

# Energy Sector

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## Installed capacity in India

The total installed generation capacity of India as of May 31, 2023, is 417.67 GW.

- Total Fossil Fuel Capacity: 237.27 GW
- Total Non-Fossil Fuel Capacity (Including Hydro): 173.62 GW
- Nuclear Capacity: 6.78 GW

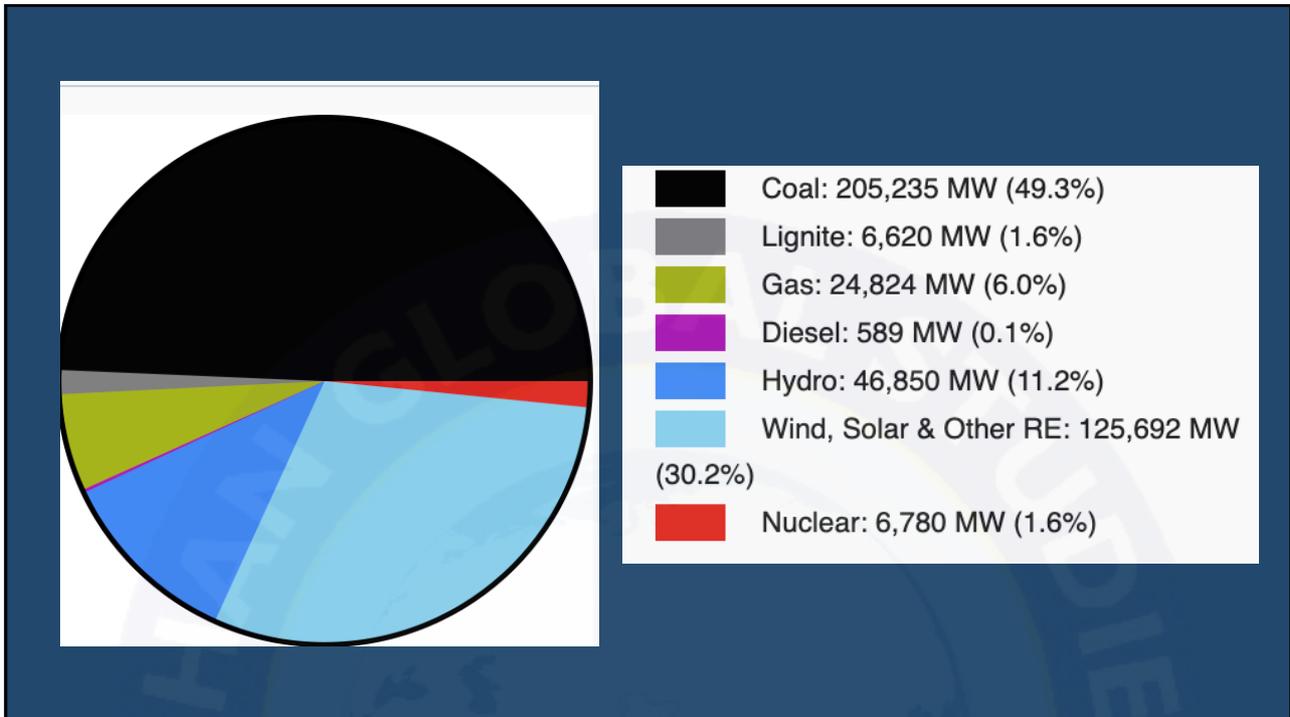
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| Current scenario         |                                    |                  |
|--------------------------|------------------------------------|------------------|
| Category                 | Installed Generation Capacity (GW) | % Share in Total |
| <b>Fossil Fuels</b>      |                                    |                  |
| Coal                     | 205.24                             | 49.1%            |
| Gas                      | 24.82                              | 6.0%             |
| Lignite                  | 6.62                               | 1.6%             |
| Diesel                   | 0.59                               | 0.1%             |
| <i>Total Fossil Fuel</i> | 237.27                             | 56.8%            |

