PES UNIVERSITY

ENVIRONMENTAL STUDIES & LIFE SCIENCES

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ENVIRONMENTAL STUDIES & LIFE SCIENCES

Energy Resources

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Energy resources

- An energy resource is something that can produce heat, power life, move objects, or produce electricity.
- Human energy consumption has grown steadily .throughout human history. Early humans had modest energy requirements, mostly food and fuel for fires to cook and keep warm. In today's society, humans consume as much as 110 times as much energy per person as early humans.
- Most of the energy we use today come from fossil fuels (stored solar energy).

Energy resources

- But fossils fuels have a disadvantage in that they are non-renewable on a human time scale, and cause other potentially harmful effects on the environment. In any event, the exploitation of all energy sources (with the possible exception of direct solar energy used for heating), ultimately rely on materials on planet Earth.
- There are two major classes of energy:
  a) Non-renewable
  b) Renewable

Energy resources

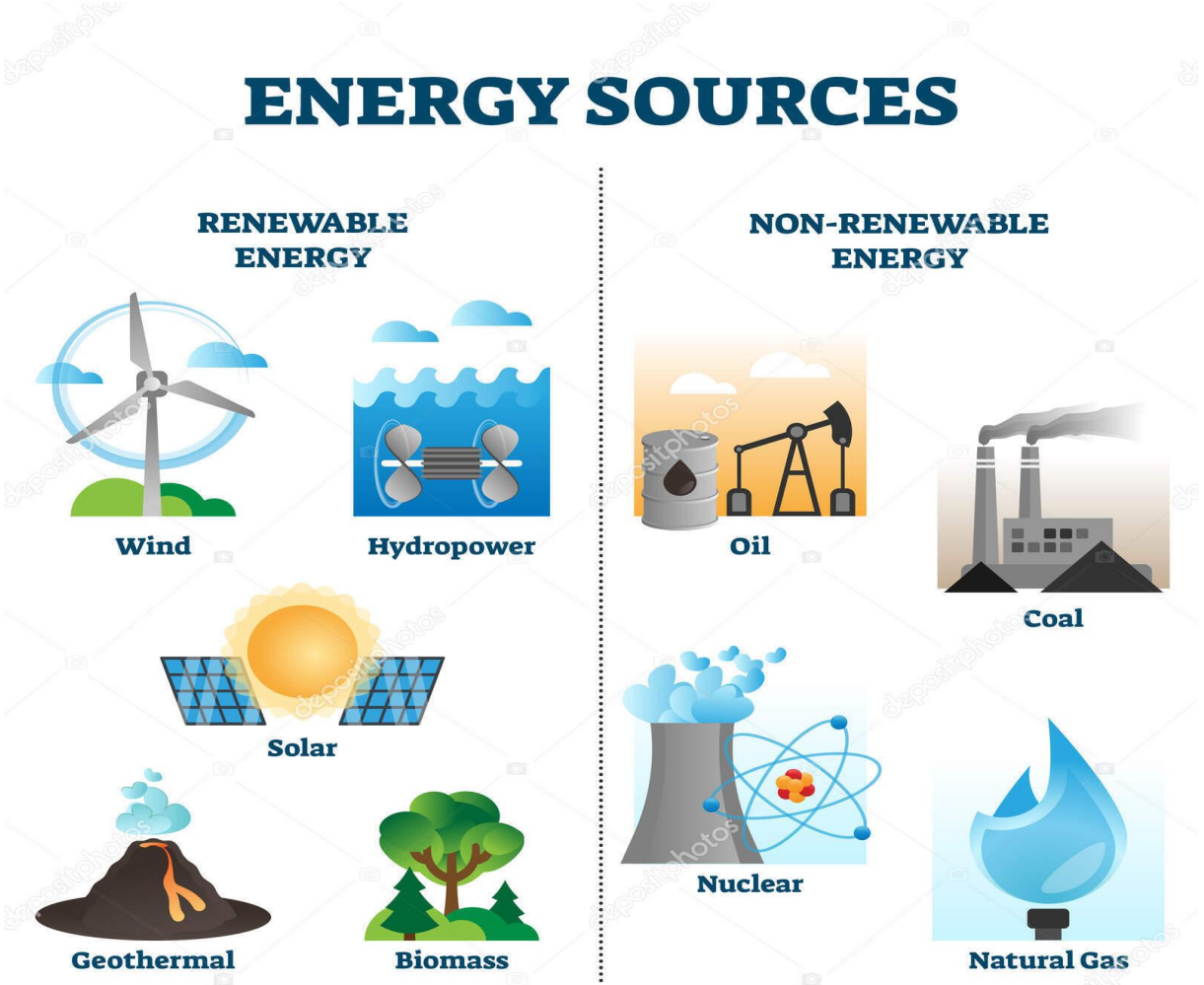


Image source: depositphotos.com

Energy resources

- **Non-renewable resources of energy**
- Energy resources that cannot be replaced after they are used or can be replaced only over thousands or millions of years.
- *Example*- Fossil fuels
- These consist of the mineral based hydrocarbon fuels coal, oil and natural gas, that were formed from ancient prehistoric forests

Energy resources

- When these fuels are burnt, they produce waste products that are released into the atmosphere as gases such as carbon dioxide, oxides of sulphur, nitrogen, and carbon monoxide.

