IGA NEWS

Newsletter of the International Geothermal Association

Quarterly No. 106

IGA ACTIVITIES

Message from the President

Greetings to all members of IGA and those that are reading this newsletter.

I have recently taken up the position of President of IGA for the 2016-2019 board term. The Board of IGA is elected every three years for a three years-term among its members, while the President is then elected by the incoming board members. I am therefore quite grateful for the trust given to me to fill this position over the next three years.

I will follow in the position of President distinguished predecessors, like Juliet Newson (formerly with Contact Energy, New Zealand, and now at the Iceland School of Energy), Roland Horne (Stanford University), Ladislaus Rybach (ETH Zuerich) and many more. This is an incredible honor and responsibility and while I am very much looking forward, I also understand that I have some large shoes to fill. I would like to thank my former board colleagues for their contribution to the activities of IGA.

With Marietta Sander, the Executive Director of IGA, leaving the Secretariat at the end of the year, I would like to thank her for her passion, dedication and hard work on the daily struggle of running the secretariat and representing the association in various international events, initiatives and conferences. Together with my predecessors, I wish her all the best for her next professional appointment and hope to see her in the geothermal sector again in the future.

Last year, we held the World Geothermal Congress in Melbourne, Australia, and had the chance to see New Zealand. I would like to thank the organizers and all involved in making this event a successful event for the industry, despite the challenges endured.

The next World Geothermal Congress will be held in 2020 in Reykjavik, Iceland. The 2016-2019 term of the board falls in between two World Congresses and provides a good opportunity to reflect on our work as an association, our cooperation with national associations and an evaluation of our strategy for the next challenging coming years.

The geothermal sector and its national and international associations, underfunded as they are, play an important



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role for the sector, promoting, informing, but also gathering support to help with the development of geothermal projects worldwide: for power generation, direct use and combined heat and power plants. But they also need the support of the sector and its representatives.

During the past board term of the IGA, I was heavily involved in preparing and working on a future strategy for IGA and worked with the Secretariat and other board members on a new approach to branding of the association. This work continues and I hope we can make a big push forward involving also our membership. In all the activities, I worked closely with and have supported the Secretariat throughout these activities.

IGA can build on the fantastic support by the host of the IGA Secretariat in Bochum, Germany. Compared to other renewable energy technologies, we are though not as visible and are often not taken that seriously. Therefore, I

believe that we need to strengthen efforts in the promotion, development and representation of geothermal energy, this not only to the general public but also national and multilateral organizations, such as the World Bank, IRENA and related.

Representing industry interests and those of our member associations is only possible by strengthening our activities and involvement with those entities and organizations. This involves research activities, project development, financing and risk mitigation tools and much more.

The pioneering research projects to tame supercritical geothermal resources such as IDDP, Japan beyond the Brittle Project, and others already involves industry, government and research institutions to share costs and risk for power production from supercritical geothermal reservoirs. They represent the huge potential of geothermal and open the way to a stronger share of geothermal among the other renewable energy sources. At the same time we need to put a focus on realistic targets.

It is important that we find ways to engage industry more strongly into our activities and thereby also strengthen the fantastic research efforts of the industry on an academic and industry level. This also includes efforts on entrepreneurship and technological development and I see IGA in a possible facilitating role going forward. With our strategy discussions in the board, we have laid a good foundation for preparing IGA for the future.



I am looking very much forward working with the Board of IGA and would like to thank all of them for their input and commitment. I am looking particularly forward working with the Chairs of the different committees on the tasks ahead. If you wish to be involved in any of the IGA Committees, please contact

the committee Chairs (listed in this newsletter and the IGA website).

It will further be important to strengthen our efforts in supporting developing countries that want to develop their geothermal resources. We can do so through interaction with international organizations and agencies such as the Global Geothermal Alliance, IRENA, Africa Renewable Energy Initiative and various other initiatives.

Engaging with the national geothermal associations, I hope to be able to meet with many of them during the term of 2016-2019, but also meet with larger players in the industry to see what IGA could do for the industry while

engaging industry more in the support of the work of IGA.

Another thing I really want to emphasize is how we can strengthen the role of women in the geothermal energy sector and thereby fully support the great work of all the WINGs (Women in Geothermal). I hope to be working closely together with all the WINGs and WINGmen over the coming years, not only on the board of IGA, but also via ThinkGeoEnergy.

I plan to report regularly on IGA and its board on a personal note via my personal blog, but also via ThinkGeoEnergy.com. I am the Founder & Editor of ThinkGeoEnergy, and have been operating this news platform for the geothermal energy sector since 2008. We are now also running a Spanish version at PiensaGeotermia.com and soon a Turkish version at JeotermalHaberler.com. I am also working as Marketing & Communication Director for UK-headquartered Green Energy Geothermal (GEG), a supplier of modular geothermal wellhead power plants. I am also a Board Member of the Canadian Geothermal Energy Association (CanGEA).

With all the planned activities and efforts, these will be some busy three years and if you want to help out with our activities on IGA and spread the word about geothermal energy, please be in touch. So for questions, comments, thoughts and more, email me at: iga@thinkgeoenergy.com.

Alexander Richter, President International Geothermal Association

64th & 65th BoD Meetings and 27th AGM in Addis Ababa

Luis C.A. Gutiérrez-Negrín, Editor

The 64th meeting of the IGA's Board of Directors (BoD) ended the 2013-2016 term and the 65th meeting began the 2016-2019 term. Both meetings were held at the United Nations Conference Centre (UNCC) in Addis Ababa, Ethiopia, on October 31 and November 1, 2016, respectively, just before the ARGeo C6 Conference that ran from 2 through 4 November in the same venue. All new and old members of the Board were invited to participate in both meetings, as well as in the 27th Annual General Meeting held on the evening of October 31.

The IGA past Vice President Herman Ibrahim Darnel, welcomed the IGA Board of Directors on behalf of the past President, Juliet Newson, who was unable to attend. Herman called the 64th Board Meeting to order at 8:30 am, and those present introduced themselves. The old Board members at the meeting were: Albert Genter, Alexander Richter, Árni Ragnarsson, Bjarni Pálsson, Bruno Della Vedova, D. Chandrasekharam, Fernando S. Peñarroyo, Herman Ibrahim Darnel, Lúdvík S. Georgsson, Luis C.A. Gutiérrez-Negrín, Meseret Teklemariam, Rolf Bracke, Toshihiro Uchida, and Zhonghe Pang. Apologies were received from Beata Kepinska, Juliet Newson, Paul Brophy, Sadiq Zarrouk and Shigeto Yamada. Also participating were Horst Rüter as Managing Director of the IGA Service Company, Marietta Sander as Executive Director, and Karolina Andersson as IGA Assistant. In addition, the

following incoming Board members of the 2016-2019 BoD were present: Bjarni Bjarnasson, Colin Harvey, Gábor Szita, Jane Brotheridge, Kristín V. Matthíasdóttir, Massimo Verdoya, Peter Meier, Peter Omenda, Surya Darma, and Valentina Svalova.

The agenda approved included the following points: 1. Call to order; 2. Approval of the Minutes of the IGA Board 63rd meeting; 3. Approval of the Agenda; 4. Focused discussion on subsequent topics:

4a. Update on activities of R&R Committee and UNFC collaboration; 4b. Update on bylaws change and name change of the African Regional Branch; 4c. Update on education grant approvals; 4d. Update on process for standardized data collection; 4e. Update on logo; 5. Update on WGC2020, MoU, preparations, timeline; 6. Group photo; 7. Adjournment.

The main aspects and agreements of the meeting follow.

- The results of the IGA Officers election: The past President, Juliet Newson, was the chair of the *ad hoc* election committee in charge of supervising the election process of new IGA officers. The results of the election are as follows: President: Alexander Richter; Vice President: Toshihiro Uchida; Treasurer: Colin Harvey; Secretary: Bruno Della Vedova.

- Standardization of data collection: The establishment was approved of a working group for data collection among the IEA GIA Annex 10, the IGA and EGEC, and other entities trying to capture and update geothermal data and information.

- Membership Committee Report: A new fee structure



was approved for student members. The student fee will be introduced on a trust basis and the IGA Secretariat will not need to ask for enrollment certificates from the students. The new student member fee for affiliated organizations are: Category U: US\$ 3 (normal individual member: US\$ 12), Category A: US\$ 1.5 (normal individual member: US\$ 6), Category B: US\$ 1 (normal individual member: US\$ 3.5) (categories refer to the World Bank economies classification).

Vice President Herman Darnel thanked the BoD and closed the 64th meeting at 15:30 pm.

In the evening of October 31, Vice President Herman called the 27th Annual General Meeting to order at the same venue. He welcomed everybody and opened the meeting. A total of 27 IGA members were present. The meeting started with a review of the minutes for the 26th AGM held in Morelia, Mexico, on 18 October 2015, and the agenda. No amendments were necessary, and both were approved. Next the reports of the IGA officers; the permanent, technical and ad hoc committees; and the regional branches were approved, as tabled, for Board meetings 63 and 64. Finally, the 27th AGM was adjourned at 16:00 on 31 October 2016.



New IGA's officers. From left: Toshi Uchida, Vice President, Alex Richter, President, Colin Harvey, Treasurer, and Bruno Della Vedova, Secretary.

The 65th BoD meeting started on the morning of November 1st. The IGA President Alexander Richter welcomed the IGA Board of Directors at the UNCC in Addis Ababa and called the 65th Board Meeting to order at 09:00 am. The following board members were present at the meeting: Albert Genter, Alexander Richter, Bjarni Bjarnasson, Bruno Della Vedova, Colin Harvey, Gábor Szita, Horst Rüter, Jane Brotheridge, Kristín Vala Matthíasdóttir, Ludvik S. Georgsson, Massimo Verdoya, Peter Omenda, Peter Meier, Rolf Bracke, Surya Darma, Toshihiro Uchida, and Valentina Svalova. Thus, the number of Board members present was 17, plus Marietta Sander as Executive Director, Karolina Andersson as IGA Assistant, and the following members of the retiring 2013-2016 BoD: Bjarni Palsson, Dornadula Chandrasekharam, Fernando S. Peñarroyo, Herman Ibrahim Darnel, Luis C.A. Gutiérrez-Negrín, Meseret Teklemariam, Zonghe Pang, Arni Rágnarsson.

The approved Agenda included: 1. Call to order; 2. Approval of the Agenda; 3. Discussion of hand-over documents of the Committee Chairs and Officers; 4. Identification of Committee Chairs and formation of committees; 5. Budget discussion 2017 – including request of R&R Committee; 6. Proposal to standardize national data collection and form a working group between the IGA and IEA GIA –on the request for travel funds; 7. Discussion on invitation letters for upcoming IGA Board meetings; 8. Adjournment.

The recently elected IGA President, Alexander Richter, presented his vision for the future of the IGA. He emphasized that the IGA and the geothermal industry should be more present and visible. He encouraged the IGA Board members and national associations to use the news website, *ThinkGeoEnergy* and encouraged using social media platforms more extensively for geothermal promotion. As a mid-term goal, the value for IGA members should be strengthened and the IGA should continue building relationships with international organizations.

The IGA Executive Director, Marietta Sander, explained that the IGA Secretariat in Bochum is funded by the federal state of North Rhine Westphalia and the EU as an EU project lasting from 1 January 2016 through 31 December 2018. The office rental at the Bochum University of Applied Sciences, office materials, IT, salaries and travel costs of project employees are covered by the EU/NRW project. Current personnel at the Secretariat include the IGA Executive Director Marietta Sander (until 31 December 2016), the IGA Assistant Karolina Andersson, the IT expert Gregor Rumberg and the Student Assistant Elisa Spichalski.

The handover reports that the past Officers and Committee Chairs of the IGA had prepared in advance on their respective posts and committees, were presented and the new committee chairs elected. Three of the new chairs did not attend the meeting and their elections need to be confirmed later. The current list of committees is presented later, in a separate note.

There were discussions on specific issues, including the IGA budget for 2017, the IGA regional branches, the new IGA logo and the next Board meeting. In particular, Meseret Teklemariam, Chair of the African

Regional Branch, discussed the issue of not having a representative from the Africa Regional Branch in the WGC2020 Steering Committee (SC). She informed the branch members they were expecting an answer from the IGA on why none of them were chosen. The IGA President will send a letter to the SC to identify a process, mechanisms and timeline on including regional SC representatives as part of their work. The SC was requested to report on this topic at the next IGA Board meeting.

Finally, the President Alexander Richter thanked the Board and closed the meeting.

Current IGA Committees

The Audit and Finance committees were still being formed as this edition closed. The current composition of the other IGA permanent and technical committees is as follows.

- Bylaws

Chair: Jane Brotheridge (New Zealand). Members: Bjarni Bjarnason (Iceland), Varun Chandrasekhar (India), Luis C.A. Gutiérrez-Negrín (Mexico), Colin Harvey (New Zealand), Beata Kepinska (Poland), Juliet Newson (New Zealand), Fernando S. Peñarroyo (Philippines), Gábor Szita (Hungary).

- Education

Chair: Ludvik S. Georgsson (Iceland). Members: Rolf Bracke (Germany), Dornadula Chandrasekharam (India), Bruno Della Vedova (Italy), Tuna Eren (Turkey), Beata Kepinska (Poland), Kewen Li (China), Diego Morata (Chile), Juliet Newson (New Zealand), Peter Omenda (Kenya), Zhonghe Pang (China), Árni Ragnarsson (Iceland), Horst Rüter (Germany), Benedikt Steingrímsson (Iceland), Valentina Svalova (Russia), Toshihiro Uchida (Japan) Massimo Verdoya (Italy), Sadiq Zarrouk (New Zealand), Meseret T. Zemedkun (Ethiopia).

- Information

Chair: Peter Meier (Switzerland). Members: Rolf Bracke (Germany), Varun Chandrasekhar (India), Albert Genter (France), Ludvik S. Georgsson (Iceland), Luis C.A. Gutiérrez-Negrín (Mexico), Susan F. Hodgson (USA), Herman Darnel Ibrahim (Indonesia), Liu Jirong (China), Kristín Vala Matthíasdóttir (Iceland), Georgina Izquierdo-Montalvo (Mexico), Marcelo J. Lippmann (USA), Diego Morata (Chile), Fernando S. Peñarroyo (Philippines), Horst Rüter (Germany), Ka Noel Salonga (Philippines), Marietta Sander (Germany), Surya Darma (Indonesia), Massimo Verdoya (Italy), Shigeto Yamada (Japan), Meseret T. Zemedkun (Ethiopia).

- Membership

Chair: Surya Darma (Indonesia). Members: Dornadula Chandrasekharam (India), Albert Genter (France), Li Hongying (China), Abadi Poernomo (Indonesia), Valentina Svalova (Russia), Árni Ragnarson (Iceland), Toshihiro Ushida (Japan), Meseret T. Zemedkun (Ethiopia).

- Nominating Committee

Chair: Albert Genter (France). Members: Jane Brotheridge (New Zealand), Dornadula Chandrasekharam (India), Ludvik S. Georgsson (Iceland), Herman Darnel Ibrahim (Indonesia), Abadi Poernomo (Indonesia), Surya Darma (Indonesia), Shigeto Yamada (Japan), Sadiq Zarrouk (New Zealand).

- Program and Planning

Chair: Andy Blair (New Zealand). Members: Rolf Bracke (Germany), Varun Chandrasekhar (India), Bruno Della Vedova (Italy), Luis Gutiérrez-Negrín (Mexico), José Luis Henríquez (El Salvador), Kristín Vala Matthíasdóttir (Iceland), Peter Meier (Switzerland), Peter Omenda (Kenya), Bjarni Pálsson (Iceland), Surya Darma (Indonesia), Gábor Szita (Hungary), Marietta Sander (Germany), Tingshan Tian (China), Toshihiro Uchida (Japan), Shigeto Yamada (Japan).

- Recourses and Reserves



Chair: Graeme Beardsmore (Australia). Members: Miklos Antics (France), Roy Baria (UK), Larry Bayrante (Philippines), Paul Brophy (USA), Varun Chandrasekhar (India), Dornadula Chandrasekharam (India), Paolo Conti (Italy), Gioia Falcone (UK), Geoffrey Giudetti (Italy), Malcolm Grant (New Zealand), Luis Carlos Gutiérrez-Negrín (Mexico), Marek Hajto (Poland), Colin Harvey (New Zealand), Manfred Hochstein (New Zealand), Rob Hogarth (Australia), Egill Juliusson (Iceland), Horst Kreuter (Germany), Jim Lawless (New Zealand), Harmen Mijnlieff (Netherlands), Inga Moeck (Germany), Annamaria Nádor (Hungary), Hugo Fernando Navas (Kenya), Juliet Newson (Iceland), Peter Omenda (Kenya), Zhonghe Pang (China), Fernando S. Peñarroyo (Philippines), Horst Rüter (Germany), Ladsi Rybach (Switzerland), Marietta Sander (Germany), Benedikt Steingrímsson (Iceland), Surya Darma (Indonesia), Janos Szanyi (Indonesia), Suryantini (Hungary), , Alison Thompson (Canada), Gregory Ussher (New Zealand), Colin Williams (USA), Kasumi Yasukawa (Japan), Katherine Young (USA), Sadiq (New Zarrouk Zealand), Meseret Teklemariam Zemedkun (Ethiopia).

