

IGA ACTIVITIES

Message from the Executive Director & the President

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

It is with great pleasure to address you in this new edition of the *IGA Newsletter*. These have been eventful weeks and months since our last newsletter.

In April of this year, our new Executive Director, Dr. Marit Brommer joined the Secretariat's team in Bochum. She jumped right into the action with our 66th Board of Directors meeting in Bochum in early May.

Traditionally a two-day affair, this time the meetings were a bit different. Instead of the conventional format, we organized a strategy meeting to discuss the strategic framework for IGA, initiatives, must-win battles, and where we want to take the organization.

So prior to our one-day official board meeting, we hotly debated and discussed the future of IGA for two days with the help of some external consultants. The goal was to explore how we can strengthen the role of our members and the wider geothermal energy community not only for our sector, but also in the wider context of the ongoing renewable energy and climate change debate.

The meetings were intense and saw valuable and informative discussions take place, all tailored to conclude on the vision and mission of the association, as well as key strategic pillars for IGA for the next few years. The overall work has just begun so we cannot share with you just yet all that we are going to work on.

One crucial element of the discussions was the topic of how we can improve the image of IGA and our branding. This was generally agreed to be a priority item, and we are proud to announce that we have made some significant steps to roll out a new logo and visual identity for IGA in the coming weeks. While the logo is only one element of our presence, the re-branding effort will affect how we present IGA visually via our content. So in the coming months, we will also see the re-launch of the IGA website with the goal of better presenting IGA, its member associations, and other members, as well as what geothermal energy has to offer in the overall renewable energy context.

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IGA Vision: “Support a sustainable and prosperous future by educating the World community in terms of the best practices and unbiased benefits of developing the utilization of Earth’s heat for both direct use and electricity generation.”

Another important discussion point was how IGA can play a stronger role in the representation of geothermal energy towards the outside world, towards international organizations, governments, banks and other crucial stakeholders that we need to reach to enable growth in our industry.

We are planning an outreach campaign to our members over the coming months to engage further on how we can work together to strengthen our efforts and support each other in our common mission to attain more visibility and support for geothermal development, both for electricity generation and the direct use of heat.

Funding of the planned strategic action items will require a lot of work and time, as well as funding. So there also several initiatives that look into how we can improve the funding position of IGA to help achieve our goals but also provide a concrete value proposition of our activities for our members.

IGA Mission: “We provide our members with a gateway and connection to the Global Geothermal Community and a strong united voice in the renewable energy sphere.”

We are looking very much forward to some exciting months ahead that will see changes to how we present ourselves, but also on how we represent geothermal energy in the public sphere, and as a professional international organization.

Please don’t hesitate to contact us if you should have any comments or questions.

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Meet Marit – An Interview

Marit Bromme accepted the position of Executive Director of the International Geothermal Association in April 2017. She is based in Bochum, Germany, and a



geologist with a decade of experience in the oil and gas industry. She is originally from the Netherlands, married, and with two children. She speaks four languages and is very fond of her family, winter sports, playing the piano and going for an evening run. Marit, involved in several *Women in Energy* networks, is

keen to share her experiences and lessons learned with the industry and she welcomes the opportunity to open dialogues on achieving gender parity throughout all ranks. Here is what we asked her.

What did you want to be when you grew up?

My earliest dreams, as far as I can remember, centered on becoming a pilot. In my teenage years I started taking flying lessons and later went on to paragliding. Being airborne and observing our planet from above was absolutely amazing. I tried a few times to get into the formal pilot schools for airline carriers but had no success. After I finished high school, I followed my other two passions, traveling and skiing, and had the opportunity for a few years to stall decisions on what I wanted to do now that I was actually grown up. And then I discovered geology! Instead of observing our planet from above, it was actually also really fun to look at rocks close by, to appreciate the origin of mountains, volcanoes, the shapes of the world’s coastlines and how it all fits together. I was hooked and wanted to become a geologist!

So what happened then?

I studied Earth Sciences in Amsterdam at the Free University, did a PhD in Reservoir Geology at Delft University of Technology, became a consultant in the UK (Royal Haskoning) and then joined the oil and gas industry in operations (Total) and R&D (Shell). My geological career has given me the opportunity to work and live in different parts of the world. Projects I worked on range from coastal zone management to well site geology on offshore rigs. My last role at Shell concentrated on deploying new technology and implementing new ways of working in geoscience.

What motivates you?

I love getting things done, and that can be anything from painting my house to moving difficult projects to the next stages. In addition, I am really motivated by

passionate people who love what they do and are proud of what they achieve with others. Last but not least, my family and friends motivate me to value the really important matters of life.

What do you consider your greatest achievement?

I consider my greatest achievement the fact that I was able to let go of my dreams of becoming a pilot and replaced them with a fantastic passion for geology.

What is so great about geothermal?

Well first of all it has geo in its name so it has to be great, right! Second, what really inspires me about geothermal energy is its purity. Yes we do need certain techniques and methods to extract heat from the subsurface; however, the essence of geothermal energy is very pure. I do think we should brand geothermal energy more cleverly than many resources, and allow them to become more visible in the renewable energy scene. At this stage we, unfortunately, are not a very well known player. We have a saying in Dutch that translates roughly to 'unknown is unloved.' Since we have moved into a digital era in which it is of the utmost importance to collect 'likes', we have to raise our profile and start our own collection.

What do you believe has been the key to your success?

The ability to understand what matters to you. Life throws many challenges at you, and sometimes they come all at once. Staying close to who you are, your values and your principles, and making decisions based on what matters to you most, is absolutely my key to success.

You come from the oil and gas industry, and are now active in geothermal. Both are male-

dominated industries. What are your experiences building your career in a male-dominated industry?

Diversity matters, inclusion matters more. This has always been my motto, and it is as true now as it was 20 years ago when I started studying geology. Every organization that shows unequal gender representation throughout the ranks has a cultural problem. Unconscious biases and stereotyping are the two top reasons for inequality. There are numerous leadership programs to empower women, introduce 'the rules of the game', make them aware on the importance of exposure and visibility, but if the corporate culture is based on masculine values, the 'female talent pipeline' will remain leaky as women will leave and find opportunities elsewhere. So for me it is clear that organizations need to adapt their corporate culture and demand inclusive behavior throughout all ranks.

Any words of advice for young professionals, male and female, entering the Industry now?

I would say to the young professionals to explore your ideas on what matters to you most, be clear about your vision and ambitions, engage the people around you and involve them in your journey. Ask for a mentor, in – or outside your organization, expose yourself, and never ever forget to enjoy the ride.

How can you be reached?

Connect with me online via *LinkedIn*. Check out the IGA website (www.geothermal-energy.org), become a member of the *IGA LinkedIn* and Facebook group, follow us on Twitter #igabochem and send me an email (marit.brommer@hs-bochum.de). I look forward to hearing from you!

66th BoD Meeting in Bochum, Germany

**Katharina Link,
GeoEnergie Suisse**

The 66th Meeting of the IGA Board of Directors (BoD) was held in the International Geothermal Centre in Bochum (Germany) on 13th May 2017—after an IGA strategy workshop.

IGA president
Alexander Richter



welcomed the IGA Board of Directors and called the 66th Board Meeting to order at 9:00 am. The participants introduced themselves, including the following Board members: Abadi Poernomo, Albert Genter, Alexander Richter, Andrea Blair, Andrew Sabin, Beata Kepinska, Bjarni Bjarnason, Bruno Della Vedova, Colin Harvey, Diego Morata, Gábor Szita, Horst Rüter, Jane Brotheridge, Juliet Newson, Kristín Vala Matthíasdóttir, Ludvik S. Georgsson, Paul Brophy, Paul Moya, Peter Meier, Rolf Bracke, Sadiq J. Zarrouk, Shigeto Yamada, Surya Darma, Toshihiro Uchida, and Valentina Svalova. Additional participants were Marit Brommer, Executive Director, and Karolina Andersson, IGA Assistant.

The agenda included the following points: 1. Call to order, 2. Approval of the Minutes of the IGA Board Meetings Nos. 64 & 65, 3. Approval of the Agenda, 4. Reports from the officers, 5. Reports from permanent committees and ad hoc committees, 6. Reports from IGA Regional Branches, 7. Focused discussions on subsequent topics: 7a. COP24 in Poland, 7b. Update on WGC2020, MoU, preparations, timeline, 7c. Visual identity and website – set and approve budget, 7d. Strategy Meeting results and Next Steps, 7e. Resources and Reserves Committee – set and approve budget, 7f. Geothermal Sustainability Assessment Protocol - a new approach proposed by an Icelandic initiative, 7g. IGA Service Company, 8. Presentation/proposed date and place for next BoD Meeting, 9. Adjournment.

The main aspects and agreements of the meeting follow.

- New strategy: The BoD discussed and approved the new strategy and the resulting key initiatives.
- COP24: The BoD has expressed full support for COP24 in Poland, which will take place in the last quarter of 2018.
- Logo: The IGA logo will be redesigned to reflect the new strategy and values.
- Geothermal Sustainability Assessment Protocol (GSAP): The Board approved taking the GSAP forward as a key IGA initiative.
- Resources and Reserves Committee (R&R Committee): The Board approved setting aside a budget for the Resources and Reserves Committee to work on a World Bank proposal as a seed fund.
- IGA Service Company (IGA SC): The supervisory board of the IGA SC will seek legal and tax advice regarding the relationship between the IGA (incorporated in New Zealand) and the IGA SC (Limited Liability Company in Germany). The IGA Executive

Director will provide the Supervisory Board a business plan for the IGA SC.

The next BoD Meeting will take place in Santiago, Chile, most likely at the end of November 2017. President Alexander Richter thanked the BoD and closed the 66th meeting at 6:00 pm.

Renewables 2017 Global Status Report by REN21, Launched on June 7

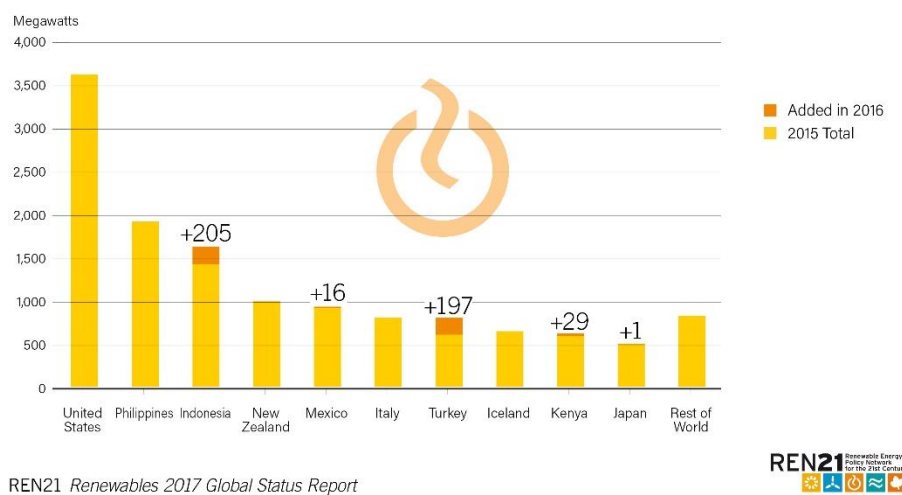
REN21, the Renewable Energy Policy Network for the 21st Century, is a global network composed of 16 international industry associations (the IGA among them), 12 international organizations, 15 Non-Governmental Organizations, 11 national governments, six scientific and academic institutions and six members at large. Since 2005, it has prepared and published each year the Global Status Report (GSR) for renewable energy.

On June 7th, REN21 launched the 2017 edition of this report with the following main highlights:

- Additions in installed renewable power capacity set new records in 2016, with 161 gigawatts (GW) installed, increasing total global capacity by almost 9% over 2015, to nearly 2017 GW. Solar PV accounted for around 47% of the capacity added, followed by wind power at 34% and hydropower at 15.5%.
- Renewables are becoming the least-cost option. Recent deals in Denmark, Egypt, India, Mexico, Peru and the United Arab Emirates saw renewable electricity being delivered at USD 0.05 per kilowatt-hour or less. This is well below equivalent costs for fossil fuel and nuclear generating capacity in each of these countries.

Geothermal Power Capacity and Additions, Top 10 Countries, 2016

Source: Figure 12 of the 2017 GSR.



- The inherent need for 'baseload' is a myth. Integrating large shares of variable renewable generation can be done without fossil fuel and nuclear 'baseload' with sufficient flexibility in the power system – through grid interconnections, sector coupling and enabling technologies such as ICT, storage systems electric vehicles and heat pumps. In 2016, Denmark and Germany, for example, successfully managed peaks of renewable electricity of 140% and 86.3%, respectively.

- Global energy-related CO₂ emissions from fossil fuels and industry remained stable for a third year in a row despite a 3% growth in the global economy and an increased demand for energy. This can be attributed primarily to the decline of coal, but also to the growth in renewable energy capacity and to improvements in energy efficiency.

- Innovations and breakthroughs in storage technology increasingly will provide additional flexibility to the power system. In 2016, about 0.8 GW of new advanced-energy storage capacity became operational, bringing the year-end total to an estimated 6.4 GW.

- Markets for mini-grids and stand-alone systems are evolving rapidly and Pay-As-You-Go (PAYG) business models, supported by mobile technology, are exploding.

But the energy transition is not happening fast enough to achieve the goals of the Paris Agreement:

- Investments are down. Although global investment in new renewable power and fuel capacity was roughly double that in fossil fuels, investments in new renewable energy installations were down 23% compared to 2015. Investment continues to be heavily focused on wind and solar PV, however all renewable energy technologies need to be deployed in order to keep global warming well below 2°C.

- Transport, heating and cooling sectors continue to lag behind the power sector. The deployment of renewable technologies in the heating and cooling sector remains a challenge in light of the unique and distributed nature of this market.

- Fossil fuel subsidies continue to impede progress. Globally, subsidies for fossil fuels and nuclear power continue to dramatically exceed those for renewable technologies. By the end of 2016, more than 50 countries had committed to phasing out fossil fuel subsidies and some reforms have occurred, but not enough. In 2014, the ratio of fossil fuel subsidies to renewable energy subsidies was 4:1. For every US\$1 spent on renewables, governments spent US\$4 perpetuating our dependence on fossil fuels.

Christine Lins, Executive Secretary of REN21, explains: "The world is in a race against time. The single most important thing we could do to reduce CO₂ emissions quickly and cost effectively is to phase out coal and

UPCOMING EVENTS

[5th Indonesia International Geothermal Convention and Exhibition \(IIGCE\)](#)

2-4 August 2017, Jakarta, Indonesia

[Fiji Geothermal Conference](#)

7-11 August 2017, Savusavu, Vanua Levu, Fiji

[International Renewable Energy Conference](#)

11-13 September 2017, Mexico City

[German Geothermal Congress \(DGK 2017\)](#)

12-14 September 2017, Munich, Germany

[41st GRC Annual Meeting & Expo](#)

1-4 October 2017, Salt Lake City, Utah, U.S.

[GEMex 2nd General Assembly](#)

2-3 October 2017, Akureyri, Iceland

[Curso sobre Energía Geotérmica en México](#)

9-10 October 2017, Puebla, Mexico

[New Zealand Geothermal Workshop](#)

22-24 November 2017, Rotorua, New Zealand

Note: Please check the [IGA website](#) for more events.

speed up investments in energy efficiency and renewables. President Trump's withdrawal of the U.S. from the Paris Agreement is unfortunate. But the renewables train has already left the station and those who ignore renewables central role in climate mitigation risk being left behind."

Source: REN21 Press release, www.ren21.net/gsr

AFRICA

Kenya: More Capacity in Olkaria, the Barrier Geothermal Complex, and the Centre of Excellence

Ground Breaking Ceremony and Commissioning of 75 MW – Late April Kenya's President Uhuru Kenyatta broke ground for the construction of the Olkaria V power project that will have a capacity of 158 MW. At the same time, the President commissioned 14 wellhead units of 5 MW each, which will produce a total of ~75 MW of electricity. The 'wellhead units' allow a reduction in time between the first drilling of a well and the generation of power—going from around five years to

two years. This was praised by the President, who challenged other Kenyan institutions to adopt the innovative approach of KenGen to transform the country.

“Innovation must be the new identity of Kenyan institutions if we are going to see the transformation Kenyans demand,” said the President. He said his government has a clear vision to provide sufficient, cheap, green and reliable energy for Kenya. He also said the expansion of geothermal power production will contribute to Kenya’s prosperity. “In commissioning these wells, and in breaking ground for the new project, we take a mighty step on the road to prosperity for this nation,” said the President.

Energy Cabinet Secretary, Charles Keter; the Nakuru Governor, Kinuthia Mbugua; and the Japanese Ambassador to Kenya also spoke at the ceremony.

Source:

<https://www.capitalfm.co.ke/business/2017/04/uhuru-breaks-ground-158mw-olkaria-v-power-project/>

The Barrier Volcanic Complex to Be Developed -

The Olsuswa geothermal project in Kenya is a private geothermal development in the country. The developer, Olsuswa Energy Limited, is a Kenyan-based company focused on renewable energy projects across Africa. The company has been granted a geothermal resource license (No.1/2016) per the Geothermal Act (1982) for the northernmost, known geothermal prospect Barrier Volcanic Complex (BVC) in Turkana County, Kenya.



The BVC prospect covers an area of 136 square km and is one of the geothermal prospects inside the Kenyan Rift Valley. It is located south of Lake Turkana, the world’s largest desert lake, popularly known as the Jade Sea. The BVC separates Lake Turkana from the Suguta

Valley. This volcanic complex, forming a ridge 20 km long and 15 km wide, consists of four, distinct, shield volcanoes: Kang’oleyang, Kakorinya, Likaiu East and Likaiu West.

Reconnaissance surveys by the British Geological Survey (BGS) identified strong surface hydrothermal manifestations. Further surface studies conducted in 2011 revealed a high-temperature resource area covering 60 km² with subsurface temperatures of around 280°C and an estimated potential of 750 MW.

