

Energy Resources & Electricity generation



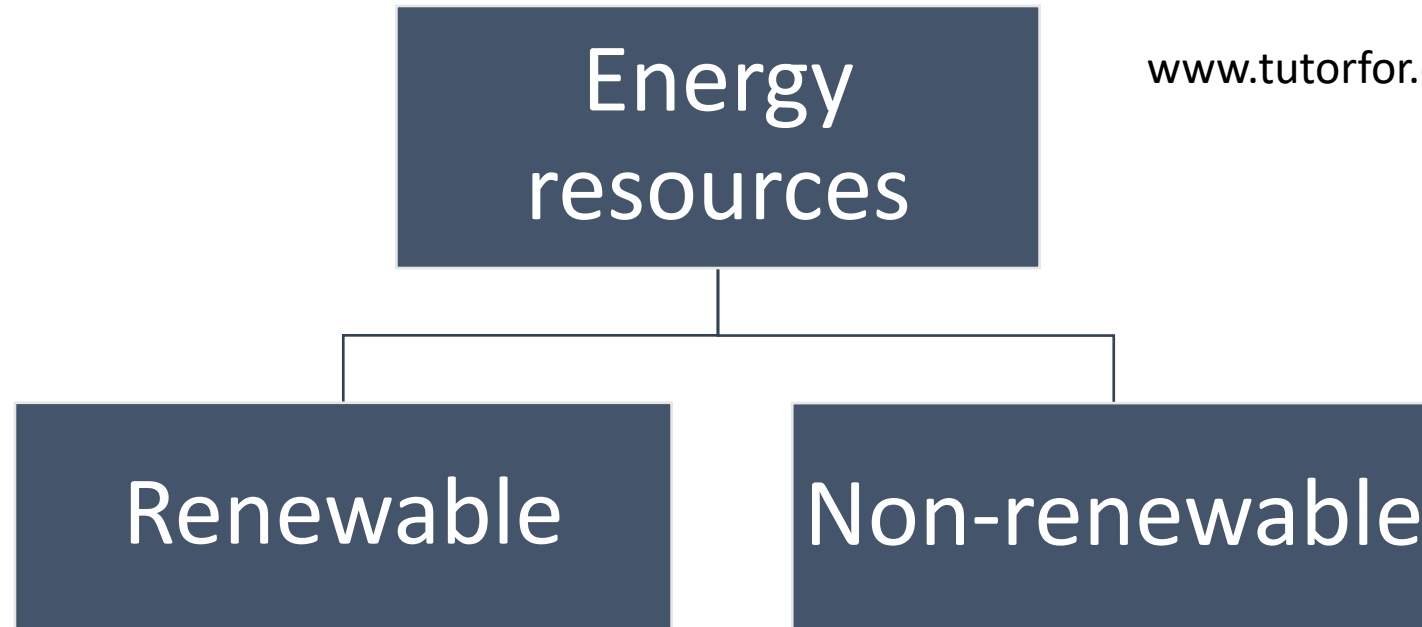
(d) Energy resources and electricity generation

Students should:

4.18P describe the energy transfers involved in generating electricity using:

- wind
- water
- geothermal resources
- solar heating systems
- solar cells
- fossil fuels
- nuclear power

4.19P describe the advantages and disadvantages of methods of large-scale electricity production from various renewable and non-renewable resources



A renewable energy resource is one that will not run out.

- Wood
- Solar energy
- Wind energy
- Moving water(hydropower)
- Geo-thermal

A non-renewable energy resource is one that effectively cannot be replaced once it has been used.