The IGA in Marrakech

The 22nd Conference of the Parties (COP22) was held in Marrakech, Morocco the past November. One of the several side events was convened by the International Renewable Energy Alliance, or REN Alliance, of which the International Geothermal Association (IGA) is a founding member. The REN Alliance was formed in 2004 during the first International Renewable Energy Conference in Bonn, Germany. It is a coalition of five



renewable industry organizations that works towards a world where our energy needs are met primarily by renewable sources. The REN Alliance mission is to demonstrate how renewables can work together in different local, national and regional contexts to meet the world's energy needs. Besides the IGA, the alliance partners are the International Solar Energy Society (ISES), the World Wind Energy Association (WWEA), the International Hydropower Association (IHA), and the World Bioenergy Association (WBA). A new website was recently launched: www.ren-alliance.org.

Since its formation, the REN Alliance has promoted and reported on how renewable energy technologies can work together to meet global energy security, economic, and environmental challenges. In this side event of the COP22, the specific objective was to demonstrate how renewable technologies working together can meet energy needs at the island, rural, city, national and regional levels.

Among the most significant challenges facing society today is the impact global climate change can have on our economies, livelihoods, and lifestyles. The COP21 Agreement, from Paris in 2015, calls for all countries to work together towards greenhouse gas reduction commitments that ultimately will result in no more than 2°C, and ideally 1.5°C, warming above preindustrial levels by the end of this century.

This is the goal the Intergovernmental Panel on Climate Change (IPCC) has established to avoid catastrophic impacts from climate change. However, the current Intended Nationally Determined Contributions (INDC's) forming a part of this agreement create an important, yet insufficient, step to be taken by national governments to achieve this goal.

During the COP22 side event the REN Alliance partners confirmed that renewable energy technologies are ready to deliver on the Paris Agreement at all levels of deployment. This was proven through the presentation of case studies and best practices being undertaken by localities, regions, and communities throughout the world. The REN-Alliance demonstrates that renewables working together can result in a decarbonized energy system, based on a global 100% renewable energy well before the end of this century, leading to the mitigation of the major environmental challenge of our time. You can watch the live stream of the event <u>here</u>.

The COP22 side event follows a side event held at COP21 in Paris. The previous event lead a discussion how technology solutions are in place for a 100% renewable future. You can read about the outcomes of the previous side event <u>here</u>.

The REN Alliance underlines that a renewable energy supply is not only good for the climate, but offers

manifold economic and social benefits, for developing and industrialized countries, alike. Renewable energy technologies are today's cheapest options when comparing new investment – as confirmed by independent organizations, like IRENA. The global transition to a renewable energy future no longer a financial burden; it will enhance economic growth and prosperity, plus mitigate climate change.

Marietta Sander, executive director of the IGA, said: "The regional geothermal development approach through the African Rift Geothermal Facility, the African Regional Geothermal Association and a regional technical assistance project through UNEP works really well in the East African countries."

Stefan Gsänger, secretary general of the World Wind Energy Association (WWEA), said: "Communities in rural areas especially can benefit tremendously from the global shift towards 100% renewable energy: They may not only cover their own energy needs from local renewable resources, but also become suppliers of urban areas, hence creating new income opportunities for themselves. This will boost rural areas in industrialized and in particular in the so-called developing countries."

Dr David Renné, president of the International Solar Energy Society (ISES), said: "Renewables working together in island settings can achieve complete energy independence and security for these communities by eliminating the need for expensive imported diesel fuel."

Remigijus Lapinskas, president of the World Bioenergy Association (WBA), said: "Bioenergy enables us to create jobs in rural areas, improve the ecological situation in the cities, strengthen the security of supply, national energy independence and could be developed in the regional level leading to cooperation in science, technology and business."

Richard Taylor, chief executive of the International Hydropower Association (IHA), said: "The information presented at today's event demonstrates the power of renewable technologies working together. Depending on the available renewable resources, we need to combine the positive characteristics of each technology to deliver robust and reliable systems, including renewable storage. Governments, investors and lenders need to take a systems approach to increase the rate of progress."

Sources:

http://www.energycentral.com/c/cp/renewables-thenlook-ren-alliance?utm_source=2016-11-

23&utm_medium=eNL&utm_campaign=CP_WEEKL Y&utm_content=214475, https://www.geothermalenergy.org/publications_and_services/news/article/pre ss-release-cop22-renewable-energy-technologies-readyto-deliver.html

Next IREC to Be Held in Mexico City

The Government of Mexico announced that it has teamed up with REN21 –the Renewable Energy Policy Network for the 21st Century– to organize the next International Renewable Energy Conference (IREC) in Mexico City from 11-13 September 2017, within the framework of the Strategic Dialogues on the Future of Energy.

Dedicated exclusively to the renewable energy sector, IREC is a high-level political conference series hosted by a national government every two years and convened by REN21. Each IREC acts as a common platform for government, private sector and civil society leaders to jointly address the goal of advancing renewable energy and has provided the impetuses for several momentous initiatives over the past decade. IREC 2017 in Mexico will continue to build upon the successes and outcomes of the previous conferences held in South Africa (2015), Abu Dhabi (2013), Delhi (2010), Washington D.C. (2008), Beijing (2005) and Bonn (2004).

On the announcement, the Secretary of Energy of Mexico, Pedro Joaquín Coldwell, commented: "Latin America has an opportunity to showcase its rapidly growing renewable energy industry and gain from the best practice as adopted in countries at the forefront of renewable energy deployment. Mexico, after having successfully completed its energy market reform, is well placed to host such an event and we are honored to partner with REN21 in this endeavor."



Arthouros Zervos, Chair of REN21, added: "REN21 is pleased that Mexico will be the next IREC host. We are convinced that MEXIREC will further boost Latin America's emerging renewable energy industry and provide a global platform showcasing how renewable energy sources provide a significant opportunity to improve energy security, mitigate greenhouse gas emissions, ensure sustainable development and significantly improve socio-economic development."

Further information will be available at <u>www.ren21.net/irec</u>.

Source: REN21 Press Release.

Good bye to the IGA

Marietta Sander



I wish to express a big word of thanks to all IGA members and IGA Board members of the terms 2010 - 2016 for the excellent collaboration, inspiring discussions, continuous support and great local insights. It was a privilege and honor for me working as IGA Executive Director over the last six years. I particularly enjoyed seeing the IGA outreach (and tasks) grow and improve since the set-up of the IGA Secretariat in Bochum, Germany in early 2011.

I wish you all the very best and hope for great upcoming accomplishments in the geothermal energy sector.

GRC 40th Annual Meeting Held in Sacramento

Marcelo J. Lippmann, IGA Information Committee

The 40th Annual Meeting of the Geothermal Resources Council (GRC) was held in Sacramento, California, from the 23rd to the 26th of October 2016. Associated with it was the 2016 GEA (Geothermal Energy Association) GeoExpo+.

Attendance was slightly higher than last year's event about 1,250 people from around the world. This year 714 people from 32 countries (including 73! students) registered for the GRC meeting and about 550 for the GEA Expo+.

Before the start of the meeting there were workshops on "Conceptual models of geothermal systems", "Reservoir simulation" and "Best practices in O&M", as well as a field trip to The Geysers featuring injection (*see* note below) and one to the headquarters of the California Independent System Operator (CAISO) in Sacramento. On Thursday, October 27, following the meeting, there was a second field trip to The Geysers featuring EGS.

The GRC meeting included technical sessions on Geology, Geochemistry, Geophysics, Drilling, Reservoir Modelling, Field Operations, Power Plants, EGS, Environmental/Regulations, "International Updates", The Geysers, Case Studies, Direct Use, Desalination, Business and Country Updates, Tools and Instrumentation, "Geovision" and "GEO 101". In addition to the oral presentations, posters were displayed on the topics just mentioned and on Exploration and Emerging/Production Technologies for the entire meeting.

Some of the highlights of the meeting were the Opening Session, Monday's International Luncheon, Monday evening's "GRC Mixer", Wednesday's Award Luncheon, the workshops and field trips. During the International Luncheon, which was sold out before the start of the conference, talks were given on "Mexico -International Cooperation" and on "Mexico - Resource Expansion".

At the Awards Luncheon, seven outstanding GRC members were honored. The Joseph W. Aidlin Award was presented to Anna Carter; the Geothermal Pioneer Award to Wilfred Elders; the Henry J. Ramey, Jr. Geothermal Reservoir Engineering Award to John Pritchett; the Ben Holt Geothermal Plant Award to Dan Hoyer; and the Geothermal Special Achievement Awards to Aroha Campbell, Dale Merrick and Paul Spielman.

A more detailed summary of the GRC Annual Meeting and the GEA GeoExpo+ is included in the November/December 2016 issue of the *GRC Bulletin*; there will be additional coverage of the meeting in the January/February 2017 issue. Over 500 photographs from the event are available on the GRC Flicker website at

https://www.flickr.com/photos/geothermalresourcesc ouncil/.

GRC 40th Annual Meeting – The Geysers Field Trip

Susan Fox Hodgson, IGA Information Committee



This is the first power plant ever built at The Geysers Geothermal Field—a famous misnomer, of course, as the field has no geysers. The tiny power plant went on line on January 13, 1923, generating 35 kilowatts of electricity. Note that the small wooden building was constructed next to a tall tree, quitted of branches and bark to support the transmission lines. This was the first geothermal power plant in the Western Hemisphere. From a GRC photo; watercolor by Susan Fox Hodgson.

Before the 2016 Annual Meeting in October, the GRC sponsored a trip to The Geysers Geothermal Field featuring the importance of treated wastewater for generating electrical power at the field (it's critical). Eight people including myself—all IGA and GRC members—signed up for the tour led by Mark Walters, Senior Geologist for Calpine Corporation. We learned how The Geysers reservoir is not recharged from groundwater but needs injected water to generate enough steam to make the field operations possible.

For this reason, two projects in surrounding communities pipe a daily total of 18 million gallons (68.13 million liters) of reclaimed injection water up to the field's two operating companies: Calpine Corporation and the Northern California Power Agency. Our group is pictured here standing in front of the water pumps at the base of the *Santa Rosa Geysers Recharge Project* where some reclaimed water begins its journey up to the field. The second project, east of the field, is called the *Southeast Geysers Effluent Pipeline Project*.

The many, continuous geophysical records kept at The Geysers include ones for injection wells and seismic events. "There are very encouraging signs from our current injection efforts," Calpine Senior Geophysicist Craig Hartline said. "The rates of seismicity are significantly declining—we are very near a mass balance."

He noted that at the end of October 2016, Calpine operations at The Geysers included 13 geothermal plants, about 325 active steam production wells, and about 53 active water injection wells producing about 720 MW—about 18 percent of California's renewable power.

"I feel the trip was highly successful," Mark Walters told me, "mostly because there was sufficient time to visit the extent of the steam field and visually grasp this rugged area of more than 30 square miles. There are about 80 miles of steam pipelines and 69 miles of waterinjection lines. The exhibits at the Calpine Visitor Center we saw after the field tour allowed everyone the chance to encapsulate their experiences into a comprehensive, 'big picture' view of the field."



The group includes three members from Iceland, three from Kenya, and one from Taiwan. Top row, left to right: Maurice Nduranu, Jóna Bjarnadóttir, and Mike Sherman, Geysers Operation and Maintenance Coordinator, City of Santa Rosa. Second row, left to right: Caroline Wanjiru Karugu, Margrét Edda Ragnarsdóttir, Tai Rong Guo, Mark Walters, Gershom Otachi Bw'Omanwa, and Ásgerdur Kristrún Sigurdardóttir. Photo by S. Hodgson.

AFRICA

Ethiopia: New Developments in Geothermal Energy

Plans to Harness 5,000 MW of Geothermal Energy – The Ethiopian Ministry of Mines, Petrol and Natural Gas has made public the country's plan to harness 5,000 MW of geothermal energy by 2037. The newly appointed Minister, Motuma Mekassa, said Ethiopia is working intensively to developing renewable energy sources like geothermal energy and to expand its partnership with other African countries, while addressing the opening of the 6th African Rift Geothermal Conference (ARGeo-C6) held at the United Nations Economic Commission for Africa Conference Center (UNCC) in Addis Ababa in early November. The ARGeo-C6's theme was Geothermal Energy Solution for Africa's Energy Needs and the conference ended on 6 November 2016.



According to Motuma, Ethiopia has identified 22 geothermal prospective sites. He said that the country has already started developing Aluto-Langano and Tendaho geothermal fields. It was noted that the two sites, respectively, will generate 70 MW and 100 MW of energy when they become fully operational.

The UNEP and ARGeo program has successfully completed an integrated geo-scientific study of Tendaho (Dubti-Ayrobera).

Motuma underscored that Ethiopia is highly interested to work cooperatively with other African countries so as to integrate regional infrastructure, networking, building, advice on policies and win-win relationships.

Lack of finance and well trained human power in science and technology are mentioned as the twin challenges that have hurt the African continent in its bid to harness more energy sources.

Ethiopia has the potential to produce 45,000 MW from hydropower, 1350 GW from wind, 7,000 MW from geothermal, and 5 kWh/day from solar energy.

Source:

http://www.waltainfo.com/index.php/news/detail/254 98 **Technical Support from Kenya -** Ethiopia is keen to further develop its geothermal potential by drawing lessons from neighboring Kenya, which is further along in using its geothermal potential, the Geological Survey of Ethiopia (GSE) disclosed. Kenya possesses advanced technologies needed to develop geothermal energy and the country is willing to share its technological capability with Ethiopia.

Cornel Ofwona, Acting General Manager-Drilling and Infrastructure at Geothermal Development Company-Kenya (GDC) said, "We are partnering very well with fellow countries in the region, especially with Ethiopia. We collaborate in terms of sharing expertise, sharing equipment, and also helping each other in organizations by organizing workshops We are going to assist our brothers here in Ethiopia to develop this resource. In the past year, we have assisted with a drilling a project for the Aluto Langano Geothermal Power Plant. Our company, GDC, sends teams of experts and equipment."

> Ethiopia can learn a lot from Kenya's success developing its untapped geothermal potential, Ofwona said, indicating the possibility that Ethiopia can get drilling rigs from Kenya and use them to develop its huge geothermal resource. Chief Geologist, Hundie Melka from Geological Survey of Ethiopia, said

the country is drawing lessons from Kenya by paying visits to its geothermal sites and offering training to personnel in the sector. At 660 MW, Kenya is currently a leading nation in developing geothermal energy in the region, while the country is also leading Africa in the development of geothermal energy.

Ethiopia will also benefit from the Africa Geothermal Centre of Excellence (AGCE) to be established in Kenya for building capacity in geothermal technology, according to the Chief Geologist. Over 22 sites in the Ethiopian Rift Valley have been identified by GSE for having good quality geothermal resources—with an estimated electric potential of over 10,000 MW, Hundie said.

Source:

http://www.ena.gov.et/en/index.php/economy/item/ 2212-ethiopia-desirous-to-build-up-geothermal-potential

Kenya: Drilling, Menengai, Exploration, Auctions, Eburru, Geothermal Side-effects, Olkaria V

Chinese Company to Drill Directional Wells in Menengai - The government's Geothermal Development Company (GDC) has contracted with the Great Wall Drilling Company Ltd. to drill directional geothermal wells in the Menengai geothermal field. Menengai is a major Quaternary caldera volcano and is one of 14 geothermal sites in Kenya. It is located inside the axis of the central segment of the Kenya Rift, about 60 km north of the Olkaria geothermal field. Geothermal drilling in Menengai started in 2011.

In early October, a brief signing ceremony was held for the GDC Managing Director & CEO, Johnson P. Ole Nchoe, and the Great Wall's director, Mr. Wei Yong Chen. "GDC is pleased to once again partner with Great Wall; under this contract Great Wall will drill 16 directional wells in Menengai," noted Ole Nchoe, who was appointed as GDC chief in April 2016.

In 2009/2010, Great Wall worked with GDC in drilling several GDC wells in Olkaria under a contractual arrangement. Directional drilling will supplement vertical drilling, which predominatese in the Menengai field. With this technique, it will be possible to drill several wells on one well pad, thus saving money and time.

Source: <u>http://www.oilnewskenya.com/gdc-contracts-great-wall-for-directional-drilling/</u>



Delay in Plants Commissioning in Menengai - In mid-October 2016, the government gave three Independent Power Producers (IPPs) 30 days to start producing electricity in the Menengai geothermal field or have their contracts terminated. Energy and Petroleum Cabinet Secretary Charles Keter said there is enough steam at the Menengai Crater to add 105 MW of electricity to the national grid. He said the continued delay by the three IPPs was hurting GDC's operations.

There has been controversy over the amount of steam available at the site and its sustainability, with the IPPs claiming there is not enough for power generation. Keter said GDC has already consumed a whopping Sh40 billion (US\$395 million) of taxpayers' money to drill 35 steam wells at Menengai Crater. He said because the new wells have the capacity to produce 137 MW, GDC has already fulfilled all conditions in the contractual agreements in the IPPs.

The producers, who include Quantum East Africa and OrPower 22, were supposed to set up their power plants by December last year. The investors, who were selected through competitive bidding in 2013, are mandated to build and operate three geothermal plants in Menengai, each generating 35 MW. Construction was supposed to have started in October 2013 and be completed by the end of last year.

