

An aerial photograph of a geothermal pool. The water is a vibrant, clear blue, contrasting sharply with the surrounding landscape. Numerous rocks of various sizes and shapes are scattered throughout the pool. These rocks are primarily light-colored, possibly white or grey, but are heavily encrusted with bright red and orange mineral deposits, likely iron oxides. The water flows around these rocks, creating small ripples and eddies. The overall scene is a striking example of natural geothermal activity.

Birds Eye of Icelandic Geothermal Innovation

Kolbrún Ragna Ragnarsdóttir

FIGURE 8. Estimated Renewable Energy Share of Global Electricity Production, End-2018

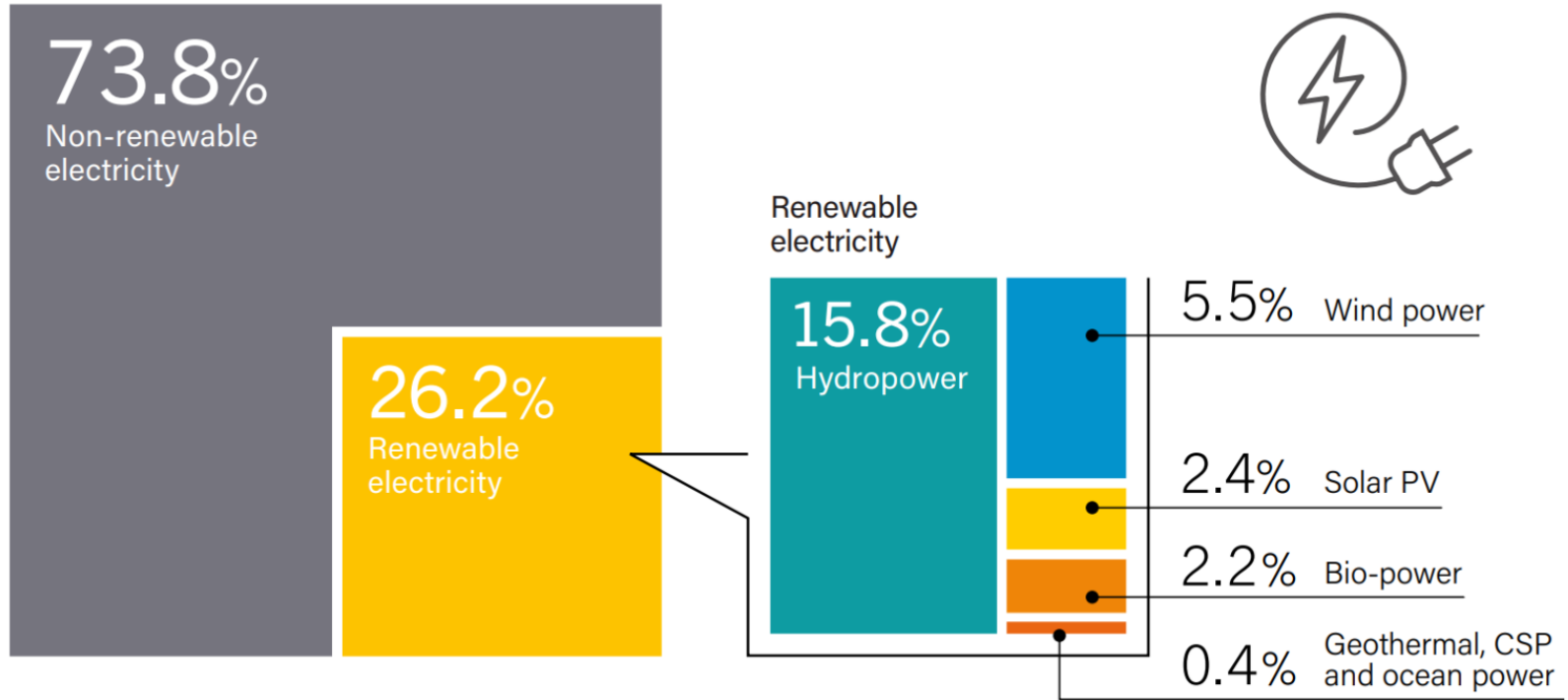
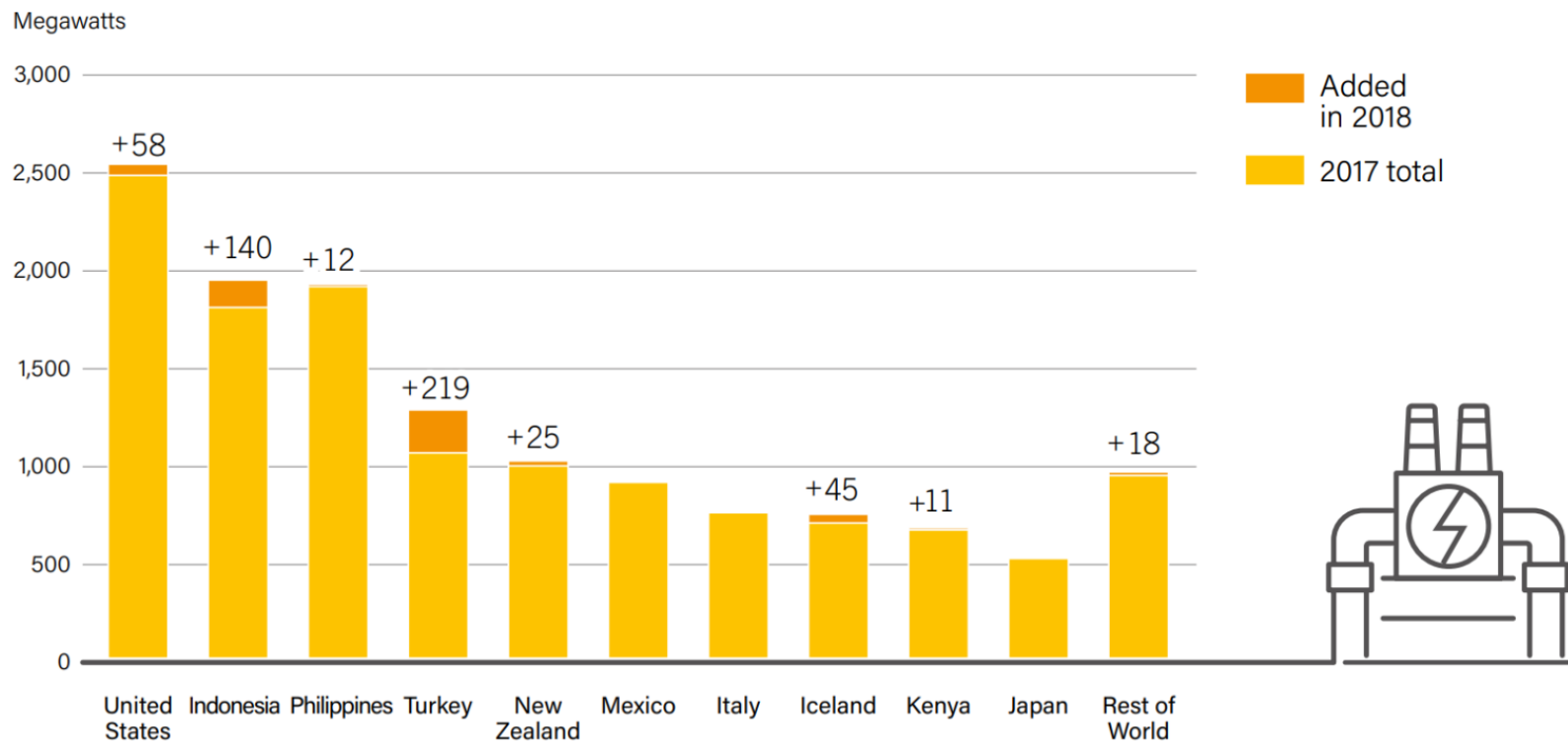
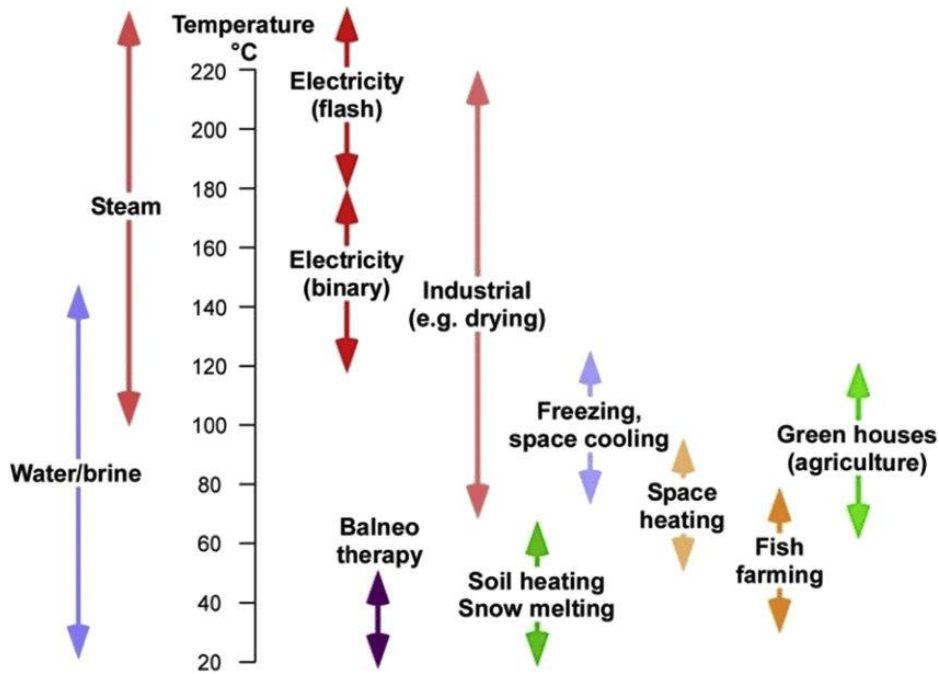


