

# POWER SECTOR REFORMS

A Journey Towards Sustainable Energy and Universal Access

## In This Document

**A** resilient power sector is at the heart of the Indian economy. The fundamental principle of India's power industry has been to **provide universal access** to affordable power. India is the only country among the G20, which is **on track** to achieve the **targets** under the **Paris Agreement 2015**. Today, India is a **power surplus nation** with an installed electricity capacity of over 400GW. Amidst all these achievements, IEA anticipates India's power system to grow to an installed capacity of **up to 1500 GW**. Therefore, the power sector has to be **financially and physically resilient** to meet the demand. However, in 2020, the coronavirus pandemic exacerbated many of the sector's existing challenges. Thus, the **pressing need for deeper power sector reform is growing**.

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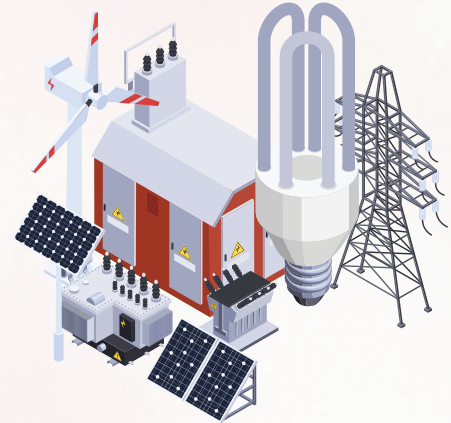
SIKAR

## I. What is the current status of India's Power Sector?

The Indian **power sector value chain** can be broadly segmented into **generation, transmission, and distribution**.







### I.1 Generation

- ⚡ India is the **third-largest producer and consumer** of electricity worldwide, with an **installed power capacity of 417.66 GW**.
- ⚡ **Thermal power** continues to be **India's most important power generation source**.
- ⚡ The public sector companies and private companies both play a key role in power generation.
- ⚡ **Central government-backed** generation companies may supply power to multiple states.
- ⚡ **State government-owned** generation companies can supply power to the parent state only.



### Box I.1. Regulation of India's Power Sector

- ⚡ Electricity falls under the **concurrent list of the 7th Schedule of the Constitution**.
- ⚡ This implies that **both central and state governments** can regulate and operate in the electricity market.

	 Policy	 Regulation	 Generation	 Transmission	 System operation	 Distribution
Central/ Inter-State	Ministry of Power, MNRE	Central ERC	Central Gencos, IPPs	PGCIL (CTU), IPTCs	POSO (NLDC & 5 RLDCs)	-
State/ Intra-State	Power Dept. of States & UTs	State ERCS & Joint ERCS	State Gencos, IPPs, CPPs	State Transcos (STU), IPTCS	SLDCs	State & private Discoms, Distribution franchisees

### I.2 Transmission

- ⚡ The **Power Grid Corporation of India Limited (PGCIL)** is the Central Transmission Utility (CTU) responsible for the **majority of the inter-state transmission projects**.
- ⚡ Similarly, each state has a **State Transmission Utility (STU)** along with **private transmission companies**, which are responsible for setting up **intra-state transmission projects**.
- ⚡ India's regional grids (Northern, Eastern, Western, North-Eastern, and Southern) are currently integrated into **one national grid**. The inter-regional capacity of the **National Grid is 1,12,250 MW**.

