IGA NEWS

Newsletter of the International Geothermal Association

Quarterly No. 112

IGA ACTIVITIES

Message from the Executive Director

Greetings to all members of IGA and those that are reading this newsletter. We hope the second Quarter of 2018 has been a good one for all of you. For us at the IGA it has been an exciting time, with the absolute milestone of IGA Board meeting #68 in Reykjavik, Iceland. Highlights and main outcomes of this meeting are discussed on pages 5 through 6 in this newsletter. From our perspective at the Secretariat, the most exciting thing is that the IGA Board has taken a bold step in executing its strategy and embark on a journey towards independence. The IGA will move its operating headquarter from Bochum to Bonn by 1 January 2019. The City of Bonn is welcoming the IGA and offered great conditions regarding office space and being close to our strongest partners such as the UNFCC and IRENA, and being co-located with the World Wind Energy Association, the 100%Renewables Platform and the International Climate Agency is simply fantastic news. We are looking forward to this new adventure very much and would also like to express our since thank you to Prof Rolf Bracke, the Geothermal Centrum Bochum (GZB), the Bundesland North-Rhein Westphalen and the EFRE program of the EU, without whom we would not be in the same position as we are today. Thank you!

The Board has also decided to change the frequency of the World Geothermal Congress from five to three years effective from the next one, WGC2020. This means that the first one after WGC2020 will be organized in 2023 and tenders will be opened in Quarter 3 of 2018.

Let us also share some family news regarding our team in Bochum. Karolina Andersson has become the proud mum of a baby boy, Viggo, on May 25. We congratulate her and her family with this fantastic news and we wish them all a great start in this new chapter of their life.

Highlights of the past few months are the continued focus on being visible and raising the geothermal flag at conferences, panel discussions and workshops. We have been involved in quite a few of them and it is clear that the IGA needs to transition into an independent sustainable organization that is renowned worldwide for its geothermal leadership and trusted voice. Focus has

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been on Iceland with both the IGC and the IGA Board meeting taking place there. Also, emphasis has been put to create synergies between the Oil & Gas Sector and the Geothermal Sector by organizing cross-over events together with the AAPG and the EAGE. Geothermal is still relatively invisible in the energy transition dialogues taking place on a global scale, however is gaining traction on the regional and national scale. It is up to us as a reputable organization and our renewable partners to facilitate upscaling from national to international, apply best practices and support the growth of geothermal development through active engagement with policy-makers and decision-takers. We cannot stress enough how important it is to hear from our membership about your ideas, your solutions and your contributions. Do not hesitate to connect to us and share your geothermal story with us and the global geothermal community. We specifically invite you to reach out to us regarding our new website, our initiatives on the UNFC, on drilling specifications and standardizations, and geothermal capacity-building in emerging countries.

For now we wish vou happy Summer or Winter Break pending where you live and work and your enjoy leisure time with family and friends.

Kind regards,

Dr. Marit Brommer, Executive Director, IGA – <u>marit.brommer@hs-</u> bochum.de

In Memoriam Ruggero Bertani

Adele Manzella, President of UGI (Italian Geothermal Union), Researcher at CNR-IGG (Italian National Research Council-Institute of Geosciences and Geo-resources)

Those who had the joy to meet Ruggero Bertani will be finding the geothermal world a much emptier place since June 21, when Ruggero passed away after one year of a hard-fought illness, at the age of 62. The news of his death surprised even those who had only met him recently: he had such a vitality -so much so that never seemed to take even his own cancer too seriously.

Ruggero was the head of the Geothermal Innovation line in Enel Green Power (EGP), the largest Italian company dealing with industrial geothermal activities. He was also President of EGEC (European Geothermal Energy Council). From these positions, Ruggero was a free-wheeling force in promoting geothermal research and innovation. He encouraged collaboration among European industry, academia and research centers by strongly supporting the launch of the ETIP – DG (European Technology & Innovation Platform on Deep Geothermal) in 2016. Elected Chair in 2017, his view of geothermal research frontiers is very well reflected in the first strategic document of ETIP-DG released on March 2018, i.e. its Vision.

Among the numerous and diversified Research & Innovation projects he launched for EGP, he was only able to see the completion of the very first one, which ended just before his death: an innovative, challenging and ambitious project co-funded by European Union named DESCRAMBLE, by which drilling at super-hot conditions has been successfully achieved in the Larderello area, Italy.

The recent activities were only the tip of the iceberg of the huge contribution that Ruggero gave into the international geothermal energy scenario.

Ruggero was a high-energy nuclear physicist and worked first as researcher at INFN and CERN and then for Enel in his study field till the denuclearization of Italy. His first public engagement in geothermal energy was the organization of pre- and post-congress courses of the 1995 World Geothermal Congress, held in Florence, Italy. He was a member of IGA Board of Directors, acting as Executive Director on 1998-2004 when the IGA Secretary was hosted by Enel. He was then IGA Vice-President on 2007-2010. For over 20 years he has been the brilliant voice presenting the geothermal power generation in the world at the IGA WGCs. Collecting and managing IGA geothermal production data, for a while he organized, in collaboration with the Italian National Research Council, the online geothermal production IGA database. The geothermal energy world status was a classic among his numerous scientific publications, mainly based on geothermal power generation.

His career spanned a wide collection of active roles in numerous contexts. After his reservoir modelling activity for Enel and participation in research projects (the European I-GET project for the application of new integrated geophysical techniques for the identification of deep targets, and the SINO-Italian cooperation project, for reservoir assessment of Yangbajing

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geothermal field, Tibet), he was Project Director in the Geothermal Center of Excellence of EGP.

He was a Board Member and then Vice-President of EGEC, and Chairman of the Technological Platform on geoelectricity of EGEC, coordinating the geothermal presence in the Strategic Energy Technology (SET) Plan of the European Commission. He also acted as Secretary of the Italian Geothermal Association (Unione Geotermica Italiana, UGI).

He was Lead Analyst in the 'Energy Resources (Fossil, Nuclear, and Renewable)' chapter of the Global Energy Assessment (GEA) from the International Atomic Energy Agency (IAEA), and was a member of the International Panel of the IEA for the elaboration of the geothermal roadmap.

Ruggero believed in the necessity

of a less polluted world where geothermal energy plays an important role, and seriously undertook his activity at the Intergovernmental Panel on Climate Change (IPCC) activities, as main author of the geothermal chapter of the 2009 IPPC report, and leading author of the geothermal chapter in the Special Report on the Renewable Energy Sources (SRREN) of IPCC working group. During 2012 and 2013 he was the local chairman of the Organizing Board of the most important geothermal European event, organized by EGEC every three years: the European Geothermal Conference (EGC) held in Pisa on 2013, with EGP as major sponsor and co-organized by UGI and IGA Euro Branch.

He loved biking, eating, and making others laugh. Young scientists, meeting him at the lessons for the ICS International School of Geothermics in Trieste or at UGI, remember well his powerful message, his advice and his support –Ruggero enjoyed teaching and sharing his knowledge and enthusiasm. At work dinners as well as in meetings he could blend together technological debates and humorous examples.

Warm, encouraging, assertive, he never gave up when faced with difficulties, and always saw the positive side. When he discovered that he had cancer at the apex of his career he said "well, this moment is better than others, now I have all the strength to fight". And he fought like a lion.



Ruggero is survived by his widow, Giovanna, and his two sons, Lorenzo and Leonardo, who have lost a

tremendously loving, generous and fun-loving husband and father. Those of us who were lucky enough to know him personally will always cherish the joy and laughter that he gave us on a daily basis, which he surely brought wherever he went.

Working Meeting of the WGC 2020 Organizing and Steering Committees

Luis C.A. Gutiérrez-Negrín, Editor

On April 27th the second working meeting of the organizing and steering committees for the World Geothermal Congress 2020 (WGC2020) was held in the offices of the company Landsvirkjun in

Reykjavik, to review the current status of this congress to be held in the Islandic capital in the week from April 26 to May 2, 2020. The WGC is the most important and attended meeting of the geothermal community worldwide, and has been organized by the IGA and a local partner every five years, since April-May 1995, when the first of this series of WGC was held in Florence, Italy. The following meetings were organized in Japan, Turkey, Indonesia and Australia, in 2000, 2005, 2010, and 2015, respectively.

After a public bidding process, which received several proposals by organizations and national associations from Chile, Kenya, Germany-The Netherlands, Iceland, The Philippines and the United States, the Board of Directors of IGA selected the Iceland proposal as the most highly qualified, and granted the venue to this country. The organization of the congress is the sole responsibility of the host country, which has appointed an Organizing Committee (OC), but much of decisions have to be approved by the IGA, for which it has also appointed a Steering Committee (SC).

The OC current composition is as follows: Chairman: Bjarni Pálsson (Landsvirkjun), Vice Chairman: Hildigunnur H. Thorsteinsson (Reikjavik Energy), Secretary: Viðar Helgason (Iceland Geothermal Cluster Initiative), Treasurer: Kristín Vala Matthíasdóttir (HS Orka), Project Manager: Hjalti Páll Ingólfsson (GEORG). Members: Alexander Richter (President of IGA, ThinkGeoEnergy), Árni Ragnarsson (ÍSOR), Hildigunnur Thorsteinsson (Reykjavik Energy), Lúðvík Georgsson (UNU-GTP), Páll Erland (Samorka), and Sigurður M. Garðarsson (University of Iceland, GEORG).

The current members of the SC are Juliet Newson (Iceland), Steering Committee Chair and Fellowships Chair; Paul Brophy (United States), Sponsorship Chair; Roland N. Horne (United States), Technical Program Chair; Lúðvík Georgsson (Iceland), Short Courses Chair; Luis Carlos Gutiérrez-Negrín (Mexico), Finance Chair; and Andrea Blair (New Zealand), Non-Technical Program Chair.

The agenda of the more recent working meeting included an introduction and welcome by the host; the status of work and pressing next steps, including the approval of the visual identity and logo, the congress theme and the launching of the official website; the presentation and update of the Master Plan, with the review of the key target dates, the marketing and promotion main activities and an updating of the preliminary budget. Another important subject was the technical program, and the SC-OC reviewed the deadlines for submission and evaluation of abstracts, the list of technical sessions, areas for poster sessions, exhibition and side-events, contents of the plenary session, and the list of possible short courses to be offered in the two previous days (April 24-25) to the congress itself.

After the discussion, the SC-OC members joined the members of the IGA Board who were developing its 68th meeting in Reikjavik (*see* separate note), and then all paid a protocol visit to the President of Iceland, Guðni Thorlacius Jóhannesson. The President offered a reception at the Presidential Residence, located in Bessastaðir, north of Hafnarfjordur town and just across the Skerjafjordur fjord, around 13 kilometers from Reykjavík center. There, the IGA members were asked to sign the visitor book, and then were received and greeted individually by the President, who later gave them a warm welcome message, and gently accepted a group photo.

Bessastaðir has been the presidential residence since 1941, but the site has a much older history, having been mentioned in the Islendinga Saga (Saga of the Icelanders). Archeological digs and researches have shown that the earliest settlers in Bessastaðir were among the first settlers in Iceland. When Iceland agreed to fall under the King of Norway and abide to his rule, Bessastaðir was claimed by the King and it became a Royal Stronghold and the dwelling place of the highest ranking official in Iceland.

The main building at Bessastaðir was built in 1761 and the church, which still stands, was consecrated in 1796. During 1761-1766 it housed a school until 1867. Grimur Thomsen, a poet and statesman purchased it and lived there with his family for almost two decades. It was in 1940 that the land was bought by Sigurdur Jonasson and donated to the state, for the future residence of the Icelandic presidents.

Some of the main features of the WGC2020, as discussed by the SC-OC meeting, are the following:

- The short courses, conference and exhibition of the WGC2020 will be held at the conference center Harpa located in the center of Reykjavík. This venue can easily accommodate a convention of up to 2500 delegates with

Members of the OC-SC and the IGA BoD, with the President of Iceland, Guðni Thorlacius Jóhannesson.

a good exhibition area as well as break-out areas for catering and 14 meeting rooms.

- The OC has prepared a preliminary budget based on between 1200-1700 delegates, including Students, Fellowship holders, Exhibition booth attendants and VIP's. The OC considers this is a conservative estimate based on two last conferences, and will be updated constantly.

- The Opening Session will be held on the morning of Monday 27 April 2020 in the Harpa Conference Hall and will commence with cultural welcomes. The Opening Session will include greetings by the Convener and Sponsors, followed by addresses from invited Keynote Speakers and VIPs. The Closing Session will be held on the afternoon of Friday 1st May in the same place, which can hold around 1750 sitting attendants. It will include messages of thanks from the Convener and Sponsors and the introduction and handover to the host Organization for the next WGC. The Closing Session might also include Keynote Addresses from invited Speakers and the Reykjavik Declaration to be prepared by the SC-OC.

- It is expected to organize around ten simultaneous technical sessions, with oral presentations of 20 minutes each and a total of at least 700 papers. At the start of each day, it is planned to hold a breakfast meeting at the Congress venue for Chairpersons and Speakers to receive instructions and get prepared. The final amount of papers and sessions will depend on the papers received and approved for oral presentation.

- There will be also poster sessions every day during the oral sessions. Each poster presenter will be allotted one day to present its poster. The poster will be for display all day and at the end of the technical sessions the presenter will be allocated approximately one hour to attend the poster and provide explanations and answers to interested viewers. During other times, posters will be on display only. The alternative option of electronic poster presentation will be assessed. It is expected to have around 500 papers in poster presentation.

- A Trade Exhibition will be a major component of the Congress. The Exhibition will be housed in the open area within the Harpa Center, where coffee and lunch will be served. The Exhibition will be held over five days. Facilities will be offered where Exhibitors may elect to entertain visitors with social drinks or luncheon events (costs to be borne by Exhibitors).

68th BoD Meeting in Iceland

Marit Brommer, IGA Executive Director

Preparing for the future - The International Geothermal Association is implementing far reaching changes

The IGA Board conducted its 68th meeting in Reykjavik, Iceland, on 29 April 2018. As a result of intense discussions the IGA Board has decided on improving the following elements which are presented here below. These improvements will help prepare the geothermal sector for the future and emphasize the IGA's role in the representation of the Global Geothermal Energy Sector.

To focus and strengthen its role, the International Geothermal Association (IGA) is proud to announce a series of reforms following the recent decisions made during the IGA Board of Directors meeting in Reykjavik, Iceland.

IGA has made strides toward a more sustainable, independent structure that reflects the international nature of the representing body of the global geothermal sector through the association. This effort will transition IGA to an independent structure and position itself for growth by changing its funding model and modus operandi.



Alex Richter addresses to the BoD in the 68th meeting.

IGA understands the need to sharpen its value proposition for members and has taken steps to redefine elements of its membership model. Henceforth, IGA will increase its emphasis on the industry with different corporate membership levels and engagement. At the same time, the association will sharpen its profile towards value proposition for our affiliated members, national associations, and institutions.

"With these changes, we are our strengthening position and engagement with international partners in our work highlighting what geothermal energy has to offer in the global energy transition. With the adaptation of our operational model we strengthen the role we play for our members and the wider global geothermal energy community." Alexander Richter, President of IGA & Principal, ThinkGeoEnergy.

Alongside many ongoing and planned initiatives, the IGA is striving to create value for the geothermal sector and expand its collective voice on behalf of global geothermal development. These initiatives are already well underway with the deployment of Specifications UNFC for Geothermal Energy Resources, and engagement on the Sustainability Geothermal Assessment Protocol. IGA is planning to establish an Advisory Council to support IGA and its initiatives.

"Working on initiatives like the UNFC Specifications for Geothermal

Resources and efforts on a Global Geothermal Sustainability Assessment Protocol, are aimed at supporting an accelerated deployment of geothermal energy, strengthening the global geothermal energy industry for further growth and utilizing all that geothermal energy has to offer." - Bruno Della Vedova, Secretary, IGA & Associate Professor, Fondazione Internazionale Trieste.

IGA is actively taking steps for a deeper engagement with industry on activities and alignment that supports and strengthens our scientific and academic roots.

Furthermore, IGA has decided to change the frequency of the World Geothermal Congress from every five to three years. Following the World Geothermal Congress 2020, which will be held from April 27 to May 1, 2020 in Reykjavik, Iceland, the next congress will take place in 2023. The aim of this decision is to engage more frequently with our global members and emphasize the importance of promoting geothermal energy and its benefits for other industries.

'In the recent years the world-wide boom of renewable energy for power production has also seized geothermal. Especially in South-East Asia, Africa and Turkey the growth rates are impressive. Geothermal for heating has developed exponentially in China and some areas in Europe. Therefore, it is time to increase also the frequency of WGC, the most important platform of the geothermal

> sector for exchange of ideas, information and technology among practitioners, academics, industry and policy makers from the whole globe." - Peter Meier, Chair of Information Committee, IGA & CEO, Geo-Energie Suisse AG.

> IGA is preparing a new communications strategy with the goal of increasing engagement with its membership, affiliated organizations, partners and the wider international geothermal community. Today, IGA is also proud to present and launch their new website: <u>www.geothermal-energy.org</u>,

www.lovegeothermal.org.

Last but not least, the IGA is moving its operating head quarter from Bochum to Bonn (Germany) by 1 January 2018. We thank Prof Rolf Bracke for all his endeavours and passion to host the IGA Secretariat since 2011 at the Geothermal Center of Bochum (GZB). The IGA has been fortunate to have strong sponsors which has helped enormously to create a future-proof platform which can operate independently.

The IGA staff is grateful having worked with so many talented people dedicated to geothermal energy. Thank you Bochum, thank you GZB, and thank you Prof Rolf Bracke!

4th Iceland Geothermal Conference Held in Reikjavik

On April 26th the Iceland Geothermal Conference (IGC) successfully concluded in Reykjavik, Iceland. Having established itself as an important regular meeting of the international community, this year's event brought together more than 600 participants from 40 countries from around the world.

As in previous years, the event featured not only an exciting program and high-level speakers, targeting a



the visit included in the BoD meeting.



Opening Session, Iceland Geothermal Conference 2018 (Photo by ThinkGeoEnergy).

wide variety of topics from financing, to technical solutions and the direct use of geothermal energy resources, but also saw a great variety of side events and field trips.

This year's event was held under the theme of 'Breaking the Barriers', which was carried throughout the days of the conference and side events.

The event was kicked off with a one-day workshop by the International Renewable Energy Agency (IRENA)'s Global Geothermal Alliance (GGA) on 'Geothermal Direct Utilization and Food Security', which highlighted the opportunities for geothermal direct use. A second event by the GGA, looked at how collaboration efforts can be strengthened between regional and national industry platforms and how industry clusters can jointly develop or support to promote geothermal development globally. Presentations and program can be accessed <u>here</u>. On the day prior to the conference, the Iceland School of Energy held a workshop on 'Geothermal System Management: Reservoir Modeling for Management'.

During the conference program, the United Nations University Geothermal Training Program (UNU-GTP) held a workshop in celebration on its 40th anniversary, bringing together a large group of current and past students of the program, and a large group of representatives from Kenya, Tanzania, Ethiopia, as well as other countries.

The World Bank and its Energy Sector Management Assistant Program (ESMAP) held a special workshop on how – through its Global Geothermal Development Plan--, the World Bank helps to change the course of geothermal development.

In its unique setup, the IGC again built in various field trips within the program of the conference right after the first half of the opening day. One trip brought people to the Hellisheidi geothermal power plant near Reykjavik, while another one showed participants how geothermal energy is being utilized in the local community of Hveragerdi. The third field trip focused on the geology and nature on the Revkjanes Peninsula, the location

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of the operations of the Svartsengi and Reykjanes geothermal plants by HS Orka.

The conference itself featured a fantastic program with speakers from around the world. They not only looked at technological issues, challenges and solution, but also targeted on how projects can be financed, how stakeholder engagement could and should be implemented, and much more. To get a sense of the full program that was offered, check out the official program.

After the conference, three different excursions offered participants the opportunity to visit Iceland's newest geothermal power plant of Theistareykir in the North of Iceland, visit the Langjökull Ice Caves and experience the sights of the Golden Circle, visiting the Gullfoss waterfall, Lake Thingvellir and the famous Geysir.

The 2018 Iceland Geothermal Conference was also a bit of a test run for the IGA's World Geothermal Congress 2020 to be held in Reykjavik at the same venue, the Harpa convention center.

Source: <u>http://www.thinkgeoenergy.com/successful-</u> iceland-geothermal-conference-highlights-future-roleof-geothermal-energy-worldwide/

25th Annual Congress of the Mexican Geothermal Association (AGM)

Abraham III Molina Martínez, Juan Ignacio Martínez-Estrella and Heber D. Diez-León, AGM BoD

In April 19-20 2018, the Mexican Geothermal Association (AGM, Asociación Geotérmica Mexicana)

held its 25th Annual Congress and General Assembly in Morelia city, Michoacán, México. The AGM is the Mexican association affiliated with the IGA and is presently composed of about 200 individual members.

The congress gathered about 140 participants from the geothermal division of the Comisión Federal de Electricidad (CFE), and the Instituto Nacional de Electricidad y Energías Limpias (INEEL, National Institute for Electricity and Clean Energy; formerly IIE), as well as the universities of Mexico (UNAM), Michoacán (UMSNH) and Nuevo León (UANL) and other institutions, like the Mexican Center for Innovation in Geothermal Energy (CeMIE-Geo: Centro Mexicano de Innovación en Energía Geotérmica), the Secretary of Energy (SENER), University of California, national and foreign private companies and numerous students, mainly from the National Politechnical Institute (IPN).

An eight-hour pre-congress workshop, divided into two, four-hour sessions, was organized by the AGM on 18th April. The first session, titled 'Introduction to Exploration Geo-chemistry', was lectured by Fernando Sandoval Medina, head of the Exploration department at the geothermal division of the CFE-Generación EPS VI. The second session 'Solutions to Chemical Operating Problems in Geothermal Developments', was lectured by Oleh Weres, Chief Scientist at PowerChem Technology LLC. Twelve participants attended the workshop.