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| Current scenario                      |                                    |                  |
|---------------------------------------|------------------------------------|------------------|
| Category                              | Installed Generation Capacity (GW) | % Share in Total |
| <b>Non-Fossil Fuels</b>               |                                    |                  |
| Hydro                                 | 46.85                              | 11.2%            |
| Wind                                  | 42.87                              | 10.3%            |
| Solar                                 | 67.08                              | 16.1%            |
| Others (BM, Waste, Small Hydro)       | 15.75                              | 4.3%             |
| <i>Total Non-Fossil (incl. Hydro)</i> | 173.62                             | 41.4%            |
| <b>Nuclear</b>                        | 6.78                               | 1.6%             |

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## India's coal reserves



- As of April 1, 2022, India's estimated total coal reserves amount to **361,411.46 million tonnes**.
- The coal reserves are primarily concentrated in five states:
  1. Odisha: 88,104.60 million tonnes
  2. Jharkhand: 86,660.10 million tonnes
  3. Chhattisgarh: 74,191.76 million tonnes
  4. West Bengal: 33,871.25 million tonnes
  5. Madhya Pradesh: 30,916.73 million tonnes

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## India's coal reserves



- At current consumption rates, these reserves are **projected to last approximately 111 years**. This substantial reserve base positions India as the **4th largest country globally** (USA, Australia, China, India) in terms of coal reserves.

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## Problem of using hydrocarbons-1

### 1. Air Pollution

Indian cities frequently appear among the most polluted in the world. The burning of coal in thermal power plants contributes significantly to air pollution levels in cities like Delhi, where air quality often falls into the "hazardous" category.

### 2. Greenhouse Gas Emissions

As per a report by the Ministry of Environment, Forest and Climate Change, India's carbon dioxide emissions from thermal power plants were over 1,000 million tonnes in 2019.

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## Problem of using hydrocarbons-2

### 3. Water Scarcity

~278 million people in India lack access to clean water. Thermal power plants consume large amounts of water.

### 4. Health Impacts

Fossil fuel combustion, especially from coal, can lead to respiratory diseases. ICMR has reported that air pollution causes about 3 million deaths in India annually.

### 5. Energy Security Concerns

India imports over 80% of its crude oil requirements. In 2020, India faced supply chain disruptions due to geopolitical tensions in the Middle East, underlining the vulnerability associated with heavy reliance on imported fossil fuels for energy.

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## Clean coal technology

- Clean Coal Technology (CCT) aims to reduce harmful emissions and improve fuel efficiency during coal combustion or conversion.
  1. **Emission Control:** Technologies like flue-gas desulfurization capture pollutants such as sulfur dioxide (SO<sub>2</sub>) and particulate matter.
  2. **Carbon Capture:** Carbon Capture and Storage (CCS) isolates carbon dioxide (CO<sub>2</sub>) from emissions and stores it underground to mitigate climate impact.
  3. **Coal Gasification:** Converts coal into syngas, a cleaner-burning fuel, allowing for more environmentally friendly industrial applications.
- **Significance:** Enables responsible coal usage while aligning with global sustainability goals, critical for countries with abundant coal reserves like India.

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## Coal Gasification

- Converts coal into **syngas** – a mixture of hydrogen, carbon monoxide, and methane – through controlled reactions with oxygen and steam.
- Offers a cleaner and more efficient way to utilize abundant coal reserves, mitigating harmful emissions like sulfur dioxide and particulates.
- Syngas serves as a raw material for essential industrial products such as methanol, DME (Dimethoxyethane), ammonia, and ammonium nitrate.
- Four coal gasification plants are planned by Coal India Ltd in 2023-24 to produce these valuable chemicals, advancing India's move toward sustainable energy.

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## Renewable energy

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## Renewable source of energy

- A source of usable energy that does not diminish
- A natural source or process keeps it going

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## Unconventional source

- A source of usable energy other than hydrocarbons and nuclear

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## Examples

- Solar energy
- Wind energy
- Energy from biomass
- Hydel energy
- Tidal energy

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## WHY

- Low carbon footprint
- Greater energy security
- Improved energy access
- Enhanced employment opportunities

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## Institutions

- The Ministry of New and Renewable Energy (MNRE) - The nodal Ministry for all matters relating to new and renewable energy.

