The global geothermal power market

- USA: +25MWe
- Turkey: +30MWe
- New Zealand: +32 MWe
- Indonesia: +143 Mwe

World: 16GWe
The global geothermal power market

- Electrification of the economy and development is a major factor of investment on the global market (Kenya, Indonesia, Philippines, Turkey...)
- Low T°C plants have seen little development globally
- Drive towards projects better integrated within the community
The role of PPAs in the global geothermal market

- Europe differs from the global market: feed in tariffs play a more important rôle in plants business models
- Core focus of geothermal developers is reducing uncertainty (geological risk and incomes): PPAs are an important factor in many markets
- Geothermal is also advantageous in a PPA framework, providing security of supply to consumers
Global geothermal heating and cooling market

• Total use of geothermal H&C globally potentially 110 GWth (Europe: 28-35 GWth)
• The global geothermal heating and cooling market is quite fragmented
• Local political, economic and social factors affect the nature of markets:
  • E.g. higher centralisation in China, greenfield cities v. outdated infrastructure framework in the USA and low planification
• Agri-food sector is a core focus of the global geothermal heating and cooling industry
• Cooling is also a key driver of geothermal heat pumps development
Lithium and the global geothermal market

- Geothermal recognised as strategic sector in the race to secure lithium supply (IRENA, EC)
- Main focus is USA and Europe
- Lithium currently is a marginal topic for many actors, but a core political driver of support to the industry
# Lithium and the global geothermal market

<table>
<thead>
<tr>
<th>Country</th>
<th>Location</th>
<th>Name of the project</th>
<th>Production</th>
<th>Consortium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada</td>
<td>Leduc</td>
<td>Alberta Lithium Project</td>
<td>Lithium/Heat</td>
<td>E3 METALS CORP.</td>
</tr>
<tr>
<td>Chile</td>
<td>Laguna Brava, La Raya</td>
<td>Laguna Brava Project</td>
<td>Lithium only</td>
<td>MGX Minerals – PureLinc</td>
</tr>
<tr>
<td>France</td>
<td>Vendenheim</td>
<td>Vendenheim</td>
<td>Lithium/CHP</td>
<td>Fonroche</td>
</tr>
<tr>
<td>France</td>
<td>Soultz-Sous-Forêt</td>
<td>Soultz-Sous-Forêt</td>
<td>Lithium/Elec</td>
<td>ES Geothermie</td>
</tr>
<tr>
<td>France</td>
<td>Rittershoffen</td>
<td>Rittershoffen</td>
<td>Lithium/Heat</td>
<td>ES Geothermie</td>
</tr>
<tr>
<td>Germany</td>
<td>Inhein</td>
<td>Inhein</td>
<td>Lithium/CHP</td>
<td>Pfalzwerke geofuture GmbH, Vulcan Energy Resources Ltd.</td>
</tr>
<tr>
<td>Kenya</td>
<td>Olkaria</td>
<td>Olkaria geothermal plant</td>
<td>Lithium/CHP</td>
<td>KenGen</td>
</tr>
<tr>
<td>New Zealand</td>
<td>Taupo</td>
<td>Ohaaki</td>
<td>Lithium/Elec</td>
<td>Geo40</td>
</tr>
<tr>
<td>USA</td>
<td>Hell's Kitchen, California</td>
<td>Hell's Kitchen Lithium</td>
<td>Lithium/Elec</td>
<td>Controlled Thermal Resources, HATCH (engineering consultant)</td>
</tr>
<tr>
<td>UK</td>
<td>Gwennap</td>
<td>Cornish Lithium</td>
<td>Lithium only</td>
<td>Cornish Lithium</td>
</tr>
<tr>
<td>USA</td>
<td>California</td>
<td>Various project</td>
<td>Lithium only</td>
<td>MGX Minerals – PureLinc</td>
</tr>
<tr>
<td>USA</td>
<td>Goldfield, Esmeralda County</td>
<td>Kibby Basin lithium brine property</td>
<td>Lithium only</td>
<td>MGX Minerals - Belmont Resources - (Quintec MT, Harris Drilling)</td>
</tr>
</tbody>
</table>
Technology focus: Digitalisation

• Focus on efficiency, shorter development time, reduced risk and increased precision: i.e. reduce costs, but also enable new projects!

• Key innovations often depend on digitalisation (subhorizontal drilling, multidrain, flexible plants, UTES, closed loops plants...)

• Specific challenge: operating conditions of digital sensors
Technology focus: Digitalisation challenges

• Managing the amount of information created to generate value (question of ownership of information, and role of economies of scale in the industry)

• Reluctance from project developers to be locked into an overwhelming digital service contract that reduces their operational flexibility

• Need to balance the benefits in terms of efficiency and safety for workers, with the demands for accountability in job creation
Drivers of digitalisation in heating and cooling

Drivers
- Cost reduction
- New business opportunities
- Improved comfort

Barriers
- Lack of information and clarity
- Fragmented field

Components of H&C digitalisation
- Software (apps, UEX, could services...)
- Data treatment
- Hardware (data storage, broadband availability...)
- Controls and equipment
- Data acquisition equipment (meters, sensors...)

Regulatory frameworks conditioning digitalisation
- Cybersecurity
- Standardisation
- Privacy and data treatment
- Energy market rules...

Digitalisation Benefits
- Energy transition drive
- Flexibility and efficiency
- Energy savings
- New energy services
Thank you to all the national coordinators!

Olof Andersson (Lund University), Teppo Arola (Geological Survey of Finland), Burcu Arslan (JESDER), Fausto Batini (Magma Energy), Finnur Beck (SAMORKA), Gioacchino Bellia (Enel GP), Carlos Alberto Bicudo da Ponte (EDA Renovaveis), Christian Boissavy (AFP), Dario Bonciani (COSVIG), David Charlet (IDEA), Robert Colbach (Service Géologique du Luxembourg), Margarita de Gregorio (GEOPLAT), Andre Deinhardt (BVG), Gregor Dilger (BVG), Ivan Djokic (GECO Ing), Matus Gajdos (GA Drilling), Robert Gavriliuc (Romanian Geothermal Society), Signhild Gehlin (Svenskt Geoenergicentrum), Gregor Götzl (Geological Survey of Austria), Marek Hajto (MEERI PAS), Oto Halás (Slovgeotherm), Elaysa Heller (BVG), Lars Henrik Nielsen (GEUS), Beata Kepinska (MEERI PAS), Attila Kujbus (GEOEX), Ben Laenen (VITO), Andrej Lapanje (Geological Survey of Slovenia), Katharina Link (Geothermie-Schweiz), Luchini Massimo (Enel GP), Dimitrios Mendrinos (CRES), Sara Milanesi (Exergy), Sara Montomoli (Enel GP), Thor Erik Musæus (Geothermal Energy Nordic AS), Mette Olivarius (GEUS), Sibela Oudech (GECO Ing), Paloma Pérez (GEOPLAT), Estelle Petitclerc (Geological Survey of Belgium), Riccardo Pasquali (GEOSERV), Armand Pomart (AFP), Sanja Popovska-Vasilevska (Macedonian Geothermal Association), Dušan Rajver (Geological Survey of Slovenia), Marcel Rosca (U. Oradea), Ufuk Şentürk (JESDER), Davide Serra (Enel GP), Virginie Schmidlé (AFP), Spanish Institute for the Diversification and Saving of Energy, IDEA, Romina Taccone (Enel GP), Loredana Torsello (COSVIG), Marco Vichi (COSVIG), Janine Verweij (Geothermie NL), Sanja Živković (EIHP)
Thank you for your attention!