production could be retrieved from the margins of magma chambers. The potential was identified in Iceland during the Krafla Drilling Project when a well accidentally hit a magma chamber, briefly creating the world's most powerful geothermal production well in 2009.

Canterbury University volcanologist Dr. Ben Kennedy said the university is working alongside Victoria University and several international organizations, including Icelandic power company Landsvirkjun, in a new consortium. Dr. Kennedy said: "New Zealand generates more suitable magma than anywhere else on the planet so it is the ideal location. And like Iceland, New Zealand has a long and proud history of geothermal energy". He added: "There are still plenty of technological hurdles, so we probably won't be drilling into magma chambers in New Zealand for commercial energy in the next 10 years, but the Icelanders have shown it is possible, and we need energy solutions so it could be a realistic prospect for the future". Technologies developed in the project, would be shared as Kiwi power firms drilled into hotter rocks and eventually magma.

Source:
http://www.nzherald.co.nz/nz/news/article.cfm?c_id=1&objectid=11591953

# Other

## Book Reviews: DiPippo's Geothermal Power Plants, 4th edition

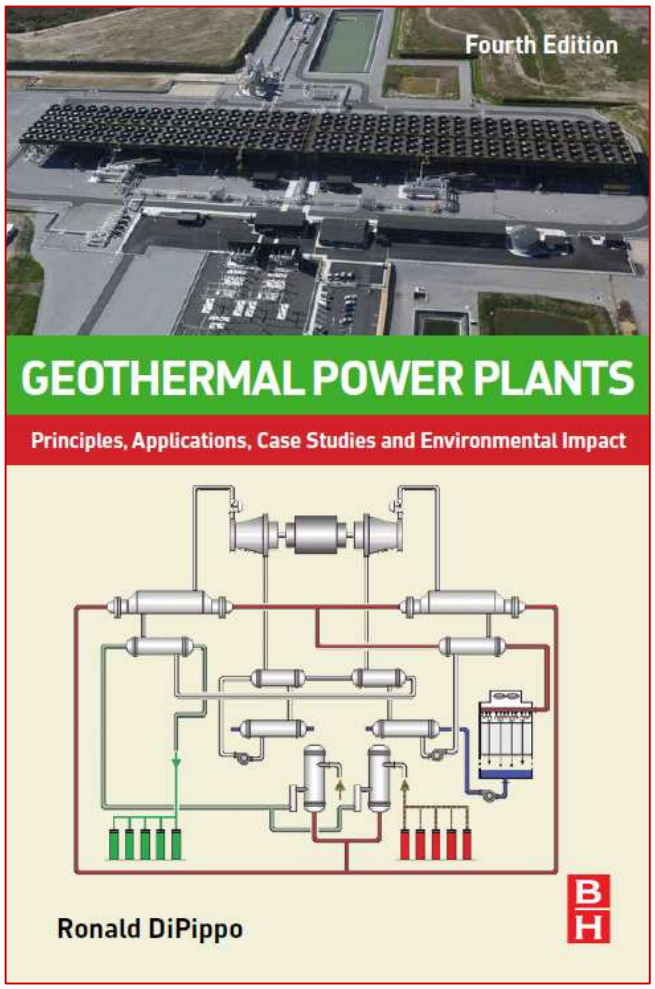
### *Raffaele Cataldi, Honorary President of the Italian Geothermal Union*

After those of 2005, 2008 and 2012, last January came to light the fourth edition of a 'classic' of applied geothermal energy, which probably many experts on the subject were expecting to see. It is *Geothermal Power Plants*, a hardcover book of more than 750 pages with numerous illustrations and tables, published by Butterworth-Heinemann, an imprint of Elsevier.

The author, Prof. Ronald DiPippo, needs no introduction. He is an expert of world renown with basic research, project studies and hundreds of publications (all very much appreciated), who has been for over 50 years one of the main authorities in geothermal technology development in the world.