Olsuswa Energy and their consultants, Icelandic GeoSurvey (ISOR), plan to develop this geothermal field. The upcoming studies include geological, geochemical, geophysical, structural analyses and micro seismicity. A conceptual model will be made to characterize the geothermal resource at the BVC and locate the sites for the first three exploration wells.

Olsuswa Energy Limited is prepared to implement the subsequent drilling plans it has developed. These include accessing additional financial support, continuing community engagement, preparing a work plan for exploratory drilling, further project development activities and, finally, power plant commissioning.

Source: <http://www.thinkgeoenergy.com/private-olsuswa-geothermal-project-in-kenya-to-start-early-exploration-work/>

Regional Geothermal Hub to Be Set – The regional office for Africa of UNEP (United National Environmental Program) will set up an African regional geothermal hub in Kenya as a center of excellence for the rest of the world. The African Rift Geothermal Development Facility (ARGDF) program manager, Meseret Zemedkun, said in late May the African Geothermal Centre of Excellence will be set up in Nakuru County. “Kenya will be the main hub of the African region in terms of capacity building for geothermal technology. Kenya will share their ‘best practices’ with the rest of the world,” she said.

The Africa Geothermal Centre of Excellence is expected to build the capacity of young African geothermal scientists, engineers, drillers, technicians and financiers to ensure secured and sustainable geothermal development in Africa. In 2016, African countries agreed to set up the center to be hosted by the Government of Kenya. A Steering Committee was formed to be chaired by the African Union Commission to lead and oversee the establishment of the hub.

The financial support for the geothermal center will come in part from the Government of Iceland. In late May, a Partnership Agreement was officially signed by Erik Solheim, Head of the UN Environment, and Maria Erla Marlesdóttir, Director General for International

Development Cooperation, Ministry of Foreign Affairs in Iceland. The agreement provides financial support up to US\$1 million from Iceland and represents the continuation of a long-term partnership to support sustainable geothermal development in Africa. This financial support will also go toward completion of already initiated surface exploration studies in the project's member countries. The cooperation is co-funded by the Nordic Development Fund.



Meseret Zemedkun witnesses the signing of the agreement by Maria Erla Marlesdóttir and Erik Solheim.

UN Environment, through the Africa Rift Geothermal Development Facility Project, continues to provide technical support to African countries to build their geothermal exploration and development capacities.

Sources: <http://www.unep.org/africa/news/un-environment-partners-iceland-boost-geothermal-development-africa>, http://www.the-star.co.ke/news/2017/05/30/major-geothermal-hub-in-nakuru-to-be-african-model_c1569884

Rwanda: Concluded, Four Years of Geothermal Exploration Surveys

Rwanda is concluding a four year research project that will lead to exploring new geothermal zones. Two feasibility studies launched in 2013 at a cost of US\$ 300,000 each are expected to lead to drilling geothermal energy in the Western province.

In early May, Uwera Rutagarama, geothermal development manager at Energy Development Corporation Limited (EDCL), said “We have undertaken surface exploration studies of the Bugarama and Gisenyi sites in the Western Province.” The surveys included geological, hot springs and geophysical studies to learn if underground hot waters can be used for power generation.

Two months before the results were to be released, EDCL officials cannot yet confirm the outcome.

Negative results would be a second shock that may even lead the country to decide to drop similar research.

The Kalisimbi Geothermal project expected to generate 50MW of geothermal was deemed unsuccessful in 2014, after wasting Rwf 22 billion (US\$26.6 million) from government resources. The project was stalled in July 2014 following evidence indicating the lack of geothermal potential in the Kalisimbi area. Exploratory activities in Kalisimbi included two exploration wells, a water supply system to the drilling sites and access roads.

The CEO of the country's energy body, the Rwanda Energy Group (REG), in charge of energy utility in Rwanda, Jean Bosco Mugiraneza, said that the power generation project of “Kalisimbi geothermal reserves was abandoned forever but the exploration studies are underway at other sites.”

Source:

<http://ktpress.rw/2017/05/rwanda-to-release-new-results-on-geothermal-energy-potential/>

Tanzania: The Government to Define a National Strategy for Develop Geothermal Resources

Global law firm Norton Rose Fulbright has been appointed by the Government of Tanzania, through the Tanzania Geothermal Development Company (TGDC), a subsidiary of the state-owned electricity supplier, TANESCO, to formulate a strategy for the development of geothermal energy resources in Tanzania. The initiative is funded by a grant from the Strategic Climate Fund, which is administered by the African Development Bank.

The appointment entails working with the government and its relevant institutions as well as other stakeholders in Tanzania over the next six months (April to September 2017) to reach a recommended legal, institutional and regulatory framework which will best enable the country to develop its geothermal resources.

A Government representative commented: “We see unlocking Tanzania's potential in geothermal energy as key to providing a stable and renewable energy source to power Tanzania for generations to come. As part of a diverse energy mix, it will assist Tanzania in reaching its electrification target rate of 75% by 2035. We look forward to working with Norton Rose Fulbright and the other consultants to make our bold ambitions for the future of Tanzania a reality.”

The project team working with Norton Rose Fulbright to develop the framework includes: Carbon Counts, a UK energy and climate change consultancy; GeothermEx Inc., a specialized US geothermal consultancy; Economic Consulting Associates, a UK economic and regulatory advisory firm; and Neema Siwingwa, a Tanzanian development finance specialist.

Source:

<http://www.nortonrosefulbright.com/news/147560/norton-rose-fulbright-advises-on-tanzania-strategy-for-geothermal-energy>

It was unveiled that the government plans to start the development of geothermal resources in a zone located at Lake Ngozi in Mbeya in the next fiscal year. The manager of planning and projects for TGDC, Shakiru Kajungus, said the feasibility studies in Songwe, Mbaka Kiejo and Ngozi had been completed. According to him, 200 MW of geothermal energy are expected to be generated by 2025. It is thought that the country has 50 geothermal zones with a combined geothermal potential of 5000 MW. Kajungus said the government was working with foreign development partners to get more project funding.

Source:

<http://allafrica.com/stories/201704120481.html>

Zambia: USTDA Finances a Geothermal Feasibility Study

By mid-June, the U.S. Trade and Development Agency (USTDA) signed a grant with Kalahari GeoEnergy Limited, a Zambian geothermal development company, for a feasibility study supporting the development of a 10-20 MW geothermal power plant. Kalahari GeoEnergy selected California-based Geologica Geothermal Group to carry out the study, which will provide technical and environmental analyses needed to advance the project. The plant, which is expected to be the first geothermal generation facility in Zambia, will add new renewable energy capacity to the Zambian grid and will expand access to reliable electricity.

“This grant is an endorsement of the work Kalahari GeoEnergy has conducted to date, and of the Bwengwa River geothermal resource, which we can now validate as a source of stable sustainable power,” said Peter Vivian-Neal, CEO of Kalahari GeoEnergy. “This type of power source is essential for economic development.”

“USTDA is excited to support this new project, which will expand access to reliable electricity in Zambia,” said Lida Fitts, USTDA’s Regional Director for Sub-Saharan Africa. “This project represents an excellent opportunity for U.S. businesses to export technologies and services in support of Zambia’s infrastructure goals.”

U.S. Ambassador to Zambia, Eric Schultz, signed the grant, on behalf of USTDA, at a ceremony at the U.S. Embassy in Lusaka, along with Peter Vivian-Neal, CEO of Kalahari GeoEnergy.



Chinyunyu Thermal Spring (Photo by Kalahari GeoEnergy:

<http://www.kalaharigeoenergy.com/media.htm#gallery>

The USTDA helps companies create U.S. jobs through the export of U.S. goods and services for priority development projects in emerging economies. USTDA links U.S. businesses to export opportunities by funding project planning activities, pilot projects, and reverse trade missions while creating sustainable infrastructure and economic growth in partner countries.

Source: <https://www.ustda.gov/news/press-releases/2017/ustda-creates-opportunities-us-energy-industry-zambia-1>

AMERICAS

Bolivia: Approved, Credit to Build the Laguna Colorada Geothermal Plant

The Bolivian Parliament passed a law in early May approving a US\$542.9 million credit from Japan to build the Laguna Colorada geothermal plant in the southeastern region of the country, near the border with Chile. The Senate, controlled by the government party, issued the regulation that must now be enacted by President Evo Morales.

This plant will initially generate 50 MW and later double this amount. The project will be in charge of state-owned Empresa Nacional de Electricidad (Ende). Technically, this will be the first power station in the

world to use geothermal sources at an altitude exceeding 4800 meters above sea level.

The project is part of President Evo Morales' Administration plan to increase the country's installed electrical capacity and allow the beginning of exporting energy to neighboring countries. Bolivia generates a total 1900 MW from diverse energy sources to meet domestic demand, but is considering raising this amount to 8000-10,000 MW in order to export energy.

Source: <http://www.energia16.com/bolivia-approves-542-9-million-credit-to-build-geothermal-plant/?lang=en>

Chile: World Bank Grant to Develop Geothermal Resources

The World Bank Board of Executive Directors approved a US\$1.78 million Clean Technology Fund (CTF) Grant to "strengthen the Chilean Ministry of Energy's capacity to further develop the country's geothermal sector and improve its energy security." The World Bank announced "... the grant will contribute to Chile's Energy Agenda (Agenda de Energía. Un Desafío País, Progreso para Todos) and the Energy Policy 2050-aimed to boost the use of non-conventional renewable energy (NCRE) and reduce electricity costs. Chile's abundant geothermal potential provides a good renewable energy option to further diversify the country's power generation mix and reduce price volatility."

Among other elements that justify this grant, the World Bank stated "the Government of Chile has made a concerted effort to develop its nascent geothermal energy industry." The bank added that "despite what appeared to be a promising start, a number of issues have stymied exploration investments."

Source: <http://www.energia16.com/wb-approves-1-78-million-grant-to-help-develop-geothermal-energy-in-chile/?lang=en>

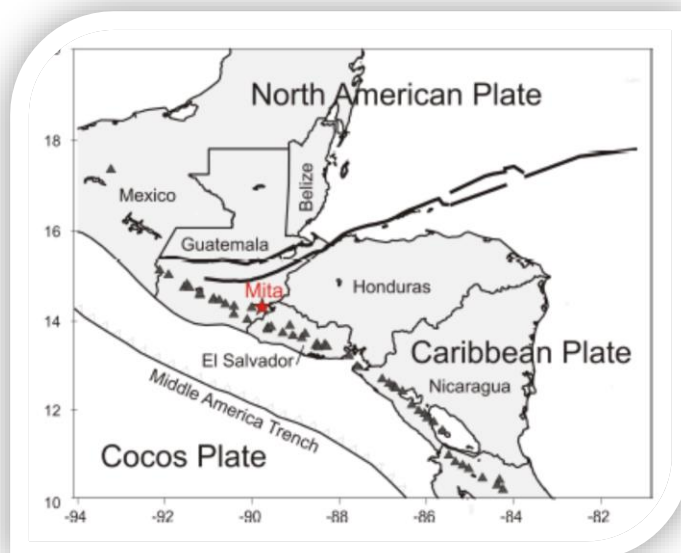
Guatemala: The Mita Geothermal Project, Acquired by Bluestone Resources

Vancouver-based Bluestone Resources Inc. has announced that the acquisition is closed of the Cerro Blanco Project and the Mita Geothermal Project located in Guatemala from Goldcorp Inc., effective May 31, 2017. The Canadian firm acquired 100% of the Cerro Blanco gold project located in Guatemala, which was owned by Goldcorp's indirect, wholly owned subsidiary Entre Mares de Guatemala, SA, and 100% the Mita Geothermal project located adjacently to Cerro Blanco

that was owned by Goldcorp's indirect, wholly owned subsidiary, Geotermia Oriental de Guatemala, SA (GOG). Thus, Bluestone has acquired all of the issued and outstanding shares of Entre Mares and a 100% interest in the Cerro Blanco Project and all of the issued and outstanding shares of Goldcorp NRG Limited (which owns GOG) and, consequently, a 100% interest in the Mita Geothermal Project.

Pursuant to the terms of the transaction, Goldcorp received approximately US\$20 million in cash (which includes the US\$2 million non-refundable deposit for the Marlin assets), a 1% net smelter return royalty on production, the right to receive 3,099,160 common shares of Bluestone (which will represent 4.9% of Bluestone's issued and outstanding common shares), and 258,805 common share purchase warrants. Goldcorp will also receive an additional US\$15 million in cash within 6 months of the commencement of commercial production at Cerro Blanco.

The Mita geothermal system is located approximately 80 km east of Guatemala City, less than 10 km from the border with El Salvador. It is a moderate temperature geothermal system discovered in 1997 during gold exploration in southeastern Guatemala. This system is associated with bimodal basalt-rhyolite volcanism, and occurs alongside (and overlapping with) the Cerro Blanco epithermal gold deposit. Fluids at temperatures up to 180°C were encountered in 150-400 m deep gold exploration wells.



Tectonic setting of the Mita Geothermal System in southern Guatemala (after Monterroso and Kulhánek, 2003).

Geothermometry on hot springs and well fluids indicated most fluids were derived from the shallow 180°C reservoir, but that deep temperatures were at least 220°C. The shallow reservoir appears to be a

localized outflow from a deeper hotter system. A comprehensive MT resistivity survey suggested that the deeper reservoir was to the northeast of Cerro Blanco, and gravity surveys indicated some very strong structural control on deep permeability. Four, 1000-1500 m deep slim wells were drilled in 2008-2009 to confirm the nature of the deep reservoir. It is planned to develop the geothermal system to provide geothermal power for the proposed gold mine and surplus power for the Guatemalan national grid.

Sources: <https://www.geothermal-energy.org/pdf/IGAstandard/WGC/2010/1119.pdf>,
<https://globenewswire.com/news-release/2017/05/31/1005004/0/en/Bluestone-Completes-Acquisition-of-the-Cerro-Blanco-Gold-and-Mita-Geothermal-Projects-from-Goldcorp.html>

Latin America: 25 Geothermal EoI Submitted to the GDF

Jens Wirth, Senior Project Manager at KfW, shared results of the first call of the Geothermal Development Facility (GDF) in his panel called “Participating in Risk Mitigation” at the GEOLAC conference held in Mexico City in late April. The GDF was set up as the first multi-donor climate initiative to promote geothermal energy in Latin America. With the first call for proposals concluded, the facility is now operational.

Wirth also shared details of the expressions of interest received, which are being evaluated. Qualified technical proposals will then be invited. The program received 25 expressions of interest (projects) from nine of the 10 participating countries. These are Bolivia, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Honduras, Nicaragua and Peru. El Salvador expressed no interest in the initial round.

Entities seeking support are 22 private sector players (88%), seven public companies and one public-private project. About 56%, or 14 projects, have sought funding for surface studies and 44% (or 11 projects) have sought funding for exploratory drilling.

Here is the list by country:

- Bolivia: 2 projects (one each for surface studies and exploratory drilling)
- Chile: 8 projects (5 for surface studies and 3 for exploratory drilling)
- Colombia: 2 projects for surface studies
- Costa Rica: 1 project for surface studies
- Ecuador: 1 project for surface studies
- Guatemala: 4 projects (2 for surface studies, 2 for exploratory drilling)

- Honduras: 2 projects (1 for surface studies, 1 for exploratory drilling)
- Nicaragua: 1 project for surface studies
- Peru: 4 projects (2 for surface studies, 2 for exploratory drilling)

The GDF program will share more details at a special workshop in late April and hopes to report on them later.

Source: <http://newenergyevents.com/chile-guatemala-and-peru-lead-the/>

Mexico: In Memoriam of Héctor Alonso-Espinosa

Luis C.A. Gutiérrez-Negrín & Marcelo J. Lippmann, IGA Information Committee.

Héctor Alonso-Espinosa passed away on May 19 in Morelia, Michoacán, Mexico. He was one of the geothermal energy pioneers in Mexico, the first head of the geothermal division of Mexico's Comisión Federal de Electricidad (CFE), and one of eight members of the International Working Group that founded the IGA, as well as a member of its first Board of Directors.



Héctor was born in the Mexican city of Puebla in June 1936. He received a Geology Degree from UNAM's Engineering School in 1959, and he completed geothermal courses in Larderello, Italy, and Wairakei, New Zealand in 1965. He joined CFE in 1958 as a field geologist and was a consultant to the former

Geothermal Energy Commission of Mexico between 1958 and 1960. In 1964-1965 he was in charge of exploratory studies at the Cerro Prieto geothermal field, and between 1968 and 1976 was a geothermal consultant to CFE, as well as an officer (1969-1974) and Technical Sub-director (1968-1976) of the then CETENAL (Commission to Study Mexico's Territory; currently the INEGI: the National Institute for Geography and Statistics).

In 1977, Héctor was appointed CFE's Executive Coordinator for Cerro Prieto, which at that time was the only geothermal field in operation in Mexico, with an installed capacity of 75 MW. Between 1982 and 1989, he was the first head of the newly created Gerencia de Proyectos Geotermoeléctricos (GPP) of CFE, the division in charge of geothermal-electric development in Mexico. Under his executive direction, Units 3, 4 and 5 of CP-I (105 MW), CP-II and CP-III (220 MW each) at Cerro Prieto, and Units 6 (5 MW) and 7 (50 MW) at the Los Azufres geothermal field were designed and installed, totaling 600 MW, representing more than 60% of the current geothermal-electric installed capacity in the country (Units 3 and 4 of CP-I have been dismantled).

During his GPG tenure, the regional geothermal exploration of almost all Mexican territory, as well as several earth-science surveys in promising zones, were carried out. In addition, several exploration-production wells were drilled at Los Humeros, Cerritos Colorados, Las Tres Vírgenes and other geothermal fields and zones.

Between 1989 and 1996, after his retirement from CFE, Héctor was a consultant for the Mexican EPN Group, assessing possible geothermal developments in several countries of Central and South America. He became a partner of the consulting company Geocónsul, SA de CV; since 1998 he was president of the company. He was also a consultant for the geothermal division of CFE between 2003 and 2006, and for the company Energy Forever during 2015.