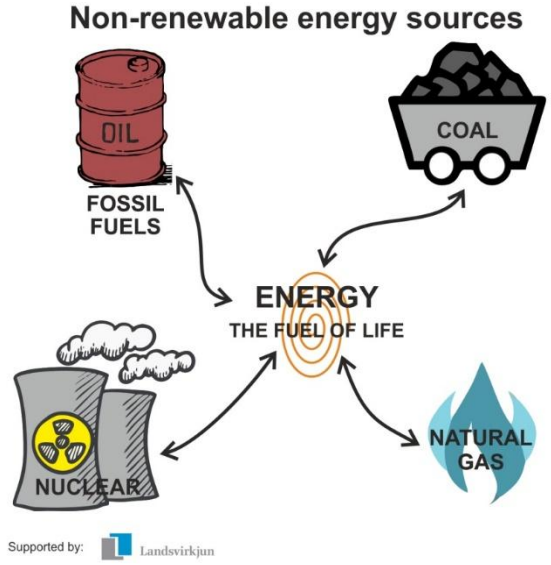


Image source: Polar pedia

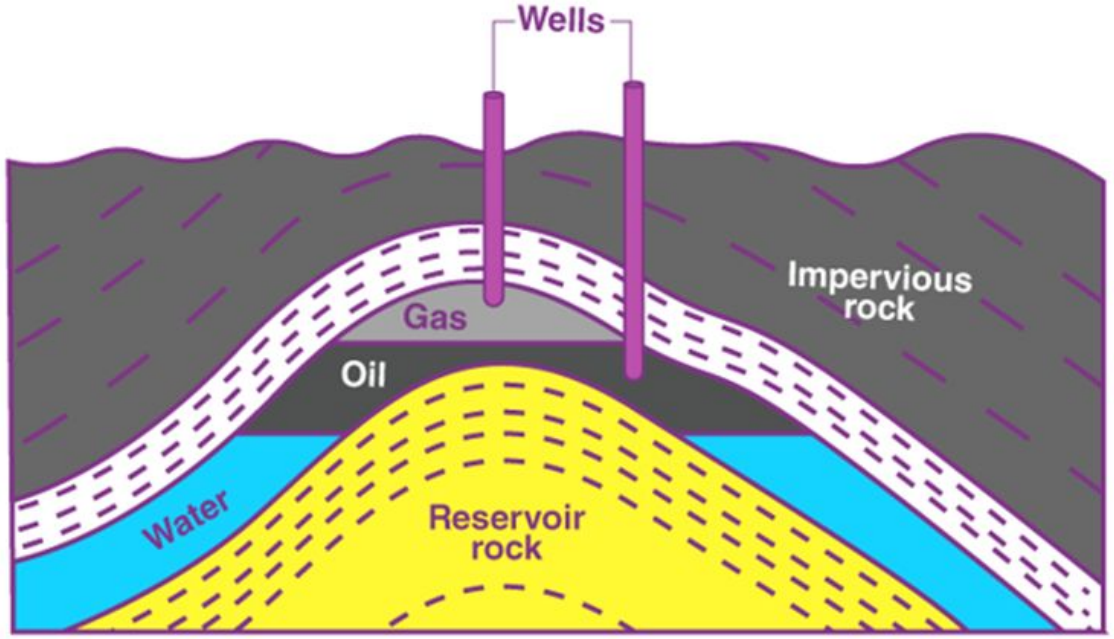
Energy resources

- Obtaining fossil fuels

1. **Coal** is obtained either by mining deep beneath the Earth's surface or by strip mining.
   - Strip mining- a process in which rock and soil are stripped from the Earth's surface to expose the underlying materials to be mined.
2. **Petroleum and natural gas** are removed from the Earth by drilling wells into rock that contain these resources.
   - Oil wells exist on land and in the ocean.

Energy resources

Strip mining



Extraction of petroleum and natural gas

Image source: Careers360

Energy resources

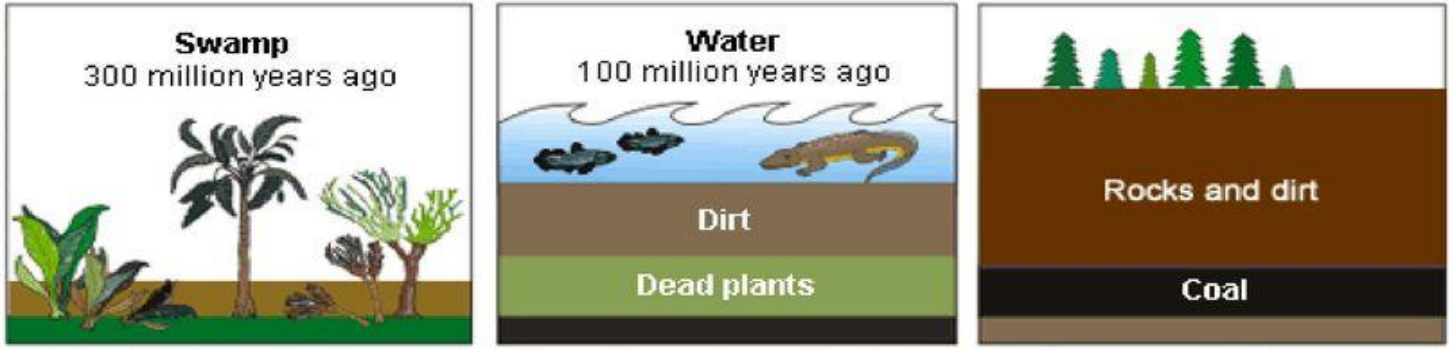
Oil wells exist in land and in the ocean

Image source: World Ocean Review

Energy resources

Formation of fossil fuels

How coal was formed



Petroleum and natural gas formation

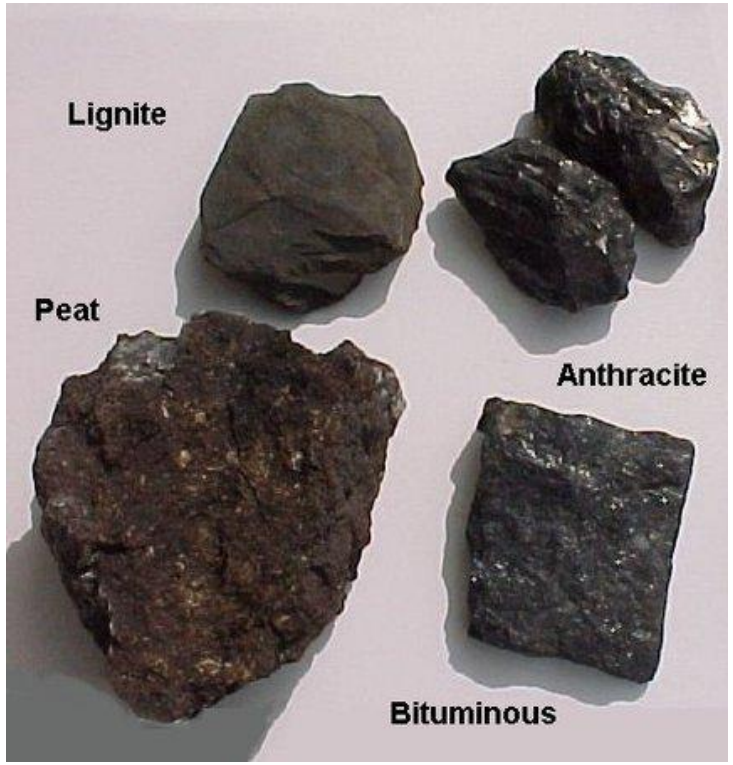
Image source: National Energy Development project

Energy resources

- Different types of coal:

1. Peat – about 50% carbon. The rest is water and contaminants.
2. Lignite (brown coal) – about 70% carbon.
3. Bituminous (soft coal) – about 85% carbon.
4. Anthracite (hard coal) – greatly than 90% carbon. This is the cleanest burning and least abundant.