The main body of the volume consists of 23 chapters divided into three parts. The first one (four chapters and 100 pages) is about exploration and development of the Earth's heat. The second part (six chapters and over 200 pages) details the technical aspects of all the geothermal

power plants that exist in the world. The third part (13 chapters and more than 350 pages) presents and discusses in depth, as 'case studies', the basic geological situation, historical evolution, and technical characteristics of the main geothermal-electrical plants in the principal countries and regions of the world, through December 2014.




All chapters contain an essential bibliography. In addition, those chapters of the first and second parts are integrated at the end with problems to solve: almost a hundred questions in all. They are set up as exercises for students in various disciplines, but are also useful for experts who want to delve into topics, or refresh their memory on various issues of their activity.

The volume also contains six appendices in practice, namely:

Appendix A: Development status of geothermal energy in the world to December 2014;
Appendix B: Unit conversions between different systems;
Appendix C: Equivalent energy values;
Appendix D: Elements of thermodynamics;

Appendix E: Answers to the problems presented at the end of the first ten chapters;

Appendix F: REFPROP (Reference Fluid Thermodynamic and Transport Properties) to illustrate ways to simulate geothermal plants using a software program for fluid properties from NIST, the US National Institute of Standards and Technology.

In addition to most recent data, research and development situations of new geothermal fields, this book reports on technological advancements integrated with various topics, especially of geothermal power stations. With respect to its third (2012) edition, the volume includes many problems and some appendices. This is a work completely revamped compared to the previous edition, and is even more advanced.

In short, is the sort of book that has to be part of the best scientific libraries in the world. Especially those of universities, research institutes, academic departments, public and private and service companies that deal with energy, environment and property development. And it is also the work that every geothermal expert of any discipline, will be proud to have in his or her personal library.

## Technology: The IMAGE Project of the European Union

Funded by the European Union, the Integrated Methods for Advanced Geothermal Exploration (IMAGE) project is refining geothermal exploration, answering the question of where to drill. Developing a new methodology, the project helps to increase the chance that a geothermal reservoir be discovered during the drilling process, which can then be used in electricity generation. The new methods 'image' geothermal reservoirs with high accuracy, allowing pin-pointed drilling.

The IMAGE partners applied advanced methodologies to complete geophysical explorations at different sites in Europe. Using a series of surveys, the partners discovered an abundance of data surrounding the spatial distribution of important parameters of subsurface rock formations. The team also performed laboratory experiments to study rock physical properties at supercritical conditions as encountered below the Earth's surface. The results of these experiments add to the scientific community's understanding of the existing geochemical databases currently used in numerical models.

The IMAGE project will help develop the process behind the prediction of reservoir factors such as fracture permeability, temperature, and in situ stresses. Once the data are fully analyzed and incorporated, the information will be used to enhance current geothermal exploration techniques. The IMAGE team is composed of eleven leaders in geothermal research alongside eight industry partners spanning various European countries.

Their unifying goal is the advancement of a reliable, scientific exploration method in the search for geothermal reservoirs.

Source:
http://cordis.europa.eu/result/rcn/170356_en.html

## Technology: Geothermal Energy and $CO_2$ Sequestration and Storage (CCS)

Researchers from Lawrence Livermore National Laboratory (LLNL), Ohio State University, University of Minnesota and TerraCOH, Inc. are developing a large-scale system that incorporates $CO_2$ sequestration and energy storage. The team's paper, published in the December 2015 issue of the Mechanical Engineering magazine, describes a subsurface energy system that could tap geothermal energy, store energy from above-ground sources, and dispatch it to the grid throughout the year like a massive underground battery, while at the same time storing $CO_2$ from fossil-fuel power plants.

"If you want to store the large quantities of renewable energy necessary to balance seasonal supply-demand mismatches and store it efficiently, we believe the best way to do that is underground," said the paper's author, Thomas Buscheck, leader of LLNL's Geochemical, Hydrological and Environmental Sciences Group. "We believe this is a cost-effective way to store the energy long enough so it can be used later."

