



Geothermal Energy: Opportunities and Challenges

A workshop funded from the collaborative projects Geo-Coat and S4CE



Agenda

Speakers and Participating Organisations





Date: 10th of October 2019
Venue: TWI Ltd, Granta Park,
Great Abington, Cambridge, CB216AL

The Workshop regarding geothermal energy will be taking place at TWI in Granta Park, on the 10th of October 2019.

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The workshop Geothermal Energy: Opportunities and Challenges targets to identify challenges with geothermal exploitation and demonstrate the techno-economic solutions through contributions of H2020 projects S4CE and Geo-Coat. This workshop is supported from the collaborative projects S4CE and Geo-Coat under grant agreement numbers 764810 and 764086 respectively.



Geothermal at TWI

Building on its expertise and knowledge in **coatings, material properties and performance**, plant management, and joining technologies, TWI pioneers geothermal energy research by providing solutions to help improve flexibility and efficiency of **geothermal systems**, while reducing plant operational costs, including provision of holistic approaches for cheap and efficient drilling solutions.

TWI is working on a number of **geothermal** heat and power projects - our current collaborative initiatives include:

GeoCoat: Developing Next Generation Coatings for Geothermal Power Plant (<http://www.geo-coat.eu/>)

Led by TWI, the **project** aims to develop novel high performance, specialised corrosion- and erosion-resistant coatings for exceptionally harsh environments. These high performance corrosion and erosion resistant coatings are based on selected high entropy alloys (HEAs) and ceramic/metal mixtures (Cermets) to be applied through high velocity oxy fuel (HVOF) thermal spray, electro spark deposition (ESD), electroless plating, and laser cladding.

Although originally designed to target the key failure points within geothermal power plants, the coatings developed have cross sector benefits and can potentially be applied to other sectors, such as glass, paper, oil and gas, food and drink, etc.



Geo-Drill: Holistic Drilling Solutions for Cheaper Geothermal Power (<https://www.geodrillproject.eu/project>)

The **project** aims to reduce the high costs associated with drilling by addressing the **materials challenges** associated with the wear and fracture of drilling components. The Geo-Drill concept is based on three technology pillars:

- a) Reduced drilling cost through hydraulic DownTheHolefluid/mud hammer
- b) Advanced drill monitoring through low-cost and robust 3D printed sensors
- c) Improved component life through advanced materials and coatings





The strength of these technologies will be combined to meet the unified objective of developing novel drilling technologies that will significantly reduce the cost of deep geothermal drilling, with a targeted depth of 5 km and high temperatures of 250°C and above.



GeoSmart: Towards Flexible and Efficient Geothermal Systems (<https://www.geosmartproject.eu/>)

Geothermal energy is currently engineered as an "always on" baseload supply in power generation, due to the limited flexibility to throttle the well without scaling and liner fatigue problems, and is engineered for maximal efficiency at this output level. Project **GeoSmart**, aims to address the strategic flexibility required from European geothermal installations, as they become significant energy sources over the next 20-30 years, replacing decommissioned fossil fuel plants.

GeoSmart aims to optimise and demonstrate innovations to improve the flexibility and efficiency of geothermal heat and power systems, by developing a suite of equipment and tools including:

- a) Energy storage and power block management innovations to provide daily flexibility
- b) Integration of more flexible Organic Rankine Cycle (ORC) systems that can cope with variations in needs in the electricity markets
- c) Combined Heat and Power (CHP) supplier to extract more heat from the post-generator ("waste" heat) brine outflows when required for increased heating supply during colder weather





S4CE: A well-established interdisciplinary network of scientists to trust the environmental safety of geo-energy operations (<https://science4cleanenergy.eu/>)

The Horizon 2020 project S4CE aims to develop, test and implement technologies needed for successfully detecting, quantifying and mitigating the risks connected with geo-energy operations in the sub-surface. It includes 23 partners, representing academic institutions, industry energy operators, industrial partners and research institutes. The consortium is led by UCL. S4CE deploys advanced instrumentation in three existing field sites in Europe: the CarbFix site in Iceland, one geothermal operation in Cornwall and a water-gas well in St. Gallen, Switzerland.

