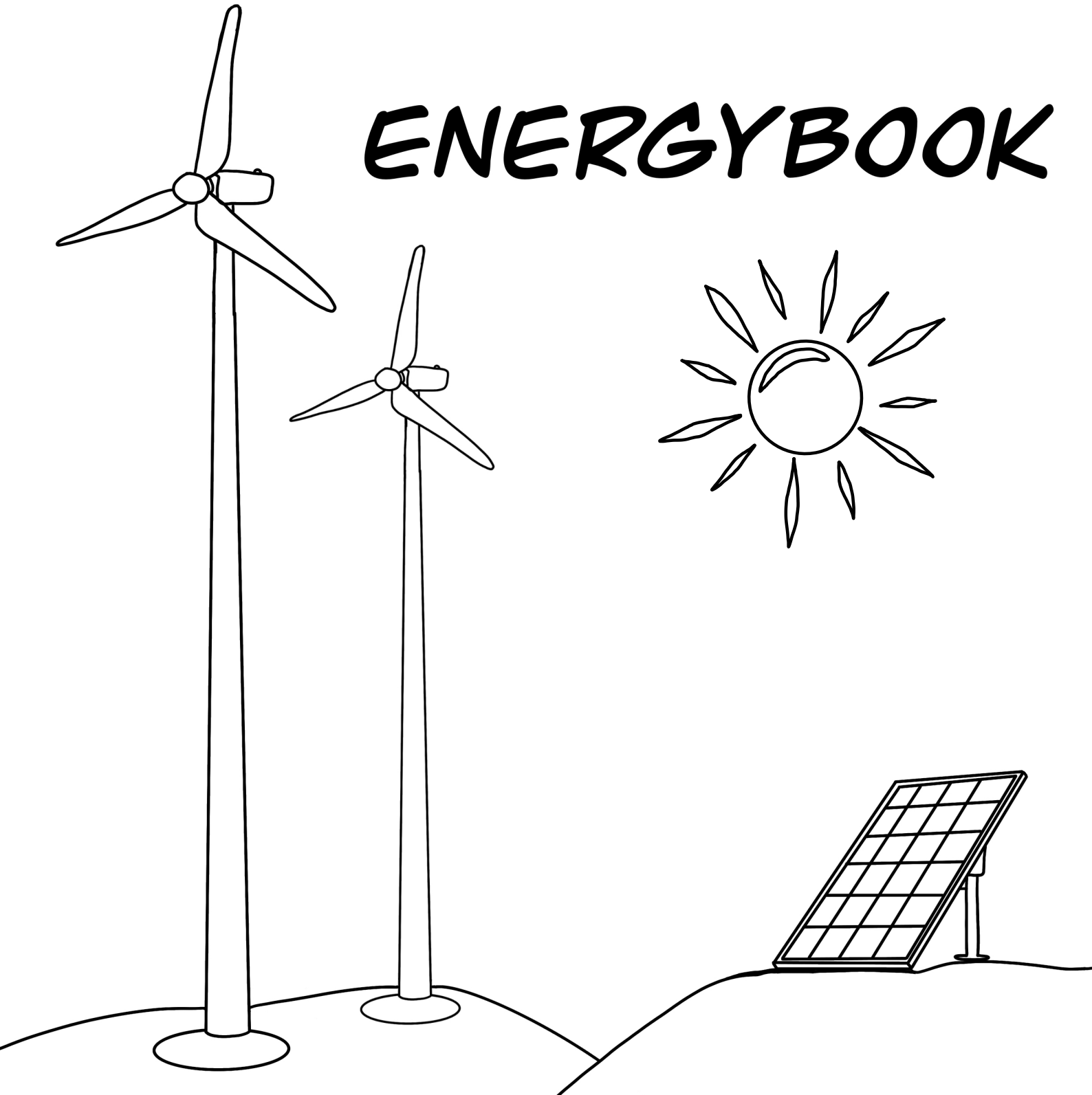
Erasmus +

ENERGYBOOK



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1. Introduction:

The main objective of Erasmus is to promote European cooperation in education and to support people's personal development through international mobility. Our project, which started in September 2020 and ended in March 2023, focused specifically on the implementation and acceptance of energy saving measures in the Czech Republic, Germany, Ireland and the UK. Egbert Gymnasium Münsterschwarzach from Germany, Glenstal Abbey School from Ireland, Ampleforth College from England and Arcibiskupské gymnázium v Kroměříži from the Czech Republic took part. Last year we acquired a lot of knowledge about this topic on the four different trips. Our first trip started in May 2022 in Ireland. In September 2022 we went to the Czech Republic where we learned about water and wastewater treatment. In Germany, we worked out how the government uses small plants and grants to stay green, and on our last trip, to the UK, we founded out landscape conservation and discovered how strict rules and regulations can sometimes delay decisions that need to be made quickly if they are to have an impact. In our little energy book, we look at the different the ways energy is produced in different countries and schools.

2. How can we save energy?

Saving energy is very important. Everyone of us is able to contribute to the protection of our environment. There are many ways to use less energy in everyday life, and often small changes are all it takes. These household tips can help you save a considerable sum a lot of money, energy and the environment.

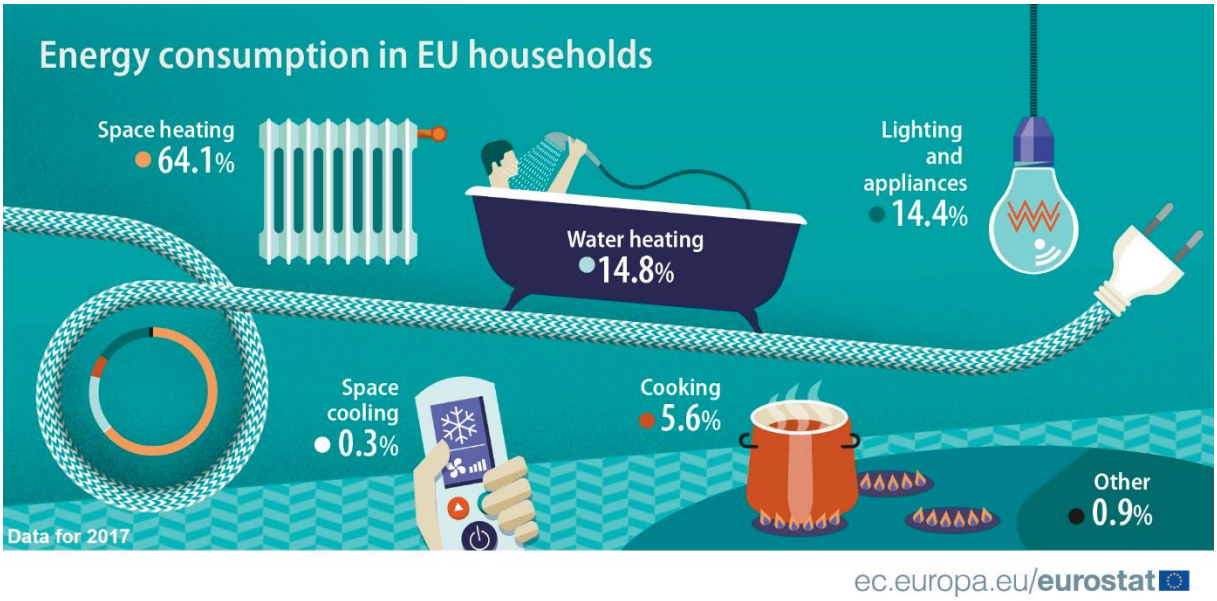


figure1: Energy consumption in Eu households

<u>Tips for saving energy in the household.</u>

1. Fill the washing machine completely, instead of only half full.
   → Saves 25 euros per year (corresponds to approx. 43 kg CO2)

2. Lighting: Replace halogen lamps with LED lamps.
   → Saves 55 euros per year (corresponds to approx. 95 kg CO2)

3. Avoid standby mode and always switch off all household appliances completely using a power strip.
   → Saves up to 60 euros per year (corresponds to approx. 100 kg CO2)

4. Kettle: Always boil only the amount of water you really need.
→ Saves 14 euros per year (corresponds to approx. 25 kg CO2)

5. Computer: Put it to sleep instead of activating the screen saver.
→ Saves 17 euros per year (corresponds to approx. 30 kg CO2)

ABTEI MÜNSTERSCHWARZACH
EGBERT-GYMNASIUM

Germany

3.1 Solar energy
3.2 Wind power
3.3 Hydro power
3.4 Biogas plant

3.1 Solar energy

Solar energy, also called solar power, is the term for the radiant energy emitted by the sun.