Buscheck's team's approach involves injecting liquid-like $CO_2$ into underground reservoirs located in sedimentary rocks, creating a pressurized plume that pushes brine up production wells to the surface. The brine could be heated and reinjected into the reservoir to store thermal energy, and the resulting pressurized $CO_2$ would act as a shock absorber, enabling the system to be charged or discharged depending on supply and demand. When there's insufficient renewable energy, the pressurized $CO_2$ and brine could be released and converted to power.

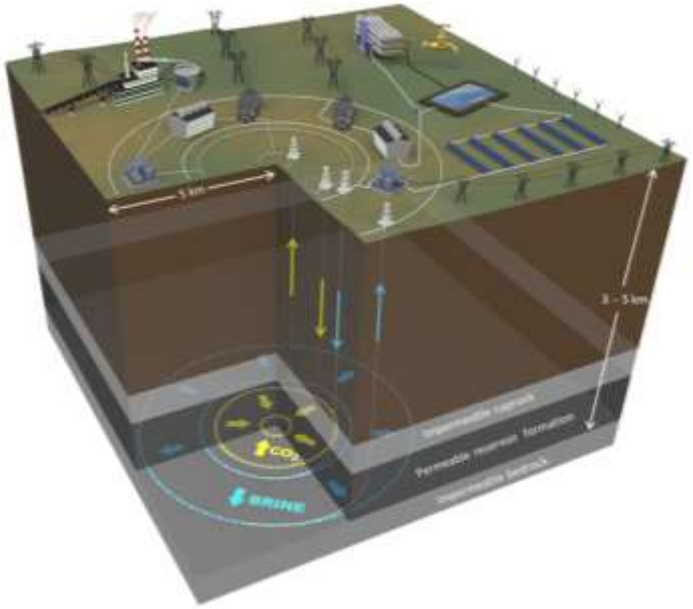
"Storing such vast quantities of $CO_2$ creates so much pressure. This is the biggest challenge for keeping it permanently underground, but it is manageable," Buscheck said. "To make sure we don't have too much pressure, we can divert some of the produced brine to generate water through desalination. Then, if we tap into the remaining pressure, we can recharge the system selectively and put energy into our storage system when there's excess and deliver it when it's needed."

According to the computer models, the amount of $CO_2$ that could be stored underground by the system would be at least 4 million tons per year over 30 years, the equivalent of the $CO_2$ impact of a 600 MW coal plant.

Seven years in development, the concept, which combines Multi-Fluid Geo-Energy Systems developed at LLNL and Ohio State University with CO2 Plume Geothermal (CPG) from researchers at the University of Minnesota, is drawing interest from industry.

The US Department of Energy, Office of Energy Efficiency and Renewable Energy's Geothermal Technologies Office funded the study.

Source: https://www.llnl.gov/news/underground-battery-could-store-energy-co2




*This integrated system would store carbon dioxide in an underground reservoir, with concentric rings of horizontal wells confining the pressurized $CO_2$ beneath the caprock. Stored $CO_2$ displaces brine that flows up wells to the surface where it is heated by thermal plants (e.g., solar farms) and reinjected into the reservoir to store thermal energy*

## Climate Change: New Study Shows Rising Seas Slowed by Increasing Water on Land

New measurements from a NASA satellite have allowed researchers to identify and quantify, for the first time, how climate-driven increases of liquid water storage on land have affected the rate of sea level rise.

A new study by scientists at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, California, and the University of California, Irvine, shows that changes in weather and climate over the past decade have caused Earth's continents to soak up and store an extra 3.2 trillion tons of water in soils, lakes and underground aquifers. This occurs in spite ice sheets and glaciers continue to melt, and has temporarily slowed the rate of

sea level rise by about 20 percent. The study was published in the Feb. 12, 2016 issue of the journal *Science.*

Each year, a large amount of water evaporates from the oceans, falls over land as rain or snow, and returns to the oceans through runoff and river flows. This is the global hydrologic cycle. Small changes in the hydrologic cycle –by persistent regional changes in soil moisture or lake levels, for instance—could change the rate of sea level rise from what we would expect based on ice sheet and glacier melt rates. "We always assumed that people's increased reliance on groundwater for irrigation and consumption was resulting in a net transfer of water from the land to the ocean," said lead author J.T. Reager of JPL. "What we didn't realize until now is that over the past decade, changes in the global water cycle more than offset the losses that occurred from groundwater pumping, causing the land to act like a sponge –at least temporarily. These new data are vital for understanding decadal variations in sea level change. The information will be a critical complement to future long-term projections of sea level rise, which depend on melting ice and warming oceans."