The opening ceremony of the congress was held on the morning of 19th April. The presidium was composed of David Alejandro Rocha-Ruiz, Technical Coordinator of

Geothermal Energy at SENER representing Michelle Alejandra Ramírez-Bueno, head of the geothermal energy area in this Secretary; Miguel Ramírez Montes, deputy manager of Geothermal Studies of the geothermal division of the CFE-Generación EPS VI, representing Carlos Sánchez Cornejo, head of this division; Georgina Izquierdo-Montalvo, head of the geothermal division of the INEEL, Aída López-Hernández technical leader of the GEMex Project cooperation between Mexico and the European Union, and the current AGM's President, Abraham III Molina-Martínez.

The congress started with two plenary presentations, one by David Alejandro Rocha-Ruiz ('Perspectives of Geothermal Energy in Mexico') and the second by Miguel Ramírez Montes ('Geothermal Energy in Mexico'). During the congress, 34 technical papers were presented orally and 8 as posters. In the first day, the papers covered topics related only to geothermal exploration (geology, geohydrology, geophysics, geochemistry). In the second day the papers covered other topics such as reservoir engineering and modeling, well and steam field engineering/technoloy, geothermal turbines, direct uses and geothermal heat pumps.

In parallel to the technical sessions, a commercial exhibition was mounted in a space adjacent to the conference hall, where different agencies and companies involved in geothermal energy in Mexico exhibited their products and services. The sponsors and exhibitors were: Tenaris-Tamsa, Air Drilling Equipment Services, CeMIE-Geo, Vinco Energy Services, Geothermal Congress for Latin America & the Caribbean (GEOLAC), INEEL, CFE, CARSO Infraestructura y



Construcción, and Compañía Perforadora México.

In conjunction with the congress, on the afternoon of April 19th it was held the workshop 'Successful community and indigenous engagement: sharing lessons from New Zealand', which was sponsored by the Embassy of New Zealand in Mexico and offered by a group of lecturers from Upflow NZ.

On the evening of April 19th, as every year since 2005, the AGM presented the Pathé Award, which is a recognition to a person who has been involved in the field of Mexican geothermal energy in an outstanding way, by at least 15 years, and whose trajectory, merits or contributions are considered relevant. On this occasion, this distinction went to Magaly del Carmen Flores Armenta, former Manager of the CFE's geothermal division, and currently Deputy Director of Network Business at the same CFE. She is the first woman awarded, and got the recognition from the President of AGM, Abraham III Molina-Martínez and the previous Pathé Award winner, Luis C.A. Gutiérrez-Negrín. Magaly Flores was accompanied by her husband and daughters and other close relatives, and gave an emotive speech thanking the distinction.

Finally, on the evening of 20th April, the AGM held its 25th General Annual Assembly, where the President and the Treasurer of the AGM Board presented the official annual report to its members.

IGA, IRENA and World Bank Team Up to Streamline Geothermal Energy Development

Countries can expect a more robust and reliable set of procedures when screening a potential site for setting up geothermal energy projects, thanks to new geothermal resource data gathering and classification efforts being piloted by the IGA, the International Renewable Energy Agency (IRENA) and the World Bank, with the support of the Global Geothermal Alliance (GGA).

The specifications of the United Nations Framework Classification (UNFC) to Geothermal Energy Resources and Reserves provides a harmonized framework to qualify estimates of extractable geothermal energy by projects — taking into account economic viability, technical feasibility and geological confidence — that will help stimulate geothermal investments in countries where it is applied.

"Geothermal energy is fully recognized as a stable, reliable source of energy that can power economic development without contributing to climate change. As a result, globally we have seen a growing demand for geothermal projects and growing need for initial appraisals of potential sites for geothermal power, heat

UPCOMING EVENTS

GEOHEAT International Geothermal Conference

4-7 September 2018, Petropavlovsk-Kamchatsky, Russian Federation

6th Indonesian International Geothermal Convention & Exhibition 5-8 September 2018, Jakarta, Indonesia

GRC Annual Meeting & Expo 14-17 October 2018, Reno, Nevada, U.S.

<u>VI Polish Geothermal Congress</u> 23-25 October 2018, Zakopane, Poland

Seventh African Rift Geothermal Conference (ARGeo-C7)

29 October – 4 November 2018, Kigali, Rwanda

12th Asian Geothermal Symposium (AGS12) 9-12 November 2018, Daejeon, Korea

40th New Zealand Geothermal Workshop 14-16 November 2018, Taupo, New Zealand

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

and other direct uses," said Henning Wuester, Director of IRENA's Knowledge, Policy and Finance Centre.

"Through collaboration between IRENA, the IGA and the World Bank we expect to develop and promote transparency and standardization in the way resource assessments are conducted, reviewed and reported to promote a better understanding of the true potential and value of geothermal prospects," Wuester explains.

In September 2017, countries of the Global Geothermal Alliance, an IRENA initiative, agreed to work together to identify and implement measures to significantly increase the speed of geothermal energy development through the Florence Declaration. Standardization of geothermal resource estimates in countries is key to achieving this, as it provides clarity to investors, regulators, governments and consumers — critical when considering development opportunities at both project, company and national level.

"The UNFC system, when applied, is expected to foster an easier understanding of the geothermal resource base in most countries, and facilitate effective valuation of geothermal fields, and as a consequence, increase access to finance for investments in the sector," adds Abdulmalik Oricha Ali, IRENA's coordinator for the project.

Since its official endorsement by the United Nations

Economic Commission for Europe Committee on Sustainable Energy in 2016, the UNFC Geothermal Specifications have only been applied to single project case studies in just a few countries, but the new collaboration will see the classification for the first time applied to whole countries.

Piloting the initiative will involve authorities at national level in four countries with strong geothermal ambitions applying the UNFC to all geothermal projects in their country, and will include

developing a near holistic picture of geothermal potential including maps and tables in IRENA's Global Atlas for Renewable Energy platform.

"Geothermal deserves a global standard. The IGA is excited to collaborate with IRENA and the World Bank to leverage the important work done on the UNFC geothermal resources and reserves classifications and standardizations," said Marit Brommer, Executive Director of the IGA. "Building strong partnerships at a multi-national level and jointly deploying industrystandards at national levels, will be crucial for the successful uptake of geothermal energy worldwide."

To be jointly implemented by IRENA and the IGA, with support from the World Bank's Energy Sector Management Assistance Program, the project will begin by reviewing and classifying the identified geothermal projects and resource estimates of Flores –an Indonesian island with 14 different geothermal projects, representing significant geothermal development activity.

Source:

http://www.irena.org/newsroom/articles/2018/Apr/I RENA-IGA-and-World-Bank-Team-Up-to-Streamline-Geothermal-Energy-Development

IGA-IRENA-WB Workshop on UNFC Geothermal Specifications

From 20 to 23 of March, 2018, IRENA and partners from the IGA and World Bank shared with Indonesian government officials and geothermal project investors how the UNFC system can help classify Flores's

View of a Flores volcano. Photo taken from the source.ermal
lobalFlores, an Indonesian island named for its beautiful
flora, is the test-bed of these newly adapted
classification guidelines for geothermal projects. Called
the 'UNFC Geothermal Specifications,' this United
Nations' adapted resource classification system is for the
first time being piloted on the small island with the
support of IRENA, the International Geothermal

Committed to improving socio-economic conditions through stable and reliable energy access, some countries with the right geothermal resources are pursuing geothermal energy. Challenging this pursuit, however, has been the struggle to attract financing showing that to succeed a geothermal project needs to be more than just technically possible.

Association (IGA) and the World Bank.

"Tapping into geothermal energy is about more than just steam," said Abdulmalik Oricha Ali, an IRENA program officer helping to coordinate the new geothermal assessment pilot schemes. "Geothermal energy can only benefit anyone if it's economically competitive, and for that investors need both technical and socio-economic assessments," Ali adds. In Indonesia, the UNFC Geothermal Specifications can be used by authorities to promote clarity to potential investors on geothermal prospects.

The UNFC system holistically encompasses the management of socio-economical, technological and uncertainty aspects of energy and mineral projects. Using the classification system's project maturity and resource progression model, investors can identify projects to match their preferred risk profile, reduce exposure to potential costly failures and protect their investments.





It is estimated that across Indonesia's 17,000 islands there could be as much as 29.5 gigawatts (GW) theoretical geothermal potential, and the country has set in motion plans to harness it. In 2017, Indonesia had almost 2 GW of installed geothermal capacity, and during September's High-Level Conference of the Global Geothermal Alliance, Indonesia's Ministry of Energy and Mineral Resources outlined how the country intends to become the world's biggest producer of geothermal energy by 2021.

"By 2025 we plan to have over 7 GW of geothermal capacity," said Pak Sanusi Satar, Vice Chairman of the Indonesian Geothermal Association (INAGA), describing his country's geothermal ambitions. INAGA representatives attended the Flores workshop and were presented with an overview of the initiative's objectives –joining in group work to classify a subset of Flores's projects.

"This workshop has been useful to us because in our standards we've been focusing on just the technical aspects of geothermal projects, but in the UNFC we include it all –the social, economic, financial, and geological aspects. I find them interesting and useful and hope we can apply classification," Satar said. The sessions provided hands-on training to empower the Indonesian authorities to continue the work themselves to classify projects in the rest of Indonesia.

"For us this session was very much needed," said Pak Dikdik Risdianto, a geologist with the Indonesian Geological Agency. "Our work has only looked at

exploration without feasibility or economic considerations, but after this UNFC course, we've realized we need to look beyond just resources and think about economics."

Though the initial the feedback from workshop in Indonesia has been overwhelmingly positive, the work for the IRENA team working on the initiative, has just begun. IRENA and its partners plan to continue to pilot the classification system in different countries and across continents to optimize it different needs for globally.

Source: http://irena.org/newsroo

Top five countries in power and heat production from renewables in 2017, after the 2018 GSR.

m/articles/2018/Apr/Growing-Floress-Geothermal-Garden

GSR 2018 Launched

On June 4th the 2018 version of the Global Status Report (GSR) was released by REN 21, the worldwide network on renewable energy, from which IGA is a partner. The 2018 Global Status Report presents developments and trends through the end of 2017, as well as observed trends from early 2018 where available.

First published in 2005, the annual GSR is the most comprehensive and timely overview of the status, recent developments and trends in renewable energy markets, industries, investments, and policy developments worldwide. By design, it does not provide analysis or forecast. Data are provided by a network of 900 contributors, researchers, and authors from all over the world.

Some of the highlights of this 2018 GSR are as follows:

- Renewable power accounted for 70% of net additions to global power generating capacity in 2017, which is the largest increase in renewable power capacity in modern history.

- New solar photovoltaic (PV) capacity reached record levels, with 29% relative to 2016. Wind power also drove the uptake of renewables with 52 GW added globally.

- Investment in new renewable power capacity was

| | 1 | 2 | 3 | 4 | 5 |
|---|---------------|---------------|--------------|---------------|--------------------|
| POWER | | | | | |
| Renewable power capacity (including hydropower) | China | United States | Brazil | Germany | India |
| Renewable power capacity (not including hydropower) | China | United States | Germany | India | Japan |
| Renewable power capacity per capita (not including hydro) ³ | Iceland | Denmark | Germa | ny/Sweden | Finland |
| Bio-power generation | China | United States | Brazil | Germany | Japan |
| Bio-power capacity | United States | Brazil | China | India | Germany |
| 3 Geothermal power capacity | United States | Philippines | Indonesia | Turkey | New Zealand |
| Hydropower capacity ⁴ | China | Brazil | Canada | United States | Russian Federation |
| E Hydropower generation ⁴ | China | Brazil | Canada | United States | Russian Federation |
| 🖸 Solar PV capacity | China | United States | Japan | Germany | Italy |
| Solar PV capacity per capita | Germany | Japan | Belgium | Italy | Australia |
| Concentrating solar thermal power (CSP) | Spain | United States | South Africa | India | Morocco |
| Wind power capacity | China | United States | Germany | India | Spain |
| Kind power capacity per capita | Denmark | Ireland | Sweden | Germany | Portugal |
| HEAT | | | ~ | | |
| Solar water heating collector capacity ⁵ | China | United States | Turkey | Germany | Brazil |
| Solar water heating collector capacity per capita | Barbados | Austria | Cyprus | Israel | Greece |
| Geothermal heat capacity 6 | China | Turkey | Iceland | lapan | Hungary |

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more than twice that of net, new fossil fuel and nuclear power capacity combined, despite large, ongoing subsidies for fossil fuel generation.

- Investment in renewables was regionally concentrated: China, Europe and the United States accounted for nearly 75% of global investment in renewables in 2017.

- Both energy demand and energy-related CO_2 emissions rose substantially for the first time in four years. Energy-related CO_2 emissions rose by 1.4%. Global energy demand increased an estimated 2.1% in 2017.

- Little change in renewables uptake in heating and cooling.

- In transport, increasing electrification is offering possibilities for renewable energy uptake despite the dominance of fossil fuels.

Rana Adib, Executive Secretary of REN21, said "We may be racing down the pathway towards a 100% renewable electricity future, but when it comes to heating, cooling and transport, we are coasting along as if we had all the time in the world. Sadly, we don't."

Source: <u>http://www.ren21.net/wp-</u> <u>content/uploads/2018/05/GSR2018_PressRe</u> <u>lease_EN.pdf</u>

First Global Visibility Partner for Women in Geothermal (WING)

New Zealand-based Seequent, a world leader in the development of data visualization software, has signed on as the first Global Visibility Partner for Women in Geothermal (WING) to help raise the visibility of women in the industry and to inspire others.

The announcement was made at IGC 2018, the 4th Iceland Geothermal Conference in Reykjavík, at an event co-hosted by Iceland's Women in Energy (KíO) and WING, a global network that aims to promote the education, professional development, and advancement of women in the geothermal community.

The WING/Seequent Visibility Scholarship was also launched at the event which will fund one WING member each year to attend a global geothermal conference and present a research paper.

Graham Grant, Seequent's Chief Operating Officer, says: "We've been long-time supporters of WING and their mission to support women in the geothermal industry to reach their potential. Visibility has an important role to play in helping achieve this. We saw this partnership as a fantastic opportunity to work with

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WING to support a number of global visibility initiatives, the first of which is the scholarship."

Andrea (Andy) Blair, Global Chairman of WING, says: "We're delighted to have Seequent step up and support WING as our Global Visibility Partner. Women need to be visible, in positions of influence, making decisions and leading, and serving as role models for those wanting to step into these roles too. We thought it was a really good fit to have Seequent as our partner in this area given their Leapfrog Geothermal software, used by many in the industry, provides the tools to enable visualization and provide clarity."



Left to right: Andy Blair, Chair of WING with Jeremy O'Brien, Seequent's Geothermal Business Manager and Clare Baxter, Seequent's Technical Sales Advisor Energy (UK & Europe) (Source: WING).

Founded in 2013, WING now has around 1000 members in 48 country teams in geothermal hotspots around the world from New Zealand to El Salvador to Denmark.

Open to all WING women, this year's Visibility Scholarship will support speaking at the New Zealand Geothermal Conference in November. Seequent will provide flights, accommodation and conference registration for the successful applicant, chosen from conference abstracts screened by WING and Seequent.

Blair said Seequent's efforts play an important part in their wider action plan around the key themes of visibility, connect, inform and advance. In 2015 WING set an ambitious 5-year plan 'Roadmap to Iceland 2020', which is the next World Geothermal Congress, to actively pursue gender equality in the geothermal industry. She says, "Our goal to engage with all those

that enable and drive geothermal initiatives across the world, and we're making great progress."

Blair added it's also important to have a meaningful proportion of WINGmen as members as they make up 84% of the geothermal industry, and hold the vast majority of leadership positions. "Without the support of men, its unlikely meaningful change will occur."

Jeremy O'Brien, Seequent's Geothermal Business Manager, is one of the founding WINGmen. "I've been involved with Andy and the WING team from the start, along with other colleagues at Seequent. It's been really inspirational to be part of the network as they work to break down barriers for women in the industry. The tools and initiatives to support women in the workplace also support men, whether its workshops or the work they are doing on maternity and paternity models.

Seequent is well known in the geothermal community by its Leapfrog® modelling software, whose 3D geological version was introduced over seven years ago.

Source: <u>http://www.thinkgeoenergy.com/seequent-becomes-first-global-visibility-partner-for-women-in-geothermal/</u>

WGC 2020: Launching Website & Call for Abstracts

The IGA and the Icelandic geothermal community have launched a dedicated website for the World Geothermal Congress (WGC) 2020, to be held in Reykjavik, Iceland in April 2020. WGC 2020 will bring together the entire geothermal community in what will be the largest geothermal conference ever held.

Featuring renowned international speakers from academia, the business sector as well as government and NGOs, WGC 2020 will be a platform for the discussion that will shape the development and direction of the industry in the 21st century.

Benefitting greatly from the proximity of Iceland's geothermal resources to Reykjavik, field trips and excursions to Geothermal Power Plants and Iceland's unique geothermally shaped nature will feature prominently in the Program of WGC 2020.

Alex Richter, President of IGA, states in the website that "On behalf of the International Geothermal Association, we are excited to see the World Geothermal Congress being finally hosted in Iceland. The country stands like no other for the sustainable utilization of geothermal energy, with power generation, space heating, bathing and wellness, food production and so much more. Iceland represents a showcase of the world of opportunities geothermal energy has to offer."

The technical program committee of the WGC 2020, chaired by Roland N. Horne, has launched the call for

abstracts. The deadline to send abstracts is Thursday 31st January 2019, and the author instructions are on the web at <u>http://www.wgc2020.com</u>. The list of themes is grouped into four main subjects, as follows:

General

Keynote Country Updates Environmental Aspects Policy, Legal and Regulatory Aspects Economics and Financing Sustainability and Climate Change Case Histories Societal and Cultural Aspects Business Strategies Geothermal Education

Geoscience

Exploration Geology Geophysics Geochemistry Hydrogeology Resource Assessment Geomicrobiology

Engineering

Drilling and Completion Technology Reservoir Engineering Injection Technology Field Management Production Engineering, Steam Gathering Systems Power Generation Corrosion and Scaling Direct Use Geothermal Heat Pumps

Cross-cutting

EGS - Enhanced Geothermal Systems Big Data and Data Analytics Software for Geothermal Applications Health, Tourism and Balneology District Heating Agriculture Advanced Technology (Magma, Geopressure, etc.) Integrated Energy Systems, Cascaded Uses Minerals Extraction and Processing Other

Source: http://www.wgc2020.com/



AFRICA

Djibouti: Loans for Geothermal Plant and Project

On late March, a loan agreement over the amount of KWD 8 million (Kuwaiti Dinar) or around \$27 million for the financing of a 15 MW geothermal power project in Djibouti.

The loan agreement between the Republic of Djibouti and Kuwait Fund for Arab Economic Development, stipulates the extension of a Loan of Kuwaiti Dinars K.D. 8 million equivalent to about US\$ 27.2 million, to the Republic of Djibouti to assist in the financing of a Geothermal Power Station Project with a planned capacity of 15 MW. An agreement (Project Agreement), concerning arrangements for implementation of the Project, was also signed between Kuwait Fund for Arab Economic Development and Djibouti Geothermal Power Corporation which is undertaking the Project. It is worth-mentioning that the Fund is a Kuwaiti Public Corporation which relies entirely on its own resources for making loans and providing other kinds of development assistance".

The Loan Agreement was signed on behalf of the Republic of Djibouti by His Excellency Elias Mousa Douala, while the Project Agreement was signed on behalf of Djibouti Geothermal Power Corporation by Eng. Qeyad Mousa Ahmad, Chief Executive Officer of the said Authority. Mr. Hesham Al-Waqayan, Deputy Director-General of Kuwait Fund for Arab Economic Development, signed both the Loan and Project Agreements on behalf of Kuwait Fund.

The project aims to contribute to meet part of the demand for electricity in Djibouti, reduce the interruption of electricity services and reduce the import of fuel and electricity from abroad, through the establishment of a new power station using geothermal energy through the use of renewable local resources. The project also aims to protect the environment from contaminants from thermal stations using fossil fuels.

The project includes the drilling of about 10 wells for the production of steam and reclaimed water reinjection and the construction of a 15 MW power station at Jalla Koma (Phase I), 120 km west of the capital, Djibouti, in the area of Lake Assal. The new generation station will be connected to the central network by a 230 kV transmission line and a length of about 2 km. It also includes consulting services.

The project also includes the supply, installation and testing of three units of power generation each of about 5 MW with the necessary requirements to connect the station to the electrical network, spare parts and all the necessary mechanical and electrical supplements, civil works and control system and measurement.

Project implementation is expected to be completed by the end of 2021.

The Loan is made for a term of 25 years, including a grace period of 5 years, and is to be amortized in 40 semi-annual installments, the first of which will be due on the first date on which interest or other charges on the loan will fall due, in accordance with the Loan Agreement, after the expiry of the grace period. The loan bears an interest rate at 2% per annum, in addition to 0.5% per annum to cover administrative costs and other expenses incurred in the implementation of the Loan Agreement.

In separate news, it was announced the award of another loan to what seems to be a different geothermal project located in the Fiale Caldera, in the same Lake Assal. It is a saline lake, 155 meters below sea level, situated in central-western Djibouti at the top of the Great Rift Valley. The geothermal potential of the area, known for its seismic and volcanic activity, has been studied for many years and now the drilling campaign to capture this energy is under way.



Scheme of wells to be drilled in Fiale Caldera. Taken from the second source.

The project in the Fiale Caldera area of Lake Assal consists of drilling four exploration wells for a new geothermal power plant, set to come on-line in 2021. The power plant will have a total capacity of 50 MW. The Fiale project is managed by the Project Management Unit under the authority of Electricity of Djibouti, EDD. It is financed by the World Bank, the African Bank for Development, OPIC, French Agency for Development, GEF and ESMAP.

The produced fluid from the wells is expected to be concentrated sea water that has been heated to around 305°C, although the temperatures could be as high as 360°C at the bottom of the well. The wells will be drilled directionally, reaching vertical depth of 2500 meters.

