Iceland Liechtenstein Norway grants

DZS

Ministerstvo financí České republiky

TOPIC: Iceland - Czech republic: comparison of electricity generation systems

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PROJECT: Comparison of energy potencial of Iceland and the Czech Republic

DATE: 1/ 8/2021 – 31/ 8/ 2022

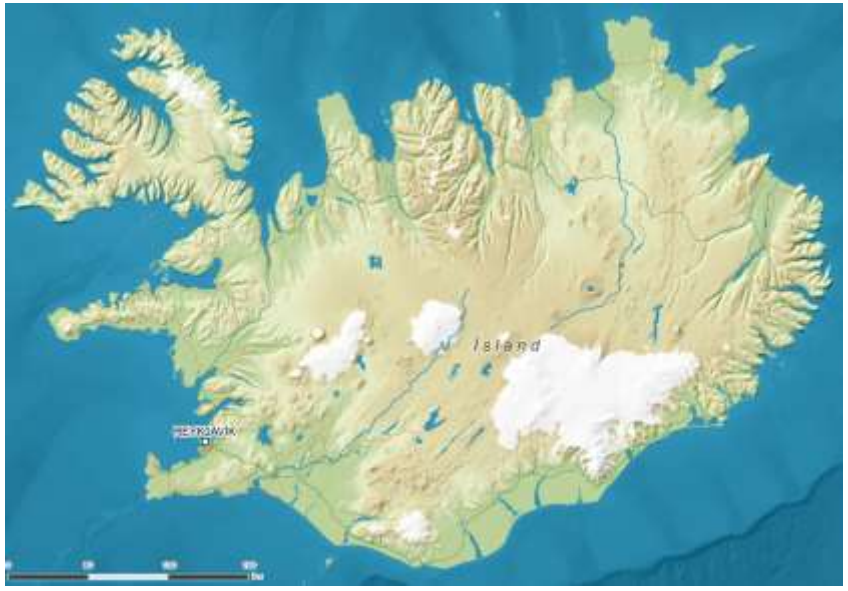
ICELAND - CZECH REPUBLIC

COMPARISON OF ELECTRICITY GENERATION SYSTEMS

OLGA BURŠÍKOVÁ, SŠPTA JIHLAVA

IMPORTANT FACTS - SIZE, POPULATION

- **Iceland**
  - **Area:** 102 775 km^2
  - **Population:** 371 000
  - **Population density:** 3.5/km^2
  - **Largest towns (population):**
    - Reykjavík (129 th.)
    - Kópavogur (37 th.)
    - Hafnarfjörður (30 th.)
    - Reykjanesbær (19 th.)
    - Akureyri (19 th.)



- **Czech republic**
  - **Area:** 78 871 km^2
  - **Population:** 10 700 000
  - **Population density:** 136/km^2
  - **Largest towns (population):**
    - Praha (1,3 mil.)
    - Brno (380 th.)
    - Ostrava (290 th.)
    - Plzeň (171 th.)
    - Liberec (104 th.)

      …
    - Jihlava - 17th largest (51 th.)

IMPORTANT FACTS - NATURAL CONDITIONS

- **Iceland**
  - High altitude differences (0-2110 m)



  - Mid-Atlantic ridge =>volcanic activity, geysers



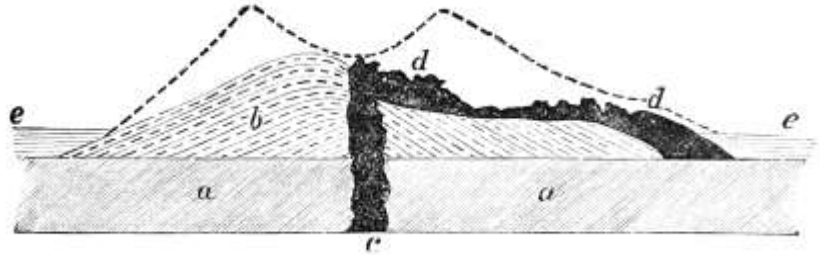
  - Inland: tundra, partly covered with claciers, habitable land on the sea coast



- **Czech republic**
  - Moderate altitude differences (115-1603 m)

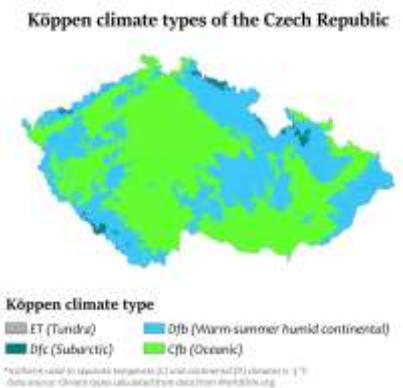


  - Geologically stable - last erruptions app. 200 th. yrs ago

  - Lower altitude: agricultural land / forests, higher altitude: forests / grasslands