The NASA's Gravity Recovery and Climate Experiment (GRACE) twin satellites provided the first tool capable of quantifying land liquid water storage trends. By measuring the distance between the two GRACE satellites to within the width of a strand of human hair as they orbit Earth, researchers can detect changes in Earth's gravitational pull that result from regional changes in the amount of water across Earth's surface. With careful analysis of these data, JPL scientists were able to measure the change in liquid water storage on the continents, as well as the changes in ice sheets and glaciers.

This study is the first to observe global patterns of changes in land water storage, with wet regions getting more wet and dry areas getting drier. "These patterns are consistent with earlier observations of changing precipitation over both land and oceans, and with IPCC (UN's Intergovernmental Panel on Climate Change) projections of changing precipitation under a warming climate," said Jay Famiglietti, senior author of the paper and a professor at the University of California, Irvine.

Source: http://www.nasa.gov/press-release/nasa-university-study-shows-rising-seas-slowed-by-increasing-water-on-land

## Climate Change: Largest Gas Leak in US History Leaves 100-year Climate Legacy

An estimated 60 metric tons of gas spewed from a well near San Fernando Valley, California, every hour, mounting to over 100,000 tons of methane and ethane during the 112-day blowout, according to a scientific study in the journal Science. The figures overcome previous estimations and will leave an impact on the climate for the next 100 years, equal to the annual greenhouse gas emissions from 572,000 cars, said the report, prepared by researchers from the University of California, Irvine (UCI) and the National Oceanic & Atmospheric Administration (NOAA) among other.

The American gas company SoCal detected the ruptured well on 23 October 2015, which continued to spew gas until it was plugged on 11 February 2016. At its worst, the ruptured well –finally plugged in early February– was California's largest point source of methane. The amount of gas being released was double that of a coal mine in Alabama and equal to one-quarter of the annual methane pollution from all other sources in the Los Angeles Basin combined, the report added.

Statewide methane emissions during the event increased by around 20%, according to the California Air Resources Board, undermining efforts to reduce greenhouse gas levels. Methane is 84 times more polluting than carbon dioxide in the initial decades after it is released, and over a 100-year period, the effect of methane on warming the planet is 25 times that of $CO_2$.

The report confirms the adverse human health impacts of major gas leaks. Scientists discovered above average levels of potentially dangerous compounds were found in the densely populated Porter Ranch in the San Fernando Valley, causing mass evacuations.

SoCal is currently determining the cause of the leak and authorities aim to develop a climate mitigation program in response to the leak.

Source: Note by Joanna Peasland, http://www.climatechangenews.com/2016/02/26/largest-gas-leak-in-us-history-leaves-100-year-climate-legacy/

## Climate Change: Climate Denial Is Alive and Kicking Say Scientists

It has been 15 years since researchers last ran the numbers on how climate denial is disseminated in public discourse. A study recently published in the journal Global Environmental Change fills the gap, taking a fine tooth-comb to misinformation pumped out by conservative think tanks from 1998 to 2013.

It analyzed almost 25 million words of op-eds, blogs and policy reports available online from 16 US groups such as the American Enterprise Institute, Heritage Foundation and Heartland Institute. Here are the main findings.

1. Climate science denial isn't over. The volume of output has ballooned from 203 documents between 1990-97 to 16,028 in 1998-2013. The Heartland Institute tops the list, followed by the Science and Public Policy Institute, then Center for the Study of Carbon Dioxide and Climate Change (CO2 Science).