Source:

http://www.standardmedia.co.ke/article/2000219962/c s-charles-keter-puts-power-producers-on-30-daynotice/?pageNo=1

GDC Ready to Provide Steam in Menengai - According to GDC Corporate Communications Manager Ruth Musembi, the field is now ripe for electricity production. GDC projects to generate Sh1.7 billion (US\$16.7 million) from sale of steam to operate the three power plants. "All the paperwork is completed and GDC has already signed a project-implementation and steam-supply agreement with the power producers," she stated. Musembi said that by 2018, Menengai fields are expected to generate at least 105 MW under phase one of the multibillion dollar project.

Apart from Menengai, Musembi revealed that plans were at an advanced stage to launch the Baringo-Silale project where phase one is targeted to generate 200 MW. "Drilling the fields is expected to begin in early 2017 and GDC has already acquired an environmental and social impact assessment license, allowing for the exploitation of the massive resources," she said. The first phase is funded by the government and development partners who have provided a loan of Sh8 billion (US\$78.7 million). GDC says a 70 km access road has been completed while the water supply and drilling services contracts were being awarded.

The state corporation is also exploring the prospect of developing an initial 150 MW at the Suswa Field. The site has an estimated potential of 750 MW when fully developed. "We have already completed the scientific studies and infrastructural designs and GDC is awaiting a go ahead from the government to commence drilling activities at Suswa," said Ms Musembi.

Source: Geothermal Energy Association Weekly, No. 42

Deal Between GDC and the Forests Regulator – Another pending issue in Menengai seemed to be the use of the land. In late November, GDC agreed to pay Sh114.9 million (US\$1.13 million) per year to the forest

regulator, the Kenya Forest Service. KFS owns the Menengai geothermal site where GDC drilled the wells and the private companies will construct the power plants.

"We have now concluded the lease agreement and have paid. Now we are issuing sub-leases to the power producers," said Johnson Ole Nchoe, chief executive at GDC.

GDC has already signed a deal with Ormat Technologies, Quantum Power and Sosian Energy to supply the steam at a cost of US¢3.5 (Sh3.05) per kilowatt hour. "They could not close funding without the land leases," Mr Nchoe said in an interview.

The state-owned steam developer has leased 4,591 hectares (11,492 acres) from KFS and will pay "a conservation fee" of Sh10,000 (US\$ 98) per acre per year, as provided for in the Forest Act.

Mr Nchoe said the power firms will pay sub-lease only for the land where they construct their plants, with the largest piece being four acres, translating into a yearly fee of Sh40,000 (US\$392). The managing director said the firm had settled pending payments totaling Sh500 million owed to the engineering firm H Young, which is constructing the steam-gathering system.

GDC has in the recent past been steaming with headwinds such as tendering irregularities and fraud, which have slowed down projects and scared away multilateral financiers. Construction of the electricity plants is now rescheduled to start in February 2017 and is expected to take about 18 months.

Source:

http://www.nation.co.ke/lifestyle/smartcompany/Thre e-steam-power-plants-built-Geothermal-strikes-Sh115m-deal/1226-3467864-ihgjgiz/index.html

Promotion of Geothermal Exploration - Kenya is seeking to promote private investment into the geothermal energy sector through a review of policies. The Principal Secretary for Energy and Petroleum, Joseph Njoroge, said on early October that under the new regulations, private sector will be given land concessions to explore for geothermal steam. "The aim is to enable the private sector to complement governmental exploration efforts so as to increase the amount of geothermal electrical production in the country," Njoroge added.

According to the Ministry of Energy, over 90 percent of Kenya's electricity production comes from renewable sources. "Geothermal is now a significant source of energy. About 50 percent of all electricity produced from renewable energy comes from geothermal sources," Njoroge said. He said also that Kenya has exploited less than five percent of its geothermal resources, partly due to "...a deficit in financing

UPCOMING EVENTS

<u>42nd Stanford Geothermal Workshop</u> 13-14 February 2017, Stanford, California, U.S.

Latin American Geothermal Symposium 14-15 February 2017, Offenburg, Germany

GeoTHERM 2017 Expo & Congress 15-16 February 2017, Offenburg, Germany

8th European Geothermal PhD Days 1-3 March 2016, International Geothermal Center (GZB), Bochum, Germany

24th Annual Congress of the Mexican Geothermal Association 29-31 March 2017, Morelia, Mich., Mexico

International Renewable Energy Conference 11-13 September 2017, Mexico City

German Geothermal Congress (DGK 2017) 12-14 September 2017, Munich, Germany

41st GRC Annual Meeting & Expo 1-4 October 2017, Salt Lake City, Utah, U.S.

Note: Please check the <u>IGA website</u> for more events.

geothermal projects." The government plans to cooperate with the private sector to ensure more electrical generation from geothermal energy, the official said.

Source: <u>http://www.coastweek.com/3941-Kenya-seeks-investment-for-geothermal-energy-sector.htm</u>

For his part, Alberto Mugo, MD of the Kenya Electricity Generating Company (KenGen), said the company has begun a geothermal development study with a view to producing more power. He added that Kenya has the potential to produce 10,000 MW of geothermal energy from 23 sites, but added that "...so far we have only tapped the cost of geothermal exploration. This has for years remained the biggest impediment," he said, "but despite the challenge, we have seen the number of geothermal wells rise from two in the 1970s to 218 currently".

Source: <u>http://www.the-</u> star.co.ke/news/2016/10/12/kengen-startsgeothermal-study-to-produce-more-untappedpower_c1436099

Competitive Auctions to Replace the Current Feedin Tariff System – Kenya's Energy Regulatory

Commission (ERC) is reported to be in the process of drafting new regulations that are expected to be implemented by the end of March 2017. The new regulations are expected to introduce competitive auctions for awarding renewable energy projects in Kenya, shifting from the current feed-in tariff regime under the Feed-in Tariff Policy 2012 that offers tariffs for small renewable projects up to 10 MW and for large renewable projects above 10 MW.

Currently the feed-in tariff system offers developers and investors pre-determined rates for wind, geothermal, solar, biogas, hydro and biomass energy power projects without any requirement for tendering. As is typical in renewable-energy programs in other developing markets, the feed-in tariff system offers developers reliability, transparency and equality.

The main argument to move away from feed-in tariffs and adopt a competitive auction system is to introduce competition amongst project developers and investors in order to achieve lower pricing. The ERC believes that this new approach will encourage project developers and investors to reduce tariffs. This will ultimately benefit the end consumers.

Source:

http://www.lexology.com/library/detail.aspx?g=98237 d4e-0abe-46b0-90a7-2bba88e73459

Eburru Geothermal Wellhead Plant to Be Expanded to 25 MW - KenGen has announced a project to renovate the Eburru power station and increase its production tenfold in the next two years. According to the company, plans are underway to increase the current power production from 2.4 MW plant to 25 MW between 2018 and 2019. KenGen's Geothermal Resources Development Manager, Peketsa Mangi, said geo-scientific studies were already under way in Eburru. He said the company will drill more wells in the area to reach the targeted power capacity in two years. The original modular 2.4 MW geothermal wellhead plant was commissioned in 2102. Geothermal Development Associates (GDA), of Reno, Nevada, USA, designed the plant and the steamfield and supplied all of the major equipment. This was a major milestone for KenGen, as it was their first geothermal wellhead power plant in commercial operation.

Mangi also noted that currently geothermal contributed to 51 percent of power used in the country, adding this is one of the main reasons that the cost of electricity has come down. "We have seen the cost of electricity in the country drop by over 20 percent in the last one year and this is due to the move to increase in geothermal power and reduction in thermal power."

Source:

https://www.standardmedia.co.ke/business/article/200

0226259/kengen-reveals-plan-to-upgrade-eburru-plantcapacity-tenfold



The wellhead plant. Photo by Geothermal Developers Associates (<u>http://www.qdareno.com/power/projects/eburru</u> <u>-kenya-2-4-mw-geothermal-wellhead-powerplant/</u>

Geothermal, More than Power Production - In Africa it is very common for people to walk long distances to fetch water for domestic use. At the Menengai Geothermal project in Kenya, this has changed. Once, community members had to walk up to 12 kilometers in search of clean water. As part of its corporate social responsibility (CSR) program, the Geothermal Development Company (GDC) has drilled 10 large wells, one of which is dedicated to the community.

Water from the borehole is pumped into a four millionliter tank, and distributed to neighboring households through a water kiosk. About 3,000 families and a school are benefitting from the water, as well as livestock. The CSR activity is one of the key, indirect benefits of the project. The main impact is that of boosting the energy supply.

Launched in 2012, the Menengai Geothermal Development Project seeks to develop a geothermal steam field meant to produce enough energy to generate 400 MW of power generation facilities built by the private sector and/or in partnership with the Government. It aims at addressing Kenya's increasing demand for power and, at the same time, diversifying sources of the power supply by developing the country's huge geothermal potential. The addition is equivalent to 26 percent of the country's total installed generation capacity.

The project also provides employment opportunities for the younger generation in the region—between 30 and

60 youths have gained monthly employment, according to the GDC.

The company has embarked on a pilot project for direct use of geothermal energy. The aim is to demonstrate the other benefits of using geothermal, apart from power generation. The pilot is in four areas: geothermally heated aquaculture ponds, greenhouses, dairy units, and laundry facilities.

Source: <u>http://www.thinkgeoenergy.com/afdb-</u> geothermal-plays-an-important-role-for-africa-beyondelectricity/

KenGen to Sale Valuable Minerals in Geothermal Fluids - KenGen is eyeing the sale of valuable minerals, like silica and lithium found in geothermal fluids, as a strategy to diversify its revenue base. The State-owned power generator is seeking a consultant to assess the feasibility of extracting minerals from the hot brines.

KenGen managing director, Albert Mugo, said the firm is turning to innovation to exploit the minerals found in geothermal fluids. "We want an expert to establish the technical and financial viability of this project," Mugo said in early December. He declined to offer any timelines or capital commitments, saying it is still "very early" in the project cycle. "If it is found feasible, we'll go ahead," he said.



The new venture of using geothermal by-products will potentially cut KenGen's reliance on electricity sales to the national grid, which accounts for 94 percent its income. Total revenue hit Sh38.6 billion (US\$ 378 million) in the year up to June 2016, with net profit nearly halving to Sh6.7 billion (US\$66 million)—hurt by a lack of tax credit enjoyed in the previous year, surging finance costs, and higher expenses.

"The consultant will carry out field testing and other studies necessary of the geothermal fluids in Olkaria Geothermal Field to establish the actual available quantity of the minerals and viability of the mineral extraction project," KenGen said in its tender documents.

KenGen said brine from its Olkaria fields contains about 600-800 milligrams of silica per kilogram of fluid and between 1.5 and 2 mg of lithium per kg of fluid. Silica, which clogs tanks and pipes during geothermal generation, is used in the pharmaceutical and glass industry, as well as for making a range of resins. Lithium is mostly used in making batteries, toys, in medicine to make pacemakers and combined with aluminum to form an alloy that is used in making high-speed railcars and planes. The mineral is currently trading at about US\$ 7,475 per ton in the global markets.

Source: <u>http://www.energycentral.com/news/kengen-eyes-sale-valuable-minerals-geothermal-</u>

fluids?utm_source=2016_12_06&utm_medium=eNL& utm_content=214475&utm_campaign=GENERATIO N

KenGen Secures Loan for Olkaria V - The Japan International Cooperation Agency (JICA) has lent KenGen ¥45.7 billion (US\$401.3 million, Sh40.9 billion) for the Olkaria V project, which involves putting up two geothermal power plants of 70 MW each. Albert Mugo, Managing Director, said the drilling has been completed and the company will start the construction soon. The first plant will be ready to begin generating electricity in 24 months (at the end of 2018) and the second unit will be completed six months later, according to KenGen. Part of the project will be financed using KenGen's cash reserves, including proceeds from the recently concluded rights issue which raised Sh6.35 billion (US\$62.3 million) from minority shareholders. The total cost of the project is estimated at US\$555 million-at US\$3.96 million per megawatt.

The Kenyan Treasury, which controls 70 percent of KenGen, participated in the cash call by converting into equity Sh20.15 billion (US\$197.5 million) of loans advanced to the power producer. Albert Mugo said Olkaria V is the only new project the State-owned power producer will build this fiscal year that ends in June 2017.

Source:

http://www.businessdailyafrica.com/Corporate-News/KenGen-to-build-new-Olkaria-plant-/539550-3470668-is5okrz/index.html

AMERICAS

Canada: Saskatchewan and Kitselas Geothermal Projects

Saskatchewan Project to Start Drilling in February 2017 - With its project in Saskatchewan, Deep Earth Energy Production (DEEP) has been trying to get an

important pilot project up and running. The company plans to start drilling in February 2017 as part of a US\$8 million feasibility study. The investment is coming from Regina-Saskatchewan based MPM Construction Services, which is investing in the company for equity. The working plan and the project final reporting will be conducted by GeothermEx.

Kirsten Marcia, DEEP CEO, says the project will require a total investment of US\$45 million. Preliminary results on the project site are promising and suggest it is a utility-scale project that will be economically and technically viable. For the state utility, SaskPower, it is an interesting first step to acquire baseload renewable energy power. A term sheet for a potential PPA is currently being discussed.

Marcia says DEEP aims to produce the first baseload power in 2.5 years due to the long lead time on turbines. The project currently anticipates 5 MW net power capacity from a 10 MW plant. Half of the power will be consumed driving the system—which could double if the study shows it is the best option.

Sources:

http://www.albertaoilmagazine.com/2016/10/saskatch ewan-unsung-hero-green-energy/, http://www.thinkgeoenergy.com/saskatchewangeothermal-project-to-start-drilling-in-february-2017/

Kitselas Geothermal Project in BC - The Kitselas Geothermal Power Generation Project is a project of LL Geothermal Inc., a company formed by Kitselas Development Corporation and Borealis Geopower. It is positioned to be one of Canada's first geothermal power plants. The plant would have a capacity of 15 MW of electricity and the potential to provide another 135 MW of thermal energy as a main heat source for local businesses. The project is located in the Lakelse area, about 10 kilometers south of Terrace in northwest B.C., within the Kulspai Indian Reserve No.6 own by the Kitselas First Nation.

With support from B.C.'s First Nations Clean Energy Business Fund, Kitselas First Nation is pursuing private power purchase agreement partnerships with major project proponents. These partnerships will support the exploratory drilling stage for the proposed Kitselas Project. The Kitselas First Nation will receive CAD 10,000 (US\$ 7480) in capacity funding to support negotiations with major project proponents to establish private power purchase agreements for the sale of electricity from the proposed plant. Kitselas will also seek a private power purchase agreement with a local buyer for thermal energy produced by the plant.

In 2013, Kitselas First Nation received CAD 40,000 in capacity funding from the Province to support the geothermal permit proposal and the formation of LL Geothermal Inc. The private Borealis Geopower is a Canadian corporation specializing in advice about the geothermal energy industry. The Kitselas Development Corporation is the economic arm of Kitselas First Nation.

Chief Joseph Bevan, of the Kitselas First Nation, said, "Clean geothermal energy is a key priority for Kitselas First Nation. The funding provided by the Province will help us garner the necessary financial assistance to support the completion of this project that will bring many benefits to our community. This includes longterm energy security and powerful economic benefits through power purchasing agreements."

Source:

https://news.gov.bc.ca/releases/2016ARR0055-002333

Caribbean: US\$15 Million Available for Dominica's Project

In December 2012, the Dominica Government signed a US\$18.1 million contract with the Iceland Drilling Company for geothermal exploration. The three test wells constructed in Trafalgar, Wotten Waven and Morne Prosper were followed by four flow tests to determine the generation capacity of the wells.

Now, US\$15 million has been set aside to develop the



Geothermal well in Roseau Valley. Photo by DaVibes, The Caribbean's News Portal.

island's geothermal resource in Dominica. In October, Prime Minister Roosevelt Skerrit stated, "We had made an initial commitment of US\$10 million as the government's cash injection into the construction of the production plant and we have since increased the amount to US\$15 million that the government will be putting in."

Since 2014, the Government of New Zealand has been providing the Government of Dominica with Technical Assistance for the development of Dominica's geothermal resources. In September 2016, both governments expanded their cooperation in geothermal energy development with the signing of a 4 million EC dollars partnership agreement to support the construction of a 7 MW geothermal power plant in Dominica.

Apart from New Zealand, Skerrit informed that his government has received "...a very firm commitment from the government of the United Kingdom which will be providing us with between US\$9 and 10 million toward the geothermal plant".

In addition, a geothermal resources development bill –a critical piece of legislation to facilitate investment in geothermal energy– was tabled in Parliament in October 2016. The bill has been extensively reviewed by regional and international partners.

The Government plans to, once the geothermal plant is operational, offer shares to the Dominican public. According to Mr. Skerrit, the Government plans to dispose of as much as 40 to 50 percent of its ownership in the geothermal plant.

Source: http://www.dominicavibes.dm/featured-213414/

Chile: Grant to Boost Chilean Geothermal Market

The World Bank Board has approved a US\$1.8 million Clean Technology Fund grant to strengthen the Chilean Ministry of Energy's capacity to further develop the country's geothermal sector and improve energy security. The grant will contribute to Chile's Energy Agenda and Energy Policy 2050, which aim to boost the use of non-conventional renewable energy (NCRE) and reduce the cost of electricity.

The World Bank said in mid-October that the Government of Chile has made a concerted effort to develop its nascent geothermal energy industry. Despite what appeared to be a promising start, a number of issues have stymied exploration investments. The goal of the new funding is to resolve those issues and improve the geothermal energy-market conditions.

