

Cascading use of geothermal energy in Iceland

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Iceland and energy

Electricity and heating in Iceland is 100% renewable.

Electricity generation:

- 73% Hydro
- 27% Geothermal
- < 0.1% Wind

Space heating:

- 90% Geothermal
- 10% Renewable electricity





Landsvirkjun – The National Power Company of Iceland

Generates 73% of Iceland's
electricity.

Owned by the Icelandic state.

Founded in 1965.

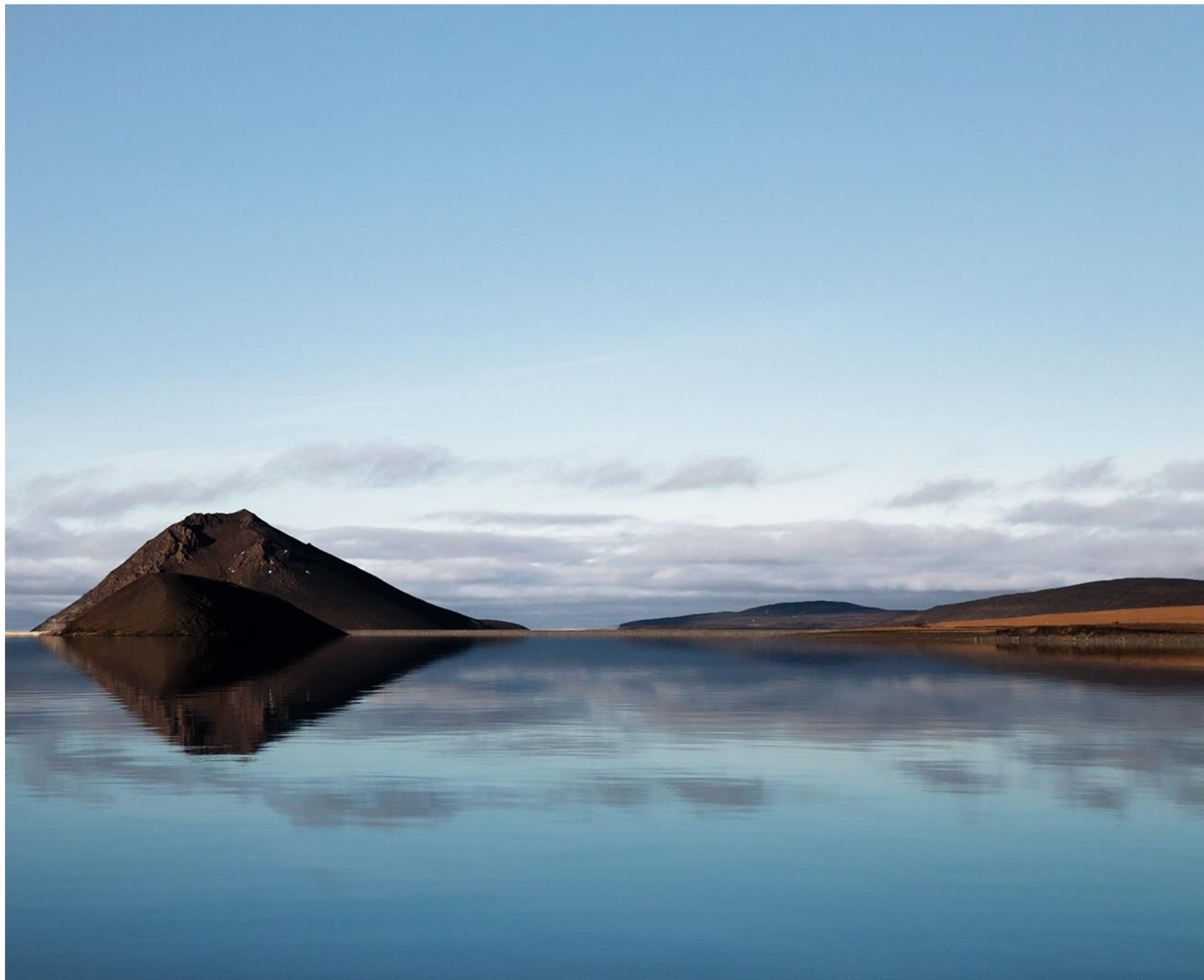




Landsvirkjun – The National Power Company of Iceland

Landsvirkjun's role is to maximise the yield and value of the natural resources we have been entrusted with, in a sustainable, responsible and efficient manner.