How Münsterschwarzach uses solar energy

Photovoltaic: - generates electricity
- three systems spread across the area
- is fed into the public grid
- covers 4% of the electricity requirement

figure 2: Photovolthaic system at Münsterschwarzach Abbey

Solar thermal:

- generates heat and is used for water heating
- 21sq m of collector area (can hardly be distinguished from the photovoltaic system)
- third pillar for regenerative heating energy
- in summer more than 1000 liters of heating oil can be saved because of this system

Benefits of solar energy	Disadvantages of solar energy
- after purchasing, the use of solar power is free of charge! - offers independent energy production - renewable and environmentally friendly	- not available at night and depending on the location´s solar radiation - A solar system costs several thousand euros (but pays off over time)

Facts:

- The sun´s energy will be available for at least another 5 billion years!
- Every year the sun sends us 1.119 trillion kWh of energy (→ 7000 times more energy than we need in a year!)
- Münsterschwarzach has a CO2 footprint below 0

3.2 Wind power

Wind turbines convert the wind, which that causes the rotors to turn into electricity. A wind turbine placed in a windy location in good conditions produces 15 million KWh of electricity a year unless it is in good conditon. They can be up to 130 meters high! Some wind turbines are built in the water. There are onshore and offshore turbines.

Onshore Facility

→ Wind turbines, that are built on land

figure 3: onshore Facility

Offshore Facility

→ Wind turbines, that are built in water

figure 4: offshore Facility

Benefits of wind power	Disadvantages of wind power
- sustainable - energy efficient - clean - no consumption of fossil fuels - can be built anywhere	- loud - impact on landscape, wildlife and the environment - cause the of 1000 birds per year - depend on wind

3.3 Hydropower

Hydropower is a renewable energy source. Which comes from the flow of water. In 2020, hydropower will account for 16 percent of the global electricity production. It is the third most important energy source after coal and natural gas. Of all renewable energy sources, hydropower has the greatest potential. The usable potential is estimated at 26,000 TWh, of which 21,000 TWh can be used at economically. The developable potential is 16,000 TWh. This corresponds to electricity consumption in 2005. Five of the largest hydropower producers in 2020.

Table 1: Energy production in countries

Country	Production (TWh)	Portion from the energy production in country
China	13322,0	16,99%
Brazil	396,8	63,99%
Canada	384,7	59,75%
United States	288,7	6,73%
Russia	212,4	19,57%

In 2006, there were 7.300 active hydroelectric power stations in Germany. They carried a share of 3,4 percent to the entire power production.

figure 5: Hydropower plant

3.4 Biogas plant

A biogas plant produces biogas and fertilizer by fermenting plant or animal material in large tanks.

<u>The use of the biogas plant in Münsterschwarzach:</u>

The biogas plant in Münsterschwarzach went into operation in June 2006 and was expanded in 2012. It has an electrical output of 200kW and a thermal output of 200kW.

