

Resources



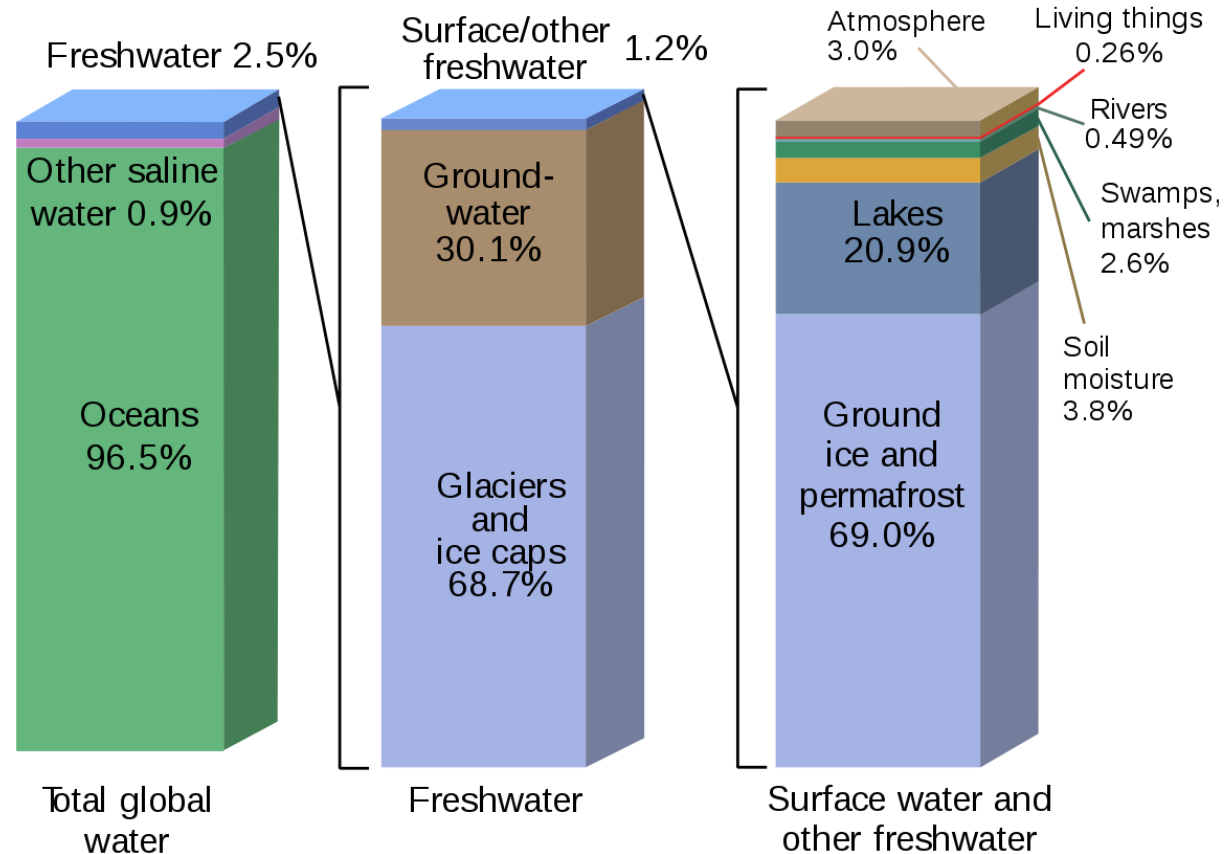
Water resources

The world's water exists naturally in different forms and locations: in the air, on the surface, below the ground, and in the oceans.

Almost all the living species require water to grow.

Majority of water utilized on a daily basis is freshwater.

Where is Earth's Water?



Fresh water sources

Surface water: It is any body of water above ground, e.g., rivers, streams, lakes, reservoir, creeks, or wet-lands etc.

Oceans can also be considered as a part of surface water.

Surface water participates in the water cycle.

Precipitation and water runoff feed bodies of surface water.

Evaporation and seepage of water into the ground, cause surface water bodies to lose water.

Since surface water is more easily accessible, it is relied on for many human uses. Most of the water used come from surface water.

Surface water are also important habitats for aquatic plants and wildlife.

Fresh water sources

There are three types of surface water: perennial, ephemeral, and man-made.

Perennial, or permanent, surface water persists throughout the year and is replenished with groundwater when there is little precipitation.

Ephemeral, or semi-permanent, surface water exists for only part of the year. Ephemeral surface water includes small creeks, lagoons, and water holes.

Man-made surface water is found in artificial structures, such as dams and constructed wetlands.

Fresh water sources

Ground water: It is the part of precipitation or fresh water bodies, that seeps down through the soil until it reaches rock material that is saturated with water.

Water in the ground is stored in the spaces between rock.

Groundwater fills in all the empty spaces underground, in what is called the saturated zone, until it reaches an impenetrable layer of rock.

Groundwater is contained and flows through bodies of rock and sediment called aquifers.

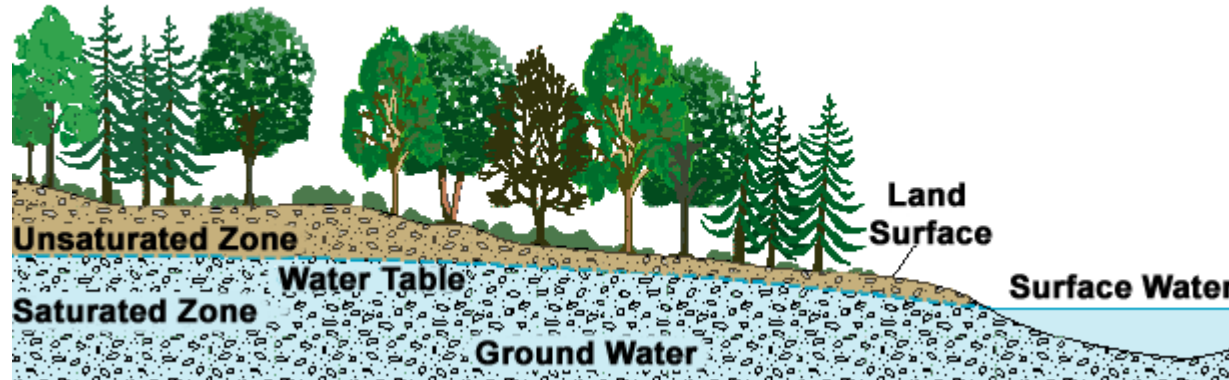
The amount of time that groundwater remains in aquifers is called its residence time, which can vary widely, from a few days or weeks to 10 thousand years or more.

Fresh water sources

Surface water and groundwater are reservoirs that can feed into each other. While surface water can seep underground to become groundwater, groundwater can resurface on land to replenish surface water. Springs are formed in these locations.

The top of the saturated zone is called the water table.

Above the water table is the unsaturated zone, where the spaces in between rocks and sediments are filled with both water and air. Water found in this zone is called soil moisture, and is distinct from groundwater.



Usages of water



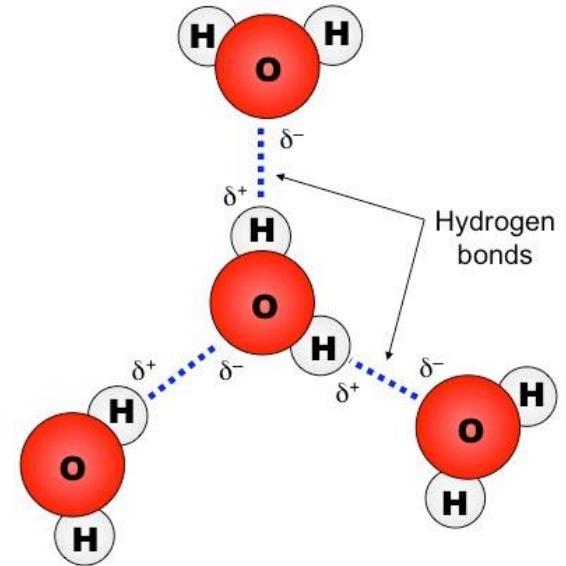
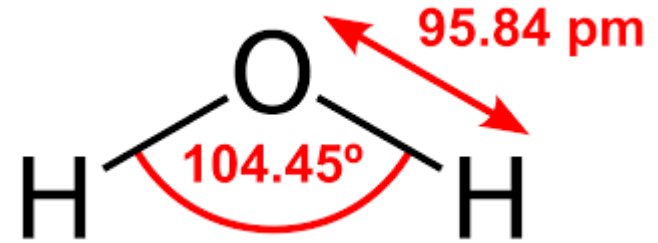
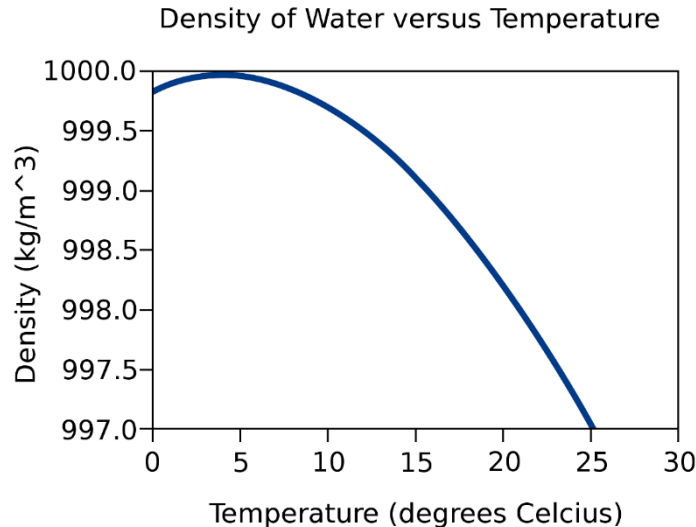
Properties of water