2. The emphasis has shifted from debating the usefulness of policy to disputing the science, researchers from Trinity College Dublin and Exeter University found. By casting doubt on the scientific consensus, they seek to undermine public support for a range of green policies, rather than fighting them one by one.

3. Denial is reactive. Content peaked around the time of the Copenhagen summit in 2009, a major attempt to strike a global warming accord. The data similarly shows spikes in attacks on "alarmism" after the release of Al Gore's Inconvenient Truth and subsequent Nobel Prize awards for him and the Intergovernmental Panel on Climate Change. In response to bills on $CO_2$ regulations in 2008 and 2009, talk of damage to national economy flared similarly.

4. Attacks on scientists are rooted in politics. Bids to question the integrity of scientists or scientific bodies "appear closer (semantically) to politics than science". Rather than tackling point-by-point the claims, the language is emotive. A Heartland Institute report accuses climate scientist Michael Mann of being in the business of "spreading myths and misinformation to further their agenda," for instance.

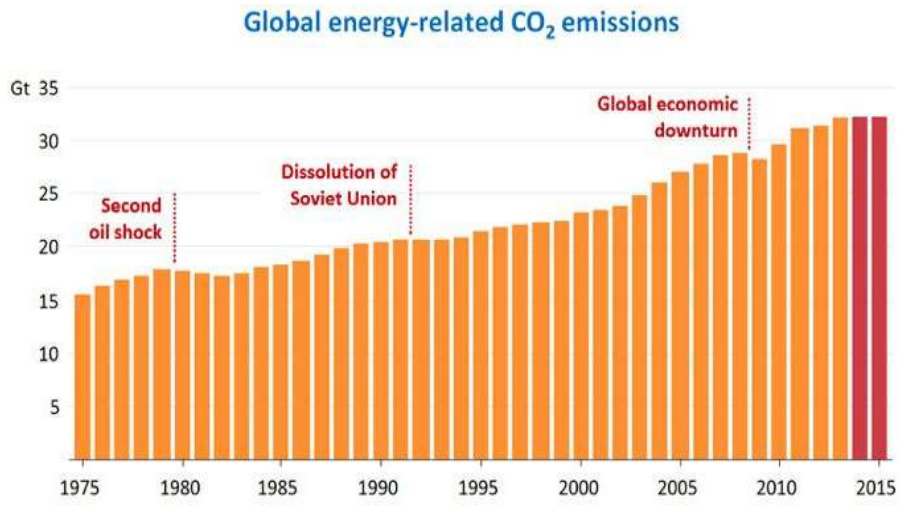
5. Influential US newspapers are presenting science on man-made climate change more in line with consensus. But it's not clear if that holds in the case of TV channels, talk radio, social media or a larger sample of conservative newspapers, they note.

Source: Note by Alex Pashley, Climate Home (http://www.climatechangenews.com/2016/01/07/five-takeaways-from-15-years-of-climate-sceptic-literature/)

## Climate Change: $CO_2$ Emissions Flat in 2015 Thanks Largely to Renewables

Renewable energy generation has proven crucial in keeping global energy-related carbon dioxide ($CO_2$) emissions flat for a second year in a row, according to preliminary 2015 data released by the International Energy Agency (IEA). Last year global $CO_2$ emissions stood at 32.1 billion tons, remaining somewhat unchanged since 2013, as the two largest emitters, China and the US, both saw a decline in energy-related greenhouse gas emissions, the IEA said.

In China, emissions went down by 1.5% because the use of coal fell for the second year in a row. At the same time, US emissions decreased by 2% due to the switch




from coal to natural gas use. Still, the improvement observed in the two largest emitters was offset by rising emissions in most other Asian developing economies and the Middle East. There was moderate growth in Europe, as well.

The analysis shows that renewables accounted for some 90% of new electricity generation in 2015 and played a vital role in decoupling greenhouse gas emissions from economic growth. Wind farms accounted for more than half of new power generation.

