



Geothermal energy uses the heat from the earth to deliver power, heat, and cold. It is a clean, renewable, stable resource

Geothermal energy is potentially the largest – and presently the most misunderstood – source of energy in the world today

– Al Gore in “Our Choice – A plan to solve the climate crisis”

- Geothermal energy contributes a **tiny** proportion of the world’s primary energy consumption. Even in electricity generation, geothermal produces **less than 1%** of the world’s output
- The pace of geothermal development might **accelerate** due to climate change and increasing need to decarbonise the energy sector

Source: WEC, 2016

The role of Geothermal in World Energy

- Total installed geothermal power generation in 2015: **13,2 GW**
- Total geothermal heat use (direct & storage) reached **563 PJ**s in 2014
- Global investment in 2015: **US\$2 billion**; during 2010-2014 around **US\$20 billion** were invested by 49 countries (both direct use and electric power)
- Geothermal burdened by **higher** installed costs and longer development periods relative to solar and wind. Government incentives are necessary to compete against natural gas and other renewables

Source: WEC, 2016

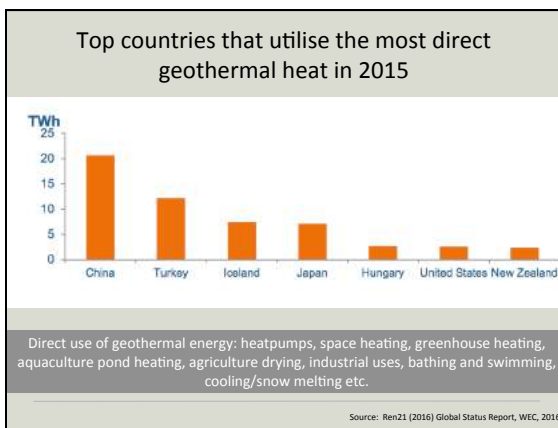
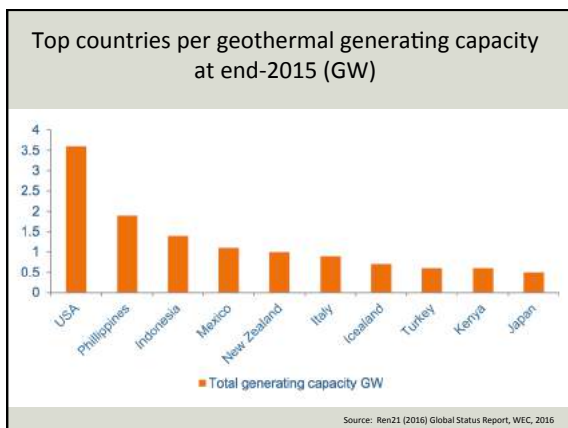
Japan will triple its geothermal electricity capacity: 540 MW (2011) to 1,500 MW (2030)
El Salvador aims to source 40% of its electricity from geothermal by 2019 (up from 25%)
Kenya: 51% of the nation’s electricity is geothermal

BOOSTING GEOTHERMAL AROUND THE WORLD

Many nations are in the process of ramping up their geothermal electricity generation, so much so that the Geothermal Energy Association has forecast that global geothermal electricity capacity could reach about 18.4 gigawatts by 2021 and 32 GW by the early 2030s, from 13.3 GW in 2015.

Source: 2016 Annual U.S. & Global Geothermal Power Production Report, Geothermal Energy Association

Source: <https://www.vox.com/energy-and-environment/2017/1/15/14220240/geothermal-energy>



Geothermal environmental impacts & risks

Geothermal extraction results in a number of discharges/impacts:

- Gas discharges (CO₂, H₂S, CH₄ etc) to air
- Chemicals (mercury, arsenic etc) to land and water
- Noise
- Potential for subsidence, induced seismicity

- Geothermal operations have widely varying impacts on the environment
- Many countries regulate practices to manage these effects
- Geothermal energy development faces increasing environmental costs relative to its rival renewable energy sources