In 1973-1974, Héctor Alonso was the Vice President of the Sociedad Geológica Mexicana (SGM, the Mexican Geological Society) and in 1975-1976, Vice President of the Unión Mexicana de Asociaciones de Ingeniería (UMAI, Mexican Union of Engineering Associations). In 1982, he received the Premio Nacional de Ingeniería Geológica (the Geological Engineering National Award). In 1983, he was president of the sixth national convention of the SGM. Since 1984 he was member of the Academia Mexicana de Ingeniería (Mexican Academy of Engineering). He was also member of IGA's first Board

of Directors (1989-1992) and member of the 1987-1990 Board of the Directors of the Geothermal Resources Council. He received in 2005 the Premio Pathé of the Asociación Geotérmica Mexicana (AGM, the Mexican Geothermal Association), and he received a special recognition award for being "one of the eight promoters and first founders of the IGA" from the IGA during an event held at the 2015 World Geothermal Congress.

Héctor Alonso is survived by his wife, Griselda, his sons and daughters Héctor, Fabiola, Mónica, Erika and César, and his grandchildren. He will be missed not only by his family, but also by the geothermal community in Mexico and by his many friends and colleagues, worldwide.

Mexico: Three New Geothermal Exploration Permits, and Meeting of GEMex Project

SENER Grants Three New Exploration Permits - Mexico's Ministry of Energy (SENER) has issued three exploration permits to ENGIE, a global energy company, and Reykjavik Geothermal, an Icelandic geothermal development company. These permits authorize their holders to spend three years exploring geothermal resources located in three zones, each measuring 150 km², at Sangangüey (in the state of Nayarit) and at Cerro Pinto and Las Derrumbadas (in the state of Puebla).



This major step forward in the development of geothermal energy in Mexico follows the signature of a cooperation agreement on December 2015 (between ENGIE, through its wholly owned subsidiary Storengy, and Reykjavik Geothermal) geared towards obtaining and jointly developing Mexico's concessions and geothermal exploration permits.

Both efficient and economical, geothermal energy is a renewable, non-intermittent and eco-friendly source of energy that uses heat from deep underground for heating, power generation and even air-conditioning systems. It is the main activity of Reykjavik Geothermal and one of the components of the energy transition in which ENGIE intends to become a world leader. ENGIE is a leading producer and supplier in Europe of geothermal energy for the heating and cooling of residential or commercial facilities, using various geothermal sources.

The Mexican Energy Reform has effectively opened up the electricity market and is encouraging private investors to participate in power generation. SENER, the Mexican Development Bank Nacional Financiera (NAFIN), and the Inter-American Development Bank (IDB) jointly backed the development of a program designed to curb the risks of exploration. This has played a key role in attracting private developers and will be a key element in helping the various actors to overcome the barrier to exploration in the domain of geothermal development.

“We are very confident regarding the potential of those areas, in order to develop carbon-free projects at the heart of our strategy,” stated Cécile Prévieu, CEO of Storengy.

“With these three licenses granted, Reykjavik Geothermal reinforces its position in the Mexican geothermal market,” said Reykjavik Geothermal CEO, Gudmundur Thoroddsson.

Efraín Villanueva Arcos, General Director of Clean Energies of SENER, said, “Granting these exploration permits to a partnership between France and Iceland marks a major step in the implementation of geothermal energy reform—they are the first, 100% foreign-capitalized companies to invest in the Mexican geothermal industry.”

Thanks to their complementary know-how, ENGIE, through its subsidiary Storengy, and Reykjavik Geothermal will jointly continue the exploration program for each of the three permitted projects.

Source:

<http://www.engie.com/en/journalists/press-releases/mexican-ministry-energy-geothermal-exploration-permits/>

First Technical Meeting of the GEMex Consortium, and Installation of its BoD - On 2nd May 2017, the technical leaders and those responsible for the Work Packages (WP) and the main tasks of Project GEMex’s Mexican consortium gathered in Morelia, Mexico, for their first meeting at Michoacán University’s Cultural Center.

The event was officially inaugurated by the then scientific research coordinator of Michoacán University (UMSNH), Dr. Raúl Cárdenas-Navarro, who was accompanied by the Technical Leader of the project in Mexico, Dr. Aída López-Hernández, and the director of the UMSNH Civil Engineering Faculty, M.A. Wilfrido Martínez-Molina, among others. Aída López welcomed the participants and explained the objectives and expected outcomes of the meeting, Wilfrido Martínez stressed the relevance of the project for the University of Michoacán, and Raúl Navarro declared the meeting officially open on behalf of the Rector of UMSNH, Dr. Medardo Serna-González. Later on, the Rector informally welcomed and greeted the participants.

The project’s Mexican consortium is composed of three distinct units of the National University: the Geophysical Institute headquartered in Mexico City, the Geosciences Center of Juriquilla located in Querétaro, and the National School of High Studies, Morelia campus. Other partners are the scientific research and high education center of Ensenada (CICESE), the National Institute for Electricity and Clean Energy (INEEL), headquartered in Cuernavaca, two private companies (Geominco, based in Querétaro, and JL Energía, based in Morelia) and UMSNH, which is the leader. The project is funded by the feral government through the Energetic Sustainability Fund (FSE).

The administrative procedures of the FSE require that the UMSNH negotiate and sign a specific agreement with each one of the consortium partners; these

View of the first meeting of the GEMex’s Mexican Board (Photo by UMSNH)



agreements include the specific activities and deliverables for each of the stages of the project as well as the economic resources broken down into human resources, trip expenses, operation expenses, external services, intellectual property related expenses, equipment, and scholarship fees.

Since the original budget of each of the WPs and the tasks for the Mexican parts of the project had to be re-arranged to include a stimulation test in one of the exploration wells drilled by CFE at the Acoculco geothermal zone some time ago, the re-negotiation and signing of the specific agreements has experienced a significant delay. That was explained in detail by Aída López at the first meeting of the Board of Directors (BoD) held after the technical meeting during the evening of May 2nd.

The GEMex BoD of the Mexican consortium is composed of Aída López, President; Julio Vargas-Medina (WP2); Luis C.A. Gutiérrez-Negrín (WP3); Víctor Hugo Garduño-Monroy (WP4); Claudia Arango-Galván (WP5); Alfonso Aragón-Aguilar (WP6); Abel Hernández-Ochoa (WP7); Eduardo González-Partida (WP8); Zayre González-Acevedo (WP9); and José Manuel Romo-Jones (CeMIE-Geo). All but the latter participated in this first meeting.

The BoD approved re-structuring the WP4 into nine tasks, and Aída López confirmed that the starting date of the Mexican side of the project is 31st January 2017. Thus all expenses after that date can be reimbursed when the funds are distributed (*Note prepared by Luis C.A. Gutiérrez Negrín*).

Nicaragua: Seven Potential Geothermal Areas Ready for Exploratory Drilling

With large private and public investments and the support of the World Bank and the Inter American Development Bank (IDB), Nicaragua is ready to take advantage of its high renewable energy potential. With a potential of more than 2000 MW, Nicaragua is one of the most attractive countries in Central America when it comes to investment into geothermal energy development.

In 2014, the *Law for the Exploration and Exploitation of Geothermal Resources* (Law 443) was approved, one of the most modern in the region. An attractive policy of incentives and tax exemptions for the introduction of equipment and implementation of new projects in the renewable energy sector is being implemented.

The President of the Nicaraguan Electricity Company (ENEL), Ernesto Martínez Tiffer, said in mid-April that there are currently two geothermal plants operating and

progress is being made in the study and drilling for seven new projects in the western part of the country.

The Geothermal Master Plan of Nicaragua has identified twelve areas of geothermal interest located along the Pacific Volcanic Range: Cosigüina Volcano, Casita-San Cristóbal Volcano, Mombacho, Apoyo Caldera, Masaya Caldera, Managua-Chiltepe, Telica Volcano-El Najo, San Jacinto-Tizate, El Hoyo-Monte Galán, Momotombo Volcano, Tipitapa and Isla de Ometepe.

“Geothermal energy continues in Nicaragua. We have two geothermal fields in operation: Momotombo and San Jacinto Tizate, seven ready to be explored (beginning of drilling): Cosigüina, Casitas-San Cristobal, El Hoyo-Monte Galán, Caldera de Masaya, Caldera de Apoyo, Mombacho and Península de Chiltepe,” Martínez Tiffer added.

Source: <http://newenergyevents.com/nicaragua/>

United States: Deep Changes in Climate Policy, and a Large PPA Geothermal Contract

Obama's Climate Policies to Be Dismantled - Late March, President Trump signed an executive order directing his administration to begin undoing several more of the Obama administration's climate change policies. The order's most prominent target is the Clean Power Plan, which required states to meet individual carbon emission reduction goals and is a key policy in the U.S. effort to meet its obligations under the 2015 Paris Climate Agreement. “My administration is putting an end to the war on coal,” said Trump at the signing of the order at EPA (Environmental Protection Agency) headquarters. The order instructs federal regulators to stop using the “social cost of carbon” in their economic analyses of future environmental rules. Trump's signature also lifted a ban on coal leasing on federal lands, halted rules limiting methane leaks from oil and gas facilities, and rescinded multiple presidential memos meant to integrate climate action across numerous federal agencies. The EPA's underlying endangerment finding naming greenhouse gas emissions a threat to public health and U.S. involvement in the Paris Agreement both went unaddressed in the order, but are viewed as major targets by the administration.

Source: *Geothermal Energy Association Weekly* No. 56.

EPA Pulls Plug on Effluent Limitations Rule - The U.S. top environmental official Scott Pruitt has issued an administrative stay to delay compliance deadlines limiting effluence from steam electric power generation. The EPA will review and reconsider revisions on effluent limitations made under the Clean Water Act

under the Obama administration in 2015, according to an EPA press release.

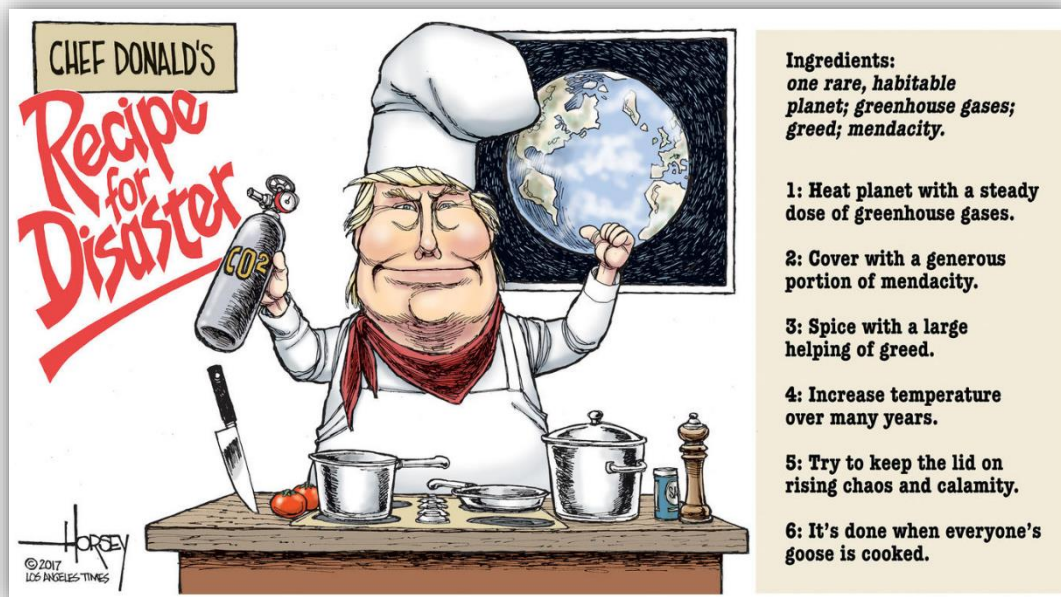
The rule was the first federal limit on the levels of metals in wastewater discharge from steam-electrical power plants. Plants had been expected to comply with the regulations between 2018 and 2023 as the owners renew Clean Water Act permits.

The statement issued by the EPA on April 13 said the rule has been estimated to cost US\$480 million per year and has a reported average cost of US\$1.2 billion per year in the first five years of compliance.

EPA Administrator Scott Pruitt stated, “This action is another example of the EPA implementation of President Trump’s vision of being good stewards of our natural resources, while not developing regulations that hurt our economy and kill jobs.”

The release said the administrative stay will last as long as litigation is ongoing.

The Utility Water Group had petitioned the agency through court to reconsider the rule. The ad hoc group of 163 energy companies claims the rule would cause job loss due to the excessive cost of compliance.



Cartoon by David Horsey, ©Los Angeles Times, Digital Version, June 7, 2017.

“Some of our nation’s largest job producers have objected to this rule, saying the requirements set by the Obama administration are not economically or technologically feasible within the proscribed time frame,” said Pruitt. “It is in the public’s best interest to reconsider the rule and assess the wide-ranging and sweeping objections that the agency received.”

Source: <http://www.energycentral.com/news/epa-pulls-plug-effluent-limitations->

rule?utm_medium=eNL&utm_campaign=PG_NEWS&utm_content=214475&utm_source=2017_04_18

Changes in the DOE Website - The Energy Department has changed its website to cut down on Obama-era language touting renewable energy sources as a climate-friendly replacement for fossil fuels. Whereas the site formerly touted technologies such as wind, solar and geothermal energy as a replacement for sources such as coal, oil and natural gas, the department’s website now focuses on renewable energy’s potential to create jobs.

With the Trump administration deemphasizing climate change and looking to promote climate-friendly and carbon-intensive energy sources—an agenda that coincides with a broad attempt to eliminate regulations on fossil fuels and particularly on coal—the priorities outlined on these Web pages have been shifting since the inauguration. Together, the changes collectively downplay the climate benefits of each form of technology and distance the agency from the idea that they might be used to reduce dependence on fossil fuels—emphasizing instead their economic advantages. It’s a move that’s well in line with the Trump

administration’s generally dismissive attitude toward the issue of climate change.

Multiple climate-related reports disappeared from the State Department website in January 2017. And in the same month, employees of the Environmental Protection Agency (EPA) indicated that the Trump administration was planning to remove certain sections on climate change from the agency’s website, although the

administration later backed away from those plans.

Source:

<https://www.washingtonpost.com/news/energy-environment/wp/2017/04/21/the-energy-department-is-changing-its-website-to-reflect-trumps-climate-agenda/>

Highly Reduced Budget Request for Geothermal Technologies - The President’s Budget for Fiscal Year

(FY) 2018 requests US\$28.0 billion for the Department of Energy (DOE) to make key investments in science and technology innovation that support its missions in nuclear security, basic scientific research, energy innovation and security, and environmental cleanup. This request is only \$1.6 billion (5.4%) less than the FY 2016 enacted level of US\$29.6 billion.

However, the FY 2018 request provides US\$2.2 billion for energy and related programs, which is US\$2.4 billion below the FY 2016 enacted level, i.e. a cut by more than 50%. Within these programs is the Energy Efficiency and Renewable Energy (EERE) program, whose resources are requested to be cut by 68% as the budget request targets US\$636 million—i.e. US\$1.4 billion below the FY 2016 enacted level. EERE focuses on early stage R&D to support American energy independence and domestic job-growth.

The Geothermal Technologies Office (GTO) is part of the EERE program. The budget provides only US\$12.5 million in FY 2018 for the GTO, which is US\$58.5 million below the FY 2016 enacted level—representing an astonishing slash of 82%. The main GTO activity is the Enhanced Geothermal Systems (EGS) collaborative effort, bringing together National Laboratory-led teams, academia, and industry to conduct early-stage R&D to explore the fundamental relationships between seismicity, stress state, and permeability to validate and verify models and to provide feedback to incorporate into the next stage of EGS research. A comparison of the authorized budget for FY 2016 and the requested budget for FY 2018 is presented in the following table:

Program	FY 2016 Enacted	FY 2018 Request
EGS	45.0	5.4
Hydrothermal	13.8	6.1
Low Temperature & Co-produced	8.0	0
System Analysis	3.7	1.0
NREL Site	0.5	0
Total GTO	71.0	12.5

Figures in US\$ million.

Source: <https://energy.gov/cfo/downloads/fy-2018-budget-justification>

The Geothermal Energy Association (GEA) stated, “The information on DOE’s proposed FY18 budget for geothermal research paints a bleak picture and it cuts the DOE geothermal research program to the bone... The DOE GTP has established a thoughtful and balanced R&D program that targets specific near-term and long-term opportunities for geothermal to contribute to our national energy security and economic growth. In contrast, the proposed budget would

severely limit the ability to make meaningful geothermal energy advancements in the United States.”

Source: *Statement by the Geothermal Energy Association on the Release of the FY18 DOE Budget*, by Karl Gawell.

Trump Withdraws the U.S. from the Paris Climate Agreement – As expected, on 1st June President Donald Trump announced the U.S. will withdraw from the Paris Accord, so fulfilling his “solemn duty to protect America and its citizens”. He characterized the Paris agreement as a deal that aimed to hobble, disadvantage and impoverish the U.S., and that it would cost the country US\$3 trillion in lost GDP and 6.5 million jobs, while rival economies like China and India were treated more favorably. “We don’t want other leaders and other countries laughing at us anymore –and they won’t be”, he added amid the applause of the people gathered in the White House. But the “other leaders”, like Emmanuel Macron (France), Angela Merkel (Germany), Paolo Gentiloni (Italy), Jean-Claude Juncker (European Commission), Antonio Guterres (UN), Narendra Modi (India) Taro Aso (Japan), Justin Trudeau (Canada), and even Vladimir Putin (Russia, who said that the U.S. should not abandon the Paris accord, but he wouldn’t judge Trump), were not laughing at the U.S. but regretting the decision and its probable consequences: the UN World Meteorological Organization estimated that, in the worst scenario, the U.S. pullout could add 0.3°C to global temperatures by the end of the century.

The formal withdrawal of the U.S. will take time. Under the agreement, a nation seeking to leave the pact can only give notice three years after the agreement from the date it entered into force. The process of leaving then takes another year, meaning it would not be complete until just weeks after the U.S. presidential election in 2020.