S4CE's ambition is to develop and implement state of the art technologies to assess the environmental footprint of geo-energy sub-surface operations in EU. The project promotes the benefit of a multi-sensor approach in managing sub-surface operations. TWI is leading the work carried out in WP6 within the project related to the Implementation of Novel Technologies in the field sites described before.





Agenda

Meeting venue: Granta Room, TWI Ltd

08:30 Arrival, Registration and Refreshments

08:45 Short video interviews

Session 1

Current market trends and state of the power sector: Are we ready for a geothermal revolution?

10:00 Welcome

Paul Woollin, Director Research and Technology (TWI)

10:15 From Oil and Gas to Geothermal

Chris Punshon, Industry Group Manager, Power, Equipment and Infrastructure (TWI)

10:30 Geothermal for Sustainable Development

Marit Brommer, Executive Director (IGA)

10:45 Turkish Geothermal Development-Zorlu Energy Case Study

Ural Halaçoğlu, Project and Business Development Assistant Manager (Zorlu Energy)

11:00 Thematic Core Service Anthropogenic Hazards - Step-change in Tackling Grand Challenges of Hazards Associated with Exploitation of Geo-resources

Piotr Salek, Geophysicist at the Department of Seismology (IGF)

11:15 Geothermal energy: new challenges for a cornerstone in renewables

Massimo Luchini, Project Manager for geothermal projects (Enel Green Power)

11:30 Coating testing, demonstration, and hybrid cooling for low temperature geothermal plants: results of the H2020-project MATCHING

Johan Van Bael, Project Manager (Vito)

11:45 Applications of fluid-rock interaction experiments to estimating permeability evolution in geothermal systems: the Cornish Granite case study

Catalina Sanchez-Roa, Research Associate (UCL)

12:00 Lunch break and networking



Session 2

Solutions to materials and casing challenges: Showcasing H2020 initiatives at TWI

S4CE Project

13:30 United Downs Deep Geothermal Project

Sofia Sampethai, Senior Project Leader, Condition and Structural Monitoring section (TWI)

13:45 Condition monitoring for defect detection in geothermal well casings

Sofia Sampethai and Jialin Tang, Project Leaders, Condition and Structural Monitoring section (TWI)

14:00 Fracture and Fatigue testing in sour environment – You can choose the strongest one but it still breaks when things turn sour

Fokion Oikonomidis, Senior Project Leader, Asset Fracture Management section (TWI)

14:15 Q&A

Geo-Coat project

14:45 The main erosion, corrosion in geothermal power plants

Sæmundur Guðlaugsson, Manager of Turbines and Workshop (ON Power)

15:00 Development of high level coatings for geothermal applications

Francesco Fanicchia, Senior Project Leader, Surface Engineering Section (TWI)

Sigrún Nanna Karlsdóttir, Professor in Mechanical Engineering (University of Iceland)

15:15 Q&A

Session 3

15:45 Panel Discussion

What are the obstacles to economic exploitation of geothermal energy resources in terms of:

1. Specification and build of geothermal plant?
3. Operation, maintenance and repair?
4. Environmental issues?
5. Financing and return on investment?
6. Public perception and acceptance?
7. Energy use and storage?

16:30 Closing remarks





Speakers



Dr. Paul Woollin
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Paul Woollin is Research and Technology Director at TWI, responsible for the Technology Group's £45m business, which provides research and technology solutions in materials joining and structural performance to the TWI Industrial Members. His technical work included generating the data that underpins standards for the avoidance of hydrogen induced stress cracking in duplex stainless steels and guidance for the welding of supermartensitic stainless steels to avoid stress corrosion cracking.



Dr. Chris Punshon
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Chris Joined TWI in 1983 as a project leader following graduation with an Honours degree from Sheffield University in Metallurgy BMet (hons) after a brief period post-graduation 1982-83 working again as a heavy goods vehicle fitter and arable/livestock farming.

He has conducted a significant number of large and varied research programs mainly focused on the power sector as well as oil and gas and marine industries examining the relationships between materials, properties and performance in a wide range of materials and environments. For several years he was responsible for the development of advanced joining process technologies for pipelines and pressure plant seeing development from grass roots R&D to commercialisation, code approval and industrial exploitation.

