Proposed Joint Activity

Financial Instruments and Funding of *Geothermal Projects*

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Geothermal ERA NET Meeting
Hotel Livada Prestige, Slovenia
14 October, 2016
Overview of the presentation

• Objectives and Structure of the Project

• Funding of RD&D

• Funding of Geothermal Projects
Overview of the presentation

- Objectives and Structure of the Project
  - Funding of RD&D
  - Funding of Geothermal Projects
The Overall Objective

- To **improve the synergies** between different players

- Better understanding of this financial landscape - to **highlight barriers and recommend practical solutions**

- Knowledge exchange will **enhance cooperation** and lower barriers and improve joint programming and **better funding instruments and opportunities**.
Process description

• Analyse the financial instruments that are available - and map the operational structure of the different national funding bodies

• Highlight the main barriers and opportunities, and how these instruments can more easily work together
Aims, Outputs and Priorities

Proposed Joint Activity

Financial Instruments and Funding of R&D and Geothermal Projects
Structure of the Project

Increase Utilisation and Opportunities of Financial Instruments and Funding to R&D and Geothermal Projects in Europe to increase Growth of Geothermal Activities, Energy Security, Savings and Quality of Life

Aims, Overall Objective

Outcome

Outputs

Increased knowledge, Cooperation, Utilization and Effectiveness of Geothermal Funding for R & D Activities

Increase knowledge, Cooperation, Access and Financing Possibilities for Geothermal Projects

Priority 1 Mapping of funding policy for geothermal R&D activities
Priority 2 Highlight barriers and opportunities of geothermal R&D activities
Priority 3 Mapping of geothermal financial and funding project policy
Priority 4 Highlight barriers and opportunities of geothermal funding instruments
## Activities and Deliverables

### Activities
- Coordinated desk research – meeting with experts – collection of data from countries
- Evaluation of existing instruments and national markets
- Working meetings e.g. with stakeholders regarding relevant topics
- Drafting report
- Evaluation of option regarding - possible Joint Call

### Deliverables
- Report - Recommendations for financial instruments for the development of geothermal R&D and for the development of geothermal projects in Europe.
- Conclusion Seminar - Barriers & Opportunities and Policy recommendation.
  - National research funding
    - Needs –Barriers – Opportunities and Policy recommendation.
  - Financial funding for geothermal projects
    - Needs –Barriers – Opportunities and Policy recommendation
- Implementation of Joint Call
Overview of the presentation

• Objectives and Structure of the Project

• Funding of RD&D Survey

• Funding of Geothermal Projects
As perhaps was to be expected the responses are very varied and unique to each country.

Geothermal is not high on the agenda of most partners and statistical data on geothermal as part of renewable is scarce.
Policy and Sectorial Factors

- **Unclear vision on geothermal issues at the European level**: 59%
  - High: 23%
  - Medium: 14%
  - Low: 14%
  - Factor does not contribute at all: 5%

- **Lack of commitment to the geothermal sector by national government**: 55%
  - High: 36%
  - Medium: 36%
  - Low: 5%
  - Factor does not contribute at all: 5%

- **Lack of staff mobility opportunities**: 41%
  - High: 14%
  - Medium: 36%
  - Low: 9%
  - Factor does not contribute at all: 5%

Source: Geothermal ERA-NET WP 6.2 Identification of Training Needs and Knowledge Gaps
Funding of RD&D

• Funding is allocated by public competitive funds.
• In many cases more than one fund is applicable for a category of research.
• However, one fund can also be applicable to more than one type of category of research.
• Occasionally funding is dedicated to geothermal energy research however more often not.
• Funding is mostly national, and only a few countries have the possibility of funding foreign parties.
RD&D Funding Challenges

Support to H/C in the H2020 energy challenge: from R&D to implementation

R&D
Commercial Application

From R&D to commercial application (EE-13, LCE-2, LCE-3)

Project intention & planning

Working with market actors -> decision making (EE14, LCE4)

Detailed design & financing

Procurement contracts

Investments

Projects

Project development assistance to public and private project promoters (EE20)

Support to all these stages is provided under the EC H2020 Energy Challenge via Call for Proposals
RD&D Funding Challenges

Where is H/C in the H2020 energy challenge?