IEA noted that there have been only four periods over the past 40 years in which emissions remained at the same level or even decreased compared to the prior year. In particular, this happened in the early 1980s, in 1992 and 2009. These three periods are associated with global economic weakness, unlike in 2014 and 2015, when global gross domestic product (GDP) grew by 3.4% and 3.1%, respectively, based on data from the International Monetary Fund.

Source: http://renewables.seenews.com/news/co2-emissions-flat-in-2015-thanks-largely-to-renewables-iea-517100

## Climate Change: Human-driven Carbon Release Rate Unprecedented in the Past 66 Million Years

The earliest measurements of Earth's climate using thermometers and other tools started in the 1850s. To look further back in time, scientists investigate air bubbles trapped in ice cores, expanding the scope of

climate records to nearly a million years. But to study Earth's history over millions of years, researchers examine the chemical and biological signatures in deep-sea sediments.

New research published in March in the journal Nature Geoscience by geoscientist Richard Zeebe of the University of Hawaii at Manoa and colleagues, looks at changes in Earth's temperature and atmospheric carbon dioxide ($CO_2$) since the end of the age of the dinosaurs. The evidence is in sediment cores retrieved from beneath the seafloor by geologists working aboard the ocean drillship JOIDES Resolution.

The findings suggest that humans are responsible for releasing carbon about 10 times faster than during any time in the past 66 million years.

The research team developed a new approach and was able to determine the duration of the onset of an important past climate event, the Paleocene-Eocene Thermal Maximum (PETM), 56 million years ago, which was thought to have the largest carbon release during the past 66 million years. The team combined analyses of chemical properties of sediment cores dating back to the PETM with numerical simulations of Earth's climate and carbon cycle. The new method allowed them to extract rates of change from sediment records. Applied to the PETM, they calculated how fast the carbon was released, how fast Earth's surface warmed, and what constrained the time scale of the onset, which was across 4000 years.

The rate of carbon release during the PETM was much smaller than the current input of carbon to the atmosphere due to human activities. Carbon release rates from human sources reached a record high in 2014 of about 37 billion metric tons of $CO_2$. The researchers estimated that the maximum sustained carbon release rate during the PETM was less than four billion metric tons of $CO_2$ per year –about one-tenth the current rate.

Whereas large climate transitions in the past may have been relatively smooth, there is no guarantee that will happen in the future, the scientists said. The climate system is non-linear, which means that its response to inputs, such as $CO_2$ emissions, is a complex process involving multiple components. Research suggests that the consequences of our massive burning of fossil fuels will have much longer-lasting effects.

The scientists are continuing their work on the PETM to study other aspects of the event -- for example, determining how severe ocean acidification was during that time and what effect it had on calcifying organisms in the ocean. The results will provide insights about what to expect in the future as Earth's climate likely continues to warm and the acidity of oceans' waters keeps increasing.

Source:
http://www.nsf.gov/news/news_summ.jsp?cntn_id=137908&WT.mc_id=USNSF_51&WT.mc_ev=click

## Finance: Renewables Attracted Record US$329 Billion of Investment in 2015

The slump in oil prices that has brought upheaval and cost-cutting to the traditional energy industry spared renewables such as solar and wind, which raked in a record US$329.3 billion of investment last year. The four percent increase in clean energy technology spending from 2014 reflected tumbling prices for solar PV and wind turbines, as well as a few big financings for offshore wind farms on the drawing board for years, according to research from Bloomberg New Energy Finance (BNEF) released last January.

"These figures are a stunning riposte to all those who expected clean energy investment to stall on falling oil and gas prices," said Michael Liebreich, founder of the London-based research arm of Bloomberg LP. While oil companies such as Exxon Mobil Corp. and Royal Dutch Shell Plc eliminate jobs and curb capital spending to cope with prices that have fallen two-thirds in 18 months, renewables are enjoying a renaissance underpinned by rules designed to curb fossil-fuel emissions damaging the atmosphere.