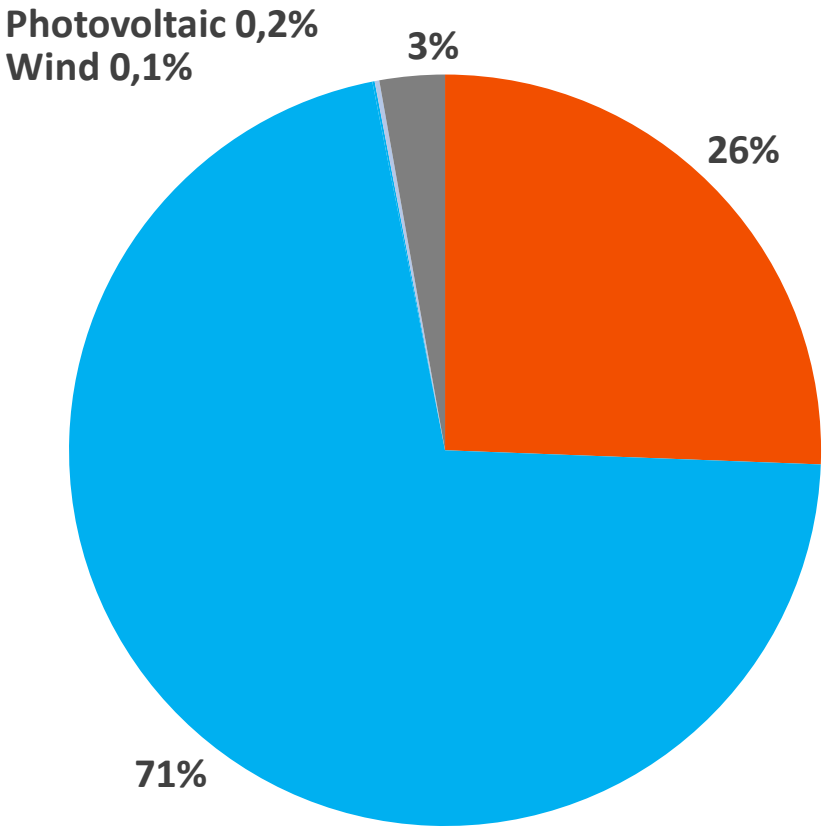




STRUCTURE OF ELECTRICITY GENERATION AT ICELAND

installed capacity

Total :2,95 GW



Majority of installed capacity and production is represented by hydro power plants.

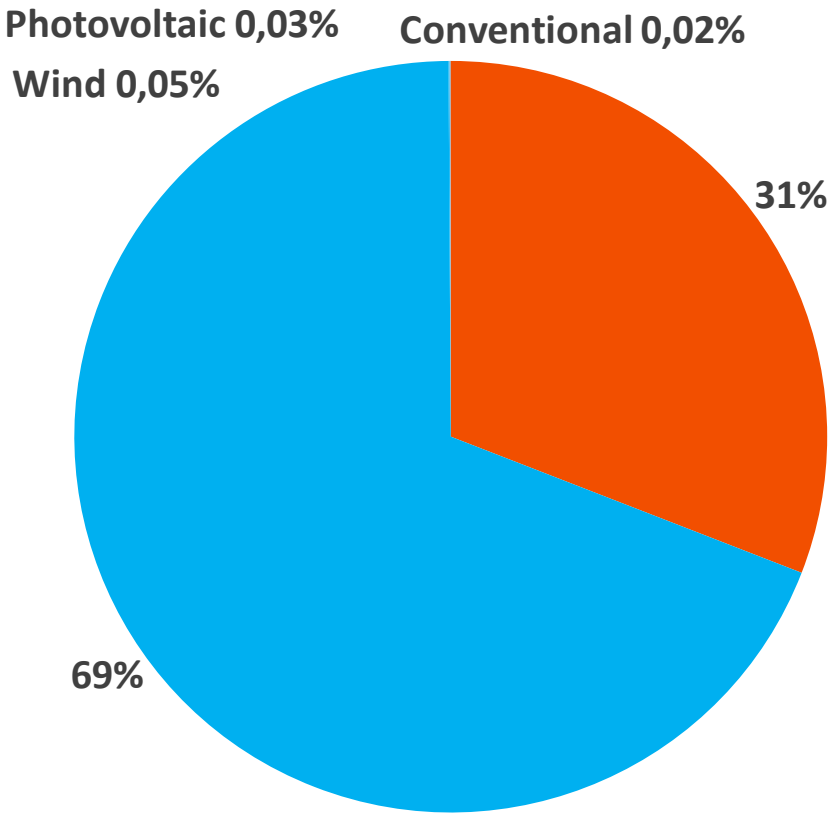
Geothermal power plants represent app. ¼ of the installed capacity, share on production is slightly higher.

Share of wind and solar is negligible.

There are a few conventional power plants, but their production is negligible.