Landsvirkjun has pledged to be carbon neutral by 2030.



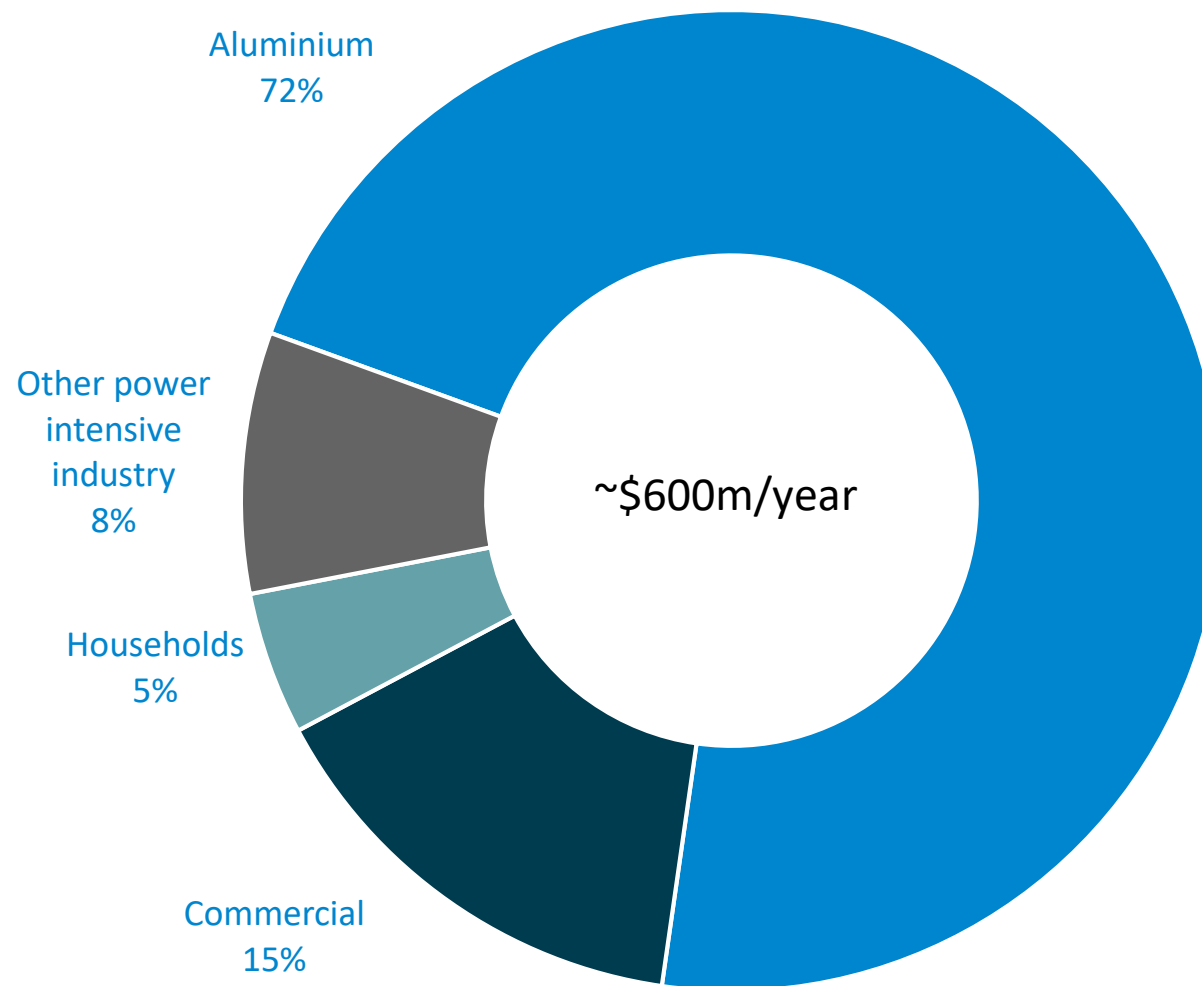


Power intensive industries are Iceland's largest electricity consumers

Aluminum and other power intensive industry consume 80% of the electricity generated in Iceland.