Energy resources



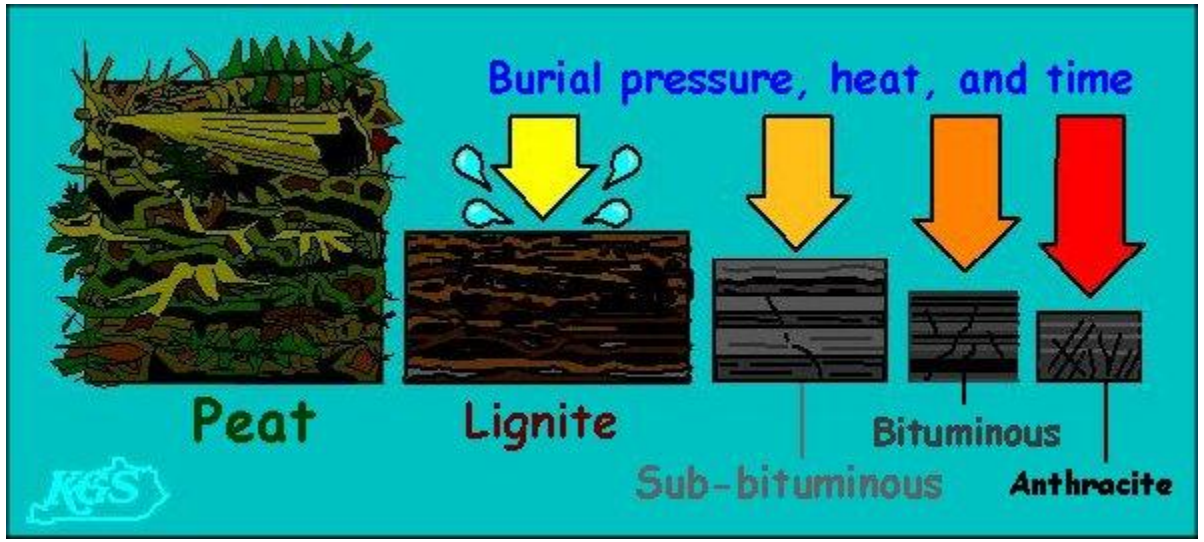


Image source: American geosciences institute

Energy resources

- Liquid fossil fuels
- Can be called **crude oil**
- An oily mixture of flammable organic compounds from which liquid fossil fuels and other products, such as asphalt, are separated
- Gasoline, plastics, and petrochemicals (which are used to make synthetic fibers, such as rayon) are some of the products
- Cleanest burning fossil fuel- natural gas

Energy resources

- Crude oil and other hydrocarbons exist in liquid or gaseous form in underground pools, or reservoirs, within sedimentary rocks and near the earth's surface in tar (or oil) sands.
- Petroleum products are fuels made from crude oil and the hydrocarbons contained in natural gas.
- After crude oil is removed from the ground, it is sent to a refinery where different parts of the crude oil are separated into useable petroleum products.

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Energy resources

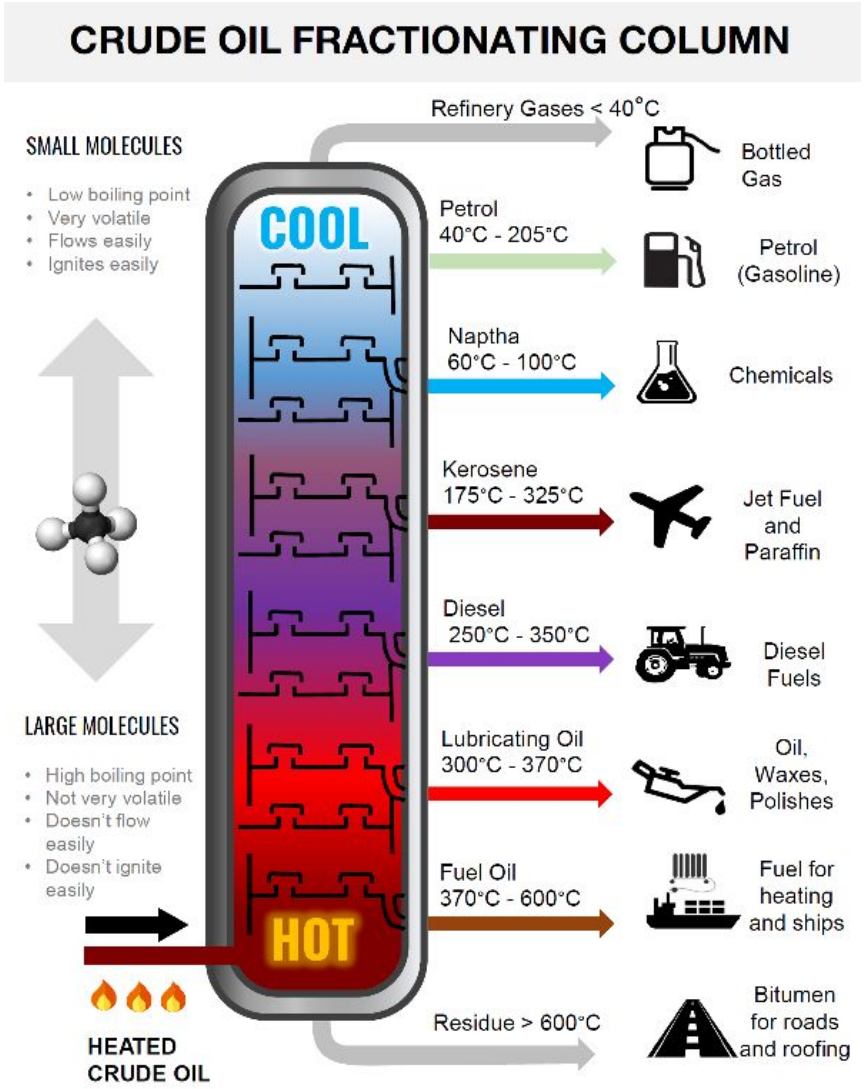


Image source: Enerpac.com

Energy resources

- The world is moving towards green energy, but this does not mean that we can completely do away with fossil fuels. Fossil fuels are the most widely used energy sources in the world.
- They account for ~80% of the total energy consumption.
- Easier to store and transport
- It is more reliable than renewable energy
- Fossil fuels can generate a large amount of electricity at a single location.