Molecular weight: 18.015 g/mol

Melting point/freezing point: 0 °C

Boiling point: 100 °C

Maximum density: 1.0 g/cc (4 °C)

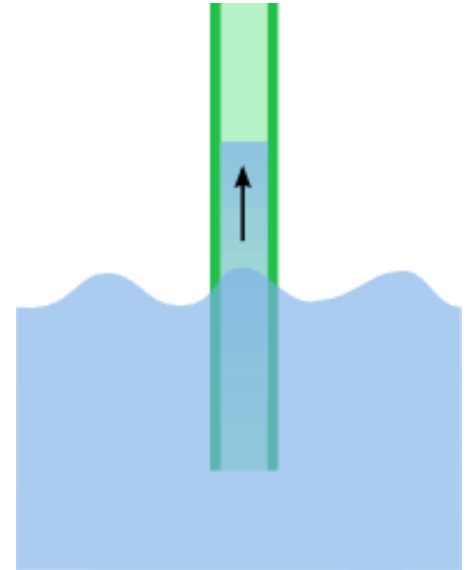


Properties of water

Water is the only natural substance that is found in all three physical states—liquid, solid, and gas—at the temperatures normally found on Earth.

Physical Properties:

1. **Adhesion** (attraction of water towards other substances) and **cohesion** (attraction between water molecules) are water properties that the interaction of water with other substances.
2. **Surface tension**: The property of the surface of a liquid that allows it to resist an external force, due to the cohesive nature of its molecules.
3. **Capillary action**: It is the ability of a liquid to flow in narrow spaces without the assistance of, or even in opposition to, external forces like gravity. Capillary action arises due to adhesion, cohesion, and surface tension.



Properties of water

4. **Color:** Color in water comes from suspended or dissolved materials. Pure water is transparent in nature.

Color caused by dissolved matter: tannins



Color caused by suspended material: sediment



Properties of water

5. **Turbidity:** It is the measure of relative clarity of a liquid and measures the amount of light that is scattered by material in the liquid when a light is shined through the liquid sample.

Turbidity makes water cloudy or opaque.

Material that causes water to be turbid include clay, silt, very tiny inorganic and organic matter, algae, dissolved colored organic compounds, and plankton and other microscopic organisms.

Excessive turbidity in drinking water may represent a health concern. Turbidity can provide food and shelter for pathogens.

Traditional water treatment processes have the ability to effectively remove turbidity when operated properly.

Properties of water

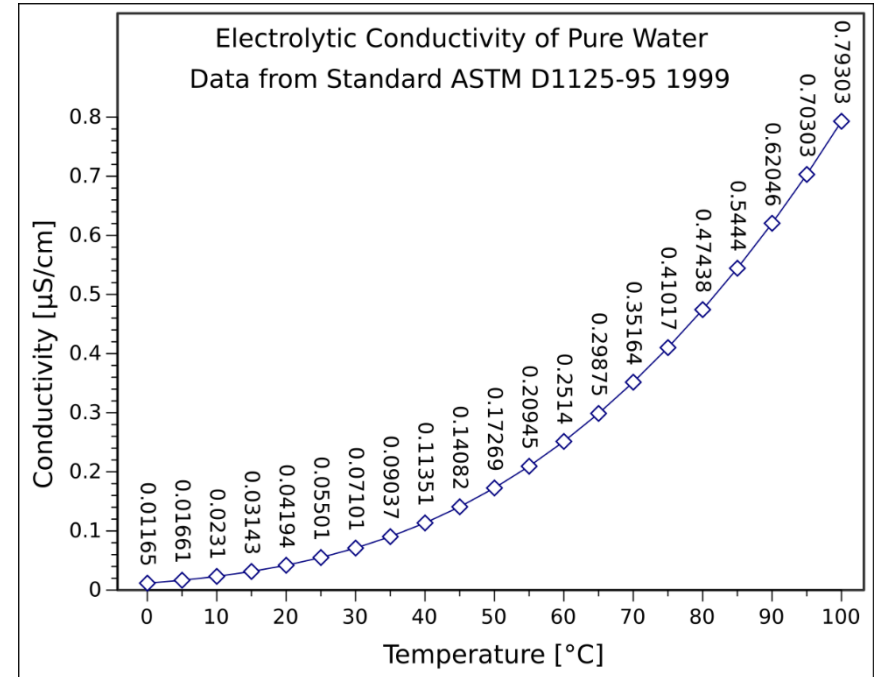
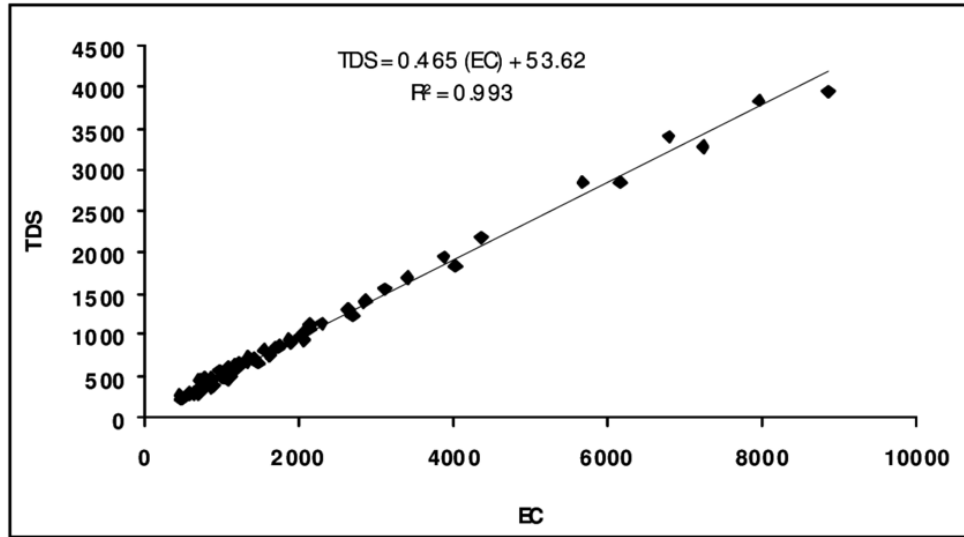
6. **Temperature:** Temperature exerts a major influence on biological activity and growth. Temperature governs the kinds of organisms that can live in rivers and lakes. Fish, insects, zooplankton, phytoplankton, and other aquatic species all have a preferred temperature range.

Temperature is also important because of its influence on water chemistry. The rate of chemical reactions generally increases at higher temperature. Water, particularly groundwater, with higher temperatures can dissolve more minerals from the surrounding rock and will therefore have a higher electrical conductivity.

It is the opposite when considering a gas, such as oxygen, dissolved in the water.

Properties of water

7. **Conductivity:** Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water.



Properties of water

Chemical properties

1. **pH:** The pH of water determines the solubility (amount that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical constituents such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.).

Excessively high and low pHs can be detrimental for the use of water.

The pH of precipitation, and water bodies, vary widely across the geographical regions. Natural and human processes determine the pH of water.

Properties of water

2. **Alkalinity:** It may be termed as the buffering capacity of a water body; a measure of the ability of the water body to neutralize acids and bases and thus maintain a fairly stable pH level.