**Energy efficiency**
- Buildings, consumers, products
- Industry – heat recovery (EE18)
- Heating and Cooling (EE-13, EE-14)
- Finance for sustainable energy

**Smart Cities and Communities**
- SC&C solutions integrating energy, transport and ICT sectors – lighthouse projects (SCC-1)
- others

**Low Carbon Energy**
- RES E and H/C technologies (LCE-2, LC-3, LCE4)
- Energy storage
- Sustainable bio fuels
- others

H/C is included in a number of topics of the Energy Challenge

Actions supported go from R&D to market uptake and include DHC
Topic EE 14: Removing market barriers to the uptake of efficient H/C

1. SPECIFIC CHALLENGES
Action is needed to remove non-technological (including legislation) barriers to exploit the full potential of efficient H/C

2. SCOPE
A number of areas relate to DHC, for example:

- Identifying, developing, and promoting new markets for the recovery of heat from industry
- For district heating and cooling industry
  - improve the transparency of the market and increase consumer trust
  - exchange of information, best practice examples, consumer practices, motivations and barriers
- Heating and cooling planning
RD&D Funding Challenges

- Legal basis
- Dedicated /
general funding
- Ability to fund
activities abroad
- Call process
- Selection process
- Award process
- Reporting
- Quality control
- Assessment of impact

Universities (via Swiss National Fund SNF and Cantons) – 0.5 million
ETH-Domain – 1 mln
Unis of Applied Sciences – < 0.1 mln
Private sector
SNF – 1.5 mln
Comm for Tech. & Innov. – 0.2 mln
Swiss Federal Office of Energy – 3.5 mln

Typical figures – annual funding in Fr. / € mln
• A lot of barriers are mentioned in regards to geothermal energy research

• In all categories; technological, economical, commercial, organizational and political
  ➢ … most in technological and political

• Opportunities were also mentioned by all participants, both already established ones as well as future ones. Ranging from awareness raising to the potential of collaboration between stakeholders.
Barriers according to survey

- Lack of commitment to the geothermal sector by national government (50%)
- Lack of collaboration and coordination between stakeholders (e.g., industry, academia, and policy makers) (47%)
- Lack of continuous education within the sector (33%)
- Too few geothermal training opportunities (33%)
- Unappealing operational environments for companies within the geothermal sector (28%)
- Lack of appropriate trainers (28%)
- Lack of national collaboration and coordination between educational and training partners (26%)
- Lack of training opportunities for individuals within similar sectors that want to relocate to the geothermal sector (22%)
- Too few geothermal courses at the tertiary level (21%)
- Unappealing working conditions of employees within the geothermal sector (17%)
- Unappealing image of the geothermal sector (17%)
- Lack of staff mobility opportunities (17%)
- Lack of international collaboration and coordination between educational and training partners (17%)
- Little variety of geothermal courses at the tertiary level (17%)
- Lack of student mobility opportunities (11%)
- Little variety when it comes to geothermal training opportunities (11%)
- Unclear vision on geothermal issues at the European level (67%)

GEOTHERMICA – a fixing tool
Key Recommendations RD&D

- Amount of funding is not enough. More joint plan and cooperation between national and European stakeholders.
- Look at the market and try to see what elements are needed for the market. Role of public authorities is important there.
- Being able to speak in a single voice, and express the opinion of the geothermal industry.
- Strengthening the organization. Bring together academia and industry. Position the sector as one that can provide reliable affordable technology.
  - Action: Geothermica
- The geothermal sector is very broad one. We need to create better links between these sectors.
- Stick to the geothermal roadmap. Funding by national programme owners with an add-on from EU and the Industry is recommended.
Key Recommendations RD&D

... from the Brussels meeting:

• more funds fully committed to the field of geothermal energy are needed

• mutual virtual funds for international cooperation, leaning on transnational agreements for intellectual exchange

• more cooperation
  • bringing academia and industry closer together

• technological platform

• awareness raising of geothermal energy
Future Growth of Geothermal

Conditions, necessary for further growth of the utilization of geothermal energy in general fall into three categories:

• Financial:
  • instruments that meet the challenges of high investments, uncertain success, long pay-back period for district heating systems.

• Legislation/regulation:
  • a need for adequate and transparent legislation. Adjustment period for permits should be reasonable.

• Geological issues:
  • knowledge of the resources, availability of relevant data, knowledge on re-injection issues (WP2 D2.1).
Seminar of Experts in Brussels 5 October 2015, on Geothermal Opportunities and Policy Recommendation
Overview of the presentation

- Objectives and Structure of the Project
- Funding of RD&D
  - Funding of Geothermal Projects
    - The Geothermal Structure
    - The Questionnaire
    - The Brussels Seminar
    - Awareness Raising - Climate concerns
Number of Countries with Renewable Energy Policy, by Type, 2011 – 2015

- **Power Policies**
  - FIT
  - Tendering
  - Net metering

- **Heating and Cooling Policies**
  - Heat obligation/mandate

- **Transport Policies**
  - Biofuels obligation/mandate

The chart shows the number of countries implementing different types of renewable energy policies from 2011 to early 2015.
Understanding better benefits of GeoDH
Legal and Financial Framework for GeoDH

Sources: GeoDH 2014, B. Petursson National Energy Authority amended 2016
Cost Structure of Geothermal Heat Generation Project

Sources: GeoDH 2014, B. Petursson National Energy Authority, amended 2016
Understanding better benefits of GeoDH

Capital Cost Structure of Geo Projects

Capital Cost of Geothermal Heating
€ million / MWth installed

€ million / MWth

Geothermal DH

Geothermal uses

Geoth. source heat pump (GSHP)

