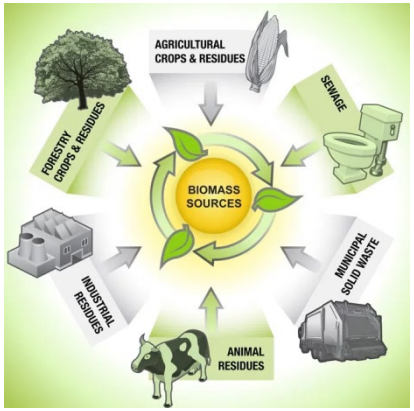
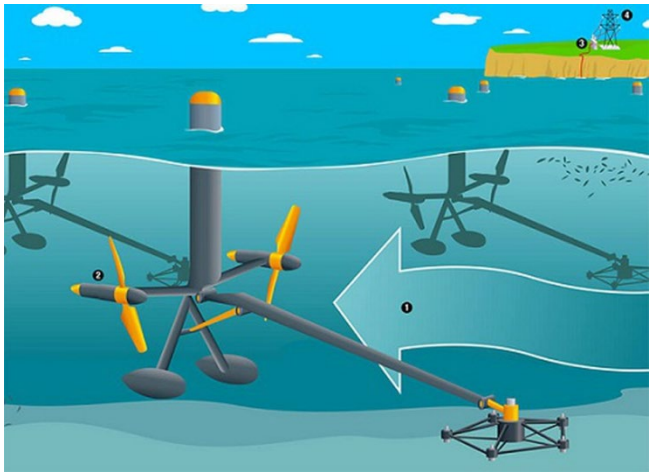
Renewable Energy Sources

Chapter:1: Introduction

MOHAMMED NOMAN KASMANI

Syllabus


AGRICULTURAL CROPS & RESIDUES
SEWAGE
FORESTRY CROPS & RESIDUES
BIOMASS SOURCES
MUNICIPAL SOLID WASTE
INDUSTRIAL RESIDUES
ANIMAL RESIDUES



Basic Terminologies

- **Work** : Work is defined as the product of force and the distance travelled in the direction of action of force.

$$W=(F*S)\ N\text{-}m$$

SI Unit is N-m or Joule

- **Power**：Power is the rate at which the work is done, or it is the work done per unit time.

Power=Work done/Time

=Joule/Second

In SI unit Joule/Second is Watt(W)

Watt is very small unit so recommended larger units are kW , MW etc.

- **Energy** : Energy is the ability to do work. The unit of energy is the unit of work i.e. **Joule.** Another important unit of energy is Kilowatt hour (kWh).

Different forms of energy are : Mechanical energy, Chemical energy, Heat energy, Electrical energy, Nuclear energy etc.

Types of Mechanical Energy :

1. **Potential Energy**: The energy possessed by a body by virtue of its position or elevation is the potential energy.

P.E.= w*h

P.E.= mgh

Where, w is weight of the body in Newton , h is height in mts , m is mass of body in kg, and g is gravitational acceleration.

2. Kinetic Energy: Energy which a body possesses by virtue of its motion is said to be the kinetic energy.

Examples:

- A vehicle moving
- An aircraft in flight
- A rock dropping
- A baby crawling
- A planet rotating around sun
- K.E.= $1/2mV^2$ N.m


make a gif.com

Thermodynamic laws related to Energy and Power

- Energy exists in many forms, such as heat, light, chemical energy, and electrical energy. Energy is the ability to bring about change or to do work. Thermodynamics is the study of energy.

- First Law of Thermodynamics: Energy can be changed from one form to another, but it cannot be created or destroyed. The total amount of energy and matter in the Universe remains constant, merely changing from one form to another. The First Law of Thermodynamics (Conservation) states that energy is always conserved, it cannot be created or destroyed. In essence, energy can be converted from one form into another.

2nd Law

- *Kelvin-Planck statement*: It is impossible to make a thermal engine that works in a thermodynamic cycle and generates power while it has a heat exchange only with one thermal reservoir. In other words, heat engines must exchange heat with two thermal reservoirs, including a heat source and a heat sink. Hence, all heat additions to heat engines cannot be converted into useful work, and a part of thermal energy must be rejected into the thermal sink.