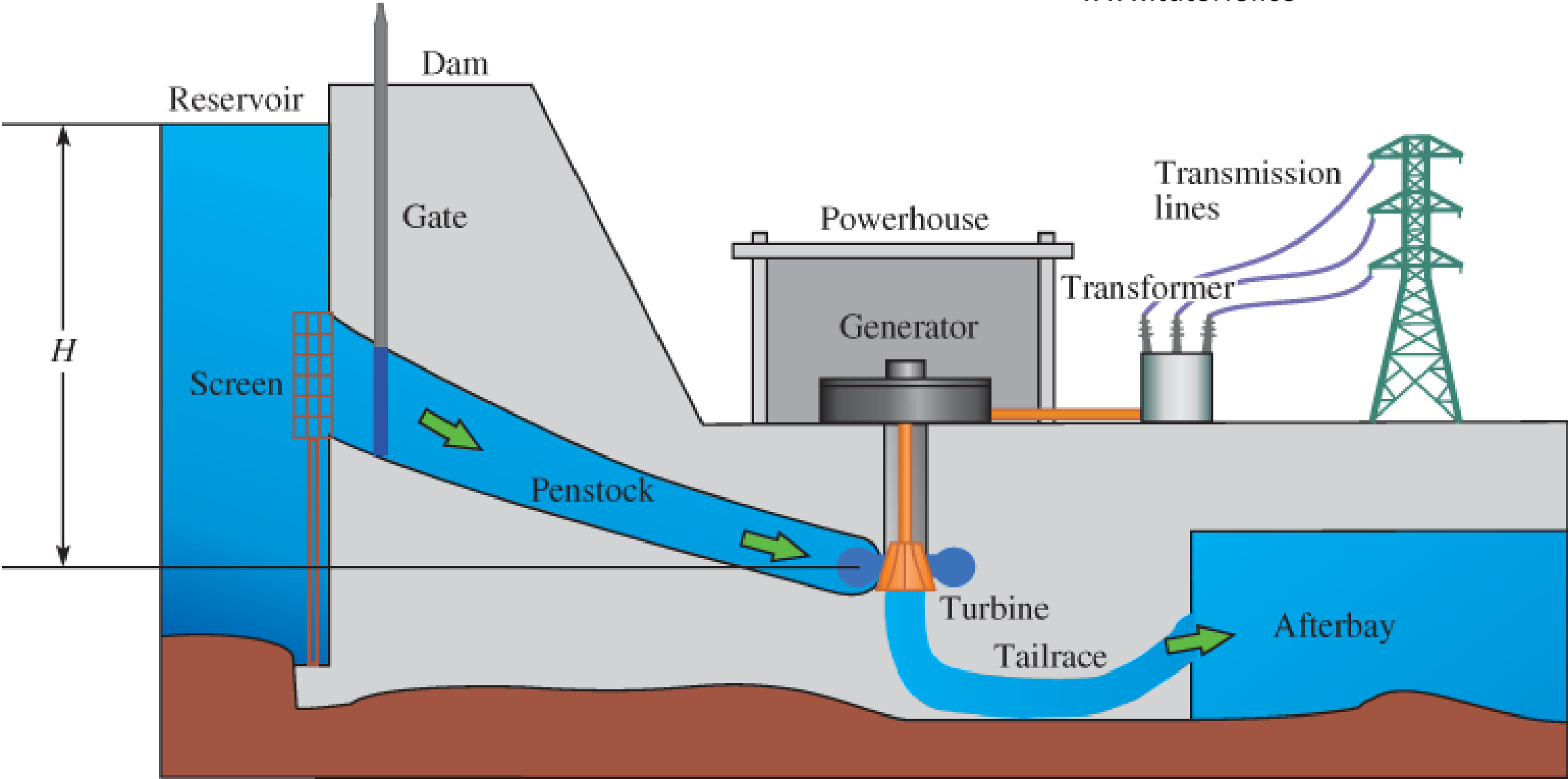
- Fossil fuel (Coal, oil, natural gas)
- Nuclear fuel





Hydropower





Hydropower

Advantages

Renewable energy source.

Hydropower generates electricity without burning fossil fuels, thus reducing greenhouse gas emissions and air pollution.

Once a hydropower plant is built, the operating and maintenance costs are relatively low

Disadvantages

Building dams and reservoirs can disrupt local ecosystems, fish migration, and wildlife habitats.

Hydropower is dependent on water flow, which can be affected by droughts, climate change, and seasonal variations.

Not all geographical areas are suitable for hydropower plants due to the need for specific topographical and hydrological conditions.