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## CURRENT SCENARIO

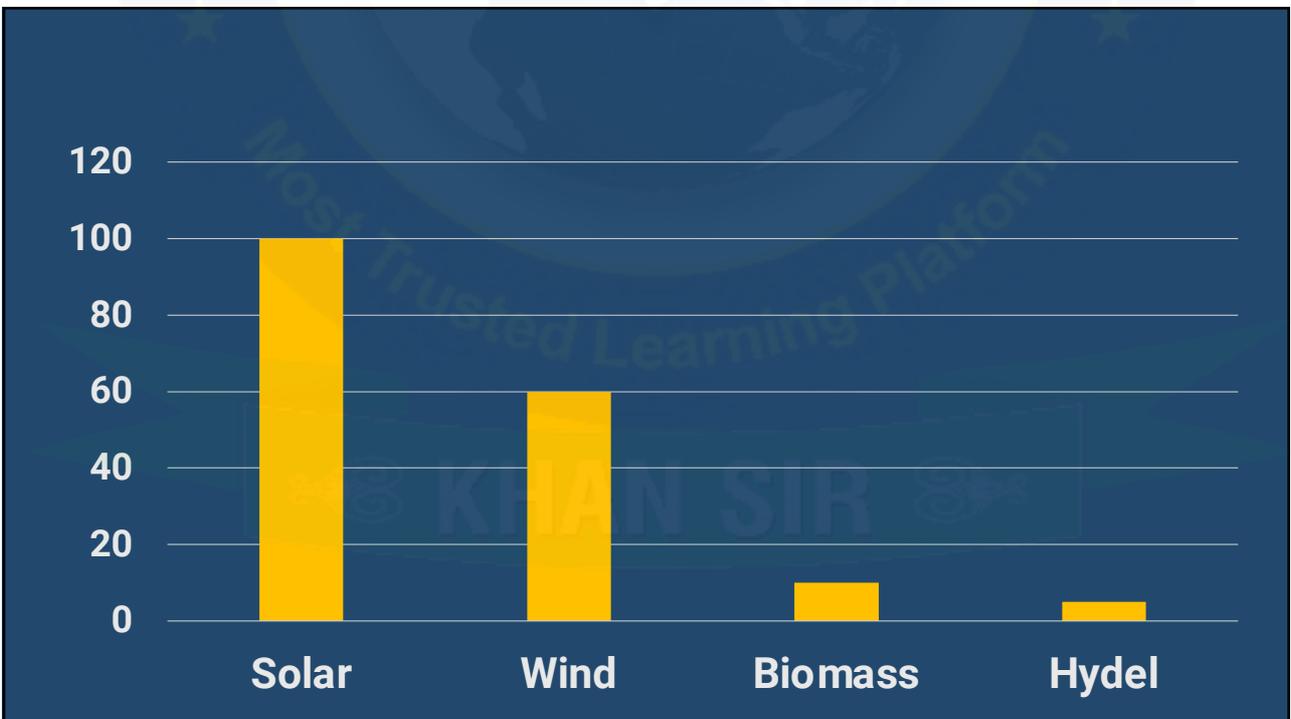
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**WORLD'S LARGEST  
RENEWABLE ENERGY  
EXPANSION PROGRAMME**

**175 GW TILL 2022**

The banner features a hand holding a green globe with icons of wind turbines, solar panels, and hydroelectric dams. The background is a blue sky with clouds and a sun.