"Developing geothermal technology allows Chile to meet its growing energy demand, provide energy



Geothermal zones and active volcanoes en Chile. Total potential is estimated at 3350 MW.

The Ministry of Energy will be the lead implementing agency for the project, with support from the International Cooperation Agency of Chile within the Ministry of Foreign Relations. The grant has a four-year implementation period, the World Bank said.

Source:

http://www.renewableenergyworld.com/articles/2016/ 10/world-bank-approves-1-8-million-grant-to-boostchilean-geothermal-market.html

Costa Rica: Plant for Las Pailas II, Almost 100% Renewable Electricity

Mitsubishi to Provide Las Pailas II Power Plant – The Costa Rican state utility, the Instituto Costarricense de Electricidad (ICE), secured a 55 MW steam turbine for the Las Pailas II geothermal power plant in the Guanacaste Province of Costa Rica. Mitsubishi Hitachi

Power Systems (MHPS) will supply the turbine for the project. Costa Rica ranks eleventh, worldwide, in terms of geothermal power-generation capacity. In recent years, the demand for electric power has been increasing in step with the country's steady economic growth. In response, ICE is focusing on building new geothermal plants and expanding the output of existing facilities. MHPS has delivered equipment to two of Costa Rica's Miravalles geothermal plants, with a combined output of 32 MW. INITEC Energía, S.A., a Spanish engineering firm, will be in charge of engineering, procurement and construction management (EPC) for the project, according to MHPS. In addition, MHPS will provide engineers at the site for technical support installing and commissioning activities. A generator, manufactured by Mitsubishi Electric Corp., will be supplied for the project.

Source:

http://www.renewableenergyworld.com/articles/2016/ 11/costa-rican-utility-secures-turbine-for-las-pailas-iigeothermal-plant.html

Geothermal Provided 13% of Electricity in 2016 – By mid-December 2016, ICE reported most of the electricity for the year had come from renewable sources (98 percent). The agency said the country surpassed 250 days using only renewable power sources.



Electricity in 2016 came mostly from hydroelectric plants (74 percent), with geothermal plants producing almost 13 percent of the total. Costa Rica uses five renewable sources to produce electricity: hydro, geothermal, wind, biomass and solar. Fossil fuels represent only 1.9 percent of the total, since ICE considers them a backup energy-generation source.

During the dry season, the National Electric System takes advantage of the greater availability of wind and biomass to guarantee sustainable renewable generation.

ICE Executive President, Carlos Obregón, said that the institute expects electricity generation using renewable sources to remain stable through 2017. "We will open four new wind plants next year and we expect favorable meteorological conditions in the river basins that feed our hydroelectric plants," he said. The country ended with figures similar to those recorded in 2015 when generation based on renewable sources reached 99 percent.

In 2015, Costa Rica made headlines worldwide with two, long, clean-energy streaks. In March, the country ended 75 days of running the grid on 100 percent renewable sources (see IGA News 99, p. 9), and in August it broke that record by running 94 days on purely renewables (see IGA News 101, p. 8).

Source.

http://www.ticotimes.net/2016/12/16/renewableelectricity-costa-rica

Mexico: Kick-off Meeting of the **GEMex** Project

Luis C.A. Gutiérrez-Negrín, Editor

On 15-17 November 2016, the initial general meeting of the GEMex project was held in Morelia, capital city of the State of Michoacán, Mexico. The GEMex project is composed of two consortia, one from Europe and one from Mexico. The European consortium was formed from the EERA joint program of geothermal energy and is funded through the International Cooperation Programme within the framework of Horizon 2020. The IGA Service Company is one of the several parties of this consortium. The Mexican consortium is mainly composed of the CeMIE-Geo (the Mexican Center for Innovation in Geothermal Energy) led by Michoacán University (UMSNH). It is funded by the Mexican Government under a specific fund managed by the Energy Secretary (SENER) and Conacyt (the Mexican National Council for Science and Technology).

The GEMex project aims to assess the resources of two unconventional geothermal sites in Mexico: the EGS development at Acoculco and the super-hot resource at Los Humeros. To do so, the project starts by understanding the tectonic evolution, the fracture distribution and the hydrogeology in the respective regions to predict in-situ stresses and temperatures at depth. The project includes reservoir characterization using techniques and approaches developed at conventional geothermal sites, and high-pressure/hightemperature laboratory experiments to derive parameters for rock samples from Mexico or equivalent

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materials. All existing and newly collected information will be applied to define drill-paths and investigate optimum stimulation and operation procedures for safe and economic exploitation, controlling undesired sideeffects (*see* IGA News No. 105, pp. 28-29).

On November 15th, around 25 researchers and officials from the universities and agencies part of the European consortium met with their Mexican counterparts to start the meeting. The representatives for both sides, David Brunh from GFZ and Aída López-Hernández from UMSNH, greeted the participants and presented the responsibilities for each of the three Sub-projects (SP) and eight Working Packages (WP) constituting the project. Officers Susanna Galloni and Petre Petrov explained the policy context and the contractual obligations and communications within the European consortium before the first two working packages were presented. WP-1 is Project Management, including decision making, communications and organizational mechanisms. It was presented by Aída López and Egbert Jolie. WP-2 includes the dissemination and outreach policies and procedures for both parties. These were presented by Julio Vargas and Eugenio Trumpy.

The official opening was held on the morning of November 16th, with a formal ceremony including the Principal of Michoacán University and the EU Ambassador to Mexico, as well as representatives from SENER, Conacyt, CFE (Comisión Federal de Electricidad) and the Michoacán Government. Each of the six technical Working Packages were explained by those responsible. WP-3 (Regional resource models) was presented by Luis Gutiérrez-Negrín and Damien Bonté; WP-4 (Tectonic control on fluid flow) by Domenico Liotta who also spoke on behalf of his counterpart Víctor Hugo Garduño; WP-5 (Detection of deep structures) by Claudia Arango and Sæunn

Hallsdorsdóttir; WP-6 (Reservoir characterization and conceptual models) by Alfonso Aragón and Paromita Deb on behalf of Christopher Clauser; WP-7 (Concepts for the development and utilization of EGS) by Abel Hernández and Jan Diederik van WP-8 Wees; and (Concepts for the development and utilization of superresources) hot bv Ernst Huenges who also spoke on behalf his counterpart of

Eduardo González-Partida. That evening the UMSNH offered a dinner to all the participants.

On 17 November, the European parties discussed and adopted several immediate agreements, including the official project logo; the on-line platform for reporting technical progress; and the places and dates of the semiannual European meeting (March 2017 in The Netherlands) and the second general meeting (October 2017 in Iceland). After that, the Mexican and European participants of all WPs discussed how to avoid duplicating activities, organize common field campaigns, and define general interaction between themselves.

It is worth mentioning that both sites, Acoculco for EGS and Los Humeros for super-hot resources, are owned and managed by the geothermal division of CFE. CFE has a geothermal exploration permit for Acoculco, and a geothermal exploitation concession for Los Humeros geothermal field, as well as a huge amount of technical information and data on the areas. We learned that a framework agreement between the Mexican consortium and CFE was almost in force, and that all communications with CFE will be made through the Mexican person responsible, Aída López. She will receive and manage all the technical and non-technical requests from the WP's.

Outside of the official agenda, on the afternoon of November 16th, most of the European researchers went to Los Humeros and Acoculco on a short field trip conducted by Aída López, Gerardo Carrasco and Eduardo González. In Los Humeros, which is a geothermal field with an operating capacity of 68 MW, the visitors were hosted by CFE personnel headed by Heber Diez.

GEMex (Cooperation in Geothermal energy research Europe-Mexico for development of Enhanced



An additional official ceremony on the launching of the GEMex project was held in Mexico City on November 17th. Photo by SENER.

Geothermal Systems and Superhot Geothermal Systems) is one of the 11 geothermal projects under the European Union's Horizon 2020 research and innovation program. The other 10 projects are, in alphabetical order: Cheap-GSHPs (Cheap and efficient application of reliable ground source heat exchangers and pumps), CHPM 2030 (Combined Heat Power and Metal Extraction), DEEPEGS (Deployment of Deep Enhanced Geothermal Systems for sustainable energy business), DESCRAMBLE (Drilling in dEep, Super-CRitical AMBient of continentaL Europe), DESTRESS (Demonstration of soft stimulation treatments of geothermal reservoirs), GEOTeCH (Geothermal Technology for Economic Cooling and Heating), GeoWell (Innovative materials and designs for long-life high-temperature geothermal wells), MATChING (Material innovations for the optimization of cooling in power plants), SURE (Novel Productivity Enhancement Concept for a Sustainable Utilization of a Geothermal Resource), and ThermoDrill (Fast track innovative drilling system for deep geothermal challenges in Europe) (see IGA News No. 105, pp. 26-31). An additional official ceremony launching the GEMex project was held in Mexico City on November 17th.

United States: DDU Technologies & Geothermal-Hydro Hybrid Power Plant

Deep, Direct-use (DDU) Technologies, Promoted by DOE – Deep, direct-use (DDU) systems are an emerging technology area in the geothermal sector that draw on lower-temperature geothermal resources that can be tapped to provide heating and cooling to both residential and commercial buildings, manufacturing processes, greenhouses and aquaculture ponds. Deeper than geothermal heat pumps and other conventional direct-use systems, DDU is deployable at a similar temperature range—between 100°F (38°C) and 300°F (149°C)—but on a much larger scale. DDU maximizes system efficiencies and returns on investments. This new technology could result in large-scale, lowtemperature geothermal applications that create greater opportunities for geothermal resource development



throughout the United States.

The US Energy Department (DOE) is providing up to US\$4 million for research and development projects led by the private sector, universities and national labs to pursue the feasibility studies for large-scale DDU systems.

As highly efficient systems, geothermal DDU operations extract the most energy possible from the local geothermal resource. Rather than using geothermal heat to produce electricity, DDU uses hot underground fluids to directly heat and cool facilities. Directly using geothermal energy in homes and commercial operations can be much less expensive over the long run than traditional energy sources because it reduces electrical demand and replaces the need for electrically driven heating and cooling appliances.

Although direct-use is the oldest, most versatile and most prevalent form of geothermal energy, deep directuse systems have not been developed in the United States because technical, cost and institutional barriers remain. The Energy Department's new funding opportunity could help unlock these lower-temperature geothermal applications for near-term deployment and support the goals of improving energy efficiency in manufacturing and reducing the energy bills of businesses and institutions nationwide.

Source: <u>http://energy.gov/eere/articles/heat-beneath-ground-working-advance-deep-direct-use-geothermal</u>

First Commercial Geothermal-Hydro Hybrid Power Plant - Enel Green Power North America, Inc. (EGPNA), has started operations at the world's first integrated, commercial-scale, geothermal hydro-power plant at its Cove Fort site in Utah. At Cove Fort, EGPNA added a fully submersible, down-hole generator to a geothermal injection well, combining geothermal and hydroelectric power at one site.

Findings from the initial testing phase, between July and September 2016, reveal that the addition of the hydro generator to the geothermal injection well resulted in an overall increase in output of 1008 MWh for this period, offsetting the energy consumption of the Cove Fort

plant by 8.8 percent, therefore improving the plant's operational efficiency.

The innovative generator technology captures the energy of the water flowing back into the earth to generate additional electricity while also better controlling the return flow of the brine into the ground. The presence of the generator creates pressure against the brine flow, which reduces the flow's turbulence into the well, hence minimizing the likelihood of any potential damage to the well. The result is

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a first-of-its-kind innovation that can reduce operational and maintenance expenses, while also having the potential to generate additional revenues.

Cove Fort is EGPNA's second hybrid power plant to begin operations in the United States. The company also operates the award-winning Stillwater facility in Fallon, Nevada, the world's first power plant to combine medium enthalpy, binary cycle geothermal, solar thermal and solar PV technologies at the same site.

With an installed capacity of 25 MW, Cove Fort began operations in 2013 and generates up to 160 GWh of power each year, powering more than 13,000 US households while avoiding the annual emission of about 115,000 tons of CO_2 into the atmosphere.



(1) Water heated by the earth is pumped to the surface under pressure. (2) The binary power plant uses heat extracted from the water to generate electricity. (3) The cooled water or brine is returned under pressure down the injection well. (4) The downhole generator captures the kinetic energy as the water flows down the injection well and produces additional electricity. (5) The water is then reheated in the geothermal reservoir, closing the system's loop. This process repeats.

Source:

https://www.enelgreenpower.com/en/media/press/d2 01612-enel-begins-operations-at-worlds-firstcommercial-geothermal-hydro-hybrid-power-plant-.html

ASIA/PACIFIC RIM

Armenia: Second Geothermal Exploration Well Drilled at Karkar

Armenia, officially the Republic of Armenia, is a sovereign state in the South Caucasus region of Eurasia. Located in Western Asia, on the Armenian Highland, it is bordered by Turkey to the west, Georgia to the north, the *de facto* independent Nagorno-Karabakh Republic and Azerbaijan to the east, and Iran and Azerbaijan's exclave of Nakhchivan to the south.

In late November, the Deputy Minister of Energy Infrastructures and Natural Resources, Hayk Harutyunyan, announced the construction of a geothermal power plant in southern Armenia near the town of Sisian, with a capacity of 30 MW. He said the project will cost about US\$100 million and that geothermal exploration is underway.

> "We have drilled the second well, reaching the depth of 1675 meters, and we can say that the well has a geothermal resource where we can build the station, which will use the underground hot springs", said Harutyunyan. He said when it is built it will be the first geothermal power plant in the region.

> He stressed that the next step will be to prepare the feasibility study of the project and announce a tender to choose the investor who would offer the lowest price.

> The drilling near Sisisan (Karkar village) was financed by a World Bank grant worth US\$8.55 million. According to preliminary estimates, the geothermal power plant in Karkar will have a capacity of 30-50 MW.

Source:

http://arka.am/en/news/technology/som e 100 million to be invested in construc tion of geothermal plant in southern ar menia/

Indonesia: Geothermal Areas and Projects, FiT, PGE, Sarulla Project

New Geothermal Areas to Be Offered -Two geothermal working areas in Jambi and North Maluku, worth a total of US\$420 million, will be offered by the Indonesian Government to help reach renewable energy goals, a ministry representative said. The government has established 33 projects for investors after passing a geothermal law in 2014 that allows the exploitation of forested areas to tap 29,000 MW of geothermal energy potential.

The latest two projects are the 110MW Graho Nyabu power plant in Jambi, which covers an area of 109,000 hectares and has an estimated reserve of 200 MW; and

the 20MW Gunung Hamiding power plant in North Maluku on 42,100 hectares, with an estimated reserve of 265 MW. Benchmark prices offered for Graho Nyabu geothermal block are capped at 15 US\$ cents/kWh and 22.6 cents/kWh for Gunung Hamibing, according to Yunus Saefulhak, director of geothermal services at the Ministry of Energy and Mineral Resources.

Four more geothermal projects are being offered: the 10 MW Gunung Galunggung in West Java; the 20 MW Gunung Wilis in East Java; the 20 MW Marana in South Sulawes; and the 65 MW Gunung Talang-Bukit Kili in West Sumatra. According to the ministry, 25 more projects with a total capacity of about 1,500 MW will be auctioned by 2018.

Source: Mia Messina, News from the World Geothermal Energy Summit.

Inauguration of Three Power Plants - In late President Widodo December, Joko (Jokowi) inaugurated the geothermal power plants of Lahendong (Units 5 and 6) and Ulubelu (Unit 3), all owned and operated by the state oil and gas company Pertamina. The ceremony was also attended by Energy and Mineral Resources Minister Ignatius Jonan, State-Owned Enterprises Minister Rini Soemarno, President Director of Pertamina Dwi Soetjipto, as well as State-owned electricity firm Perusahaan Listrik Negaras President Director Sofyan Basir. Lahendong's Units 5 and 6 have an installed capacity of 20 MW each, while Ulubelu Unit 3 has a total capacity of 55 MW. The investment in the two geothermal projects has reached US\$532 million.

With these plants, the geothermal installed capacity in Indonesia seems to be reached 1647 MW, according to the *Yakarta Globe*. This source reported that Yunus Saefulhak said "If everything goes to plan, our capacity will soon reach 1,908 megawatts, higher than the Philippines", adding that "We will hopefully catch up with the US in 2021".

Sources:

http://www.antaranews.com/en/news/108623/lahend ong-ulubelu-geothermal-power-plant-absorb-thousandsof-workers-president-jokowi, http://jakartaglobe.id/business/indonesia-set-become-

worlds-2nd-largest-geothermal-power-producer/

Feed-in Tariff for Geothermal Energy - The government is set to introduce a feed-in tariff mechanism this month to push down the huge costs and limit the risks of geothermal exploration, in efforts to reach the country's target of generating 7000 MW of electricity from geothermal sources, a ministry official said.

The new policy aims to provide security for investors as geothermal exploration accounted for 60 percent of the investment costs, Yunus Saefulhak stated in early November. "In future, the auction of geothermal work areas will not be based on price anymore, but according to the work program and exploration commitment," he said.

The feed-in tariff policy obliges energy suppliers to purchase electricity produced from renewable energy at fixed costs. At present, the only off-taker available is state-owned electricity company PLN.

"The draft regulation is already at the State Secretariat, waiting to be signed by the President," Rida Mulyana, the energy and mineral resources director general for Renewable Energy and Energy Conservation said on November 8.