figure 6: Biogas plant of the Münsterschwarzach monastery

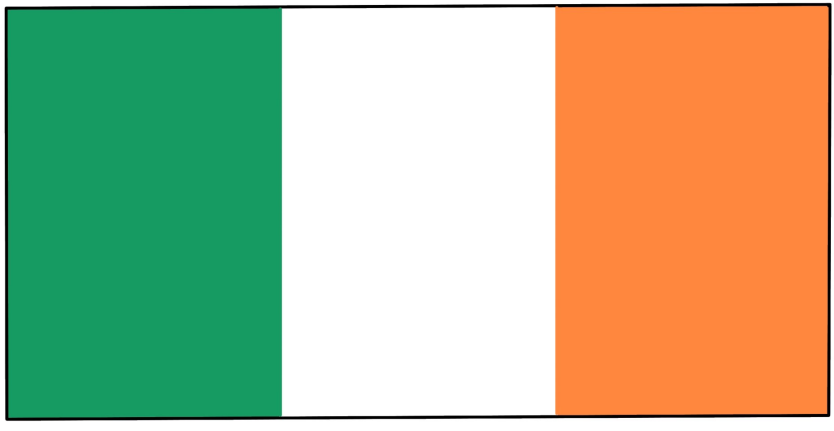
Benefits of biogas plant	**Disadvantages of biogas plant**
- Biogas is a promising source of income for farmers, saves on fossil fuels and burns CO2 neutrally. - uses agricultural waste	There is an unpleasant odor that can bother people and the combustion also produces methane and other problematic substances.

Facts

- Germany is at the forefront when it comes to biogas
- In Germany, there are 9,600 biogas plants that produce electricity for over 9 million households

Glenstal Abbey
SCHOOL

Ireland



4. Geothermal heat pump

4. Geothermal Heat Pump

Geothermal heating is energy extracted from the earth's core. This is a very sustainable way of getting energy because the earth's core will remain hot for hundreds of thousands of years, it works by pumping water about a hundred metres into the ground and heating it. This water is then pumped back up to the surface and used for geothermal heating.