Geothermal Europe at a glance (2016)



<http://www.egec.org/media-publications/>

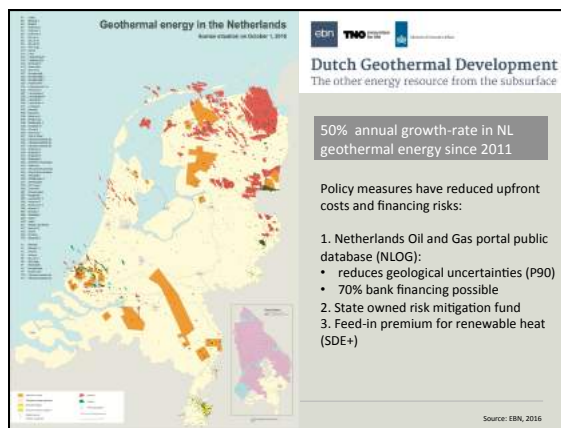
Source EGEC.org



main markets for future years France, Netherlands, Germany, and Hungary. Compared to 2012, average annual growth of 10%.

2011-2016: 90% of the new installed capacity in Turkey!

source EGEC.org



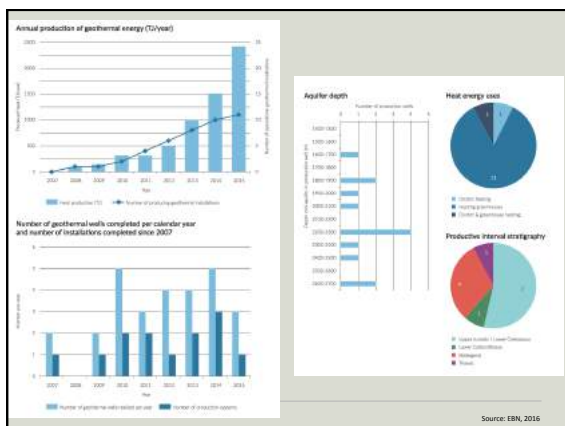
Dutch Geothermal Development

50% annual growth-rate in NL geothermal energy since 2011

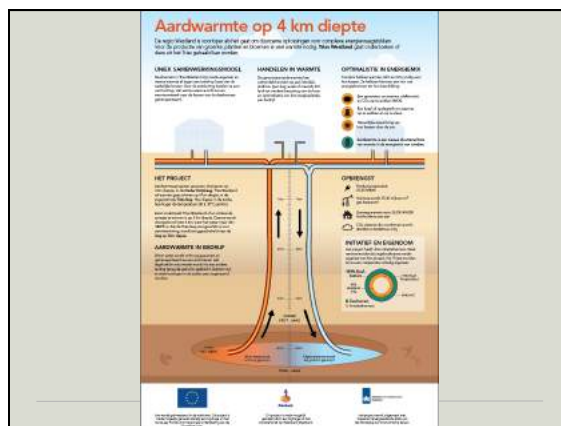
Policy measures have reduced upfront costs and financing risks:

1. Netherlands Oil and Gas portal public database (NLOG):
 - reduces geological uncertainties (P90)
 - 70% bank financing possible
2. State owned risk mitigation fund
3. Feed-in premium for renewable heat (SDE+)

Source: EBN, 2016



Source: EBN, 2016



July 2017: Critical report on Dutch Geothermal Operations



Observations:

- Environmental and safety risk: not recognised
- Regulations: not properly observed
- Safety culture: poorly developed

Sector is small, inexperienced, inadequate knowledge sharing

Recommendations:

- Adjustment of mining act: stricter requirements
- Learn from the oil and gas industry!
- Set safety standard; secure learning curves

Green Deal Ultra Deep Geothermal Energy

20 juni 2017: Green Deal signed between MinEZ, EBN, TNO & various consortia to stimulate the development of ultra deep Geothermal energy (UDG). They agreed to share their strengths and knowledge in the research to the use of ultra-deep geothermal energy in the process industry