Sources: http://www.thinkgeoenergy.com/kuwait-fundextends-27-million-loan-for-geothermal-plant-indjibouti/,

http://www.vallourec.com/EN/group/MEDIA/News /Pages/geothermie-djibouti.aspx

Ethiopia: Additional Funds to **Tendaho Project**

On June 21st 2018, two grants agreements were signed between the Ethiopian Minister of Finance and Economic Cooperation, the Embassy of France to Ethiopia and the French Agency for Development (AFD), in Addis Abeba, for a total of 18 million euros US\$21 million).

With one of the agreements, 8 million euros grant will be provided in contribution to the Tendaho Geothermal Development Project. It is funded by the European through the European Union Africa Union, Infrastructure Trust Fund (EU-AITF). This investment grant constitutes an additional funding to this project, which already benefited from a 9 million euros concessional loan from AFD and a total of 7.5 million euros from previous EU-AITF grants. The financing will enable to complete the drilling activities planned as part of the geothermal exploration and development effort in the Afar region.

The Tendaho project is implemented by Ethiopian Electric Power (EEP), in coordination with Geological Survey of Ethiopia (GSE). The activities will focus on developing a shallow reservoir in Tendaho in order to allow a sustainable exploitation with estimated capacity of 10MW, and on exploiting a deep reservoir by drilling wells at great depth.

The Agence Française de Développement (AFD) is the French bilateral development bank, which has been working for more than 70 years implementing French development-aid policy. In 2017, AFD committed for 10.4 billion euros (US\$ 12.16 billion) financing worldwide.

Source: http://addisstandard.com/news-frenchdevelopment-agency-provides-18-million-euros-forurban-and-geothermal-development-in-ethiopia/

Kenya: Expansion of Olkaria **III, Possibly New FiT, Grants** and Loans for Geothermal **Projects**

Expansion Plant of Olkaria III in Operation -Ormat Technologies Inc. announced in late June that the 11 MW Plant 1 expansion project in the Olkaria III complex in Kenya successfully completed its tests and commenced commercial operation on June 2, 2018.

Since 2000, Ormat has developed and expanded the Olkaria III complex in phases and increased its generating capacity from 13 MW to 139 MW by 2016. With the completion of the 11 MW expansion project, the total generating capacity of the complex has reached 150 MW. The scope of the project included drilling of new wells, adding a new Ormat Energy Converter unit, and optimizing other existing units.

> The electricity generated from the expanded Plant 1 will be sold to Kenya Power and Lighting Company Limited under the terms of Plant 1 within the Olkaria III complex power purchase agreement (PPA).

> Plant 1 expansion was financed by Ormat corporate sources and it is covered under a political insurance umbrella policy from leading global insurers in the private sector to cover exposure to certain political risks involved in operating in developing countries.

> "Kenya has a large geothermal potential East African Rift," along the commented Isaac Angel, Ormat's CEO. "Tapping into this potential

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supports improved access to electricity and also contributes to the economy of Kenya. During peak construction of the Olkaria III Plant 1 expansion, more than 200 workers were hired locally. In addition, several employees were hired permanently and joined the Ormat team in the Olkaria III complex."

Source:

http://investor.ormat.com/file/Index?KeyFile=394036 901

Plans to Scrap the Current FiT – Kenya is planning to replace the current feed-in-tariff (FiT) system with an energy auction tariff in which the government will award energy contracts to companies offering the lowest electricity tariffs.

Director of Renewable Energy at the Ministry of Energy Isaac Kiva says the auction model will replace the current feed-in-tariff system where investors identify potentially viable power projects and then acquire licenses to operate them at pre-determined rates.

For the last ten years, Kenya has been using the feed-intariff model where investors interested in investing in wind power, geothermal, solar, hydropower and biomass energy sources are offered a power purchase agreement to construct the power plant and sell the electricity to Kenya power.

However, the model has been criticized as being responsible for making power tariffs expensive.

The government now plans to scrap this with an auction system where tenders are given for the company offering the lowest rates.

The Ministry of Energy has drafted a bill which will offer more incentives to renewable energy investors.

Director of Renewable Energy at the Ministry of Energy Isaac Kiva says more than 800 companies have benefited from the time of use tariff plan introduced last December offering large power consumers a 50 per cent discount on power used between 10pm and 6am.

More than 3,000 large companies are yet to enjoy the time of use tariffs since they do not operate at night.

Kenya plans to use low power tariffs to lure more investors into the country to drive the big four agenda on manufacturing.

Source: <u>http://www.kbc.co.ke/kenya-to-scrap-current-feed-in-tariff-system/</u>

US\$180 Million Loan Guarantee for KenGen - The World Bank announced on late April the approval of a US\$180 million International Development Association (IDA) Guarantee to mobilize private sector financing to strengthen the financial position of Kenya Electricity Generation Company Limited (KenGen) and build energy security for all Kenyans.

The World Bank's IDA was established in 1960 and helps the world's poorest countries by providing grants and low to zero-interest loans for projects and programs that boost economic growth, reduce poverty, and improve poor people's lives.

This IDA Guarantee will build on Kenya's gains that have diversified the energy mix and significantly improved electrification bringing much needed energy to millions of households and businesses. Ultimately, these gains lower the cost of electricity.

"Affordable and accessible electricity is essential to ensuring that Kenyan businesses remain competitive in the international market, allows women and youth to run their businesses safely late into the night within informal settlements and strengthens citizen contribution into growing Kenya's economy," said Diarietou Gaye, World Bank Country Director for Kenya. "This is what Kenya needs if it is to achieve a middle-income economy status by 2030."

KenGen today manages 70% of Kenya's generation capacity of 1,631 megawatts making it one of the largest in East Africa. The project supports KenGen in raising up to US\$300 million in long-term commercial financing to be used to refinance an expensive portion of KenGen's existing commercial loans, enhancing KenGen's credit quality and promoting sustainable development of renewable energy in Kenya.

"This IDA Guarantee will solidify KenGen's financial



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position as the company pursues its aspirations towards geothermal development, building energy security for all Kenyans, and becoming a sustainable energy hallmark in Africa," said Mariano Salto, World Bank Energy Economist and Task Team Leader.

Source: <u>http://www.worldbank.org/en/news/press-</u> release/2018/04/26/kenya-world-bank-approves-180million-to-support-energy-sector

Grant for Exploration in Western Kenya - Kenya renewable energy firm Capital Power has secured US\$720,000 from the African Union Commission (AUC) for start the exploration of a 140 megawatts (MW) geothermal prospect in Homa Bay County. Currently, this is the only geothermal prospect known in western Kenya.

Director Tony Wanyama said the funds will be used to conduct a surface study and infrastructure upgrade program at the Homa Hill. The grant represents 80 per cent of the total cost of the surface exploration, estimated at US\$1.07 million. Capital Power will conduct the studies starting this year, with the commissioning of the power plant expected by 2023.

AUC Commissioner for infrastructure and energy Amani Abou-Zeid (represented by Philippe Niyongabo) said the grant is part of efforts to support geothermal energy development in eastern Africa, which has a potential of over 20,000 MW.

In other related news, Henry Rotich, the Cabinet Secretary for National Treasury of Kenya, twitted that the Kenyan government has allocated Sh 12.7 billion (~US\$125 million) for geothermal energy in the budget for 2018/19.

Source:

https://www.businessdailyafrica.com/markets /marketnews/Homa-Bay-geothermal-firmgets-exploration-millions/3815534-4578486a4o4al/index.html, http://www.thinkgeoenergy.com/kenyangovernment-allocates-125-million-forgeothermal-exploration-201819/

Loans for US\$49.5 Million for 35MW Project in Menengai - The African Development Bank (ADB) approved on June 6, 2018 a senior loan of US\$29.5 million and a concessional loan of US\$20 million from the Climate Investment Funds (CIF) Clean Technology Fund (CTF) to Quantum Power East Africa GT Menengai Ltd.

The funding will support the development of a 35MW geothermal power plant at the Menengai geothermal field in Nakuru County, Kenya, one of three modular geothermal plants in the Menengai field with a combined

capacity of 105 MW. The project is part of the CTF Geothermal Concessional Finance Program under the Dedicated Private Sector Program designed to finance programs that can deliver development results, impact, private-sector leverage and investment at scale and can be deployed rapidly and efficiently.

Amadou Hott, Vice-President, Power, Energy, Climate and Green Growth at the ADB, welcomed the approval, noting that "the partnership between the African Development Bank and the CIF to contribute to Kenya's efforts in scaling up the development of this renewable resource and boost economic growth is commendable. The deployment of CTF funds is directly contributing to unlocking the power of the private sector in driving long-lasting market transformation and mitigating risks in the geothermal power sector."

Quantum Power-Menengai Geothermal Project, the second geothermal independent power project in Kenya, will strengthen public-private partnerships and enable the country to harness its abundant geothermal resources to provide reliable, low-cost, environmentally friendly base-load electricity. It supports the Government's Big Four growth agenda and reinforces the Bank's commitment to its strategy to 'Light up and power Africa' and 'Industrialize Africa'.

"The African Development Bank has invested considerable resources and time in the development of the Menengai geothermal steam field with the objective of enabling Kenya to find a productive source of steam for on-grid power generation," said Anthony Nyong, Director for Climate Change and Green Growth at the ADB.

GDC's drilling rig at Menengai field (Photo by Lcagn).



The project will provide positive environmental effects and contribute to green growth by developing renewable energy infrastructure (annual savings of up to 95,100 tons of CO_2 equivalent) and increase the baseload, grid-connected generation capacity (potential to serve 48,800 households per year), at a low generation cost of 7 cents/kWh.

This will be the first independent power project to which the Bank is providing debt funding as a nonsovereign operation. As the deal's mandated lead arranger, the Bank is mobilizing all necessary debt funding from other development finance institutions.

Source: https://www.afdb.org/en/news-andevents/the-african-development-bank-and-the-climateinvestment-funds-support-their-first-private-sector-ledgeothermal-power-plant-in-kenya-18233/

Malawi: Toshiba Signs MoU for Geothermal Power

Multinational Toshiba Energy Systems and Solutions on early May signed four memoranda of understanding (MoUs) to cooperate with African countries to develop hydropower and geothermal energy systems.

One of the MoUs was concluded with Malawi's Ministry of Natural Resources, Energy and Mining (MNREM) for the development, supply of equipment, development of operational and management guidelines and to facilitate capacity building programs for geothermal power in Malawi. The country is located in the southern tip of the African Rift Valley and is supposed to have an important geothermal potential.



African Rift Valley (red) and Malawi (Credit: <u>https://commons.wikimedia.org/w/index.php?curi</u> <u>d=215385</u>). Specifically, the agreement includes feasibility and geotechnical work, early construction and the supply of geothermal power generation equipment, including a 1 MW to 10 MW geothermal wellhead system.

"The MoU with MNREM anticipates a comprehensive partnership in geothermal power projects, including capacity building programs in relation to geothermal technology. Toshiba has an installed geothermal base of 56 turbine systems totaling 3628 MW. Toshiba will continue to contribute to stable electricity supply and the realization of a low-carbon economy across the globe," said Toshiba Africa MD Iwasuke Shimada.

Additionally, Toshiba provides opportunities for local partners or subsidiary employees to complete masters and doctorate degrees at Japanese universities, specifically on geothermal sciences, including chemical, electrical, geological, mechanical and electronic engineering, said Toshiba business development executive Toyoaki Fujita.

Toshiba also aims to help reduce no-load losses, estimated between 8% and 18% across Africa, through the use of its amorphous distribution transformers, which has an amorphous metal core and requires less maintenance than most other transformers.

Toyoaki highlighted the changing nature of financing and development of energy systems, and notes that Toshiba has signed MoUs with power leasing companies in anticipation of private sector-financed small-grid and renewable energy solutions.

Source:

http://www.engineeringnews.co.za/article/toshibasigns-african-energy-development-mous-2018-05-03/rep_id:4136

Tunisia: Increasing Output and Export of Geothermally Grown Tomatoes

The North-African country of Tunisia has low enthalpy geothermal resources, located primarily in the southern part of the country. In recent news it was reported that exports of geothermal early crops in the governorate of Gabes, on the coast of the Mediterranean Sea, reached 14 thousand tons until June 2018, against 9,700 tons in the same period of last year.

Among these products are mainly tomatoes of very good quality exported to the European markets and the Gulf countries, said Amel Ghiloufi, head of plant production at the Regional Commission for Agricultural Development in Gabes.

The cultivation of geothermal crops is widespread especially in El Hamma where the areas reached 128

hectares. In the region, 11 companies and 40 small farmers operate in this agricultural activity.

During the past season, the production of geothermal early crops in the Gabes region was 25 million tons, of which 12 thousand tons were exported.

A Tunisian-Dutch company based in the area of El Hamma in the governorate of Gabes built the first hightech glass greenhouse in North Africa, producing "ox heart" tomatoes back in 2016. The company, Maison de l'oasis, has invested in 4.5 hectares and plans to make extensions to reach 20 hectares of glasshouses.



For thousands of years, geothermal water has been used in bathing in the country. Now, most of the resources are utilized for irrigation or oases and heating of greenhouses. Today, the cultivated area of greenhouse is 244 ha.

Source: <u>http://www.thinkgeoenergy.com/tunisia-</u> increasing-output-and-export-of-geothermally-growntomatoes-to-european-and-gulf-countries/

AMERICAS

Canada: Modular Plants, Two Geothermal Projects and Proposed Royalties

Modular Mini Plants to Be Installed in British Columbia this Year - The Swedish company Climeon received the world's first order for a geothermal power plant in Canada from Borealis GeoPower. The order relates to a demonstration project named Sustainaville, in Valemount, British Columbia. It includes delivery of three 150kW Climeon modules and is valued at approximately one million euros (US\$1.23 million).

The municipality of Valemount is situated near the end of a transmission line. The distributed power production from the Climeon Heat Power solution will contribute to Valemount's economic development by providing additional energy to the area. Borealis GeoPower has conducted extensive field work and is confident that the Climeon Heat Power system can operate at optimal levels even when there are large variations in flow and temperature.

Drilling of the wells will start in the spring of 2018 and the delivery of the Climeon Heat Power modules is planned for the end of 2018. Together with Borealis GeoPower, Climeon is taking an important step to demonstrate the viability of commercial geothermal heat power in Canada.

The demonstration project makes Borealis GeoPower a leader in the Canadian geothermal sphere. Longer term, the company aims to make remote communities less dependent on fossil fuels by heating and fully powering them with clean energy from geothermal resources.

Canada is the only large country in the volcanic area surrounding the Pacific Ocean, called the Ring of Fire, which still lacks geothermal power production. Canada is estimated to have similar geothermal potential as the U.S., which has 3.5 GW of installed geothermal power production capacity. Canada's know-how and expertise from the oil and gas industry together with the progressive geothermal sector sets a good foundation for the geothermal market to accelerate in the coming years.

Natural Resources Canada contributed CAD 1.541 million (US\$1.207 million) through its Energy Innovation Program.

"Our impact goes deeper than the drilling. We provide energy and food security solutions with an emphasis on 'please in my backyard' from the local community and Indigenous Peoples. We look forward to working with the low temperature Heat Power market leader Climeon and our myriad stakeholders on bringing the Sustainaville project to life. Thanks goes out to the British Columbia and other governments involved in this project for their continued support," said Alison Thompson, Co-Founder and CEO of Borealis GeoPower.

Source: https://climeon.com/investorenglish/?type=single&title=climeon-wins-the-world-sfirst-geothermal-heat-power-order-in-canada

Drilling Started in Geothermal Project in Saskatchewan - The Government of the Province of Saskatchewan has announced funding of CAD 175,000 (around US\$136,000) for geothermal developer Deep Earth Energy Production Corporation (DEEP). This company is working on developing a geothermal power demonstration plant in the Estevan area in Southern Saskatchewan, and will receive the funds over two years through Innovation Saskatchewan's Saskatchewan Advantage Innovation Fund (SAIF). With the funding the company will be able to buy equipment and work on necessary infrastructure to prove the feasibility of a geothermal power plant in the province.

The funding by SAIF is in line with the provincial government's commitment to innovate and develop technological solutions to reduce the province's greenhouse gas emissions.

"Saskatchewan is already a world leader in innovative carbon capture and storage technologies that reduce greenhouse gas emissions," said Tina Beaudry-Mellor, the minister responsible for Innovation Saskatchewan.

DEEP has completed a pre-feasibility study for the project and expects to start initial drilling for a production and injection well in June 2018, with an expected drilling depth of 3,400 meters. Tests will determine if the project is economically feasible. Construction would then continue throughout 2018.

Source: <u>http://www.estevanmercury.ca/news/business-</u> energy/government-announces-funding-forgeothermal-project-near-estevan-1.23302617

Exploration Drilling Started in the Canoe Reach Project – Borealis GeoPower, a Calgary-based energy company began drilling of four geothermal test wells near the Canoe Reach geothermal project, Alberta, on June 11, 2008.

The four geothermal test wells, if successful, could give rise to the first geothermal power plant in the country, potentially supplying the valley with stable local power. The test well will show how the temperature increases with depth and, with luck, will confirm the exploration work already been done in the area over the last eight years.

This is the first exploratory drill-hole in the area despite an interest in the area's geothermal resources dating back to the 1970s.

In a press release issued just before drilling commenced, Borealis GeoPower's CEO Alison Thompson thanked all three provincial political parties including NDP Minister of Energy Michelle Mungall who had a hand in approving the drilling. Notably the project is being supported by national and provincial research organizations including the National Research Council and Alberta Innovates. Resources. "Our government is proud to support Borealis to discover how this demonstration project may lead to further geothermal energy deployments that will help our country create a brighter future."

Maureen Kolla, Manager Clean Power and Heat for Alberta Innovates says the opportunities for geothermal power to create renewable electricity and other forms of low-carbon energy are exciting and projects like this are at the frontier of the new economy. Alberta Innovates is a provincially-funded corporation focused on Alberta's research and technology development and aims to diversify the provincial economy, improve environmental performance and enhance Albertans' well-being.

Source:

https://www.therockymountaingoat.com/2018/06/gro undbreaking-geothermal-drilling-finally-begins/

Proposed Geothermal Royalties in British Columbia - British Columbia's Ministry of Energy, Mines and Petroleum Resources (EMPR) is considering the development of a royalty regulation under the Geothermal Resources Act (GRA), and proposed a royalty framework and regulation, asking for comments up to past July 15th, 2018.

British Columbia already charges royalties for the production or use of its mineral, petroleum, and clean energy resources. Existing royalties for clean energy can be classified into two types: *ad valorem* and specific. Ad valorem rates are determined as a percentage of the market value based on the sale price; specific rates are calculated on a quantity, rather than revenue, basis.

Some countries like United States, Australia and Kenya impose (or are planning to impose, as in the case of Kenya) different royalties to geothermal developments, as is presented in the table (*see* below).

Now, EMPR proposes to apply an *ad valorem* royalty of 3% following an initial 10 year royalty holiday (see attached figure), similar to the wind participation rent, for any electricity or energy that is sold. This rate is aligned with the wind participation rent, which is 1%-3% of gross revenue with the highest 3% rate applied for developments with greater than a 40% annual capacity factor. Geothermal energy plants typically have

"Through this demonstration of renewable power, we have the opportunity to showcase clean, reliable energy generation," said the Honourable Jim Carr, Canada's Minister of Natural

| 5 | | United | States | Australia | | | | |
|---|-------------------------------|---------------|-------------|----------------------------------|---------------|-------------------|------------|--|
| f | Invidiation | | California, | Tasmania, | New | South | Kenya | |
| е | Jurisalction | Federal lands | Washington, | Western | South | Australia | (proposed) | |
| 7 | | | State lands | Australia | Wales | Australia | | |
| , | | 1 75% year | | | | 2.5% | 1 2 5% for | |
| 7 | Rovalty | (1-10 years) | | | | Royalty | 1-2.570101 | |
| e | Rate 3.75% year (11+ years | 3 75% year | 10% | 6 2.5% 4% holid proje payo | holiday until | until vears: 2-5% | | |
| ı | | (11 + vears) | | | | project for there | thereafter | |
| s | | () () | | | | | | |

Table: Jurisdictional comparison of geothermal royalties in three countries.

capacity factors around 90%, so the 3% royalty rate would apply. In 2005, at the time the land use policy governing wind energy plants was developed, a 10 year royalty holiday was given as an incentive for the then nascent wind industry. EMPR proposes a similar royalty holiday for the initial ten years of production for a geothermal development. The royalty holiday may be reevaluated in future as the industry develops and matures.

An alternative royalty model, an inclining ad valorem royalty rate which starts low with scheduled increases, was also considered. In this proposed option, geothermal projects would be subject to an initial rate of 0.25% and increases every 5 years by 0.75% to a maximum of 3% (see attached figure). Royalty payments would commence in the first year of production (i.e., no royalty holiday). When compared to royalty schemes that do not have a royalty holiday this royalty type would provide a front-end incentive with low royalty rates at the start of the project to improve project economics.

law 19.998 that authorizes the agreement of a line of credit for US\$500 million to the Costa Rican Electricity Institute (ICE) from the Inter-American Development Bank (IDB).

The instrument, known as the CCLIP (Conditional Credit Line for Investment Projects), will be aimed at the development, modernization and expansion of infrastructure linked to renewable electricity generation projects, including the Boringuen Geothermal Field, as well as transmission networks and national distribution.

The negotiation of this CCLIP between the ICE and the IDB began in 2013. The Government of Costa Rica is the guarantor of the investment, through the Ministry of Finance. The agreement between the three actors was signed in February 2016, and had to go through legislative approval to become the law of the Republic.

"This is a sample of the excellent reputation that Costa Rica has before the international financial organizations. The funds will be vital for the de-carbonization of our economy. I congratulate the deputies for ratifying the

for



Proposed and alternative geothermal royalty rate for BC.

Since the GRA requires that royalties, or a payment in lieu of royalties, must be provided to the government for the use of the Crown's geothermal resources, the BC Government intends to proceed with a royalty rate of 3% following a ten-year royalty holiday aligning geothermal royalties with the wind participation rent.