2nd Law

- *Clausius statement*: It is impossible to transfer heat from the low-temperature heat sources to a media with a higher temperature without providing the additional energy from an external source. In other words, the transfer of the heat from the low-temperature heat medium to a high-temperature media needs a heat pump that consumes external energy, usually in the form of mechanical power.

Energy conversion and unit system

Temperature

- Temperature is Qualitative indication of relative hotness or coldness of body. The unit of temperature is degree Celsius or Kelvin.
- 1 ℃ = 273K

Absolute zero temperature

- It is the Temperature at which gas will occupy zero volume and lowest temperature that can be measured by gas thermometer.

????


Radisson

COOKING AT MOUNTAIN

WHY ??

Pressure

- Pressure is the force applied perpendicular to the surface of an object per unit area over which that force is distributed. It is denoted by P.Gauge pressure is the pressure relativeto the atmospheric pressure.
- In SI base units: 1 Pascal (N/m^2), 1 kg/ ($m \cdot s^2$), or 1 J/m^3.
- 1bar = $10^5 N/m^2$

Kilowatt-hour (kWh)

- It is the product of power in kW and time in hours and Equal to 1000 Watt-hours.
- For example,
- If a 100W light bulb is used for 4 hours, 0.4kWhs of energy will be used (100W x 1kW / 1000 Watts x 4 hours). Electrical energy is sold in units of kWh.
- Kilowatt-hour Meter is a device used to measure electrical energy use.

Watt

- The watt is the unit of power. The watt is the power which in one second gives rise to energy of 1 joule.
- 1watt =1 joule/second

Current

- Current is the rate at which electric charge flows past a point in a circuit. Or current is the rate of flow of electric charge.

Ampere

- The ampere comes from the study of magnetism. Electric currents in wires give rise to magnetic fields .Those magnetic fields in turn give rise to magnetic forces on the wires .Two parallel wires carrying current exert a force on each other.

Potential difference

- It is define as difference in the amount of energy that charge carriers have between two points in a circuit. It unit is volt.

Volt

- Electric potential difference is also known as voltage. The size of 1 volt is officially defined as the potential difference between two points of a wire carrying a current of 1 ampere when the power dissipated in the wire is 1 watt.
- 1volt =1watt/ampere