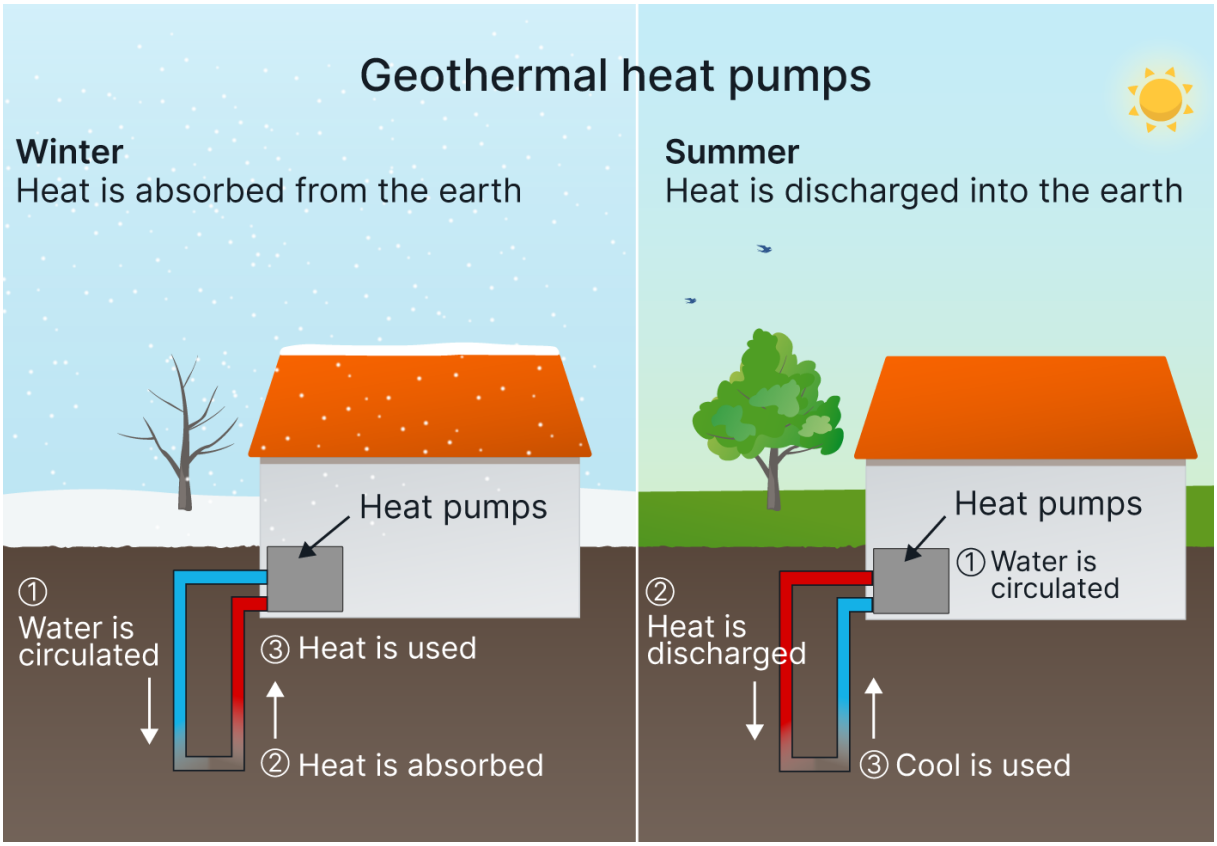


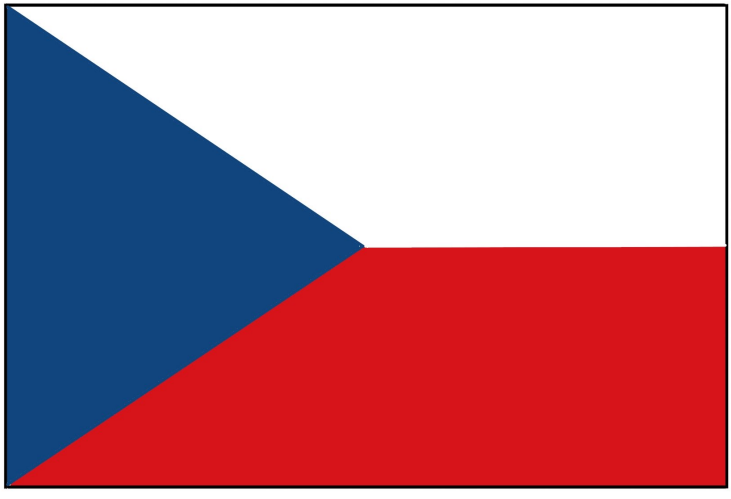
figure 7: geothermal heat pumps

<u>Geothermal Heat Pump in Glenstal Abbey School:</u>

We also use a geothermal heating system at Glenstal, there is a man-made reservoir called Chapel Lake which is connected to pumps 3 meters below the riverbed, these pumps then send the water 100 meters down and back up to the surface to heat the refectory, monastery and church via underfloor heating (although geothermal energy is compatible with all types of heating).

ARCIBISKUPSKÉ
GYMNÁZIUM
V KROMĚŘÍŽI

Czech Republic



5.1 Solar energy
5.2 Nuclear energy
5.3 Hydro power

5.1 Solar energy

Solar energy is becoming increasingly popular around the world as people seek cleaner and more sustainable sources of energy, and the Czech Republic is no exception. The Czech Republic currently ranks among the top European countries in terms of solar energy production. According to the International Energy Agency, the country will generate 2.7 TWh of solar power in 2020, accounting for around 4% of the country's electricity production. The largest solar power plants in the country include the 57 MW Dukovany solar power plant and the 55 MW Tisová solar power plant.

The benefits of solar energy in the Czech Republic:

1. Solar energy is a clean and renewable source of power. Unlike fossil fuels, solar power does not produce harmful greenhouse gas emissions. Solar power also does not produce other pollutants, such as sulfur dioxide and nitrogen oxides, which can harm the environment and human health.

2. Can help to reduce the country's dependence on foreign energy sources. By producing more of its own electricity through solar power, the Czech Republic can reduce its reliance on imported fossil fuels.

3. Finally, solar energy can help to create jobs and stimulate economic growth. The country has set a goal of generating 22% of its electricity from renewable sources by 2030, and solar power is expected to play a significant role in achieving this target.

With continued investment and innovation, solar power has the potential to become a major source of clean and renewable energy in the Czech Republic, helping to reduce dependence on foreign energy.