Electricity production

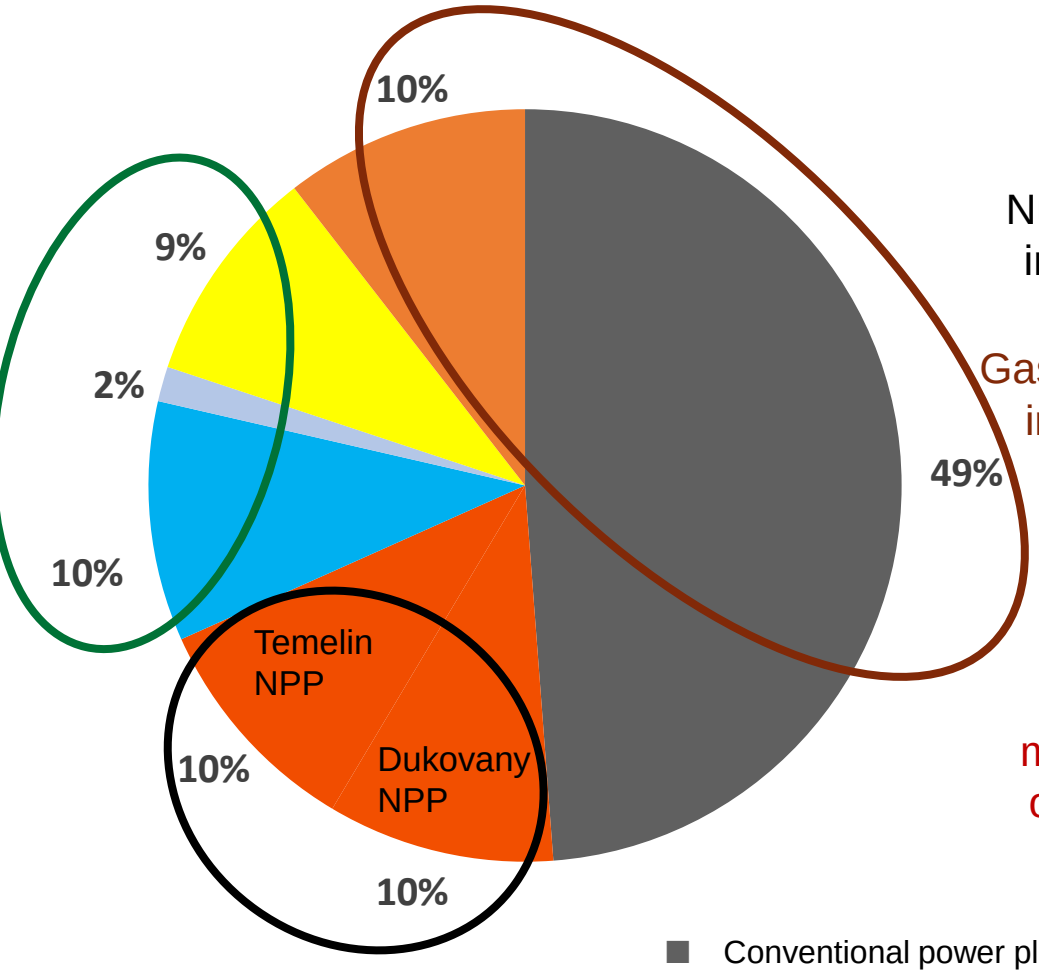
Total: 19,5 TWh



- Hydro and pumped storage power
- Geothermal power plants
- Conventional power plants
- Wind power plants
- Photovoltaic power plants

STRUCTURE OF ELECTRICITY GENERATION IN THE CZECH REPUBLIC

installed capacity
Total: 21,3 GW



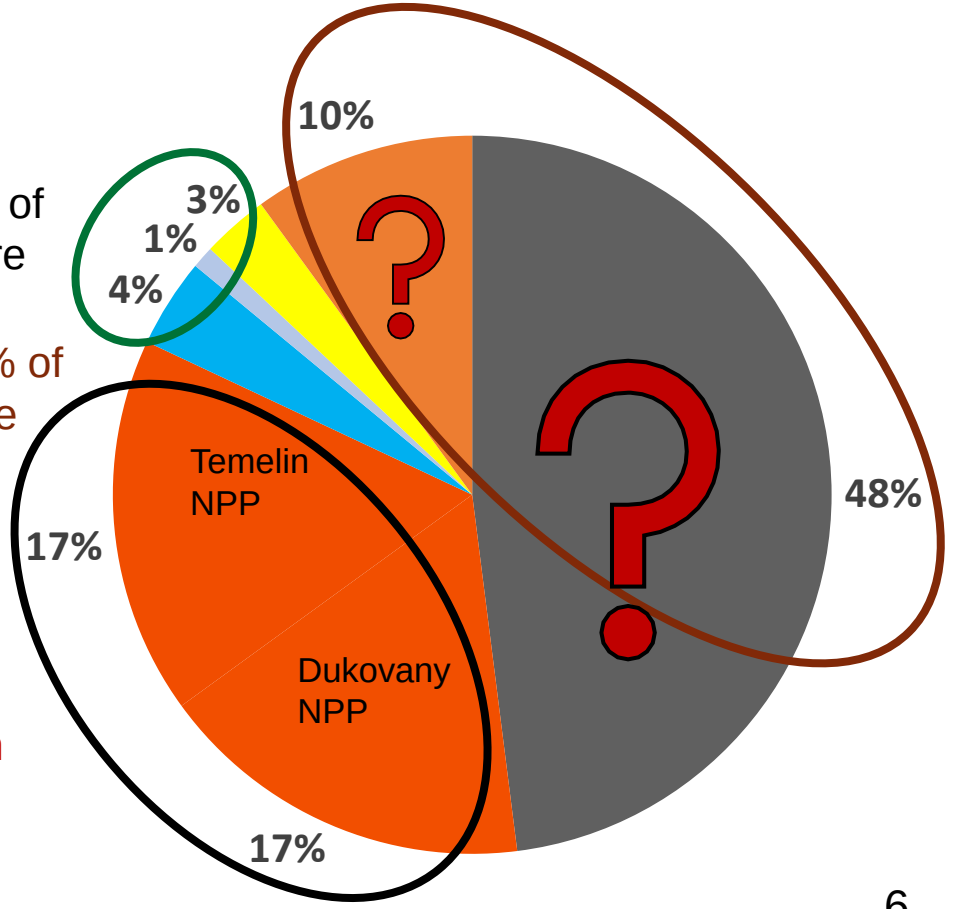
Nuclear power represents 20 % of installed capacity but their share on production is 34 %.