Lowest

Highest

Sources: EGEC, 2013
Understanding better benefits of GeoDH
Capital Cost Structure of Geo Projects
Legal and Financial Framework for GeoDH

Cost Structure of Generation Project Depending on Size

Cost Structure of Generation Project and Sensitivity Analysis of Interest

Sources: GeoDH, 2014
Understanding better benefits of GeoDH
Price Structure of Geo Projects

Heat Generation Cost for District Heating Network by Fuel

- Domestic Gas
- Light fuel Oil
- Condensing Gas Boiler (without DH)
- Geothermal Energy

Source: GeoDH 2014.
Overview of the presentation

External cost per technology for heat and CHP technology, in Europe

** In a closed circulation, and if renewable energy is also used powering the pumps, very little external cost is resulting from geothermal district heating. National Energy Authority Iceland.

Source: ECOFYS, Europe 2014
Understanding better benefits of GeoDH
Price Structure of Geo Projects

Figure 2.4.6.2.

Annual Operational Cost Comparison of DH powered by Gas (100%) and Geothermal (75%) and Gas (25%) in France

- Selling: 7.0 €/kWh
- Geothermal: 3.3 €/kWh
- Gas: 5.6 €/kWh
Understanding better benefits of GeoDH

Price Structure of Geo Projects

Annual Operational Cost Comparison of DH powered by Gas (100%) and Geothermal (75%) and Gas (25%) in France

- Gas to purchase on the market 3830
- Gas to purchase on the market 1099
- Electricity consumption for gas plant 22 22
- Electricity for geothermal pumping 240
- Ordinary geothermal maintenance 550
- Ordinary gas station maintenance 423
- Ordinary gas station maintenance 200
- Ordinary network maintenance 326 326
- Geothermal installation replacement 246

€ Thousands
Understanding better benefits of GeoDH

Price Structure of Geo Projects

Average District Heating Prices in Europe, the United States, Japan and S-Korea

*Price is subsidized.

Orkustofnun Data Repository: OS-2016-T006-01
Comparison of Energy Consumption for Households between Countries in Europe

- Sweden: 125 kWh/m²
- Denmark: 129 kWh/m²
- Finland: 188 kWh/m²
- Iceland: 200 kWh/m²
- Norway: 201 kWh/m²
- Malta: 7 kWh/m²
- Portugal: 25 kWh/m²
- Spain: 48 kWh/m²
- Luxembourg: 67 kWh/m²
- Greece: 71 kWh/m²
- Bulgaria: 79 kWh/m²
- Netherlands: 95 kWh/m²
- Ireland: 100 kWh/m²
- Slovakia: 112 kWh/m²
- Italy: 119 kWh/m²
- United Kingdom: 121 kWh/m²
- Hungary: 124 kWh/m²
- France: 125 kWh/m²
- Slovenia: 132 kWh/m²
- Lithuania: 142 kWh/m²
- Austria: 151 kWh/m²
- Romania: 156 kWh/m²
- Germany: 160 kWh/m²
- Czech Republic: 161 kWh/m²
- Croatia: 166 kWh/m²
- Poland: 169 kWh/m²
- Estonia: 183 kWh/m²
- Latvia: 198 kWh/m²

Orkustofnun Data Repository: OS-2016-T006-01
The Proportion of Annual's Salaries That Go into Buying District Heating for 100m² Household in Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iceland</td>
<td>0.7%</td>
</tr>
<tr>
<td>Norway</td>
<td>1.2%</td>
</tr>
<tr>
<td>Sweden</td>
<td>1.3%</td>
</tr>
<tr>
<td>Finland</td>
<td>1.6%</td>
</tr>
<tr>
<td>Denmark</td>
<td>1.9%</td>
</tr>
<tr>
<td>Austria</td>
<td>1.3%</td>
</tr>
<tr>
<td>France</td>
<td>1.5%</td>
</tr>
<tr>
<td>Germany</td>
<td>2.0%</td>
</tr>
<tr>
<td>Slovenia</td>
<td>2.8%</td>
</tr>
<tr>
<td>Hungary</td>
<td>2.8%</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>3.9%</td>
</tr>
<tr>
<td>Poland</td>
<td>4.2%</td>
</tr>
<tr>
<td>Slovakia</td>
<td>4.9%</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>5.2%</td>
</tr>
<tr>
<td>Lithuania</td>
<td>5.7%</td>
</tr>
<tr>
<td>Latvia</td>
<td>7.9%</td>
</tr>
<tr>
<td>Romania</td>
<td>9.5%</td>
</tr>
</tbody>
</table>

Orkustofnun Data Repository: OS-2016-T006-01
Understanding better benefits of GeoDH
Price Structure of Geo Projects