Source:

https://www.geothermalcanada.org/news/2018/6/7/b c-royalties-proposal-comments-requested

Costa Rica: Legislative Assembly Approved IDB Credit Line for Electric Projects

On middle May, the Costa Rican Legislative Assembly unanimously approved in the second debate the bill of

Source:

http://www.bnamericas.com/en/news/electricpower/l egislative-assembly-approves-500-million-idb-creditline-for-electric-projects/

years.

Mexico: New CEMIE-Geo Company Formed

Luis C.A. Gutiérrez-Negrín, Editor

On late 2017 it was officially constituted a commercial, non-profit company called CEMIE-Geo, AC. composed by most of the partners of the Project CeMIE-Geo. This is a project launched by the Mexican Energy Ministry (Sener) and the Mexican Council for Science and Technology (Conacyt) through a funding trust for energetic sustainability (FSE: Fondo de Sustentabilidad Energética). The project started four years

the confidence

country in its

www.geothermal-energy.org

ago and since then has been developing 30 technical projects and two transversal projects (laboratories and human resources), funded with 956 million pesos (almost US\$50 million at the current exchange rate). Its 30 projects include improvements in exploration tools and methods, Mexico's EGS potential, development and testing direct-use prototypes, improvement of conduction pipes and turbine materials, and specific studies in geothermal areas (*see* IGA News 95, pp. 15-16)

The center is a consortium composed of 22 entities headed by CICESE (The Center for Scientific Research and High Studies of Ensenada). Twelve members are public research institutes and universities, including CICESE, the national university (UNAM), the Michoacán University (UMSNH), the Baja California polytechnic university (UPBC), and the Electric Research Institute (IIE). Nine are private companies, and the 22nd entity is CFE. A steering group (Grupo Directivo) was formed, composed of three from representatives private companies, two representatives each from UNAM and UMSNH, and one representative from CICESE, IIE and CFE. The CEMIE-Geo will never have any physical offices or an

administrative structure. Management activities will be undertaken by the current management of the 22 parties (*see* IGA News 95, pp. 15-16).

Currently, the CeMIE-Geo is finishing its seven semester stage,

with the eight, last stage, to be completed in October 2018. Most of the 30 projects have been finished in the previous stages, but the Grupo Directivo has decided to ask the FSE for an extension of at least a couple of months and perhaps an additional nine stage of six more months, with no additional funds.

Anyway, one of the requirements stated by the FSE since the beginning of the CeMIE-Geo, was the consortium should manage itself to form a permanent organization that subsists beyond the original four years, with the aim to try to commercialize the results of the projects able to do that. Some of the 30 technical projects included testing prototypes of products and/or technologies in an advanced level of development that could be offered to the geothermal industry, and the idea was the CeMIE-Geo could to do that through a special purpose company or something similar. With that requirement, the FSE tried to concrete and land at least some of the investment.

For that reason, the board of the CeMIE-Geo discussed several options of companies that the commercial regulation includes in Mexico, that allow to start the possible commercialization of some of the products and services (in particular, the many and specialized analyses the CeMIE-Geo laboratories are capable of offer), but that also allow the public universities and research centers that are part of the consortium to be part of the new company. It was finally decided to constitute a company known as a civil association (AC: Asociación Civil), which was officially registered in Mexico City in October 2017. The official name is CeMIE-Geo, AC, and it is a legal company whose purpose is offer the products and services of its members.

CeMIE-Geo, AC was formed initially by only three public entities: CFE (Comisión Federal de Electricidad), CICESE and UPBC (Polytechnic University of Baja California), and eight private companies BajaInnova, ClusterGeo, Geocónsul, Geominco, GENERA, Geotem, GS Energía and Prados Camelinas. Currently are also members the two public universities of Michoacán (UMSNH) and Guadalajara (UdeG), as well as the private companies Turbopartes and JL Energía. Excepting the latter, all of the members of the company are also members of the initial consortium.

The board of the CEMIE-Geo, AC, is formed by the President, Silvio Marinone (CICESE), the Vice President Magaly Flores (CFE), the Secretary Luis Gutiérrez Negrín (Geocónsul) and the Treasurer Juan Jesús Algravez (UPBC).



U.S.: Forge, DOE Funding Projects, Companies Movements, Micro Plants, Puna Geothermal Plant, Support to Fossil and Nuclear Plants

Forge Project Goes to Milford, Utah - The U.S. Department of Energy (DOE) announced on middle June that the University of Utah will receive up to US\$140 million in continued funding over the next five years for cutting-edge geothermal research and development. After three years of planning, site characterization, and competition, the proposed site outside Milford, Utah has been selected as the location of the Frontier Observatory for Research in Geothermal Energy (FORGE) field laboratory dedicated to research on enhanced geothermal systems (EGS), or manmade geothermal reservoirs.

The University of Utah's Milford site was one of the two finalists announced in August 2016 by the DOE, altogether with the site in Fallon Nevada, proposed by the team headed by the Sandia National Laboratories.

Both teams got US\$29 million in funding to fully instrumentalize, characterize and permit the candidate sites in the last stage of competition that finished in June with the announce of the winner (*see* IGA News 105, p. 17).

"Enhanced geothermal systems are the future of geothermal energy, and critical investments in EGS will help advance American leadership in clean energy innovation," said U.S. Secretary of Energy Rick Perry. "Funding efforts toward the next frontier in geothermal energy technologies will help diversify the United States' domestic energy portfolio, enhance our energy access, and increase our energy security."



EGS has the potential to significantly expand geothermal energy production by harnessing more than 100 gigawatts of clean, efficient electricity that is currently inaccessible. Exceptional, creative, and responsible technological innovation, such as that taking place at FORGE, is not only necessary to bring EGS to technical maturity, but also a critical step on the path to American energy security and global geothermal energy leadership.

Critical to broad EGS deployment, FORGE will be a laboratory where scientists and researchers can learn how to engineer these manmade systems. The geothermal community will gain a fundamental understanding of the key mechanisms controlling EGS success; develop, test, and improve new techniques in an ideal EGS environment; and rapidly disseminate technical data and communicate to the public.

Source: <u>https://www.energy.gov/articles/department-</u> energy-selects-university-utah-site-140-milliongeothermal-research-and

DOE Announces US\$14.5 Million to Advance Geothermal Drilling Technologies - The U.S. Department of Energy (DOE) announced on late April up to US\$14.5 million in new funding to advance geothermal energy development. The Efficient Drilling for Geothermal Energy (EDGE) funding opportunity announcement (FOA) will focus on geothermal drilling in support of accelerating the research and development of innovative geothermal energy technologies in America.

"Advancing research in geothermal drilling technologies will help harness the heat beneath our feet to expand our domestic energy resources," said Daniel Simmons, Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy. "Geothermal is a reliable, baseload renewable energy source with firm and flexible operation, allowing it to provide a range of essential services that contribute to our nation's grid stability and resiliency."

The U.S. currently has an installed geothermal capacity of more than 3.8 gigawatts (GW), and there is an estimated 100 GW or more of additional potential geothermal development accessible in undiscovered hydrothermal and enhanced geothermal systems. Technological innovation is necessary to economically convert these resources into cost-effective energy services.

The EDGE FOA aims to continue and expand GTO's R&D in geothermal drilling by covering three topic areas:

Topic Area 1 focuses on early-stage R&D projects to reduce common delays in drilling operations like lost circulation, stuck pipe, unstable wellbores, and other issues that take time away from deepening the hole, typically referred to as non-drilling time.

Topic Area 2 focuses on early-stage R&D projects in innovative drilling technologies that improve the rates of penetration for drilling geothermal wells.

Topic Area 3 focuses on exploring innovative approaches and models to accelerate the transfer of geothermal drilling and related technologies from the laboratory into the real world by focusing on building partnerships that will increase adoption of nascent technology and improving knowledge transfer in the geothermal industry.

The application process will include two phases: a Concept Paper phase and a Full Application phase. Applications for first phase were closed on May 31, 2018.

Source: <u>https://www.energy.gov/articles/department-</u> <u>energy-announces-145-million-advance-geothermal-</u> <u>drilling-technologies</u>

DOE Announces Funding for Geothermal Energy Research - As part of the US\$99 million announcement by the U.S. Secretary of Energy for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) research and development projects, the Office of Energy Efficiency and Renewable Energy (EERE) will manage two new projects that involve geothermal energy research. The



awarded projects are the following.

E-Spectrum Technologies, Inc., from San Antonio, TX, will get US\$0.98 million for a Near-Real-Time Electromagnetic Data-Link for Geothermal Downhole Instruments. This project proposes a high-temperature electromagnetic tool to provide wireless, near-real-time access to geothermal well downhole data in reservoirs up to 300°C. The proposed effort will leverage existing electromagnetic data transmission technology used for oil and gas exploration to provide a cost-effective means to characterize underground environmental variables such as bit vibration, downhole temperature, and pressure conditions. This capability will minimize risks associated with developing geothermal energy as a viable power source.

Olympic Research, Inc., from Port Townsend, WA, will receive around US\$1 million for Controlled-Porosity Ceramic Materials for High Temperature Downhole Applications. Advanced geothermal energy production is challenged by the harsh thermal and chemical

environments posed by fluids produced in geothermal wells. This technology introduces a novel method of forming high performance ceramic components in place to extend the operating life of the well components.

Source:

https://www.energy.gov/articles/depa rtment-energy-announces-99-millionsmall-business-research-anddevelopment-grants

Ormat Closes the Acquisition of U.S. Geothermal Ormat Technologies, Inc. announced on late April that it has closed the previously announced acquisition of U.S. Geothermal, Inc. for total а consideration of around US\$110 comprising approximately million, US\$106 million funded in cash by the company to acquire the outstanding shares of common stock of U.S.

Geothermal, Inc., and approximately US\$4 million, funded from available cash of U.S. Geothermal, Inc., to cash-settle outstanding in the money options to acquire outstanding shares of U.S. Geothermal, Inc.

As a result of the acquisition, Ormat now owns and operates U.S. Geothermal's three power plants at Neal Hot Springs, Oregon, San Emidio, Nevada and Raft River, Idaho with a total net generating capacity of approximately 38 MW. In addition, Ormat now owns development assets held by U.S. Geothermal, which include a project at the Geysers, California; a second phase project at San Emidio, Nevada; a greenfield project in Crescent Valley, Nevada; and the El Ceibillo project located near Guatemala City, Guatemala.

The operating assets sell power under existing power purchase agreements at favorable price terms for the electricity, with an aggregated contract capacity of 55 MW. Ormat plans to improve the acquired operating assets and implement synergies and cost reductions which are expected to improve profitability of the operating projects by approximately 50% during 2019.

Source:

http://investor.ormat.com/file/Index?KeyFile=393150 291

JV Between Dajin Resources and GDA - Dajin Resources Corp. has announced that it has signed a Joint Venture Agreement (JV) with Geothermal Development Associates (GDA), Reno, Nevada. The main GDA's line of business is the development of geothermal resources for electrical generation, and they hold geothermal leases that overlap Dajin's placer claims in the Teels Marsh valley (*see* figure below).



As a result of this JV, GDA and Dajin will share exploration data with the ultimate aim of supporting the development of a Lithium brine extraction facility as well as development of a geothermal plant for electrical generation and the production of direct-use thermal water. This agreement outlines a cooperative relationship where both companies will be focusing on their key strengths to mutually develop Lithium brine and renewable energy resources.

The Dajin's Teels Marsh valley lithium brine project includes identified lithium-bearing brines, possession of granted water rights and minimal land fragmentation.

The basin beneath the playa is up to 2500 meters deep. Prior geothermal exploration results indicate favorable geochemistry and shallow temperatures of 97°C ad 40 m depth at the northwest portion of the valley. In March 2017 the Bureau of Land Management (BLM) accepted Dajin's notice to proceed with civil works and drilling as part of the exploration of lithium brines, and now roads and drilling pads are under construction.

Source: <u>http://www.dajin.ca/blog/post/dajin-</u> resources-and-geothermal-development-associates-signjoint-venture-agreement

Micro Power Plant in Surprise Valley Uses a Hot Spring - In early May, the advanced-technology company PwrCor, Inc. announced it has successfully launched its breakthrough heat conversion engine technology at Surprise Valley Hot Springs in Modoc County, California.

The engine is the first of its kind using the company's proprietary technology, designed and constructed by PwrCor's team and the Southwest Research Institute in San Antonio, TX, and funded by the California Energy Commission (CEC) and project participants. The technology operates on more advanced thermodynamic principles than the thermal pneumatic principles employed by steam (Rankine cycle) engines and their cousins, the organic Rankine cycle (ORC) technologies. The PwrCorTM technology uses the physical expansion of fluids under heat to drive a piston, has very low or no fuel costs, has no internal fuel combustion, produces no pollution, and operates silently.



Curt Rose is next to the hot spring that supplies the hot water. It was tarped to keep the heat in and prevent evaporation. Photo by The Modoc County Record.

The state-of-the-art engine had successfully passed a rigorous testing regimen prior to being shipped to California. The Surprise Valley geothermal installation is a prime example of executing the Company's strategy to apply its exclusive PwrCorTM technology to strategic markets. In this case, the engine operates using ultralow-grade heat from a geothermal hot spring. The machine utilizes a small flowing hot spring east of the Surprise Valley resort by putting eleven 100 foot (~30 m) long copper loops into the spring. "This spring runs at 189 degrees F (87°C), but by covering the spring with a tarp we reduced evaporation and increased the temperature of the spring to 206 degrees F (96°C). This increased the efficiency of the machine," said Curt Rose of Warner Mountain Energy, the company in charge of the project.

Most people envision big pipes and steam when they think of geothermal energy plants, but this plant is difficult to find in the surrounding landscape. "This machine is small enough it could be installed in a small shed or basement," explains Rose.

It was not informed the power capacity of the PwrCor engine, but considering it is a distributed generation demonstration project, whose energy is to be used by the resort, it would be in the order of a few kilowatts.

PwrCorTM technology can cost effectively convert ultra-low-grade heat to usable mechanical or electrical energy. This is wasted energy that previously could not be economically harnessed as usable power by competing technologies. The technology can be used in place of or in conjunction with almost all existing technologies, that uses no fossil fuels, does not operate via combustion, has no emissions, and does not process

> any working fluids that are flammable, harmful to the environment, or costly to replace. PwrCorTM is scalable, modular, and runs relatively silently, all within a small footprint.

> California has vast amounts of ultralow-grade geothermal heat that previously could not be economically utilized for the generation of electricity. PwrCor's technology can change that, permitting the use of these resources for uninterrupted base-load power production. With this plant, Modoc County became the sixth county in California to generate power from geothermal sources, but it was the first time ultra-low temperature (less than 90°C) geothermal water was used in this fashion... And it doesn't require to drill a single well.

Sources:

https://globenewswire.com/newsrelease/2018/05/01/1493998/0/en/PwrCor-Successfully-Launches-New-Breakthrough-Energy-

Technology.html, http://www.pwrcor.com/wp_ content/uploads/2018/04/PwrCor-Surprise-Valley-History-Historic-day-4-15-18-trimmed-6.pdf, http://www.pwrcorinfo.com/

Kilauea Eruption - The Kilauea volcano in the Hawaii Big Island started to erupt on May 3rd, 2018, spewing basaltic lava and high levels of sulfur dioxide into the area. Three days after, at least 26 homes and 35 structures had been destroyed as a result of the eruption, which was followed by a 6.9-magnitude

earthquake on May 4th -the island's most powerful since 1975, according to the US Geological Survey. Around 25 volcanic vents, elongated fractures, cracks or fissures in the earth surface, have erupted in evacuated neighborhoods on the island, and all residents of Leilani Estates, a community of about 1700 people near the Big Island's eastern edge, and nearby Lanipuna Gardens had to be evacuated. Watch the stunning movement of lava flow in this time-lapse video.

The Puna Geothermal Venture (PGV) is a 38 MW geothermal power plant own and operated by Ormat Technologies Inc. that used to provide up to 22-25% of the local power demand in Hawaii. Operators had to shut-

iron plugs. On May 27th, lava covered the wellheads of two geothermal wells, KS-5 and KS-6.

"We developed a strategy, which was to quench the well, plug the well, and remove topside equipment from the well so that it produces a low-profile to the oncoming lava, and we've accomplished that on all three production wells on pad E," Thomas Travis, Hawaii Emergency Management Agency administrator, and one of the people appointed by the governor to oversee the process of securing PGV, explained.



Iconic photo of the eruption: People play golf as an ash plume rises in the distance from the Kilauea volcano on Hawaii's Big Island on May 15, 2018, in Hawaii Volcanoes National Park, Hawaii. Photo credit Mario Tama / Getty.

off the plant and the wells since the first day of the eruption, and in coordination with the local authorities proceeded to evacuate the facilities, leaving only some essential technical personal to monitor the lava flow. Precautionary measures were taken to remove flammable materials (the pentane working fluid) offsite. Hawaii's Governor David Ige issued an emergency declaration for the immediate removal of pentane, and 60,000 gallons (around 227 cubic meters) of pentane were relocated to Shipman Business Park in Keaau.

The other highly risky problem were the geothermal wells. State and county officials talked with well experts in California about how to seal the production wells to prevent the release of hydrogen sulfide if the wellhead installation were compromised. Experts were brought in to help secure the area and the plan was to start to plug the wells after they were filled with cold water.

By May 22nd, workers managed to cap the 11th and final well at the facility in anticipation of the lava eventually reaching the well pads, and to prevent the uncontrollable release of toxic gases. Cold water was pumped into all 11 wells prior to capping them with

"All three of those wells have been plugged," he added. "Two of those wells have been quenched. We had to do a different kind of plug on KS-14, but it was plugged and all of the wells, presenting minimum interference to the lava. They're all close to the ground and covered, so the lava should go right over them".

It was informed that the values on the top of the wells can easily with stand 2000°F (~1090°C) lava.

Lava was pouring into the ocean at a location 5 km east of the plant, producing noxious clouds of acid fumes, steam, and glass-like particles –a phenomenon known as "laze," a portmanteau of lava and haze. Laze is potentially deadly if inhaled.

Scientists with the U.S. Geological Survey announced on May 23rd that the eruption was producing 15,000 tons of sulfur dioxide gas per day, an amount that is far beyond the amounts normally produced at the Kilauea Volcano summit or at the Puu Oo crater.

Michael Kaleikini, senior director of Hawaii affairs for PGV, said noise and gas emissions from more than 20

fissures and the enormous lava flow that extended to the ocean, dwarfs any emissions or damage that could result from an uncontrolled breach of the geothermal wells on the PGV site.

On May 30th, Ormat Technologies Inc. unveiled that the substation of the Puna complex and an adjacent warehouse that stored a drilling rig were burned by the lava flow. The lava also had covered and blocked the main access road to the power plant. By middle June, PGV remained stuck in a precarious spot between a river of lava and a line of fissures that have gone quiet. PGV's employees could no longer access the site by road, but most of the plant has been spared destruction. The PGV was almost completely surrounded by lava.

The Hawaii Public Utilities Commission has met with the Hawaiian Electric Companies and Hawaii Energy to develop a series of rapid response actions to address the loss of renewable generation from the PGV power plant. It was informed that in the near-term, electricity formerly provided by PGV will be generated mostly by burning fossil fuels, increasing air pollution and raising electricity prices for customers.

By early July, as the PGV entered its third month of shutdown, Ormat affirmed its commitment to reopening the facility and has told the 30 full-time workers they will remain on the payroll for at least a

year. But even under the best of circumstances, the facility likelv wouldn't resume providing power for at least a few years. Lava has covered three of the wells burned PGV and а substation and an adjacent warehouse that held a large drilling rig. At its closest point, the current flow is roughly 1,000 feet (~300 m) from the remaining plant facilities but it was largely confined а channel to through the property, according to Michael Kaleikini.

By early July, the eruption had extruded more than 250 million of cubic meters of lava, having outpaced the 1955 and 1960 eruptions.

https://edition.cnn.com/20 18/05/06/us/hawaiikilaueavolcano/index.html?utm_source=digg&utm_medium= email, http://www.staradvertiser.com/2018/05/09/breakingnews/ige-to-issue-emergency-proclamation-to-securepuna-geothermal-plant/, http://www.hawaiitribuneherald.com/2018/05/11/hawaii-news/one-fearalleviated-another-looms-at-geothermal-plant/, http://www.kitv.com/story/38190693/19th-fissuresparks-worry-in-regards-to-puna-geothermal-plant, https://gizmodo.com/creeping-lava-now-threatensmajor-hawaiian-power-plant-1826222711?utm_source=digg&utm_medium=email, http://www.staradvertiser.com/2018/05/23/hawaiinews/geothermal-plant-declared-essentially-safe/, http://www.khon2.com/news/local-news/punageothermal-venture-deemed-stable-after-lava-coverstwo-wells/1205182245. http://investor.ormat.com/file/Index?KeyFile=393711 325, http://www.hawaiitribuneherald.com/2018/06/04/hawaii-news/pgv-stuckbetween-lava-river-fissures/, https://volcanoes.usgs.gov/volcanoes/kilauea/status.ht ml. http://www.hawaiifreepress.com/ArticlesMain/tabid/5 6/ID/21843/PUC-Geothermal-Shutdown-Means-

Higher-Rates-Dirtier-Air.aspx,

http://www.staradvertiser.com/2018/07/08/hawaiinews/geothermal-plant-faces-challenges-amiduncertainty/



Trump Orders Action to Stem Coal, Nuclear Plant Shutdowns – On early June, President Donald Trump ordered his energy secretary to take immediate action to stem power plant closures, arguing that a decline in coal and nuclear electricity is putting the nation's security at risk.

"Impending retirements of fuel-secure power facilities are leading to a rapid depletion of a critical part of our nation's energy mix and impacting the resilience of our power grid," White House spokeswoman Sarah Sanders explained in an emailed statement. Trump has directed Energy Secretary Rick Perry "to prepare immediate steps to stop the loss of these resources and looks forward to his recommendations."

Trump's directive comes as administration officials search for ways to extend the life of money-losing coal and nuclear power plants that face competition from cheaper natural gas and renewable energy. The plants are considered "fuel-secure" because they house coal and nuclear material on site and are not dependent on pipelines that can be disrupted, wind that stops blowing or a sun that sets.