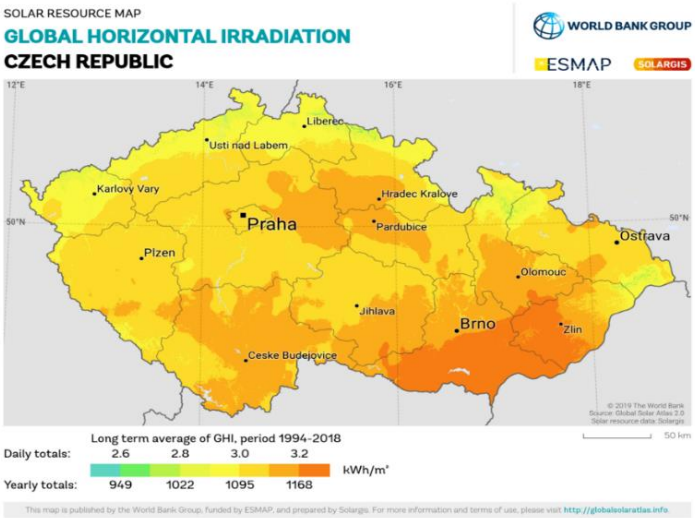


figure 8: solar resource in the Czech Republic

5.2 Nuclear energy

The first nuclear power station on the territory of the former Czechoslovakia was Jaslovse Bohunice in the present-day Slovak Republic. In the following years, 2 more plants were built: Temelin and Dukovany. Dukovany was built from 1985-1988 and Temelin from 2002-2003. Both power plants are operated by ČEZ (the largest energy producer in CZ). Today, Temelin is the power plant with the largest installed capacity in the Czech Republic with a total production of 15.72 TWh of energy in 2019. The average utilisation of this power plant is 87.1%. In 2021, nuclear power plants in the Czech Republic has produced a total of 30.7 TWh of energy, which is 36% of the total electricity production in the Czech Republic. Throughout its lifetime until the end of 2020, Dukovany will produce more than 460 TWh of electricity, while Temelín has produced about 255 TWh of electricity. Nuclear power plants provide stable power that covers the basic load of the electricity system, and their operation is in most cases not adapted to the needs and requirements of the electricity grid system. Given the limited potential of renewable energy sources in the natural conditions of the Czech Republic, it is expected that nuclear energy will make up for the shortfall caused by the closure of coal-fired power plants and will therefore remain an important pillar of the Czech energy mix at least until the middle of the 21st century.

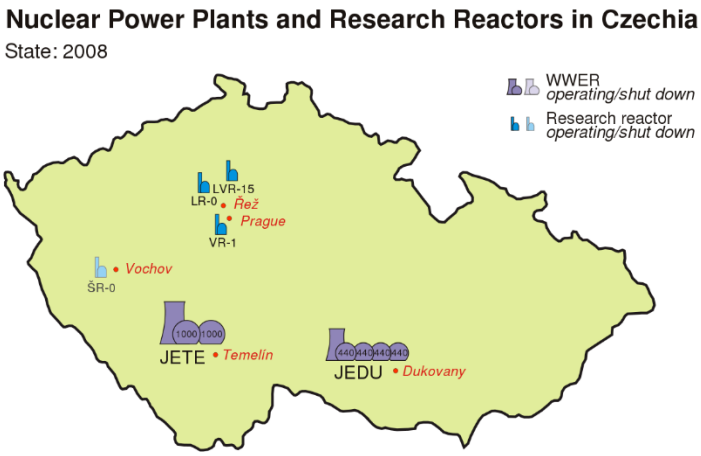


figure 9: nuclear power plants and research reactors in Czechia

ill.10: Nuclear power plants in the Czech Republic:

5.3 Hydro power

The majority of hydropower generation is located on the Vltava River in the central part of the Czech Republic. The total installed capacity of run-of-river and storage hydropower plants in the Czech Republic is about 1100 MW (2021), of which about 70% is accounted for by nine large power plants with a capacity of more than 10 MW, located mainly on the Vltava River. These are the Orlík, Slapy, Lipno I, Kamýk, Štěchovice I, Střekov and Vrané plants (all operated by ČEZ). This whole section is called the Vltava cascade and was built in the 60s of the 20th century. Although there are several large and small hydropower plants in the Czech Republic, their total share of energy production is small. In 2021, the share of hydropower in total energy production will be just under 3%, namely 2.7%.

This table shows the total number of produced energys coming from hydropower plants in the Czech Republic.