Electricity Consumption in Iceland

Total 19 TWh/year



Source: Iceland National Energy Authority and Landsvirkjun

Hydropower

Iceland's main source of renewable energy.

- 13,2 TWh in 2018
- Landsvirkjun owns 15 hydropower stations.



Wind

Landsvirkjun has two wind turbines in operation (2 MW).

Results show very high efficiency and significant benefits of combination with hydropower.



Geothermal energy in Iceland

There are seven geothermal power plants in Iceland.

Geothermal power supplies

- 90% of space heating
- 27% of electricity



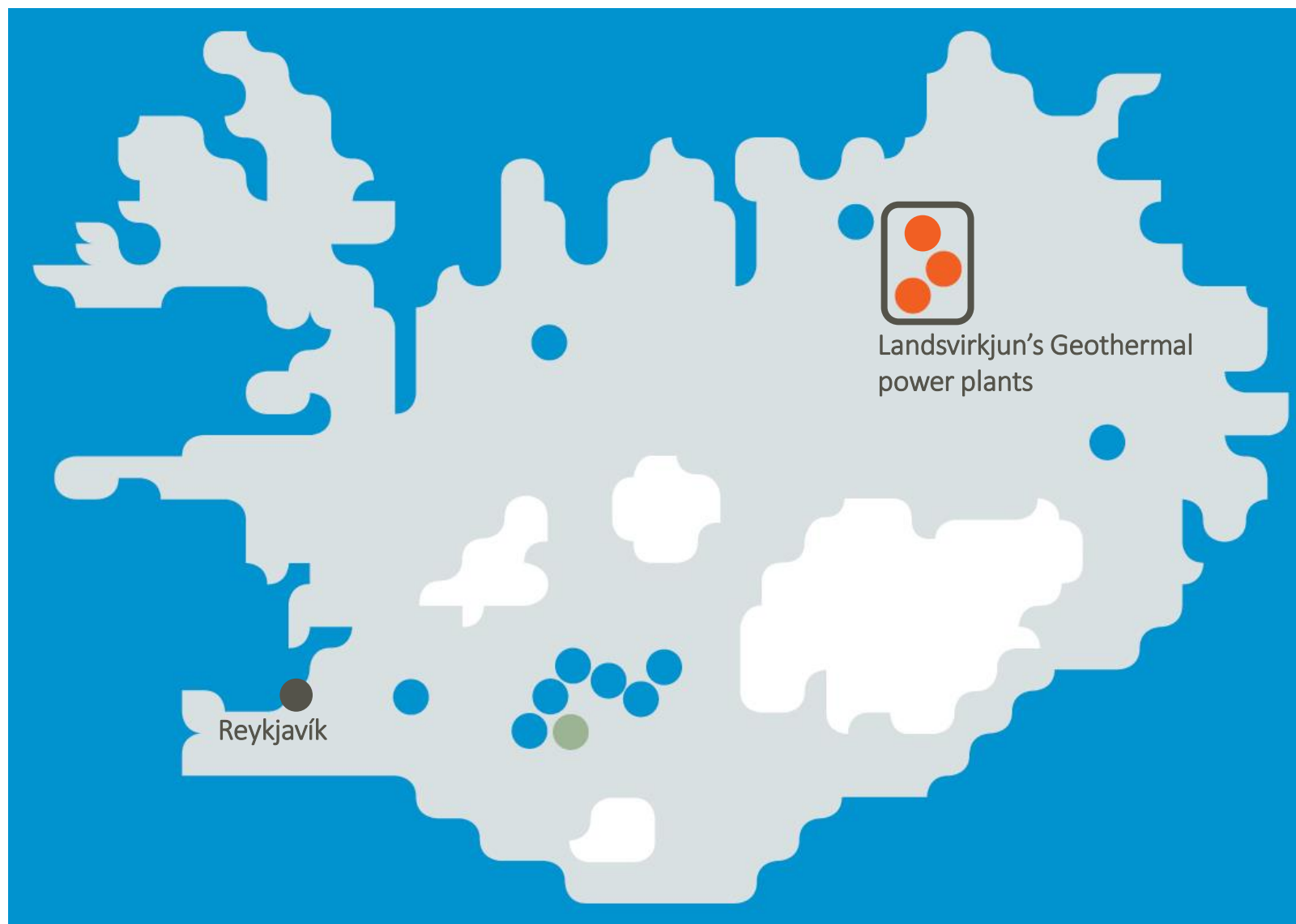


Landsvirkjun operates three geothermal power plants

Bjarnarflag
(5 MW, since 1969)