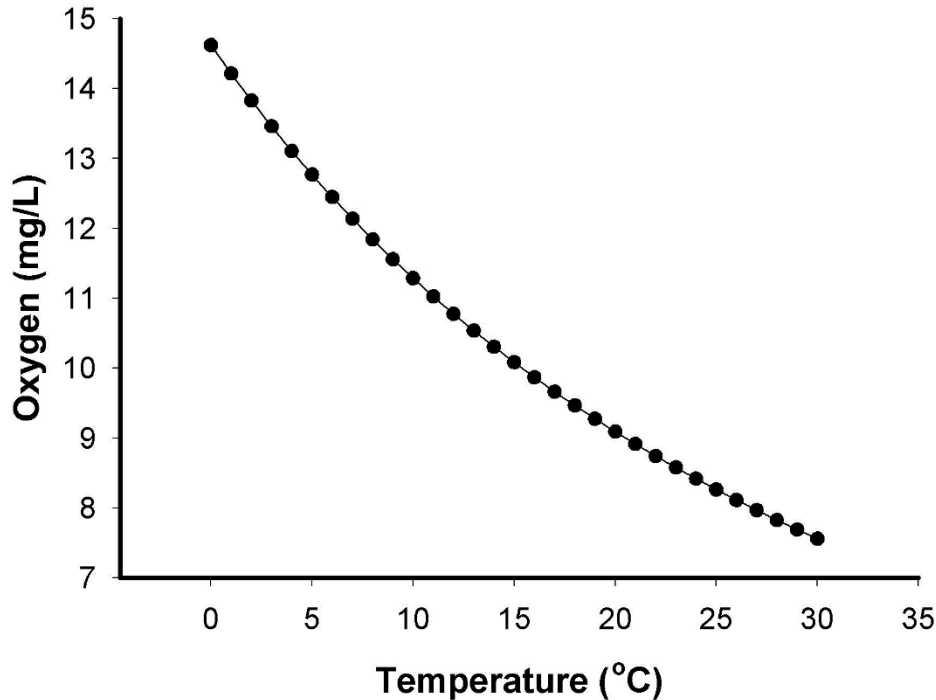
In a surface water body, such as a lake, the alkalinity in the water comes mostly from the rocks and land surrounding the lake.

In modern times, water bodies can be subjected to sudden inputs of chemicals, such as wastewater.

A water body with a high level of alkalinity has higher levels of calcium carbonate, CaCO_3 .

Properties of water

Solubility of oxygen with temperature



3. Dissolved oxygen: It is a measure of how much oxygen is dissolved in the water - the amount of oxygen available to living aquatic organisms.

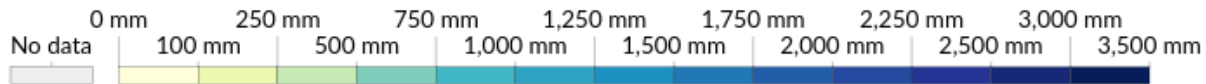
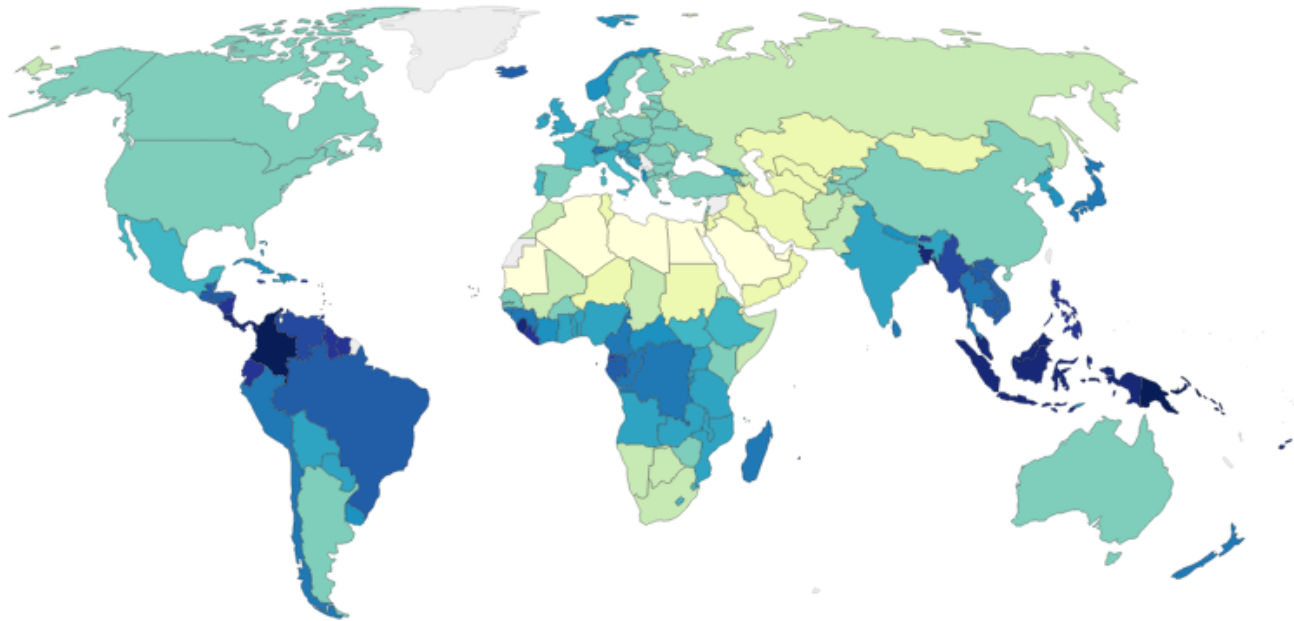
A small amount of oxygen, up to about ten molecules of oxygen per million of water, is actually dissolved in water.

Rapidly moving water, such as in a mountain stream or large river, tends to contain a lot of dissolved oxygen, whereas stagnant water contains less.

Distribution of water

Average annual precipitation, 2014

Precipitation in millimeters per year. Precipitation is defined as any kind of water that falls from clouds as a liquid or a solid.



Distribution of water

Hydrological cycle constantly redistribute the water.

Rain falls unevenly on the planet. Some places get almost no precipitation, while others receive heavy rainfall daily.

Three principle factors control the water precipitation globally:

(1) Wind circulation, (2) Proximity of the water body, and (3) Topography.

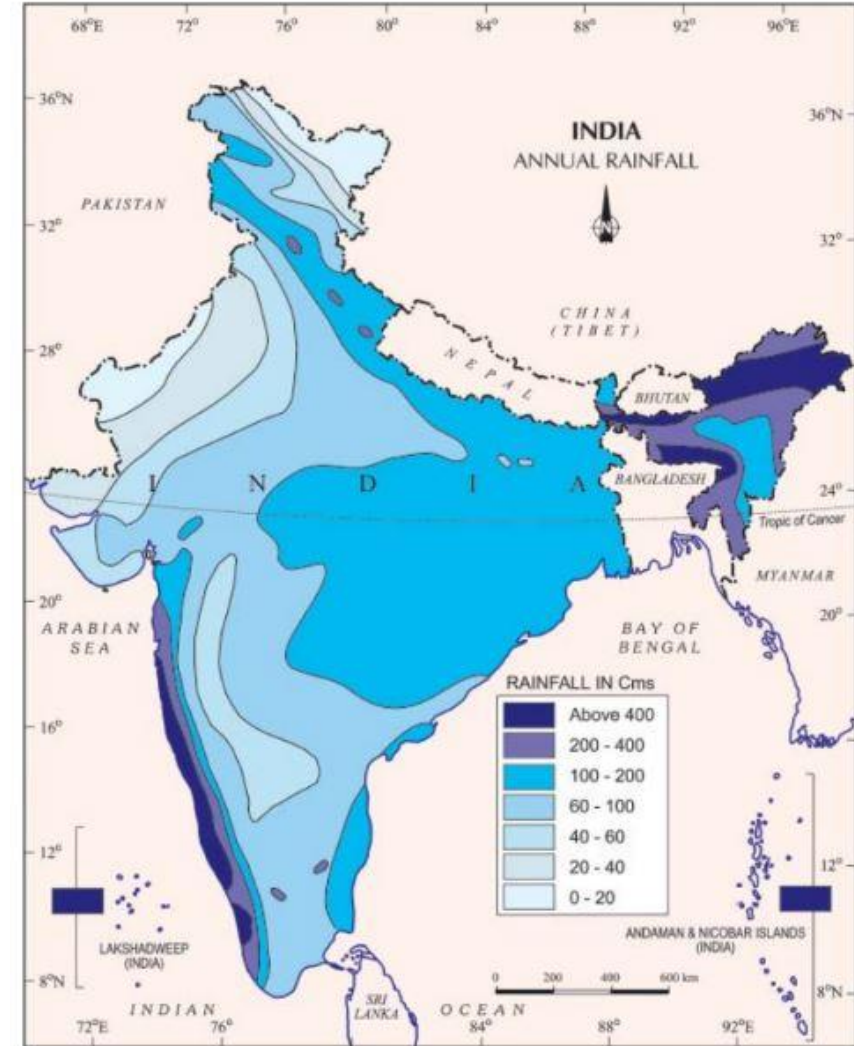


Figure 4.7 : Annual Rainfall

Distribution of water

UN considers 1000 m³ of water per person per year to be the minimum necessary to meet basic human needs.