Fears that low oil prices will continue into 2016 have knocked confidence among oil companies, delaying US$380 billion worth of investment in upstream projects, according to analysis by industry consultant Wood Mackenzie Ltd. released on January. Companies are "going into survival mode" this year with more projects delayed and budgets cut, said Angus Rodger, one of the report's authors.

While BNEF has said lower prices may hurt funding for efficiency projects and the spread of electric cars, the main clean energy technologies enjoyed record installations in 2015.

Another "strong year" is in store for renewables in 2016, said Angus McCrone, chief editor at BNEF, stopping short of saying another record will be reached. Balancing that is a potential slip in funding for yieldcos, which drew higher investment in 2015, and a clouded outlook for offshore wind in its biggest market.

China remained the biggest market for renewables, increasing investment 17% to US$110.5 billion. That is almost double the US$56 billion invested in the US, which was second in the BNEF rankings. The strength of the dollar helped boost the value of investment. In India, funding for clean energy rose 23% to US$10.9 billion, and new markets including Mexico, Chile and

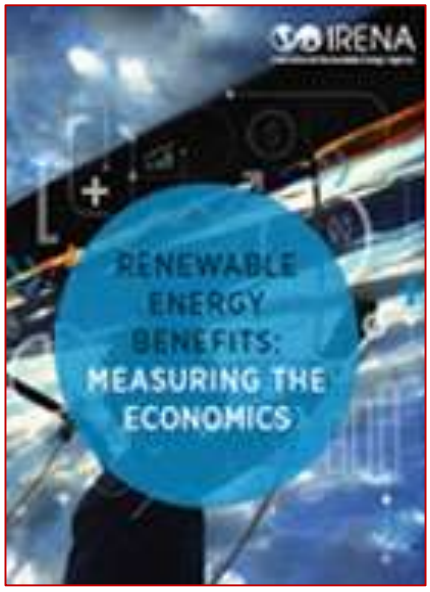
South Africa attracted tens of billions of dollars. Brazil bucked the trend with a 10% drop to US$7.5 billion.

New wind and solar power accounted for about half of all new generation last year. Around 64 GW of new wind power and 57 GW of new solar PV was added, representing an increase of 30% from to 2014.

Source:
http://www.renewableenergyworld.com/articles/2016/01/as-oil-crashed-renewables-attracted-record-329-billion.html?cmpid=renewable01202016&eid=291021978&bid=1284951

## Finance: Renewable Energy Would Increase Global GDP by 1.1% in 2030

Achieving a 36% share of renewable energy in the global energy mix by 2030 would increase global gross domestic product (GDP) by up to 1.1%, roughly US$ 1.3 trillion, according to new analysis by the International Renewable Energy Agency (IRENA).




*Renewable Energy Benefits: Measuring the Economics (available here: http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=690)*

*Renewable Energy Benefits: Measuring the Economics*, released at IRENA's sixth Assembly, provides the first global estimate of the macroeconomic impacts of renewable energy deployment. Specifically, it outlines the benefits that would be achieved under the scenario of doubling the global share of renewable energy by 2030 from 2010 levels.

"The recent Paris Agreement sent a strong signal for countries to move from negotiation to action and rapidly decarbonize the energy sector," said Adnan Z. Amin, IRENA Director-General. "This analysis provides compelling evidence that achieving the needed energy transition would not only mitigate climate change, but also stimulate the economy, improve human welfare and boost employment worldwide."

The report also analyses country-specific impact. Japan would see the largest positive GDP impact (2.3%) but Australia, Brazil, Germany, Mexico, South Africa and South Korea would also see growth of more than 1% each.

According to the report, improvements in human welfare would go well beyond gains in GDP thanks to a range of social and environmental benefits. The impact of renewable energy deployment on welfare is estimated to be three to four times larger than its impact on GDP, with global welfare increasing as much as 3.7%. Employment in the renewable energy sector would also increase from 9.2 million global jobs today, to more than 24 million by 2030.

"Mitigating climate change through the deployment of renewable energy and achieving other socio-economic targets is no longer an either or equation," said Amin. "Thanks to the growing business case for renewable energy, an investment in one is an investment in both. That is the definition of a win-win scenario."