Source:

http://www.thejakartapost.com/news/2016/11/07/fee d-in-tariff-for-geothermal-energy-to-be-finalized-thismonth.html

PGE to Add up to 165 MW in 2017 – The President Director of Pertamina Geothermal Energy (PGE), Irfan Zainuddin, said current installed geothermal power generation capacity of the company is 512 MW, but is expected to reach 677 MW this year. The company expects to add 35 MW with the Karaha geothermal unit, 55 MW with the Ulubelu Unit 4, 55 MW in Lumut Balai, and 20 MW in Lahendong. "So with the additional 165 MW expected to start operation next year (2017), we expect our total geothermal power generation capacity to reach 677 MW in 2017," said Irfan. By late 2019/early 2020, PGE expects its geothermal capacity to reach up to 900 MW in total.

Source: http://www.thinkgeoenergy.com/pge-aims-toadd-165-mw-in-geothermal-power-generation-capacityin-2017/



First Phase of Sarulla Geothermal Plant to Begin Operations in January - Ormat Technologies expects to begin commercial operations in January 2017 for the first 110 MW phase of the Sarulla geothermal power

plant in Tapanuli Utra, North Sumatra, Indonesia, Ormat CEO Isaac Angel said in early November. He said the project is in the commissioning and "finetuning" stage. Commercial operation has been delayed briefly due to a work stoppage. Ormat, as part of an owner consortium with PT Medco Energi International, Itochu and Kyushu Electric, is developing the Sarualla project in three 110 MW phases. "For the second phase, engineering and procurement has been substantially completed, site construction is in progress and all of the equipment to be supplied by Ormat was delivered," Angel said. "For the third phase, engineering and procurement is still in progress, construction work at the site is in progress and manufacturing of equipment to be supplied by Ormat is underway as planned." He added that drilling activities for the second and third phases are still going on. "Based on the preliminary estimate, the project has achieved to-date approximately 80 percent of the required production and injection capacity," Angel said. Operation of the second and third phases is expected to commence within 18 months after the commercial operation of the first phase.

Source:

http://www.renewableenergyworld.com/articles/2016/ 11/first-phase-of-sarulla-geothermal-plant-set-to-beginoperations-in-january-17.html

Iran: 55 MW Power Plant to Be Installed in 2017

Hamid Chitchian, the Iranian Energy Minister, said in early October the country's first geothermal power plant will be launched by September 2017. This is a 55 MW

plant to be located in Meshgin Shahr, Ardebil Province, near the Azerbaijan border in the northwest. It will be the first geothermal power station in the Middle East.

"Iran does not need foreign knowhow, including any from Iceland, New Zealand and the Philippines, to drill wells for geothermal energy," Chitchian said, during a tour of the site of the power station in early October. "The plant's turbine and generator are purchased from Italy and will be delivered in two months," the minister noted.

The plant will be installed on the heights of the volcanic Sabalan Mountain in the Ardebil region that attracts millions of tourists to its famed hot springs, believed to have health benefits.

Chitchian also hopes the Meshgin Shahr geothermal plant will help steam-related industries like greenhouses, fish farming and tourism.

With huge hydrocarbon reserves, Iran has based its power industry largely on oil and gas. According to government data, around 62,000 MW, or 80 percent of Iran's 75,000 MW output, is generated from thermal plants burning fossil fuels. In addition, 12,000 MW comes from hydroelectric plants and 1,000 MW from the sole nuclear powered plant in Bushehr. Solar and wind power account for 241 MW.

Source:

https://financialtribune.com/articles/energy/51404/ira ns-geothermal-power-plant-launch-slated-for-2017

Japan: Recent Activities of the Japan Young Geothermal Network (JYG-Net)

Daisuke Oka (Geological Survey of Hokkaido) and Hanae Saishu (AIST)

The Japan Young Geothermal Network (JYG-Net), established in 2014 to facilitate the interaction among young engineers and scientists, was approved as the Technical Division of the Geothermal Research Society of Japan (GRSJ) in April 2016. It has held two regional seminars and the first annual meeting in Koriyama, Fukushima Prefecture.



Listening to a lecture at the Matsukawa geothermal power plant. Photo by the authors.

In the summer of 2016, the JYG-Net carried out its first big event in two geothermal areas in Kyushu and Tohoku, Japan. In Kyushu, 10 members participated in a field excursion to the Hatchobaru geothermal power plant and Kuju geothermal power plant in Oita Prefecture on August 29, and in a seminar at Nishijin Plaza, Fukuoka City the next day. In the seminar, three presentations were given on general information and the applications of geothermal energy, including specific fields of information and research techniques.

In Tohoku, 15 participants attended a seminar at the Onsen Hotel Taikan, in Morioka, Iwate Prefecture, on September 1. Five gave presentations on geothermal power generation and shallow geothermal systems related to using heat pumps. The next day, the participants traveled to the Matsukawa geothermal power plant, which has been in operation since 1966. They learned about the history of the first geothermal power plant in Japan, from the early-stage exploration to the inauguration of the operation, all of which took place before any of the field trip participants were born. This was the first time many participants had visited a geothermal power plant and attended a seminar with various themes. The events offered good opportunities to discuss the other participants' studies and work.

On October 19, a luncheon meeting, which included the first annual business meeting of JYG-Net and a series of lectures, was held at the Koriyama Central Community Center in Fukushima Prefecture with 39 young GRSJ members. It was a side meeting of the 2016 Annual Meeting of GRSJ. In the business meeting, Dr. Hanae Saishu from the National Institute of Advanced Industrial Science and Technology (AIST) was elected as the first chairperson of JYG-Net. Following the election, there were two lectures. One was on the Matsukawa geothermal power plant (the oldest geothermal power plant in Japan), and the other was about the latest developing area, the Wasabizawa geothermal area.

The lecture on the Matsukawa power plant was presented by Takurou Kanetsuki from Tohoku Sustainable & Renewable Energy Co. Inc. He showed a video of the early stage of its development and explained its 50 year history. The Wasabizawa geothermal area is now in the development phase, and a power plant is scheduled to operate in 2020. Hiroaki Asai from Yuzawa Geothermal Power Co. Ltd. talked about the progress of geothermal development and the future plan of the Wasabizawa power plant.

The JYG-Net expects to expand the network of young geothermal researchers and experts in industry, academics and government and to contribute to the development of geothermal science and technology in the near future.

Contact: young.geothermal.j@gmail.com

Philippines: Starts the Construction of Maibarara-2

Text & photo sent by Sylvia G. Ramos, IGA Information Committee

Maibarara Geothermal Inc. (MGI) held a ceremonial groundbreaking on October 26, 2016 for its 12 MW Maibarara-2 Geothermal Power Facility (M2GPF) in Sto. Tomas, Batangas, Philippines. The event was led by Department of Energy (DOE) Assistant Secretaries Atty. Richie Avigale R. Pilares and Atty. Jose M. Layug, former DOE Undersecretary. It was also graced by local government officials of Sto. Tomas led by Mayor Edna P. Sanchez and by Mr. Katsutoshi Shoji from Fuji Electric of Japan.

MGI is a joint-venture company owned by PetroGreen Energy Corp. (65 percent), Trans-Asia Oil & Energy Development Corp. (25 percent), and PNOC-

> In the photo: PNOC RC External Relations Manager Mr. Mario U. Tercero, REMB Director Mario C. Marasigan, Fuji Electric Japan General Manager Katsutoshi Shoji, PHINMA Energy Senior, Vice President Raymundo A. Reyes, Jr., Former DOE Usec. Atty. Jose M. Layug, Jr., MGI President Francisco G. Delfin, Jr., DOE Asec. Atty. Richie Avigale Pilares-Ramos, Sto. Tomas Mayor Edna P. Sanchez, and MGI Chair Milagros V. Reyes.



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Renewable Corporation (10 percent). PetroGreen Energy Corp. (PGEC) is a subsidiary of PetroEnergy Resources Corporation (PERC).

Maibarara-2 is currently the only new geothermal power station being constructed in the Philippines. MGI Chair and PGEC President Milagros V. Reyes declared, "We target Maibarara-2 to be on-line by 4Q, 2017. Thus, we expect MGI revenues to increase further by 2018 along with our royalty remittances and tax payments to our host, LGU. Just as important, Maibarara-2, when commissioned, will be the fourth power station completed by parent company PGEC in four years following our 20MW Maibarara-1 in 2014, 36MW Nabas-1 wind in 2015 and the 50MW (DC) Tarlac-1 solar facility in 2016."

MGI President, F.G. Delfin Jr., said, "The 12 MW Maibarara-2 (M2) project was based on the successful drilling, completion and flow testing of wells MB-15D and MB-16RD in 2014-2015. After California-based Geothermal Science, Inc. (GSI) independently affirmed the Maibarara reservoir has more than sufficient reserves for the combined M1 and M2 power generation for 25 years, the MGI Partners decided to increase the M2 investment from the original capacity of 10 MW gross to 12 MW. This improved the project economics and led to the signing of an off take agreement for M2 with PHINMA Energy Corp. and a ₱ 1.4B (US\$28.2 million) project loan with Rizal Commercial Banking Corp. (RCBC). We have again contracted with Fuji Electric of Japan to supply the turbine-generator for M2 along with the other major plant equipment, just as they have done for M1. Despite its modest size, Maibarara-2 combines the advantages of being base-loaded, not FiT dependent, renewable and free of harmful greenhouse gas emissions."

Since 2014, Maibarara Geothermal Inc. has owned and operated Maibarara-1, a 20MW integrated steam field and power plant. This plant was the first renewable energy project declared commercial by the Philippine Department of Energy within the Renewable Energy law of 2008.

Source:

https://www.google.com/url?hl=es&q=http://www.m anilatimes.net/12-mw-maibarara2-geothermal-startrunning-q4-2017/293514/&source=gmail&ust=1477832653748000 &usg=AFQiCNG-Q6OiXhi1L_yzNmHNIAB408eAyg

South Korea: Soft Stimulation of a Deep Geothermal Well in Pohang

Late December saw the start of the soft stimulation of a deep geothermal well (PX-1) in Pohang, Korea. The site

is located in the Heunghae Basin in southeastern South Korea, an area covered by Tertiary sedimentary rocks and Quaternary alluvium. This stimulation is a part of the DESTRESS project funded by the European Union, the Swiss Confederation and the National Research Foundation of Korea. DESTRESS stands for Demonstration of Soft Stimulation Treatments of Geothermal Reservoirs and is one of the projects under the Horizon 2020 Research and Innovation Programme (*see* IGA News 105, p. 28), under grant agreement No.691728 and a total funding amount of about EUR 25 million.

Following the first hydraulic stimulation in well PX-2 at a depth of 4.35 km in early 2016, the second hydraulic stimulation in PX-1 at >4.2 km (total vertical depth) has started. Because of a large, natural earthquake (ML 5.8) about 40 km away from the site in September 2016, all consortium members, especially those from GFZ and GES, are making every effort to minimize seismic hazards through the soft stimulation strategy. In the first half of 2017, a complementary hydraulic stimulation of PX-2, and the circulation test between PX-1 and PX-2 are planned with the eventual installation of an on-site binary power plant.

DESTRESS focuses on soft stimulation techniques that aim to achieve enhanced reservoir performance while minimizing environmental impacts, including induced seismicity. It includes methods like cyclic or fatigue, multi-stage, chemical and thermal stimulation.



Pohang, South Korea (Photo taken from http://www.destressh2020.eu/export/sites/destress/.galleries/destress

With its emphasis on soft stimulation, the primary objective of DESTRESS is to develop a comprehensive compilation of good practices for successful geothermal projects through demonstration and research. A strong project cooperation between eight academic and eight industrial partners from Europe and South Korea aims to expand knowledge and provide solutions for a more

economical, sustainable and environmentally responsible exploitation of underground heat.

Besides Pohang, DESTRESS involves other geothermal sites: Haute-Sorne in Switzerland, Soultz-sous-Forêts and Rittershoffen in France, Klaipeda in Lithuania and Westland in the Netherlands. The techniques applied at the DESTRESS demonstration sites are designed to be transferable to other geological settings, so that the concepts can become the basis for a standardized procedure in the development of EGS projects.

One aim of DESTRESS is to bring together social and economic challenges related to soft stimulation. An initial step for this task is to investigate possible risks. A preliminary list of the top 10 risks consists of blow outs, fluid-fluid interactions (thermal brine and chemicals), fluid-rock interactions, induced seismicity (with time delay after injection), induced seismicity exceeding threshold, lack of information, loss in hole (measuring tool), political instability, public acceptance and unwanted subsurface hydraulic connections. The risk assessment results will be further evaluated and serve to prioritize the research efforts in the years to come.

Sources: http://www.thinkgeoenergy.com/innovativesoft-geothermal-reservoir-stimulation-project-started-inpohang-korea/, http://www.destressh2020.eu/demonstration-sites/pohang/

EUROPE

EGEC Gives a Tepid Welcome to the EU Commission's Proposals for the Revision of the EU Energy Framework

The European Commission unveiled the "Clean Energy Package" including, amongst other things, the revision of the directives on Renewable Energy (2009/28/EC), the Energy Performance of Buildings (2010/31/EU), and Energy Efficiency (2012/27/EU), and of the Electricity Regulation and Directive.

The package is by no means a great leap forward. It lacks ambition and deals serious blows to renewable power, by withdrawing measures such as priority dispatch (with exceptions for small PV projects). Moreover, the current proposal suppresses the EU-wide definition of "geothermal", which is a negative step backwards for the European market in geothermalrelated equipment and services.

The Commission states a strong support to increasing the share of renewables in the building and the heating and cooling sectors; yet it shies away from binding measures for faster development. Even worse, loopholes under energy efficiency legislation still allow support to new fossil-based heating equipment. The European Geothermal Energy Coucil (EGEC) therefore encourages the European Parliament and the Council to build on this package to put the European Union back on track towards its commitment to becoming the world number one in renewable energy.

Source: <u>http://egec.info/egec-reaction-to-the-clean-</u> energy-package/

Finland: Well Programed to 7000 m Depth

By mid-November 2016, a large diameter geothermal well, programed to reach a depth of 7000 meters, had reached 4500 m in only two months of drilling. The well was being constructed by Strada Energy International Limited, part of a district-heating geothermal project under development in Finland. Since the beginning, the well has been drilled in granite, and the company has used a patented, fluid-hammer technology for which it has an exclusive operating license. This technology is especially suited to hard-rock environments.



Drilling rig in Finland. Photo by Strada Energy.

Using drilling technology and methods developed in Australia by founder and Chairman Warren Strange, on occasion Strada Energy was able to drill more than 200 meters per day. The well has been drilled in sections using internationally recognized standard drilling sizes.

It its website, Strada Energy writes it is developing a 500-ton, highly-mobile, super-double drill rig in Germany that can be readied to drill in less than one shift and transported in under 25 loads. This exclusive Strada Energy product, called the ED500, is designed to drill wells up to 8,000 meters deep in the car parks of existing district heating systems in Northern Europe and

on small drill pads on the sides of volcanoes in locations like South East Asia, South America and Central America. The ED500 is able to drill wherever the ideal location may be and to minimize the pipeline and property purchase costs associated with geothermal projects. It is planning to commission the first new rig in 2017 and leverage the advantages of the rig into further lowering drilling costs.

Strada Energy plans to provide a fixed price per meter drilled for district heating, desalination and electricitygeneration projects around the globe. The intention is to use its patented technology to drill geothermal wells and act to meet the growing demand for base-load green energy by providing a cost-effective, fully integrated drilling service.

Source: http://www.stradaenergy.com/news-andmedia/company-announcements/2016/46-stradaenergy-breaks-renewable-energy-hard-rock-drillingrecords

Germany: *Patricius Medal* 2016 for Prof. Dr. Manfred Hochstein

Mara Slawinski, Bundesverband Geothermie e.V.



Prize-ceremony: from left Dr. Erwin Knapek, Prof. Dr. Manfred Hochstein, Prof. Dr. Ernst Huenges, and Minister Johannes Remmel (photo by BVG).

Prof. Dr. Manfred Hochstein was awarded the Patricius Medal during the opening session of the German Geothermal Congress 2016 in Essen from 29th November to 1st December. He was honored by the German Geothermal Association (BVG) for his pathbreaking scientific work exploring and evaluating geothermal reservoirs. Prof. Dr. Manfred Hochstein developed concepts for using geothermal reservoirs in countries, including New Zealand, Indonesia, China, Tibet, East Africa and the Philippines. Prof. Dr. Ernst Huenges, who spoke about the winner of the Patricius Medal, highlighted the fact that the national award goes to a scientist who has studied and received a Ph.D. in Germany. Prof. Dr. Manfred Hochstein presented his profound knowledge about volcanoes in Indonesia and the potential for the geothermal sector. He introduced methods, challenges and findings of the projects and work in that location.

Italy: Merger in Chile and Sale of Stakes in the U.S. of Enel S.p.A.

Enel S.p.A. announced that its subsidiaries, Enersis Américas S.A., Endesa Américas S.A., and Chilectra Américas S.A., have signed a document certifying that the conditions have been satisfied for the merger of Endesa Américas and Chilectra Américas into Enersis Américas. The merger took effect on December 1, 2016. On that date, Enersis Américas changed its name to Enel Américas S.A. Taking into account the withdrawals exercised by the shareholders of Enersis

> Américas, Endesa Américas and Chilectra Américas who did not approve the merger, as well as the acceptances received in the public tender offer launched by Enersis Américas for the free float of Endesa Américas, as a result of the merger, Enel indirectly controls-through subsidiaries- 51.8 percent of the Enel Américas share capital.