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## Current scenario

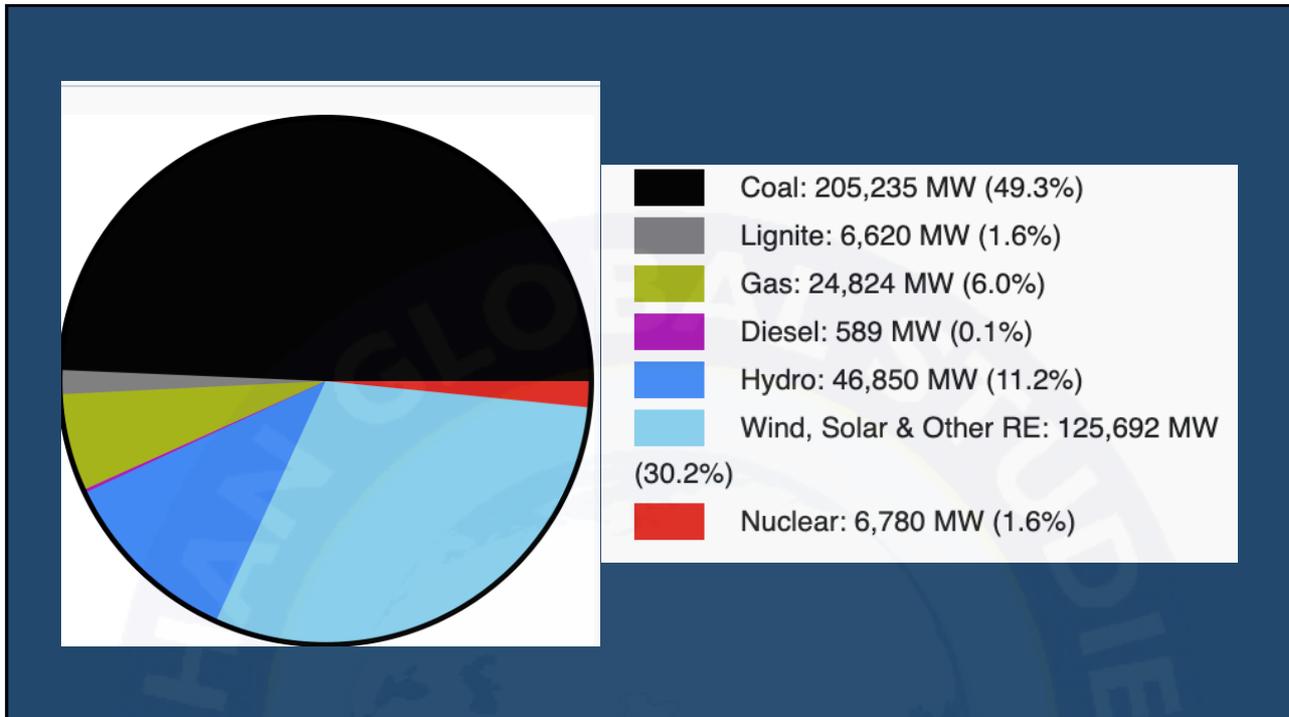
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## Updated data

- After India's 2070 Net Zero announcement in 2022, India updated its Nationally Determined Contributions (NDC) to commit to 50% installed capacity from non-fossil fuels by 2030.
- Central Electricity Authority (CEA) projects that India will exceed its renewable energy target, achieving 57.4% of installed power capacity from green sources by 2026-27, against the committed 50% by 2030.

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## Updated data

- However, due to the variable nature of renewable sources like solar and wind, only 35.04% of total electricity generated is expected to come from renewable sources by 2026-27, and 43.96% by 2031-32.
- By 2031-32, the total capacity is estimated to be 900,422 MW, with renewable energy making up 68% of this mix.

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## SOLAR ENERGY IN INDIA

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## How do solar panels work?

Every solar panel contains photovoltaic (PV) cells. PV cells take light, or photons, and turn the light into electricity. When sunlight hits the solar panel, PV cells produce direct current (DC) electricity.

### 1 - Solar panels collect sunlight



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**2 - Inverters convert solar power to usable electricity**

**3 - Electricity is used in the home**

**4 - Leftover electricity goes back to the grid**

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## 5 - Electricity is measured by the net meter



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### GOOD

- Clean
- Cheap
- Convenient even in remote areas
- Decentralized
- Versatile

### NOT SO GOOD

- Not round the year
- Grid integration not so easy
- Takes a lot of land

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## Solar energy – Plans

- Revision of target:
- Earlier - 20,000 MW by the year 2021-22
- Revised - 100,000 MW by the year 2021-22 under the **National Solar Mission**.

