Geoscience needs for Geothermal Energy Development

Western Canada Workshop
Vancouver, BC
October 16-17 2008
Workshop topics

• Geoscience needs for high-temperature geothermal development (electric generation or thermal heat)

• Out of scope: Geoexchange systems (shallow geothermal production retrieving stored solar or shallow groundwater heat with heat pumps)
Key questions for the workshop

- What are the characteristics of key geothermal energy resources and tools?
- What are the geoscience needs (e.g. knowledge gaps) to support geothermal energy development?
- What could be the role of a governmental geological survey in addressing these geoscience needs?
Is there potential for geothermal energy production in Canada?
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>2774.6</td>
<td>2816.7</td>
<td>2228</td>
<td>2,687</td>
<td>29%</td>
<td>2.94%</td>
</tr>
<tr>
<td>Philippines</td>
<td>891</td>
<td>1227</td>
<td>1909</td>
<td>1,970</td>
<td>21%</td>
<td>0.46%</td>
</tr>
<tr>
<td>Mexico</td>
<td>700</td>
<td>753</td>
<td>755</td>
<td>953</td>
<td>10%</td>
<td>3.75%</td>
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<tr>
<td>Indonesia</td>
<td>144.8</td>
<td>309.8</td>
<td>589.5</td>
<td>992</td>
<td>11%</td>
<td>9.75%</td>
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<tr>
<td>Italy</td>
<td>545</td>
<td>631.7</td>
<td>785</td>
<td>811</td>
<td>9%</td>
<td>0.47%</td>
</tr>
<tr>
<td>Japan</td>
<td>214.6</td>
<td>413.7</td>
<td>546.9</td>
<td>535</td>
<td>6%</td>
<td>-0.31%</td>
</tr>
<tr>
<td>New Zealand</td>
<td>283.2</td>
<td>286</td>
<td>437</td>
<td>472</td>
<td>5%</td>
<td>1.14%</td>
</tr>
<tr>
<td>Iceland</td>
<td>44.6</td>
<td>50</td>
<td>170</td>
<td>421</td>
<td>5%</td>
<td>21.09%</td>
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<tr>
<td>El Salvador</td>
<td>95</td>
<td>105</td>
<td>161</td>
<td>204</td>
<td>2%</td>
<td>3.82%</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>0</td>
<td>55</td>
<td>142.5</td>
<td>163</td>
<td>2%</td>
<td>2.06%</td>
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<tr>
<td>Total top 10</td>
<td>5692.8</td>
<td>6647.9</td>
<td>7723.9</td>
<td>9208</td>
<td>100%</td>
<td>2.74%</td>
</tr>
</tbody>
</table>

Canada’s total Electric generation capacity was 111000 MW in 2000, none from geothermal

Is there potential for geothermal energy production in Canada?

North America: Very favorable context:
Geology Scientific Industry Economy Policy: Energy & CC
Geothermal for Electrical generation by continent

- Total geothermal electric: 57 TWh/yr (2005 numbers)
- Total Canada Electricity: 609 TWh/yr
- Total World Electricity: 17350 TWh/yr
  1 GWe installed = approx 5 TWh/yr (50%)

**MIT (2006) report suggests that US potential alone is 100 GWe from EGS by 2050**

Sources:
- [Iceland president testimony to US Senate 2007](http://energy.senate.gov/public/_files/testimony.pdf)
- [EIA DOE 2006 report](http://www.eia.doe.gov/emeu/international/electricitygeneration.html)
Thermal Geothermal produced 76 TWh/yr (2005)

Sources: http://energy.senate.gov/public/_files/testimony.pdf (Iceland president testimony to US Senate 2007)
What are the characteristics of key geothermal energy resources and tools? – Topics to discuss

Geothermal resources in Western Canada

• High temperature volcanic belts
• Sedimentary basins
• Deep Fluids systems (crustal circulation, thermal springs, etc.)
• Hot dry rocks

Technology, tools, databases, maps

• Enhanced Geothermal Systems
• Geothermal prospecting tools
• Geothermal: State of geoscience database and mapping in Canada and British Columbia and future needs
What are the **geoscience needs** (e.g. knowledge gaps) to support geothermal energy development?

- Geoscience supports governments (resource assessment, regulations, Clean energy and GHG policy)
- Geoscience supports exploration and development of mineral and energy resources by reducing economic risks
- Geoscience reduces environmental risks of resource development
What could be the role of a governmental geological survey in addressing these geoscience needs?

• Maps or atlas of geothermal potential?
• New databases?
• Supporting industry with geotechnology and method development?
• Supporting extra-mural research in universities?
• Developing an integrated national geothermal research program?
• Bringing lessons learned to home from leading geothermal countries?
Developed countries with potential invest in Geothermal Research
Some examples- Long-term research and Exploration

- **Canada**
- **USA**
- **Iceland**
- **France**

First geothermal power plant, 1904, Lardarello, Italy.
Workshop Agenda

Day 1
• Background: BC context, GSC past program
• Key resources
  – Break out groups and summary
CANGEA dinner

Day 2
• Key technology, tools and datasets
  – Break out groups and summary
• Wrap up
### Geothermal potential

<table>
<thead>
<tr>
<th>Region</th>
<th>Installed Capacity (MWe 2005)</th>
<th>Potential (MWe)</th>
<th>%</th>
<th>% Future</th>
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<tbody>
<tr>
<td>North America</td>
<td>3,517</td>
<td>30,000</td>
<td>39%</td>
<td>20%</td>
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<tr>
<td>Asia</td>
<td>3,290</td>
<td>42,000</td>
<td>37%</td>
<td>28%</td>
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<tr>
<td>Europe</td>
<td>1,124</td>
<td>15,800</td>
<td>13%</td>
<td>11%</td>
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<tr>
<td>Oceania</td>
<td>441</td>
<td>9,000</td>
<td>5%</td>
<td>6%</td>
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<tr>
<td>C. &amp; S. America</td>
<td>424</td>
<td>38,000</td>
<td>5%</td>
<td>26%</td>
</tr>
<tr>
<td>Africa</td>
<td>136</td>
<td>14,000</td>
<td>2%</td>
<td>9%</td>
</tr>
<tr>
<td><strong>World Total</strong></td>
<td><strong>8,933</strong></td>
<td><strong>148,800</strong></td>
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