Average Natural Gas Prices for Households around the World

<table>
<thead>
<tr>
<th>Country</th>
<th>Price (€/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>10.0</td>
</tr>
<tr>
<td>Sweden</td>
<td>14.1</td>
</tr>
<tr>
<td>Russia</td>
<td>0.7</td>
</tr>
<tr>
<td>Romania</td>
<td>3.9</td>
</tr>
<tr>
<td>Moldova</td>
<td>4.0</td>
</tr>
<tr>
<td>Hungary</td>
<td>4.4</td>
</tr>
<tr>
<td>Turkey</td>
<td>4.7</td>
</tr>
<tr>
<td>Lithuania</td>
<td>5.3</td>
</tr>
<tr>
<td>Estonia</td>
<td>5.7</td>
</tr>
<tr>
<td>Serbia</td>
<td>5.8</td>
</tr>
<tr>
<td>Croatia</td>
<td>5.9</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>6.0</td>
</tr>
<tr>
<td>Latvia</td>
<td>6.2</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>6.2</td>
</tr>
<tr>
<td>Slovakia</td>
<td>6.2</td>
</tr>
<tr>
<td>Poland</td>
<td>6.3</td>
</tr>
<tr>
<td>Bosnia and Herzegovina</td>
<td>6.4</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>7.2</td>
</tr>
<tr>
<td>Belgium</td>
<td>7.3</td>
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<tr>
<td>Slovenia</td>
<td>7.9</td>
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<tr>
<td>United Kingdom</td>
<td>7.9</td>
</tr>
<tr>
<td>Ireland</td>
<td>8.4</td>
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<tr>
<td>Germany</td>
<td>8.5</td>
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<tr>
<td>Greece</td>
<td>8.5</td>
</tr>
<tr>
<td>France</td>
<td>8.8</td>
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<tr>
<td>Austria</td>
<td>9.1</td>
</tr>
<tr>
<td>Spain</td>
<td>9.1</td>
</tr>
<tr>
<td>Netherlands</td>
<td>9.6</td>
</tr>
<tr>
<td>Italy</td>
<td>9.6</td>
</tr>
<tr>
<td>Switzerland</td>
<td>10.0</td>
</tr>
<tr>
<td>Liechtenstein</td>
<td>11.4</td>
</tr>
<tr>
<td>Portugal</td>
<td>3.1</td>
</tr>
<tr>
<td>Canada</td>
<td>3.2</td>
</tr>
<tr>
<td>Mexico</td>
<td>3.2</td>
</tr>
<tr>
<td>United States</td>
<td>6.5</td>
</tr>
<tr>
<td>S-Korea</td>
<td>9.1</td>
</tr>
<tr>
<td>Chile</td>
<td></td>
</tr>
</tbody>
</table>

Median: 7.1
EU-28: 8.3

Orkustofnun Data Repository: OS-2016-T006-01
The Proportion of Annual's Salaries That Go Buying Natural Gas for 100m² Household in Europe

- Denmark: 1.9%
- Sweden: 2.5%
- Luxembourg: 0.5%
- Portugal: 0.7%
- Spain: 1.1%
- Netherlands: 1.3%
- United Kingdom: 1.5%
- Ireland: 1.5%
- Greece: 1.7%
- France: 2.0%
- Germany: 2.3%
- Austria: 2.3%
- Italy: 2.6%
- Hungary: 3.7%
- Slovenia: 4.0%
- Slovakia: 4.2%
- Estonia: 5.3%
- Croatia: 5.4%
- Czech Republic: 6.0%
- Bulgaria: 6.1%
- Lithuania: 6.2%
- Poland: 6.9%
- Romania: 7.1%
- Latvia: 8.8%

Orkustofnun Data Repository: OS-2016-T006-01
The Proportion of Annual's Salaries That Go into Buying District Heating and Electricity for 100m² Household in Europe

- Iceland: 1.4%
- Norway: 1.7%
- Sweden: 2.1%
- Finland: 2.4%
- Denmark: 3.2%
- Austria: 2.3%
- France: 2.4%
- Germany: 3.5%
- Slovenia: 4.6%
- Hungary: 5.1%
- Poland: 7.0%
- Estonia: 7.1%
- Bulgaria: 7.5%
- Slovakia: 7.7%
- Czech Republic: 7.7%
- Lithuania: 11.0%
- Latvia: 11.4%
- Romania: 14.1%

District Heating
Electricity

Orkustofnun Data Repository: OS-2016-T006-01

Understanding better benefits of GeoDH
Price Structure of Geo Projects
Then the Oil Crises – Now the Climate Crisis
The Crises was the Awareness Trigger 1970 -1980
• Biggest steps in GeoDH were taken during the oil & war crisis 1970 – 1982
• **External conditions** – raised the need of evaluation and GeoDH Planning
• Policy goals to increase geothermal – both national and within main cities
• It took only **12** years to increase GeoDH from **40% to 80%** of total space heating
Awareness Raising
Cumulative Savings of Geothermal District Heating
1944–2013, (mostly since 1978, last 35 years)
2% interests, fixed price

- 2.500 billions Isk 2013, is
- 31 million Isk. per family (4 persons), and
- 7.8 million per capita

equal to

- 16 billion €
- 200 thousand € per family (4 persons),
- 50 thousand € per capita.

equal to

Price of an Apartment for Every Family (4 persons)

68 years 500 billion Isk.