### I.3 Distribution

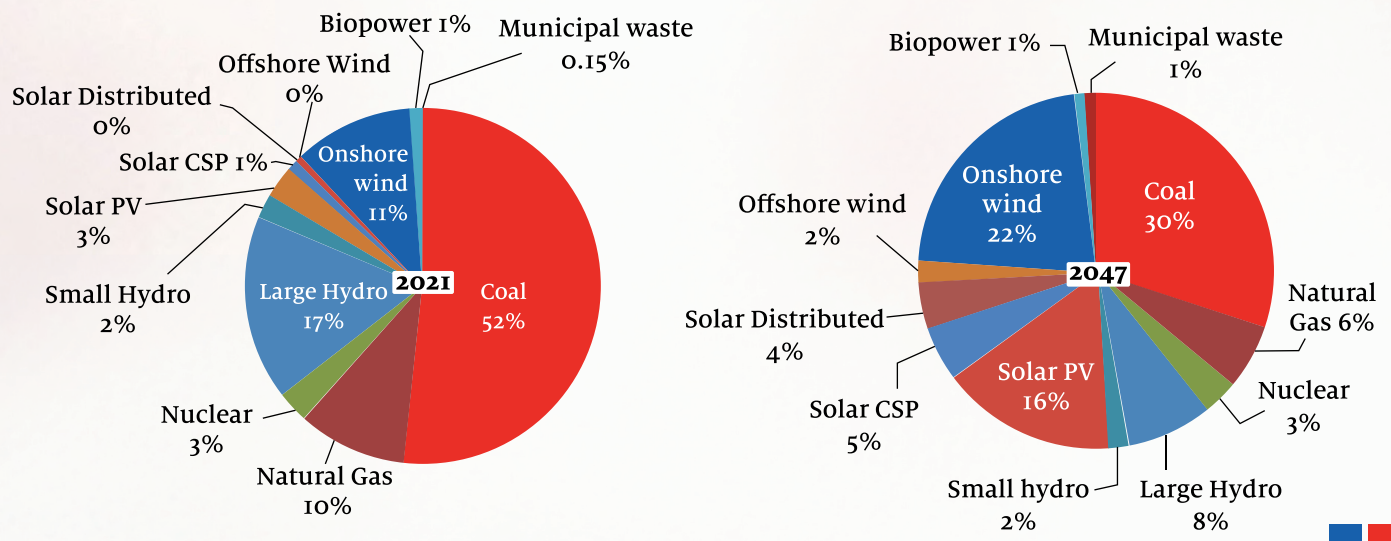
- ⚡ The distribution sector consists of **Power Distribution Companies (DISCOMs)** responsible for the **supply and distribution of energy to the consumers** (industry, commercial, agriculture, domestic, etc.).
- ⚡ **DISCOMs** (mostly state government-owned with few private ones) are considered to be the **weakest link in the Indian power sector value chain**.

**Box: 1.2. Production and Consumption in India's Power Sector**

**Power Consumption in India**

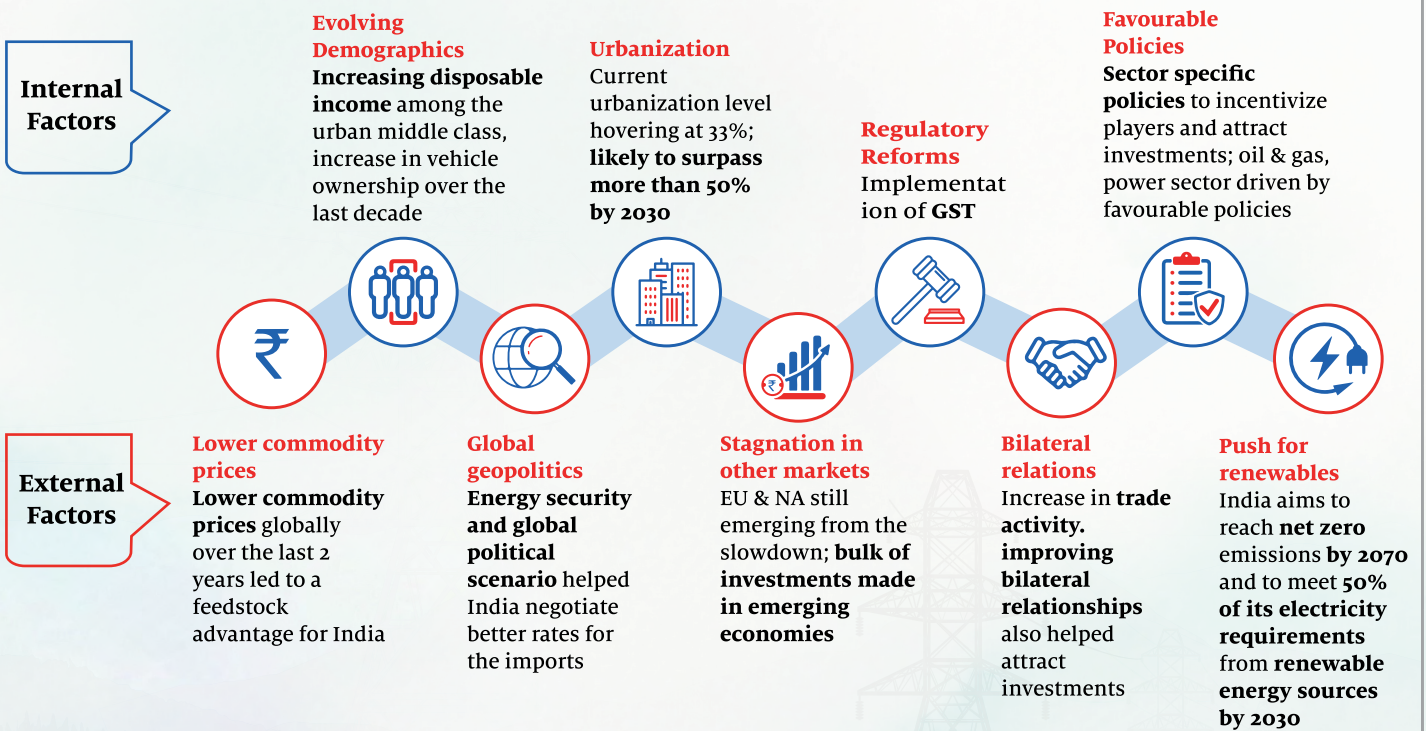
- ⚡ **Power consumption** in India in December 2022 logged an 11% growth to **121.19 billion units**.
  - ◆ Currently, **Industrial consumption is the highest** with around 40% of total consumption followed by domestic and agriculture.
- ⚡ **Grid electricity demand**, without losses, captive power, or behind-the-meter generation, is projected to be between **2040–2857 TWh by 2030 (TERI, 2019)**.