Energy resources

Total primary energy consumption in India by fuel type (2020)

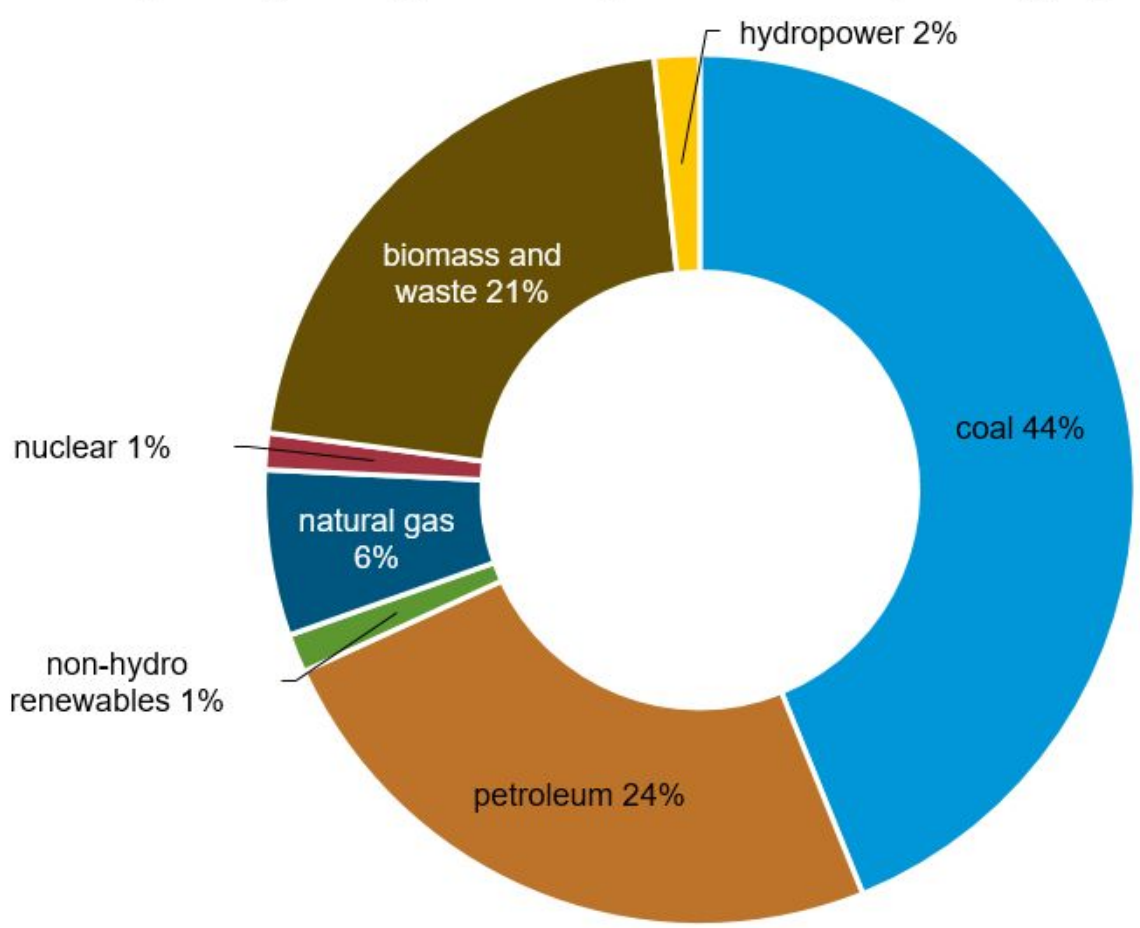


Image source: World Energy Outlook

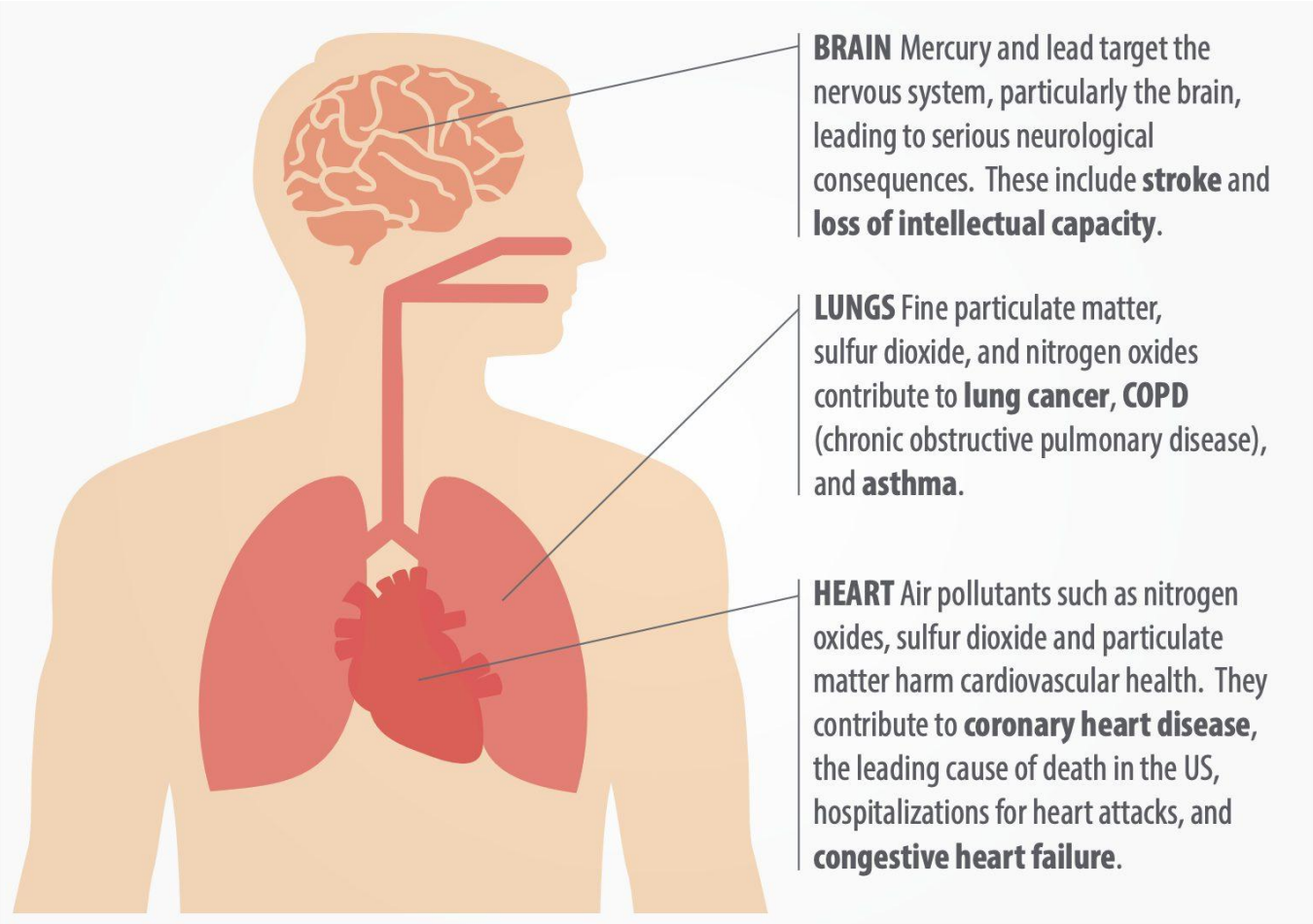
- Disadvantages:

- Fossil fuels emit carbon dioxide when burnt which is a major greenhouse gas and the primary source of pollution. This has contributed to global warming.
- They are a non-renewable resource, i.e., once used they cannot be replaced.
- Combustion of fossil fuels makes the environment more acidic. This has led to unpredictable and negative changes in the environment.

Energy resources

- Extraction- Strip mining causes environmental damage.
- Oil spills can kill hundreds of thousands of animals and wildlife as well as damage the fishing industry.
- Harvesting of fossil fuels also causes fatal diseases among the people. For eg., the coal miners often suffer from Black Lung Disease. The natural gas drillers are constantly exposed to chemicals and silica which is dangerous for their health.

Energy resources



Health Effects of Fossil Fuel Pollutants

Image source: Energy innovation

Energy resources

- **Renewable sources of energy**
- Renewable energy is energy that comes from a source that won't run out. They are natural and self-replenishing, and usually have a low- or zero-carbon footprint.
- Examples of renewable energy sources include wind power, solar power, bioenergy (organic matter burned as a fuel) and hydroelectric, including tidal energy.
- Renewable sources are considered vital in the race to tackle climate change.

1. Wind

- Onshore and offshore wind farms generate electricity by spinning the blades of wind turbines.
- The turbines convert the kinetic energy of the spinning blades into electric energy by turning a drive shaft and gear box, which is connected to a generator.
- Electricity is then converted into higher voltages and fed into the national grid.

2. Solar

- Sunlight is one of the planet's most freely available energy resources. But of course, the amount of sunlight we get can vary greatly depending on location, season and time of day.
- Solar power generates electricity by capturing sunlight on solar panels in a joint chemical and physical reaction, known as the 'photovoltaic effect' (or PV).

Energy resources

- Sunlight can be changed into electricity by the use of solar cells. Example: solar calculator, solar panels (large panels made up of many solar cells wired together)
- Solar collectors- dark-colored boxes with glass or plastic tops used to directly heat
- Solar mirrors- mirrors that use sunlight to produce electricity for large-scale solar power

3. Hydroelectric

- Hydro power is created using the movement of flowing or falling water. Hydroelectric power plants are found at dams and generate electricity through underwater turbines that turn a generator.
- Hydro power also encompasses wave and tidal power, which rely on ocean forces to generate electricity at the mouths of large bodies of water, using similar technology.

4. Bioenergy/Biomass

- Electricity can be generated when organic matter is burned as a fuel source. These fuels are known as biomass and include anything from plants to timber to food waste.
- Carbon dioxide (CO_2) is emitted when bioenergy is made, but these fuel sources are considered renewable because they can be regrown and absorb as much carbon as they emit across their lifespans.

Energy resources

- Examples- plants, wood, and waste
- Gasohol- Plant material that is changed into liquid fuel
- Plants containing sugar or starch can be made into alcohol. The alcohol is burned as a fuel or mixed with gasoline to form the gasohol.

5. Geothermal

- Harness heat from the Earth
- Ground water that seeps into hot spots near the surface of the Earth can form geysers. (Natural vents in which steam and water escape)
- Example: Old Faithful (geyser) in Yellowstone National Park
- The steam is used in power plants to generate electricity

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Energy resources

Image source: Energy innovation

Energy resources

- Is renewable energy the same as clean or green energy?
- Clean energy produces electricity without emissions. However, its manufacture or maintenance can sometimes have a ‘carbon cost’. For example, natural environments have to be cleared to create hydroelectric plants with a dam, and the work to construct them often creates carbon emissions.
- Green energy comes from totally natural sources, which have low or no environmental impact in their creation or use.
- They can both be renewable, which essentially means that they come from a source that can’t be depleted.
- *So, while most green energy sources are renewable, not all renewable energy sources are considered green.*

Disadvantages of renewable energy sources:

1. Solar: – Expensive to use for large-scale energy production – Only practical in sunny areas
2. Water: – Dams disrupt a river's ecosystem. – Available only in areas that have rivers
3. Wind: – Only practical in windy areas (require strong, steady breezes to be effective), so there are limited locations for wind farms
4. Geothermal – Only practical in locations near hot spots (Hot spots are volcanic regions with a hotter mantle than most places.) – Waste water can damage soil
5. Biomass – Requires large areas of farmland – Produces smoke

Energy resources

- Whether the natural resources we use are renewable or non-renewable, we should be careful on how we use them.
- Only use them when necessary.
- Recycle! The process by which used or discarded materials are treated for reuse.