Additional 9 years + 1000 billion Isk.
Additional 22 years + 1000 billion Isk.

Source: Orkustofnun, 2014
Accumulative CO2 Savings using Geothermal District Heating instead of oil in Iceland 1944-2014

Million tons CO2

Orkustofnun Data Repository: OS-2015-T008-01
Accumulative CO2 Savings using Renewables instead of oil in Iceland 1944-2014

Annual CO2 Saving by Renewables in Iceland
- equal to 18 million tons of CO2
- equal to 9 billion trees in bindings of CO2
- equal to 43 thousand square km of woods –
- equal to 41% of the size of Iceland
- equal to 6 million tons of oil annually

Items for consideration
- Important to show important results of renewables in fighting with CO2 - in visible terms – that can be understood - trees
- growth of renewables are going too slow
- global temp. are increasing faster than expected
- the climate risk is growing
- renewables / geothermal have a great potential – in fighting against rising climate risk

Awareness Raising – linked to Climate Contribution of Geothermal to lower CO2

Orkustofnun Data Repository: OS-2015-T008-01
Awareness Raising – linked to Climate
Contribution of Geothermal to lower CO2

Renewable savings of CO₂
2014, was equal to additional
wood covering 41% of Iceland

Source: Orkustofnun
The Brussel Meeting – Geo Projects

Status of the EERA Joint Programme on Geothermal Energy
Adele Manzella on behalf of Ernst Hüenges and David Bruhn
EERA Joint Programme on Geothermal Energy

www.eera-net.eu

Being the world leader in developing Geothermal technologies
Philippe DUMAS
Secretary general EGEC

Bringing low-carbon technologies to the market: the NER 300 programme
Financial Instruments and Funding of RD&D and Geothermal Projects
Hotel Bedford, Brussels
October 5, 2015

For all questions on the Energy efficiency call, please contact:
Executive Agency for Small and Medium-Sized Enterprises
(EASME – formerly EACI)
EASME-Energy@ec.europa.eu
or
contact your National Contact Point:
http://ec.europa.eu/research/participants/portal/desktop/en/support/national_contact_points.html
The Brussel Meeting – Geo Projects

Geothermal ERA NET Meeting
Brussels, Belgium
5 October 2015

Financial Instruments and Funding of Geothermal Projects

Stadler Pehrsson
Sigurður Bjarnason
Günter Stagl
Liia Jonsdóttir

Cohesion Policy Investments in Sustainable Energy 2014–2020

September 2015

Maud SKÄRINGER
Policy Analyst
Directorate-General for Regional and Urban Policy
European Commission

The Role of the Private Sector in the Development of Geothermal Power – EBRD GPP Financing

Adonai Herrera-Martínez
Energy Efficiency and Climate Change (E2C)
The Main Geothermal Problems

<table>
<thead>
<tr>
<th>Problem</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unclear vision on geothermal issues at the European level</td>
<td>62%</td>
</tr>
<tr>
<td>Lack of commitment to the geothermal sector by national government</td>
<td>52%</td>
</tr>
<tr>
<td>Lack of collaboration and coordination between stakeholders (e.g.)</td>
<td>45%</td>
</tr>
<tr>
<td>Lack of continuous education within the sector</td>
<td>33%</td>
</tr>
<tr>
<td>Too few geothermal training opportunities</td>
<td>29%</td>
</tr>
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<td>Too few geothermal courses at the tertiary level</td>
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<td>Unappealing working conditions of employees within the geothermal...</td>
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<td>Little variety of geothermal courses at the tertiary level</td>
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<td>Lack of student mobility opportunities</td>
<td>14%</td>
</tr>
<tr>
<td>Little variety when it comes to geothermal training opportunities</td>
<td>10%</td>
</tr>
</tbody>
</table>

Unclear vision and lack of cooperation is one of the biggest problem for the geothermal sector - including regarding financing.
The Survey – Geothermal Projects

- Several barriers, mainly, economical and political
Three important Geo EU Pillars

More cooperation and communication necessary at European level, National level and Company level

Industry, RD&D, Banks, etc - Cooperation
- Practical information
- Using existing information
- Highlight barriers
- Financial - opportunities
- Awareness – building
- Policy - recommendation
The Survey – Geothermal Projects

- Financial barriers on early stages geo. process

- Exploration and test drilling is risky and difficult to finance
- Iceland support exploration and test drilling in GeoDH
- Iceland support new GeoDH operation for 12 years

Sources: ESMAP 2012, National Energy Authority, amended 2014
The Survey – Geothermal Projects