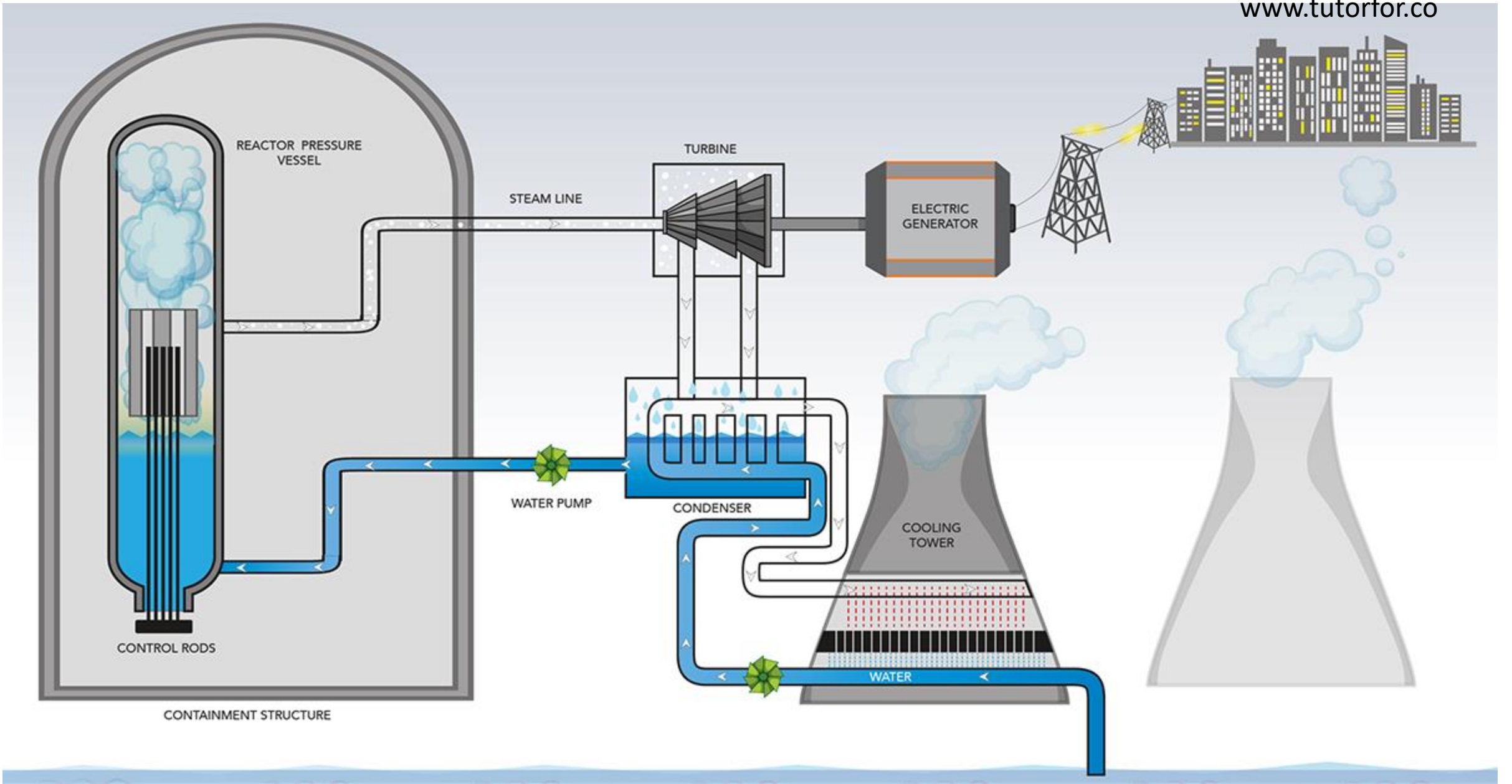




Nuclear power stations

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Nuclear power

Advantages

No greenhouse gas emissions-clean source of energy.

A small amount of nuclear fuel can produce a large amount of energy.

Nuclear power plants provide a continuous, stable base load power, unlike some renewable sources that are intermittent.



Disadvantages

Nuclear power generates radioactive waste that remains hazardous for thousands of years.