FIGURE 22. Geothermal Power Capacity and Additions, Top 10 Countries and Rest of World, 2018



Source: [ren21.net](https://www.ren21.net)

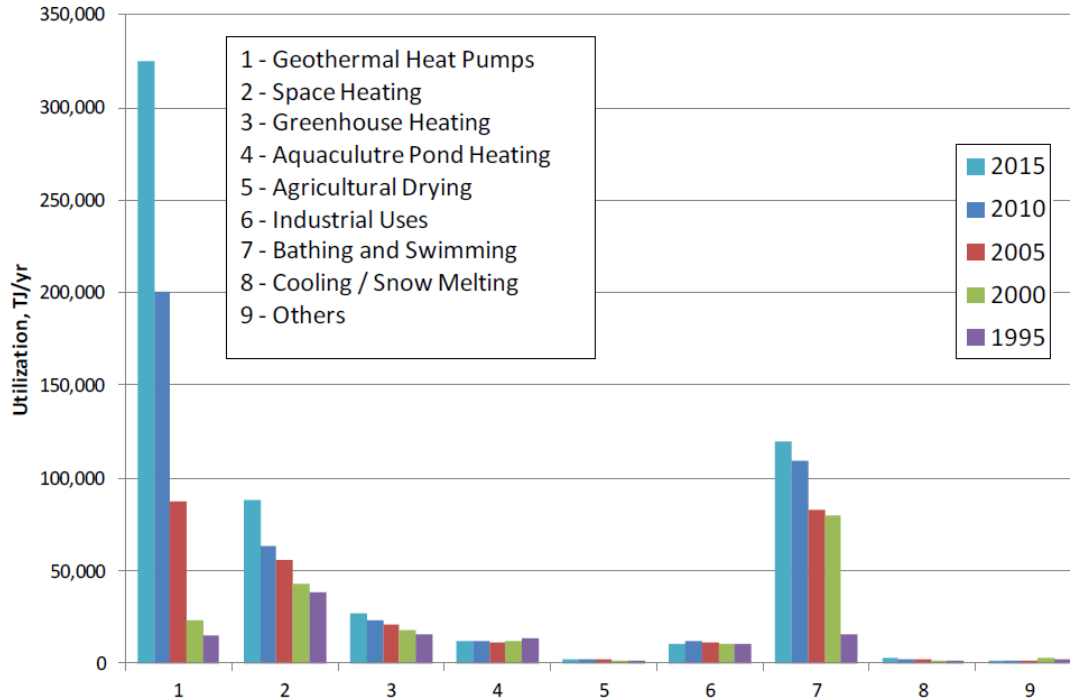


Geothermal energy utilization

Possible to enhance the feasibility of geothermal projects with cascading and combined uses