Source: http://www.bbc.com/news/world-us-canada-40128431?ocid=global_bbccom_email_01062017_top+news+stories



150-MW PPA Contract at US\$75.50 per MWh in California - Ormat Technologies Inc. has signed the

biggest electricity contract in its history. The contract is likely to amount US\$95 million a year, if fully exercised.

The sale of electricity to the Southern California Public Power Authority (SCPPA) under terms of the contract will begin in the fourth quarter of this year, and the entire portfolio is slated to be connected to the grid by the end of 2022. SCPPA will sell the entire output to the Los Angeles Department of Water and Power.

The volume of the contract is 150 MW, with a minimum of 135 MW and a maximum potential of 185 MW. The contract is for 26 years and will expire at the end of 2043. The contract bears a fixed tariff of US\$75.50 per megawatt-hour.

“We are excited to receive final approval for the first contract of its kind for a portfolio of assets with a unique structure, which supports our long-term growth plans for expanding our geothermal business in the US,” said Ormat CEO, Isaac Angel. “This contract will enable us to both construct several new projects simultaneously and ensure stable activity for several existing geothermal power stations. We are delighted to have been selected by the SCPPA for the third time, and we very much appreciate their confidence in Ormat.”



Isaac Angel, Ormat CEO. Photo: Eyal Izhar, Ormat.

Los Angeles Mayor Eric Garcetti sent an implicitly critical message to the White House, following President Donald Trump's decision to withdraw from the Paris Agreement to combat global warming. Garcetti said, “I promised Angelenos we would kick L.A.’s dependence on coal, and projects like this are exactly how we’ll do it... Washington may be burying its head in the sand -- but by embracing geothermal energy and other renewables, we’re showing that cities can, and will, continue to lead the fight against climate change.”

Source: <http://www.globes.co.il/en/article-ormat-awarded-95m-per-year-california-deal-1001191105>

ASIA/PACIFIC RIM

Indonesia: Movements in the Geothermal Sector

Pertamina Ready to Take over the Ciremai Geothermal Area - The Managing Director of Pertamina Geothermal Energy (PGE), Irfan Zainuddin, said in mid-April his company is ready to manage the geothermal working area of Ciremai in Kuningan Regency, which has been returned by Chevron to the central government.

PGE had prepared a series of work programs to manage the natural resources located in forest conservation areas. “We’ve done some early research for geothermal development at Ciremai. Nevertheless, work will have to be extended. The point is that we are ready to take over the project,” Irfan said.

Existing studies indicate a geothermal power generation capacity of 55 MW that could fuel the electricity demand of about 110,000 households. “But that’s only an early indication, the resource could present a larger or smaller potential,” he said.

Planned development would ensure the protection of the forest conservation area by only requiring an area of 26 hectares at an early stage. When operating, it would only take about 5×6 meters for the placement of the wellhead. Development of a geothermal project would require a protection of the surroundings that could be made “greener than before utilization.”

According to Irfan, geothermal activities could also help develop tourism, such as visits to the Kamojang crater or the Ulu-ulu area, Lampung—currently a pilot project of Pertamina in cooperation with Indonesia’s Ministry of Tourism. With its experience in social development, Pertamina could solve some of the challenges faced by the government and Chevron.

Source: <http://www.thinkgeoenergy.com/pertamina-ready-to-take-over-development-of-ciremai-geothermal-project-indonesia/>

PGE Completes Geothermal Units in Lampung – It was also unveiled that PGE has completed the development of Units 3 and 4 of the Ulubelu geothermal power plant in Lampung, with a total capacity of 2 x 55 MW. Unit 3 started commercial operations in July 2016 and Unit 4 in March 2017. The new units have a total investment value of US\$397 million.

Meanwhile, Units 1 and 2 of the Ulubelu power plant, operated by the state-owned electricity firm PLN, have a total capacity of 2 x 55 MW. PGE only supplies the geothermal energy to fuel these units.

“In total, the Ulubelu plant now generates 220 MW of electricity, or 25 percent of the electrical demand in Lampung,” said PGE’s general manager for the Ulubelu region, Dirgo Rahayu.

At present, PGE contributes around 35 percent of the energy produced by all existing geothermal power plants in Indonesia, which have a combined capacity of 1698.5 MW.

By the end of 2017, the government has targeted an increase in total capacity of 1858.5 MW with the completion of three other facilities: the Sarulla Unit II plant (110 MW) and the Sorik Merapi Modular Unit I plant (20 MW) in North Sumatra, and the Karaha Bodas plant (30 MW) in West Java. Indonesia aims to produce 7200 MW from geothermal power plants by 2025, or 3.8 percent of the targeted 23 percent of the national energy mix from renewable energy sources.

Source:

<http://www.thejakartapost.com/news/2017/06/16/pertamina-completes-us397-million-geothermal-units-in-lampung.html>

Acquisition of Chevron’s Indonesia Geothermal Assets Is Completed - A consortium led by Star Energy, a utility subsidiary of Indonesia’s largest petrochemical group, Barito Pacific, has completed the US\$2.3 billion acquisition of two geothermal power plants from Chevron. The transaction is part of a US\$3 billion takeover of three Chevron geothermal assets in Indonesia and the Philippines.

Chevron closed the deal for its Indonesian assets on March 31. For the acquisition, Star Energy teamed up with AC Energy Holdings, Inc. —a unit of Philippine banking and property conglomerate Ayala Group— and Thailand’s Electricity Generating Public Company (EGCO). The joint venture company is Star Energy Geothermal (Salak-Darajat) B.V., from which Star Energy has 68.31 percent stake, with AC Energy controlling 19.8 percent and EGCO 11.89 percent.

The consortium and Chevron signed a share sale and purchase agreement for the deal on December 22, 2016. The geothermal power plants sold to Star Energy Geothermal consortium are a 370 MW power plant in Mount Salak in Bogor, West Java, and a 240 MW power plant in Darajat in Garut, West Java, both in Indonesia.

The consortium will also buy from Chevron a 40 percent stake in 326 MW Tiwi Makban geothermal plant in the Philippines. The closing is expected to take place by the end of 2017.

Source: <http://jakartaglobe.id/business/star-energy-closes-deal-chevrons-salak-darajat-geothermal-plants/>

Business Agreement with the U.S. - Indonesia and the U.S. signed nine business agreements following the visit by U.S. Vice President Mike Pence to the country from April 19 through 21. One agreement regards cooperation between PLN and Halliburton for the development of the geothermal power plant in Tulehu, Ambon, and long-term strategy for the development of geothermal energy. An additional announcement had been made regarding the cooperation between PLN and Ormat Technologies for the conclusion of the 3 x 110 MW PLTP (geothermal plant) Sarulla with an investment of around US\$1.7 billion, out of which US\$260 million would come from Ormat. PLTP Sarulla Unit I has been operated commercially since March 2016. It will be the biggest in the world and the most efficient in Indonesia.

Source:

<http://www.antaranews.com/en/news/110567/ri-us-sign-nine-business-agreements>



Chevron operators. Photo by Agung Pambudhy, taken from Detik Finance.

New Regulation for Geothermal Financing - The Finance Ministry recently issued a new ministerial decree regulating the management of funds for the geothermal sector by the state-owned infrastructure financing company, PT Sarana Multi Infrastruktur (SMI). The new decree stipulates SMI will be able to supply funds to be used for loans, capital or exploration activities to compile data.

“For loans or capital, SMI will supply the funds based on a business corporation scheme with SMI. Meanwhile, [funds] for geothermal data and information will be based on assignments by the Finance Ministry,” a press statement said. SMI’s funding is expected to help minimize the risks that come with the large investments needed during the exploratory stage, which has led to a lack of eagerness from prospective investors.

The government hopes the funds will help with new discoveries, which will eventually increase the use of

geothermal for electricity generation. Indonesia is estimated to have 29 gigawatts of geothermal potential. However, it still operates geothermal power plants with an installed capacity of 1698.5 MW, but aims to increase it to 1858.5 MW by the end of the year.

Source:

<http://www.thejakartapost.com/news/2017/05/31/new-regulation-opens-way-for-geothermal-sectors-infrastructure-financing.html>

PLN Re-starts Tulehu Project - Indonesian state power utility PLN has launched the work on the Tulehu geothermal power project, located in Suli and Tulehu in the Central Maluku Regency in Maluku Province. It is expected that the plant will be operational and commence commercial operation in 2019, with a capacity of 20 MW in two 10 MW units.

The resources in the Tulehu geothermal working area are estimated at 60 MW. The number of geothermal wells to be drilled consists of four wells –three production wells and one injection well. Engineering Drilling and Supervision Drilling is conducted by WestJec-Connusa Energindo Consultant, while the drilling of the wells is conducted by PT Halliburton Logging Services Indonesia in the form of Full IPM (Integrated Project Management) contract. The cost for the drilling is estimated at US\$31 million and is funded by PLN and JICA.

The project was initially launched in 2010, but is only kicking off now due to lack of funding or loans since then. Land acquisition issues were also a problem.

Source:

<http://www.thinkgeoenergy.com/pln-launches-construction-on-20-mw-tulehu-geothermal-project-in-central-maluku-indonesia/>

Malaysia: Works Continue to Develop the First Geothermal Plant

Tawau Green Energy Sdn Bhd (TGE) has announced that the company is on track to develop Malaysia's first geothermal power plant project in Tawau, Sabah, in 2019. TGE has received all requisite approvals to develop, construct, operate and maintain a geothermal power plant, exporting 30MW to the Sabah Grid, under a 21-year renewable energy power purchase agreement with Sabah Electricity Sdn Bhd at a feed-in tariff of RM 0.45 per kWh (around US\$0.10/kWh).

The approvals included land lease agreements with the Sabah Forestry Department and Sabah Parks, the lands in which the project areas are located, said Andrew Amaladoss of TGE project development. TGE has undertaken extensive subsurface studies, including geology, geophysics, geochemistry and LiDAR (light detection and ranging) surveys. "The outcomes from all these surveys were integrated and analyzed by reputable geothermal consultants to indicate that seven production wells and four injection wells would be required to support the export capacity of 30MW... There is also an indication that the overall potential of the Apas Kiri geothermal reservoir could exceed 70 MW," he said.



View of one wellpad in Tawau, on 24 October 2016 (Photo taken from:

http://www.tgepower.com/gallery_exploratory_well_testing.html)

Amaladoss added that the project cost was estimated at RM670 million (US\$152 million) with an expected payback period of eight to nine years. He said the challenges faced by TGE in developing the project included the stakeholders not being conversant with the development process of geothermal energy, high upfront capital outlay and risk, and difficulty in obtaining financing from local lenders.

The project, expected to be completed in 2019, will provide green energy to Sabah's East Coast, which currently is about 70% diesel-based. "The project will also be a catalyst for economic activities in the Tawau district," Amaladoss concluded.

Source: <http://www.thinkgeoenergy.com/30-mw-apas-kiri-geothermal-project-in-malaysia-on-track-to-operate-in-2019/>

Philippines: Activities to Improve the Efficiency of Power Plants in some Geothermal Fields

Commissioned Restored Binary Power Plant in MakBan – In late April, Aboitiz Power Renewables, Inc. (APRI), the renewable power unit of Aboitiz Power Corp., launched the newly restored, 6MW binary plant at the Makiling-Banahaw (MakBan) geothermal project in Sto. Tomas, Batangas.

In July 2016, APRI completed the restoration of Binary Plant 1, which uses excess heat from spent brine to generate clean energy for the Luzon grid. The plant restoration cost P107 million (US\$2.1 million), lower than the initial budget of P130.7 million (US\$2.6 million). “It took us more than a year to complete the restoration, but we were able to add 6MW of installed capacity in renewable energy to our facility, using heat from geothermal byproducts and idle equipment,” said APRI President and Chief Operating Officer, Felino Bernardo.

By the end of 2016, the additional renewable capacity was added to the Luzon grid.

The plant is one of three binary-cycle power plants in the MakBan Geothermal Project complex that the company acquired in 2009, and the only one found fit for rehabilitation. Prior to the restoration, the plant had commercial issues until it was shut down in 2004 when it was operated by the National Power Corp.

Source:

<http://www.bworldonline.com/content.php?section=C&title=aboitizpower-restores-6-mw-binary-plant&id=144419>

EDC to Continue its Geothermal Rehabilitation Program - The Energy Development Corporation (EDC) will spend P7 billion (US\$137.4 million) in the last part of its rehabilitation program for its aging plants, with the aim of improve reliability and generating capacities by 2018. More than 40% of the capital expenditure this year will be allotted for the rehabilitation of the 112.5 MW Tongonan geothermal plant in Leyte, EDC president and COO Richard Tantoco said.

“The two units of the Tongonan plant will be shut down for 110 consecutive days when there will be changes in the whole turbines, some of the foundations, everything. So our future drilling costs and our work-over costs will lessen. There will be an increased output

by 10 MW and a decrease in steam consumption by nine percent,” Tantoco said. He added that the retrofit of both units will be completed by the third quarter of 2017.



Retrofitting of Unit 1 of Tongonan. Source: EDC.

EDC will also optimize its 125MW, Upper Mahiao geothermal plant this year, with a budget between P400 and 500 million (US\$8 to 10 million). In this case, the turbines will be replaced with new metallurgy. The first turbine has been refurbished, the second is being refurbished and the third and fourth will arrive in October and in March 2018. Turbines will have more chrome and some titanium in their alloys.

EDC is convinced that efficiently run geothermal energy is still commercially viable, despite the lack of incentives on the horizon. The government has indicated that it does not favor a third round of renewable energy Feed-in-Tariffs (FIT), preferring instead to focus on keeping prices down for consumers and industry.

Geothermal energy, which makes up 1169 MW of EDC's total installed capacity of 1457.8 MW, is not on the FIT list along with solar, wind, and biomass energy sources. “I don't think the absence of incentives means it's the end, but we really need to do things differently in geothermal,” said Richard Tantoco. He noted that the most critical point is reducing operational costs, which EDC has been doing for the past few years.

Source:

<http://powerphilippines.com/2017/05/09/edc-spend-p7-billion-plant-rehabilitation/>

EUROPE

GEOthermica's Call to Action

GEOthermica is a new consortium of 16 geothermal energy research and innovation program

owners and managers from 13 European countries and their regions. Its objective is to combine the financial resources and know-how of its partners. Together with financial support from the European Commission, GEOTHERMICA will launch joint projects that demonstrate and validate novel concepts of geothermal energy deployment within the energy system, which can identify paths to commercial large-scale implementation.

Europe aims to increase the share of renewable energy for direct heating and cooling, industrial processes, power generation and energy storage. Geothermal energy today is only utilized in choice market sectors and in few regions. It is an under-utilized widely distributed, clean, low-carbon footprint and a continuously available energy resource. Thus geothermal is uniquely positioned to substantially contribute to a safe and secure energy supply for Europe's Energy Union.

GEOTHERMICA is calling for innovative demonstration projects and technology development projects that accelerate geothermal energy deployment. Projects will deliver outcomes by 2021. Joint projects will have strong industry participation. Project proposals will meet both GEOTHERMICA and national/regional funding rules.

This joint effort by EU Member States and Associated Countries will complement Europe's research and innovation community and industry sector efforts. It will reinforce the sector's contribution to the goals of the European Energy Union and the implementation of the SET Plan.

The total budget of GEOTHERMICA is about €32

million (US\$35.7 million), of which national and regional funding organizations contribute about €24 million and the EC about €8 million. The project is led by the Icelandic Orkustofnun and is composed of another 17 institutions, governmental agencies and research centers from Belgium, Denmark, France, Germany, Ireland, Italy, Portugal, Romania, Slovenia, Spain, Switzerland, Turkey and The Netherlands.

GEOTHERMICA has published its Call Text and Guideline for Applicants for the first transnational call. All pre-proposals and full proposals shall be submitted via the electronic submission system (ESS) of the Call Secretariat, which opened in 1 June 2017. Pre-proposal materials (Stage 1) must be submitted before 10 July 2017. The invitation to enter the second stage for pre-proposals that pass Stage will be issued on 11 September 2017. The full proposal must be submitted before Friday, 24 November 2017. Notification will be sent on 1 March 2018. The signing of new contracts is on 1 May 2018. Project completions are due 1 May 2021.

Project proposals have to be from European consortia with several partners from several participating countries. Details can be found in the GEOTHERMICA Joint Call text rules. Participants have to meet the specifications of GEOTHERMICA in addition to the funding rules and regulations of their home countries or regions.

Source: <http://www.geothermica.eu/call-to-action/>

DARLINGe - Danube Region Leading Geothermal Energy



GEOTHERMICA: Thematic areas and aims of each one.

Fifteen partners—representing geological surveys, universities, industries, regional energy and development agencies, ministries and municipalities, assisted by seven Associated Strategic Partners from Hungary, Slovenia, Croatia, Serbia, Bosnia and Herzegovina and Romania—will work together with the objective of improving energy security and efficiency in the Danube Region by promoting sustainable use of the existing, but still largely untapped, deep geothermal resources in the heating sector.

This is the DARLINGe project, developed under the umbrella of Interreg, the EU's Danube Transnational Programme. The project area covers the central and southeastern part of the Danube Region, encompassing southern Hungary (southern Transdanubia and the southern part of the Great Plain), northeastern Slovenia (Pomurska and Podravska), northern Croatia (Slavonia), the northern parts of Bosnia and Herzegovina, northern Serbia (Vojvodina) and western Romania (Crisana and Banat), altogether about 95,000 km².

The specific objectives follow:

- Increase the use of geothermal energy and help the penetration of energy-efficient cascade systems (where users are sequentially linked according to their decreasing heat demands) in heat markets.
- Establish a market-replicable tool box consisting of three complementary modules for sustainable management of geothermal resources: an independent indicator-based benchmark evaluation of current uses; a decision tree to help developers; and a geological risk mitigation scheme to maximize the success rate of a first geothermal well reaching the expected yield and temperature.
- Advance stakeholder cooperation (establishing a Transnational Stakeholder Forum) to foster geothermal development and create a strong geothermal-value chain.