**Share of Different Types of Fuels in Power Generation**



**2. What are the megatrends Shaping the Energy Landscape?**

India is the 3<sup>rd</sup> largest energy market globally, and accounts for 5.5% of global energy consumption



**Box 2.1. In Conversation: Impact of urbanisation on energy security**



**Vinay**



Hey Vinay, with great progress in Urbanization and industrialization, don't you think it brings its own set of challenges as well.



Absolutely, Vini. One major hurdle we face is the intermittent supply of electricity. It's high time we found a solution.



And you know what, Vinay, it's only going to get worse. As the demand rises, we should question if India can ensure a continuous supply of uninterrupted electricity.



That's a valid concern, Vini. In addition to this, we also need to address the lack of building codes in residential areas to improve efficiency.



Exactly! Enhancing our capacity requires understanding such shortcomings. But it's not just about fixing what's broken. We need to diversify our energy supplies too.



True, Vini. We're transitioning to green energy, particularly solar power. And let's not forget about coal-based plants and other initiatives. We need a multi-pronged approach to meet our future energy demands.



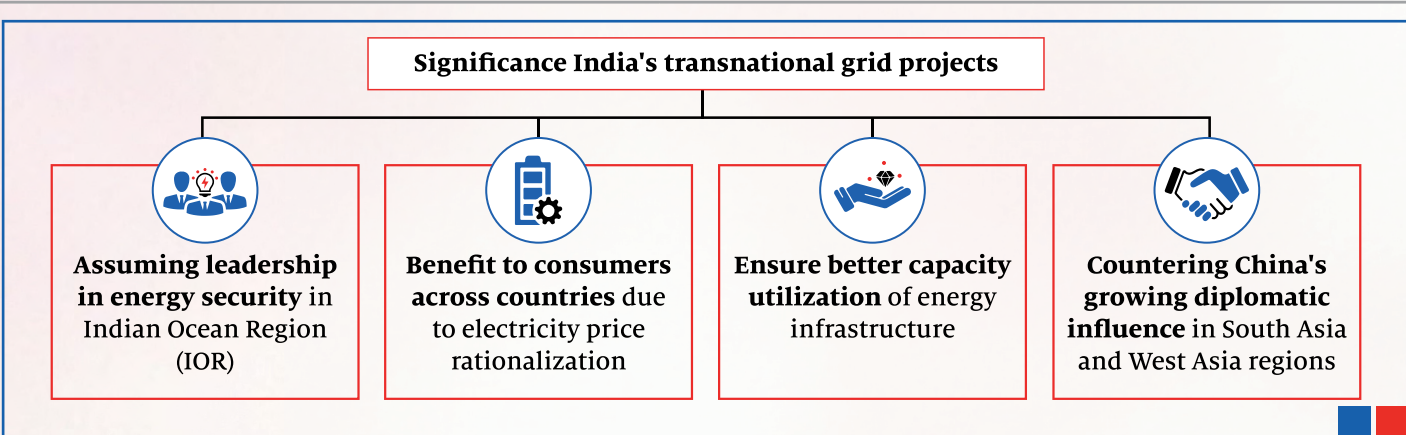
Absolutely! It's time to stimulate the 'good' demands while curbing the 'bad.' We must encourage responsible energy consumption while embracing alternative sources.