Krafla
(60 MW, since 1977)

Geistareykir
(90 MW, since 2017)



Quality of life in Iceland induced by geothermal energy

- Very affordable, wide-spread district heating
- Swimming pools, hot tubs, spas
- Pavement snow-melting
- Greenhouses
- Indoor football halls

Life in Iceland would be very different without geothermal energy.

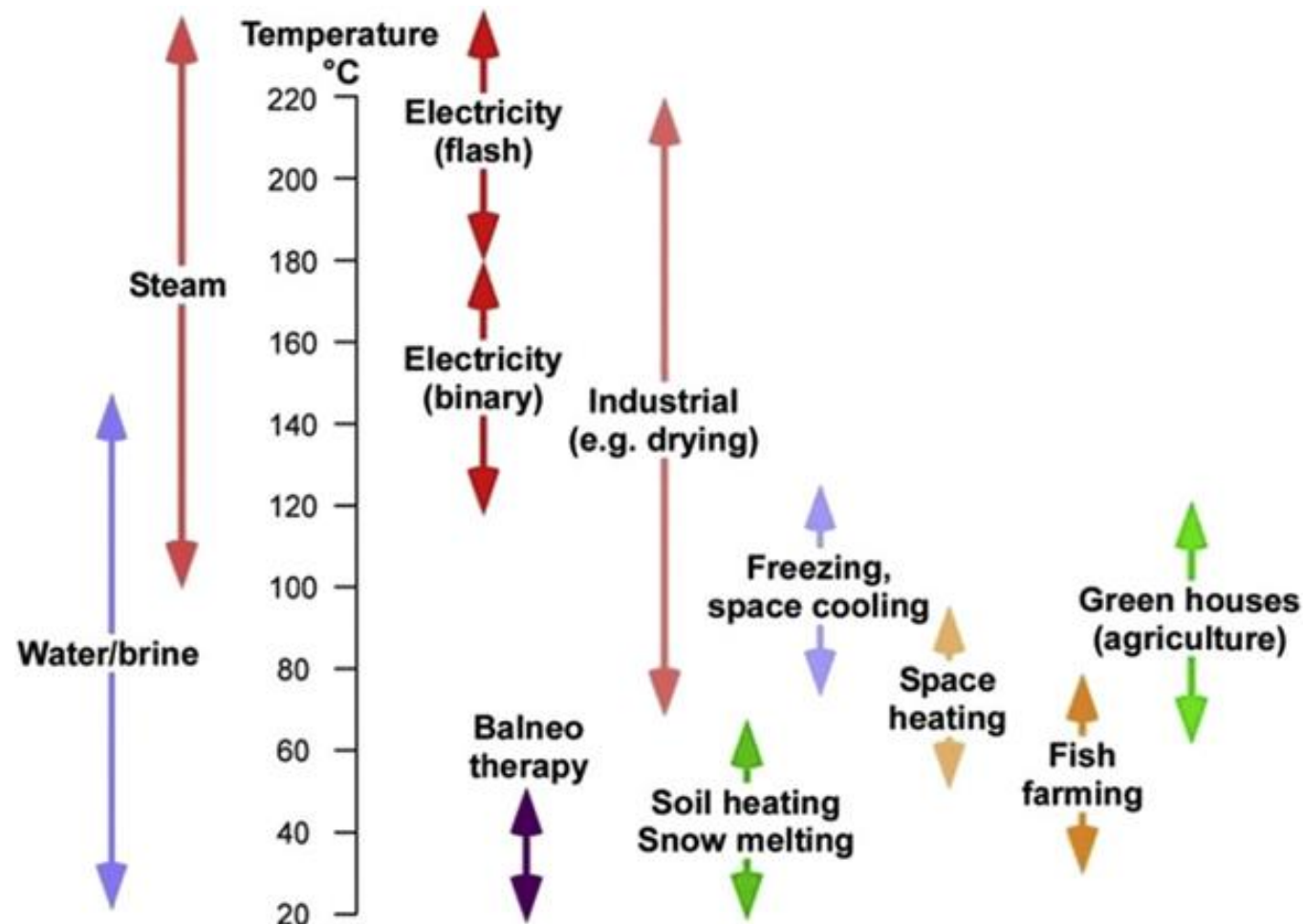


Cascading use of geothermal energy

Electricity production requires high temperatures.

The water is still very hot after electricity production and can be utilized in various ways.

Geothermal gas, e.g. CO₂, can be turned from waste to value.



Why use geothermal energy for more than electricity generation?

- Better utilization of geothermal energy and material resources, less waste streams.