As a main result, the intensity of cooperation will increase and contribute to energy security and energy efficiency by increasing the use of geothermal energy in the heating sector, which will make the Danube Region less dependent on imported fossil fuels while respecting the environment.



The project outputs include various training materials, the Danube Regional Geothermal Information Platform (interactive web portal), a Transnational Geothermal Strategy and Action Plans, and a tool-box tested at three cross-border pilot areas. The project began on 1 January 2017 and the completion date is 30 June 2019. The total budget is over €2.5 million.

Source: <http://www.interreg-danube.eu/approved-projects/darlinge>

Geothermal Energy Needs Regulatory Certainty in Europe, According to EGECE

Last May, the European Geothermal Energy Council (EGEC) published the sixth edition of its annual study evaluating the development of the European geothermal sector. In conjunction with the release of the report, the EGECE has also unveiled its new logo and website.

The report demonstrates that over the last five years (2012-2016), the use of geothermal energy, particularly for heat, has slowly but steadily increased across Europe.

In Europe, there exist more than 100 geothermal power plants, with an installed capacity of around 2.5 GWe in 2016 (of which 1 GWe is in the EU), producing some 15 TWh of electrical power every year. It is believed that the installed capacity on the continent will grow to around 3 GWe in 2020—a major increase linked to the rapid growth of the Turkish market.

District heating and cooling is a success story for geothermal in Europe, one appearing ready for rapid and dynamic expansion in coming years. Between 2012 and 2016, 51 new plants have entered into operation (all in the EU), which represents an average annual growth of 10%. The total installed capacity in Europe is now approximately 4.9 GWth, with the main markets for future years being France, Netherlands, Germany and Hungary.

The shallow geothermal market is the largest market by far. Yet the installation growth rate is declining; a capacity of more than 20 GWth was achieved at the end of 2015 in more than 1.7 million European installations.

“While geothermal energy is on its way to becoming a key player in Europe, there is a need for long-term financial and regulatory stability”, said EGECE President Ruggero Bertani. “The EU legislative proposals currently on the table in Brussels do not provide sufficiently strong incentives to increase the share of the most efficient renewable heating and cooling technologies and to develop the next generation of flexible renewable electricity,” he added. The EGECE encourages the European Parliament and the Council to improve the Commission’s proposals and put the European Union back on track towards its commitment to becoming the world number one in renewable energy.

Since its first edition in December 2011, the EGECE Geothermal Market Report has come to be seen as the authoritative overview of the entire geothermal sector in Europe. Every edition offers an in-depth review of different geothermal technologies: the focus of the 2016 edition will be the market as regards equipment and operation and maintenance costs. This year, for the first time, the report also includes a global market overview. The key findings can be downloaded at: www.egec.org.



Source: <https://www.egec.org/media-publications/european-geothermal-energy-needs-regulatory-certainty-to-sustain-its-steady-growth/>

Belgium: Insurance Scheme for Geothermal Exploration

Flanders' energy minister hopes to boost the geothermal sector with a guarantee scheme for companies that invest in deep geothermal energy projects. Drilling for deep geothermal energy requires major investment, with significant risk that it will generate less energy than hoped for, as there is still a lack of detailed knowledge about the subsurface. "With the guarantee scheme, we hope to convince companies to invest and to facilitate a breakthrough of deep geothermal energy in Flanders," said Energy Minister, Bart Tommelein.

Companies that want to deep drill can submit a dossier to the government. If it turns out after drilling that the estimated energy production is not achieved, the government will pay back certain costs. The companies contribute to the scheme by paying a premium.

Until now, only the Flemish Institute for Technological Research (Vito) has carried out a trial project on deep geothermal energy in Flanders, one with promising results (*see* IGA News 107, p. 24). The Kempen region, north of Antwerp and Limburg, is the most attractive area for drilling because there the hardest layers of rock lie deeper than elsewhere.

Source:

<http://www.flanderstoday.eu/innovation/companies-encouraged-explore-geothermal-energy>

Finland: Agreement to Develop Geothermal Projects in the Scandinavian Peninsula

In May, two Finish firms, Rototec Oy and Robit Oyj, signed a comprehensive cooperation and delivery agreement, with the aim of advancing the use of geothermal energy in Finland and Scandinavia. The agreement contains cooperative product-development plans to meet the industry's development trends, such as increasingly deeper geothermal bore holes.

The agreement extends existing company cooperation by being more comprehensive. Now, geothermal energy solutions have expanded from private buildings to apartment buildings, large business centers and warehouses. The solutions include cooling technologies, as well.

Rototec Oy is the largest European provider of geothermal energy

solutions, and has started to provide consultant services in China, where geothermal heating solutions are becoming more common.

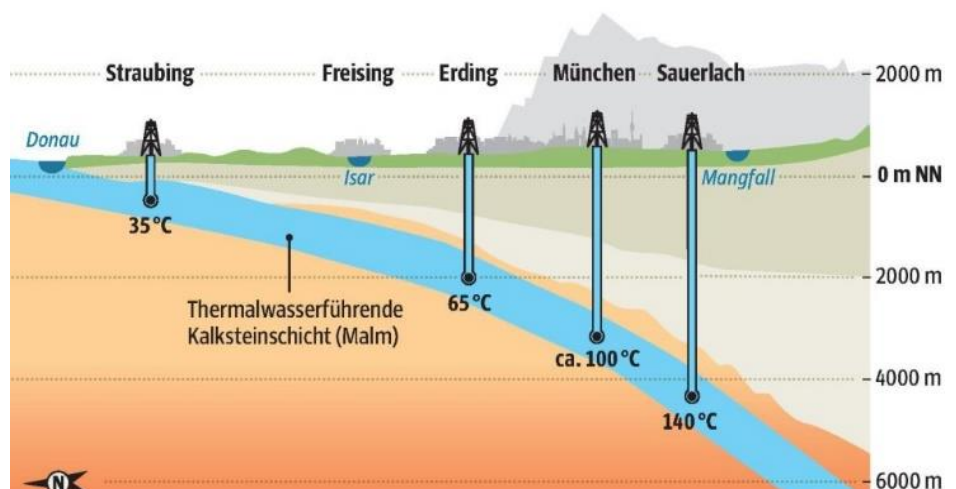
Robit Oyj is an international company selling and servicing drilling consumables. Geothermal wells have formed an important and growing segment of the company's business. The manufacturing units are located in Finland, South Korea, Australia, UK and the U.S.

Source: <http://globenewswire.com/news-release/2017/05/16/985385/0/en/ROTOTEC-OY-AND-ROBIT-OYJ-DEEPEN-THEIR-CO-OPERATION.html?f=22&fvtc=5&fvty=35850855>

Germany: Drilling Developments in the Area of Munich

Alternative Risk Transfer Applied in Drilling Contract - Daldrup & Söhne AG, a German drilling contractor and energy company, announced in April a new integrated risk insurance model for drilling. In the geothermal project Geretsried, located in southern Munich, the drilling company is using the alternative risk transfer (ART) structure as a new drilling contractor in Germany for the first time.

The Enex Geothermieprojekt Geretsried Nord GmbH & Co. KG awarded the contract for drilling two geothermal wells at the Geretsried site to Daldrup & Söhne, using an integrated insurance model, which has been successfully tested in the Netherlands. It has been used in Germany to hedge the risk of discovery risks developed by Daldrup & Söhne AG. The ART structure is an integrated backup model that enables geothermal drilling and energy projects within a reinsurance structure financed through debt at an early project stage.



Graph taken from <http://www.sueddeutsche.de/muenchen/erdwaerme-fuer-muenchen-schatzsuche-per-schall-1.2719650-2>

In addition to hedging liquidity risks, the capital requirements of the clients are significantly reduced during the search phase. Enx finances the energy project with the involvement of an international bank.

In cooperation with the BMWi research project 'Dolomitkluft', the 6186 meter deep well, which has reached a temperature of 160°C but has not found sufficient depth of groundwater, is to be used economically in Geretsried. For this purpose, the geothermal reservoir of the Oberjura is to be connected by means of a sidetrack from the existing main borehole via a modified drilling path. A second well is to open the reservoir at a depth of 4900 m. These plans are based on preliminary geological and seismic investigations and on knowledge gained from the well drilled in the year 2013. The results show structures that allow the assumption of sufficient water quantities. If such a finding is given, Enx plans to install a geothermal power plant.

Source: <http://www.thinkgeoenergy.com/german-drilling-firm-daldrup-offering-an-integrated-risk-insurance-model/>

Two Deep Doublets to Be Drilled for District Heating - The mentioned drilling company, Daldrup & Söhne AG, received a major order from the Munich-based energy provider Stadtwerke München GmbH (SWM) to drill two geothermal doublets (four deep drillings) for the production of geothermal energy. With a value in the range of double-digit millions, the order is one of the largest in the company's history. The wells will go into a depth of more than 4000 meters with work to start later this year. The wells are part of SWM's vision for district heating, which calls for Munich to be Germany's first major city whose district heating will be generated entirely through renewable energies by 2040.

Geothermal energy from hot thermal water is key to the production of this heating: Munich is located on top of vast supplies of this environmentally friendly energy, which is contained in easily permeable layers of limestone that are part of the geological layers underneath the city.

Josef Daldrup, CEO of Daldrup & Söhne AG, said, "We are excited to support SWM in implementing their 100 percent renewable energy strategy, and to establish geothermal energy as a climate-friendly local heat supplier on an industrial scale for Munich, with its more than one million inhabitants."

Source:

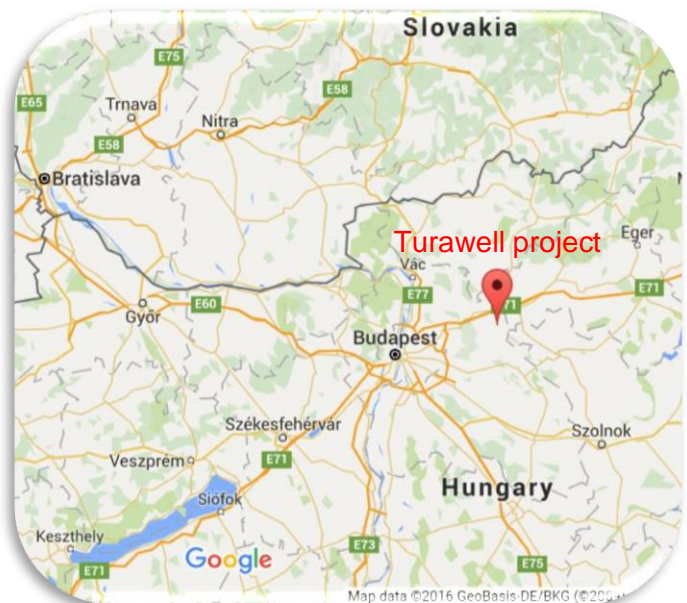
<http://www.dgap.de/dgap/News/corporate/daldrup-soehne-receives-major-order-for-four-geothermal-drillings-from-stadtwerke-muenchen/?newsID=1002249>

Hungary: Agreement on Project Financing for the First

Geothermal Power Plant in Turawell

Turawell Kft a project company owned 51% by KS Orka Renewables Pte Ltd of Singapore (KS ORKA) and 49% by the Hungarian entrepreneurs Miszori Laszlo and Szanto Laszlo, has signed an agreement with Erste Bank Hungary on a project financing for the its first geothermal power plant in Hungary.

The Power Plant is a combined heat and power plant (CHPP) that produces 3 MWe of electricity and 7 MWth of geothermal heat for heating homes. All the geothermal fluids will be returned to the ground after the heat is used.



KS Orka is a joint venture between Hugar Orka ehf, an Icelandic company, and Zhejiang Kaishan Compressor Co., Ltd (Kaishan). The Kaishan Group is the largest manufacturer of hammer drills in the global market, as well as the largest drilling equipment manufacturer in the PRC market. In addition, Kaishan is the manufacturer of the Kaishan Screw Turbines based on the design of the R&D Center in Seattle, U.S. The company KS Orka combines Hugar Orka's geothermal and project development expertise with Kaishan's power plant technology and manufacturing expertise to form Asia's only vertically integrated, geothermal- and waste-energy company.

Eiríkur Bragason, KS Orka's CEO, said the company "...is prioritizing investments in geothermal power plants in Asia and in Europe and aims to build up further 400 MW of combined heat and power plants in Europe over the next three years."

Richard Szabados, Head of Corporate Division of Erste Bank Hungary, emphasizes the bank "...aims to support the growth of renewable energy investments in Hungary with its Energy Efficiency and Renewables Financing

Programme. The main focuses of the Financing Programme are renewable energy (geothermal and solar) and energy-efficient investments.”

Source: <http://ksorka.com/first-geothermal-power-plant-hungary/>

Iceland: Testbed Project, Submarine Geothermal, Agreement in Mexico, and Geothermal for Drilling

The Krafla Magma Testbed Project - Scientists will study the possibility of producing geothermal energy from magma for the first time in a US\$100 million project in Iceland. If the project is successful, it could produce up to 10 times more energy than a conventional well. The project, called Krafla Magma Testbed, is coordinated by Iceland's Geothermal Research Group (GEORG) and the British Geological Survey, with the participation of 38 institutes and companies from 11 countries including the United States, Canada and Russia.

Producing geothermal energy from magma would enable Iceland to export more energy and could also revive a plan to build a power cable from Iceland to Britain to provide power to British homes. This would be the world's longest power interconnector.

Iceland is a volcanic island that produces all its electricity from geothermal energy and hydropower. The country agreed with Britain last year to study building the 1000-km long *IceLink* cable, which could power 1.6 million British homes.

Those plans were delayed due to Britain's vote to leave the European Union and concern in Iceland that exports would increase power prices at home and reduce the island's attractiveness to energy-intensive industries such as data centers.

The magma project will involve drilling a hole 2.1 kilometers deep directly into a magma chamber below the Krafla volcano in northern Iceland. The first phase of the project is planned to start by 2020 and will cost US\$30 million, the British Geological Survey said in a statement on mid-April—noting the study will also explore the mechanism of eruptions to protect communities from volcanic disasters and that it was confident of securing the financing as a number of countries and companies had expressed interest in contributing. No details were provided.

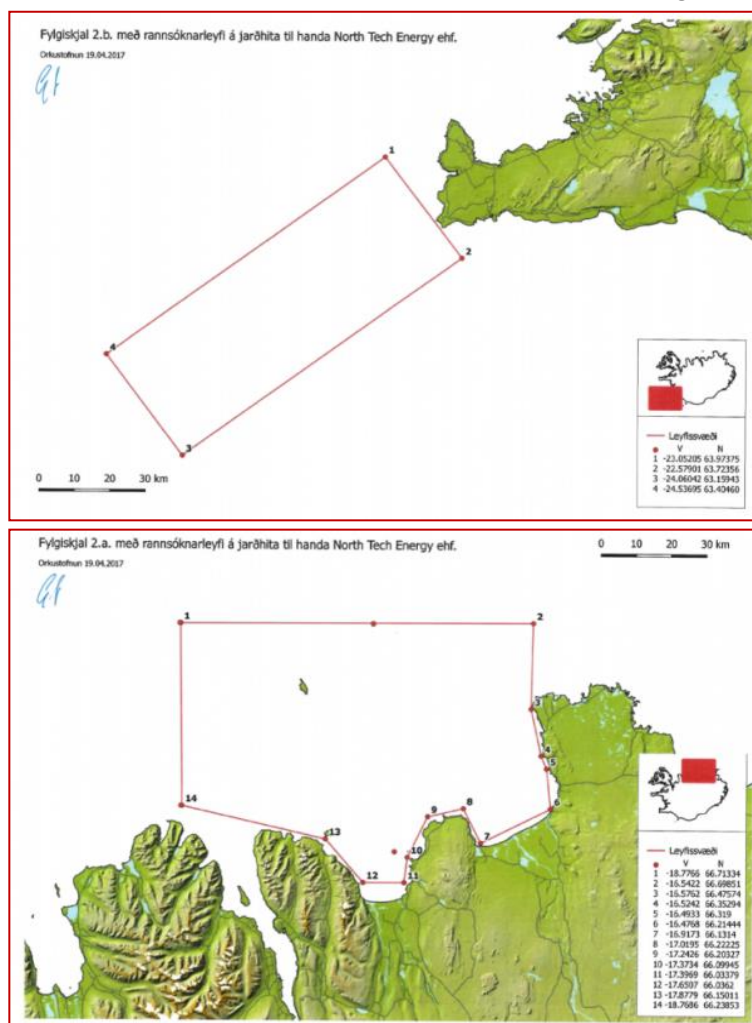
“A magmatic geothermal well can produce 5 to 10 times more energy compared to a conventional well,” said Sigurdur Markusson, a project manager for Icelandic utility Landsvirkjun, which will develop the site. “In a country like Iceland with frequent volcanic eruptions capable of disrupting Europe's

aviation system, the project's security is a priority,” said Hjalti Pall Ingolfsson, head of the GEORG project. “It is quite secure. We have reached magma before... Nothing indicated that we could cause an eruption,” he said.

Source:

<https://www.usnews.com/news/news/articles/2017-04-10/iceland-magma-drilling-project-may-revive-giant-uk-power-cable-link>

Seabed Geothermal Research Allowed - An Icelandic exploration company is looking into tapping an enormous new source of green renewable energy in Iceland: submarine geothermal energy. The company envisions using the energy to generate electricity in offshore geothermal power plants on platforms not unlike those used in offshore oil drilling. The Icelandic National Energy Authority has granted the company, North Tech Energy, a permit to search for geothermal energy on two exploration areas on the Icelandic continental shelf. At this stage, the goal is to gather data and search for areas that could be used to generate



The two exploration areas. Top: Reykjanes ridge, bottom: the area off the coast of N. Iceland. Photo/National Energy Authority (taken from the first source).

geothermal energy.