His various roles within TWI since involved definition of a renewed business strategy focusing on TWI key strengths and the emerging opportunities in nuclear fusion and fission and renewable energy sectors including offshore wind, solar PV, hydro, tidal stream and feeding a childhood passion for geothermal energy.

Lately, in 2017, following a re-structuring of the business development team Chris was made responsible for the Industry Group covering Power, Materials equipment and Infrastructure with responsibility for an annual R&D budget of over £15m.



Dr. Namrata Kale
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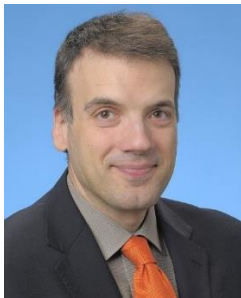
Namrata Kale is a Collaborate Project Manager in the Materials Business Development Section. Her current activities includes management and delivery of European and Innovate UK projects across different sections within the Materials group. Namrata also manages the dissemination and exploitation activities of the projects including website management, social media, interfacing with similar initiatives in other organizations, and organizing workshops and webinars. She has a PhD in Organic chemistry.



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Sofia Sampethai is a Senior Project Leader at TWI Ltd in the Condition and Structural Health monitoring section. She has a master's degree in Process Engineering and Nanotechnology. Sofia is a Chartered Engineer and a member of the Welding Institute. She has been working as a manager in numerous projects ensuring their prompt delivery based on the clients' requirements. She has worked at ABB Research Centre in Switzerland, IBM Nanotechnology Centre and at Centre for Research and Technology in Greece managing collaborative projects. She has a Bachelor in Chemical Engineering and a Master at ETH Zurich in Process Engineering with specialization in Nanotechnology.



Dr. Fokion Oikonomidis
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Fokion is a mechanical Engineer with specialization in fracture mechanics. He is working at TWI where he has developed expertise in small and large-scale fracture toughness testing in air, seawater, and sour environments. Before joining TWI, he has worked in the area of Fracture Mechanics in a research Centre in Belgium. He is a chartered mechanical engineer with work experience in the fields of water and wastewater treatment, building services, health and safety and business process management in the aerospace industry. He holds a PhD in Mechanical Engineering, a PhD in Business and Management, and an MBA degree in general business administration.



Dr. Jialin Tang
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Dr Jialin Tang has extensive experience in structural health monitoring techniques including acoustic emission and guided wave techniques. Her PhD research focused on developing pattern recognition techniques to identify the failure modes on acoustic emission signals acquired from the fatigue damage progression in complex composite structures. Through her PhD, Jialin Tang developed advanced mathematical techniques in pattern recognition to benefit engineering. In January, 2017, Jialin became a Project Leader at TWI. Her activities in the section includes managing collaborative projects, liaising with clients on technology requirements and managing prototype condition monitoring system development.





Dr. Francesco Fanicchia
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Francesco joined TWI in 2018 as a Senior Project Leader in the Surfacing section, after a PhD focused on novel Thermal Barrier Coatings (TBC) for aerospace applications. Francesco now coordinates European (Horizon2020), Innovate UK and single client projects, primarily focusing on novel coating materials for aggressive environments deposited through cold spray and thermal spray technologies.



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Ural Halaçoğlu has been working in Zorlu Energy Group for 6 years as a Project and Business Development Assistant Manager in Investments Department. He is mainly focused on Geothermal Power Plant projects both in Turkey and all over the world. He obtained his Master's Degree in Yıldız Technical University in 2015. He is now studying his Ph. D. at the same university by focusing on Geothermal Power Plant Design and Optimisation. He has contributed the investment, construction and commissioning activities of 45 MWe Alaşehir-I GPP and 165 MWe Kızıldere-III GPP which has the largest geothermal plant capacity in Turkey. He is now responsible for the development of new projects and fields. He is also working as the official company coordinator of European Union funded Horizon2020 R&D projects such as GECCO, GeoSmart and GEOPRO



Marit Bente Brommer
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Marit graduated as a Geologist in 2002 and finished her PhD in 2007 in Exploration Geophysics. Until 2016, Marit was working in the Oil and Gas Industry as Advisor, in Operations and as Technology Deployment Lead.

In 2017 she joined the International Geothermal Association (IGA), a non-profit registered in New Zealand, as their Executive Director with the ambition to make Geothermal a successful player in the Renewable Energy Transition.