Source: http://futurenergyweb.es/36-renewables-by-2030-will-boost-global-gdp-by-1-3-trillion/?lang=en

## Finance: Investment Call from BNEF

A whopping US$12.5 trillion is needed in the next 25 years to meet the goals outlined in the Paris climate deal, says a report from the Boston-based Ceres consultancy and Bloomberg New Energy Finance (BNEF) released on late January (*Mapping the Gap: The Road From Paris*). Of that, wind, solar, geothermal and other zero-emission power sources will need US$5.2 trillion of backing, largely in emerging and developing economies. The total is around 75% more than current predictions of clean energy growth, but it is realistic if investment funds and big business signal their support for the sector. "The clean energy industry could make a very significant contribution to achieving the lofty ambitions expressed by the Paris Agreement," BNEF Chairman Michael Liebreich said.

Source:
http://www.ceres.org/resources/reports/mapping-the-gap-the-road-from-paris/view

## Finance: Role of Public Finance in Deploying Geothermal Energy in Developing Countries

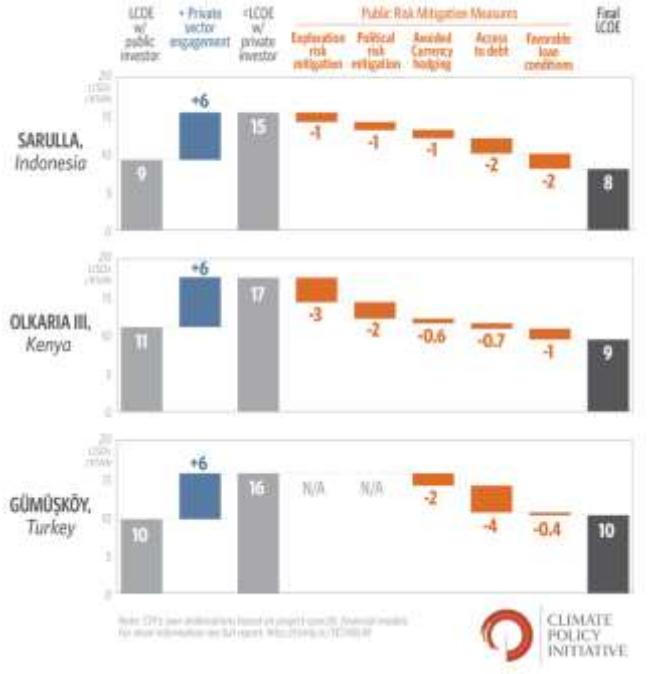
Despite great potential, geothermal deployment in developing countries has been below expectations since 2010. The major barrier is securing early-stage project finance given the scarce public resources available to

invest in exploration and development. While some countries are pursuing policies to liberalize energy and electricity markets to attract private investment, significant difficulties remain.

Recently, Climate Policy Initiative (CPI) analyzed three case studies on behalf of the Climate Investment Funds, with the aim of helping policymakers and development finance institutions understand which policy and financing tools to use in order to enable rapid and cost-effective deployment of geothermal for electricity.

The case studies (the Sarulla project, Indonesia, the Olkaria III project in Kenya, and the Gümüsköy in Turkey) show that the increase in tariffs needed to provide sufficient returns to incentivize private investment can be entirely offset by public measures addressing specific risks. This graphic illustrates how these public risk mitigation measures (orange) combine to result in a final levelized cost of electricity for a privately developed project (dark grey) that is even lower than what it would have been for the state to develop it (light grey).

*Public risk mitigation measures can entirely offset the increase in tariffs needed to incentivize private investment in geothermal projects*




The CPI analysis shows that by implementing specific risk mitigation measures governments achieved the same amount of electricity generation while appropriating only 15-35% of the resources they would have spent had they built and operated the project themselves.

Source:
http://climatepolicyinitiative.org/2016/03/09/graphic-spotlight-role-public-finance-geothermal/

## 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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