Gas / coal power represents 59 % of installed capacity with the same production ratio.

Renewables represent 21 % of installed capacity but only produce 8 % of electricity.

European Green Deal also means that a significant portion of today's production is at risk.

Electricity production
Total: 81,4 GWh



- Conventional power plants
- Hydro and pumped storage power
- Gas and combined cycle power plants
- Nuclear power plants
- Photovoltaic power plants
- Wind power plants

MAJOR POWER PLANTS AT ICELAND

Blöndustöð Hydropower Plant
- 150 MW

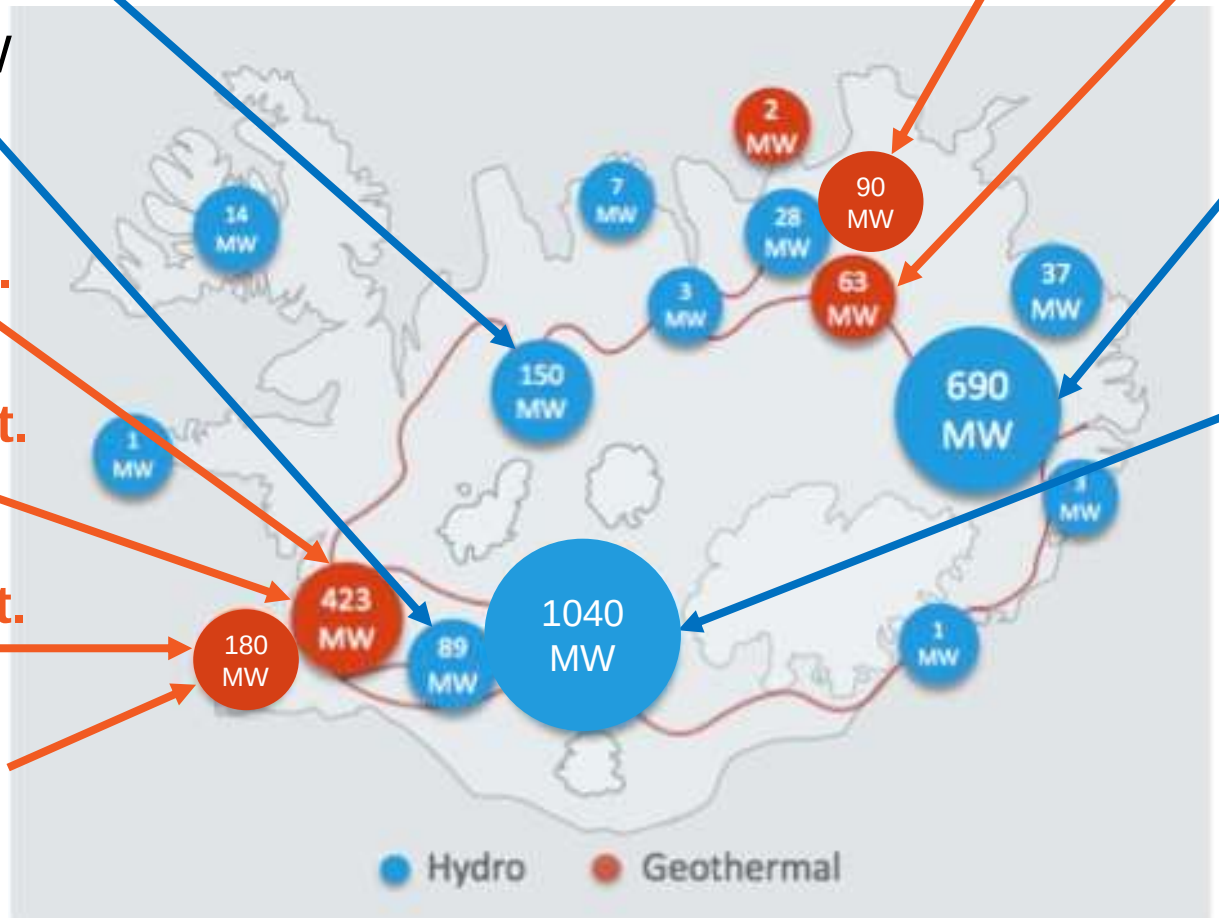
Sog hydro cascade
- Steingrímsstöd - 27 MW
- Ljósafoss - 16MW
- Írafossstod - 48 MW