- Increased value creation from the geothermal resource utilization.
- Increased sustainability of the resulting products.
- Job creation and innovation in the local area.
- Better „social license to operate“ the geothermal power plants.
- Landsvirkjun is focused on sustainable, energy-intensive cascading use that requires two or more of the available resources, such as:
 - Electricity
 - Thermal energy
 - CO₂



Energy intensive, high-tech food production

- Greenhouses
- Algae farming
- Fish farming





Renewable fuel production (power-to-fuel)

- Hydrogen
- Methane
- Methanol



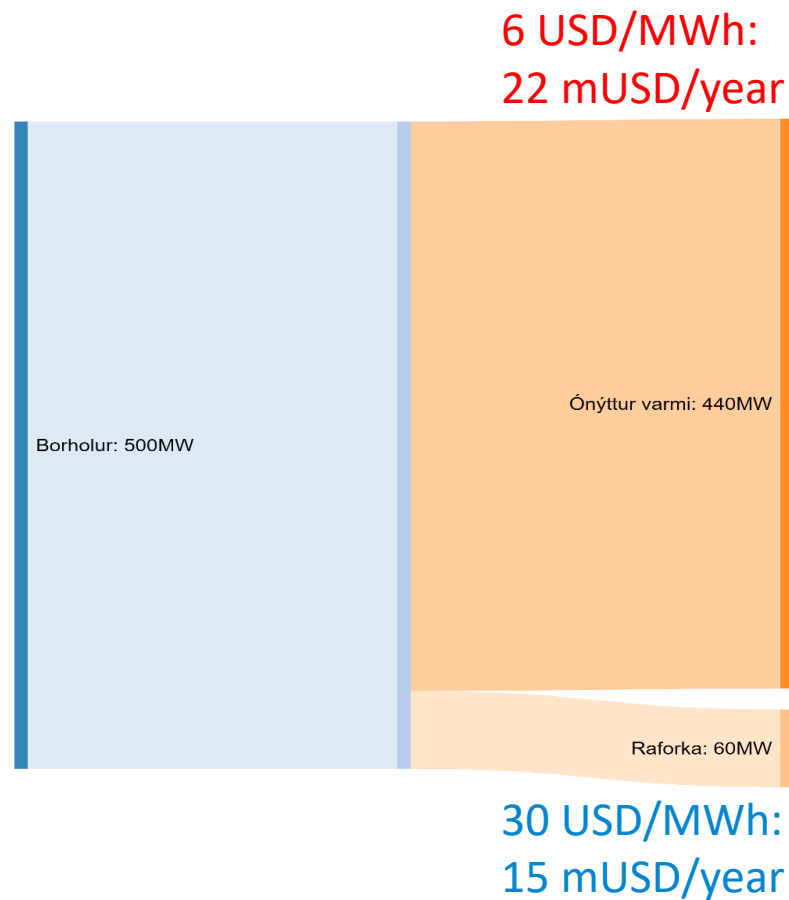
Geothermal tourism

- Bathing
- Luxury spa hotels
- Tours of geothermal areas.
- Geothermal and volcanology exhibitions.