**Vini**

**Box 2.2. Transnational grid: India's leadership in securing regional and global energy security**

- ⚡ India aspires to build a trans-national grid to **enhance energy security**.
- ⚡ It already exports electricity to **Nepal, Bangladesh**, and **imports hydropower from Bhutan**.
- ⚡ An exchange at a small scale is also being done with **Myanmar** which would be **ramped up** with the implementation of **BIMSTEC Grid Interconnection**.
  - ◊ **BIMSTEC Grid Interconnection** will build a **3,000-kilometre-long power grid** mostly by way of interconnection of existing national or regional grid.
  - ◊ It will ensure **regional energy security among BIMSTEC members comprising** Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka, and Thailand.
- ⚡ The **"One Sun One World One Grid (OSOWOG)" initiative** connecting 140 nations is also a manifestation of **India's leadership in creating a global grid**.
  - ◊ **OSOWOG is led by India and the UK** in collaboration with the **International Solar Alliance (ISA)** and the **World Bank Group**.
  - ◊ It entails the **first international network of globally interconnected solar electricity grids**.



### 3. What are the key challenges in India's power sector?

#### 3.1 Challenges in power generation

Most of the power generation is from **old, inefficient coal-fired thermal power units**, while the **more efficient units** are **underutilised**.

- ⚡ **Power Purchasing Agreements (PPA):** The newer underutilised plants do not have long-term PPAs with the DISCOMs and/or established coal linkages, and therefore, despite being more efficient, these plants are not given due preference.
- ⚡ **Coal Sourcing Issues:** Mining for new coal reserves in India presents many hurdles, including **land acquisition, approvals and licenses** from multiple authorities.
  - ◊ **Coal logistics** also faces issues like a shortage of railway rakes, inefficient logistics, etc.
- ⚡ **Geopolitical instability:** The Russia-Ukraine conflict led to a rise in the price of coal in the international market from \$70 per tonne to more than \$421 per tonne. As a result, power plants **based on imported coal incurred huge losses**.
- ⚡ **Disruption of domestic coal supply:** India's domestic coal supply also declined due to the pandemic-induced **lockdown**.
  - ◊ **Heavy rains** also lead to disruptions in the transportation of coal and gas extraction.

#### 3.2 Challenges in transmission

- ⚡ **Financing:** For example, to achieve the **500GW target of RE** in the system by **2030**, the transmission sector requires investments of approximately **Rs 5 lakh crores**.
- ⚡ **Construction:** Remote or sensitive **terrain, Rights of Way, weather conditions**, etc., lead to huge challenges and delays in the construction of power transmission lines.
- ⚡ **Conflict with biodiversity conservation :** For example, **high-tension power lines** pose a threat of electrocution of the **Great Indian Bustard (GIB)** in some districts of **Rajasthan**.
  - ◊ The Supreme Court has mandated **all the powerlines in the habitat of the GIB to be laid underground** in the future.
- ⚡ **Loss and disruption due to overloading:** The transmission line has set capabilities; if these limitations are exceeded (higher loads during peak hours), the **heat load may grow**, potentially **causing damage**.
- ⚡ **Upgrading transmission line:** Earlier lines were laid as per requirement at that time. Now power transmission requirements have increased, and it is not always possible to lay lines along the same corridor.
- ⚡ **The threat of cyber-attacks:** Digitalization of the energy sector may lead to hackers infiltrating the systems of energy companies and **exposing thousands of households to a controlled blackout**.
- ⚡ **Pollution and climate change:** With time, metallic parts get rusted. Pollution adversely affects the infrastructure, including insulators.
  - ◊ **Flooding** can damage electrical equipment in the substation. **Heavy winds** are causing uprooting of poles and galloping of conductors.