Hellisheiði Geothermal St.
- 303 MW

Nesjavellir Geothermal St.
- 120 MW

Reykjanes Geothermal St.
- 100 MW

Svartsengi Power Station
- 90 MW



Theistareykir Geothermal Station
- 90 MW

Krafla geothermal Station
- 60 MW

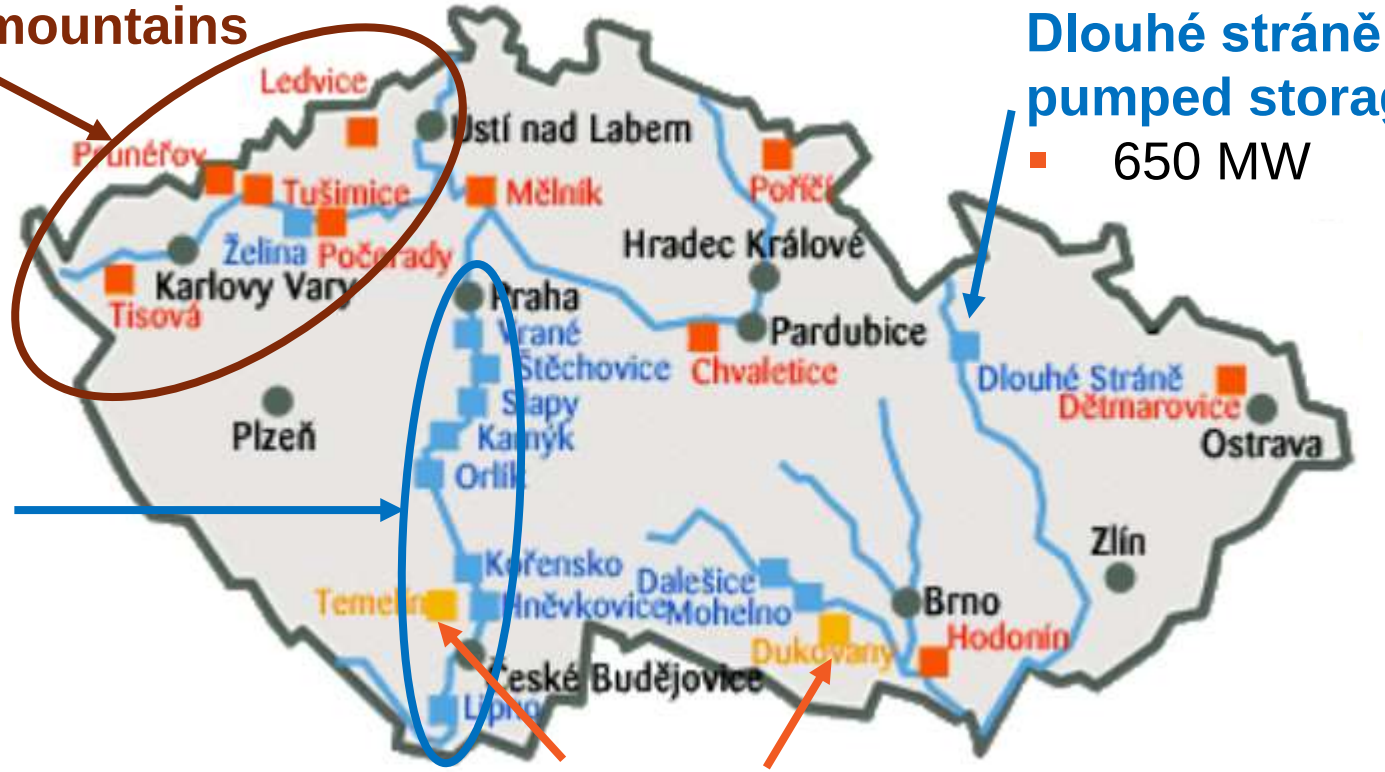
Kárahnjúkar Hydropower Plant
- 690 MW

Þjórsá-Tungnaá hydro cascade
- Búðarháls - 95 MW
- Búrfell I, II- 370 MW
- Sultartangi - 125 MW
- Hrauneyjafoss - 210 MW
- Vatnsfell - 90 MW
- Sigalda - 150 MW

MAJOR POWER PLANTS IN THE CZECH REPUBLIC

Lignite basin - Krušné mountains

- Prunéřov - 750 MW
- Tušimice - 800 MW
- Ledvice - 770 MW
- Počerady - 1000 MW
  + CCGT 880 MW