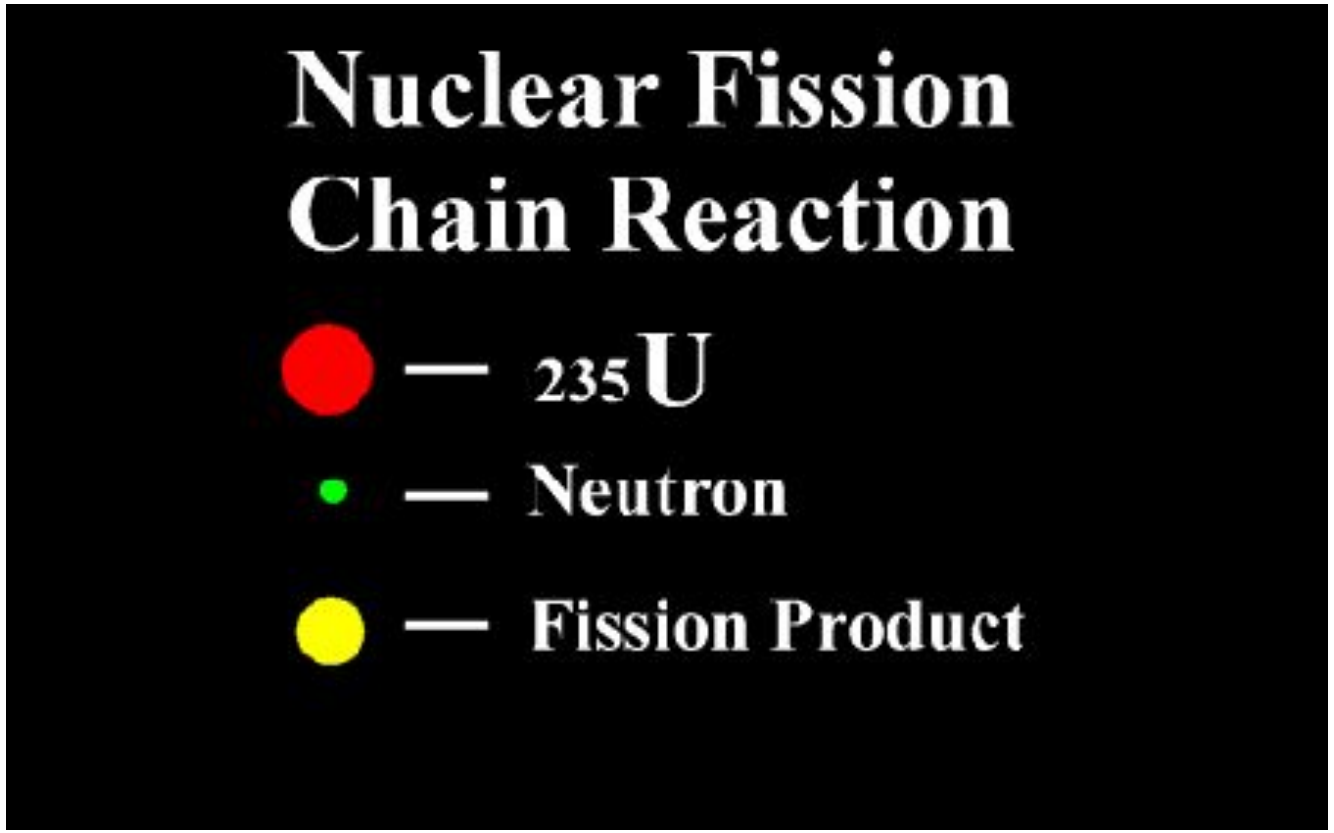
- **Nuclear energy**
- It is a form of energy released from the nucleus, the core of atoms, made up of protons and neutrons. This source of energy can be produced in two ways: fission – when nuclei of atoms split into several parts – or fusion – when nuclei fuse together.
- Nuclear energy is usually considered another non-renewable energy source. Although nuclear energy itself is a renewable energy source, the material used in nuclear power plants is not.

Nuclear Fission

Nucleus of a uranium atom is split into two smaller nuclei, releasing nuclear energy