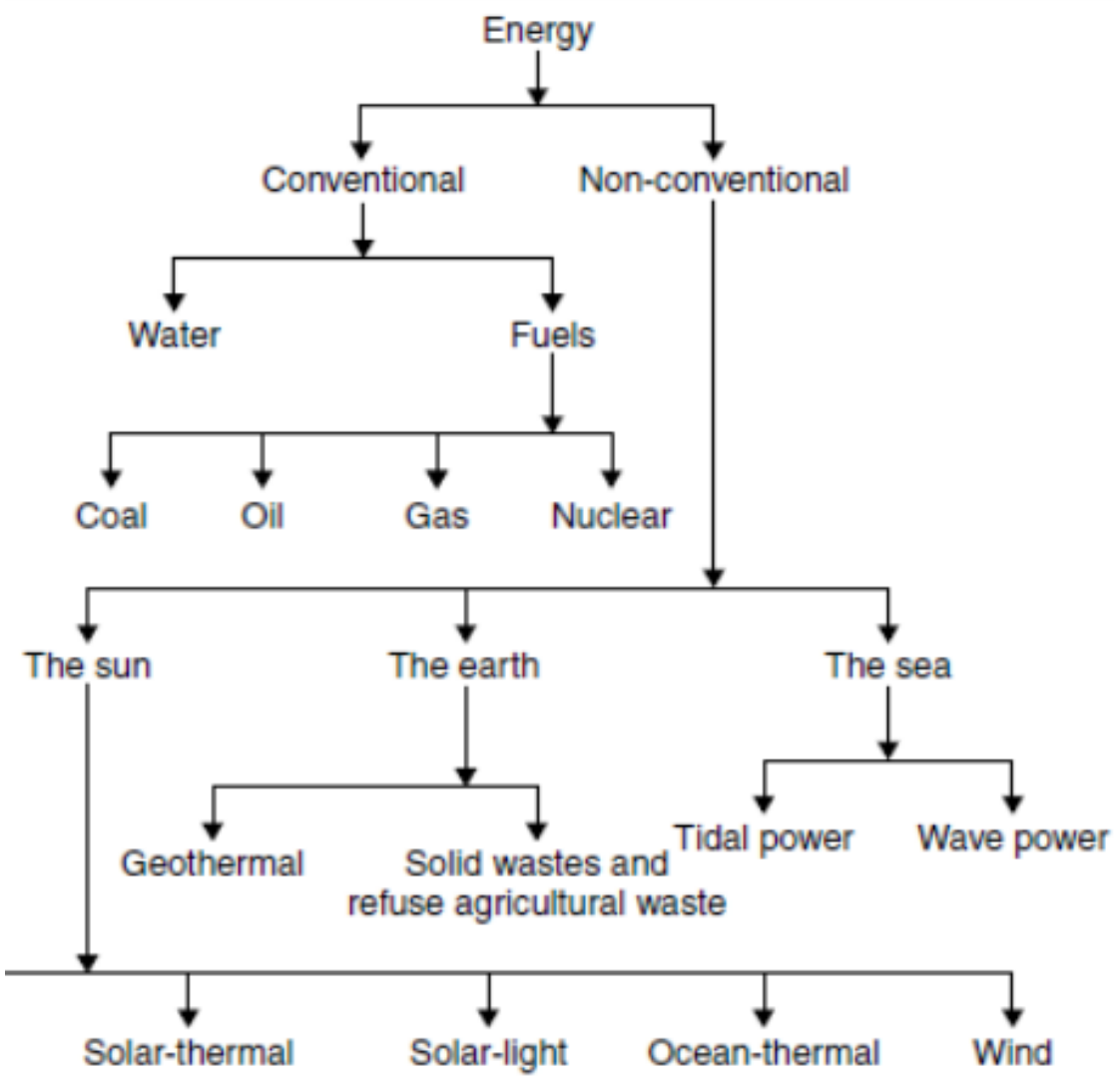
Resistance

- It is define as electrical quantity that measures how the device or material reduces the electric current flow through it. The unit of resistance is ohms (Ω).

Ohm

- The ohm is the electrical unit of resistance. One ohm is defined as the resistance between two points of a conductor when 1 volt is applied and a current of 1 ampere is flowing.
- 1ohm =1volt/ampere

Energy Sources



Primary and Secondary Energy

- Primary energy sources are those that are either found or stored in nature. Common primary energy sources are coal, oil, natural gas, and biomass (such as wood). Other primary energy sources available include nuclear energy from radioactive substances, thermal energy stored in earth's interior, and potential energy due to earth's gravity.

Primary and Secondary Energy

- Primary energy sources are mostly converted in industrial utilities into secondary energy sources; for example coal, oil or gas converted into steam and electricity. Primary energy can also be used directly. Some energy sources have non-energy uses, for example coal or natural gas can be used as a feedstock in fertiliser plants.

Commercial Energy and Non Commercial Energy

- Commercial Energy The energy sources that are available in the market for a definite price are known as commercial energy. By far the most important forms of commercial energy are electricity, coal and refined petroleum products. Commercial energy forms the basis of industrial, agricultural, transport and commercial development in the modern world. In the industrialized countries, commercialized fuels are predominant source not only for economic production, but also for many household tasks of general population. Examples: Electricity, lignite, coal, oil, natural gas etc.

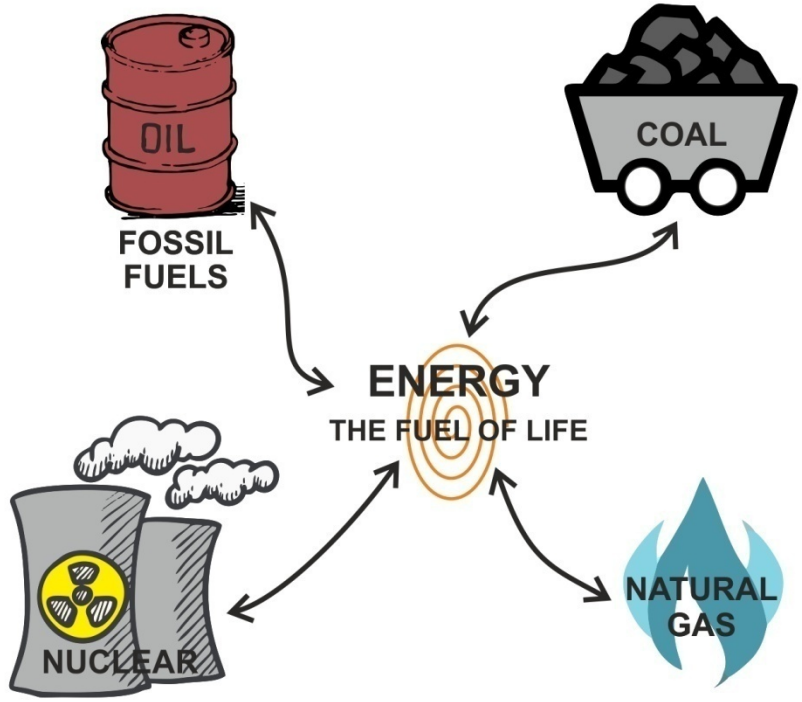
Commercial Energy and Non Commercial Energy