The resource temperature limits the possible uses

Worldwide direct use



Source: John W. Lund et. al., WGC2015, Melbourne

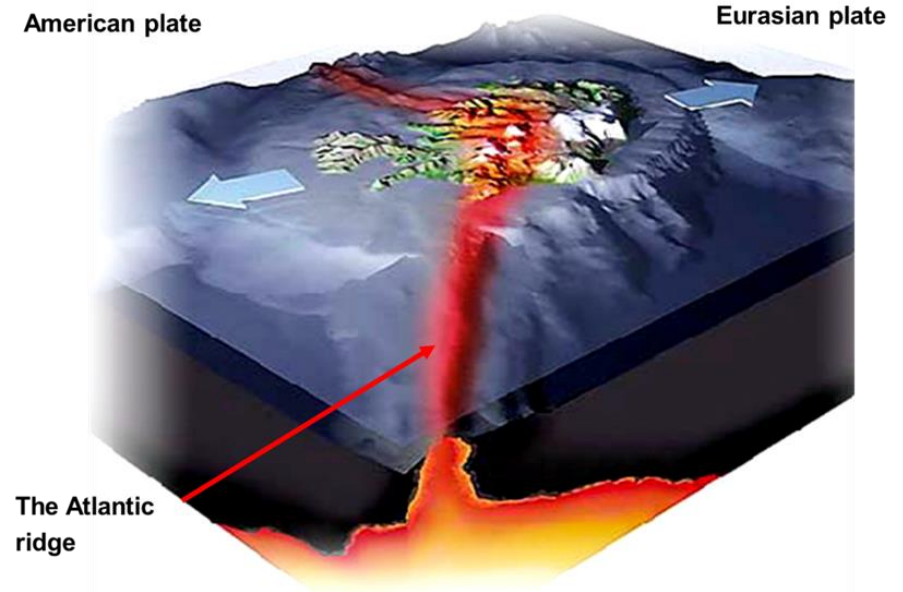
Geothermal reservoir in Iceland

Drilled down to 1500-3000 m

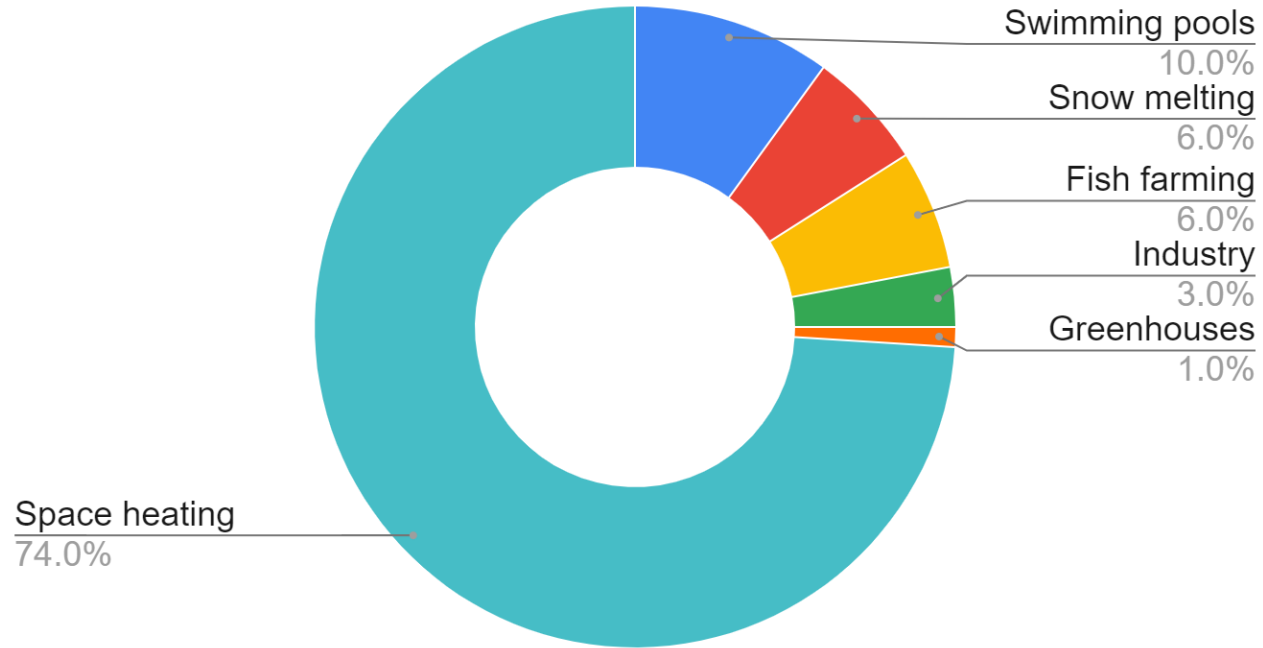
Temperature around 250-280°C

The pH value is normally neutral

Three major geothermal sites



Geothermal direct use in Iceland - 2017



Environmental benefits



Reykjavik in 1933 covered with smoke from coal heating



With geothermal space heating today

Overview of utilization projects in Iceland

Geothermal space heating



- District heating system
- Snow melting

Bathing and swimming



- Natural hot spring
- Swimming pools
- The Blue Lagoon

Aquaculture



- Fish farms
- Seaweed plant
- Drying fish

Greenhouses



Growing vegetable and flowers with low temperature heating

Salt production



Using return geothermal water from seaweed plant

Other



- CO₂
- Methanol
- Diatomite plant

A wide-angle photograph of a snowy mountain landscape under a clear blue sky with scattered white clouds. In the foreground, a red, faceted geodesic dome is partially visible. The middle ground shows a snow-covered slope with several tall, thin poles or masts. In the distance, a small cluster of buildings and more poles are visible on a lower slope. The overall scene suggests a high-altitude research station or observatory.

Research projects in Iceland

Heat pumps

Reduce the cost of electricity for district heating in cold areas in Iceland such as Vestmannaeyjar. Heat pumps are used to utilize the heat from the sea and produce electricity.

- 49 GWh/year savings of electric energy
- Will be the second largest of its kind in the world
- Reduction of 1.4 M USD annual cost