### 3.3.Challenges in distribution

⚡ **Financial constraints of DISCOMS:** Most power DISCOMS incur losses every year. The total loss is estimated to be ₹ 90,000 crore in FY 2021.

⦿ As a result, DISCOMS are **unable to pay generators** on time which also **hampers** its ability to make **future investments** in infrastructure improvement.

⚡ **Cross subsidy:** Some categories of consumers, such as **commercial, industrial, etc., pay more than the cost of supply to cover the shortfall in revenue from other categories** of consumers, such as domestic, agriculture, etc.

⦿ The **Electricity Act 2003** has a **provision for**

**cross-subsidies** based on load factor, power factor, voltage, and total electricity consumption.

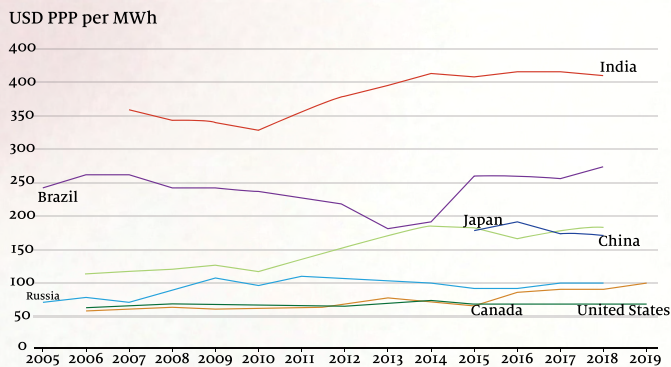
⦿ IEA data shows **India's electricity prices for industry are among the highest** in the world, based on purchasing power parity.

⦿ **Residential electricity prices are similarly high**, despite being subsidised, largely by industrial consumers.

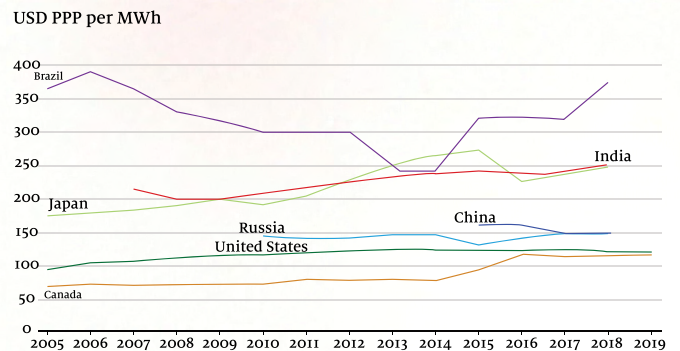
⚡ **Regulatory issues:** The power sector is a heavily regulated industry. **Companies cannot change prices**, even if input costs drastically increase, which makes their functioning financially unviable.

#### Box: 3.1. India's electricity price vis a viz price in other countries

**Industrial electricity prices in India and selected countries, 2005-2019**



**Residential electricity prices in India and selected countries, 2005-2019**



#### Box 3.2. How is renewable energy shaping India's energy mix?

⚡ India has **ramped up its renewable energy capacity by 250%** between **2014-2021**.

⦿ Today, **India is the world's third largest producer of renewable energy**, with 40% of its installed electricity capacity coming from non-fossil fuel sources.

⚡ Also, **its per capita CO2 emissions at 1.8 tonnes per capita are much lower than the US (14.7 tonnes) and China (7.6 tonnes)**.

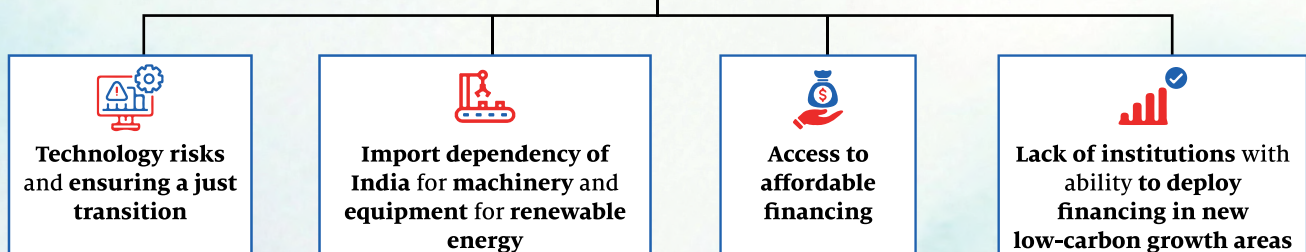
⚡ India has **progressively decoupled economic growth from greenhouse gas emissions**.