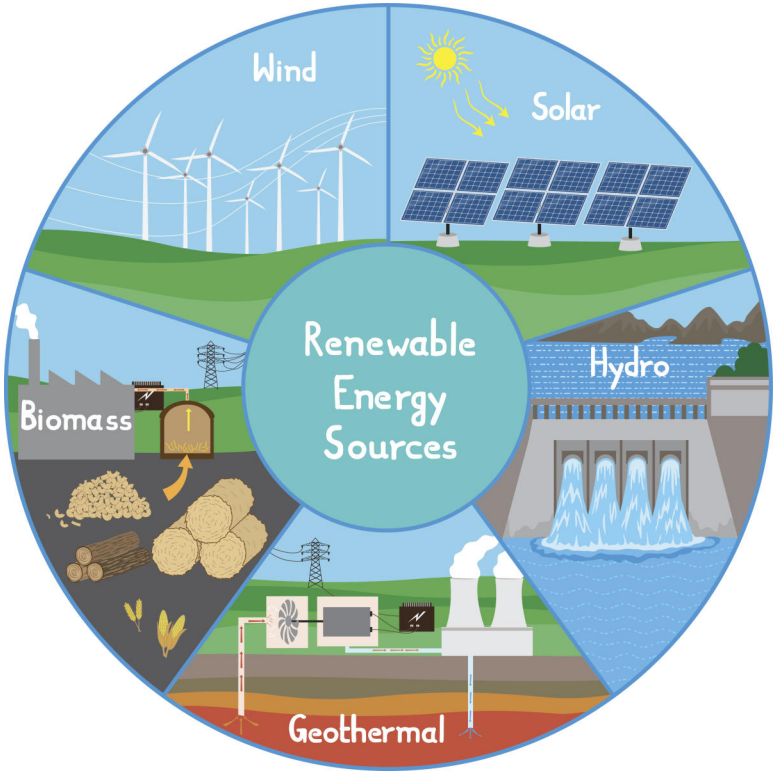
- Non-Commercial Energy The energy sources that are not available in the commercial market for a price are classified as non-commercial energy. Non-commercial energy sources include fuels such as firewood, cattle dung and agricultural wastes, which are traditionally gathered, and not bought at a price used especially in rural households. These are also called traditional fuels. Non-commercial energy is often ignored in energy accounting. Example: Firewood, agro waste in rural areas; solar energy for water heating, electricity generation, for drying grain, fish and fruits; animal power for transport, threshing, lifting water for irrigation, crushing sugarcane; wind energy for lifting water and electricity generation

Renewable and Non-Renewable Energy

- Renewable energy is energy obtained from sources that are essentially inexhaustible. Examples of renewable resources include wind power, solar power, geothermal energy, tidal power and hydroelectric power,The most important feature of renewable energy is that it can be harnessed without the release of harmful pollutants. Non-renewable energy is the conventional fossil fuels such as coal, oil and gas, which are likely to deplete with time