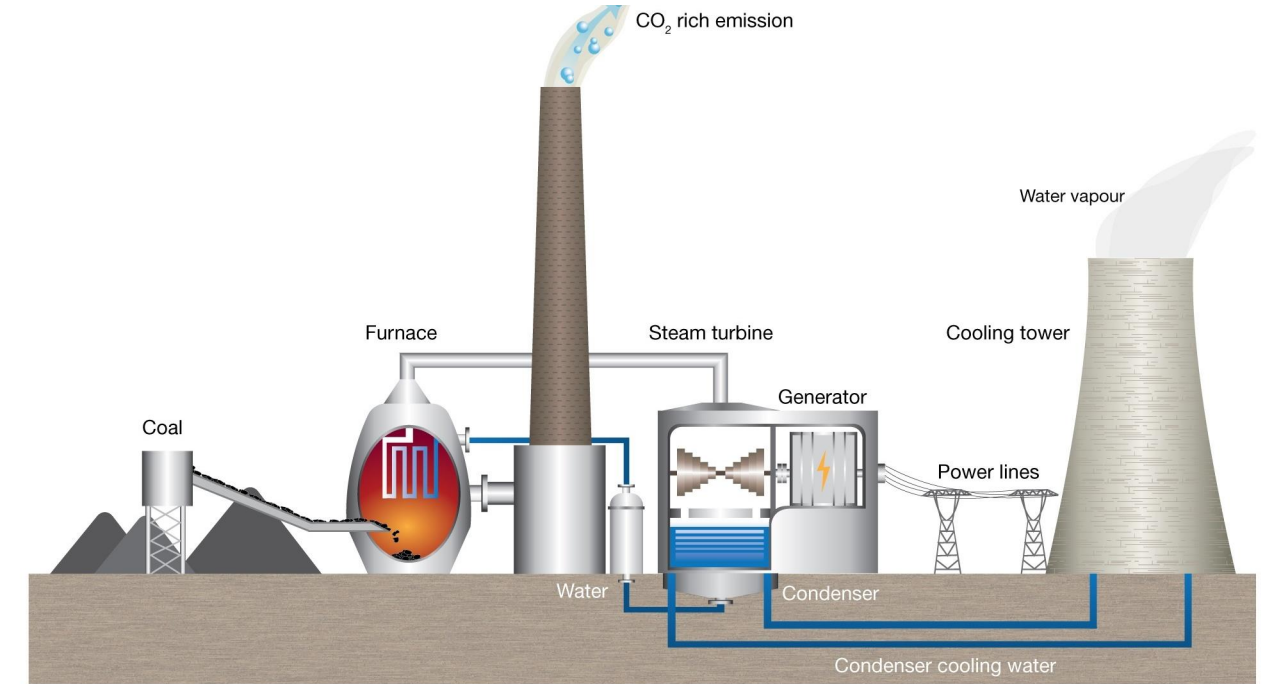
High initial cost.

Accidents, although rare, can have catastrophic consequences, as seen in Chernobyl and Fukushima.

The construction of a nuclear power plant requires a significant amount of land, leading to the clearing of vegetation and potential disruption of local wildlife habitats.