Source:

https://www.enel.com/content/dam/enelcommon/press/en/1666470-1 PDF-1.pdf

In another press release, Enel S.p.A. said that through its US-based renewables subsidiary, Enel Green Power North America, Inc. (EGPNA), the company has signed a letter of agreement with GE Energy Financial Services. The two companies intend to sign a deal through which EGPNA will sell a 1 percent stake in EGPNA Renewable Energy Partners, LLC (EGPNA REP) to GE Energy Financial Services, at a price to be fixed at a later date. Following the transaction, EGPNA will reduce its stake in EGPNA REP to 50 percent from the current 51

percent and GE Energy Financial Services will increase its stake to 50 percent from its current 49 percent. The two companies also intend to revise their partnership LLC (Limited Liability Company) agreement, converting EGPNA REP into an equally owned joint venture.

The transaction, which is subject to all required regulatory approvals, is expected to be closed in December 2016, at which time funding will occur. The new rules of corporate governance in the revised partnership LLC agreement provide that EGPNA will continue to manage EGPNA REP assets. Upon completion of the transaction, the Enel Group will deconsolidate EGPNA REP's debt (about US\$500 million) and capacity. The partnership in EGPNA REP was launched in March 2015 as a mechanism to actively manage the Group's renewables portfolio in North America. Currently EGPNA REP's assets include 46 wind, geothermal, hydropower and solar plants with around 1,200 MW of installed capacity.

Source: <u>https://www.enel.com/content/dam/enel-</u> common/press/en/1666483-1_PDF-1.pdf

The Netherlands: New Direct Use Geothermal Project

By means of a new risk insurance scheme, the German geothermal firm Daldrup & Söhne AG will drill a well for a geothermal heating project to provide heat for greenhouse operations in the South Holland province of the Netherlands.

The drilling company expects to tap hot thermal water in the Dutch drilling project named Nature's Heat in the municipality of Kwintsheul. According to Daldrup & Söhne, the capacity is at least 110 liters per second and the temperature of the thermal water is around 86°C. This value is well above the projected average value, since experts had expected only 60 liters per second. In the future, the operators will be able to use around 20 MW of thermal energy instead of the calculated 12 MW thermal for their greenhouses. With the large amount of thermal water, about a 1.2-fold volume of natural gas is fed in parallel as a by-product. The gas will be separated



Drilling rig on site in the Netherlands (source: Daldrup & Söhne AG).

and used by third parties to generate electricity. The overall project has an above average efficiency due to the in-depth specifications.

The well will be drilled at a depth of about 3000 meters. In addition, Daldrup will set up the heating center and the district heating distribution network. Nature's Heat is a group of ten greenhouse operators in the South Holland region who are simultaneously heat consumers.

The drilling company, Daldrup & Söhne AG, has used for the first time a new, integrated insurance model (the alternative risk transfer, ART, concept) that also includes assurances as part of a reinsurance structure. Such geothermal drilling and energy projects can be financed through leverage at an early stage in the project.

Source: <u>http://www.thinkgeoenergy.com/drilling-to-</u> <u>commence-for-geothermal-heating-project-in-the-</u> <u>netherlands/</u>

Serbia: Cooperation Agreement for Geothermal Development

NIS Gazprom, a Serbian energy company, and Betec KS Orka, a geothermal-development firm in Belgrade, have signed a Cooperation Agreement to develop geothermal energy in Serbia. The companies will jointly develop geothermally active areas in northern Serbia by drilling new production wells and building power plants based on the well head power-plant technology.

Drilling is planned to begin in 2017 and the first power plant is planned to be commissioned within a year. The projects will include combined heat and power plants.

Kirill Kravchenko, NIS's CEO, said, "NIS aims to lead the growth of renewable energy in Serbia. For years, we have developed a large number of energy efficiency

> projects, especially cogeneration projects with electricity produced from gas. In cooperation with our partners, we will further develop our projects to develop geothermal resources and contribute to increasing energy production from renewable resources—also contributing to the energy independence of Serbia."

> Kevin Cao, Kaishan's CEO, noted, "KS Orka aims to be the leading global developer and operator of geothermal projects. KS Orka has prioritized investments in emerging economies and is targeting development of 500 MW of power generation capacity over the next five years. The cooperation with NIS in Serbia is an important step towards achieving this goal in the Balkans."

Source: <u>http://www.nis.eu/en/presscenter/nis-</u> <u>betec-sign-co-operation-agreement-developing</u>

Turkey: New Binary Plant, EBRD and IBRD Financing for Geothermal, Awarded Turbines

New 24 MW Binary Plant to Be Constructed -EXERGY, the Italian company owner of the Radial Outflow Turbine technology, signed a new contract with Bestepeler Energi Üretim Ticaret A.s for the supply of a 24 MW geothermal ORC power plant for a geothermal field located in Aydin region of the Germencik area. This contract follows a former contract signed in 2015. EXERGY will provide the client with a two-pressure level ORC system equipped with 2x Radial Outflow Turbines, one for each pressure level, to produce a total of 24 MW of electricity from a mediumenthalpy geothermal fluid. The large turbines continue to show the suitability of the Radial Outflow configuration for all sizes. The ORC cycle will employ an air-cooled condensing system, avoiding the use of water.

Equipment for the ORC unit will be manufactured at the EXERGY Turkish workshop in Izmir, allowing the client to take advantage of an increased feed-in-tariff that the Turkish Ministry assigns to Made-in-Turkey technologies. The factory, which has been open for two years, has already produced 20 turbines eligible for the increased feed-in-tariff.

Source:

http://www.pennenergy.com/articles/pennenergy/201 6/10/exergy-achieve-another-success-in-turkey-newcontract-signed-with-repeat-customer-bestepeler-enerjifor-a-24-mwe-geothermal-powerplant.html?eid=291021978&bid=1567129

EBRD Financing for Renewables - The European Bank for Reconstruction and Development (EBRD) is providing US\$ 55 million in new funds to the Turkish lender, Isbank, to finance private companies investing in renewable energy and resource-efficiency projects in Turkey.

The EBRD funds are extended through an investment in "A-" rated senior notes issued under Isbank's Diversified Payment Rights (DPR) securitization program, an established market instrument used by Turkish banks to raise long-term funding.

The financing –supported by a €1.9 million (US\$2 million) grant from the European Union– will benefit renewable energy and resource efficiency projects in Turkey, including solar, hydropower, wind, geothermal, waste-to-energy, energy efficiency and water saving and waste minimization.

Investing in sustainable energy and resource efficiency is a strategic priority for the EBRD in Turkey. Almost half of the bank's total portfolio in Turkey is in sustainable energy. Since 2009, the EBRD has invested over €3 billion (US\$ 3.2 billion) in more than 75 such projects, including two large wind farms –Bares and Rotor– and Efeler, the largest geothermal power plant in Turkey (and the second largest in Europe).

The EBRD is also working closely with the Turkish Ministry of Energy and Natural Resources and has helped develop the country's first National Renewable Energy Action Plan to attract more investment in renewable energy projects. The Bank has also supported the preparation of a National Energy Efficiency Action Plan, which is expected to include a wide range of sector-based resource efficiency measures aimed at achieving Turkey's 2023 energy efficiency targets.

The EBRD started investing in Turkey in 2009 and currently operates from offices in Istanbul, Ankara and Gaziantep. To date it has invested over €8 billion in the country in infrastructure, energy, agribusiness, industry and finance for more than 200 projects. It has also mobilized nearly €20 billion for these ventures from other sources of financing. Some 98 percent of the bank's investments in Turkey are in the private sector.

Source: <u>http://www.finchannel.com/business/60804-new-ebrd-financing-for-turkish-renewable-energy-via-isbank</u>

More Financing from the EBRD - The EBRD may provide a senior loan of up to US\$70 million for the construction of a 70 MW geothermal power facility in Turkey. The funds are to be used by Zorlu Dogal Elektrik Uretimi AS to build unit 2 of the Kizildere III geothermal power plant in West Anatolia. The extension will increase the plant's capacity from 100 MW to 165 MW. The Kizildere III unit 1 is currently under construction.



Somewhere Over The Rainbow: Kizildere Power Plant. Photo by Erdinç Sentürk, GRC Photo Contest.

The bank said that Zorlu Dogal presented the environmental and social impact assessment (ESIA) package for the project on December 8, 2016. The company is a renewable, energy-focused unit of the power producer Zorlu Enerji Elektrik Uretimi AS, part of the Turkish conglomerate Zorlu Holding Ai.

After the ESIA disclosure, there will be a 60-day public review and comment period, with the EBRD board expected to decide on the loan on February 22, 2017.

Other participants in the project financing package of up to US\$270 million include Akbank, IsBank and TSKB.

In September, the Japanese conglomerate Toshiba Corp. announced an order for a 50.7 MW flash steam turbine system and generator for unit 2 of the Kizildere III plant. The project will also integrate an about 19.3 MW binary cycle power generation system that uses flash turbine, exhaust steam.

Source: http://renewables.seenews.com/news/ebrdmulls-loan-for-70-mw-geothermal-project-inturkey-550198#

Financing for Geothermal from the IBRD -

In early November, the World Bank's Board of Directors approved an International Bank for Reconstruction and Development (IBRD) loan of US\$250 million and a Clean Technology Fund Grant of US\$39.8 million for a geothermal development project in Turkey which will help to create renewable energy by tapping heat sources deep in the ground..

The geothermal development project aims to encourage private sector investment in geothermal energy development in Turkey by reducing risks for investors through a Risk Sharing Mechanism (RSM) and by providing access to long term financing.

The project includes: The establishment of a Risk Sharing Mechanism for Resource Validation to support the exploration and test drilling stages and a Loan Facility for Resource Development to support the power plant development phase.

Source: <u>http://www.worldbank.org/en/news/press-</u> release/2016/10/31/turkey-to-expand-renewablegeothermal-energy-generation-with-world-bank-support

ORC Turbines from EXERGY Get Government Acceptance and Award – In late October, the Turkish Ministry of Energy and Natural Resources declared that the following Organic Rankine Cycle (ORC) turbines, designed and manufactured by the Italian firm EXERGY with its Radial Outflow Turbine technology, met the required performance targets and are eligible for the national Feed-in Tariff starting from January 2017: - Kubilay I, 24 MW unit for Bestepeler Enerji Üretim Ticaret A.s.

- Mehmet Han, 25 MW unit for Kipaş Holding
- Ken Kipas 3, 25 MW unit for Kipaş Holding
- Umurlu II, 12 MW unit for Karadeniz Holding
- Sultanhisar I, 14 MW unit for Celikler Holding

Among the five units, EXERGY delivered a total of 10 Radial Outflow Turbines that have all received the Made in Turkey certificate and can provide the operators with an additional incentive over the standard Feed-in Tariff rate. The five units will generate a total of 110 MW, delivered as renewable energy to the Turkish grid.

In the same period, EXERGY has obtained the Made in Turkey certificate for four Radial Outflow Turbines delivered to Kemaliye Alaşehir 12 MW, units 1&2.

Source:

http://www.altenergymag.com/news/2016/11/17/exer gy-achieves-new-record-in-turkey/25103/



View of the Denizli Tosunlar plant (Photo by EXERGY).

More recently, the company said that for the second time in 2016, the Denizli Tosunlar ORC geothermal power plant received an award in the Top Plant in Renewable energy project category assigned by Power Magazine in the "Power Awards" competition.

The prize was announced and published in the December issue. EXERGY conquered the stage for the leading-edge innovation represented by the world first geothermal power plant with 2-pressure-level cycle on a single-disk turbine installed in Denizli Tosunlar, Turkey, for the client Akca Enerji on June 2015. In February 2016 Exergy won first place in the European Geothermal Innovation Award from the European Geothermal Energy Council for the world's first innovation demonstrated in this geothermal plant.

What sets the Tosunlar plant apart is that it uses a twopressure, ORC system with only one single-disk turbine.

Typical binary systems use one turbine per pressure level, with the working fluid entering the high-pressure side after leaving the evaporator, before passing through the recuperator and the low-pressure evaporator (which draws heat from geothermal fluid after it leaves the high-pressure evaporator).

EXERGY has developed a different approach with a radial outflow turbine. Here the turbine uses a single disk with multiple stages. The high-pressure fluid enters at the center of the disk while the low-pressure fluid enters further out, toward the edge.

The single-disk configuration means substantially fewer components are needed for the turbine system. This lowers the overall costs and reduces operational and maintenance demands because of the reduced amount of rotating equipment and associated auxiliaries. In addition, because the radial outflow turbine is much smaller than a conventional two-stage turbine, the plant footprint is smaller, meaning reduced construction costs.

Compared to a single-pressure turbine of the same size, EXERGY says the radial outflow turbine can achieve up to 22 percent higher efficiencies—ideal for sites where temperatures are lower, geothermal flows are limited and conventional designs uneconomic.

A Jury composed of editors of Power Magazine chose Exergy's project from the many other submissions from around the world.

Sources: http://www.thinkgeoenergy.com/top-plantaward-for-tosunlar-geothermal-plant-delivered-byexergy/, http://www.powermag.com/tosunlar-1-akcaplant-saraykoy-denizli-turkey-2/

Oceania Australia: Errata

In the previous IGA News 105, a note was published on the EGS project of Habanero—closed in December 2015. The first version of the newsletter said that "According to ARENA (Australian Renewable Energy Agency), the total cost of the Habanero EGS project was AU\$144.22 million (US\$ 198.26 million at the current exchange rate), of which the federal government provided 23 percent" (p. 38). While the cost in Australian dollars is correct, the equivalence in US dollars was wrong. As Graeme Beardsmore, director of Hot Dry Rocks, pointed out, the correct figure is US\$109.6 million, taking into account the current exchange rate of US\$0.76 per 1 AUD. A new, corrected version of the newsletter was uploaded on the IGA website last October, including the corrected amount of US dollars; we are pleased to publish this correction.

New Zealand: Construction of New Power Plant, Silica Extraction Plant, Lake Rotorua

Started Construction of New Power Plant - Last October the drilling stage ended for the geothermal power plant Te Ahi O Maui, located 2.3 km east of Kawerau, on land owned by Kawerau A8D Ahu Whenua Trust. Project manager Ben Gibson said the drill rig and associated equipment had been completely demobilized from site, where they had been working since May 2016.

The drilling process targeted known sources of geothermal fluid, which could be as hot as 200-300°C, he said. "The drilling was successful. We located the high-temperature fluid that will ultimately fuel the geothermal power plant, and the injection capacity necessary to manage the cooler fluids that have passed through geothermal power plant."

Well pads were constructed on site and the Old Coach Rd, near Kawerau, was upgraded in preparation for the drilling rigs arriving in late April. Drilling began in May following assembly, inspections, and karakia and blessings from local kaumatua. Gibson said there were no major incidents or harm to any person or to the environment during the drilling process.

The project's focus now shifts to the construction of the power plant, transmission line and steam field. The Te Ahi O Maui project has engaged Israeli company Ormat for the next phase of the development. The project



consists of a 25 MW power plant, at a total cost of US\$120 million

Resource consent for the project allows for the extraction of 625 tons per hour of geothermal fluid from the Kawerau reservoir for 35 years, with the new plant on track to be operational in 2018.

Source: <u>http://www.nzherald.co.nz/rotorua-daily-</u> post/news/article.cfm?c_id=1503438&objectid=11719 418

New Silica Extraction Plant - New Zealand based Environmetals Limited (EVM) is engineering the first commercial application of its technology to extract silica from geothermal waste fluids. After its successful pilotplant operations producing colloidal silica at two geothermal fields at Wairakei and Kawerau, both in NZ, EVM is now preparing to build and install the first 5000 tons per day (tpd) commercial extraction plant at Kawerau. The pilot plant installed here was not a subscale plant but rather a sub-module of the commercial plant, so reaching the scale size involves adding additional sub-modules.

EVM's extraction and processing equipment removes silica from the waste geothermal fluids (after the generation of electricity) and creates colloids in the range of 8 - 16 nanometers with a concentration of 30 -40 percent silica by weight. Three provisional patents have been filed covering all EVM developments over the last five years, creating a robust Intellectual Property platform.



Samples of colloidal silica produced by Environmetals process (Source: <u>http://www.environmetals.co.nz/wairakei</u>).

Geothermal electricity generation is predicted to grow as a renewable energy resource, but the presence of dissolved silica in geothermal fluids can be a limiting and costly issue for the power plant. EVM's proven proprietary extraction technology can assist operators, providing them with lower capex and opex through reduced silica scaling in the plant and reinjection wells and the potential for additional electricity generation.

EVM's business model has geothermal electricity generators buying extraction plants and supplying the silica concentrate that Environmetals then uses to create

colloidal silica. The processed colloidal silica will be sold by EVM on the international markets, where there is considerable and increasing demand.

Source: <u>http://www.thinkgeoenergy.com/nz-firm-</u> working-on-first-commercial-geothermal-silicaextraction-plant/

Hydrothermal Eruption and Survey on Lake Rotorua - The spectacular eruption of a geyser near the shores of Lake Rotorua in late November came as scientists were discovering stunning new insights into the city's famous geothermal backdrop. Scientists say there isn't any evidence to link the eruption –which sent water gushing up to 30m near Rotorua's Ohinemutu village—with the earthquake activity registered in November.