Vltava hydro cascade

- Lipno I - 120 MW
- Orlík - 364 MW
- Kamýk - 40 MW
- Slapy - 144 MW

Dlouhé stráně - hydro pumped storage

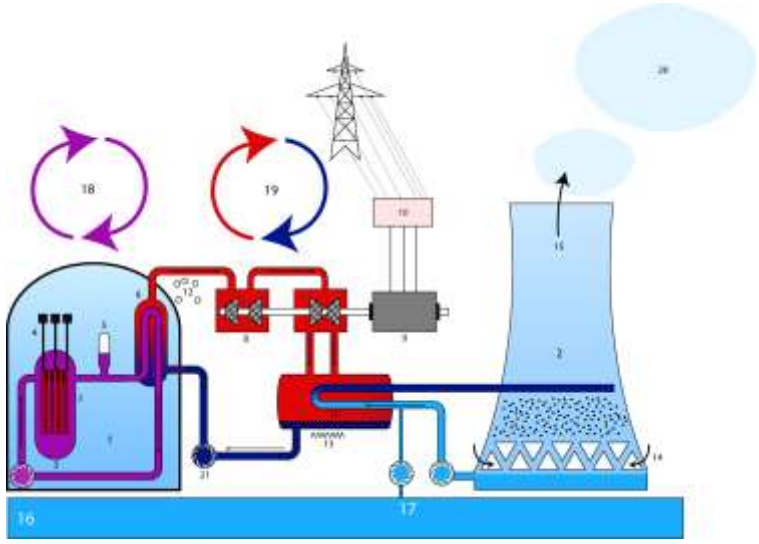
- 650 MW

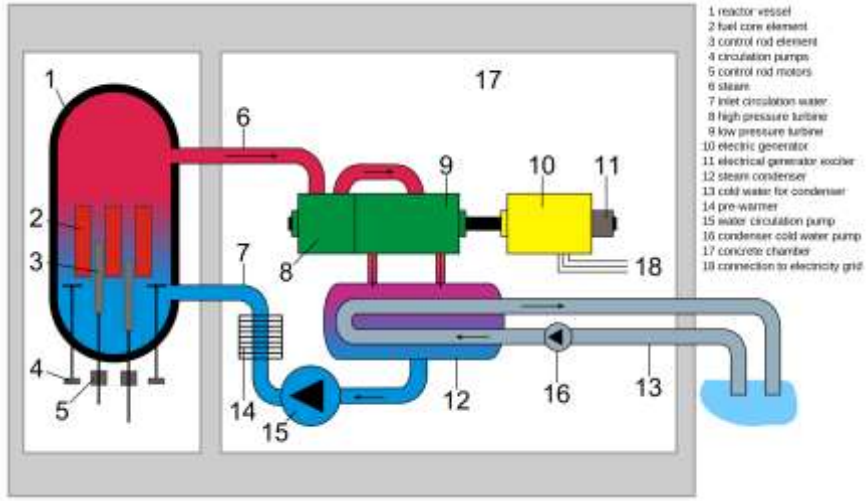
Nuclear power plants

- Dukovany - 2040 MW
- Temelín - 2168 MW

NUCLEAR POWER PLANT

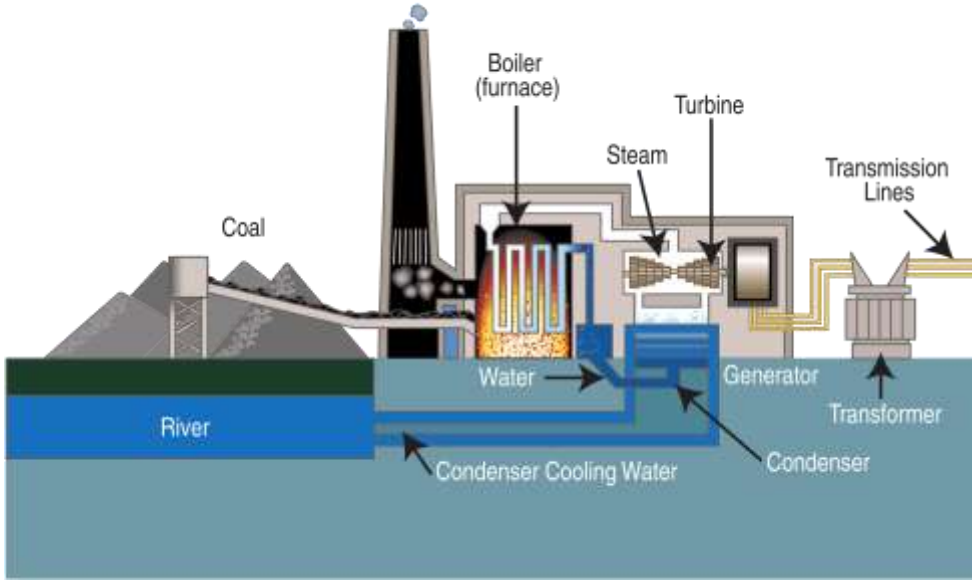
- **Types:**
  - Pressurized water reactor (PWR) - light/heavy water
  - Boiling water reactor (BWR)
- **Specific requirements**
  - Tectonically stable area
  - Distance from populated areas
  - Strong source of cooling water
- **Efficiency: medium** (30-40 %)
- **Advantages**
  - Significant installed capacity with low impact to the landscape
  - Small amount of fuel required
  - No CO_2 production
- **Disadvantages**
  - Risk of accident with radioactivity release
  - Lower regulation possibilities (short term ~ 10 %, long term ~ 50 % - not economical, speed of regulation ~1 % / min, depends on type) - **baseload** source
  - Large initial investment
  - Radioactive waste & spent fuel