⦿ For example, the **Net Zero Emissions target by 2030 by Indian Railways alone will reduce emissions by 60 million tonnes annually**.

⚡ India has also launched the **National Hydrogen Mission (NHM) in 2021 to make India the world's hydrogen hub**.

⚡ **India has set a target to increase the share of gas in the energy mix up to 15% by 2030**.

#### Challenges in clean energy transition



## Initiatives taken

- ⚡ **Waiver of transmission system charges for inter-state solar and wind power sales**, establishing renewable power purchase obligations, and creating Ultra Mega Renewable Energy Parks.
- ⚡ **Innovative green energy trading platforms** such as the GTAM (Green Term Ahead Market) and GDAM (Green Day Ahead Market).
  - ◆ These platforms **enable renewable energy developers to sell power on the open market** without signing long-term Power Purchase Agreements.
- ⚡ India has spearheaded the **International Solar Alliance (ISA)**. The Alliance aims to efficiently utilise solar energy to reduce fossil fuel dependence, thereby creating a greener planet.

## Way ahead

- ⚡ **Creating a market for green grids fed with these fuels should be a priority.**
- ⚡ **Adoption of newer service models such as Microgrids:** The **decentralized energy systems** such as Microgrids, which can operate in 'island modes', will be able to **mitigate power disruptions** which will benefit millions.
- ⚡ **Digitalization** has also accelerated the adoption of innovative business models like **Energy as a Service (EaaS)**.
  - ◆ The growth of EaaS will bring a significant change in the energy landscape from **being centralized, predictable, and linear, to being distributed and multi-directional.**
- ⚡ Governments need to **design policy mechanisms and targeted programs to realize the social opportunities** of the transition including quality green jobs, and improvement of gender equality.
- ⚡ **Leverage innovation in lithium-ion batteries and battery recycling technology** to enhance energy storage capabilities and optimize renewable energy utilization.

## 4. What are the key initiatives taken to make India's power sector more productive and efficient?

### ⚡ Improving quality of services:

- ◆ **Electricity (Rights of Consumers) Amendment Rules, 2023**
  - ◆ **Introduction of Time of Day (ToD) Tariff:** Rather than being charged for electricity at same rate at all times of the day, **price for electricity will vary according to the time of day.**
  - ◆ **Facilitating smart metering:** Post installation of a smart meter, **no penal charges** will be imposed on a consumer based on **maximum demand recorded** by the smart meter **for the period before installation date.**
- ◆ **Financial incentives to states:** Allowing additional borrowing (0.25%- 0.5% of the GSDP) annually in lieu of reforms in the power sector.
- ◆ **Privatisation of Power Departments and utilities in Union Territories:** To provide better services to consumers with improvement in operational and financial efficiencies.

### ⚡ Initiatives to lessen the loss of DISCOMs:

- ◆ **Revamped Distribution Sector Scheme (RDSS):** Eligible DISCOMs are provided **result-linked**

**financial support** for the **upgradation** of the Distribution Infrastructure and Smart Metering Systems.

- ◆ **Liquidity infusion scheme:** Power Finance Corporation (PFC) Ltd. and Rural Electrification Corporation (REC) are extending special **long term transition loans up to 10 years to DISCOMs** to bridge the liquidity gaps.

### ⚡ Transition to Renewable Energy:

- ◆ **Guidelines for Tariff Based Competitive Bidding Process for Procurement of Power** from Grid Connected Wind Power Projects issued under Electricity Act, 2003.
- ◆ **Policy for Repowering of Wind Power Projects 2016** to promote the optimum utilisation of wind energy resources.
- ◆ **Waiver of Inter-State Transmission System charges** for the sale of **solar and wind power** from certain projects.
- ◆ Other initiatives like **International Solar Alliance, PM KUSUM, Green Energy Corridors**, etc.

**⚡ Electricity for all:**

- ◆ **Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY):** Launched in 2014 to provide continuous power supply to the entire rural India.
- ◆ **Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA):** Launched in 2017 to provide electricity connections to **all un-electrified households in rural areas** and **all poor households in urban areas.**
- ◆ **Integrated Power Development Scheme (IPDS):** For strengthening the **power sub-transmission and distribution networks in urban areas.**
- ◆ **North Eastern Region Power System Improvement Project (NERPSIP):** For strengthening of the Intra-State Transmission and Distribution Systems for 6 States (Assam, Manipur, Meghalaya, Mizoram, Tripura and Nagaland).