Countries with low population and wet climate have excess of this resource. On the other hand dry and densely populated countries has water scarcity.

Iceland has 600 million liters of water per person per year. Egypt only has 42000 liters of water per person per year. Bahrain is completely dependent on import and desalinization for water.

One of the wettest place on the planet, Cherrapunji, is now experiencing water shortage during the dry seasons. This is primarily due to human activities, e.g., increase in population, global warming, urbanization, and deforestation etc.

Increasing water usages

Human water use is increasing about twice as fast as population growth over the past century.

Water use is stabilizing in developed countries, but demand of water in developing nations is rising continuously.

Countries like Canada, Brazil and Congo are utilizing less than 1% of the renewable water supply.

Countries like Yemen, Libya and Israel are withdrawing more than 100% of the renewable groundwater.

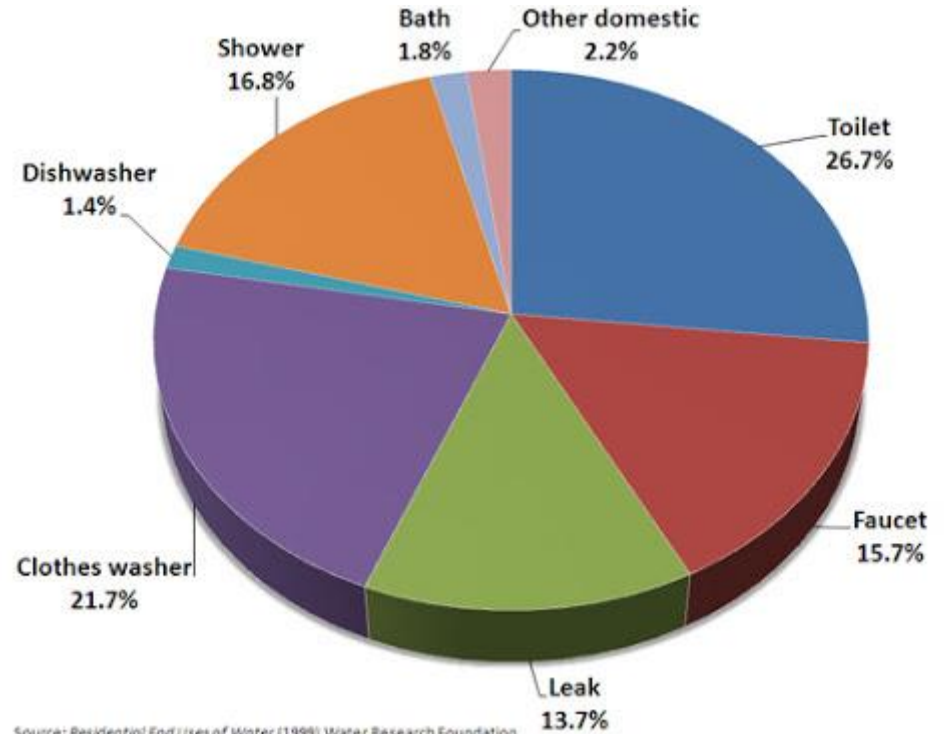
Agriculture uses more than 90% of water in India, and only 4% for Kuwait.

Increasing water usages

Worldwide domestic water use accounts for only 6% of water withdrawals.

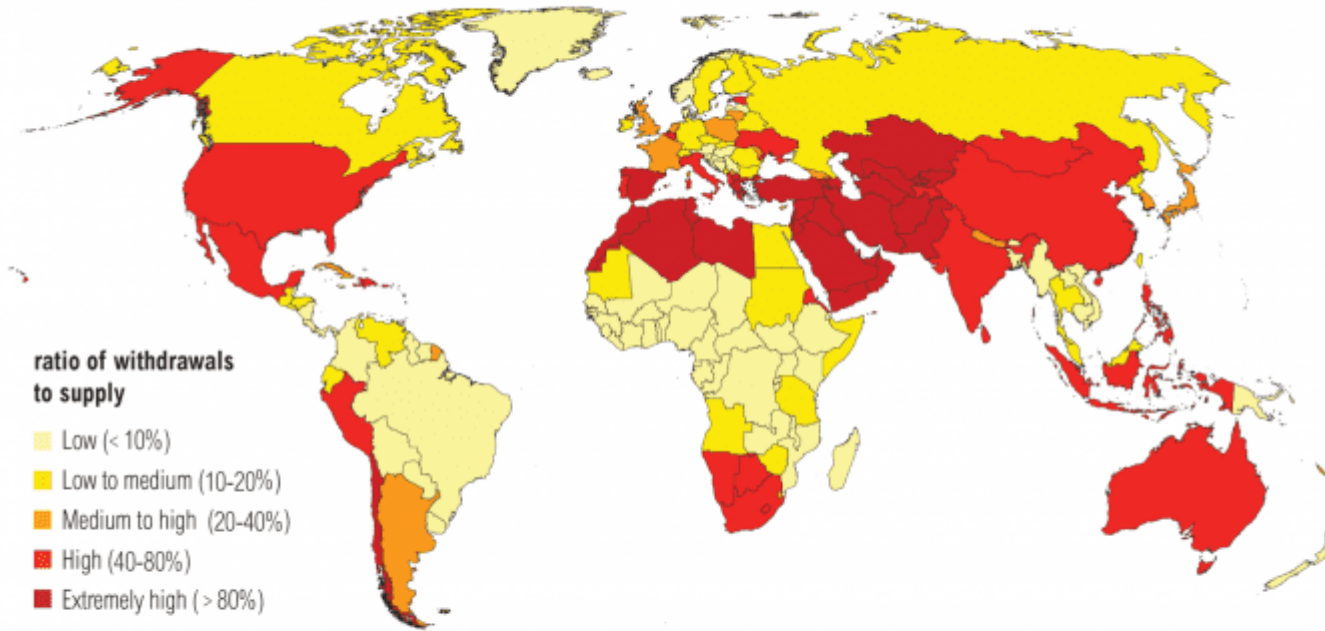
Industries account for 20% of the global freshwater withdrawals.

Industries like mining and energy are the greatest producer of the degraded water.



Water scarcity projection

Water Stress by Country: 2040



NOTE: Projections are based on a business-as-usual scenario using SSP2 and RCP8.5.

For more: ow.ly/RiWop

Water management

Water scarcity is driven by two converging phenomena: growing freshwater use and depletion of usable freshwater resources.

At the global level, 31 countries are already short of water and by 2025 there will be 48 countries facing serious water shortages.

Around 20 major cities in India face chronic or interrupted water shortages.

There are 100 countries that share the waters of 13 large rivers and lakes.

Water management is the control and movement of water resources to minimize damage to life and property, and to maximize efficient beneficial use.