The first part of the project is the search for suitable areas for heat exploration, but the license given North Tech Energy also gives the company priority for being granted a license to harvest the energy for electricity production, if the initial tests are successful. The research licenses last for three years and work is expected to start in June 2018.

The size and energy of offshore geothermal fields have not been studied. Previous studies have shown that the areas are extremely active geothermally, generating immense quantities of energy which is currently simply bleeding into the ocean.

The two exploration areas are vast. One stretches along the Reykjanes ridge, and the other covers most of the seabed off the coast of Northern Iceland. Both areas are on the North Atlantic ridge, the fault line where the European and North American continental plates drift apart and magma rises up from the earth's mantle. The ridge is extremely geologically active, with frequent submarine eruptions and high levels of geothermal activity.

Source: <http://icelandmag.visir.is/article/unexplored-source-green-energy-submarine-geothermal-power-be-harnessed-shore>,
<http://icelandreview.com/news/2017/04/24/groundbreaking-seabed-geothermal-research-allowed>

Icelandic Cluster and the Mexican CICESE Signs Cooperation Agreement - Within the framework of the Geothermal Conference for Latin America and the Caribbean (GEOLAC 2017), held in Mexico City on 25-26 April, the representatives of the Iceland Geothermal Cluster, Vidar Helgason, and the Mexican CICESE (Center for Scientific Research and High Education of Ensenada), Luis Alonso Gallardo, signed a cooperation agreement. CICESE is the lead institution of the Mexican Center for Innovation in Geothermal Energy (CeMIE-Geo).



Iceland
Geothermal Cluster
Initiative



CeMIEGeo
Centro Mexicano de Innovación en Energía Geotérmica

The agreement aims to encourage the creation of scientific consortiums and collaboration in the scientific, research, educational and exploration aspects of geothermal projects. "The agreement between the clusters marks the beginning of a fruitful cooperation between Mexican and Icelandic geothermal companies," said Vidar Helgason, manager of the Iceland Geothermal Cluster.

The Mexican and Icelandic governments are currently discussing specific trade agreements that include geothermal. So this agreement between both geothermal energy bodies is timely. The cooperation is aimed at helping to promote geothermal energy as part of the future energy mix of both countries.

Source: <http://www.thinkgeoenergy.com/geothermal-clusters-of-iceland-and-mexico-sign-cooperation-agreement/>

10 Wells to Be Drilled Using Geothermal Electricity

- Icelandic energy companies ON (Reykjavik Energy) and Iceland Drilling (Jardboranir) have agreed to drill seven wells in the Hengil area in the coming years. An additional three wells can be added to the contract, if necessary.

The power from the ON power plants will be used to power the drilling rigs for the project, saving more than one million liters of oil used in conventional methods.

The drilling contract was tendered in the European Economic Area earlier this year. Iceland Drilling won the tender with its lowest bid for the seven wells at ISK 2.6 billion (around US\$27 million, or around US\$3.8 million per well). Drilling is expected to start this summer.

The agreement assumes all of the wells will be drilled with electricity from the ON power plants—not diesel usually used for drilling activities of that kind. It takes about a month to drill one hole and the powerful drilling rig needs about 4500 liters of oil per day. For the up to ten holes planned, this will save about 1.3 million gallons (almost 5 million liters) of diesel and 50,000 tons of carbon dioxide emissions. Using electricity for drilling geothermal wells is one of the components of the climate objectives of ON. In addition, financial savings include using local electricity instead of imported oil.

The wells to be drilled are for steam production and reinjection. The water produced from the wells for power production is returned to the geothermal reservoir to promote sustainable utilization of the geothermal resource. At the Hellisheidi Power Plant, carbon dioxide and hydrogen sulfide from the geothermal gas are mixed with the processing water, which then is returned to the reservoir via the reinjection holes. The geothermal gas flows into the bedrock where it is bound for the future.

Source: <http://www.thinkgeoenergy.com/7-additional-wells-to-be-drilled-at-hellisheidi-geothermal-plant-in-iceland/>

The Netherlands: New Geothermal Heating Project near The Hague

Drilling of a new deep geothermal well started in early May in the Westland greenhouse growing region, near The Hague. The well, programmed to reach 4 km in depth, is expected to be completed by September. By December, it will start to provide hot water at 140°C serving the vast flower and vegetable growing greenhouses in the area. This pilot project is developed by Trias Westland at a cost of €50 million (US\$57.2 million). Once completed, the geothermal heating plant will be twice the size of other geothermal heating plants in the Netherlands. Trias Westland director, Marco van Soerland, said geothermal projects are much more expensive than solar panels as a heat source. It remains uncertain whether the project will succeed, Van Soerland said. The Westland auction and 43 growers have committed to buying the geothermal heat which, if successful, is expected to provide between 10% and 20% of annual heating needs. Van Soerland said that green energy is increasingly important: "Growers, whether in flowers or vegetables, have clients who demand sustainable products."

Source:

<http://www.dutchnews.nl/news/archives/2017/05/geothermal-heat-for-westland-greenhouse-region-near-the-hague/>

Spain: Two Direct-use Geothermal Projects to be Developed

Geothermal District Heating Project in Galicia - A geothermal district heating system in Spain's Galicia province has been given the go-ahead with the signing of a partnership framework agreement. The council in the city of Ourense aims to collaborate with the Institute for Energy Diversification and Saving (IDAE), a government agency, to develop pilot geothermal

heating projects in the city.

The first project is now in the planning phase after Ourense's mayor, Jesús Vázquez, and Alvaro Nadal, Spain's minister for energy, tourism and the digital agenda, signed the partnership agreement.

The project will be located in the city's fifth district and will serve a population of about 28,000 as well as a number of public buildings. Once completed, it would be the first geothermal district heating system in Spain.

Galicia is rich in geothermal resources and studies by Spain's Geological Survey have shown temperatures of 50°C to 90°C at depths of 500 to 1500 meters.

Ourense is a historical hot springs town, known to the Romans as *Aquis Auriensis*. It is now a member of the European Historical Thermal Towns Association (EHTTA).

Source: <http://www.decentralized-energy.com/articles/2017/04/spanish-geothermal-district-heating-project-gets-green-light.html>

Hot Water for Greenhouses in Níjar - The company Cardial has reported the discovery of a geothermal resource 490 meters deep in the fields of Níjar, in the Spanish province of Almeria. The firm, which is promoting a project for greenhouse air-conditioning in Níjar using geothermal energy, has reported in a note that the reservoir has an average temperature of 41.8°C, an increasing gradient of 8.9°C per 100 meters, and an average flow of 22.72 liters per second.

The data, certified by a company collaborating with the public administration, will allow for the first geothermal plant to start being built in Almeria next August. The company in charge of extraction will be Sacyr Industrial.

Cardial's first module will make it possible to meet an initial demand of about 24 hectares, but with a second survey, this capacity could double almost without having

to expand the facilities. The initial development plans foresee the construction of three plants in just two years, and a much faster development from that point onwards, depending on the success of the first models.

The model proposed by Cardial, to which numerous producers have already signed up (with sufficient energy needs to cover the first three plants), consists in extracting hot water from the Níjar reservoir, re-circulating it through a network that will transport it to the greenhouses and return it again to the reservoir, creating a closed



circuit that makes the resource renewable. These waters, which stay at such high temperatures (about 100°C at the 1000 meters depth they intend to reach), are not suitable for irrigation because of the enormous concentration of salt and other elements that make it unviable in that field, but, which make them exceptionally suitable to power a more ecological energy model that can be applied to Almeria's horticultural production, competing in price with other energy sources such as gas, biomass and other fuels.

Source:

<http://www.hortidaily.com/article/35114/Spain-Geothermal-deposit-for-greenhouse-air-conditioning-discovered>

Switzerland: Energy Strategy and New Geothermal Project in Lavey-les-Bains

Referendum Approved New Energy Strategy - The Swiss government decided to stepwise phase out nuclear power after the Fukushima event in 2011. Both Swiss chambers adopted the new energy law in September 2016. The strategy focuses on the reduction of the energy consumption, the enhancement of the energy efficiency and the increased deployment of renewable energies to substitute for the use of nuclear power. The Swiss population voted with a majority of 58.2 percent in favor of the new energy strategy in a referendum on 21 May 2017. Only four of Switzerland's 26 cantons voted against the overhaul to renewables.

Switzerland's so-called Energy Strategy 2050, spearheaded by Energy Minister Doris Leuthard, who is also the current Swiss president, involves decommissioning Switzerland's five reactors as they reach the end of their safe operational lifespan. Currently, they produce around a third of the country's electricity. Although the plan does not lay down a clear timetable for phasing out the plants, it envisages increasing reliance on hydraulic power and solar, wind, geothermal and biomass energy sources, as well as reducing energy consumption and improving energy efficiency. Its targets are ambitious, with the aim being

to cut the average energy consumption per person per year by 43 percent by 2035 as compared with levels in 2000.

For geothermal energy, the strategy targets at 4400 GWh/yr of geothermal power produced in 2050. Other measures related to geothermal include, as informed before (*see* IGA News 107, pp. 29-30), the following:

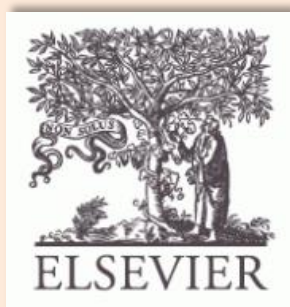
- Different Feed-in Tariffs (FiT) for hydrothermal and EGS projects. Hydrothermal projects (using naturally occurring hot water) currently receive a FiT of 0.227 to 0.4 CHF (practically equal in US\$) per kilowatt-hour depending on the plant size. Now, EGS projects (without natural fluids) would receive 7.5 additional cents to reach 0.302 to 0.475 CHF per kilowatt-hour, depending on the plant size (see table below):

Capacity (MW)	FiT (CHF/kWh)	
	Hydrothermal	EGS
≤5	0.400	0.475
≤10	0.360	0.435
≤20	0.280	0.355
>20	0.227	0.302

- Deep exploration can be supported by up to 60 percent of eligible costs. The most important of these eligible costs include access roads and well pads, drilling, tests and stimulation of exploration wells.

- Geothermal energy guarantee for electricity projects increases from 50 to 60 percent. If a well is not successful, the Confederation can reimburse up to 60 percent of the eligible costs, among them: preparation, construction and dismantling of the drilling site, drilling costs including pipes, cementation and completion for all planned production and injection wells, and well logs and tests.

The guarantee and the exploration support scheme are both funded via a maximum 0.1 Rappen (about the same in US Cent) per kWh from voltage grid surcharge. The annual Swiss electricity consumption is about 60 TWh and results in a fund of about 60 Million CHF per



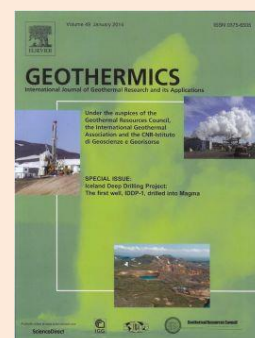
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year. For all measures, a cap of a maximum 2.3 Rappen per kWh is defined. Both support schemes are available until 2031.

- Direct geothermal heat utilization. For geothermal heat projects, up to CHF 30 million can be spent annually on exploration and development. The Federal Government can accept up to 60 percent of the eligible costs, among them: preparation, construction and dismantling of the drilling site; drilling costs including pipes, cementation and completion for the planned exploration and production wells; and well stimulation and tests.

All applications from project developers will be assessed by an expert committee from the Swiss Federal Office of Energy (SFOE). If the project is assessed positively, the committee will recommend a specialist as a project support for the entire project. This expert will report to the expert committee.

Geothermal energy is now deemed of national interest in the country, which will also accelerate the planning and permitting of new geothermal projects.

Sources: <http://www.thinkgeoenergy.com/swiss-vote-for-nuclear-exit-and-several-incentives-for-geothermal-development/>, <http://www.dw.com/en/swiss-vote-in-favor-of-gradual-nuclear-phaseout/a-38921057>

Heat and Power Geothermal Project in Lavey-les-Bains

– The project is located in Lavey-les-Bains, in the Rhone valley, on one of the best known sites in Switzerland in terms of geothermal energy. The existence of a geothermal resource of importance in the region has been known since the 19th century. These are the hottest springs in Switzerland, causing the development of Lavey. Alpine Geothermal Power Production (AGEPP) is moving forward following completion of the feasibility study, finalization of financing arrangements and formation of AGEPP SA. The next step will be obtaining exploration and operational authorization from Vaud Canton, after which drilling can begin.

The project plans to extract water at 110 degrees Celsius with a flow rate of 40 l/s, conditions that would allow the project to operate year round. If successful, it is expected that an ORC plant could provide up to 4.2 GWh gross electricity/year and about 15.5 GWh thermal to supply the Lavey Baths with thermal water for renewal the swimming pool water and thermal energy for the heating of pools and buildings. In the longer term, it is also looked at a possible upgrade to waste heat for other uses: remote heating, fish farms, greenhouses, etc.

There have already two wells been drilled to a depth of 200 m and 550 meters in 1973 and 2000. Thanks to geothermal energy, the Baths at Lavey already benefit from thermal water at an average temperature of 60 degrees Celsius.

Under the plans of the company, a single production (a well called a ‘singlet’) will raise water to the surface by drilling down as deep as 3000 meters. AGEPP SA will pump geothermal water from highly permeable rock substrate that has naturally occurring cracks to produce round-the-clock electricity for some 900 households. It will also supply thermal energy and ground-heated water to the Lavey thermal spa.

This is a highly innovative project as it contains plans to generate power from a hydrothermal reservoir – which would be a first in Switzerland. It also responds to the Swiss Confederation’s Energy Strategy 2050.



Aerial view of the project area. Photo taken from AGEPP website.

The project brings together private- and public-sector shareholders, including several Western Swiss firms operating in the renewable energy field: SI-REN SA, Holdigaz SA, EOS Holding SA, Romande Energie Holding SA and CESLA SA, as well as the municipalities of Lavey-Morcles (Vaud) and Saint-Maurice (Valais). The project is also financially supported by the Swiss Federal Office of Energy (SFOE) and Vaud cantonal authorities.

Scientific and financial analysis for the project – including a thorough investigation of seismic activity and potential environmental impacts– has been completed. In addition, financing arrangements have been finalized. The authorization request, to be submitted to Vaud Canton, will cover drilling as well as the construction of surface installations to harness the geothermal energy.

The public consultation is planned for early 2018, and drilling is scheduled to start in 2019. Operations are due to begin in 2020.

Source: <http://www.thinkgeoenergy.com/geothermal-power-and-heat-project-launched-in-lavey-les-bains-switzerland>

Turkey: OrmaTurk Will Manufacture Geothermal Turbines in the Country

The newly-inaugurated (late May) OrmaTurk Company in Turkey's Aegean coastal city of Izmir will bring a great deal of geothermal plant-equipment know-how to the Turkish geothermal industry, the U.S.-based parent company CEO said during the International Geothermal Conference (IGC Turkey 2017). Isaac Angel, CEO of the parent company, Ormat Technologies, spoke about the new Turkish company's structure and its planned contribution to the country's geothermal energy sector.

"We are probably the biggest power plant provider in Turkey over the last 10 years, with a 52 percent share of all operations in Turkey. We will also support another 11 power plants during 2017 and 2018," Angel said. He explained that in Turkey, Ormat Technologies Inc. does not operate power plants but provides technical support and builds power plants for Turkish developers.

"Yesterday (May 24) OrmaTurk started operations as a Turkish company, one 100 percent owned by Ormat Technologies. The employees are Turkish, including the management," Angel said. He added that because of the geothermal potential in the Turkish market, the investment in the country was made with strong confidence.

"The facility will not only supply customer products, but, more importantly, Turkey will gain know-how on how to build turbines from A to Z, ones that can be labeled 'Made in Turkey,'" Angel said. "Local turbine production labeled 'Made in Turkey' helps the company, its partners and its customers obtain subsidies from the Turkish Government," Angel explained.

The company's presence in Turkey involves the construction of power plants for Turkish developers but they refrain from functioning as operators. This decision is based on the servicing of a very dense number of customers, which Angel maintained Ormat would compete against if the company also operates these plants.

"That's why we decided not to build our own facilities in Turkey," he said. Angel added that if the Turkish market continues to grow as expected, the company plans to enlarge its facilities in the coming years.

"We always look for opportunities in Turkey," he concluded.

Source:

<http://www.worldbulletin.net/haberler/189996/turkey-to-produce-made-in-turkey-geothermal-equipment>

United Kingdom: Hot Dry Rock Project in Cornwall

GeoScience Limited was founded in 1985 as a spin-off from the Hot Dry Rock geothermal research project run by Camborne School of Mines. That project, based at Rosemanowes Quarry near Penryn, developed techniques for the creation of artificial geothermal reservoirs that have been applied around the world.

Now, twenty five years after work stopped at Rosemanowes, the company is once again at the forefront of geothermal research in the UK. In partnership with Geothermal Engineering Limited, GeoScience is starting work on the United Downs Deep Geothermal Power project in Cornwall.



The project has secured funding of £10.6 million (US\$13.44 million) from the European Regional Development Fund. An additional grant of £2.4 million (US\$3.04 million) from Cornwall Council and private investment of £5 million (US\$6.34 million) will allow to explore the geothermal resources at a depth of 4.5 km and build a 1MW power plant to demonstrate the technical and commercial viability of supplying both electricity and heat. This will be the first geothermal power project in the UK.

Two wells will be drilled into a target geological structure within the granite beneath United Downs; one to a depth of 2.5 km and the other to a depth of 4.5 km. Water will be circulated through the fracture system from the shallow injection well to the deep production well, mining heat from the rocks. It will be pumped to surface at a temperature of about 175°C where it will supply the demonstration power plant to produce 1MW of clean renewable electricity.

During the second half of 2017 the site will be prepared for drilling, project infrastructure will be put in place and a micro-seismic monitoring network will be installed. It is expected start the drilling of the injection well in early 2018.