**⚡ Other initiatives:**

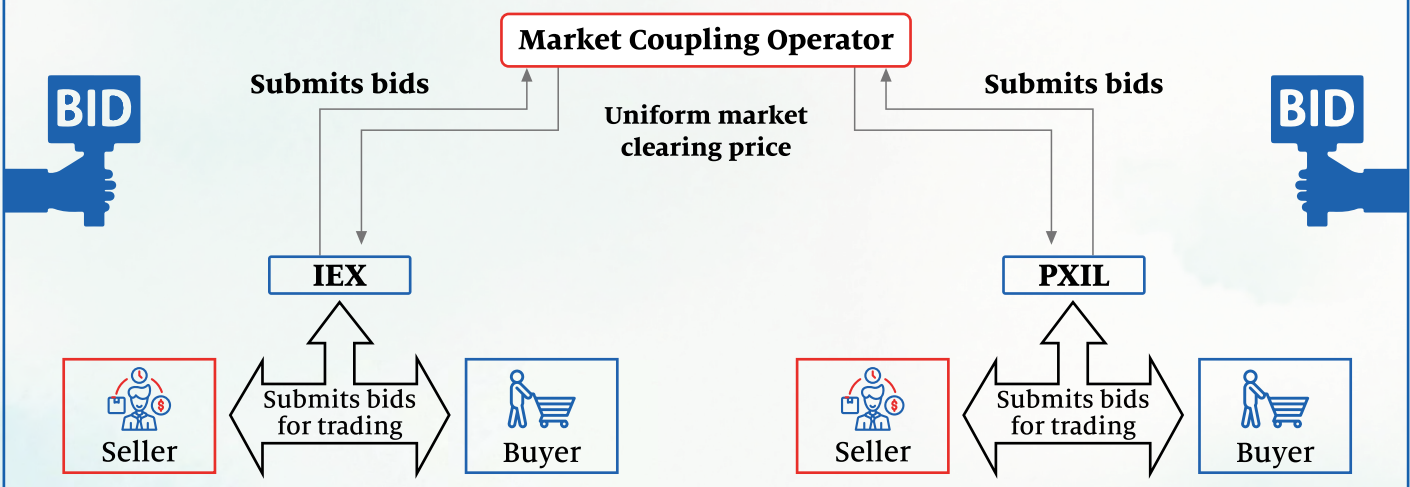
- ◆ **National Electricity Plan (NEP) for 2022-32:**

Launched by Central Electricity Authority (CEA), the NEP provides a detailed plan for 2022-27 and the **prospective plan for 2027-32.**

- ◆ **Mission on Advanced and High-Impact Research (MAHIR):** To facilitate **indigenous research, development and demonstration** of the latest and emerging technologies in the power sector.
- ◆ **Guidelines for Resource Adequacy Planning Framework for power procurement** by distribution licensees, ensuring a reliable operation of the power system across all timeframes.
- ◆ **PUSHp portal** (High Price Day Ahead Market and Surplus Power Portal) to ensure greater **availability of power during the peak demand season.**
  - ◇ It aggregates excess power generation capacity on a national basis, offering **DISCOMs a view of the supply and demand scenario.**
- ◆ **Market coupling of power exchanges** order by Ministry of Power to have uniform prices across multiple exchanges.

**BOX 4.1. Power trading and exchange in India**

- ⚡ An important role played by trading companies and power exchanges is **to balance the demand and supply of power.**
- ⚡ At present, India has **three power exchanges** - Indian Electricity Exchange (IEX), Power Exchange of India (PXIL) and Hindustan Power Exchange (HPX).
- ⚡ **Buyers and sellers at each exchange do trading** of electricity and discover spot prices separately at these exchanges.
- ⚡ However, recently the **Union Ministry of Power has directed the Central Electricity Regulatory Commission (CERC) to initiate the process of “market coupling” of power exchanges.**
  - ◆ Market coupling refers to the forming of a **single power trading entity owned by the government.**
  - ◆ Under it, **buy and sell bids from all power exchanges in the country will be aggregated and matched to discover a uniform power price** or market clearing price (MCP).