Water management

Write a short note on following:

1. Irrigation water management
2. Waste water management
3. Industrial water management
4. Drinking water management

Energy sources

Classification

1. Renewable

Solar

Geothermal

Wind

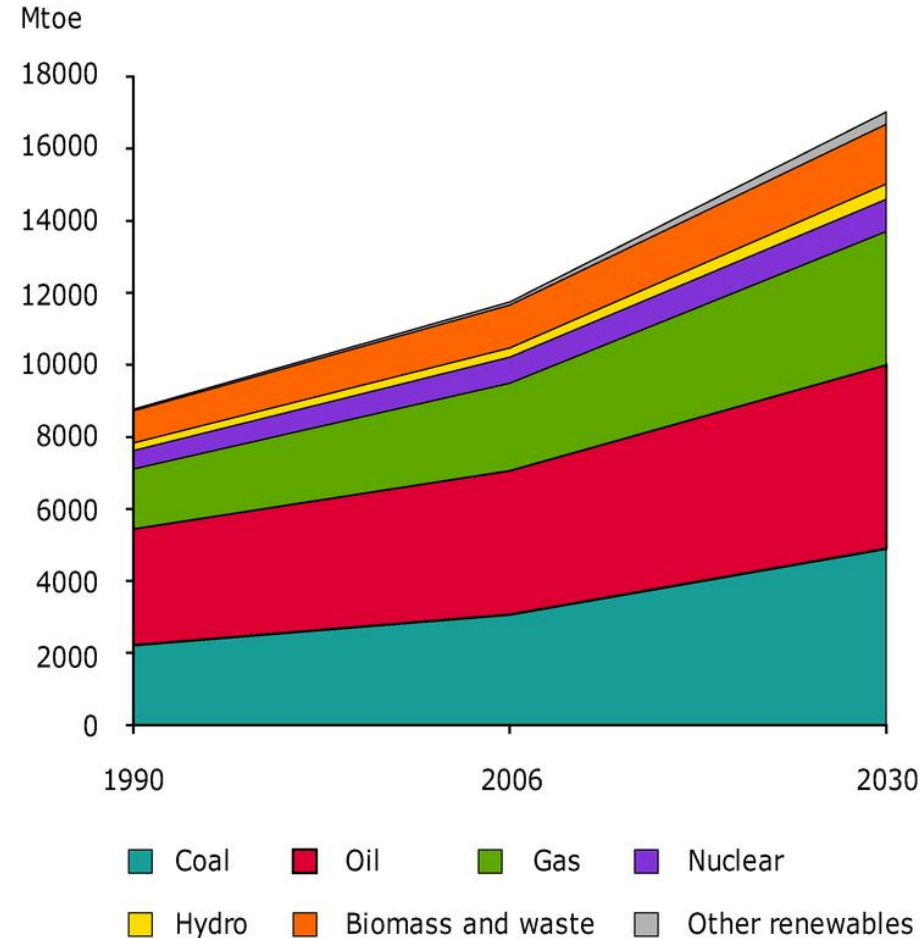
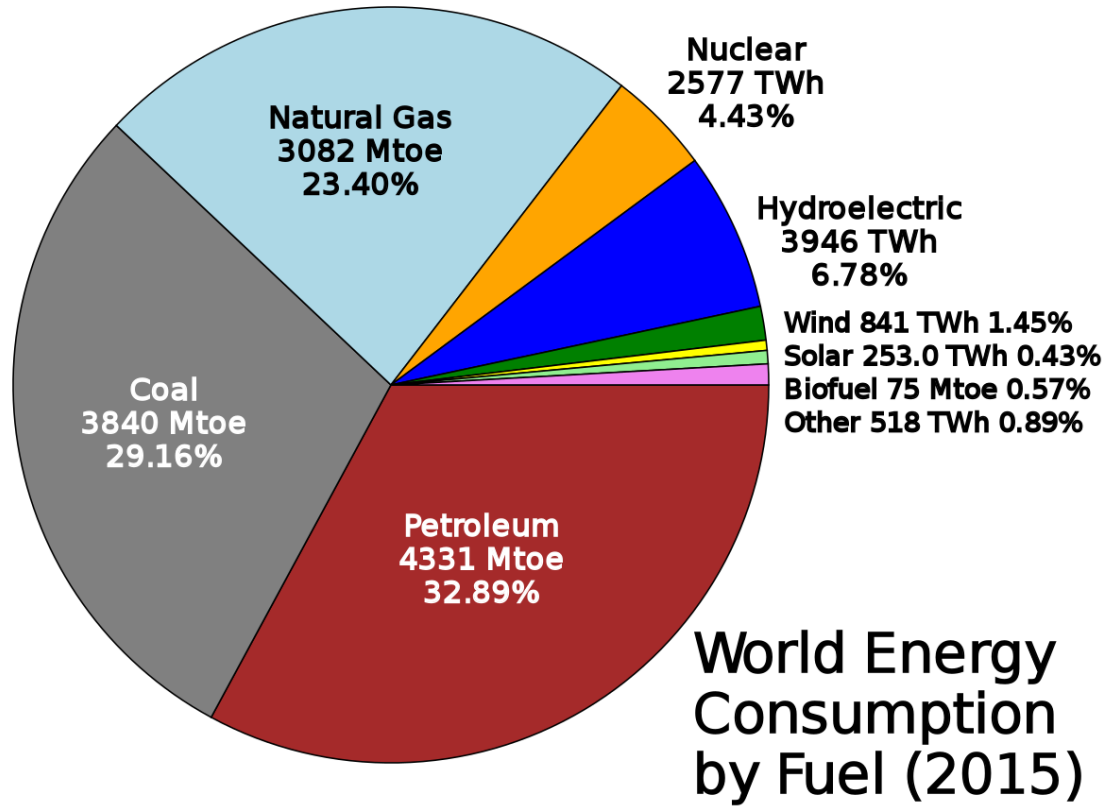
Water

2. Non-renewable

Fossil fuels (coal, petroleum, natural gas)

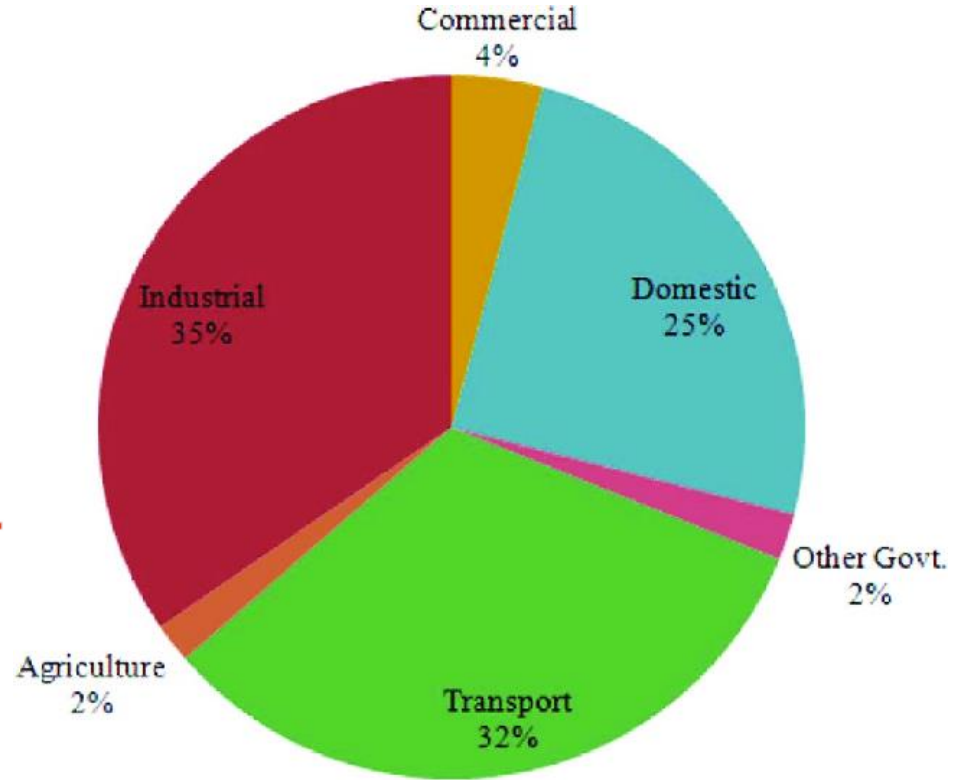
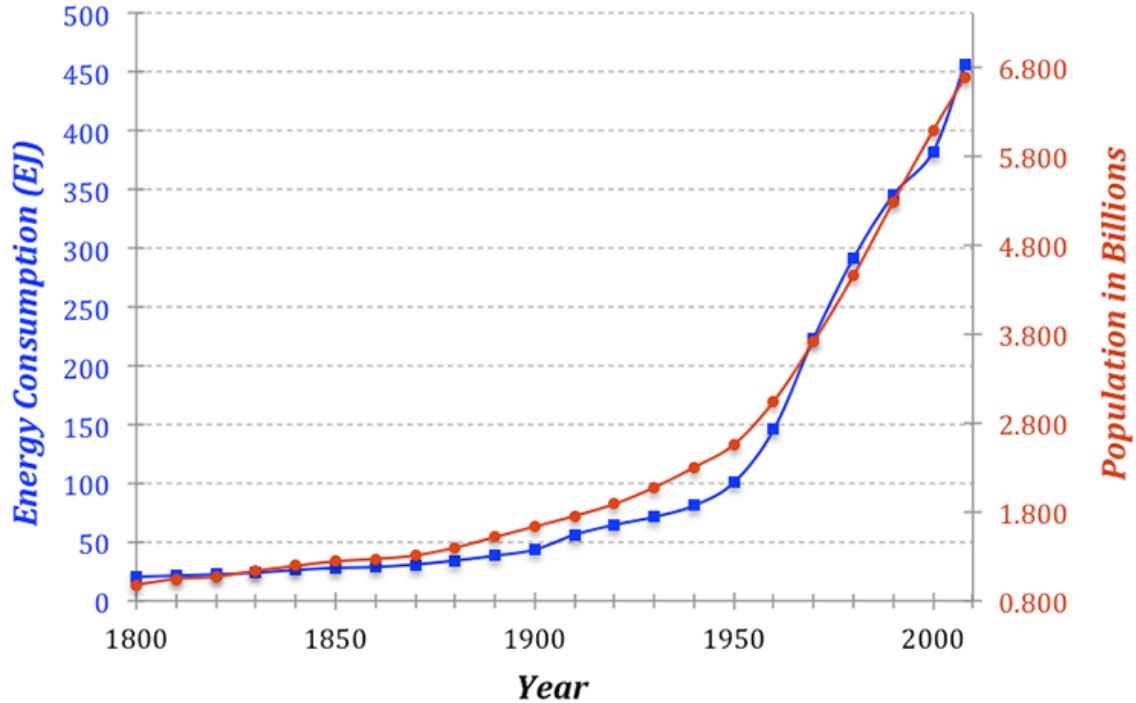
Nuclear materials