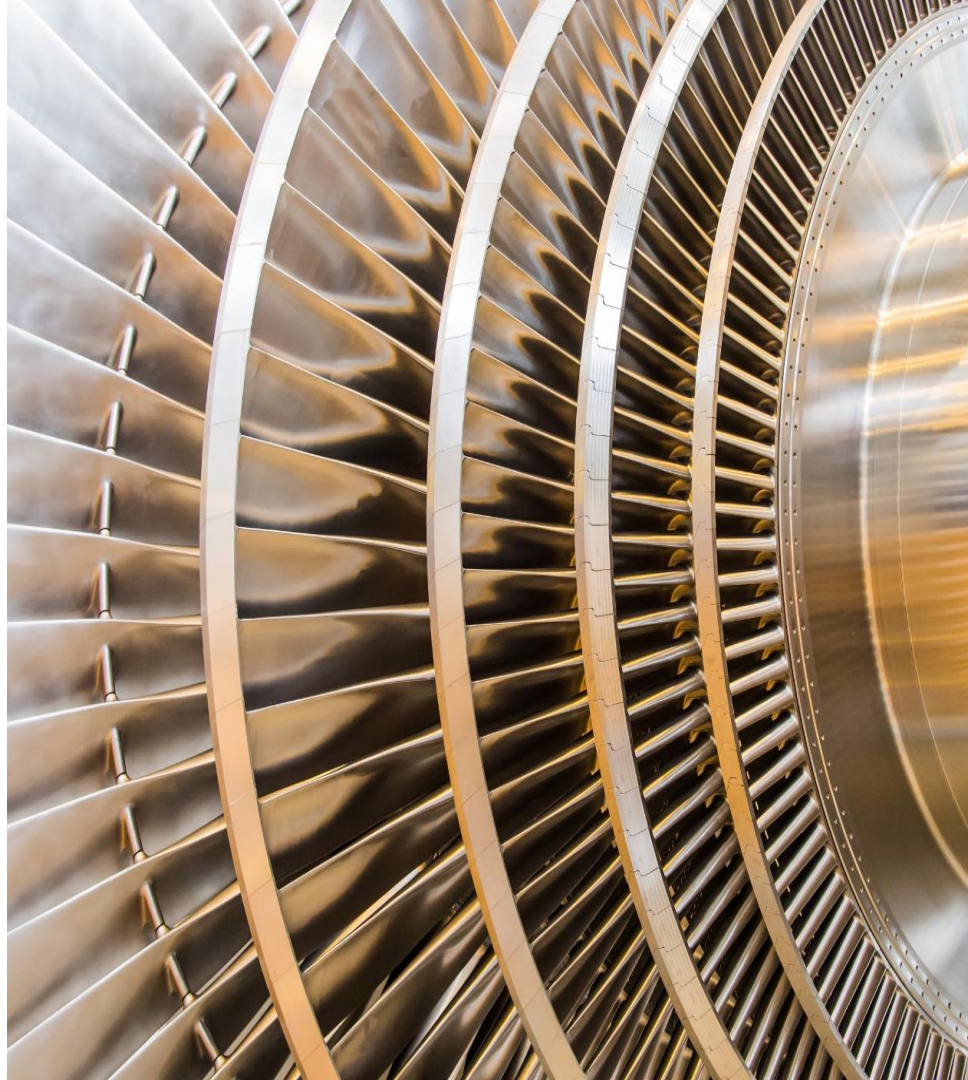


MEET - H2020

Make geothermal energy more accessible worldwide by reducing the CAPEX (capital expenditure) of EGS (Enhanced geothermal systems) wells. An EGS is a man-made reservoir, developed in an area where there is abundant hot rock but insufficient or little natural permeability or fluid saturation.

Geo-Coat - H2020

Develop a new design for material surface coatings in geothermal systems to extend their **lifetime**, **reliability** and **reduce CAPEX**. Thermal spraying processes and multi composite technology will be applied to enhance surface performance of carbon steel and higher grade alloy components.





Icelandic Deep Drilling Project (IDDP)

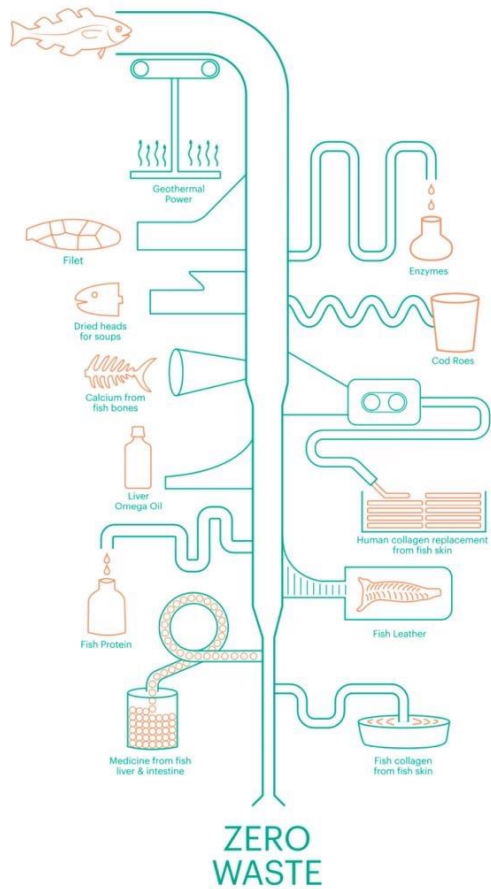
The IDDP project is to drill deep enough into the roots of a conventional high temperature hydrothermal system to produce water at **supercritical conditions** and bring it to the surface as 400-600°C **superheated steam**, at subcritical pressures (<220 bar).

Flexible couplings - H2020 (GeoWell)

Flexible coupling allows displacement that compensates for thermal expansion of the casing.

- Thermal expansion of casings is one of the most severe structural concerns in high temperature geothermal wells (collapse and tensile rupture)





The incredible fish value machine describes the mission of the Iceland Ocean Cluster: to use resources to the fullest.

Icelandic Ocean Cluster

Mission: Zero waste, use fish resources to the fullest

Source: Thor Sigfusson, LinkedIn

INNOVATION IN

TECHNOLOGICAL DEVELOPMENT

IS

ESSENTIAL