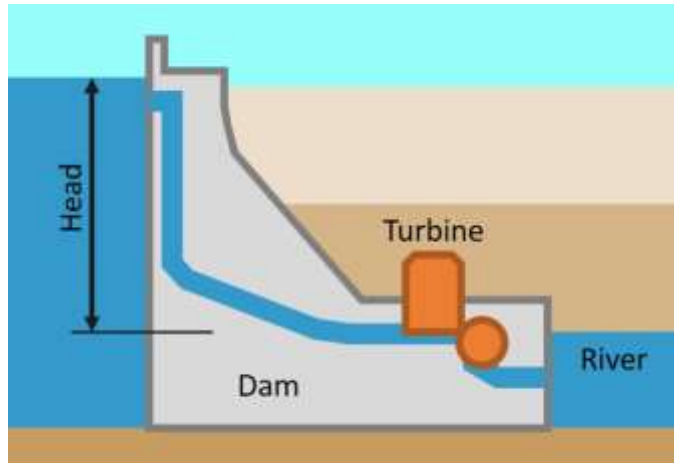
COAL/LIGNITE POWER PLANT

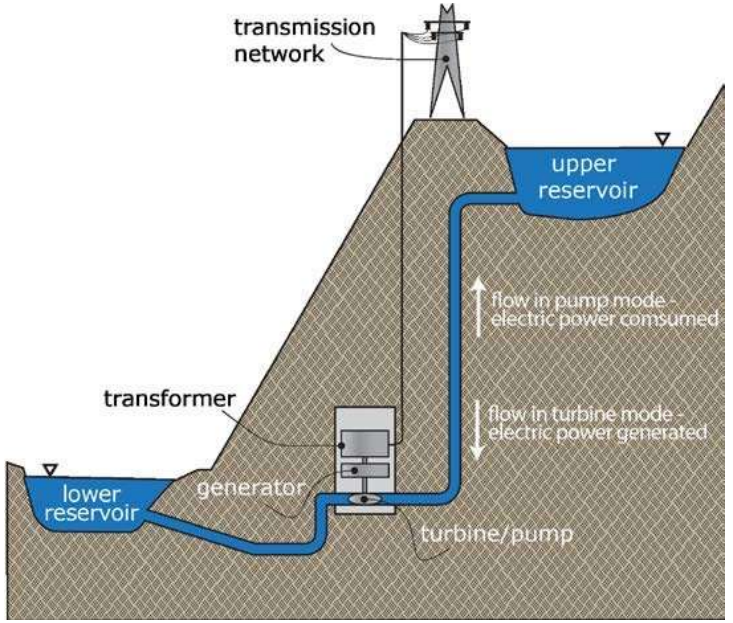
- **Types:**
  - Hard coal
  - Lignite
- **Specific requirements:**
  - **Hard coal:** coal mine or sea port
  - **Lignite:** coal mine close to the power plant
- **Efficiency: medium** (30-45 %)
- **Advantages:**
  - Significant installed capacity
  - Good power regulation capabilities
  - Can be built close to towns - district heating
- **Disadvantages:**
  - Large impact to the landscape
  - Significant CO_2 production



HYDRO POWER PLANT

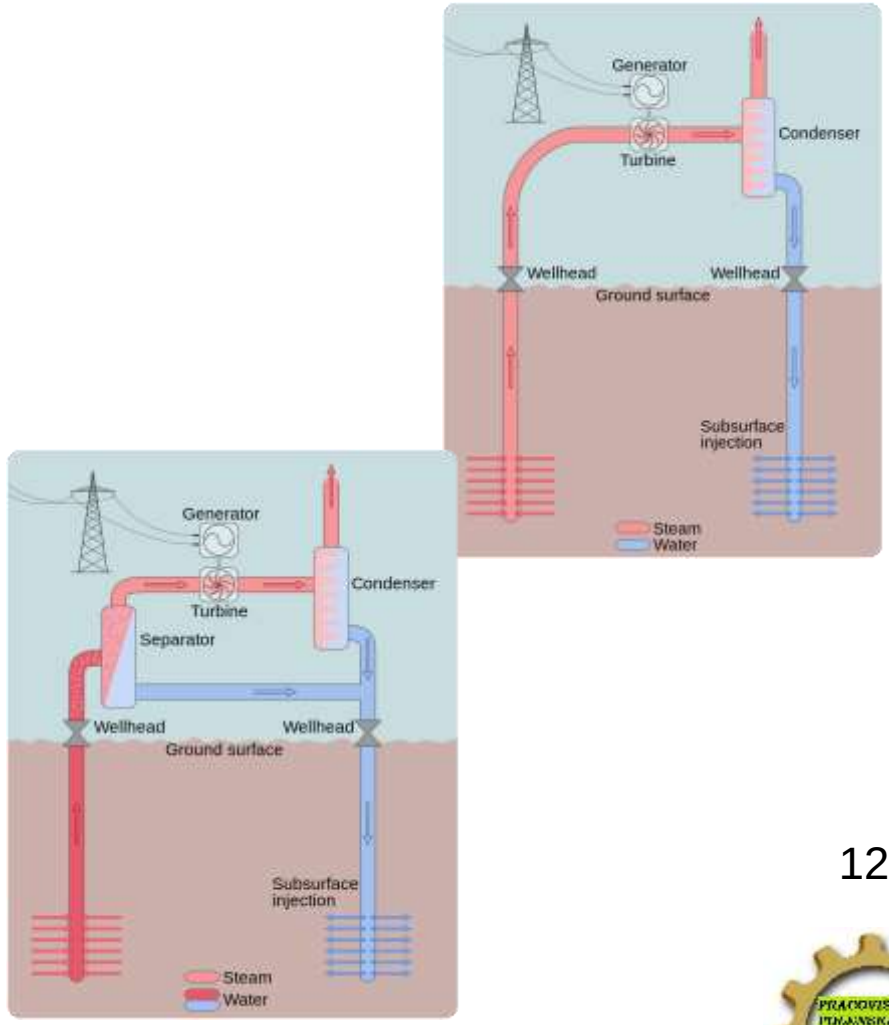
- **Types:**
  - Run of river
  - Accumulation
  - Pumped storage
- **Specific requirements:**
  - River with sufficient flow and gradient
  - Suitable valley for reservoir type
  - Mountain for pumped storage
- **Efficiency: high** (up to 90 %, pumped storage up to 75 %)
- **Advantages**
  - No waste / CO_2 production
  - No fuel costs
  - Fast start
  - Regulation 0-100%
  - Accumulation type can prevent floods behind the dam
- **Disadvantages**
  - The dam floods large areas
  - Cutting the river: fish migration, ship routes
  - Risk of flood wave in case of dam rupture
  - Large initial investment