1960	1970	1980	1990	2000	2010	2020
1257 GWh	1659 GWH	2016 GWh	1161 GWh	1758 GWh	2789 GWh	2144 GWh

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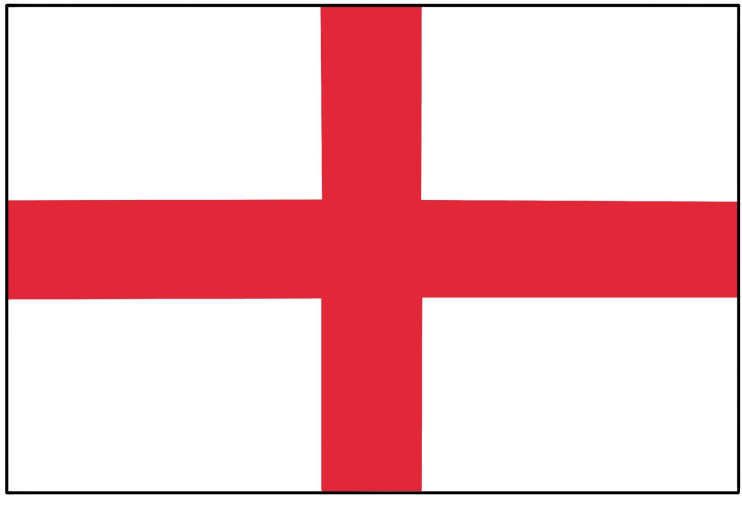
figure 11: Hydropower plant Štěchovice

AMPLEFORTH COLLEGE

England



6. Energy production and consumption

6. U.K. energy production and consumption

Generally, the UK's energy sources are privately owned, however the energy grid is owned by the national grid to prevent natural monopolies.

Power production:

The UK's main energy sources are natural gas, wind and nuclear power. When the wind is blowing, wind power is used to supply the national grid and natural gas production is reduced to compensate. When the wind is not blowing, natural gas takes over to meet the limited wind production. All this while nuclear power remains at a steady rate. The result is a largely carbon-free energy production that produces much more than before. However, natural gas is still burned because there is currently no way to store electricity on such a large scale.

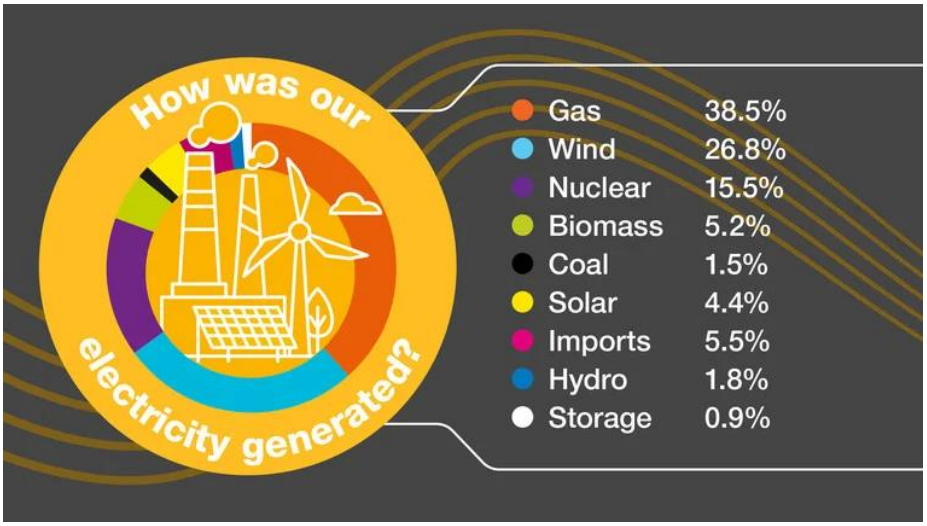


figure 12: how was our electricity generated?

ESO ESO 2022 generation mix, National Grid data Impact of the Russian invasion of Ukraine on the UK energy market:

The Russian invasion of Ukraine has led to a full scale war between the two countries. In an attempt to thwart Western aid to the West by making the Western population suffer. Russia is one of the biggest producers of natural gas, which is needed in western countries to heat homes and power the national grid. They have gone and cut off natural gas sales to the West, reducing supply and therefore (according to the law of supply and demand) prices have risen as a result. There is an energy price cap in the UK (energy companies cannot charge more than this amount).