Administration officials are still weighing the best approach, Sanders said. The National Security Council was discussing the Energy Department's strategy, which was to use authority granted under a pair of federal laws to establish a "strategic electric generation reserve" and compel grid operators to buy electricity from at-risk plants "to protect national security".

The draft plan is meant to buy time for a two-year study of vulnerabilities in the American energy delivery system, extending to natural gas pipelines as well as power plants. The agency argues that power plant closures must be managed for national security reasons, because nuclear and coal-fired facilities can easily be restored after extreme weather events, cyber-attacks and other emergencies.

The move would represent the president's most direct effort to bring back coal mining jobs and reward voters who helped put him into office, ahead of pivotal midterm elections that could decide whether Republicans retain control of the House and Senate.

Some 12,000 megawatts of coal-fired power are expected to retire this year, the National Mining Association said.

PJM Interconnection said in a statement that the power system is more reliable than ever. "There is no need for any such drastic action," the grid operator said. "Any federal intervention in the market to order customers to buy electricity from specific power plants would be damaging to the markets and therefore costly to consumers."

Mike Jacobs, senior energy analyst at the Union of Concerned Scientists, said: "This attempt to turn an era of cheap, abundant electricity into an emergency should be seen for what it is –a scare tactic, pure and simple...

Energy Secretary Perry is being forced to issue another unnecessary and unprecedented emergency order to favor coal and nuclear over more economic electricity suppliers, including renewables. The Federal Power Act, which ensures a reliable power supply after sudden emergencies, is not meant to insulate uneconomic power plants from market forces. The Energy Department has primarily used that authority to address major power outage events and shortages, such as the California energy crisis in 2000 and the Northeast blackout in 2003. Abusing this authority to bail out uneconomic power plants for such an extended time makes no sense, especially when most regions of the country are awash with excess electricity."

Sources:

https://www.renewableenergyworld.com/articles/2018/06/trump-orders-action-to-stem-coal-nuclear-plant-shutdowns,

https://www.energycentral.com/news/white-housewhims-are-not-grounds-emergency-coal-nuke-plantbailouts?utm_medium=eNL&utm_campaign=DAILY_ NEWS&utm_content=214475&utm_source=2018_06_ 05

ASIA/PACIFIC RIM

China: Tibet, Hainan, Green Action Plan

Joint Venture for Exploration in Tibet - On early April, Chen Hua, Chairman of the Board of China Nuclear Power Company, CNNC (Tibet) Industrial Development Co., Ltd. signed an agreement with CNNC KunHua Energy Development Co., Ltd. on the development and operation of the clean energy projects in Tibet. This is a successful integration of CNNC's resources in geothermal development, laying a solid foundation for CNNC Group's expansion of Tibetan geothermal industry projects.

According to the agreement, the Tibetan company was commissioned by CNNC KunHua to carry out the development of geothermal and other clean energy projects in Tibet. The Tibetan company will use its geographical advantages, actively coordinate the relevant local government departments responsible for the daily procedures required for the operation, project development and construction. CNNC KunHua Energy will be able to act as the geothermal specialized investment platforms to accelerate investment in geothermal projects in Tibet.

Source: <u>https://nbn.media/cnnc-geothermal-projects-in-tibet/</u>

Deep Geothermal Well Drilled in Hainan - A pilot well to explore possibilities for develop a Hot Dry Rock

(HDR) project, was drilled to a true depth (TD) of 4387 meters in middle March, 2018. The well reached a temperature of 185°C and was drilled by LandOcean Hainan Company, a subsidiary of LandOcean Energy Service Co., Ltd., in Hainan Province, a south-eastern province of China.

It is the first time for China to conduct such exploration campaign, and it is the first HDR well in Hainan Province representing a milestone in the country's endeavor to develop this type of geothermal projects through the EGS (Enhanced Geothermal Systems) technology.



Drilling rig in the Hainan Province (Photo taken from the source).

EGS is a type of geothermal power that utilizes the high temperatures of rocks found a few kilometers below ground. This is done by pumping high pressure water down a borehole into the heat zone. The water travels through fractures in the rock, capturing the heat of the rock until it is forced out of a second borehole as very hot water, which is converted into electricity using either a steam turbine or a binary power plant system. All of the water, now cooled off, is injected back into the ground to heat up again. The utilization efficiency is fairly high up to 73%, which is 5.3 times of solar power and 3.5 times of wind energy.

To accomplish the drilling of this deep well, a series of technical difficulties have been overcome. A candidate area was finally decided in Qiong Bei Area, which contains little granite and no volcanic activity. Research has also been done to locate the best place for drilling the well, including geophysical and geological surveys, and drilling/logging/mud-logging data of adjacent wells. LandOcean spent near half year taking comprehensive consideration of site accessibility, operational safety, environmental protection and minimum impact to local residents.

The well was drilled in just 66 days.

Source:

http://www.ldocean.com.cn/En/NewsInfo566.aspx

Sinopec Green Action Plan - On early April 2018 Sinopec launched its Green Action Plan, aiming to become a clean, efficient and low-carbon enterprise by 2023. According to the Plan, by 2023, Sinopec will see the share of its clean energy output exceed 50 percent of its total, with an annual natural gas production capacity of 40 billion cubic meters. Among its plans, Sinopec will boost its geothermal heating capacity to 120-150 million square meters by 2023, providing geothermal heating to about 2.1 million urban residents.

Source:

http://www.sinopecgroup.com/group/en/Sinopecnew s/20180411/news_20180411_536665179295.shtml

Indonesia: Geothermal Capacity, Sarulla, Risk Mitigation, New Tariffs

Second Largest Geothermal Capacity Worldwide -By the end of the first quarter of 2018, the installed capacity of geothermal power plants reached 1924.5 MW in Indonesia, which put the country in second place in the world after the United States in utilizing geothermal power, shifting second position previously occupied by the Philippines. This was stated by Rida Mulyana, Director General of Renewable Energy and Energy Conservation (EBTKE) in a press conference hold on April 27 in Jakarta.

The Indonesia's geothermal reserves are estimated to be 17,506 MW, and then the current installed capacity is barely 11% of that potential. This represents a great opportunity for investors to develop geothermal as well as meet national energy needs. The goal for the end of this year is to reach 2058.5 MW.

"We are proud of this achievement that exceeds the 1870 of the Philippines' installed capacity, which means

that we have become the world's number two geothermal producer," said Director Mulyana.

Rida said the additional installed capacity comes from the operation of the power plants of Larah Karaha Unit 1 (30 MW) and Sarulla Unit 3 (110 MW). For the second semester the following plants are planned to start operations: Sorik Marapi Modullar Unit 1 (20 MW) in August 2018, Sorik Marapi Marapi Modullar Unit 2 (30 MW) in December 2018, Lumut Balai Unit 1 (55

MW) in December 2018, and Sokoria Unit 1 (25 MW) in December 2018.

After shifting the Philippines position as the second largest geothermal power producer in the world, the Government projects Indonesia to become the largest geothermal world's power producer by 2023, beating the U.S. with geothermal power capacity of 3729.5 MW.

To simplify the utilization of geothermal energy, the government continues to facilitate investments through the fiscal and non-fiscal incentives. In addition, the government has also issued special regulation on geothermal, namely Law no. 21 of 2014 on Geothermal, Government Regulation no. 7 of 2017 on Geothermal for Indirect Use and

other technical regulations. The two first regulations changed the old barrier that geothermal development can't be done in conservation forest areas, because it is no longer categorized as a mining business.

Source: https://www.esdm.go.id/id/mediacenter/arsip-berita/kini-indonesia-menjadi-produsenlistrik-panas-bumi-terbesar-kedua-dunia

Third Unit of Sarulla Inaugurated on May 4th -Ormat Technologies Inc. announced that NIL 2, the third unit of the Sarulla geothermal power plant, has commenced commercial operation on May 4th, 2018, bringing the project to its full capacity of 330 MW.

Located in North Sumatra, Indonesia, the 330 MW Sarulla power plant is one of the world's largest geothermal power plants and it includes three units of approximately 110 MW each, utilizing both steam and brine extracted from the geothermal field to increase the power plant's efficiency.

In addition to being one of the sponsors, Ormat also provided the initial conceptual design of the Geothermal Combined Cycle Unit (GCCU) power plant and supplied its Ormat Energy Converter (OEC). The OECs are producing over 40% of the total power by utilizing low pressure steam and the separated brine, and

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World Bank Supports Credit Facility for Geothermal Energy - The World Bank Group is developing an innovative credit facility to manage risks inherent to developing geothermal energy in Indonesia. The Geothermal Resource Risk Mitigation (GREM) project in this country is an example of the catalytic effect of the Maximizing Finance for Development (MFD) approach. Successfully developing a geothermal site requires deep pockets and a large appetite for risk barriers that have often been too high for developers.

The initial exploration and drilling phases of developing geothermal sites are particularly costly and risky.

as such maximizing resource exploitation for maximum power output.

SIL, the first unit of the power plant, commenced commercial operation in March 2017 and NIL 1, the second unit, commenced commercial operation in October 2017. Both units are performing well. NIL 2, the third unit, commenced commercial operation on May 4, 2018, reaching full completion under the Energy Sales Contract on schedule.



Aerial view of SIL (Photo by Ormat).

The Sarulla 330 MW power plant is a US\$ 1.7 billion project that sells its power to the state-owned Indonesian Power Company PT Perusahaan Listrik Negara (PLN) under a 30 year Energy Sales Contract. The Sarulla power plant is operated by Sarulla Operations Ltd. (SOL), an operation company established by a consortium consisting of Medco Energi Internasional Tbk, Inpex Corporation, Itochu Corporation, Kyushu Electric Power Co. Inc., and an Ormat subsidiary that holds a 12.75% equity interest.

Source:

http://investor.ormat.com/file/Index?KeyFile=393388

Resource exploration of a potential site in Indonesia can cost from US\$30 to 50 million, with no way to recoup losses if the resource proves insufficient. Later stages are less risky but even costlier –up to US\$400 million to develop a 100-megawatt site.

The World Bank is helping the Indonesian government establish an innovative credit facility to unlock investment in geothermal energy. Designed to bridge financing gaps and mitigate risks, the facility will channel US\$650 million of finance into exploration. This includes US\$150 million from the government, US\$175 million in concessional climate finance, and US\$325 million in loans from IBRD (International Bank for Reconstruction and Development)

Key features of GREM include:

• Partial funding through concessional finance for the initial high-risk phases, with a mix of public money and climate finance structured to ensure that developers have a stake in the outcome.

• If insufficient steam resources are found, up to 50 percent of the loan will be forgiven, considerably reducing the risk for developers.

• Financial packages specially tailored to public sector developers, private sector developers, and public-private partnerships.

Alongside the World Bank, IFC (International Financing Corporation, which is also a member of the World Bank Group) has been advising on the implications of various facility structures based on the needs of the private sector. IFC is now developing a financing instrument to dovetail upstream investments under the World Bank-supported facility, which will kick in once private investors pass through the high-risk exploratory phases.

The facility is projected to leverage up to US\$4 billion in private sector funding to develop a gigawatt (GW) of capacity through 20 new geothermal located throughout the archipelago –enough to power about a million Indonesian homes. Beyond expanding access, this will help Indonesia reach its NDC under the Paris Agreement with 23 percent renewable energy by 2025 and a 29 percent cut in carbon emissions by 2030.

Source:

http://www.worldbank.org/en/about/partners/brief/i ndonesia-tapping-geothermal-for-greener-growth

New Tariff Regime for Renewable Energies - The Indonesian government has introduced a new tariff regime for renewable energies. The new regime gives the Indonesian state power company, PT Perusahaan Listrik Negara (PLN), greater control over tariffs in the sector through business-to-business negotiations and benchmarking against the applicable Electricity

Generation Basic Cost (Biaya Pokok Penyediaan Pembangkitan or BPP).

Director General of Renewable Energy and Energy Conservation, Rida Mulyana, during a press conference last April. Photo taken from : https://www.esd m.go.id/id/mediacenter/arsipberita/kiniindonesiamenjadiprodusen-listrikpanas-bumiterbesar-keduadunia



The new tariff regime (MEMR Reg. 50/2017) was elaborated by Minister of Energy and Mineral Resources regarding Utilization of Renewable Energy for Power Supply, came into force on August 8, 2017. It provides a new mechanism to determine the tariff for electricity generated by renewable energy power plants and purchased by PLN from Independent Power Producers (IPP). The tariff is now determined by benchmarking against the applicable BPP in the area where the power is generated or through negotiations between PLN and the IPP.

BPP reflects the cost of PLN in generating power and in procuring electricity supply from third-party suppliers such as IPP, but does not include the cost of transmitting the electricity. BPP is stipulated annually by the MEMR, based on a recommendation from PLN, and includes both national and local BPP, with reference to BPP for the previous calendar year.

For hydro, waste and geothermal sources, the tariff calculation under MEMR Reg. 50/2017 is as follows: If the local BPP is greater than the national BPP from the previous year, the maximum benchmark tariff is the local BPP. If the local BPP is equal to or less than the national BPP from the previous year, the tariff shall be based on a mutual agreement between the IPP and PLN. MEMR Reg. 50/2017 requires that the price of electricity from renewable energies as stipulated above be approved by the MEMR.

The exceptions for geothermal energy are entities that have been awarded a geothermal working area but have

not signed a PPA; any state-owned company that has been mandated with geothermal concession; and any holder of a geothermal concession that has signed any steam sale contract (*perjanjian jual beli uap*) and/or PPA which has been verified or is in the process of being verified by the Indonesian Financial and Development Supervisory Board (BPKP).

Source:

https://www.lexology.com/library/detail.aspx?g=a15bd 966-4144-477a-954a-a12d58ff3b6a

Japan: ElectraTherm Commissions Heat-to-Power Generator at Micro-Geothermal Site

ElectraTherm of

Reno, Nevada, USA, has commissioned a Power+Generator® at a geothermal site in the northern part of Japan. The geothermal heat forms an onsen where the local community has enjoyed bathing at this natural resource for centuries. The Power+installation offers another resource to the community. The installation also



reduces the cost of cooling the onsen water that is otherwise too hot for bathing. This marks the second Power+Generator in Japan utilizing geothermal heat to generate fuel-free, emission-free electricity.

ElectraTherm utilizes the Organic Rankine Cycle (ORC) and proprietary technologies to generate up to 65 kWe of electricity at the site. The Power+Generator captures low temperature heat ranging from 77°C to 116°C and flow rates up to 45.4 m3/hour. The geothermal resource captures hot waterto drive the ORC cycle and turning ElectraTherm's twin screw power block, driving an electric generator to make clean electricity.

Source: <u>https://electratherm.com/electratherm-</u> <u>commissions-heat-to-power-generator-at-micro-</u> <u>geothermal-site-in-japan/</u>

Korea: EGS and Quakes

Following are some excerpts from the text 'Quakes, fracking and geothermal: opportunities and challenges' published online by The Climate Examiner on May 18, 2018 in the website referred in the source. It is an interview with Ernest Majer, who is introduced in the first paragraphs altogether with the background (see also IGA News 110, pp. 19-20). Even though his answers can't be conclusive, Majer pointed out more elements that have widen the perspective.

A pair of papers appeared in the prestigious U.S. academic journal *Science* in the Spring of 2018, concluded that in 2017 a pilot power plant in South Korea that employed enhanced geothermal systems (EGS) triggered the most damaging earthquake since the country started monitoring seismic events in 1905. The finding prompted discussions within the clean energy community about the potential impact on the development of this renewable resource.

Ernest Majer, one of North America's foremost experts in the subject of seismicity and geothermal systems, spoke to *The Climate Examiner* about EGS, how it differs from conventional geothermal, what challenges the sector faces, and his views on the events in South Korea.

Majer began his career in the 1970s exploring seismic activity at California's Geysers geothermal field, a complex of 22 geothermal plants and the largest single geothermal power producer in the world. He has worked at the Lawrence Berkeley National Laboratory on the issue for over 40 years.

Here is what he has to tell to answer the direct question, What do you think happened in South Korea?

"There is certainly very compelling evidence in the two papers suggesting the injections induced the earthquake, but there are also a few arguments against the conclusion that the sole cause of the events was the injections.

The first is that the magnitude 5.4 and 4.7 earthquakes, both on Nov. 15, 2017, came two months after the injections had stopped. There was also another earthquake of 4.7 magnitude at the EGS site five months after the injections had stopped on Feb. 10, 2018. This is normally a very low seismicity area of Korea. But there was also 4.9, 5.4, 4.6 and 3.5 magnitude earthquakes from Sept. 12-21, 2016, 30 kilometers to the southwest along the same fault zone (and 11 months before the hydraulic stimulation in August 2017, followed by flow-back of 100% of the injected water - Note of the IGA News editor). The last big seismic events in the region were in 1903, and since then until now, there has been nothing. So is the seismicity due to the larger parts of the fault being naturally reactivated? Was the EGS plant just really unlucky? Was it more of a 'triggered' event -meaning partially natural, partially human-caused-- versus induced only by injection?

If these injections alone did indeed lead to the unexpectedly large earthquakes, then we need to

determine why they did. This would prompt such questions as: How much of the fault do you need to affect before it goes off, the majority of the fault or just a pinprick? What are the critical data needed to have a successful EGS project?



The epicenter of the Pohang Earthquake (red) along with the aftershocks (yellow) (Provided by Korea Institute of Geoscience and Mineral Resources).

In both EGS and hydro-fracturing, we are still asking: What is this induced seismicity telling us? Is this really where the fluid is going? Is this where the stresses are going? How far out do the stresses go? How far away from a fault can you be before you really make it go off?

So the two papers have prompted a lot of discussion already within the energy community and elsewhere because this doesn't just impact geothermal energy. If it is the case that our understanding of natural seismicity is lacking, then this could impact the oil and gas industry, carbon sequestration, and other activities beyond clean energy.

Source:

http://theclimateexaminer.ca/2018/05/16/quakes-fracking-geothermal-opportunities-challenges/

Philippines: US\$ 90 Million IFC loan to EDC

Energy Development Corporation (EDC) and the International Finance Corporation (IFC), a member of the World Bank Group, signed a 15-year financing agreement for US\$ 90 million. The proceeds of the loan will fund a portion of the 2018 capital requirements and other general corporate purposes of EDC's existing geothermal operations. These capital expenditures include the balance of work related to the return of service of the geothermal power plants in Leyte that were affected by the July 2017 earthquake and other project initiatives aimed at increasing the reliability, efficiency and throughput of EDC's existing geothermal facilities as well as reducing outages and health, safety & environment (HSE) risks.

The IFC loan to EDC has been announced since January 2018, but was signed in Manila on late April.

Richard Tantoco, EDC President and Chief Operating Officer, said, "With this most recent financing on the back of previous financings in 2011, 2008, and even an IPO-enabling IFC investment in 2006, EDC & IFC continue to strengthen our partnership. We share a joint commitment to provide sustainable energy sources for the Philippines and to mitigate carbon emissions."

EDC Senior Vice President and Chief Financial Officer, Nestor Vasay, stated that "Securing this financing with IFC further confirms that EDC continues to adhere to the high standards of multi-lateral funding organizations in the aspects of financial discipline, good corporate governance, environmental and social stewardship, safety and security, and fair labor practices."

EDC is an integrated geothermal steam and electric power producer in the Philippines and a global geothermal energy industry leader. It is the Philippines' largest vertically-integrated geothermal developer. As of December 31, 2017, EDC and its subsidiaries owns and operates a diversified portfolio of renewable energy projects in the Philippines with a total installed capacity of 1,472 MW, including geothermal, hydro, wind and solar projects. As a leader in the geothermal industry, EDC aims to promote and improve the utilization of indigenous geothermal technology, which is still the most superior renewable energy technology today offering base load operations, low greenhouse gas emissions, and low land and water utilization. EDC's power generation in 2016 represents approximately 9% of the country's total power generation capacity.

Source: http://www.thinkgeoenergy.com/ifc-extends-90-million-loan-to-energy-development-corp-in-thephilippines/

Taiwan: MOU to Develop Geothermal Project in Yilan County

State-run utility Taiwan Power Co and oil refiner CPC Corp Taiwan signed a memorandum of understanding in late March 2018 to invest in two geothermal power plants in Yilan County, the Ministry of Economic Affairs (MOEA) said.

Under the cooperation plan, CPC would drill one or two wells near the Renze's hot spring to conduct tests,

and if these are successful, the state-run refiner would hand over the project to Taipower, which would be tasked with generating geothermal power.

Geothermal potential in Yilan seems to be huge, given the large number of hot springs in the county. CPC said it selected Renze for the tests after geological evaluation because it has greater geothermal potential than other areas in Taiwan. Moreover, the plots of land on the site in Renze belong to the Forestry Bureau, making the process less costly and time-consuming than if the company were to lease land from private owners.

CPC has ample experience drilling geothermal wells, and in 1981 helped set up a geothermal power plant in the county's Cingshuei area, which was shut down in 1993 as its generators became less efficient.

Taipower is interested in developing geothermal energy and is simultaneously engaged in a geothermal development project on Green Island this year.

The state-run utility has carried out well tests and is on track to build a small geothermal power station capable of generating 200kW of electricity on the island by next year. It was unveiled that Taipower plans to build a larger geothermal power plant there capable of generating 40 megawatts by 2020.

The Bureau of Energy has said that the government's target is to install 200 megawatts of geothermal generation capacity by 2025, as part of the Democratic Progressive Party administration's pledge to establish a "nuclear-free homeland" by that year.

If tests are positive in the Renze hot springs, Taipower plans to construct a 2MW geothermal power plant that will have the capacity to supply electricity to about 3,000 households for a year after it becomes operational in



CPC Chairman Tai Chien (left) and Taipower Chairman Yang Wei-fuu during the signature ceremony (Photo taken from the source).

According to Taipower, the Renze plant will be built at cost of approximately NT\$600 million (US\$20.57 million), and a second geothermal plant will be set up later in Tuchang. When both plants are completed, they will have a total capacity of 8 megawatts, Taipower said.

In recent years, the development of renewable energy has been accelerating, and geothermal power generation technology capabilities have also been improving, said Taipower Chairman Yang Wei-fuu, adding that Taiwan has good potential in that field.