Energy sources



Energy sources

Energy Consumption and Population



Energy sources: India

India is the 7th largest country, 4th largest power producing, and 3rd biggest primary energy consumption country. To maintain the growth rate, we need rapid growth in energy sector.

As per the 2011 census, 55.3% rural household had access to electricity. Still most of the rural area have limited supply hours of electricity.

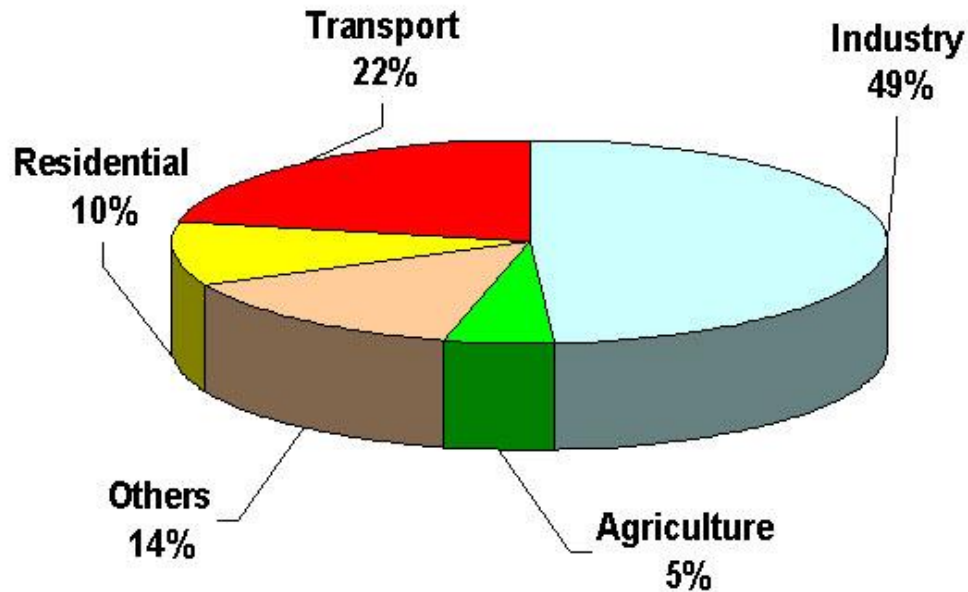
With 68 billion tonnes of coal, India is the third largest coal producing country in the world. With current rate of mining, 323 million tonnes per year, our coal reserve will be sufficient for about 200 years.

Oil with stock of 250000 million tonnes, would suffice only for 100 years in India.

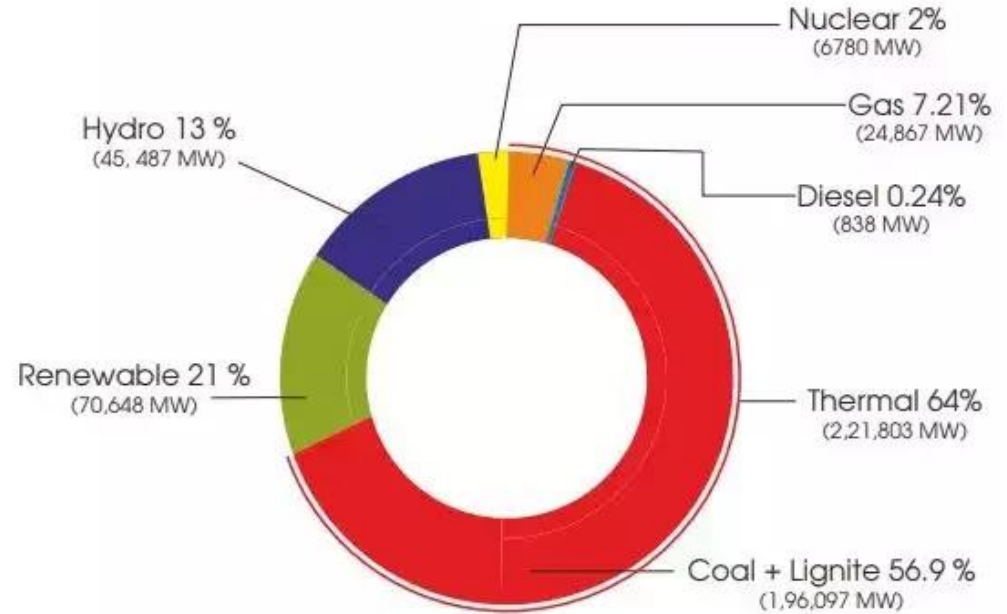
Our reserves of natural gas about 700 billion meter 3 will suffice only for next 20 years.