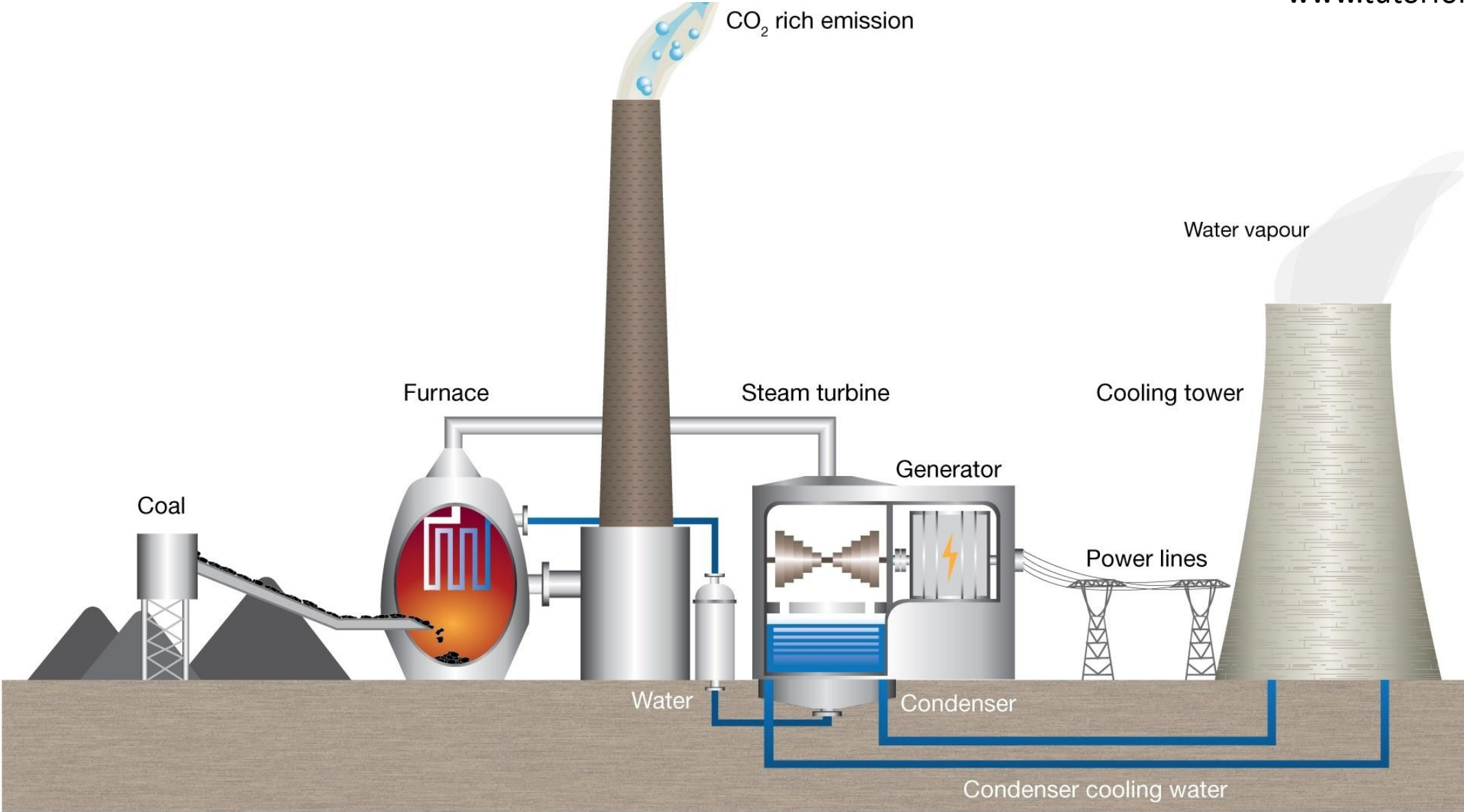
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Coal Power stations







Coal power

Advantages

Coal power generation is relatively inexpensive compared to other energy sources, both in terms of fuel cost and infrastructure investment.

Coal power plants provide a consistent and reliable supply of electricity, capable of meeting base load demands.

The technology for coal power generation is well-developed and understood, making it easy to implement and maintain.

Disadvantages

Burning coal produces significant amounts of greenhouse gases such as carbon dioxide (CO₂), contributing to global warming and climate change.

Coal combustion also releases pollutants like sulfur dioxide (SO₂), nitrogen oxides (NO_x), and particulate matter, leading to air pollution and respiratory health issues.

Coal is a non-renewable resource, and while it is abundant now, it will eventually become depleted with continued use.

Coal mining, especially surface mining, causes significant land degradation, deforestation, and habitat destruction



Wind Power

Wind power

Advantages

Wind power generation produces no greenhouse gas emissions or air pollutants, contributing to a reduction in overall carbon footprint.

Once a wind farm is constructed, the operational and maintenance costs are relatively low compared to fossil fuel plants.

Renewable energy resource.



Disadvantages

Wind power is variable and intermittent, as it depends on wind speeds which can fluctuate daily and seasonally.

Wind turbines can pose risks to birds and bats, which may collide with the blades.

Wind turbines can produce noise that may be disturbing to nearby residents.