Sources:

http://taipeitimes.com/news/biz/archives/2018/03/1 2/2003689101, http://focustaiwan.tw/news/aeco/201803280025.aspx

EUROPE

EGEC's 20th Anniversary Declaration & New President

For the energy transition to be successful, we need integration and a coherent mix in all energy sectors which cannot be accomplished without the versatile contribution of geothermal energy, the European Geothermal Energy Council (EGEC) stated in a declaration released on June 8th, celebrating its 20 years anniversary.

Ahead of the meeting where the European Energy Ministers will meet to decide on the level of ambition for Europe's 2030 renewable energy target, EGEC highlights the contribution of geothermal to the decarbonization of the European economy and its even bigger untapped potential. The presentation of the declaration was accompanied by a tasting of 'geothermal food and drinks' –cheese, tomatoes, wine, beers, and other delicacies, all produced with the contribution of geothermal energy– that showcased how geothermal is more than just energy. It also means food, tourism, jobs, and development for local communities.

The EGEC declaration looks at the current challenges of the energy transition and at the necessity to meet our energy needs with optima scenario in terms of both costs and affordability, for customers and citizens. A single technology, a single renewable energy can never meet this demand alone. However, when combined renewable energy sources can meet our future energy needs. This is where the role of geothermal comes into play. As a truly local source of energy, which can produce power and heat for cities, industries, and rural communities, geothermal fosters local economic development through many indirect positive effects, such as jobs creation and air quality.

"Europe has been a global leader in the geothermal sector for decades," said Marco Baresi, Institutional Affairs and Marketing Director at Turboden Spa and EGEC Board Member, introducing the event. "When we look at the future energy targets for Europe and those laid out in the Paris agreement, we see that many challenges still lie ahead. Both EGEC and the European geothermal industry are committed to maintaining this leadership, delivering affordable energy and constant innovation."

On the milestone of 20 years of the association, Burkhard Sanner, founding member and former President of EGEC, said: "I had the pleasure to chair the founding session of EGEC, with 21 representatives from all over Europe, from Iceland, to the Azores, to Turkey. When we released the Ferrara Declaration, someone said that the numbers and the ambition for 2020 were impossible to reach. But now we are close, and we must be proud of our achievements."

In other news, on July 9th EGEC unveiled it has appointed Miklos A. Antics as new President. The appointment comes after the tragic loss of EGEC president Ruggero Bertani last June 21 (see obituary in pages 12-15). The meeting board unanimously approved the nomination of Miklos Antics, Managing Director of the company GPC Instrumentation Process (GPC IP), who has been member of the EGEC board since 2004 and served as EGEC vice-president since 2013.

Commenting on the appointment, the new president said: "I'm looking forward to serving as President, as well as continuing the valuable work, by building on the achievements inherited from my predecessors, in fostering

geothermal development and highlighting the important role of geothermal in the energy transition".

Sources: https://www.egec.org/geothermal-energysociety-industry-economy/, https://www.egec.org/new-egec-president/

EGEC's 2017 Geothermal Market Report

The European Geothermal Energy Council, has published the seventh edition of its annual study evaluating the development of the geothermal sector in Europe. The EGEC Geothermal Market Report confirms the trend towards the steady growth observed in recent years, but also notes the need for greater recognition in order to enable the full deployment of geothermal energy in Europe.

Installed geothermal electricity capacity in Europe amounts to 2.8 GWe, producing over 15 TWh per year. In Europe there are 117 plants, 16 of which were inaugurated in 2017. The new additions are quite significant, with 330 MWe of new geothermal electricity capacity coming online, mainly in Turkey.

The use of geothermal for heating is also increasing, supported by the construction of new district heating networks and the retrofitting of old ones, thanks to local and national planning identifying geothermal heat as a cost-efficient solution to meet heating needs. In 2017, nine new plants were inaugurated, adding over 75 MWth across France, the Netherlands and Italy. The number of new plants coming online each year is on an

> upward trend, with an average annual growth rate of 10% in recent years.

> Looking at individual geothermal heating systems, the shallow geothermal market remains the largest segment of the sector in terms of number of installations, installed capacity and energy produced. Individual geothermal heating systems, or geothermal heat pumps, represent over 20 GWth of heating capacity in Europe, with nearly 2 million installed units.

> Since its first edition in December 2011, the EGEC Geothermal Market Report has come to be seen as the authoritative overview of the entire geothermal sector in Europe. The report includes details of all major projects in operation, under development, and under investigation, as well as an analysis

of market development, the regulatory and public policy environment, financial tools and incentives, the market forecast, and key players. Every edition also offers an indepth review of different geothermal technologies. The focus of this year's edition is exploration equipment.

content/uploads/media publication/MR17 KF final

France: Eurometropol & **Grigny-Viry Projects**, **Discussion on the PPE**





July-September 2018

Successful Development of the Eurometropol CHP

Project - The French geothermal developer Fonroche announced in early May the test results of its first well drilled in the Eurometropol city of Strasbourg, which produced over 80 liters of thermal water per second at a temperature over 200 degrees Celsius. Later on, Fonroche informed it will drill the second well to have a geothermal doublet.

In Strasbourg's district of Reichstett, the location of a former refinery, Fonroche has drilled for geothermal energy since June 2017. The Managing Director Jean-Philippe Soulé, explained "We have found water with a temperature above 200 degrees Celsius, which is the hottest hole in Europe, apart from the volcanic zone in Tuscany. This is an extraordinary result in the European context. In terms of fill, it is more than 300 cubic meters per hour, which can supply 26,000 residents with heat and about 9000 with electricity."

At 4600 meters, the well drilled is the deepest in France. During drilling, maximum safety was ensured to avoid accidents. Among other things, 500 houses in Reichstett were included in advance. Georges Schuler, the mayor of Reichstett, also emphasizes: "If we really want to evolve towards a less polluted planet, we should also engage with the use of geothermal energy, which must be embedded in a secure legal framework."

Based on these excellent results, the manufacturer invested EUR 15 million (US\$ 17.6m) in a 'zero noise hydraulic' drilling rig of German TBM Herrenknecht, to drill the second well starting in early June.

A total of EUR 80 million (US\$94 million) is invested by Fonroche in this transaction: EUR 10 million for exploration, EUR 30 million for the drilling of two wells and EUR 40 million for the construction of a CHP (Combined Heat and Power) plant, with 8 MWe of power capacity and 40 MWth of thermal capacity. The company expects to finish the plant and the connection to the electricity grid by end of 2019.

The energy will fuel the future neighboring Rhine EcoParc and the companies that will settle there in the coming months. The Strasbourg Eurometropolis has also called for the creation of agricultural greenhouses on one hectare, in partnership with interested farmers.

Sources: <u>http://www.thinkgeoenergy.com/geothermal-</u> project-in-strasbourg-france-drills-hottest-well-incentral-europe/,

http://www.thinkgeoenergy.com/fonroche-to-proceedwith-second-well-on-geothermal-site-near-strasbourg/

Inauguration of a New Geothermal District Heating System - Inaugurated in early June, the new heating network Grigny and Viry Chatillon already produces 124 GWh heat per year, the equivalent of heating for 12,000 homes. Hot water is drawn from the basement of the two towns at a depth of 1,800 meters. At this level, its temperature reaches 71°C.

The new geothermal plant was planned and built to fight against 'fuel poverty' of sensitive neighborhoods. Les Sablons, Tuileries, Grande-Borne, Plateau Viry-Châtillon: all these so-called 'sensitive' neighborhoods, mainly made up of collective habitats, are now exclusively heated and supplied with hot water by the inter-municipal geothermal network. In all, 10,000 dwellings, but also schools, gymnasiums, colleges of the two cities, are connected.



Geothermal heating plant of Sipperec in Rosnysous-Bois, France (source: SIPPEREC)

The pumping operations are outsourced to specialized companies. After transit through the heating network, the water is reinjected into the aquifer. It warms up again slowly in contact with the rock. Thus, in principle, the underground water reservoir never dries up.

This is the fourth geothermal heating network set up by the intercommunal syndicate in the greater Paris region for energy and communication networks (Sipperec). Sipperec owns 51% of the renewable energy company, Seer, which manages the project; the city of Grigny 34% and Viry 15%. "This project is entirely carried by the public, the development was long and complex, we had moments of concern, but today, everything is perfectly successful," says Therese Leroux, president of the Seer, and mayor of Villiers-sur-Orge.

The goal of the operation is environmental and social. Geothermal heating must be much cheaper than gas or electricity. According to Sipperec, the new heat network would save EUR 800,000 (US\$ 940,000) per year in heating costs and hot water on the cities. "The inhabitants of this district have abnormally high heating costs that can reach up to 60% of the expenses," says Laurent Georges, general manager of Sipperec.

Another advantage is the stability of costs. According Georges, the price of geothermal heating should not increase, unlike gas. That is because most of the costs come from depreciation and maintenance expenses and not from the fluctuation of energy prices.

It took an investment of around EUR 29.1 million (US\$34.2 million) to build the Grigny-Viry geothermal network. The State, through the Local Investment Support Fund, granted aid worth EUR 2.6 million, while the region and Ademe paid EUR 8.9 million.

Source: http://www.thinkgeoenergy.com/more-than-10000-homes-heated-by-geothermal-energy-in-grignyand-viry-chatillon-france/

Discussion on the PPE - On Thursday 24th May, ENGIE Réseaux and the French Association for Renewables (SER: *Syndicat des Energies Renouvelables*), in cooperation with EGEC (European Geothermal Energy Council) and the city of Villepinte, gathered to discuss the French objectives for geothermal energy in the framework of the Multiannual Program on Geothermal Energy (PPE: *Programmation pluriannuelle de l'énergie géothermie*). The event took place in the framework of the public debate on the PPE, which was open on March 19th, and at the district heating plant of Villepinte, operated by ENGIE Réseaux and supplied for 64% by geothermal energy.

ENGIE Réseaux and SER chose to highlight the contribution of the third renewable energy source in France in terms of energy consumption, geothermal, ahead of the open days to visit renewable installations in cities during 25-26 May 2018. The discussion also aimed to present the position of France in the geothermal market development, and its leadership in a number of technologies.

The French energy law PPE, adopted in 2016, will be revised at the end of 2018, together with an update of the national low carbon strategy. French stakeholders in the renewable sector launched an initiative to promote the different renewable technologies, including the site visits and presentations open to the public on 25-26 May 2018, when renewable energy sources were presented by showing their technologies, jobs profile, operational onsite management, and questions from citizens were answered explaining the role and the advantages of renewable energy sources.

A press conference was organized on 24th May by ENGIE Réseaux and SER, in combination with a site visit to the geothermal district heating plant in Villepinte, which is one the ten geothermal systems operated by ENGIE Réseaux. The Mayor of Villepinte and representatives from ENGIE Réseaux, SER and the EGEC were on the agenda to present the geothermal potential in France and in Europe and future objectives.

France started an energy transition aiming, progressively, to reduce energy consumption and diversify the energy mix to produce electricity, heating and cooling, and fuels for transport from renewable energy. Geothermal is already a key sector in the development of renewable energy in France to reach the mid-term and long-term objectives fixed by the French law on energy transition Law on Energetic Transition for Green Development (LTECV: *Loi de Transition Energétique pour la Croissance Verte*).

Those goals include reduce greenhouse emissions by 40% between 1990 and 2030 and divide by four GHG emissions between 1990 and 2050; reduce final energy consumption by 50% in 2050, in comparison with the reference 2012 targeting an intermediate objective of 20% by 2030; decrease primary energy consumption from fossil fuels by 30% in 2030 from the reference 2012; increase the share of renewable energy to 23% of the gross final energy consumption in 2020 and to 32%



Site visit at the geothermal district heating system in Villepinte, France (Photo by EGEC, taken from the source).

in 2030.

Thanks to its great experience in the Paris basin, France is leading the geothermal district heating market in Europe. More than 70 geothermal plants space heating provide in France. The majority of these installations have been installed in the 80s, and today they supply heating to around 300,000 Equivalent Dwelling Unit (EDU). In the Paris area, geothermal supplies heat to more than 187,000 EDU, which corresponds to more than 240,000 tons of CO_2 avoided annually. In 2015, the geothermal market French represented €388 million, in

comparison with €282 million in 2013 (+38 %).

Source: <u>https://www.egec.org/france-european-leader-geothermal-energy/</u>

Germany: Public Tender for CHP Projects, Thalkirchen Project

First Public Tender for CHP Projects - Germany announced in early April the start of its first innovative combined heat and power (CHP) tender in which projects have to use heat sources such as solar thermal, geothermal energy or heat pumps.

The tender will award contracts to 25 MW of projects, which will include a cogeneration plant, an innovative renewable heat source and a power generator. The deadline for offers is June 1 and the bid cap has been set at EUR 0.12 (US\$ 0.15) per kWh, according to the Germany's Federal Network Agency (*Bundesnetzagetur*).

The innovative CHP tenders in Germany are to help determine the role of CHP plants in decarbonizing power and heat supply, the agency said.

In parallel with this tender, the Bundesnetzagetur will also hold Germany's second normal CHP auction. The quota there is a bit over 93 MW and the maximum bidding price is lower, at EUR 0.07/kWh. The deadline for bids is the same.

Source: <u>https://renewablesnow.com/news/germany-starts-25-mw-tender-for-chp-with-renewable-heat-source-608438/</u>

Started 50 MWth Geothermal Heating Project in the Middle of Munich - Construction has started on the Thalkirchen geothermal heating project in the city of Munich in Bavaria/Germany. With a planned 50 MW of thermal capacity, the plant will be the largest geothermal heating plant in Germany, since it is planned to supply geothermal heating to up to 80,000 residents of Munich.

Six wells will be drilled for the plant, a in a star shape from a drilling pad to depths of 2800 to 3100 meters. After 900 meters, they are to be drilled horizontally. The aim is for the production and injection wells in the deep aquifer to be more than 1200 meters apart. This distance prevents the hydraulic short circuit from occurring, meaning that the cooled water returned to the subsoil is once again lifted above the production well.

The special feature of the facility on Schäftlarnstrasse is that Stadtwerke München (SWM), the local utility and developer, is drilling for the first time in the middle of Munich. Helge-Uve Braun, from SWM, explains: "That's why we have developed a special noise prevention concept here. The impact on the environment should be reduced to a minimum. Among other things, the concept includes ongoing measurements in order to be able to locate and control noise sources immediately, noise barriers, a particularly quiet drilling rig and adapted construction site logistics. Thus, the noisy delivery and unloading almost exclusively during the day."

Josef Daldrup, CEO of Daldrup & Söhne AG, said: "This project is currently one of Europe's largest geothermal projects for heat production. The six wells will be drilled by experienced drilling crews using one of our emission-optimized deep drilling rigs and a noise reduction concept adapted to local conditions. The geothermal wells for SWM, in particular due to their size in the inner-city area, have lighthouse character for the use of geothermal energy as a renewable energy source in Germany and Europe."



Helge-Uve Braun, from SWM, und Josef Daldrup, from Daldrup & Söhne AG, with one of the largest diameter drill bits to be used. Source: SWM.

The drilling work should be completed by the end of 2019. Then the plant will be built, and after that long-term pumping experiments and the fine adjustment of the system will be carried out. By 2020, it will finally go online.

SWM is one of the pioneers of deep geothermal energy. In Riem, they have been using this process to supply heat to the trade fair city and trade fair since 2004. Their geothermal co-generation plant (electricity and heat) in Sauerlach went into operation in 2013, and the geothermal heating plant in Freiham in 2016. In the same year, SWM acquired two more geothermal power plants in Dürnhaar and in Kirchstockach. Helge-Uve Braun stated that SWM is "developing renewable energies holistically –in the electricity as well as the heating sector. And in the heat area, the most energy is consumed. Our goal is to make Munich Germany's first major city by 2040, in which district heating is generated 100 percent from renewable energy sources. The essential contribution will be provided by geothermal energy."

Source: http://www.thinkgeoenergy.com/work-hasstarted-on-50-mw-geothermal-heating-project-inmunich-germany/

Iceland: Theistareykir, UNU-GTP Session, Investment in Geothermal Direct Uses

Second 45 MW Unit of Theistareykir Started Operation - The second unit of the Theistareykir geothermal power plant in Iceland started operation by middle April. This is the 17th power plant of national power company Landsvirkjun and the first geothermal plant built by Landsvirkjun from scratch. The plant has now reached 90 MW power generation capacity with two 45 MW Fuji Electric turbines.

The first unit of Theistareykir was launched in November 2017 (*see* IGA News 110, pp. 24-25). The second unit arrived at the plant in April 2017 and installation was completed in January 2018. Since mid-February, Unit 2 has been in testing operation until all its functionality has been verified and Landsvirkjun having officially taken over its operation.

Initiatives for the utilization of the natural resources in Theistareykir came from local people, but local authorities and residents established company Theistareykir ehf in 1999. Landsvirkjun first came to the project in 2005, but since 2011, it has begun its preparation and implementation.

Studies in the geothermal area in Theistareykir stretch for decades back in time. Environmental impact assessment was based on the development of up to 200 MW of power plants in the area, but the current project has been the construction of 90 MW power plants in two phases. Right from the beginning, relations with stakeholders were prioritized and a focus was set on environmental issues. The planning of projects aimed at minimizing environmental impact as much as possible.

A re-naturalization project was initiated in parallel with the preparatory work and aimed at restoring land that ended up under construction. This task is now at the final stage.

Special attention has been paid to interaction with stakeholders in the area, as farmers have used Theistareykir as a pastoral landmark for decades, which the project did not impact. It was also possible to cooperate with tourism organizations during the construction phase, so that both parties could continue their work.

Source: http://www.thinkgeoenergy.com/second-45mw-unit-of-theistareykir-geothermal-power-plant-startsoperation-in-iceland/

40th Session of the UNU-GTP Opened on April -The United Nations University-Geothermal Training Program (UNU-GTP) was established in the shadow of the oil crisis, when nations were looking for new and renewable energy sources in order to reduce dependence on hydrocarbons, in particular oil with its rapidly escalating prices. The current situation is somewhat similar in the sense that the international community is looking towards renewable energy sources as an alternative to fossil fuels in order to reduce emissions of greenhouse gases.

The development of geothermal resources requires a group of highly skilled specialists from a number of disciplines of science and engineering. Because of its diversity, geothermal energy has not been taught as a specific subject at universities.

The first official statement on establishing a UNU geothermal institute in Iceland was made in 1975 when the United Nations University (UNU) had just been established. After a first proposal in 1976 and an international workshop in 1978, the Government of

Iceland decided in October 1978 to ask Orkustofnun (the National Energy Authority - NEA), to sign Agreement an on Association with the UNU and establish the United Nations University Geothermal Training Programme (UNU-GTP). The UNU-GTP has been hosted by the Orkustofnun ever since. The Government



of Iceland funds UNU-GTP through its official development assistance.

The first annual training session of the UNU-GTP started in May 1979 with two UNU Fellows from the Philippines. Since then, a group of scientists and engineers from energy agencies and research organizations as well as universities in the developing countries and Central and Eastern European countries, have come to Iceland every spring to spend six months in highly specialized studies in geological exploration, borehole geology, geophysical exploration, reservoir engineering, borehole geophysics, chemistry of thermal fluids, environmental science, geothermal utilization, drilling technology, and project management and finances.

UNU-GTP also offers successful candidates the possibility of extending their studies to MSc, or PhD degrees in geothermal sciences or engineering in cooperation with the University of Iceland and Reykjavik University.



The UNU-GTP Director, Lúdvik S. Georgsson, lead the 2018 opening ceremony and gave a speech about the work and history of the this program and welcomed the new group of

Fellows. Dr. Guðni A. Jóhannsson, the Director General of Orkustofnun, welcomed the Fellows on behalf of the host institution.

This year 24 UNU Fellows from 14 countries participate in the six month specialized courses. The Fellows come from Bolivia, China, Djibouti, Ecuador, El Salvador, Ethiopia, Indonesia, Kenya, Nevis, Philippines, St. Lucia, Tanzania, and Zambia.

Source:

http://www.unugtp.is/en/organization/frettir/the-40th-session-of-the-unu-gtp

Chinese Companies Invest in District Geothermal Heating Company - Arctic Green Energy, a renewable energy company based in Reykjavík, focusing on creating zero-emission cities, has completed a new funding deal from CITIC Capital, China Everbright Ltd. and Asian Development Bank.

CITIC Capital, an early investor in Arctic Green Energy since 2015, has exercised its conversion rights to acquire equity of US\$30 million in Arctic Green Energy. China Everbright Ltd. has purchased shares and an exchangeable bond issued by Arctic Green Energy for a total of US\$70 million.

Asia Development Bank announced on March 22 it would provide a US\$250 million loan to Sinopec Green Energy Geothermal Co (SGE) and Arctic Green Energy Corp (AGE) to develop clean geothermal heat in smogprone northern China. SGE is a joint venture set up by China's state-owned oil giant Sinopec and AGE.

Arctic Green Energy focuses on creating zero emission cities through renewable resources, technology and infrastructure. Currently, most of its projects are based on geothermal as the primary energy source.

After the completion of the current deals, Haukur Harðarson, chairman and founder of Arctic Green Energy, will remain the company's majority shareholder, with CITIC Capital and China Everbright holding significant minority stakes.

"We have been working with Arctic Green Energy for three years now, and this milestone in the company's development confirms all...it has achieved so far in implementing geothermal technology in China and abroad," said Fanglu Wang, senior managing partner at CITIC Capital.

Founded in 2002, CITIC Capital is an alternative investment management and advisory company with over US\$22 billion under management across 100 funds and investment products through its multiple asset class platform covering private equity, real estate, structured investment & finance, and asset management.

China Everbright Ltd. (CEL) is China Everbright Group's largest cross-border asset-management and investment platform. Through its managed funds and principals, CEL has invested in more than 300 companies in China and around the world.