This has led to the power companies making a loss. The government has raised the cap to prevent energy companies from going bankrupt. In turn, the average person has to pay more. However, the government has not raised the price high enough, so the energy companies are still losing money, just less. So far 28 have gone out of business, with many more on the verge. Bigger energy companies are buying up the smaller ones and, if left unchecked, this could lead to an energy monopoly in the UK.

Death of fossil fuel:

It has become clear that human activity in the form of CO2 emissions is leading directly to a rise in global temperatures known as global warming. In the UK, the government has pledged to be carbon neutral by 2050 and, more importantly for this section, to have a carbon neutral electricity grid by 2035. Currently, most new electricity generation is carbon neutral. The only exception to this rule is the Drax power station in North Yorkshire, which is currently under development and which has caused a lot of controversy and may not be built as a result. Many oil companies have seen the end coming and have decided to use their windfall profits to fund renewables (windfall being profits made by a change in the market, in this case the rise in the cost of oil). Finally, the war in Ukraine and the subsequent rise in energy prices has led to a shift away from reliance on gas-fired generation, as it simply becomes unprofitable compared to renewables. All in all, this seems to point to a shift towards renewables, even by the very producers of such CO2 emissions.

All in all, the UK appears to be on track to achieve carbon neutrality in the electricity grid by 2035, however many argue that this is not fast enough and by the time we (as a world) stop polluting we would already be seeing a 3.2 degree rise in global carbon emissions (according to the Emissions Gap report). It is essential that we take action to prevent such a reality. This can take the form of subsidising non-carbon polluting power generation and electrifying CO2 polluting industries (such as cars). Electrification, if electricity is green, would make it carbon neutral, thus solving other problems in various sectors (electrification is making carbon polluting things run on electricity, not fossil fuels, e.g. electric cars vs. petrol cars).

7. Conclusion

What have we learnt from our project and what message do we want to convey with our e-book, which we have been working on for three years?

First of all, we became quite familiar with different types of renewable energy in the four different countries. The e-book is an overview of the different forms of sustainable energy, how they work and what their advantages and disadvantages are. But the perfect energy generator hasn't been invented yet. So the logical next steps are to focus more on development in these specific areas and to encourage innovation in our countries.

8. Works cited

figure1: https://ec.europa.eu/eurostat/documents/4187653/9806083/Energy+consumption+in+EU+households

figure 2: https://www.abteimuensterschwarzach.de/templates/yootheme/cache/7e/Abtei_Muensterschwarzach_Photovoltaik_Abteikirche-7ed953ea.webp

figure 3: https://www.scinexx.de/wp content/uploads/A/e/Aerodynamik10g-768x576.jpg

figure 4: https://img.welt.de/img/regionales/hamburg/mobile236365925/4192502367-ci102l-w1024/Windkraft-auf-See.jpg

Figure 5: https://www.renovablesverdes.com/wp-content/uploads/2021/07/que-es-la-energia-hidroelectrica.jpg

Figure 6: https://www.abteimuensterschwarzach.de/templates/yootheme/cache/49/Abtei_Muensterschwarzach_Biogasanlage 49776445.webp

figure 7: https://montanarenewables.org/geothermal/

figure 8: https://upload.wikimedia.org/wikipedia/commons/4/45/Czech_Republic_GHI_Solar-resourcemap_GlobalSolarAtlas_World-Bank-Esmap-Solargis.png

figure9: https://upload.wikimedia.org/wikipedia/commons/thumb/5/5a/Kernenergie_in_Tschechien.svg/1200pxKernenergie_in_Tschechien.svg.png

figure 10: https://www.vltavariver.com/media/upload/activity/85/99/859953f0-b844-458f 8e80c94f5df84151.jpeg?p=gallery-full&s=48e1fb70ac5f961de6077b7fc8b98068

figure 11: https://mapcarta.com/de/18476098

figure 12: https://www.dexma.com/blog-en/energy-mix-from-coal-to-renewables/