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Piotr is currently a Geophysicist at the Department of Seismology, Institute of Geophysics Polish Academy of Sciences, in Krakow, Poland. He holds an MSc in Exploration Geophysics from the Faculty of Geology, Geophysics and Environmental Protection of the AGH University of Science and Technology in Krakow and a BSc in Geodesy and Cartography from the Mining Geodesy and Environmental Engineering Department of the AGH University of Science and Technology in Krakow. He has also been working as a Senior Geophysicist for Seismic Imaging in Crawley, MAERSK and TOTAL.



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Sæmundur Guðlaugsson is working for the Icelandic Geothermal company ON Power. He has been working there for the past nine years, first as Maintenance manager, then Technical director and now as Manager of turbines and workshop. Sæmundur established the turbine workshop at ON Power in 2013 and developed repair techniques in the workshop for turbine parts, namely for





rotors and diaphragms. Before joining ON Power, he was a chief engineer on fishing vessels for 23 years.

Sæmundur has been on boards of maintenance societies in Iceland since 2010. He graduated from the University of Reykjavík with a Master's degree of Project Management MPM in 2019. Father of four children and married for 31 years, he also has eight grandchildren, lives in Reykjavik and is interested in summer house construction and planting.



Dr. Sigrún Nanna Karlsdóttir
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Sigrun Nanna Karlsdottir is a Professor in Mechanical Engineering at the University of Iceland. She received her B.S. degree in Mechanical and Industrial Engineering in 2003 from University of Iceland and her Ph.D. degree in Materials Science and Engineering from University of Michigan in USA in 2007. Dr. Karlsdottir's research focus is on material performance in challenging environments, specifically regarding corrosion and scaling in geothermal environment. Her recent involvement in projects in national and international collaboration includes corrosion studies of coatings in high-temperature geothermal environment and research on corrosion behavior of corrosion-resistant alloys in simulated high temperature deep geothermal environment. She has published over 40 papers in her field, received research grants from international and national research funds and consulted Icelandic energy companies in matters related to corrosion and material selection in geothermal environments. Dr. Karlsdottir is co-founder of Gerosion Ltd. an engineering consulting and R&D Company, where she has served as a COB since 2014. She is also board member of the Geothermal Association of Iceland (GAI) since 2018 and served as a session chair in 2017 and co-chair in 2018 for the symposium Geothermal Scaling and Corrosion at the annual conference CORROSION organized by the National Association of Corrosion Engineers (NACE).



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Massimo has a Degree in Geology from University of Pisa (Italy) in 2005 with a thesis on Applied Mineralogy. After some years of experience in geotechnical geology for Civil Engineering, joined oil & gas industry where he worked for about 5 years for service companies on field. Joined Enel in 2012, in the Up Stream Gas department, working in the drilling operations group. From 2016 joined to Enel Green Power, where he is working as project manager for geothermal innovation.



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Johan Van Bael (male), has a Master's Degree in electromechanical engineering. As a project manager since 1995 he worked on several regional, national and European projects both for the government and for the industry on cooling and heating systems, conversion systems (ORC, heat pumps and heat exchangers), cogeneration, thermal energy storage and renewable energy sources. He is currently project manager for the research group on conversion systems (heat pumps, heat exchangers and ORC) and thermal energy storage. Johan is expert in different European projects like FP7 Merits, FP7 E-Hub, H2020 Story, H2020 MATCHING, H2020 FHP, H2020 Res4Build, H2020 Geosmart, H2020 Excess and different KIC EIT projects like KIC Energy Storage, KIC Estore and KIC Flex². He is also inventor of several VITO patents.



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Dr Catalina Sanchez-Roa is a Postdoctoral Research Associate in the Department of Earth Sciences at University College London. She is part of the Science for Clean Energy team, a European-wide research consortium assessing the risks of clean energy operations. Her current research focuses on the study of geothermal energy in Iceland and The UK (Cornwall) by combining field, experimental and modelling approaches. She uses experimental rock mechanics and mineral analysis techniques to understand the response of fracture zones to fluid flow, and the evolution of physical properties of reservoir rocks when subject to changes in pressure, temperature and fluid chemistry.