Source:

https://www.chinamoneynetwork.com/2018/04/26/cit ic-capital-china-everbright-back-renewable-energy-firmarctic-green-energy

The Netherlands: Lansingerland, Pijnacker, and Other Geothermal Projects

Geothermal Doublet Completed in Lansingerland -In Bergschenhoek north of Rotterdam in the

Netherlands, Wayland Energy 15 currently developing several concessions in order to produce thermal water for production heat purposes. Warmtebedrijf Bergschenhoek BV, a subsidiary of Wayland Energy, is utilizing the geothermal energy to heat greenhouses situated in the Lansingerland region and contracted the Venture Züblin Joint Ground Engineering and Huisman Equipment for drilling and completion of a geothermal doublet as a turnkey project with lump sum contract.

The JV executed all subsurface works for the completion of the geothermal doublet in the Lansingerland concession. The wells were drilled using

the Huisman LOC 400 drilling rig –a fully containerized modular rig outfitted with a fully automated pipe-handler and rig floor.

The production and injection wells have been successfully drilled with positive displacement mud motors instead of using a rotary steerable system to 2709 m (maximum inclination of 54°) and 2860 m (maximum inclination of 61°) in order to produce thermal water from the Berkel/Rijswijk Sandstone and Delft Sandstone which have been selected as the primary target formations. The secondary target (Alblasserdam) was also encountered in the production drilling.

The drilling works included all drilling services: drilling fluid and solid control, directional drilling, casing running, cementing, mud logging, wireline logging). Also the required energy and material supply (casings, float equipment, liner hanger, mud chemicals, wellheads) and the waste management, have been part of the contract.

The pump tests showed a very productive reservoir with at least 400 m³/h flowrate and up to 63°C temperature.

With the recently established connection of the geothermal heat plant to the local district heating system the connected greenhouses can now grow plants and vegetables on a CO₂-neutral basis. It is planned to connect about 15 greenhouses in the Bergschenhoek and Bleiswijk area.

Source: <u>http://www.thinkgeoenergy.com/successful-</u> completion-of-geothermal-doublet-in-the-netherlands/

Drilling Starts at Pijnacker Geothermal District Heating Project – The drilling Dutch company Huisman Equipment B.V. was recently awarded a contract for the delivery of a geothermal doublet in Pijnacker, the Netherlands. Drilling started at the end of



Drilling rig on site on Bergschenhoek project site, Netherlands (credit: Zublin; taken from the source).

April and the installation will heat a large area of greenhouses, a residential area and a local pool. The wells will be drilled directionally to a planned depth of approximately 2300 meters.

The well will be drilled utilizing the Huisman LOC 400 drilling rig –a fully containerized modular rig outfitted with a fully automated pipe-handler and rig floor. End 2017, the LOC also successfully finalised a geothermal energy project in Bergschenhoek, the Netherlands. Source:

https://www.linkedin.com/feed/update/urn:li:activity:6 402145927150264320

Geothermal Projects Awarded in Second Round of the SDE+ Program - Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland – RVO) announced in May that it has allocated around 3330 MW of renewable energy generation capacity through the second round of its 2017 SDE+ (*Stimulering Duurzame Energieproductie*) program, out of which 149.4 MW was for geothermal projects. The biggest shares were for solar PV (57.3% of the total) and onshore wind (34.1%), and a total of 4215 renewable energy installations were ultimately selected in the round.

The five geothermal projects and their thermal installed capacity are as follows:

- Amerlaan Geothermie B.V., 31.2 MWth
- ECW Geo Andijk B.V., 32.2 MWth
- Hoogweg Aardwarmte B.V., 29.3 MWth
- Ennatuurlijk B.V., 20.6 MWth
- Agriport Warmte B.V., 36 MWth

Including the latest round, around 5.9 GW of solar capacity has been allocated in all rounds of the SDE+ program since it was launched in 2008. In the four first years of the program, solar had only a minimal share,

overwhelmed by wind and geothermal projects. As the costs of PV technology started to decrease consistently, and the Dutch energy sector began becoming aware of the advantages of PV, solar saw its share grow significantly round by round.

Source: <u>https://www.pv-</u> magazine.com/2018/05/09/netherlands-awards-1-9gw-of-pv-in-sde-2017-autumn-round/, http://www.thinkgeoenergy.com/five-geothermalprojects-under-renewable-energy-funding-programnetherlands/

Norway: Deepest Well Drilled at the Oslo Airport

Norway's deepest geothermal well was under construction at Oslo Gardermoen Airport, with the aim to use the natural heat to heat the engine test site in winter.

Airport operator, Avinor, is managing the energy project, called Rock Energy, in partnership with the company Båsum Boring through its joint venture Norwegian Energy Drilling.

The Norwegian technology "allows us to drill the deepest land-based geothermal borehole in Norway ever," enthuses Henning Bråtebæk, director of airside operations. "It will enable us to use the heat in the ground to heat buildings or other major installations", or in the case of this project, to heat the engine test site and keep it clear of snow.



Drilling site at the airport. Source: Avinor.

Never before has a Norwegian land-based geothermal borehole been drilled so deep, Avinor says.

"We've drilled to a depth of 1,500 meters for both boreholes, and when the project is completed they should be capable of heating the entire area of the engine test site. This has never been achieved before in Norway," says Thor Erik Musæus, the project's general manager, who adds that the extracted energy could also be used to heat large buildings.

Source: <u>https://standbynordic.com/why-is-an-airport-</u> <u>drilling-norways-deepest-borehole/</u>

Romania: District Heating Project Planned in Oradea

A geothermal district heating project is being planned in Romania. The Nurafel geothermal district heating project includes drilling of two injection and two production deep wells (at 2900 m depth) and the construction of a new district heating network. It could start this fall, according to Mayor Ilie Bolojan and Deputy Mircea Mărlan, in Oradea, Romania. The project funded by funds from Norway, likely through EEA Grants, will reinject used water.

The Nurafel geothermal project refers to the area known as Nufărul 1, between the streets of Constantin Noica, Nufărului and Bumbacului-Morii, that will provide heat to more than 13,000 people.

Besides the four deep wells, the project also envisages the construction of a new district heating network, the pipes being laid over a length of more than 15 km. The seven thermal points of the current district heating are going to be dismantled. "They will be demolished, the land will be equipped with green spaces and parking spaces. At the request of the inhabitants, they can

become recreational spaces," said the Deputy Mărlan.

Instead of the thermal points, one thermal module will be installed in each of the block stairs in the project perimeter, 276 in total. The new network will remain connected to the municipal district heating network, as a fail-safe solution or extreme cold when geothermal water heating fails to meet acceptable parameters.

The purpose of the project is to increase the use of geothermal water for the production of thermal energy by creating new production capacity. The goal would be to reduce production costs and network losses.

The investment volume of the project is EUR 19 million (US\$23 million), of which the city will cover EUR 4 million (US\$4.9 million). It is expected to launch the tender and, after approval of the funding, the execution will be completed in 24 months.

The private company Transgex is the holder of the exploitation license for the geothermal water resource in Oradea. However, the municipality wants to increase the

city's role, and is in the process of obtaining the exploration and exploitation license for geothermal water. The municipality aims to "take over the geothermal water wells in Oradea..." from Transgex, "...to continue the investment by constructing new wells and reinjection for the perimeter of the concession that Oradea has," explained Mărlan.

The Deputy sees the possibility of two approaches: "a (public-private) partnership with Transgex or, if we do not reach a convenient solution with this company, licensing Termoficare SA to operate the geothermal system."

Source: <u>http://www.thinkgeoenergy.com/municipality-</u> in-romania-plans-extension-of-geothermal-districtheating-system/

Switzerland: Successful Well in Geneva, Geothermal Greenhouses in Schlattingen

Successful Well for Heating Project in Geneva - The first phase of the exploration well, completed as part of the GEothermie 2020 program, confirms the forecasts for the exploration phase for the geothermal heating project in the canton of Geneva. Hot water was found at 744 meters depth. The water naturally rises and reaches the surface at 33 degrees Celsius of temperature and discharge rate of more than 50 liters per second.

The pilot project, managed by the canton of Geneva, was implemented as part of the GEothermie 2020 program by the Industrial Works of Geneva (SIG). The plan was that the theoretical data compiled in seismic campaigns since 2014 should be confirmed with the exploration. And it was to check that the targeted geological strata and faults are at the positions predicted by the model and that the water temperature and the discharge are in an interesting range. This first goal was fully achieved and even surpassed expectations for water temperature and runoff.

"These initial results are promising and allow the canton of Geneva to implement its energy transition, in particular thanks to renewable heat," says Antonio Hodgers, the State Councilor responsible for the Département du Territoire (DT). "We aim to cover 20% of our canton's heating requirements with geothermal energy by 2035."

Instead of drilling at 650 meters as originally planned, the well was drilled deepened to 744 meters to gather additional information. The drilling will serve the canton of Geneva as a reference in the preparation of the regulations of the law on the use of natural resources. The law aims at a sustainable and controlled development of geothermal energy.



The results of this well will be analyzed in detail and as many lessons learned as possible before further exploration drilling is performed. In addition, the GEothermie 2020 program will continue its work with new seismic investigations. These will be implemented between Jura and Salève on both sides of the national border in 2018

and 2019 and in consultation with the French authorities.

Source: <u>http://www.thinkgeoenergy.com/first-drilling-results-promising-for-geothermal-heating-project-in-geneva-switzerland/</u>

Geothermal Greenhouses Restarted in Schlattingen - Hansjörg Grob Vegetable Agriculture, a large vegetable production company with extensive greenhouses in Schlattingen, has restarted the pumps for its geothermal heating system. The project now again derives water with a temperature of 60°C, after a twoyear involuntary break.

In February 2016 the company had to stop using its geothermal well, as oil-contaminated water reached the river Rhine. For a long time it was assumed that sabotage was responsible. But early 2018, it was discovered that natural oil from the subsurface was the reason for it.

Now, it will take about one year to provide the company with sufficient data in order to obtain the concession for a permanent operation of the geothermal system from the canton.

The company wants to use the thermal water to heat the greenhouses and in return to refrain having to use oil. The experiment will show how the operation affects the thermal water. The cooled and treated water should be discharged into the Rhine "in compliance with all legal requirements," according to a press release from the company. A closed derivation and "various safety and

protective measures have been realized". These measures are a consequence of the accident two years ago.

The vegetable farmer Hansjörg Grob was looking for hot water for five years. The geothermal project in Schlattingen was started in December 2010, when the drilling work began. In March 2015, the two deep wells were completed. At a depth of 1,500 to 2,000 meters, there is water at a temperature of 65 degrees Celsius, which Grob wants to use to heat greenhouses and thus replace natural gas or oil. In the spring of 2015 Grob started the trial operation to use the thermal water as heating energy. In May 2015, there was a first oil spills in the local Geisslibach. The trial operation was interrupted and should have resumed in February 2016, where it came to renewed pollution.

Source: http://www.thinkgeoenergy.com/pumpsrestarted-for-geothermal-heating-of-greenhouseoperations-in-schlattingen-switzerland/

United Kingdom: Plans Submitted For Geothermal Research Opportunity

Two of the UK's leading scientific agencies have submitted plans for a new research development proposed for the Clyde Gateway area in the east end of Glasgow.

The focus of the research at the Glasgow Geothermal Energy Research Field Site would be geothermal energy. It is one of two sites proposed in the ± 31 million (US\$42.2 million) UK Geoenergy Observatories Project

led by The Natural Environment Research Council (NERC), the UK's main agency for funding environmental sciences, and the British Geological Survey (BGS), the UK's principal provider of impartial geological evidence since 1835. This major project will provide infrastructure for future research opportunities. The second site is proposed for Cheshire.

The Glasgow Geothermal Energy Research Field Site would be a £9 million (US\$12.24 million) project to explore the potential of geothermal energy for the benefit of local communities, as well as innovation and research into the subsurface. The project aims to create an opportunity for research in relation to the geothermal energy potential of the warm waters in the large expanse of disused coal mines under Glasgow. It may be possible to use that water to heat homes and businesses and store waste heat for future use.

The field site proposed for the Clyde Gateway area would comprise a number of wells of various depths to create the opportunity to research the area's geology and underground water systems. Measurements would be taken from wells, such as temperature, water movement and water chemistry, and the data will be monitored and assessed in the coming years.

The BGS's chief geologist for Scotland, Diarmad Campbell, said: "The UK Geoenergy Observatory in Glasgow would further our understanding of the shallow geothermal energy contained within flooded mine workings. It would help us to better understand that environment and to determine whether the warm water within the mine workings below UK towns and cities could provide a sustainable heat source to help



power the future."

The BGS held a community engagement event in Dalmarnock in September 2017 and has since been consulting with local stakeholders and residents. The BGS has been working on the technical details for the Observatory and submitted last April 2018 planning applications for 22 wells over seven locations to Glasgow City area Council and South Lanarkshire Council for consideration.

The observatory wells would enable environmental baseline observation and mine characterization, providing a real

July-September 2018

environment for scientists to research the potential of using the heat from the UK's flooded mineworkings. The observatory would be operational over a 15-year lifespan and open to the whole of the UK science community to undertake research. Realtime data from state-of-the-art sensors would feed from the boreholes to an online portal that would be open, free and accessible to all.

Source:

http://www.bgs.ac.uk/news/docs/GlasgowPlanningSu bmissionPressStatement_23.04.18.pdf

Oceania

Australia: Birdsville Decides Farewell to Geothermal

Plans to replace what was Australia's only utility-owned and operated geothermal power station in Birdsville –a small town at the end of the eponymous Birdsville Track, in central west Queensland– have been dumped in favor of a switch to distributed solar and storage.

State government-owned network operator Ergon Energy said in early June that it would encourage residents of the frontier town to install rooftop solar PV and battery storage as the best option for increasing renewables on the isolated grid.

Ergon said it had "reluctantly decided" not to continue with plans to replace the town's geothermal power station, which at its peak supplied up to 20 per cent of the town's electricity needs.

Those plans would have integrated a new geothermal power station with the existing diesel power station, lifting the share of renewables generation to 70 per cent for the outback, off grid town.

Ergon's manager of isolated networks, Glenn Dahlenburg, said the decision to drop the geothermal component was guided by rapidly changing energy market dynamics –in particular, the plummeting cost of solar PV.

"This decision was made due to rapidly changing energy market driven by our customers' adoption of



renewable energy such as PV and the continued reduction in energy storage costs, which is expected to substantially alter the energy requirements of our isolated communities in the future," he said.

"Ergon's adoption of geothermal technology at Birdsville in 1992 was ground-breaking, but it remained the only utility-owned and operated plant in Australia until it reached the end of life and ceased supplying power to customers last year", Dahlenburg explained.

Source: <u>https://onestepoffthegrid.com.au/birdsville-bids-farewell-geothermal-opts-solar-battery-storage-instead/</u>

New Zealand: Collaboration Agreement on Geothermal Signed with U.S.

The New Zealand's Ministry of Business, Innovation and Employment (MBIE) and the United States Department of Energy (U.S. DOE) have signed a new partnership agreement to facilitate collaboration on the research and development of geothermal technologies.

"New Zealand has an abundant supply of renewable geothermal reserves and a long history of utilizing this reliable and cost effective energy source to produce electricity," says New Zealand's Minister of Research, Science and Innovation, Megan Woods

"While the capacity we have to generate electricity from



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geothermal sources has significantly grown over the past decade and it now contributes around 17 per cent of New Zealand's electricity supply, this resource still offers vast and untapped potential as an energy source.

"This new research partnership with the United States Department of Energy will bring together experts from both countries to harness this potential and accelerate the development of geothermal technologies. It will also contribute towards our goal of 100% renewable energy by 2050."

The partnership builds on New Zealand's existing commitment to geothermal science through the International Partnership of Geothermal Technology (IPGT), together with the United States, Iceland, Switzerland and Australia.

"New Zealand will be working closely with the United States to increase efficiency and advance cost-effective geothermal energy technologies," says Woods.

"The partnership with the United States will accelerate the availability of these technologies internationally, and identify and address wider issues relating to geothermal energy while informing appropriate technical and regulatory environments."

Source: http://www.thinkgeoenergy.com/new-zealandand-u-s-sign-collaboration-agreement-on-rd-ofgeothermal-technologies/

Other

Geothermal Power Capacity Increased 5.6% in 2017

By the end of 2017, global renewable generation capacity increased by 167 GW and reached 2,179 GW



worldwide. This represents a yearly growth of around 8.3%, the average for seven straight years in a row, according to new data released by the International Renewable Energy Agency (IRENA), in its report Renewable Capacity Statistics 2018, released in early April.

Renewable power generation capacity is measured as the maximum net generating capacity of power plants and other installations that use renewable energy sources to produce electricity. For most countries and technologies, the data reflects the capacity installed and connected at the end of the calendar year. Data has been obtained from a variety of sources, including IRENA's questionnaire, official national statistics, industry association reports, other reports and news articles.

In particular, geothermal power capacity increased by 692 MW in 2017, with major expansions in Indonesia (306 MW) and Turkey (243 MW), and including the first geothermal power plant in South America in Chile. According to the IRENA statistics, complemented with some independent data, geothermal energy rose from 12,249 MW in 2016 to 12,941 MW capacity in 2017, an increase of 5.6%. The U.S. remains the top producer with 2,488 MW followed by Indonesia (1,950 MW), the Philippines (1,928 MW), Turkey (1,064 MW) and New Zealand (986 MW) (see graph below, prepared with data from IRENA and other recent data).

Source:

http://irena.org/publications/2018/Mar/Renewable-Capacity-Statistics-2018

Technology: More Efficient Fracture Networks in Deep Gas, Oil and Geothermal Wells

Thermal borehole enlargement through thermal spallation can be used to bore deep wells for gas, oil or geothermal exploitation in hard rock. It could also boost the efficiency of new wells and recovery of abandoned wells.

The shape of the borehole can be optimized in order to enhance the subsequent stimulation process.

The creation of deep reservoirs for gas, oil and geothermal energy extraction is impeded by insufficient stimulation. Direction and extension of the created fractures are complex to control and, therefore, large stimulated and interconnected fracture networks are difficult to create. In order to reduce the project failure risks and increase the reservoir productivity, the Swiss company ETH Zürich has developed a technology to control the creation of engineered reservoirs in hard deep rocks.

Thermal borehole enlargement is a technique that locally increases the well diameter by utilizing the thermal spallation process to excavate rock on the sidewalls of an existing borehole. One or multiple nozzles are placed at the circumference of a burner assembly, creating a hot jet of combustion gases.

When this hot jet impinges on the rock, high thermal stresses are induced, which lead to the disintegration of the rock surface. An adaptable packer system avoids water penetration during the jetting process and regulates the pressure in the jetting zone.

The prototype was successfully tested at the Grimsel Test Site, and can be used in a wide range of defined borehole enlargement geometries (e.g. notches, discs, slots). It produces an optimized fracture propagation in hydraulic stimulation phase, reducing fluid pressure to initiate fracturing process and increases the well productivity by additionally reducing the project failure risk. The technology is applicable in any deep well for gas, oil or geothermal exploitation in hard rock.

The research was published in *Applied Energy* 212, by M.A. Kant et al. (2018).

Source: <u>https://sciencebusiness.net/network-</u> news/boring-technology-makes-deeper-and-safer-wells

Technology: Improvements of ORC Using Mixtures with Liquid-Separated Condensation

In an Organic Rankin Cycle (ORC) system, the working fluid is an important carrier for achieving the power generation from heat sources, and it crucially affects the system performance. The zeotropic mixture consists of two or more pure fluids, and it can significantly increase the selectable range of working fluids for ORC systems. Moreover, the zeotropic mixture has a varying phasechange temperature which is beneficial to reduce the exergy loss in the heat transfer processes, and thereby considerably increasing the heat–power conversion efficiency for ORC systems, compared to pure fluids.

Using zeotropic mixtures in ORC systems has been a new trend in recent years. However, compared to using a pure fluid, ORC systems using a zeotropic mixture generally need a larger heat transfer area, especially a larger condenser heat transfer area; mainly due to the decreases of heat transfer temperature difference and condensation heat transfer coefficient. The purchased cost of the condenser increases as the heat transfer area increases, and studies have shown that the condenser purchase cost can account for more than 35% of the total purchased equipment costs for an ORC system.

In addition, factory building area and system maintenance costs also increase as the condenser heat transfer area increases.

The large condenser heat transfer area has been one of the crucial factors that impedes the broad application of ORC systems using zeotropic mixtures. Increasing the condensation heat transfer coefficient is an effective approach to reducing the condenser heat transfer area. However, conventional enhanced heat transfer methods generally increase the pressure drop during condensation, thereby degrading the thermodynamic performance of ORC system.

Liquid-separated condensation is an emerging enhanced heat transfer method that separates the condensed fluid from the vapor-liquid mixture during condensation. It reduces the condensing film thickness on the cooling surface and increases the vapor quality. The key idea is to use the excellent heat transfer characteristics of highquality vapor to increase the condensation heat transfer coefficient, as shown in Fig. 2. Separating the condensed fluid also reduces the flow resistance during condensation. Therefore, liquid-separated condensation can simultaneously increase the condensation heat transfer coefficient and reduce the pressure drop.



Fig. 2. Schematic for the liquid-separated condensation that enhances the condensation heat transfer (Vapor–liquid separation occurs twice) (Graph from the source).

However, unlike pure fluids, the composition of a zeotropic mixture will change after the liquid is separated from the vapor-liquid two phase flow in the liquid-separated unit, and the characteristics of mixture

condensation are also different for various vapor qualities at the liquid-separated unit inlet (xLSI, which reflects the liquid-separated unit relative location in the condenser), as shown in Fig. 3. Therefore, for ORC system using zeotropic mixtures with liquid-separated condensation, effects of vapor quality at the liquidseparated unit inlet on the net power output, condensation heat transfer coefficient, and heat transfer area, become all important issues need to be studied.



Fig. 3. Liquid-separated condensation changes the composition and condensation temperature characteristics of a zeotropic mixture (graph form the source).

In this work, the liquid-separated condensation method was first introduced into an ORC system using zeotropic mixtures (R600/R601a mixtures). The potential of liquid-separated condensation in reducing the heat transfer area was assessed, compared to the conventional condensation without liquid-separation. Effects of vapor quality at the liquid-separated unit inlet on the net power output, condensation heat transfer coefficient, and heat transfer area were studied. Characteristics of the ORC system using zeotropic mixtures with liquid-separation condensation were also revealed.