- Financial barriers on early stages geo. process
## National Support for Renewable Energy

### EU Member States' use of different instruments for electricity, heating and transport (biofuels)

| Sources:  | AT | BE | BG | CY | CZ | DE | DK | EE | ES | FI | FR | GR | HU | IE | IT | LT | LU | LV | MT | NL | PL | PT | RO | SE | SI | SK | UK |
|-----------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| **Electricity** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
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| Quota obligation |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Investm grants |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Tax exemtions |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Fiscal incentives |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| **Heating** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Investm grants | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  |
| Tax exemtions | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  |
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| Premium   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| **Transport** |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Quota obligation |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Tax exemtions | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  | X  |

Sources: SEC (2011) '1st Review of European and national financing of renewable energy in accordance with Article 23(7) of Directive 2009/28/EC
## Overview of reply by countries

<table>
<thead>
<tr>
<th>National Support for Renewable Energy Projects</th>
<th>Germany</th>
<th>Hungary</th>
<th>Iceland</th>
<th>Italy</th>
<th>Portugal</th>
<th>Netherlands</th>
<th>Slovakia</th>
<th>Slovenia</th>
<th>Switzerland</th>
<th>Turkey</th>
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<td>National support for fossil fuels (oil, gas, coal)</td>
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</table>

Sources: Geothermal ERA NET, 2015
The Survey – Geothermal Projects

- Technical barriers
  - Lack of information on geothermal energy resources – regions, areas
  - Lack of information on economic and technical data about the industry

- Regulatory barriers
  - Lack of national geothermal regulatory framework
  - Bureaucracy – too long and complex – requests from authorities for licensing for exploration and drilling

- Financial barriers
  - Lack of financial risk funds / loans for geothermal exploration and first drilling
  - Capital intensive for power production – less for district heating
  - Need for new business models to make GeoDH more economic viable
  - Limited and fragmented financial support
  - Unfair competition with conventional sources

- Awareness barriers
  - Limited awareness within the industry and on national level – more activity is needed (ERA NET has raised the awareness – but more is needed on various levels)
  - Negative view of geothermal in some areas / countries – due to lack of information
<table>
<thead>
<tr>
<th>Value</th>
<th>Activities – benefits in general</th>
<th>ERA NET</th>
<th>National</th>
<th>EU / EEA</th>
</tr>
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<tbody>
<tr>
<td>Policy coordination</td>
<td>Better quality policy and success</td>
<td>Relevant</td>
<td>Relevant</td>
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<tr>
<td>Cooperation on different topics</td>
<td>More national and international activities</td>
<td>Relevant</td>
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<tr>
<td>Building networks information cooperation</td>
<td>More networks Working with additional bodies like EU bodies, IEA, Eurostat, IGA, etc.</td>
<td>Relevant</td>
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<tr>
<td>Economic benefits</td>
<td>Economics of scale &amp; more competitiveness</td>
<td>Relevant</td>
<td>Relevant</td>
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<tr>
<td>RD&amp;D &amp; Technical benefits</td>
<td>More projects &amp; funding</td>
<td>Relevant</td>
<td>Relevant</td>
<td>Relevant</td>
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<tr>
<td>Financial issues</td>
<td>Better understanding of Geo funding - better funding</td>
<td>Relevant</td>
<td>Relevant</td>
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<tr>
<td>Climate contribution (CO2) Quality of life</td>
<td>Less CO2 – better environment – more Geothermal Projects - less pollution - reducing climate risks – raising quality of life</td>
<td>Relevant</td>
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</table>
Various benefits are expanding from ERA NET activities to other levels

- Quality of life
- Mitigate Climate change
- Better air quality
- Better environment
- Economic benefits
- Policy
- Cooperation
- Networks
- Economics
- R&D & Funding
- Financial issues

Total geothermal benefits / projects within EU/EEA
Additional geothermal funding / benefits within EU/EEA
Additional geothermal national funding / benefits
ERA NET
International Cooperation – EEA Grants
Opportunity for many countries

New program (-2021) is under final preparation
Important for interested countries (E-Europe) to act now
http://eeagrants.org/
Geothermal District Heating
Great Potential in Europe

Geothermal cities with
district heating systems

Geothermal heat
at 2000 meters

proportion of NUTS-3 regions,
where in 2000 m deep
4%: T > 200 °C
8%: 200 °C > T > 100 °C
19%: 100 °C > T > 60 °C

3882 – Europe
3070 – EU-27
International Cooperation – EEA Grants
Orkustofnun is Donor Program Partner (DPP)
Renewables Programs in some Countries
EEA-Grants:
Template for the Programme Area Renewable Energy

Objective:

Increased share of renewable energy in energy use

Expected outcome

• A less carbon-dependent economy
• Increased renewable energy production
• Increased use of renewable energy in the transport sector
• Increased feed-in of renewable energy to existing energy infrastructures
• Improved energy efficiency in buildings