Non-renewable energy sources





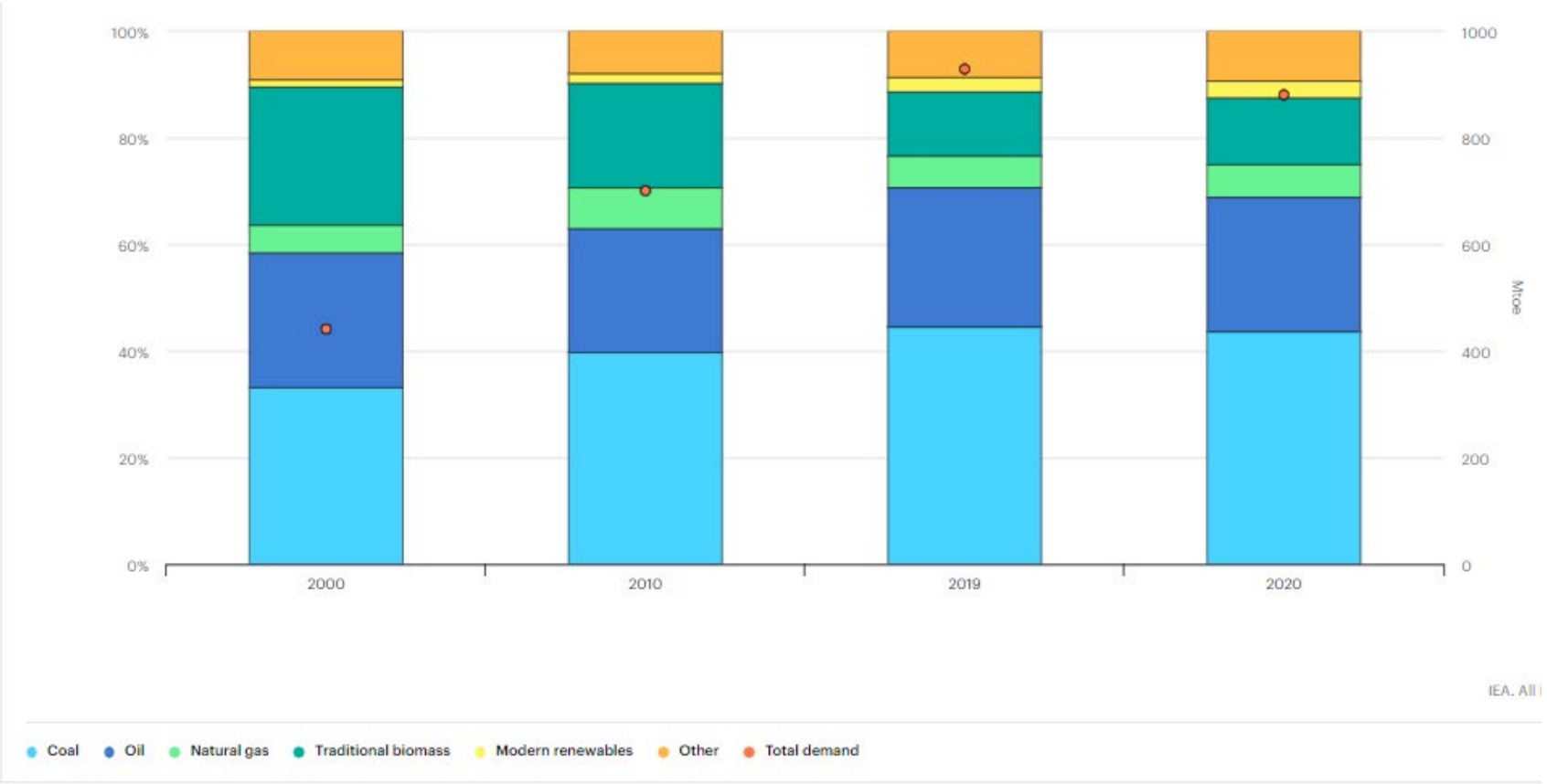
Supported by: Landsvirkjun

India Energy Outlook

- Over the next two decades, **India will have the biggest share of energy demand growth at 25%,** overtaking the EU as the world's third-biggest energy consumer by 2030. At present, **India is the fourth-largest energy consumer in the world behind China, the US and the EU.**
- The report highlights the **doubling of India's energy consumption as the GDP expands to a projected USD 8.6 trillion by 2040.**