Results show that the liquid-separated condensation may reduce the maximized net power output of an ORC system using zeotropic mixtures. Moreover, the maximized net power output may decrease as the xLSI decreases for zeotropic mixtures. The decrease of maximized net power output is strongly related to the increase of condensation pressure which is caused by the increase of the total condensation temperature glide.

The liquid-separated condensation can increase the average condensation heat transfer coefficient by 23.8% for R600/R601a mixtures, compared to the conventional condensation. The xLSI obtaining the maximum average condensation heat transfer coefficient

is determined by the heat transfer coefficient profile in the condenser, which is lower than 0.3 for the R600/R601a mixture.

Results also show that the liquid-separated condensation can reduce the condenser heat transfer area by 44.1%for R600/R601a mixtures compared with the conventional condensation. In addition, when the maximized net power output remains constant, the condenser heat transfer area can be reduced by 11.6%for R600/R601a mixtures with liquid-separation condensation.

This work also indicates that the thermo-economic method is more suitable to analyze the performance for ORC systems using zeotropic mixtures with liquidseparation condensation because the liquid-separated condensation can significantly reduce the condenser heat transfer area while it may also reduce the maximized net power output for ORC systems using zeotropic mixtures. The single-stage liquid-separated condensation can reduce the electricity generation cost by 1.3%-2.6% compared with the conventional condensation for R600/R601a mixtures. The lowest electricity generation cost occurs at the R600 mass fraction of 0.9 with xLSI = 0.3, and the electricity generation cost is reduced by 1.7% compared to R600 with the conventional condensation, and 6.9% R601a with conventional compared to the condensation.

Source: https://sciencetrends.com/performanceanalysis-of-organic-rankine-cycles-using-r600-r601amixtures-with-liquid-separated-condensation/

Technology: The CHPM2030 Project and Delphi Survey

The CHPM2030 project is one of the projects being developed in the European Union under the umbrella of Horizon 2020. The consortium is working on a novel, potentially disruptive technology that combines geothermal energy and mineral extraction in a single interlinked process: Combined Heat, Power and Metal extraction, or in short CHPM.

This technology aims to increase financial feasibility of geothermal projects, by recovering strategically important metals (e.g. Au, Sn, Fe, Li, REE, etc.) from the geothermal brine. Therefore the engineered geothermal reservoir is developed in deep rocks that have a deep metal enrichment (such as a low grade, high volume ore body), allowing for both geothermal and mineral potential.

The CHPM2030 project started in 2016 and already provided a methodology framework, laboratory results on metal content mobilization using mild leaching, and simulations for orebody characteristics (*see*

www.chpm2030.eu/outreach). The current tasks include metal recovery, system integration and integrated environmental assessment.

As part of the project, CHPM2030 launched a survey among a group of selected experts around the world asking for comment on statements about the future, in 2050. The survey was created by the working unit on Roadmapping and Preparation for Pilots, with the goal to set the scene for subsequent pilot implementation, including short-term planning (2030, preparation for pilots) and long-term planning (2050, horizon scanning), and research roadmaps for 2030 and 2050 that elaborate on how to get to the desired vision by the selected timelines. This is a 2-round Delphi survey that maps future development of uncertain but important areas for CHPM technology application.

The Delphi survey was originally developed as a technological forecasting technique, which aimed at reaching consensus over relevant technological developments. Nowadays, Delphi has expanded into a variety of modified approaches. However, at its core

Delphi stands out as a reliable method in situations where individual judgements must be elicited and combined to address an incomplete state of knowledge. Delphi is based on anonymous opinions of experts who are fed back the results of a round-based survey, allowing these experts to rethink their judgement and converge to consensus over key identified areas.

Source:

https://docs.google.com/forms/d/e/ 1FAIpQLSeQAl_CeWwa1Lfk5XNG M2gaMEjqlyAwOQPJdzGqpEn7XE 4eaA/viewform

Technology: SIMFIP, Deep ur a New Tool for Measuring and Design Hydro Fractures

The Sanford Underground Research Facility (SURF), once the most productive gold mine in the Western Hemisphere, is located in South Dakota, U.S., and currently hosts world-leading research in physics, biology, geology and engineering. On May 22, 2018, researchers with the SIGMA-V experiment worked in near silence in the West Drift on the 4850 Level of the SURF (at around 1480 m depth). The locomotives sat quietly on the tracks, jack-leg drills rested against drift walls and operations ceased for several minutes at a time as the team began pumping pressurized water into the

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injection well, one of eight boreholes drilled for this experiment.

"We requested quiet because we use sensitive seismic monitoring equipment," said Tim Kneafsey, earth scientist at Lawrence Berkeley National Laboratory (LBNL). "The signals we measure are very small and we don't want vibrations from other sources overwhelming those signals."

Kneafsey is the principal investigator for the Enhanced Geothermal Systems (EGS) Collab Project, a collaboration comprised of eight national laboratories and six universities who are working to improve geothermal technologies. The test featured the SIMFIP (Step-Rate Injection Method for Fracture In-Situ Properties), a tool that can revolutionize the way scientists develop EGS projects.

Developed at LBNL, the SIMFIP allows precise measurements of displacements in the rock and, most importantly, the aperture, or opening, of a hydro fracture.



Deep underground on the 4850 Level (~1480 m depth) at Sanford Lab. Photo taken from the source.

The extreme quiet paid off, Kneafsey said.

"Our goal was to create a fracture from a specific zone in our injection well that would connect to our production well –about 10 meters away. And we were successful in doing that," Kneafsy said.

Before the introduction of the SIMFIP, separate tools were used to create and measure hydro fractures. They work like this: "Straddle packers"—pipes with two deflated balloons on either end— are placed inside boreholes. Once inside, the balloons are inflated and water injected down the pipes to create an airtight section. They continue to pump water until the rock fractures, then remove the packers and insert the

measuring tool. In the time it takes to do all that, much of the pertinent data is lost, leaving traces, but little else.

"Even if you did get the aperture, when you released the pressure, the hydro fracture was already closing," said Yves Guglielmi, a geologist at LBNL who designed the tool. "You don't have the 'true' aperture and you also don't know how the aperture might vary during the test."

With the introduction of the SIMFIP, a small device that sits between the two packers, they can measure the aperture in real-time.

"This is really a new way to do the work," Guglielmi said. "It will help us understand the whole process of initiating and growing hydro fractures in hard rock, which is kind of new. This is fundamental science. If we understand how hydro fractures will behave in this kind of rock, we can begin to make intelligent, complex fractures that can capture more heat from the earth."

The device is "bristling with sensors and other instrumentation that give us a close-up view of what happens when the rock is stimulated—all in real-time," said Paul Cook, LBNL engineer.

The SIMFIP measures fracture openings in hard rock in the EGS Collab test site. The team had drilled eight slightly downward-sloping boreholes in the rib (side) of the West Drift: The injection hole, used for stimulating the rock, and production well, which produces the fluid, run parallel to each other through the rock. Six other boreholes contain equipment to monitor micro seismic activity (rock displacement); electrical resistivity tomography (subsurface imaging); temperature; and strain (how rocks move when stimulated).

Nestled between the straddle packers in the injection hole, the SIMFIP measured the rock opening as the team looked on.

Measurements from the SIMFIP could remove barriers that stand in the way of commercializing geothermal systems. With the first test under its belt, the EGS Collab just moved a step closer to that goal.

Source:

https://www.sanfordlab.org/article/revolutionizing-geothermal-energy-research

Technology: Demonstration of Closed-loop Geothermal Power Generation in California, U.S.

GreenFire Energy Inc. announced on late June that Electric Power Development Company, Ltd. (J-Power Company), a utility company in Japan, and the U.S.' Electric Power Research Institute (EPRI) will participate in GreenFire's demonstration of a closed-loop geothermal power generation system. J-Power Company will have project observation and information rights.

This project is the first implementation of GreenFire Energy Inc.'s innovative ECO2GTM closed-loop geothermal technology and will demonstrate the ability to produce power from a currently inactive well in the Coso, California, geothermal field. The success of ECO2G could enable geothermal project owners to generate power from idle or marginal wells at low risk and attractive cost per megawatt-hour. This is significant because worldwide, about 20% of geothermal wells are unproductive for a variety of reasons.

The demonstration project will insert a coaxial closedloop tube in an existing geothermal well that lacks sufficient pressure and permeability to generate power. Various fluids may be circulated to transfer heat to the surface where power potential will be carefully measured.

Although generating power from existing but currently non-producing geothermal wells would be an important advancement in geothermal power technology, GreenFire believes that success in geothermal well retrofits can provide the expertise and credibility required to eventually advance to large-scale ECO2GTM projects in locations unsuitable for conventional geothermal power technology.



"GreenFire Energy's ECO2GTM technology is the culmination of years of research with the U.S. Department of Energy, national laboratories, and universities. The decision of EPRI, a research collaborator with utility and energy companies worldwide, to review our development project is consistent with our effort to engage leading experts in every relevant discipline", said Joseph Scherer, Chief Executive Officer of GreenFire Energy Inc.

Source: <u>http://www.greenfireenergy.com/j-power-epri.html</u>

Technology: Searching Waterless Stimulation for Geothermal Wells

The Geothermal Technologies Office (GTO) of the U.S.' Department of Energy (DOE) announced in early July the selection of three projects to receive up to US\$4.3 million in funding to conduct early-stage research and development to advance state-of-the-art waterless stimulation technologies applied to geothermal wellbores.

The selected projects include:

Oak Ridge National Laboratory – Foam Fracturing Study for Stimulation Development of Enhanced Geothermal Systems.

Pacific Northwest National Laboratory – Responsive Fracturing Fluids for Enhanced Geothermal Systems.

Sandia National Laboratories – POT (Pressure, Orientation, & Timing) for Anhydrous Energetic Stimulation.

The most commonly applied wellbore stimulation technology, hydraulic fracturing, relies heavily on waterbased fracturing fluids due to the general availability and low cost of water as well as its capability for proppant transport. DOE is interested in developing stimulation methods that require little to no water –reducing the usage needed for geothermal progress and easing constraints on water consumption. In addition, there are crosscutting applications with oil and gas, where there is growing concern with the amount of water disposed after similar operations have been completed.

Source:

https://www.energy.gov/eere/geothermal/ar ticles/gto-announces-waterless-stimulationlab-call-selections

Climate Change: Climate Pledges of the World Are Not 'Ambitious Enough'

Speaking at the start of a new round of climate talks in Bonn, Germany, on late April, Patricia Espinosa, executive secretary of the United Nations Framework Convention on Climate Change (UNFCC), said the current climate pledges put forth by signatories of the Paris Agreement "simply aren't ambitious enough."

She said that, with the Paris Agreement's goal of limiting global temperature rise by 1.5 degrees, countries' nationally determined contributions (NDCs) as they stand take the global temperature to almost double that number.

"A rise of this magnitude in the temperature would be extremely destabilizing and we can't allow this to happen. That's why this process —these negotiations is so important," she said in a live press conference webcast on April 30. "During this round of negotiations, we are encouraging parties to increase ambitions by making progress on the Paris Agreement work program."

During the talks in Bonn, participating governments aimed to develop the guidelines —or operating manual— for implementing the Paris Agreement. But after two weeks the envoys from almost 200 nations left Bonn without producing a draft negotiating text for ministers to discuss at the end of the year. Instead, they planned another round of negotiations in Bangkok before their annual conference in Poland in December.

The holdup threatens to unravel three years of work to complete the Paris Agreement, a landmark deal reached in 2015 that set out an ambition to limit fossil-fuel pollution in all nations for the first time. Negotiators are working toward writing a rule book that will help bring the pact into force even as U.S. President Donald Trump vowed to withdraw from the Paris framework.

Tensions have been building for years on the matter of financing that industrial nations promised developing ones to pay for transforming their economies to run on clean energy –and to cope with the more violent storms and rising sea levels associated with higher global temperatures.



View of the plenary session in Bonn.

The climate talks finished with developing countries demanding more clarity from their richer counterparts on when a promised package of US\$100 billion in aid will materialize. Rich countries led by the U.S. and European Union pledged in 2009 to ramp up climaterelated aid to US\$100 billion a year by 2020. While they have made progress on that commitment, reaching US\$62 billion in 2014 according to one official study, developing nations want more detail on what money is coming before signing up to the Paris rules.

Developing nations are being asked for more transparency on the emissions they produce — and to open up to some sort of process for verifying that information. Many of them are concerned that will add expensive and cumbersome bureaucracy —or that richer nations will use those tools to limit trade. Richer countries see the rules as essential to making credible the pollution cuts that the Paris deal promises.

"If you don't have policies that underpin the number that's been put in Paris, you've got nothing to drive progress," said Elina Bardram, a European Commission official who's head of the EU delegation at the talks in Bonn.

The work of creating a text was supposed to be completed in Bonn and now will shift to another meeting to be convened in Bangkok later this year. The extra time would be used to produce clear options for the end-of-year session in Katowice, Poland, which will be attended by ministers and world leaders.

"We need that Bangkok session. Why? Because no Bangkok session, no deal in Katowice," said Tosi Mpanu-Mpanu, a representative from the Democratic Republic of Congo. "No deal in Katowice, some guys in the U.S. will be celebrating, saying, we were right to leave this thing."

Trump has remained mostly silent about the global fight against climate change since June 2017, when he vowed to withdraw from the Paris deal. His predecessor, Barack Obama, strongly supported the talks, with \$2.7 million in climate-related aid in 2014 and a pledge to help capitalize the Green Climate Fund. Trump held up money for the Green Climate Fund, and his officials in Bonn declined to comment to the press.

Ambassador Luke Daunivalu, chief negotiator of the Fiji COP23 Presidency, echoed the sense of urgency. He said the Fijian COP23 Presidency is focused on advancing the work program of the Paris Agreement. "The work program must be completed at COP24, and any suggestion that they be delayed will delay overall response to the climate crisis," he said. "We don't have any time to waste."

Sources:

https://www.renewableenergyworld.com/articles/2018

/04/climate-pledges-of-the-world-are-not-ambitiousenough.html,

https://www.renewableenergyworld.com/articles/2018/05/climate-talks-stall-as-detail-sought-on-100-billion-finance.html

Climate Change: Stronger, Slower, and Wetter Hurricanes in the Future

Scientists have developed a detailed analysis of how 22 recent hurricanes would be different if they formed under the conditions predicted for the late 21st century. While each storm's transformation would be unique, on balance, the hurricanes would become a little stronger, a little slower-moving, and a lot wetter.

In one example, Hurricane Ike –which killed more than 100 people and devastated parts of the U.S. Gulf Coast in 2008— could have 13 percent stronger winds, move 17 percent slower, and be 34 percent wetter if it formed in a future, warmer climate.



Jose (top) and Maria hurricanes in 2017. Credit: NASA.

Other storms could become slightly weaker (for example, Hurricane Ernesto) or move slightly faster (such as Hurricane Gustav). None would become drier. The rainfall rate of simulated future storms would increase by an average of 24 percent.

The study, led by scientists at the National Center for Atmospheric Research (NCAR) and published in the Journal of Climate, compares high-resolution computer simulations of more than 20 historical, named Atlantic storms with a second set of simulations that are identical but for a warmer, wetter climate that's consistent with the average scientific projections for the end of the century.

"Our research suggests that future hurricanes could drop significantly more rain," said NCAR scientist Ethan Gutmann, who led the study. "Hurricane Harvey demonstrated last year just how dangerous that can be."

Harvey produced more than 4 feet (1.2 m) of rain in some locations, breaking records and causing devastating flooding across the Houston area.

The research was funded by the National Science Foundation (NSF), which is NCAR's sponsor, and by DNV GL (Det Norske Veritas Germanischer Lloyd), a global quality assurance and risk management company.

"This study shows that the number of strong hurricanes, as a percent of total hurricanes each year, may increase," said Ed Bensman, a program director in NSF's Division of Atmospheric and Geospace Sciences, which supported the study. "With increasing development along coastlines, that has important implications for future storm damage."

With more people and businesses relocating to coastal regions, the potential influence of environmental change on hurricanes has significant implications for public safety and the economy. Last year's hurricane season, which caused an estimated US\$215 billion in losses according to reinsurance company Munich RE, was the costliest on record.

For the current study, the researchers took advantage of a massive new dataset created at NCAR. The scientists ran the Weather Research and Forecasting (WRF) model at a high resolution (4 kilometers, or about 2.5 miles) over the contiguous United States over two 13year periods.

The simulations took about a year to run on the Yellowstone supercomputer at the NCAR-Wyoming Supercomputing Center in Cheyenne.

The first set of model runs simulates weather as it unfolded between 2000 and 2013, and the second simulates the same weather patterns but in a climate that's warmer by about 5 degrees Celsius –the amount of warming that may be expected by the end of the century.

Source:

https://www.nsf.gov/news/news_summ.jsp?cntn_id=2 45396&WT.mc_id=USNSF_51&WT.mc_ev=click

Climate Change: Antarctica Is Melting Three Times as Fast as a Decade Ago

Between 60 and 90 percent of the world's fresh water is frozen in the ice sheets of Antarctica, a continent roughly the size of the United States and Mexico combined. If all that ice melted, it would be enough to raise the world's sea levels by roughly 200 feet (61 m).

While that won't happen overnight, Antarctica is indeed melting, and a study published in June in the journal *Nature* shows that the melting is speeding up.

The rate at which Antarctica is losing ice has tripled since 2007, according to the latest available data. The continent is now melting so fast, scientists say, that it will contribute six inches (15 centimeters) to sea-level rise by 2100. That is at the upper end of what the Intergovernmental Panel on Climate Change has estimated Antarctica alone could contribute to sea level rise this century.

Even under ordinary conditions, Antarctica's landscape is perpetually changing as icebergs calve, snow falls and ice melts on the surface, forming glacial sinkholes known as moulins. But what concerns scientists is the balance of how much snow and ice accumulates in a given year versus the amount that is lost.



Photo credit: The New York Times (taken from the source).

Between 1992 and 2017, Antarctica shed three trillion tons of ice. This has led to an increase in sea levels of roughly three-tenths of an inch, which doesn't seem like much. But 40 percent of that increase came from the last five years of the study period, from 2012 to 2017.

Antarctica is not the only contributor to sea level rise. Greenland lost an estimated 1 trillion tons of ice between 2011 and 2014. And as oceans warm, their waters expand and occupy more space, also raising sea levels. The melting ice and warming waters have all been primarily driven by human emissions of greenhouse gases.

Source:

https://www.nytimes.com/2018/06/13/climate/antarc tica-ice-melting-faster.html

Lithium Market: Chinese Company Controls Most of Worldwide Production

Tianqi Lithium, a Chinese company, recently paid more than US\$4 billion to become the second-largest shareholder in Sociedad Química y Minera (SQM), a Chilean mining company. The deal gives the company effective control nearly half the current global production of lithium, a critical component in battery technology.

The investments is producing an unusual amount of repercussions. The Chinese government had to intervene to warn the Chilean government that blocking the deal, which it has the power to do, could harm their bilateral relations. The Chilean government is worried that giving Tianqi so much control over lithium could distort the market.

In recent years, China has come to dominate the lithium-ion industry. Though Japan had a head start, because Sony was the company that first commercialized the technology, China was able to catch up because of its ability to manufacture the batteries at larger scales and sell them for cheaper (see attached graph).

To maintain its dominance in the lithium-ion market, Chinese manufacturers needs access to lots of cheap lithium. Along with the stake in SQM, Tianqi owns 51% of Australia's Greenbushes lithium mine, giving it effective control nearly half the current global production of the metal, according to Huang Liheng, an analyst at GF Securities.

But Chile could still have the last laugh. In April, the country's economic development agency, Corfo, complained that Tianqi's control on lithium could "gravely distort market competition." Regulators have a chance to oppose the deal by August, if they think that Tianqi owning so much of the world's lithium is a problem.



Source: <u>https://qz.com/1292202/china-now-</u> effectively-controls-half-the-worlds-lithium-production/ 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 Surva 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. Marit Brommer proofread the articles. Distributed by the IGA Secretariat. Design

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| IGA Home Page: <u>www.geothermal-energy.org</u> | | | | | |
| Membership | | | | | |
| \Box Enrol me as a new member of IGA | | | | | |
| □ Renew my membership to IGA | | | | | |
| Dr Mr Mrs Ms (circle) | | | | | |
| Family name | | | | | |
| First name | | | | | |
| Profession | | | | | |
| Organization | | | | | |
| Address 🗖 Work 🗖 Home | | | | | |
| | | | | | |

| Phone (area code) |
|-------------------|
| Fax (area code) |
| E-mail |

Note: The information you provide will be held on the IGA database. It will be used to update you on the activities of the Association, and may be changed or cancelled at any time upon your request. It will be included in the IGA Directory, which may be circulated in printed or electronic form to IGA members only. If you do not wish your details to be used for this purpose, please tick the box (in which case your name will not be printed in the IGA Directory)

| Membership category |
|---|
| □ Individual – USD 40 |
| □ Student – USD 10 |
| Corporate – USD 500 |
| □ Institutional – USD 500 |
| □ Sustaining: individual – USD 100 |
| □ Sustaining: corporate – USD 1000 |
| Representatives of Corporate and Institutional members: |
| Contact person |
| Second person |
| Third person |
| Payment |
| There are three ways to make payment to IGA: |
| 1. Credit card |
| □ Master Card |
| □ American Express |
| 🗖 Visa |
| Card # |
| Expiration date |
| Signature |

Date of signature _

Bank draft.
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Geothermal Association Please notify the Secretariat by fax or e-mail when you wire funds. Bank: Helaba Address: Friedrichstr. 74 40217 Duesseldorf, Germany Account # 1007100413 SWIFT: WELADEDD IBAN: DE77 3005 0000 1007 1004 13

| 2016 dues USD | | | | |
|--------------------|--|------|--|--|
| 2017 dues USD | | | | |
| 2018 dues USD | | | | |
| Contribution USD _ | | | | |
| TOTAL USD | | | | |
| | | | | |

These financial data will not be stored on a database, and will not be recorded in any electronic form.

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