• Developed strategies to improve the use of green investment schemes
• Improved capacity at national, regional and local level on renewable energy solutions
• Increased awareness of and education in renewable energy solutions
Conclusions

- Cohesion Policy 2014-2020 playing a strong role in delivering the Energy Union on the ground, with significant opportunities for sustainable energy

- **Commission support** includes:
  - EMA Network of Energy and Managing Authorities to support the best possible use of the funding
  - Smart Specialisation Platform on Energy
  - Advisory platform for financial instruments, fi-compass
  - Off-the-shelf financial instruments, including 'Renovation loan'
  - Guidance documents, workshops
Awareness Raising - COP21
Awareness Raising - COP21
21 years since Kyoto – climate actions goes slowly
• Last 24 months there have been heat record every month around the globe.

• In February the temperature was on average 1.35 degrees on Celsius, higher than 1951 – 1980.

• In some areas – N-America, Northern Europe and central Asia – the average monthly temperature increase was even 4–11.5 degrees C, far beyond the average 1.5 - 2 C

• Like having one foot in a water too hot – and the other in a water too cold – average ok – but one foot is burning – the other on ice.

• Therefore more regional consequences are foreseen – and more action is needed.

Source: NASA
Renewables and Global Warming

Temperature in February 1.35 °C on average warmer than 1951 – 1980, and even up to 11.5 °C in some areas NASA.
DeConto says, “This could spell disaster for many low-lying cities. For example, Boston could see more than 1.5 meters [about 5 feet] of sea-level rise in the next 100 years. But the good news is that an aggressive reduction in emissions will limit the risk of major Antarctic ice sheet retreat.”

If this is true – what about Europe – Asia and other places – what regions will be under sea level?

What kind of additional, economic, social and environmental disasters will follow?

Will this development create huge trend of relocation of people – with stressing and challenging pressure on societies?

If this is true – countries have to react much faster – to avoid disaster in near future.

New Report - University of Massachusetts
Boston will be under 1.5 meter of sea 2100 - But Europe ??
Bring the problem closer – in time, space to face reality – Europe 2050 ??

Sea-Level Rise Could Nearly Double Over Earlier Estimates in Next 100 Years

UMass Amherst, Penn State researchers model effects of melting Antarctic ice sheets

March 30, 2016
Contact: Janet Laithrop 413/545-0444

AMHERST, Mass. – A new study from climate scientists Robert DeConto at the University of Massachusetts Amherst and David Pollard at Pennsylvania State University suggests that the most recent estimates by the Intergovernmental Panel on Climate Change for future sea-level rise over the next 100 years could be too low by almost a factor of two. Details appear in the current issue of Nature.

DeConto says, “This could spell disaster for many low-lying cities. For example, Boston could see more than 1.5 meters [about 5 feet] of sea-level rise in the next 100 years. But the good news is that an aggressive reduction in emissions will limit the risk of major Antarctic ice sheet retreat.”

With mechanisms that were previously known but never incorporated in a model like this before, added to their ice-sheet model to consider the effects of surface melt water on the break-up of ice shelves and the collapse of vertical ice cliffs, the authors find that Antarctica has the potential to contribute greater than 1 meter (39 inches) of sea-level rise by the year 2100, and greater than 15 meters (49 feet) by 2500 if atmospheric emissions continue unabated. In this worst case scenario, atmospheric warming (rather than ocean warming) will soon become the dominant driver of ice loss.
Awareness Raising - the temperature is already increasing fast in some areas

For consideration

- Climate change trends are moving faster than expected – higher temperature of air and sea – and greater ocean acidification

- Increasing renewables are moving slowly – including utilisation of geothermal district heating

- Great possibilities in Europe regarding geothermal district heating - however things are moving slowly

- Can geothermal projects do more to fight the global CO2 / climate problem - after 10 - 50 years!
The Oil Crisis – and the Climate Crisis
Fundamental differences

**Oil crisis**

→ very visible → automatic awareness raising → fast reaction time → focus on economic issues → economic balance fairly quickly → no global environmental risk

**Climate crisis**

→ hidden problems, not visible → very slow reaction time (21 years from Kyoto)
→ denial of problems → very problematic and poorly managed awareness raising
→ globally very risky and urgent on all levels of societies (economic, social, envirom. etc.)
→ increasing risk of slow action and more damage and disaster than expected
Renewables and Global Warming
More and more weather extremes

One area in Iceland – no rain - summer 2016

Floods in Iceland – autumn 2016

Lakes are shrinking in California recent

Forests on fire in California 2016
Renewables and Global Warming
More and more weather extremes

Flooding in Germany June 2013, damage 3 billion € - insurance claims

Flooding in Paris 2016

Long Islands, New York “Frankenstorm” Hurricane Sandy

Philippines 2013
Renewables and Global Warming

Temperature in February 1.35 °C on average warmer than 1951 – 1980, and even up to 11.5 °C in some areas. NASA