Throughout the three years of the project data, information and knowledge will be disseminated through public engagement events and an extensive educational program for Primary, Secondary, Further and Higher Education Institutions. A parallel research program at Plymouth University will investigate issues around public perception and acceptance of geothermal energy in Cornwall, which will be critical for us to gain a social license to develop further sites if the United Downs project concept proves successful.

Source: <http://www.geoscience.co.uk/single-post/2017/06/22/GeoScience-returns-to-its-geothermal-roots-with-new-power-project>

Oceania

New Zealand: Direct Use, Geothermal Share to Power Production, More Resources in Southern Alps

Māori Trusts to Build Unique Geothermal Milk Plant - Kawerau Dairy is made up of seven Māori entities aiming to build the first geothermal-powered plant in the country to process milk from goats, sheep and cows. The groups involved are Te Manawa o Tūhoe, Māori Investments, Putauaki Trust, Ngati Makino, Rotoiti 15, Tataiwhetu Lands Trust and Poutama. The plant is expected to be making products to sell by late 2018.

Poutama Trust project leader Richard Jones said it would be the only plant in New Zealand using geothermal energy to turn cow, goat and sheep milk into powder, which will be used to make protein powder, vitamin-added powder, aged-care formula and baby formula.

“It seems a bit different because we are raised on just knowing about dairy cows -- not dairy goats and dairy sheep -- but in other parts of the world it is pretty common,” he said.

Plans for the new plant have been in the pipeline since 2012 but its feasibility study has just been given the tick of approval. Jones said it was a win for the seven Māori entities involved and a win for local Māori farmers, who would also reap benefits.

“We do not need a large amount of cows with this plant. I think it is up to a maximum of 7000 to start off with. So amongst our immediate group, we have got about 6000 cows all on Māori farms.”

A 750 kg drier for cow milk would be built as part of the first stage, with another drier for goat and sheep milk are scheduled for the second stage.

The plant would be the second geothermal-powered plant owned by Māori, the first being Miraka near Taupō.

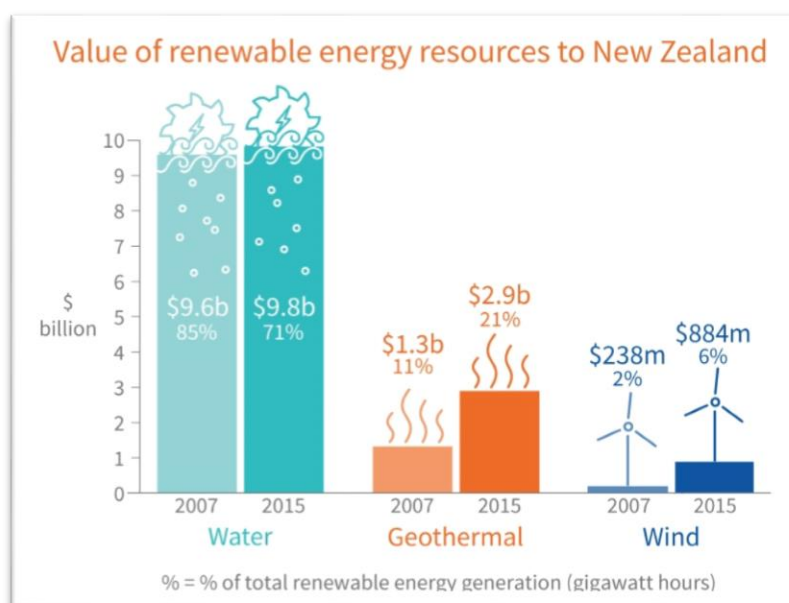
Putauaki Trust owns the land that the new plant will be built on and its chairman, Tiaki Hunia, said Māori could be huge players in this industry. Hunia, who is also the deputy Māori Trustee at Te Tumu Paeroa, said using renewable geothermal energy was a good move.

Jones said the Kawerau plant would cost about NZ\$33 million (US\$22.7 million) and the Māori groups involved so far are paying half of it. “That is the whole drive behind the project. Māori are involved all the way, in every key aspect of this project—from the farms, the land, the animals and the people to the processing plant.”

Source: <http://www.radionz.co.nz/news/te-manu-korihi/328346/maori-trusts-to-build-unique-geothermal-milk-plant>

Strong Growth in Wind and Geothermal Electrical Generation - Geothermal's contribution to New Zealand's total renewable energy generation increased from 11 percent in 2007 to 21 percent in 2015. Over the same period, its value rose from NZ\$1.3 billion (US\$893.6 million) to NZ\$2.9 billion (US\$1.99 billion).

The value of all renewable energy resources used to generate electricity increased 22 percent from \$11.3 billion in 2007 to \$13.8 billion in the year ending in March 2015. Renewable energy resources contributed 79 percent of the total electrical generation in the year to March 2015.



“Wind power has emerged as a significant energy asset,” statistical services manager Dan Oberhaus said. “The increased use of wind and geothermal energy

resources is showing positive contributions to our economy.”

This information was released in late April in a Stats NZ report, *Asset value of water resources and other renewables for electricity generation: 2007–15*. Water remains the most significant renewable energy resource in New Zealand and contributed over half the asset value for all renewable: US\$9.8 billion in 2015. It accounted for 56 percent of New Zealand’s electrical generation (23,728 of 42,362 gigawatt-hours).

Source:

http://www.stats.govt.nz/browse_for_stats/environment/environmental-economic-accounts/renewables-account-2007-15-media-rel.aspx

High Temperatures Discovered beneath the Southern Alps - An international research team has discovered ‘extreme’ geothermal conditions deep beneath the Southern Alps, according to research published in the *Nature* journal in May 2017. Temperatures measured near the surface were similar to those found in active volcanic zones such as Taupo – yet there are no volcanoes in Westland.

The surprise discovery could have economic implications for the area, and it may give clues as to the conditions of a major fault prior to a significant rupture.

The research team was led by GNS Science, Victoria University of Wellington and the University of Otago, comprising more than 100 people from 12 countries. They drilled a borehole nearly 900 meters deep at a site near Whataroa in Westland trying to establish the conditions of a major fault prior to a significant rupture.

The alpine fault is highly predictable, producing a magnitude-8 earthquake about every 300 years. The last such earthquake was 300 years ago.

At 630 m deep, they measured water temperatures of 100°C, hot enough to boil. They expected temperatures of less than 40°C. Drilling further, they determined the geothermal gradient in the well, which was unlike any

known active fault in the world.

“Nobody on our team, or any of the scientists who reviewed our plans, predicted that it would be so hot down there,” said lead scientist Professor Rupert Sutherland from Victoria University of Wellington. He said they found some of the “most extreme underground conditions on the planet”, which are similar to that of boreholes drilled directly into volcanoes.

It was likely a mixture of two processes, he said. Rocks of about 550°C are uplifted from 30 kilometers deep with such speed they do not cool down. Fractured rocks allowed water to seep into the mountains beneath valleys, further uplifting heat, before being flushed by rain and snow.

“This geothermal activity may sound alarming but it is a wonderful scientific finding that could be commercially very significant for New Zealand,” Sutherland said.

The next step would be to determine how extensive the geothermal resource is and whether using it is viable. It is necessary to do more scientific work and establish a business case for how to use the geothermal resource.

Development West Coast COO, Warren Gilbertson, said it could be a great opportunity for a local industry. “The location of geothermal activity and its possible benefit and association to the dairy and tourism sectors provide real opportunities from an economic perspective,” he said.

Source:

<http://www.stuff.co.nz/environment/92669729/the-sleeping-dragon-researchers-find-blazing-heat-beneath-the-southern-alps>

Other

Technology: CO₂-Powered Compact and Highly Efficient Turbine

The latest ‘ultra-supercritical’ steam-generator systems have around 47.5 percent efficiency. But Douglas Hofer, an engineer at GE Global Research headquarters in Niskayuna, New York, is building a compact but superefficient turbine that replaces steam with ultra-hot and super-pressurized carbon dioxide. The turbine can be used with any thermal power plant. The technology was developed in partnership with Southwest Research Institute as part of a research project with the U.S. Department of Energy’s SunShot Initiative.



View of the Southern Alps. Photo by DAVID WALKER/FAIRFAX NZ.

The combination of high heat and pressure is what allowed Hofer to design a turbine that fits on a conference table but can generate 10MW. His team, partnered with Southwest Research Institute and Gas Technology Institute, has submitted the design to the U.S. Department of Energy and won an US\$80 million award to build a 10MW turbine. The turbine features a rotor that is 4.5 feet long (1.4 m), 7 inches in diameter (~18 cm), and only weighs 150 pounds (68 kg). The engineers are now completing a scaled-down, 1MW version of the machine and will test it in July at the Southwest Research Institute.

The idea of using CO₂ to power a steam turbine has been around for a while. “The industry has been really interested in the potential benefits of using CO₂ in place of steam in advanced supercritical power plants,” Hofer says. By ‘supercritical’ Hofer means efficient power stations using CO₂ squeezed and heated so much that it becomes a supercritical fluid, which behaves like a gas and a liquid at the same time. The world’s most efficient thermal power plant, RDK 8 in Germany, uses an ‘ultra-supercritical’ steam turbine operating at 600°C and pressure of 4000 pounds per square inch (2.8 million kg/m², or 272 atmospheres).

Hofer says that the steam power plant technology “has been on a continuous march” to increase efficiency and steam temperature, but once it tops 700°C, “the CO₂ cycle becomes more efficient than the steam cycle.” Hofer’s turbine and casing are made from a nickel-based super-alloy because it can handle temperatures as high as 715°C and pressures approaching 3600 pounds per square inch.

The high heat and pressure turn CO₂ into a hot, dense liquid, allowing Hofer to shrink the turbine’s size and potentially increase its efficiency a few percentage points above where state-of-the-art steam systems operate today. “The pressure and fluid density at the exit of our turbine is two orders of magnitude higher than in a

steam turbine,” Hofer says. “Therefore, to push the same mass through, you can have a much smaller turbine because the flow at the exit end is much denser.”

Hofer’s design uses a small amount of CO₂ in a closed loop. “It’s important to remember that this is not a CO₂ capture or sequestration technology,” he says. Hofer says that the technology, which is being developed as part of GE’s Ecomagination program, could one day start replacing steam turbines.

Source: <http://www.gereports.com/call-ecomagination-ge-building-co2-powered-turbine-generates-10-megawatts-fits-table/>

Technology: Geothermal Risk of Induced Seismicity Diagnosis (GRID)

A new screening tool to assess the potential seismic risks (earthquake activity) from deep geothermal energy projects has been outlined in a recent study. The tool provides categories of seismicity risk for projects, which are dependent on factors including geological aspects, as well as social concern and location in relation to urban areas.

The study outlines a screening tool for geothermal seismicity termed the Geothermal Risk of Induced Seismicity Diagnosis (GRID), which estimates to what extent induced seismicity is a concern for a project. GRID is designed to be used during project planning and develops four categories for induced seismicity risk from very low or no concern (Category 0) to a high level of concern, where induced seismicity is likely (Category III). The framework was tested on three geothermal projects in Switzerland (Basel, St. Gallen, and Riehen) as well as a hypothetical Basel-type project located in a low-risk area with high social concern.

As the level of seismic risk is not definitively known when GRID is carried out, the framework instead reflects level of concern. A higher GRID score means more measures are required to govern the risk. Seismic concern is assessed using several indicators such as the depth of the geothermal system; rock type; the volume of rock affected; level of fluid injected or extracted and fluid injection pressure during operation; and distance from known active underground fault lines. It also considers the exposed local population, industrial and commercial activity and buildings, and infrastructure in the vicinity of the project. The data required for GRID can be obtained from



The turbine is made from a nickel-based super-alloy. Photo taken from GE Reports (see source)

regional statistics or estimated by experts at an early stage of project development. The researchers recommended that the project operator, licensing or regulating authority, and independent experts all be involved in the assessment.

GRID also comprises a framework for tailored risk governance of a project. The framework covers hazard and risk assessment, seismic monitoring, insurance for damage caused by induced seismicity, structural retrofitting of vulnerable building and infrastructure, traffic light systems to manage the risk of seismicity, information and outreach, and public and stakeholder engagement.

For the four projects where GRID was tested, the Basel and St. Gallen projects were rated as Category III, which the researchers describe as a reasonable score because both projects led to induced seismicity and are located close to large cities. The Riehen project was given a Category II, because, despite the fact that it was located close to a densely populated area with natural seismicity, the shallow depth, rock type and smaller scale of the project means that induced seismicity is unlikely. Similarly, the Basel type project would be a Category II if it were located in a lower risk area.

The researchers say the framework is the first developed for geothermal energy projects. They acknowledge that the GRID scores and indicators, as an emerging field of risk, will need updating as new evidence becomes available. However, they say the strength of GRID is in its simplicity, enabling fast, transparent, reproducible assessments that can be adapted to other regions or geo-energy applications.

Source:

http://ec.europa.eu/environment/integration/research/newsalert/pdf/screening_tool_developed_seismic_risks_geothermal_energy_projects_490na4_en.pdf

Science: Preparations to Drill Down to the Mantle

Aiming for the world's first-ever direct excavation of the earth's mantle, an international research group led by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) will conduct a preliminary study in the waters off Hawaii in September. The area is considered to be a leading candidate

site for the drilling. The research group, including researchers from Japan, the United States and the Europe, plans to intensively investigate the underground structure of the area to find a suitable spot for drilling.

JAMSTEC and its partners aim to realize the excavation of the mantle in the early 2020s—at the earliest—using Japan's deep-sea scientific drilling vessel Chikyu.

The mantle is located beneath the crust, which covers the surface of the earth. About 80 percent of the planet's volume is composed of the mantle. It is formed of rock and moves slowly, affecting the drift of continents, plate movements—which cause earthquakes—and volcanic activity. Direct observation of the mantle is expected to reveal things such as its hardness and how much water it contains, which could pave the way to better understanding of the plate movements and unveil how the planet was formed.

The preliminary study will be conducted for about two weeks from mid-September in waters northeast of the Hawaiian Islands, using JAMSTEC's deep-sea research vessel *Kairei*. The research group will study the thicknesses and temperatures of the crust through sound waves to find a place suitable for drilling and observation.

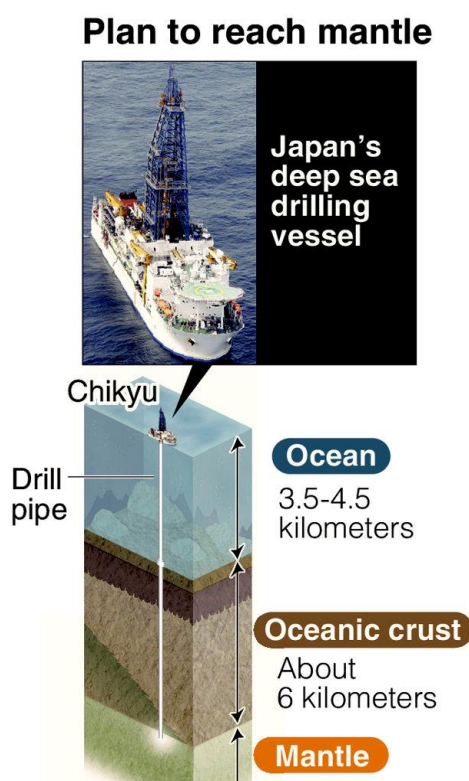
The international team has chosen waters off Hawaii, Mexico and Costa Rica as candidate sites for drilling. The depth of the area in the waters off Hawaii is about four kilometers, slightly deeper than the other candidate

sites. However, the temperature of the area around the boundary between the crust and mantle is relatively low—estimated to be about 150°C—making it easier to conduct observation activities.

Development of a light, sturdy pipe to drill six kilometers into the sea floor has been a longstanding issue. However, drilling has now become technically possible partly due to the use of newly developed materials, JAMSTEC said.

Another problem is cost—the research group estimates a total of ¥60 billion (US\$550 million) is needed. “There are still issues to be resolved, particularly the cost,” said Susumu Umino, a professor at Kanazawa University who specializes in petrology. “However the preliminary study will be a big step forward for this project to enter a new stage,” Umino said.

Source: <http://the-japan->



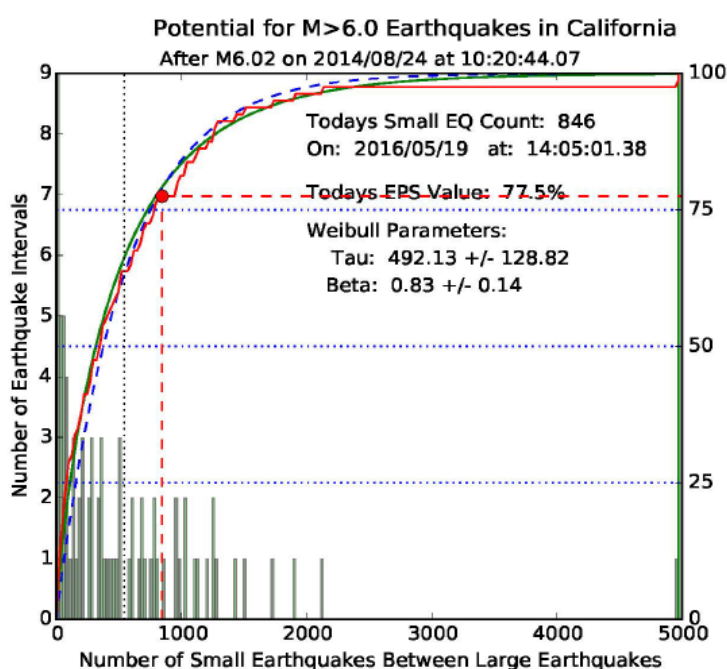
Graph by The Yomiuri Shimbun,
taken from the source.

news.com/news/article/0003619423

Science: Earthquake Potential Score for Mega-cities

Scientists have developed snapshots of the likelihood of major earthquakes occurring in mega-cities around the world using a new statistical approach for estimating earthquake risk. The work was presented on May 22 at the joint meeting of the Japan Geoscience Union and the American Geophysical Union in Chiba, Japan (John B. Rundle, Molly Luginbuhl, Alexis Giguere, and Donald L. Turcotte, 2017. Nowcasting Global Earthquakes. *JpGU-AGU Joint Meeting 2017*, 20-25 May, Chiba, Japan. Paper SSS 08-02).