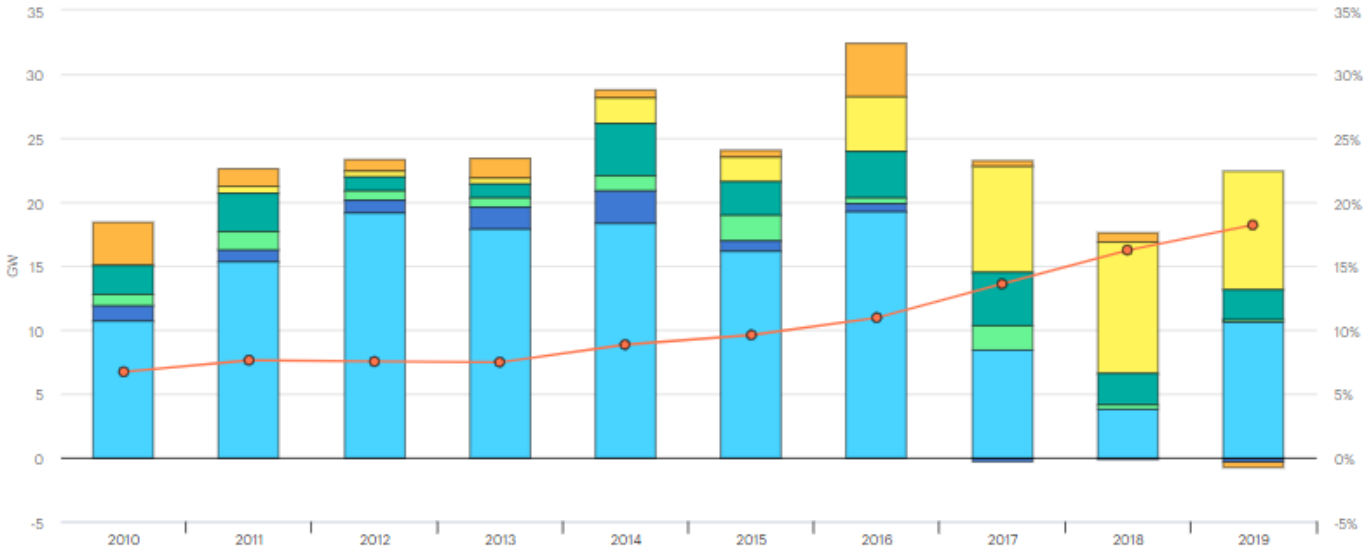
- Despite various government policies, India's **domestic oil and gas production has been stagnant for years**, which in turn, will **make it more reliant on fossil fuel imports to meet its energy requirements.**
- 6- Rising coal demand may double the **country's import bill to USD 181 billion by 2030 and to USD 255 billion by 2040.**
- 7- Under the existing policies, India's **oil demand is expected to rise by 74%-- 8.7 million barrels per day by 2040.**
- 8- India is projected to **lead the oil demand growth in the world due to a five-fold increase in per capita car ownership.** The net dependence on oil imports is **projected to increase more than 90% by 2040 from the current 75%.** This is because **domestic consumption will surpass domestic production.**

- 9- India will become the **fastest-growing market for Natural gas and the demand is expected to triple by 2040.** Natural Gas imports increased to almost 50% in 2019 and are **projected to grow more than 60% in 2040.**
- 10- At present, coal dominates India's energy sector, accounting for **more than 70% of overall generation.** Also, the **demand will rise to 772 million tonnes in 2040** from the current 590 million tonnes.
- 11- **India's share in renewable energy growth is the second-largest in the world**, after China.


100%
80%
60%
40%
20%
0%
1000
800
600
400
200
0
Mtoe
2000
2010
2019
2020
IEA. All
Coal
Oil
Natural gas
Traditional biomass
Modern renewables
Other
Total demand