Pathways of climate impacts in Fisheries and Aquaculture

Biophysical changes from GHG accumulations

Effects on:
- Production Ecology
- Fishing & Aquaculture operations
- Communities Livelihoods
- Wider society & Economy

Impacts on:
- Species composition
- Production & yield
- Distribution
- Diseases
- Coral bleaching
- Calcification
- Safety & efficiency Infrastructure
- Loss/damage to assets
- Risk to health & life
- Displacement & conflict
- Adaptation & mitigation costs
- Market impacts
- Water allocation

Ocean currents
ENSO
Sea level rise
Rainfall
River flows
Lake levels
Thermal structure
Storm Severity
Storm frequency
Acidification
Climate Awareness – We have to succeed
“There is no Plan B - or Planet B”

We are over “point of no return”
Therefore the climate battle must be successful
All renewables have a role in the battle – including various geothermal opportunities

Ban Ki-moon: Engin „áætlun B“ því við eigum ekki „reikistjörnu B“
8 Key Elements of Success in the Geothermal Sector and District Heating

1. Authorities and regulation,
2. Geothermal resources,
3. Scientific & technical factors,
4. Education & human factors,
5. Access to capital,
6. Infrastructure and access to markets, sectors and other clusters,
7. Access to international markets and services,
8. The company, management, expertise & industry, clusters assessment

In cooperation with international and domestic experts, on geothermal resources, finance, legal, management and other expertise.

Source: Sölvell & Lindquist 2012, Amended, B. Petursson, National Energy Authority, 2014
The Geothermal ERA - Recommendation

1. Authorities and Regulatory Factors
   • Design regulation specific to the promotion of direct uses of geothermal energy
   • Publicise the characteristics and benefits of geothermal energy for regional development
   • Promote cooperation with international organisations

2. Geothermal Resources
   • Improvement of geothermal regulation
   • Improvements for data analysis of reservoirs in regions

3. Scientific and Technical Factors
   • Promote relationships with industry
   • Promote alliances with research centres and educational institutions for the formation of specialised human resources

   • Promote alliances with research centres and educational institutions for the formation of specialised human resources
   • Promote cooperation with IFI for financing, donor support and consulting
   • Organize workshops and conferences to improve knowledge on geothermal energy
   • Identify geothermal energy-related productive chains
5. **Educational and Human Factors**
   - There is not enough support for the generation of the human resources needed for the geothermal industry
   - Creating seminars and specialized courses on the different stages of a geothermal project and adding them to the existing engineering degrees
   - Give the personnel technical training to participate in the different stages of a project
   - Implement programs for technical development

6. **Access to, and Cost of Capital**
   - Promote additional access to financing geothermal projects – domestic and international
   - Increase access to capital by providing capital to exploration and test drilling and DH networks e.g. soft loans or donor grants, to lower the risks at the beginning of projects

7. **Infrastructure, Access to Markets, Sectors and Clusters**
   - Promote training in the banking system for the development of financial mechanisms specific to geothermal energy
   - Awareness; organize workshops & conferences to improve knowledge of geothermal energy
   - Increase the available knowledge about opportunities and benefits of geothermal resources

8. **Access to International Markets and Services**
   - Support international cooperation in area of geothermal knowledge, training and service
   - Promote international cooperation with IFI and donors on finance, grants and funding
   - Support international consulting cooperation on various fields of geothermal expertise
The Geothermal ERA - Recommendation
The Geothermal ERA - Recommendation

**Awareness raising**
- Link geothermal awareness raising with the risk of climate trend and concerns
- Geothermal programs and projects are valuable – fighting the climate crisis
- Geothermal options can create valuable economic, environmental and climate opportunities
- Increased awareness within the industry and on national level – more activity is needed
- Focus on special groups / regions, national level and EEA/EU level

**Financial barriers**
- More financial risk funds / loans for geothermal exploration and first drilling
- Develop new business models to make GeoDH more economic viable
- Better financial support
- Equal competition with conventional sources

**Better Policy Environment**
- Better national geothermal regulatory framework
- More simpler and faster process on geo. licensing for exploration and drilling etc.
- More information on geothermal energy resources – regions, areas
- More information on economic and technical data about the industry
The Geothermal ERA - Recommendation

Sponsors
- Geothermal Expertise
- Local knowledge
- Financial Resource
- Scale to be able to finance on a corporate/portfolio basis

Regulatory / Sector Framework
- Transparent, predictable and sustainable
- Geothermal Incentives
- Standardized contracts
- Public role in bearing geothermal resource risk?

Lenders
- In-house resource engineer (or close collaboration with outside resource consultant)
- Geothermal financing experience
- Creativity and innovation

Scaling up Geothermal Financing

Technologies
- More accurate and faster resource assessment
- Faster and less costly drilling
- Reduction in US$ per MW and equipment lead-time

Source: IFC
Thanks