In the abstract, the authors explain that, “The term ‘nowcasting’ refers to the estimation of the current uncertain state of a dynamical system, whereas ‘forecasting’ is a calculation of probabilities of future state(s). Nowcasting is a term that originated in economics and finance, referring to the process of determining the uncertain state of the economy or markets at the current time by indirect means. We have applied this idea to seismically active regions, where the goal is to determine the current state of a system of faults, and its current level of progress through the earthquake cycle.”



Example of EPS value (77.5%) obtained for California on 19 May 2016 (Graph taken from the abstract).

Thus, the new technique, called seismic nowcasting, estimates the progress of a defined seismically-active geographic region through its repetitive cycle of major earthquakes. Applied to cities, the method assigns an

Earthquake Potential Score, or EPS. The EPS provides a snapshot of the current risk of a major earthquake occurring in a region and gives scientists, city planners and others a thermometer to see where a city is in a major earthquake cycle.

Using the new technique, scientists have determined that the EPS for Lima is about 70 percent; Manila, Taipei and Tokyo have an EPS of about 90 percent; Los Angeles and San Francisco have an EPS of about 50 percent, and Ankara has an EPS of about 30 percent. This means Los Angeles is about half-way through its cycle for 6.5-magnitude or greater earthquakes, while Tokyo is about 90 percent of the way through its cycle.

A region's EPS can be seen as a way of estimating how much tectonic stress has built up in the earth's crust since the last large earthquake—a notoriously difficult question for seismologists to answer. The new method does not provide an estimate of when in the future a large earthquake might occur.

“EPS is the thermometer,” said John Rundle, a seismologist at the University of California, Davis, who presented the new research at the JpGU-AGU joint meeting. “It's meant to be for city planners to see where they are in the cycle of major earthquake within a defined geographic region.”

The nowcasting method uses the number of small earthquakes that have occurred in a region since the last large earthquake to statistically work out progress through the regional earthquake cycle. The trick, says Rundle, is to first look at the past earthquake data for a larger region, then apply it to a smaller area within that region.

For example, seismological records of a large region, like all of California and Nevada, show a range of earthquakes of various sizes, with smaller quakes being more common. This information is compared to the number of small earthquakes that have occurred since the last big earthquake in smaller regions, as, for example, within 100 kilometers (62 miles) around Los Angeles. Applying the earthquake distribution for the larger region to the smaller region gives scientists an idea of how far along the region is in its cycle of smaller quakes relative to large earthquakes.

Rundle stresses that the new technique is not a model, only an interpretation of current data to provide the current earthquake status of a region. It does not forecast when a future major earthquake might occur.

Sources:

<http://blogs.ucdavis.edu/egghead/2017/05/22/new-technique-provides-earthquake-risk-major-cities->

[worldwide/](https://worldwide.confite.atlas.jp/guide/event/jpguagu2017/subject/SSS08-02/class?cryptoId),
<https://confite.atlas.jp/guide/event/jpguagu2017/subject/SSS08-02/class?cryptoId>

Climate Change: The Large Crack in the *Larsen C* Ice Shelf

The shape of the world is hanging by a thread –or rather, according to experts, by a 110 mile-long (177km) rift. That's the extent of a rapidly expanding crack in an enormous ice shelf in Antarctica. When the Larsen C shelf finally splits away, the largest iceberg ever recorded (bigger than the U.S. state of Rhode Island and a third the size of Wales) will snap off into the ocean. Widening each day by 3 feet (1 m), the groaning cleft is on the verge of dramatically redrawing the southern-most cartography of our planet and is likely to lead, climatologists predict, to an acceleration in the global rise of sea levels.

An aerial photo of the frigid fissure, taken late last year when it was discovered that the pace of the icy tear was quickening, was suddenly back in the news in early May with the announcement that a second rift in the shelf had been detected. The fracture leads our eye along a zig-zagging path –from the backward gaze of the plane's right engines to the pristine polar blue of the horizon in the distance (see photo). The jaggedness of the cleft, which takes our vision on a journey whose ultimate destination is unfathomable, seems at once monumental and terrifyingly fragile. The photo intensifies our helplessness in the face of cataclysmic change. It freezes the potential destruction in the blink of a camera's shutter, while at the same time hinting at a catastrophe that we can witness unfolding but are utterly powerless to stop.



(Photo: NASA/John Sonntag)

As a visual statement, the aerial photo of the Larsen C crack is, by definition, incomparable; never before has the world marked the glacial advance of such a sublime and fearsome fracture in its very fabric.

Source: <http://www.bbc.com/culture/story/20170505-the-crack-thats-redrawing-the-worlds-map>

Finances: Is Geothermal Competitive?

Following is a note written by Kevin Wallace, from POWER Engineers, and published by New Energy Events in the eve of the GEOLAC 2017 event, held in Mexico City in April 2017.

News on power purchase rates of 40-50 US\$/MWh for new solar-PV plants begs the question – can geothermal be competitive with prices challenging for any but the largest of geothermal projects? We feel geothermal still has a valuable role in the energy portfolio if the wider benefits are considered.

The value to the grid of stable, baseload power with some ramping capability is generally not considered in auctions that are judged merely on costs per MWh. As system operators experience higher penetrations of intermittent resources, like solar (resulting in the infamous “duck curve”), simplistic pricing methods cause distortions in the true cost of grid operations. When pricing shifts to accurately reflect system integration costs, the value of having geothermal in the energy mix will be increased.

Geothermal resources can be used for broader benefits in ways that intermittent solar and wind cannot. In regions reliant on imported fuels or scarce biomass for heating, such as in Europe or the Andes, combined heat and power plants can provide communities with more energy independence. Reliable geothermal projects can provide multiple benefit streams over decades: power, district heating, aquaculture, balneology, or thermal uses for industry clustered in ‘resource parks’. Baseload geothermal power can also be coupled with energy-intensive products such as desalinization, battery storage or fuel synthesis to produce multiple product streams, with production increased at off-peak times.

The continued competitiveness of geothermal will depend on a more accurate accounting for the values baseload plants bring to the grid, and require continued creativity in order to comprehensively integrate geothermal benefits into communities.

Source: <http://newenergyevents.com/is-geothermal-competitive-in-an-era-of-low-cost-renewables/>

Finances: The True Costs of Electricity

The price we all pay for electricity generally does not reflect the ‘true cost’ of producing it. Generating electricity creates harmful pollution, damaging the environment and public health. This comes with a cost, but it is not necessarily paid for by those generating the pollution or purchasing the electricity. These types of costs are known as ‘external costs.’

For example, a coal-fired power plant releases pollution into the atmosphere, which adversely affects the health of residents in nearby communities. This pollution is an example of an external cost because it causes health problems that neither the plant owners nor the electric users pay for (unless they live near the plant and pay the cost through their health bills).

From coal mining and energy production, to distributing and using that energy, to disposing of waste products, electricity has many external costs. By examining them, we can better understand the true cost of electricity and how it varies depending on the technology or fuel used to generate it.

Upstream operations take place before electricity is generated. For fossil-fuel and nuclear generators, the largest upstream external costs are associated with producing, processing, and transporting fuel. For solar and wind, the main upstream impacts are associated with manufacturing and transporting materials required for the solar panels and wind turbines.

The external costs associated with upstream operations can be significant. Natural gas, for example, burns cleaner than other fossil fuels such as coal. However, methane, the primary component of natural gas, is a very potent greenhouse gas – up to 84 times more powerful than CO₂ in the first 20 years it is released into the atmosphere. Leaks and intentional releases of this damaging pollutant during the production, delivery, and use of natural gas, if not addressed, have the potential to negate the environmental benefits of natural gas over coal.

The potential dangers of methane from natural gas operations can be most starkly seen in a massive methane leak at a natural gas storage facility in Aliso Canyon, California. After a well in the facility failed, it leaked a total of 97,000 tons of methane before the gas company was able to plug the leak. This is the short-term climate equivalent of burning almost a billion gallons (3785 million liters) of gasoline.

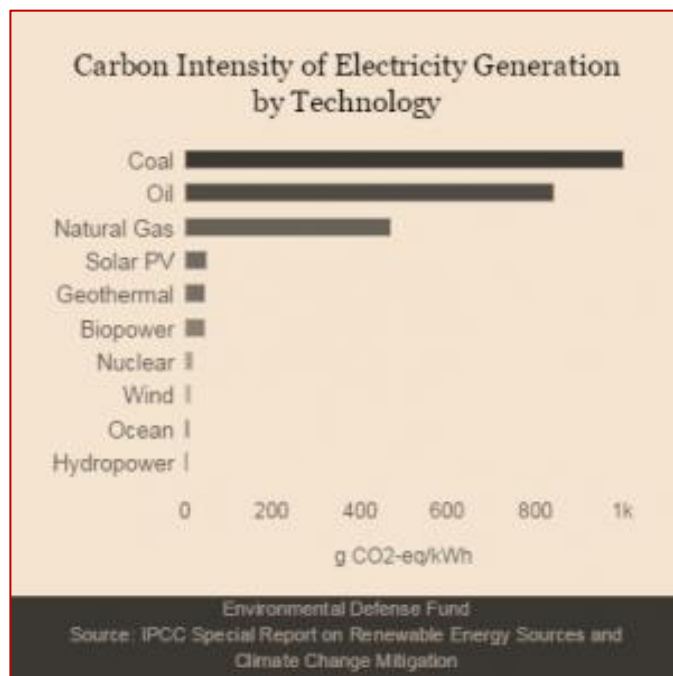
Downstream operations take place during the generation of electricity and its subsequent transmission and distribution to customers.

Pollution from fossil-fuel power plants makes up a significant portion of the downstream external costs associated with electricity generation. The U.S. Clean Air Act regulates and limits the amount of common

pollutants power plants can release, including particulate matter (PM), sulfur dioxide (SO₂), and oxides of nitrogen (NO_x). Emissions of SO₂ and NO_x are also regulated under various cap-and-trade programs. While these programs have substantially reduced SO₂ and NO_x pollution, the remaining emissions from fossil-fuel generators still have adverse health impacts, including premature death and asthma.

For example, a 2005 National Research Council study found that these health impacting pollutants from coal- and gas-fired power plants cost society US\$0.032 and US\$0.016 per generated kWh, respectively. With an average U.S. household using about 11,000 kWh each, the health cost associated with that electricity consumption would be about US\$350 per year if it all came from a coal plant.

In addition to the types of pollution described above, fossil-fuel power plants also release greenhouse gases like CO₂ into the atmosphere, the main culprit of climate change. The carbon intensity of electricity generation varies significantly by fuel and technology, with coal and oil generation producing the most CO₂, while certain renewable energy, like solar and wind, producing none. However, as mentioned earlier, these renewables do produce CO₂ in upstream operations. The following graph shows the total lifecycle carbon emissions for each technology, including upstream and downstream emissions.



A coal-fired plant emits about one ton of carbon for each 1000 kWh of electricity it generates over its lifecycle. In 2013, the U.S. Government updated its estimate of the cost to society of each ton of carbon emitted (also known as the ‘social cost of carbon’) and valued it at approximately US\$40 per ton. Based on that

estimate, on average the climate-related damages from coal plants equal US\$0.04 per kWh. However, US\$40 per ton is an underestimate because not all climate damages are considered in this figure.

Overall, the electric power sector contributes significantly to the nation's carbon emissions – equaling almost 40% of total U.S. emissions in 2015. Based on the social cost of carbon, climate-related damages from the power sector were nearly US\$80 billion in a single year. That cost is mostly borne by current and future generations through increased frequency of extreme weather events like flooding, drought, storms, etc.

Certain power plants need large amounts of water to operate, reducing water quality and intensifying drought in some areas. For example, these plants occasionally release chemical pollutants into nearby lakes or rivers. Even when these instances are limited and regulated, there are still occasional, accidental releases like the 2014 Dan River coal ash spill in North Carolina. Importantly, solar and wind require no water to produce electricity, making them a less costly choice in terms of water impacts.

So what should we do with these external costs now that we know more about them? Incorporating the health and environmental costs of electricity into the price we pay for it is one solution for which the Environmental Defense Fund is advocating. Doing so will help reduce pollution and ensure a level playing field for clean energy in our electricity markets, creating a cleaner system for everyone.

Source:

<http://blogs.edf.org/energyexchange/2016/04/28/the-true-cost-of-electricity-what-were-not-paying-for-through-our-utility-bills/>

Debate: Can the U.S. Grid Work With 100% Renewables?

A battle between competing visions for the future of energy blew open on the pages of a venerable science journal. The conflict pits 21 climate and power-system experts against Stanford University civil and environmental engineer Mark

Jacobson and his vision of a world fueled 100 percent by renewable solar, wind, and hydroelectric energy. The criticism of his 'wind, water, and sun' solution and an unapologetic rebuttal from Jacobson and three Stanford colleagues appeared in the past June's issue of Proceedings of the National Academy of Sciences (PNAS).

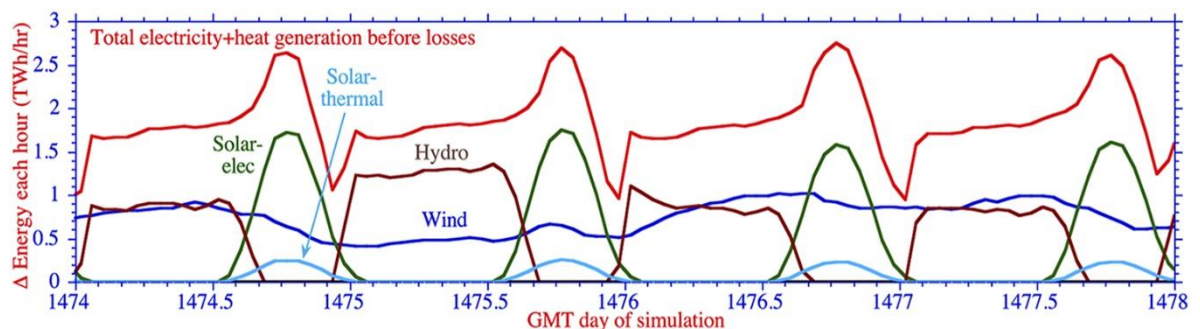
The critics enumerate what they view as invalid modeling tools, modeling errors, and "implausible and inadequately supported assumptions" in a projection of the midcentury U.S. energy supply that Jacobson and his coauthors published in PNAS in 2015. "The scenarios of [that paper] can, at best, be described as a poorly executed exploration of an interesting hypothesis," write the experts, led by Christopher Clack, CEO of power-grid-modeling firm Vibrant Clean Energy.

Clack says their primary goal is accurate science, the better to equip policymakers for critical decisions: "We're trying to be scientific about the process and honest about how difficult it could be to move forward."

The text and statements by Clack's coauthors question Jacobson's evaluation of competing energy technologies, and specifically his rejection of two nonrenewable energy options: fossil fuel power plants equipped to capture their own carbon dioxide pollution, and nuclear reactors.

In fact, while both sides claim to be objectively weighing the energy options, the arguments and backgrounds of the protagonists belie well-informed affinities for various energy sources (and informed biases against others). As sociologists of science would say, their choice of data and their reading of it reflects hunches, values, and priorities.

The weakest point in Jacobson's 2015 paper identified by his critics is a heavy reliance on hydropower plants, which serve as his simulated power grid's backstop energy supply during long periods of weak sun and becalmed winds. This jumps out in the graph [below], which simulates total continental U.S. heat and power generation over four days in January 2055. Hydro



Four Days in 2055: Dynamic heat and power supplies in the wind, water, and sunlight-fueled continental U.S., simulated by Mark Jacobson. Illustration: Arizona State University/PNAS

turbines ramp up heavily each day after the sun sets, delivering as much as 1,300 gigawatts at their peak—a level that implies a 15-fold expansion in hydropower generating capacity.

However, no such expansion is documented in the 2015 paper. Critic-in-chief Christopher Clack argues that it is a modeling error because, according to his analysis, adding the required turbines at existing dams is not physically possible. And even if it were, he says, discharging the hydropower as described would impose unacceptable impacts on aquatic ecosystems and downstream water users. Invalidating that option, says Clack, means Jacobson's scheme will cause blackouts: "The whole system breaks down."

Jacobson admits the 2015 paper was "vague" on the hydropower upgrade but stands by its technical and economic viability. The environmental impacts, he says, reflect a cost that policymakers pursuing his road map would need to consider. All clean energy solutions will require trade-offs, says Jacobson, noting that the low-carbon grid projection that made Clack's reputation, a 2016 report in *Nature Climate Change*, calls for a much larger build-out of unpopular powerlines.

What is certain, from the darkening findings of climate science, is that climate change calls for a bold remake of the global energy system of the sort that both Clack and Jacobson have championed.

The U.S. power sector is bracing for the release of a power grid study ordered by President Trump on whether renewable energy installations degrade grid reliability by undermining continuously operated 'baseload' nuclear and coal power plants. U.S. Energy Secretary Rick Perry's memo commissioning the study states as fact that "baseload power is necessary to a well-functioning electric grid."

The Rocky Mountain Institute's Mark Dyson and Amory Lovins called out that "curious claim," which they say, "has been thoroughly disproven by a diverse community of utilities, system operators, economists, and other experts that moved on from this topic years ago." What the grid needs, they write, is flexibility, not baseload power plants.

Dyson and Lovins' prescription for the power grid community, meanwhile, is unity: "The grid needs a symphony, not a shouting match."

Source:

http://spectrum.ieee.org/energywise/energy/renewable/s-can-the-us-grid-work-with-100-renewables?utm_source=Tech+Alert&utm_medium=E-mail&utm_campaign=TechAlert_06-22-17&bt_cc=POEiYqZilcPjuAdHZbYVOR6GT1mbwdEc2XIBxHap2WblSmTEKKa3f2tIz57Y5H5r&bt_ts=1498151676220

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