GNS Science volcanologist Brad Scott said it was also too early to draw any connection with the gradual return of surface features within the Rotorua Geothermal Field that has followed the closure of boreholes in the 1980s. But it occurred at a time when researchers are making fresh observations of the lively natural systems that create Rotorua's bubbling landscape.

Over the past two months, geologists have teamed up with the New Zealand Defense Force for a bathymetric and magnetic survey of Lake Rotorua. The study has yielded significant evidence of hydrothermal activity throughout the lake. These include pockmarks on the lake floor, which indicated that gas was being discharged through the lake floor —and hydrothermal vents that indicate the release of gas and hot water.

"Examples of hydrothermal activity seen on the lake floor include smaller hydrothermal eruption craters that are likely expelling hot water, and pockmarks or circular features that are several meters in diameter and are formed as a result of gas being discharged through the lake floor," GNS marine geologist Cornel de Ronde said. "Many of them appear in a linear pattern, suggesting they may be related to underlying faults."

The survey, which has so far covered 40 percent of the lake floor but not the site of the late November eruption, will ultimately provide a base map showing the locations of all underwater hydrothermal eruption craters and areas hazardous to vessels and sailors. It is also the first step in a series of surveys to determine how much heat is being discharged through the lake floor from an underlying magma source.

The Rotorua Geothermal Field, believed to have been active for tens of thousands of years, underlies much of the city and the southern fringe of Lake Rotorua, which itself was formed within the caldera of a large volcano that erupted 240,000 years ago. The field is part of the wider Taupo Volcanic Zone, whose stretched and fractured crust has been permeated with magma that, in

some places, has brought temperatures of at least 350°C at depths of less than 5km.



Rotorua geothermal field. Source: Rotorua Daily Post.

While one of the largest in recent times, last November's geyser eruption was consistent with what had happened in the area before. Rotorua Lakes Council geothermal inspector, Peter Brownbridge, said hydrothermal upwelling beneath the lake had created a geyser that was noisy and spectacular, but there is little reason for locals to be worried.

Hydrothermal eruptions happened "reasonably regularly" in that part of the lake edge –but more often than not they only resulted in the bubbling up of water and mud from the lake bottom. "We don't see many bigger ones these days, although eruptions like this were quite common about eight years ago," he said.

Source: <u>http://www.nzherald.co.nz/rotorua-daily-</u> post/news/article.cfm?c_id=1503438&objectid=11757 083

Other

Technology: New Geothermal Power System Tested in Japan

A team of researchers from the Kyoto University Graduate School of Engineering and the Japan New Energy Corporation (J-NEC), recently carried out successfully a demonstration of the J-NEC Method New Geothermal Power System, the first technology of its kind in the world.

The J-NEC Method New Geothermal Power System was conceived as a method for fundamentally resolving some of the obstacles experienced by geothermal power generators in the past. This new technology was born from the concept of 'generating electricity by absorbing geothermal heat without using hot spring water'.

It is a closed-cycle system, which injects and circulates water from above ground rather than using hot spring water. This solves problems of scaling and avoids the need to drill reinjection wells. The key component of this closed-cycle system is a dual-pipe heat exchanger, which is buried 1450 meters in the ground (apparently within a geothermal well), into which cold water from the surface is injected under pressure and heated by geothermal heat, and then extracted in its liquid form when it has reached a high enough temperature. Once the liquid is above ground, it is decompressed and instantly transformed into steam, turning the turbines and generating electricity.

In addition to the existing advantages of geothermal power generation, in terms of not emitting CO_2 during power generation and the ability to consistently generate power 24 hours a day, this new system adds elements effective for business development. It shortens development time, cuts running costs and is not subject to the Japanese Hot Springs Act since it doesn't use hot water—only underground heat. Thus it can make a major contribution to the rapid advancement of the geothermal power business.

Source: http://www.kyoto-

u.ac.jp/en/research/events_news/department/kougaku/news/2016/161021_1.html

Technology: Supercritical Carbon Dioxide Pilot Plant Test Facility to Be Build

The U.S. Department of Energy (DOE) has awarded up to US\$80 million for a six-year project to design, build, and operate a 10 MW supercritical carbon dioxide (sCO₂) pilot plant test facility in San Antonio, Texas. The project will be managed by a team led by the Gas Technology Institute (GTI), Southwest Research Institute[®] (SwRI[®]), and General Electric Global Research (GE-GR).

facility will future The new support the commercialization of sCO₂ Brayton cycle energy conversion systems by testing and demonstrating the potential energy efficiency and cost benefits of this technology. Today the average efficiency of the steam used in Rankine cycle power plants in the U.S. is in the lower 30 percent range. This new facility has the potential to demonstrate greater than 50 percent cycle efficiency. If successfully developed, the supercritical CO₂ power cycles could provide significant efficiency gains in geothermal, coal, nuclear and solar thermal power production.

Currently no commercially-feasible sCO₂ facility exists for high temperature and high-efficiency system testing. The 10 MW test facility developed under the selected project will serve as an opportunity for industry and government to work together to develop and mature the sCO₂ power cycles at the pilot-scale, bringing it one step closer to commercialization.

Supercritical CO_2 is carbon dioxide above its critical temperature and pressure so that it is in a fluid state, enabling a power plant to generate the same amount of electricity from less fuel when compared to traditional steam and water (Rankine cycle) systems commonly used today. This, in turn, decreases CO_2 emissions and operating costs. Furthermore, because sCO_2 has a highfluid density relative to steam, sCO_2 power plants may be fitted with compact turbo-machinery, which would help to reduce capital costs.



Image from: <u>http://www.energy.gov/under-secretary-science-</u> <u>and-energy/supercritical-co2-tech-team</u>

The information generated through this project has the potential to inform scale-ups for larger scale

demonstrations in the future. While sCO_2 technology has been proven in a lab setting, this pilot project will provide important data on potential challenges of operating it on a larger scale. It will also provide an opportunity to test the performance of the system's components when operated on a continuous and fully integrated basis.

Source: <u>http://energy.gov/under-secretary-science-and-energy/articles/doe-announces-80-million-investment-build-supercritical</u>

Technology: France's First Marine Geothermal Power Station

French utility Engie Cofely inaugurated on October 17th the France's first marine geothermal power station in Marseille. Thassalia, as the project is named, has been designed specifically to meet the needs of Marseille's Euroméditerranée eco-city business centre.

The investment came in at EUR 35 million (US\$ 38.5 million) for an overall heating/cooling capacity of 19 MW. Besides Engie, the project was financially backed by France's Environment and Energy Management Agency (ADEME) with EUR 3.4 million and the European fund for economic and regional development (FEDER) with EUR 1.6 million. Another EUR 2 million came from regional and city funds.

Built at the Marseille-Fos Port, Thassalia will tap the sea's thermal energy to generate space heating, water heating and air conditioning services for around 500,000

> square meters of buildings in the city of Marseille. The use of sea water heating and cooling is expected to reduce greenhouse emissions by 70 percent as well as cut water usage on site by 65 percent.

Marine geothermal exploits the differences in temperature between the warmer surface waters and the colder waters found at greater depths. In Marseille, for example, the water temperature is usually 14°C in winter and 22°C in summer. Water is pumped from the sea through pipelines as long as 1 km to coastal facilities where heat exchangers and heat pumps are used to meet heating or cooling needs. The heated or cooled water is then piped to individual buildings.

Engie's first project of this kind was brought to life through its subsidiaries, Engie Cofely for thermal matters, and Climespace for district cooling. All the technical elements of the power station were created by the company's teams. Ineo and Cofely handled electricity, Axima and

Cofely covered internal networks, and Axima provided half of refrigeration units.

Engie has announced plans to develop a larger geothermal marine project on the island of La Réunion, where the communities of St-Denis and Ste-Marie will be air-conditioned using water piped from 1100 meters below the sea from 6 km offshore.

The EUR-150-million project is expected to meet the air-conditioning needs of around 50 large-scale publicand private-sector buildings, including the airport, hospital and university.

With nearly 40 percent of the global population or 2.4 billion people living at less than 100 km from the sea, the potential for marine geothermal technology is practically unlimited, Engie Cofely said in a statement.

Source: http://renewables.seenews.com/news/engiecuts-ribbon-on-frances-first-marine-geothermal-powerstation-543545

Technology: Curie Point Depth Mapping Pilot Study in Canada

Geoscience BC is pleased to announce the release of a pilot study which demonstrates the use of publicly available, regional airborne-magnetic data as a geothermal exploration prospecting tool for British Columbia.

Geoscience BC Report 2016-14 includes a Curie point depth mapping pilot study over a small area of northwestern British Columbia. Curie point depth mapping uses regional-scale magnetic survey data to map the depth in the earth's crust where magnetization disappears. When used in combination with other data (e.g. heat flow) it can be used as a regional-scale geothermal prospecting tool.

In the report, results are compared with the BC heat flow map, known volcanism, hot springs and regional geology. Based on the results, the authors recommend using the Curie point depth mapping technique across BC to help guide geothermal exploration programs.

Source:

http://www.geosciencebc.com/s/NewsReleases.asp?Re portID=767860&_Type=&_Title=New-Geothermal-Exploration-Prospecting-Tool-for-BC-Curie-Point-Depth-Mappin

Technology: Energy-efficient Engine Turns Hot Water into Electricity

There is an alloy of nickel and titanium, called nitinol. Although nitinol can be bent, when it is heated, it undergoes a phase transition and reverts to its original crystalline lattice structure. Nitinol also has another unusual quality. Unlike most materials, it expands when cooled, rather like water when it turns to ice.

An engine developed by Exergyn uses those quirky properties of nitinol. Inside the device, a bundle of meter-long nitinol wires are attached to a piston. Hot and cold water is alternately flushed over the wires every 10 seconds, which causes them to rapidly expand and contract by 4 centimeters, driving the piston up and down. A hydraulic system converts that forceful linear motion into rotary motion, which in turn drives a generator. The core of the technology is an elegantly simple device. The drive is based around a solid-state reciprocating technology which is thermally cycled to deliver rotary motion, and then converted to electricity. The engine produces 10 kilowatts of electricity from around 200 kW of thermal energy in the waste hot water.



Exergyn (https://www.exergyn.com/) is a firm based in Dublin, Ireland, which plans to run the first industrial trials of its technology next year. The company has spent three years perfecting the design and modifying the material so that it will keep working for millions of cycles. It was awarded 2.5 million euros from the European Commission's Horizon 2020 fund last year to help bring the technology to market and is now planning three industrial tests in 2017—at Dublin Airport and two landfill sites. In all three cases, the Exergyn technology will use warm water at 90°C or less – from a gas engine at the airport and from biogas generators at the landfill sites – to produce electricity on-site.

In addition to harnessing waste heat from industry, the company hopes that the engine could expand the geothermal energy market. Exergyn's technology makes a broader range of geothermal sites viable, as it works with water at a lower temperature and flow rate.

Source:

https://www.newscientist.com/article/2113109-energyefficient-engine-turns-waste-hot-water-into-electricity/

Science: Scientists Study Rock Fracturing to Accelerate Advances in Energy Production and Waste Storage Technologies

About a mile (1.6 km) beneath the earth's surface in an old gold mine, Lawrence Berkeley National Laboratory (LBNL) scientists have built an observatory to study how rocks fracture. The knowledge they gain could ultimately help reduce greenhouse gas emissions and accelerate deployment of clean energy technologies.

The observatory is part of a U.S. Department of Energy (DOE) initiative that seeks to address challenges associated with the use of the subsurface for energy extraction and waste storage. Dubbed SubTER—or Subsurface Technology and Engineering Research, Development and Demonstration Crosscut—the initiative recognizes that the United States currently relies on the subsurface for more than 80 percent of its energy needs and that adaptive control of subsurface fractures and fluid flow is a crosscutting challenge that has the potential to transform energy production and waste storage strategies.

"As important as the subsurface is for U.S. energy strategy, our understanding of how the subsurface responds to common perturbations, such as those caused by pulling fluids out or pushing fluids in, is quite



View of kISMET, a rock observatory a mile underground at the Sanford Underground Research Facility in South Dakota. (Photo: Matthew Kapust, Sanford Underground Research Facility.)

crude," said Susan Hubbard, an Associate Director of Berkeley Lab, who helps lead the SubTER National Laboratory team.

Scientists at several of the Department of Energy's national labs are contributing to SubTER, which was launched last year after Energy Secretary Ernest Moniz identified adaptive control of the subsurface as one of the DOE's "grand challenges."

One key to gaining subsurface control is to understand how rocks fracture. "We're concerned with the ability of fluids to move through cracks and pores," said LBNL geologist Patrick Dobson. "For some applications, such as engineered geothermal systems, you want fluids to move in order to mine the heat from the subsurface, so you want to create fractures. In others, such as carbon capture and sequestration, we're more interested in making sure fractures don't grow."

To gain a predictive understanding of fracture control, LBNL is leading a SubTER project to develop an underground observatory and to conduct integrated experiments and geophysical imaging. The underground observatory is located at the Sanford Underground Research Facility (SURF) in South Dakota, the site of a former gold mine that is now primarily a research lab for particle physics. The Berkeley Lab team chose one part of the facility at 4850 feet (1460 m) below ground to set up their observatory, dubbed kISMET, for permeability [k] and Induced Seismicity Management for Energy Technologies.

Co-led by Dobson and LBNL geologist Curt Oldenburg, the kISMET team has drilled and cored four 50-meter-deep monitoring boreholes and a 100meter-deep experimental borehole. "We are essentially trying to understand the relationship between the stress field, the rock fabric, and fracturing," Oldenburg said.

The scientists injected small amounts of water into the rock at very high pressures until the rock fractured. "We are looking at the pressure which creates a new fracture, and the flow rate and volume of water that goes into the fracture to estimate its size," Oldenburg said. "Then we go back with borehole logging tools to determine the orientation of the fracture. At the same time, we are carrying out some detailed monitoring of the fracturing process. In particular, we are measuring the rock electrical resistivity in near-real time and the rock seismic properties. We are also measuring microseismicity associated with the fracturing."

The kISMET experiments are most relevant for Enhanced Geothermal Systems (EGS), a clean energy technology where underground fractures are engineered in hot rocks in the subsurface in order to inject water and extract heat.

The rock at the Sanford Lab is similar to the deep crystalline rock found in many geothermal systems.

"One of the key challenges is understanding the state of stress of the rock, which is likely to govern the direction in which the rock is likely to break and where it will do so," Dobson said.

Source:

http://newscenter.lbl.gov/2016/10/19/berkeley-labdigs-deep-clean-energy-solutions/

Climate Change: The Paris Agreement Enters into Force



The Paris agreement on climate change entered into force on 4 November 2016, marking the first time that governments have agreed legally binding limits to global temperature rises. The passage of the accord –the fruit of more than two decades of often tortuous international negotiations on combating climate change– was hailed by nations and observers around the world.

Under the agreement, all governments that have ratified the accord, which includes the US, China, India and the EU, now carry an obligation to hold global warming to no more than 2°C above pre-industrial levels. That is what scientists regard as the limit of safety, beyond which climate change is likely to become catastrophic and irreversible. The agreement commits world leaders to keeping global warming below 2°C, and pursuing a tougher target of 1.5°C. The carbon emission curbs put forward by countries under Paris are not legally-binding but the framework of the accord, which includes a mechanism for periodically cranking those pledges up, is binding. The agreement also has a long-term goal for net zero emissions which would effectively phase out fossil fuels.

Countries have put forward commitments on curbing carbon emissions under the agreement, but a report found those pledges would see temperature rises significantly overshoot the threshold, with 3°C of warming. Environmental groups urged governments to do more.

Asad Rehman, international climate campaigner at Friends of the Earth, said: "The Paris agreement is a

major step in the right direction, but it falls a long way short of the giant leap needed to tackle climate change. Far tougher action is needed to rapidly slash emissions." Greenpeace said that while the deal needed strengthening, it was a "momentous occasion" that it had come into force.

Patricia Espinosa, the UN's climate chief, and Salaheddine Mezouar, foreign minister of Morocco, said in a joint statement: "Humanity will look back on 4 November 2016 as the day that countries of the world shut the door on inevitable climate disaster and set off with determination towards a sustainable future... The Paris agreement is undoubtedly a turning point in the history of common human endeavor, capturing the combined political, economic and social will of governments, cities, regions and businesses and investors to overcome the existential threat of unchecked climate change."

Source:

https://www.theguardian.com/environment/2016/nov/04/paris-climate-change-agreement-enters-into-force

Climate Change: Main Outcomes of COP22

Billed as a meeting of action and implementation, the Conference of the Parties number 22 (COP22), held in Marrakech in past November, fast became two weeks of damage limitation in the wake of Donald Trump's election victory. On the opening session, delegates from 196 countries celebrated the Paris Agreement's entry into force: 11 months after that historic night in the French capital it was now international law. Little over 48 hours later Trump's shadow fell over the desert venue, marking the start of a new era in global climate change politics. Here are the main outcomes from two weeks of discussing how to put the Paris Agreement into practice.

Call for Nations - On the penultimately scheduled day, the conference adopted a call for all nations to honor promises made in Paris and renew their attempts to stave off disaster. The one-page document contained little new information. But it was absolutely necessary, said observers, for the conference to make a political statement of resolve after the election of a climate skeptic to the US presidency.

Ratifications galore - During the conference, 11 governments ratified the Paris climate agreement. Since the beginning of September 88 nations have joined the party, and the number of nations joined by the end of the COP22 was 111.