Energy sources: India

**Sector-Wise
Total Energy Consumption in India**

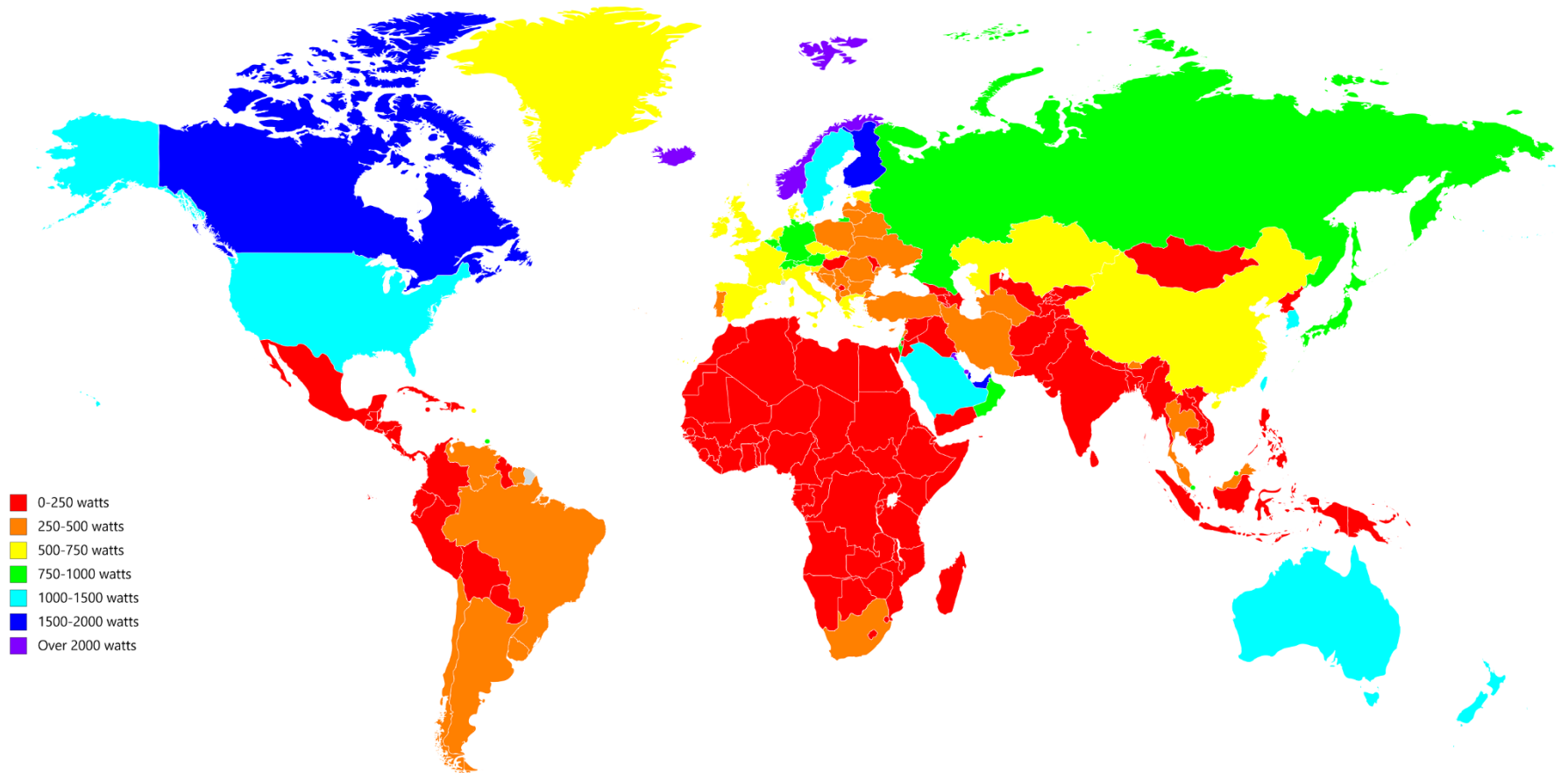


**Power Generation Capacity as on 30.09.2018 -
344,718 MW**



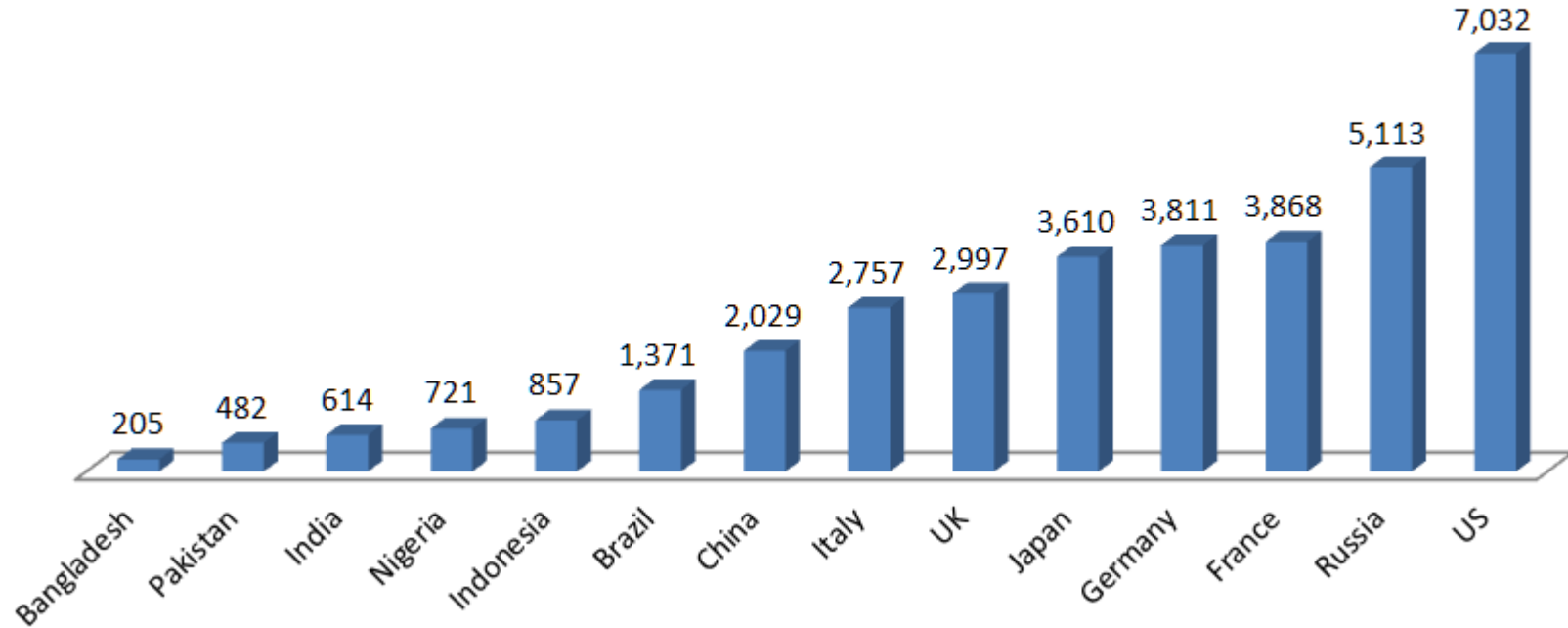
Sources	Thermal	Renewable	Hydro	Nuclear	Total
Share (MW)	2,21,803	70,648	45,487	6,780	344,718

Enegry sources



Energy sources

Energy Use per Capita



Energy efficiency

Energy efficiency is key to ensuring a safe, reliable, affordable and sustainable energy system for the future.

Energy efficiency means using less energy to provide the same level of energy. It is therefore one method to reduce human greenhouse gas emissions.

Efficient energy use is achieved primarily by means of a more efficient technology or process.

Energy efficient buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help controlling global emissions of greenhouse gases.

Energy efficiency

A 12-watt LED bulb uses 75-80% less energy than a 60-watt traditional bulb but provides the same level of light.

Many of the appliances for sale are ENERGY STAR certified, which means that they use less energy than their conventional, non-energy efficient counterparts.

Up to 75% of the electricity used in the US today could be saved with efficiency measures.

Apart from saving money, energy efficiency can also be detrimental towards the climate change.

Natural resources of India

India is the second-largest producer of steel; the third-largest producer of coal; the fourth-largest producer of iron and has the fifth-largest bauxite reserves in the world.

Some other metallic minerals found in India are copper, zinc, lead, gold, and silver.

Important nonmetallic and nonfuel minerals are limestone, dolomite, rock phosphate, building stones, ceramic clays, mica, gypsum, fluorspar, magnesite, graphite, and diamonds.

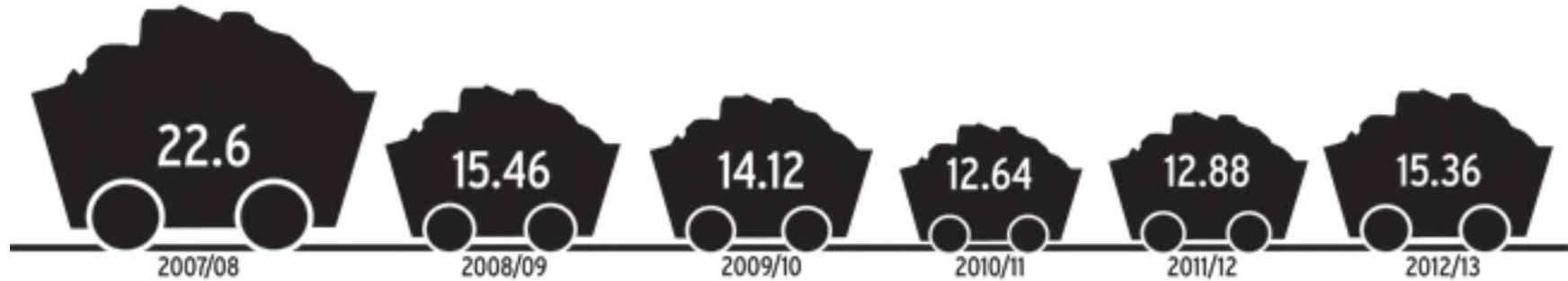
Among the fossil fuels, India is well endowed with coal.

Domestic reserves of petroleum and natural gas, though abundant, do not meet the country's large demand.