Geothermal Power Plant

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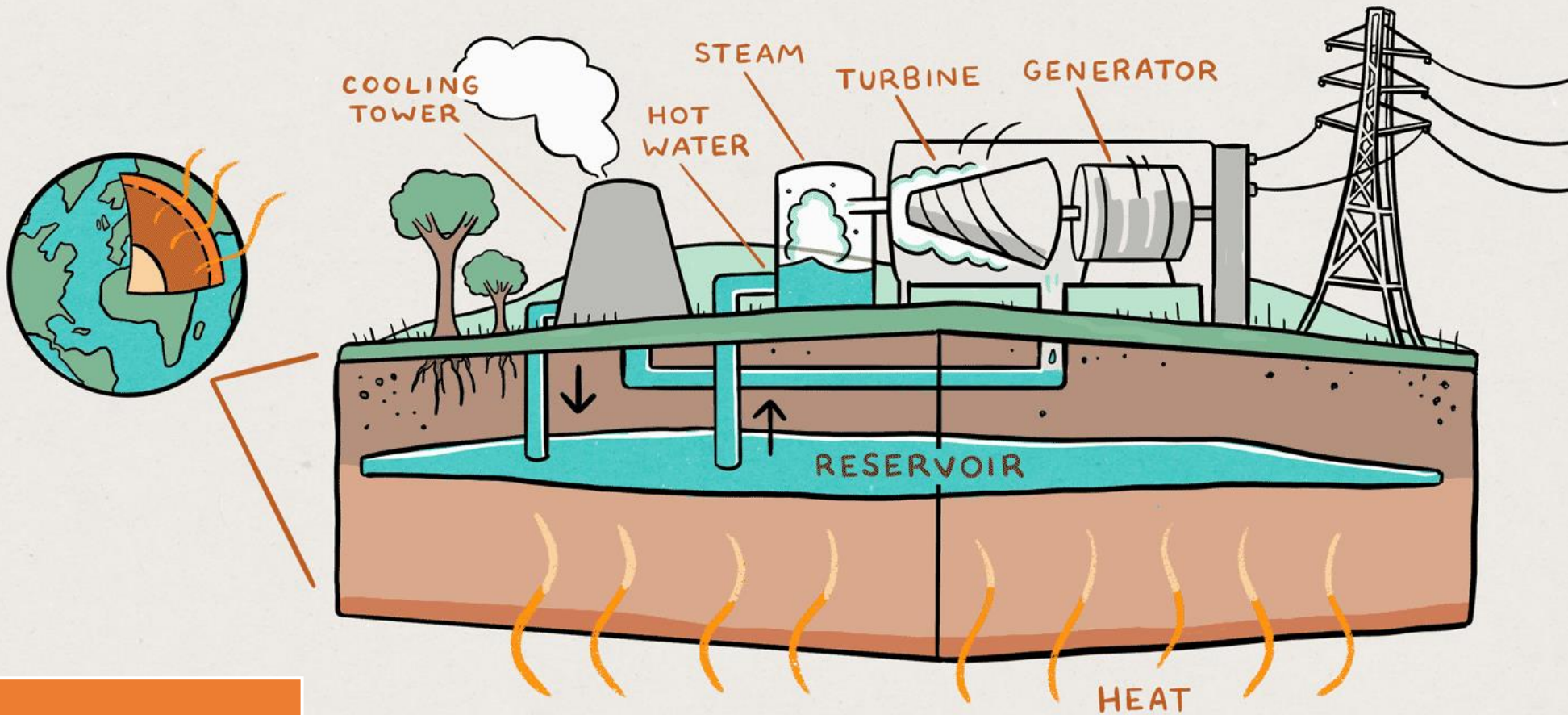
How Does Geothermal Energy Work?

1. Heat from the Earth's crust creates steam

2. Steam rotates turbine

3. Generator produces electricity

4. Water is injected back into the ground



Geo-thermal power

Advantages

Geothermal energy is derived from the Earth's internal heat, a renewable energy resource.

Geothermal power plants produce very low levels of greenhouse gases compared to fossil fuel plants, reducing the carbon footprint.

Geothermal plants require less land compared to solar or wind farms, making them suitable for areas with limited space.

Geothermal energy provides a stable and continuous power supply, unaffected by weather conditions, making it a reliable source of base load power.

Disadvantages

Geothermal energy is highly location-specific, suitable only in regions with high geothermal activity (e.g., volcanic areas, hot springs).

Geothermal plants can release small amounts of harmful gases such as hydrogen sulfide.

Over-extraction of geothermal fluids can lead to a decline in reservoir pressure and temperature, reducing the long-term viability of the resource.





Solar power



Solar power



Advantages

No greenhouse gas emissions, reducing carbon footprint.

Once installed, solar panels have low maintenance and operational costs.

Solar power systems generate electricity on-site, eliminating the need for the extensive infrastructure required to transport fuel (such as pipelines, railways, or trucking systems) to power plants.

Solar power is a renewable energy source.

Disadvantages

Solar power generation is dependent on sunlight, making it intermittent and less reliable during cloudy days or at night.

Solar panels require significant space to install, which can be a limitation in densely populated or urban areas.

Solar energy potential varies greatly depending on geographical location. Regions closer to the equator receive more consistent and intense sunlight compared to those farther from it.