Carbon cuts - The Paris Agreement acknowledges that voluntary national emissions targets are not enough to meet its global warming goals. But the focus in Marrakech has been on initiatives to reinforce existing

plans, with some countries promising to review ambition by 2020. Notably the Climate Vulnerable Forum, a 47-strong coalition of developing countries, declared it "will strive to lead" the green transition – ultimately going 100% renewable.

2050 roadmaps - The US, Canada, Mexico and Germany published strategies for radically cutting their greenhouse gas emissions by mid-century at UN talks, meeting a requirement of the Paris Agreement. Germany's targets an 80-95 percent cut from 1990 levels in line with EU ambitions, while the US and Canada's plans aim for 80 percent reduction in emissions from

2005 levels by 2050. Peru, Ethiopia and Norway were among 22 countries backing the "2050 pathways platform". Fifteen cities and nearly 200 businesses are also on board.

Transparency - On the rulebook for monitoring greenhouse gas emissions, politicized decisions on the balance between national sovereignty and global uniformity were put off until another day. Still, observers and negotiators seemed broadly satisfied with the timetable agreed.

Route to 2018 - Countries agreed that 2018 will be the next major meeting of talks under the Paris Agreement, and

that they'll try and get the rulebook for it ready that year. Governments agreed to more consultations but there will be no new or extra meetings.

Climate finance - Aside from a few strategic funds, this was not a COP for new financial pledges. Donors including the U.S., UK and Germany will put up US\$50 million to improve carbon accounting in developing countries; there was US\$23 million for a center to share clean technology expertise. While important, those are a drop in the ocean of the US\$100 billion that rich countries have promised to mobilize by 2020.

Adaptation - Perhaps surprisingly, one of the last-day controversies was whether the Adaptation Fund, started under the Kyoto Protocol, had a future with the Paris Agreement. Handling tiny cash flows compared to the flagship climate finance initiative for Paris, it is favored by recipients because of its readiness to support small projects. But a major source of revenue, the Clean Development Mechanism, is drying up, with talks on its future postponed for another six months.

Loss and damage - The sticky question of how to approach recompense for the damages caused by climate change was carefully punted down the concourse of the Bab Ighli center. There was a discussion that agreed to a framework that will provide the basis for the next five years of talks. Africa - It was billed as the "Africa COP" and African countries walked in with clear demands. In order to meet their Paris commitments they need more money to adapt to climate change, and more support to develop their infrastructure on many fronts, including data collection, climate diplomacy and research. As so many times before, the donations left them disappointed. However, many leaders supported the ambitious Africa Renewable Energy Initiative (AREI), which plans to achieve 10GW of additional generation capacity by 2020 and 300GW by 2030 – appealing to private investors not just public donors.



Source: Excerpts from texts by Megan Darby, Karl Mathiesen, Ed King and Lou Del Bello, available at: <u>http://www.climatechangenews.com/2016/11/18/cop</u> <u>22-headlines-what-did-marrakech-climate-summitdeliver/</u>

Climate Change: An Arsonist in Charge of Fighting Fires in the U.S.

With his choice of administrator for the Environmental Protection Agency, Donald Trump shattered any hope that he would moderate his stance on climate change. Michael Brune, executive director of the Sierra Club, said in a statement that putting Pruitt in charge of the EPA would be like "putting an arsonist in charge of fighting fires".

Scott Pruitt, the Oklahoma attorney general, has spent six years waging war against the EPA's climate and clean air initiatives. He's often done so in close coordination with the fossil fuel industry, which has given him nearly \$300,000 in campaign contributions during his political career. And like Trump, Pruitt has dismissed the world's most daunting environmental challenge, rejecting the overwhelming scientific consensus that human beings are heating the planet by burning coal, oil and natural gas.

Trump has long insisted climate change is a hoax, but he had seemed willing to soften his views over the first few weeks after the election. He acknowledged there is "some connectivity" between human activity and rising temperatures, and he indicated he might not pull out of the international Paris climate deal, as he'd promised to do during the campaign. He even met with former Vice President Al Gore, a vocal climate advocate.

Now, with his selection of Pruitt, the president-elect has made clear what kind of policy his administration will pursue.

Pruitt has fought President Barack Obama's climate and clean air regulations, usually decrying them as federal overreach and too costly to businesses and energy consumers. He unsuccessfully sued the EPA over a 2011 rule to limit emissions of mercury and other toxic pollutants from power plants, which the agency estimates will save up to 11,000 lives and prevent 4700 heart attacks and 130,000 asthma attacks per year. More recently, he sued the EPA over a regulation designed to reduce the amount of smog-forming, lung-damaging ozone in the air. That case is pending.

On climate change, Pruitt has helped lead the charge against Obama's EPA. He's one of 27 state attorneys general suing the agency over Obama's signature climate initiative, the Clean Power Plan, which would reduce planet-warming greenhouse gas emissions from coal plants and other sources. The Supreme Court has blocked the plan while a lower court hears the case. Pruitt also recently joined a lawsuit against a separate EPA rule to slash emissions of methane, a short-lived but powerful climate pollutant released by oil and gas facilities.

Pruitt's actions have been informed by a fundamentally incorrect view of climate science. He wrote earlier this year that the debate over global warming is "far from settled," even though virtually all scientists actively researching the issue agree that human-caused emissions are heating the planet. The consequences of climate change, which are already being felt around the world,

have included deadlier heat waves, fast-rising seas, more extreme droughts and wildfires, bigger food shortages in the developing world and the spread of diseases to new geographic areas.

Environmentalists have slammed Pruitt's ties to the fossil fuel industry. Since 2002, when he was serving in the Oklahoma Senate, he has received \$271,000 in campaign contributions from the oil and gas industry and \$25,000 from the coal industry, according to the National Institute on Money in State Politics. He has also worked closely with fossil fuel companies in his campaigns against federal regulation. The New York Times reported in 2014 he sent the Obama administration letters drafted by oil and gas lobbyists, copying the text onto state stationary and adding his signature.

Source: Excerpts from the *Geothermal Energy Association Weekly*, No. 48, 2016.

Climate Change: The Lowest Energy-related CO₂ Emissions in the U.S. Since 1991

According to the U.S. Energy Information Agency, the energy-related carbon dioxide (CO₂) emissions in the country totaled 2530 million metric tons in the first six months of 2016. This was the lowest emissions level for the first six months of the year since 1991, as mild weather and changes in the fuels used to generate electricity contributed to the decline in energy-related emissions. EIA's Short-Term Energy Outlook projects that energy-associated CO₂ emissions will fall to 5179 million metric tons in 2016, the lowest annual level since 1992.

In the first six months of 2016, the United States had the fewest heating degree days (an indicator of heating demand) since at least 1949, the earliest year for which EIA has monthly data for all 50 states. Warmer weather during winter months reduces demand for heating fuels such as natural gas, distillate heating oil, and electricity. Overall, total primary energy consumption was 2 percent lower compared with the first six months of 2015. The decrease was most notable in the residential and electric power sectors, where primary energy consumption decreased 9 percent and 3 percent, respectively.

Coal and natural gas consumption each decreased compared to the first six months of 2015. However, the decrease was greater for coal, which generates more carbon emissions when burned than natural gas. Coal consumption fell 18 percent, while natural gas consumption fell 1 percent. These declines more than



offset a 1 percent increase in total petroleum consumption, which rose in that period as a result of low gasoline prices.

Consumption of renewable fuels that do not produce carbon dioxide increased 9 percent during the first six months of 2016 compared with the same period in 2015. Wind energy, which saw the largest electricity generating capacity additions of any fuel in 2015, accounted for nearly half the increase. Hydroelectric power, which has increased with the easing of drought conditions on the West Coast, accounted for 35 percent of the increase in consumption of renewable energy. Solar energy accounted for 13 percent of the increase and is expected to see the largest capacity additions of any fuel in 2016.

Source:

http://www.pennenergy.com/articles/pennenergy/201 6/10/energy-related-co2-emissions-for-first-sixmonths-of-2016-are-lowest-since-1991.html?eid=291021978&bid=1555971

100% Renewable: Stanford University Confirms a 100 Percent Renewable World is Possible by 2050

A comprehensive energy study of 139 countries undertaken by Stanford University, in California, concludes that by 2050 it is perfectly feasible to have a world that obtains 100 percent of its energy needs from renewables. The study details a vast plan to transform current energy infrastructures (electricity, transport, heating, temperature control, industry, agriculture, forestry and fishing) in 139 countries into systems solely powered by the wind, water and sun. The road map forecasts an 80 percent conversion of these infrastructures by 2030 and 100 percent by 2050.

The study compares the energy consumption of the entire supply system required by fossil fuels and renewables. For fossil fuels, extraction, transport and the transformation of coal, gas, oil and uranium into heat, electricity and fuel involve a huge amount of energy consumption, from the supply source to reach the final consumer.

Renewables also have transport costs however they need no extraction or transformation to make them



usable, thereby bringing down their costs. Researchers have converted these costs into GW and have concluded that the current global energy mix, predominantly fossil fuel-based, would require 20,600 GW in 2050 to cover supply, compared with 12,100 GW in 2012. The study concludes however that the 100% renewable scenario would require 11,800 GW in 2050, a 42 percent saving on the world's energy consumption.

The study considers a host of data, especially the renewables potential of the 139 countries in relation to the surface area of each national territory required to cover its energy needs; the jobs created; benefits in terms of the effects of pollution on the health of residents and even the benefits that could be obtained by developing renewable energy within each of the countries analyzed.

Source: http://futurenergyweb.es/stanford-universityconfirms-that-a-100-renewable-world-is-possible-by-2050/?lang=en

Energy Savings: EU Aims to Cut Energy Use by 30 Percent in 2030

The European Commission has unveiled its big power plan, aiming to slash energy use in the bloc by 30 percent by 2030.

Cutting waste, better integrating renewables and phasing out subsidies for coal-fired electricity generation are all part of the vision. But wind and solar energy producers will no longer have priority for selling to the grid, in places where renewables already have a large share.

Campaigners have been warning against that, claiming it risks slowing progress. They have also called for more ambitious energy efficiency targets. The EU is aiming to cut greenhouse gas emissions by 40 percent compared to 1990 levels. It wants renewables to make up at least 27 percent of the power mix by 2030.

As part of the plan, regional centers are proposed to improve cooperation among grid operators. But all of this still needs to be approved by member states and the European Parliament.

Source: http://video-

mp4.euronews.com/mp4/EN/EU/BX/en/161130 E UBX_170A0-180208_E.mp4

Books: About Financing and Climate Change

A new book by Dr. Hilmar Þór Hilmarsson, Professor at the School of Business and Science University of Akureyri, Iceland, has been published in the fall of 2016 in New York. The book is entitled: International

Financial Institutions, Climate Change and the Urgency to Facilitate Clean Energy Investment in Developing and Emerging Market Economies.

The book discusses how international financial institutions (e.g. the World Bank Group and regional development banks) can facilitate increased investment in clean energy projects in developing and emerging market countries. In the coming years and decades, most of the increase in demand for energy is likely to be in those countries. Clean energy sources are mostly located in developing and emerging economies. Investment in clean energy is often capital intensive, including for geothermal and hydropower projects, and with long repayment periods. Risk in developing and emerging countries, including political risk, is often high and international financial institutions can promote increased investment in cooperation with the private and the public sector with loans and grants, but more effectively with insurance and guarantee instruments, that they have been hesitant to utilize. In spite of the threat of climate change, energy challenges and environmental degradation, international financial institutions have so far done little to invest in clean energy projects. In this book Hilmar explains how international financial institutions can use their financial instruments to multiply the number of clean energy projects in the coming years and decades. Hilmar wrote the book mostly while he was a Visiting Professor at Cornell University in the fall of 2015.

The book includes the following chapters: Introduction. Clean Energy, Environmental Degradation and Climate Change - the Global Challenge. Chapter 1. The Global Cross Border Investment Regime and the Lack of an

International Investment Organization. Chapter 2. The World Bank Group: Loans vs. Guarantees? Chapter 3. International Financial Institutions and Risk Mitigation. Chapter 4. How International Financial Institutions Can Support Cross Border Clean Energy Projects. Chapter 5. The World Bank Group and the Effectiveness of its Risk Mitigation Instruments.

More info: www.novapublishers.com.

Books: Geothermal Power Generation:





Developments and Innovation, 1st Edition

Geothermal Power Generation: Developments and Innovation provides an update to the advanced energy technologies that are urgently required to meet the challenges of economic development, climate change mitigation, and energy security.

The book is edited by Ronald DiPippo, Chancellor Professor Emeritus of Mechanical Engineering and the former Associate Dean of Engineering, University of Massachusetts Dartmouth (UMD), Massachusetts, U.S., who is a highly respected expert and world authority on geothermal power plants. It provides a comprehensive overview of the major aspects of geothermal power production. The book is composed of 26 chapters, grouped into four parts, contributed by specialists in their respective areas. They cover resource discovery, resource characterization, energy conversion systems, and design and economic considerations. Besides Ron DiPippo, among the authors of the first 18 chapters are L.Y. Bronicki, L.E. Capuano Jr., A. Chiasson, W. Cumming, A.C. de Jesus, W.A. Elders, J.R. Haizlip, W. Harvey, R.N. Horne, G. Mines, J.N. Moore, M.C. Moore, J.P. O'Sullivan, M.J. O'Sullivan, K. Phair, I.K. Smith, P. von Hirtz and K. Wallace.

The final section provides a range of fascinating case studies from across the world, presented in eight chapters, including Larderello (by R. Parri & F. Lazzeri, prologue by R. Cataldi), The Geysers (by S.K. Sanyal & S.L. Enedy), Indonesia (by S. Darma), New Zealand (by I.A. Thain & P. Brown), Central and South America (by



January-March 2017

P. Moya Rojas), Los Azufres (by L.C.A. Gutiérrez Negrín & M.J. Lippmann), EGS (by E. Huenges) and international environmental laws (by E. Rodríguez Arias).

Users will find this to be an essential text for research and development professionals and engineers in the geothermal energy industry, as well as postgraduate researchers in academia who are working on geothermal energy.

It was published 20 June, 2016 by Woodhead Publishing. 854 Pages. ISBN: 9780081003374.

Source: <u>http://store.elsevier.com/Geothermal-Power-</u> <u>Generation/isbn-9780081003374/</u>

Industry: Chevron Announces Sale of Geothermal Operations

On 23 December, 2016, Chevron Corporation announced that its wholly-owned subsidiaries have entered into a sales and purchase agreement with Star Energy Consortium to sell Chevron's Indonesian and Philippines Geothermal assets.

Chevron Corporation is one of the world's leading integrated energy companies, based in San Ramon, California. In Indonesia, Chevron subsidiaries operate the Darajat and Salak geothermal fields in West Java. In the Philippines, company subsidiaries have a 40% equity interest in the Philippine Geothermal Production Company, Inc., which operates the Tiwi and Mak-Ban geothermal power plants in Southern Luzon.

The Indonesia consortium who will acquire the Chevron's assets consists of AC Energy –with a 19.8% economic stake--, Star Energy Group Holdings Pte. Ltd., Star Energy Geothermal Pte. Ltd., and Electricity Generating Public Co. Ltd. The acquisition will be made through their joint venture company, Star Energy Geothermal (Salak-Darajat) B.V.

In the Philippines, the consortium consists of AC Energy and Star Energy Group Holdings Pte. Ltd. The acquisition will be made through their joint venture company, ACEHI-STAR Holdings, Inc.

As of closing this edition, it has not disclosed the figures of the operation, but the Chevron's assets have been estimated at US\$3 billion.

Source: <u>http://www.chevron.com/investors/press-releases</u>

Do you have some drawings, sketches, or small paintings geothermal-related? So, why not include them to illustrate your contributions to the IGA News? Next time you send an article or short note, just send your drawing attached as a *jpg or *png file. IGA News is published quarterly by the International Geothermal Association. IGA News disseminates 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: Peter Meier, Switzerland (Chairman) Rolf Bracke, Germany Varun Chandrasekhar, India Albert Genter, France Lúdvík S. Georgsson, Iceland Luis C.A. Gutiérrez-Negrín, México Susan F. Hodgson, USA Herman Darnel Ibrahim, Indonesia Liu Jirong, China Kristín Vala Matthíasdóttir, Iceland Georgina Izquierdo-Montalvo, Mexico Marcelo J. Lippmann, USA Diego Morata, Chile Fernando S. Peñarroyo, Philippines Horst Rüter, Germany Ka Noel Salonga, Philippines Marietta Sander, Germany Surya Darma, Indonesia Massimo Verdoya, Italy Shigeto Yamada, Japan Meseret T. Zemedkun, Ethiopía The members of this group submit geothermal news from their parts of the world, or their areas of specialization. If you have some news, a report, or an article for IGA News, you can send it to any of the above individuals, the Editor or directly to the IGA Secretariat. Please help us to become essential reading for anyone seeking the latest information on geothermal worldwide. While the editorial team makes every effort to ensure accuracy, the opinions expressed in contributed articles remain those of the authors and are not necessarily those of the IGA. The editorial team does not assume any liability for external content taken from public sources and websites, or endorse the products or services mentioned. Send IGA News contributions to the editor (l.g.negrin@gmail.com) and/or: International Geothermal Association (IGA) c/o Bochum University of Applied Sciences, E-mail: iga@hs-bochum.de This issue of IGA News was edited by Luis C.A. Gutiérrez-Negrín. Susan Hodgson proofread the articles. Distributed by the IGA Secretariat. Design layout by François Vuataz.

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