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## Solar energy – PRESENT STATUS

- 4<sup>th</sup> largest producer in the world
- 1. China
- 2. USA
- 3. Japan
- 4. India
- 5. Germany

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## INDIA'S SOLAR POTENTIAL

- Solar energy potential in India is about 5,000 trillion kWh per year.
- Most regions in India receive 4-7 kWh per sq. m per day.
- The National Institute of Solar Energy estimates India's solar potential to be about 748 GW, assuming 3% of the wasteland is covered by Solar PV modules.

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## Solar PARKS

- A solar park is a large area of land equipped with common infrastructure such as transmission systems, roads, water supply, drainage, and communication networks, facilitating hassle-free setup for solar project developers.
- Initiated by the Ministry of New & Renewable Energy on December 12, 2014.
- Original aim: 25 Solar Parks (100 MW+) and Ultra Mega Solar Power Projects (500MW+) with a total installed capacity of 20,000 MW within 5 years starting from 2014-15.
- The scheme's capacity was increased to 40,000 MW on March 21, 2017.
- The parks are planned to be operational by 2023-24.

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## Solar energy TARRIF

- The solar tariff has come down from around Rs 18/kWh in 2010 to Rs. 2.44/kWh in 2018 (at present, 2.85/kWh)
- Various factors like economies of scale, assured availability of land and power evacuation systems etc.

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## Solar energy TARRIF

- Industry Average: INR 6.3 per kWh
- Commercial Consumers: INR 7.7 per kWh on average, peaking at INR 11/kWh in Maharashtra.
- Rooftop Solar Power Tariffs: Without Subsidy: INR 5-8 per kWh
- New Projects: Since 2019, most newly-auctioned solar projects have tariffs in the range of INR 2.50-2.87 per kWh.

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**ISA**

- International Solar Alliance
- Formed in 2015 during Paris Climate Conference
- India played an important role
- A group of 121+ Sunshine Countries
  - Between the Tropics of Capricorn and Cancer
  - Receive abundant sunshine for more than 180 days/year

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**ISA**

- Now a Treaty based International Organization since December 2017.
- Currently, 116 countries are signatories to the ISA Framework Agreement.
- 94 countries have submitted the necessary instruments for ratification to become full members.
- HQ: Gurugram, NCR, India

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## ISA

### Purpose and Approach

1. The ISA is an action-oriented, member-driven platform aimed at increasing the deployment of solar energy technologies.
2. It focuses on energy access, energy security, and energy transition in its member countries.
3. Special emphasis is given to Least Developed Countries (LDCs) and Small Island Developing States (SIDS).

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## ISA

### Strategic Goals

- The ISA is guided by its 'Towards 1000' strategy.
- The strategy aims to mobilize USD 1,000 billion in solar energy investments by 2030.
- It also targets delivering energy access to 1,000 million people and installing 1,000 GW of solar energy capacity.
- The strategy aims to mitigate 1,000 million tonnes of CO<sub>2</sub> emissions annually.

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## ISA

### Programmatic Approach

- The ISA currently has 9 comprehensive programmes, each targeting a specific application of solar energy.
- Activities are focused on three priority areas:
  1. Analytics & Advocacy
  2. Capacity Building
  3. Programmatic Support.

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## KUSUM

### **Kisan Urja Suraksha evam Utthan Mahabhiyan (KUSUM)** provides for:

1. installation of grid-connected solar power plants each of capacity up to 2 MW in the rural areas
2. installation of standalone off-grid solar water pumps to fulfill irrigation needs of farmers not connected to grid

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## KUSUM

1. solarization of existing grid-connected agriculture pumps to make farmers independent of grid supply and also enable them to sell surplus solar power generated to DISCOM and get extra income;
2. solarization of tube-wells and lift irrigation projects of Government sector

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**The end**

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