Natural resources and economy of India

SHRINKING SUPPLY

India's bauxite production has fallen in recent years, hurting aluminium output



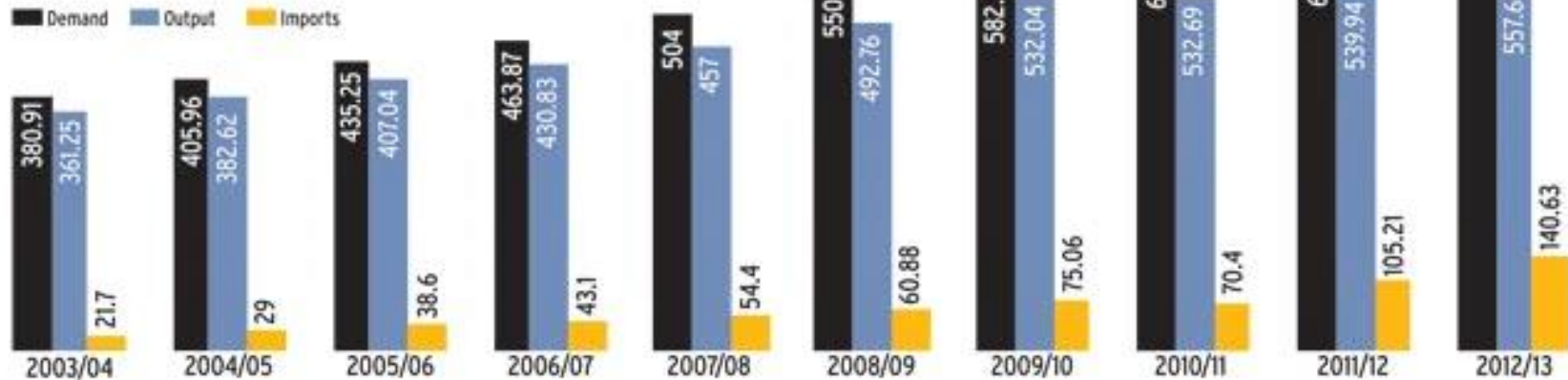
Source: Indian Bureau of Mines/FICCI

Figures in million tonne

Natural resources and economy of India

INCREASING SHORTFALL

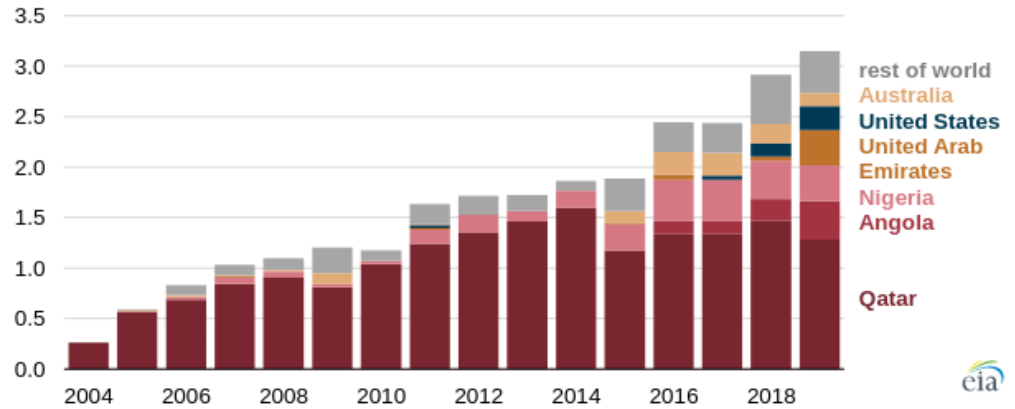
Despite having coal reserves of 293 billion tonnes, India's coal imports doubled in three years



Natural resources and economy of India

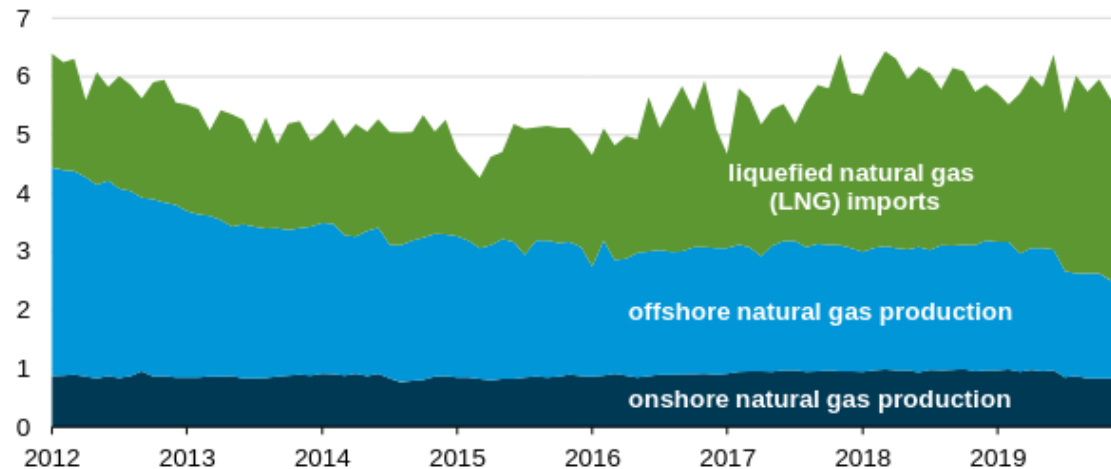
India liquefied natural gas (LNG) imports by source (2004-2019)

billion cubic feet per day



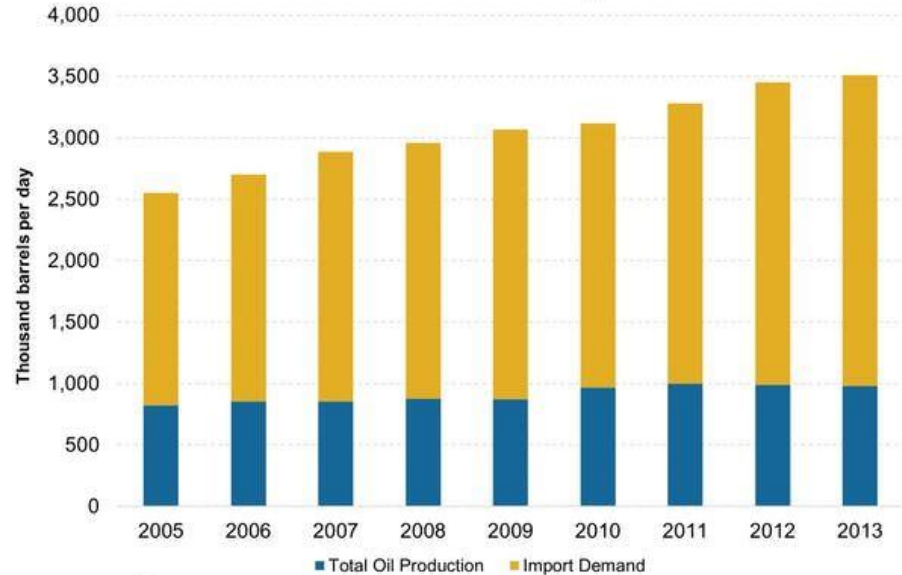
India monthly natural gas supply (Jan 2012-Dec 2019)

billion cubic feet per day



Natural resources and economy of India

India's Domestic Production and Import Demand

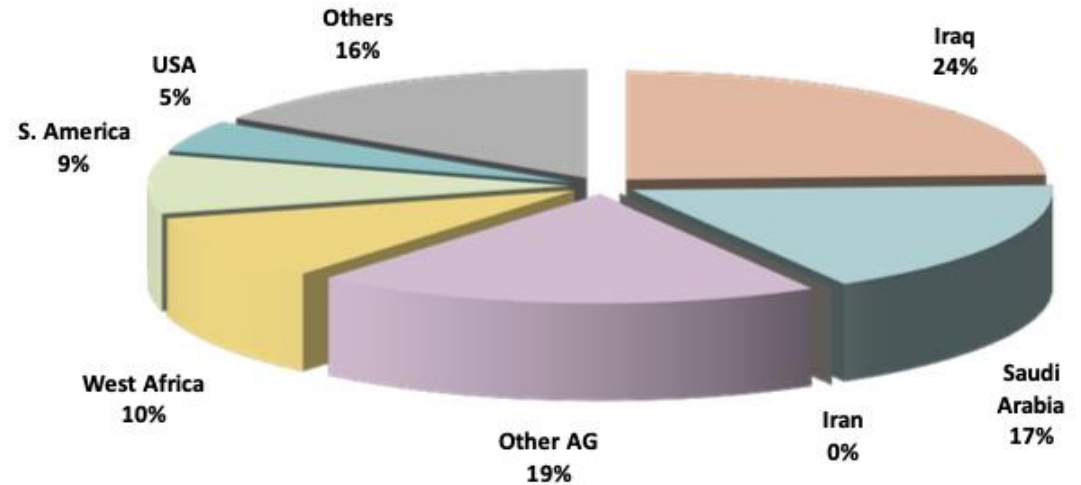


Market Realist

Source: US Energy Information Administration

India Crude Imports by Source in Jan-Mar 2020

(mar 2020 ; source: refinitiv ; % of import volume)



Natural resources and economy of India

Diversity of resources, especially of minerals, exceeds that of all but a few countries and gives India a distinct advantage in its industrial development.

Although India possesses a wide range of minerals and other natural resources, its per capita endowment of such critical resources as cultivable land, water, timber, and known petroleum reserves is relatively low.