https://atomicpsa.wordpress.com/what-is-nuclear-fission-and-fusion/

Nuclear Fission



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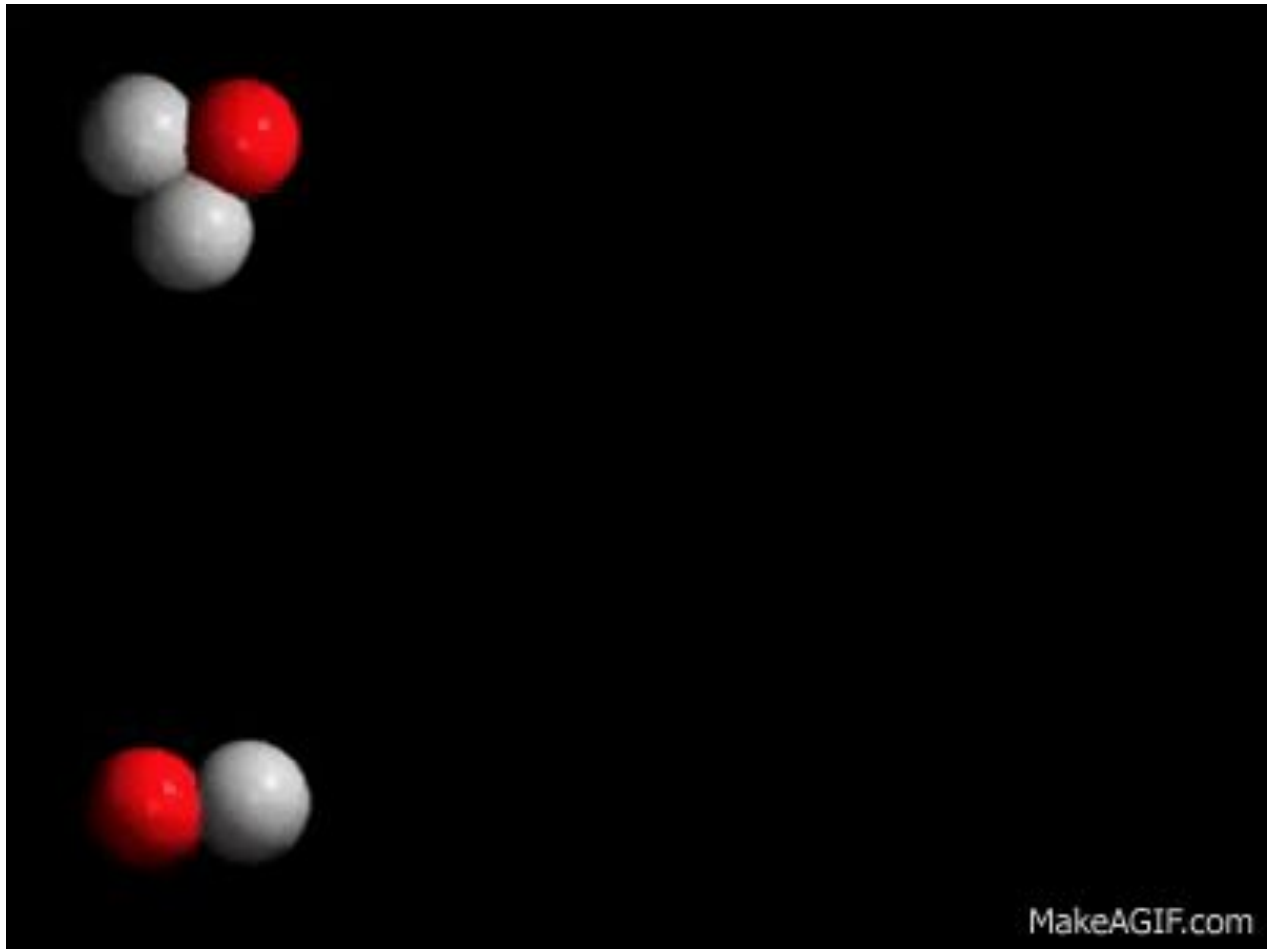
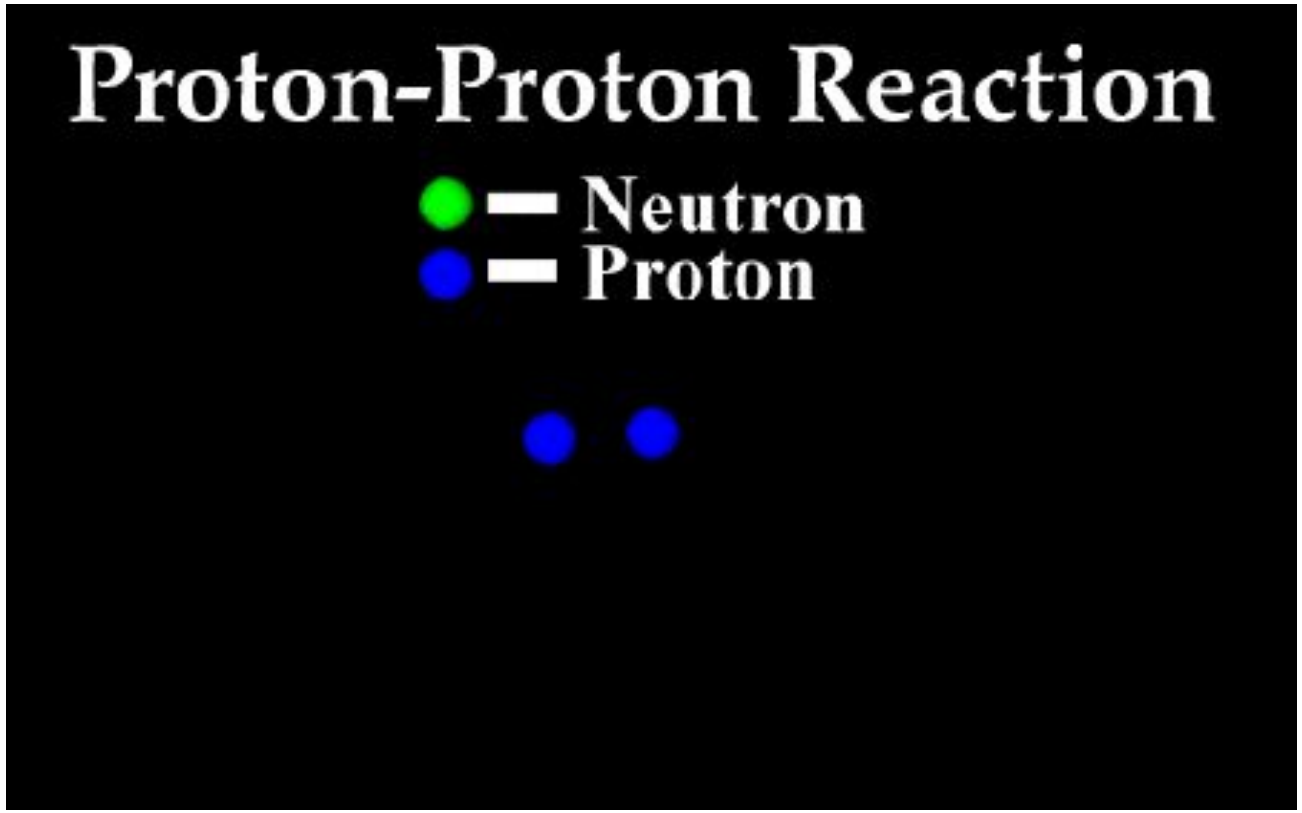
Nuclear Fusion



The joining of nuclei of small atoms to form larger atoms

https://makeagif.com/gif/nuclear-fusion-animation-mcQMHk

Nuclear Fusion



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Energy resources

- A nuclear power plant generates thermal energy that boils water to produce steam
- Fossil fuel and nuclear power plants use steam to turn a turbine, which rotates a generator that converts kinetic energy into electrical energy
- Nuclear power plants provide alternative sources of energy without the problems that come with fossil fuels, but produce dangerous, radioactive wastes

How do nuclear reactors work?

Three steps that reactors use to make clean electricity:

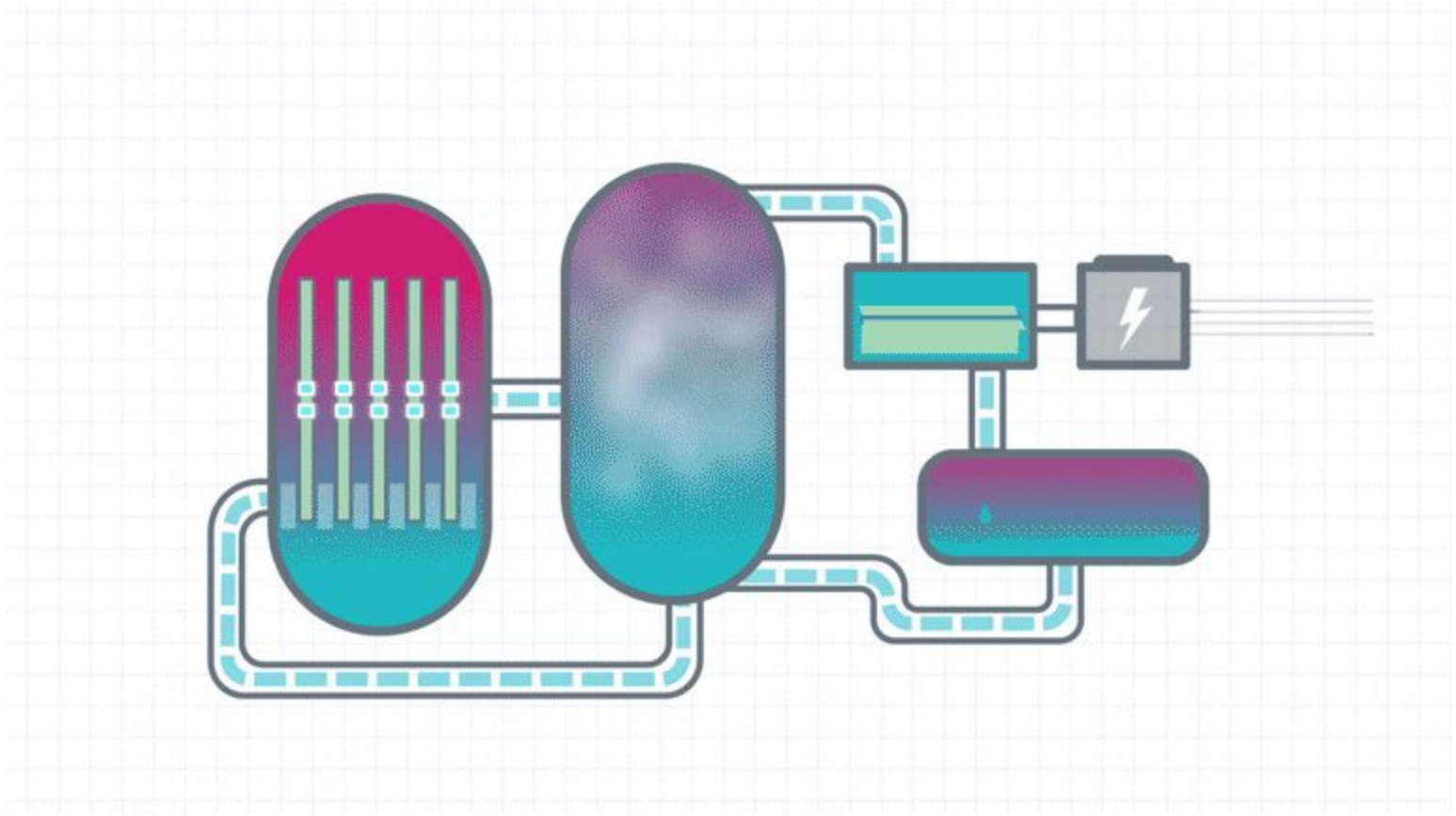
Step 1: Split Atoms to Create Heat

https://www.nei.org/news/2019/how-reactor-actually-works

How do nuclear reactors work?

Step 2: Use the Heat to Make Steam

Step 3: Use the Steam to Turn a Turbine



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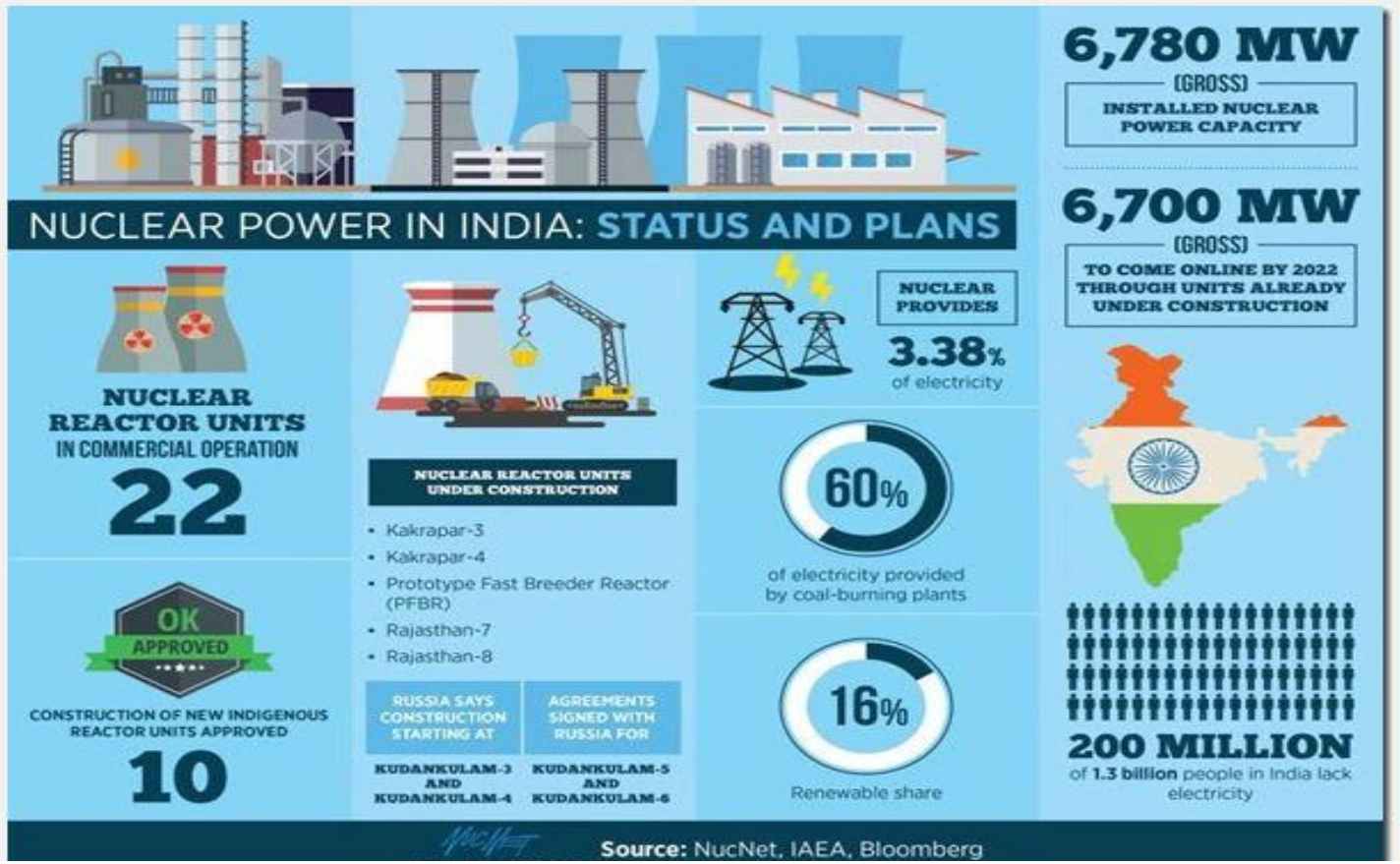
Energy resources

In India, there are 22 nuclear reactors are operational in 7 nuclear power plants that generate nearly 20 percent of the nation's electricity, all without carbon emissions because reactors use uranium, not fossil fuels.



Energy resources

Kudankulam Nuclear Power Plant is located in Tamil Nadu. It is the highest-capacity nuclear plant in India, with a total of 2,000 MW currently installed with a further 2,000 MW under construction.

THANK YOU

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