Example: Krafla geothermal power plant

Unused thermal energy

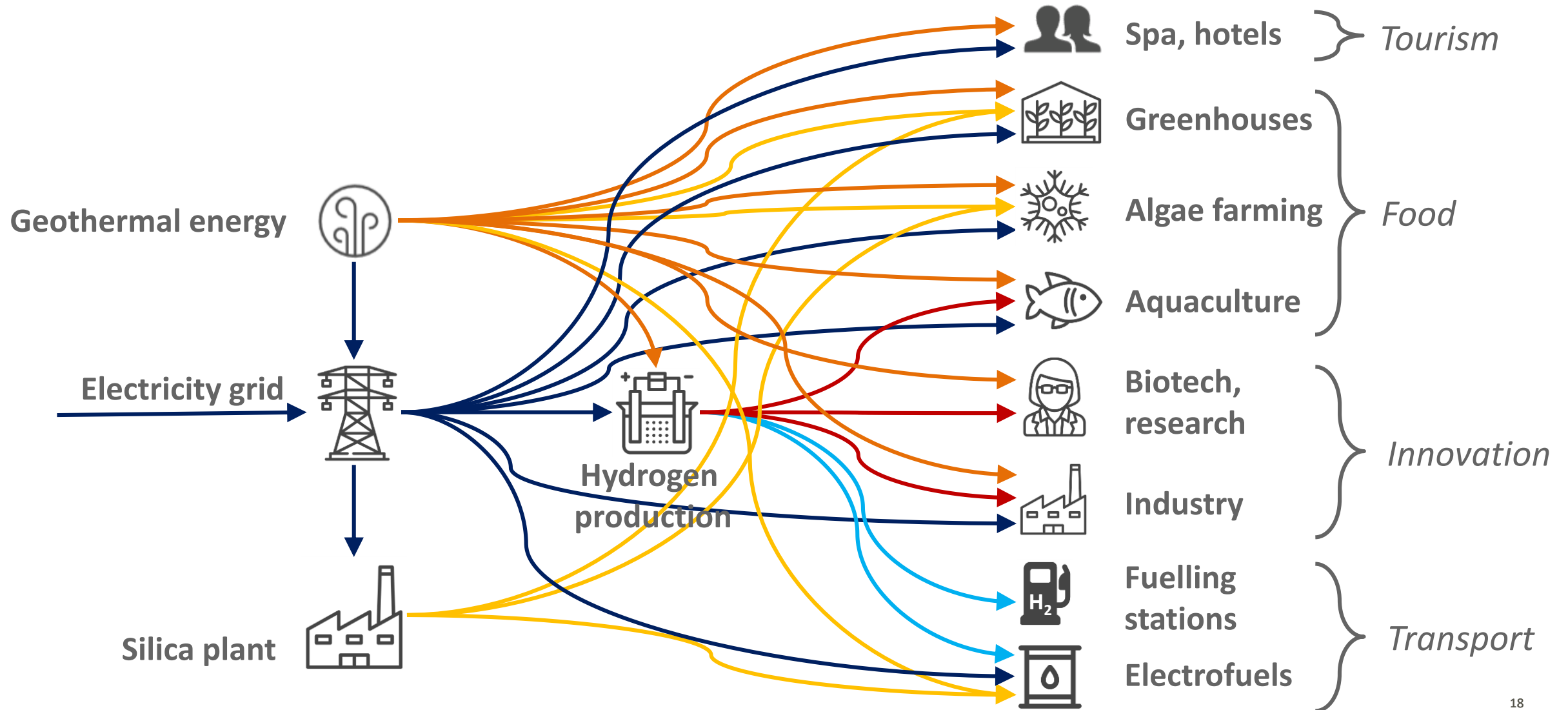


Potential for increased value creation

Product	Quantity	Value (m USD/year)
Electricity	60 MW	15
Thermal energy	44 MW (10% of the waste heat)	2,2
CO ₂	25.000 ton/year (0,16 USD/kg)	4,0

Vision: A geothermal, eco-industrial park in Northeast Iceland

Electricity Hydrogen Oxygen
CO₂ Heat



Summary

- Large amounts of surplus heat and other value streams are available at geothermal power plants.
- Waste streams can be turned into value
 - Environmentally
 - Economically
 - For the local community
- Cascading use of geothermal energy offers potential for sustainable, high-tech innovation.



Takk fyrir!

Questions?