Annual power sector capacity additions in India, 2010-2019

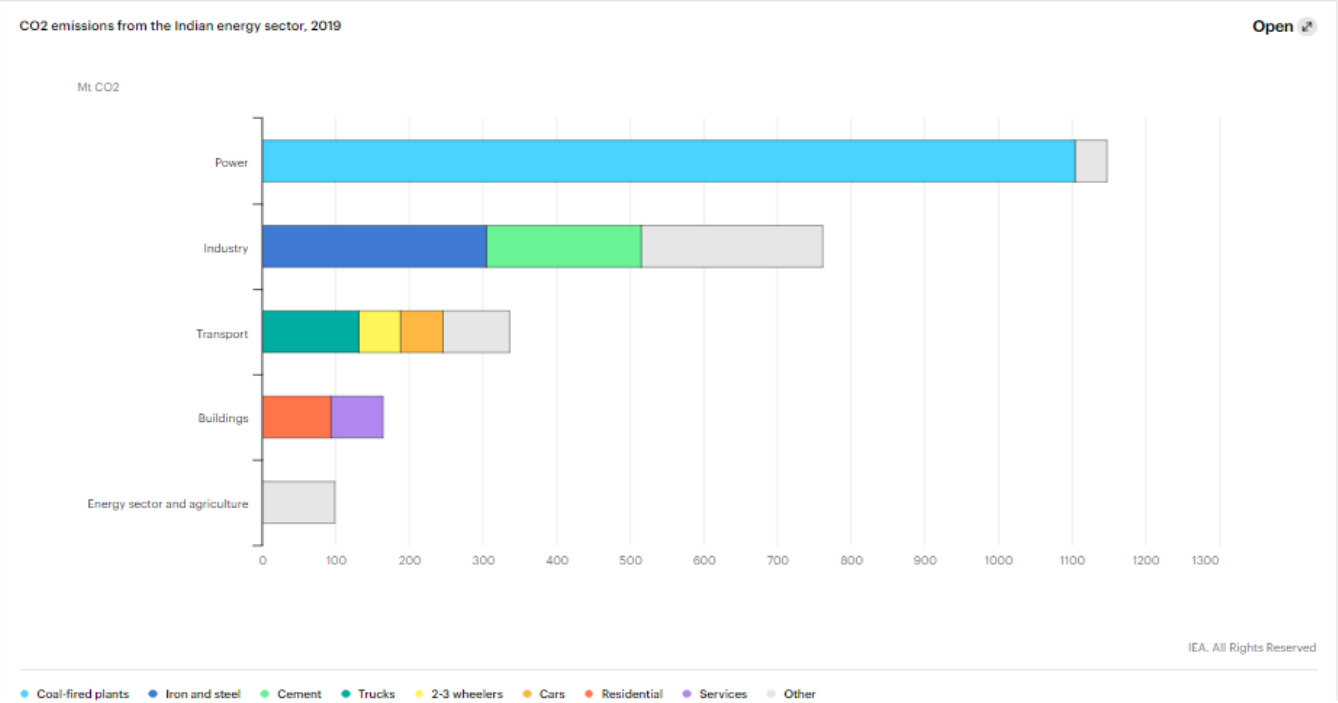
Open



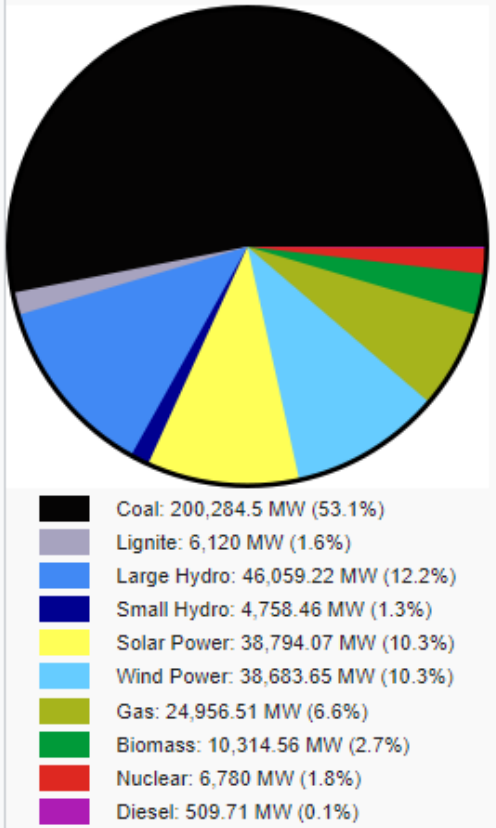
Coal Gas Hydro Wind Solar PV Other Share of wind and solar in total capacity

iea.org/reports/india-energy-outlook-2021/energy-in-india-today

Contents Cite Share Full report



Installed capacity by source in India as on 31 January 2021[15]



Electricity generation (utility sector) by source in India in FY 2019-2020