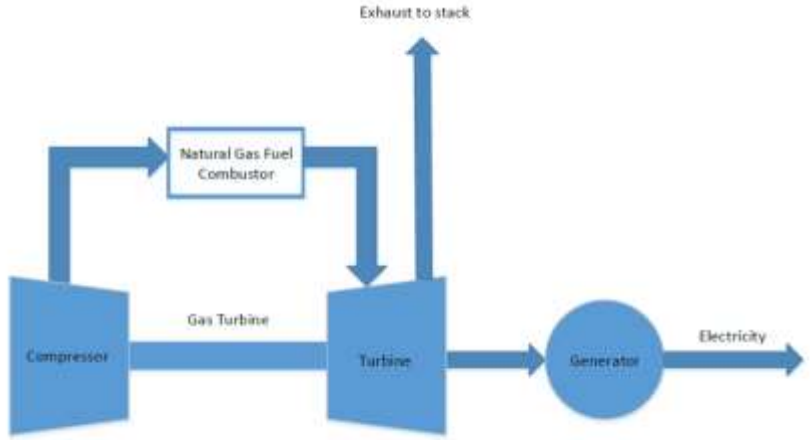
GEOTHERMAL POWER PLANT

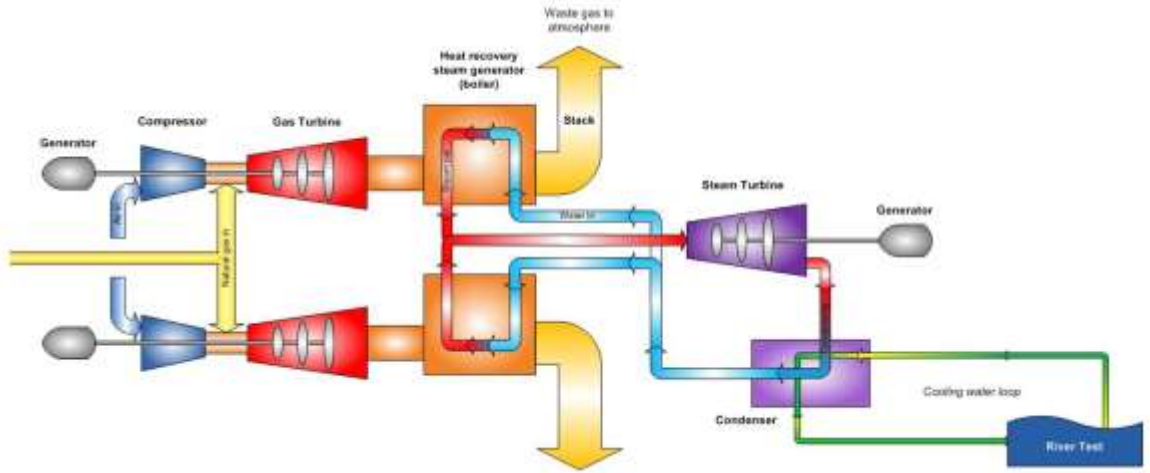
- **Types:**
  - Steam
  - Steam/water
- **Specific requirements**
  - Significant hydrothermal source with temperature >150ºC
- **Efficiency: low** (7-17 %)
- **Advantages:**
  - No fuel costs
  - No waste / CO_2 production
- **Disadvantages:**
  - Large initial investment
  - Can be built only in limited number of locations in the world



GAS POWER PLANT

- **Types:**
  - Open cycle gas-turbine (OCGT)
  - Combined cycle gas-turbine (CCGT)
- **Specific requirements**
  - High-capacity gas pipeline
- **Efficiency: medium** (OCGT 35-45 %, CCGT 55-65 %)
- **Advantages:**
  - Fast power regulation, startup and shutdown
  - Low area needed
  - Can be build near town - district heating
  - Lower initial investment
- **Disadvantages:**
  - Profitability highly depends on the price of gas
  - CO_2 production (though lower than coal)





PHOTOVOLTAIC / WIND POWER PLANT

- **Specific requirements:**
  - Suitable wind / sun conditions
  - Large area
  - Wind turbines - distance from human dwellings
- **Efficiency:** Photovoltaic - **low** (15-20 %), Wind - **medium** (up to 50 %)
- **Advantages:**
  - No waste / CO_2 production
  - No fuel costs
- **Disadvantages:**
  - Large initial investment
  - No power regulation
  - Requires backup source
  - Wind turbines - noise, bird collisions

NPP DUKOVANY

- **Type:** PWR, 4xVVER-440 V213, 510 MWe
- **Start of operation:**
  - Unit 1: 1985
  - Unit 2: 1986
  - Units 3&4: 1987
- **Original design lifetime:** 30 years (2015-17)
- **Envisaged operation till:** 2045-47

NPP TEMELIN

- **Type:** PWR, 2xVVER-1000 V320, 1082 MWe
- **Start of operation:**
  - Unit 1: 2000
  - Unit 2: 2002

- **Original design lifetime:** 30 years
- **Envisaged operation till:** 2060-62