## 5. What needs to be done further to eliminate the shortcomings in India's power sector?

- ⚡ **Informed policy making:** India needs to **invest in long-term planning** and reassess how we manage the demand side of energy and invest in climate-resilient infrastructure.
  - ◊ **Improving energy efficiency not only at an industrial level but also at the household level.**
- ⚡ **Improve quality and quantity of fuel supply:**
  - ◊ Improve the **efficiency of existing mines** through **advanced technology**.
  - ◊ **Standardise coal quality (post-washing)** from all mines.
  - ◊ **Acquire stakes in the operational coking coal mines** in countries like **Russia, Canada, and Australia** that intend to phase out of coal-based power generation.
  - ◊ **Transition to a gas-based economy** to ensure reliability of fuel supply and **bridge delays in the renewable energy system deployment**.
- ⚡ **Efficient production and consumption**
  - ◊ **Setting up new power plants with supercritical and ultra-supercritical technology** instead of sub-critical technology.
    - ◊ It can help **increase the efficiency of the thermal power plant** from the earlier 36% to 42%.
  - ◊ Ensuring that the plants are equipped with the **variable frequency drive** so that the plant uses **less electricity while running on half-capacity mode**.
  - ◊ The **maintenance time and volume need to be cut down**.
- ⚡ **DISCOM reforms:**
  - ◊ **Increase private participation** while keeping infrastructure ownership with the state-owned DISCOMs, and giving **power supply licences to private players**.
    - ◊ For a state-owned utility, ensure a **clear separation between utility and state** through **Good corporate governance practices**, including the use of independent directors.
  - ◊ **Smart and prepaid metering** for reduction of unwanted consumption.
  - ◊ **Phase out cross-subsidy charges** levied on industrial consumers.
    - ◊ Also, the revised tariff must **incorporate the dynamic nature of various inputs**.
  - ◊ **Direct benefit transfer** in electricity subsidy.

## Conclusion

India is experiencing a **surge in power demand** owing to an expanding economy. **The goal of going green** might be a medium- to long-term strategy that **should be diligently pursued** to avoid future crises. **In the short term**, however, **the focus should be on making coal-based plants work efficiently**; power plants working on imported coal in India are crucial in this regard.

# TOPIC AT A GLANCE

## Power Sector Reform

⊕ Indian power sector value chain can be broadly segmented into **generation, transmission, and distribution.**



**Generation:** Installed power capacity is **417.66 GW** and **thermal power** is major contributor.



**Transmission:** **Power Grid Corporation of India Limited (PGCIL)** and State has State Transmission Utility and **private transmission companies**.



**Distribution:** DISCOMs are responsible for the **supply and distribution of energy to the consumers.**

## Challenges in India's power sector



### Generation

- ⊕ Most of the power plants are **old, inefficient coal-fired.**
- ⊕ **Newer underutilised plants** do not have long-term **PPAs with the DISCOMs** and/or established coal linkages.
- ⊕ **Difficulty in procurement of coal** due to Geopolitical instability and disruption of domestic coal supply.



### Transmission

- ⊕ Inadequate availability of **Financing.**
- ⊕ **Difficulties in construction and maintenance** due to rugged terrain, weather conditions, conflict with conservation of biodiversity, etc.
- ⊕ **Loss and disruption** of electricity due to overloading, the threat of **cyber-attacks.**



### Distribution

- ⊕ **Financial:** Total loss by DISCOMS in 2021 was around ₹ 90,000 crore.
- ⊕ **Cross subsidy:** Cross-subsidies are based on load factor, power factor, voltage, etc.
- ⊕ **Regulatory issues:** Companies cannot change prices, even if input costs drastically increase.

## Key initiatives taken to strengthen power sector

- ⊕ **Power for all:** Deen Dayal Upadhyaya Gram Jyoti Yojana, SAUBHAGYA scheme, Integrated Power Development Scheme (IPDS), North Eastern Region Power System Improvement Project (NERPSIP).
- ⊕ **Improving quality of services:** Electricity (Rights of Consumers) Amendment Rules, 2023, financial incentives to states for reforms in the power sector, etc.
- ⊕ **Initiatives to lessen the loss of DISCOMs:** Revamped Distribution Sector Scheme (RDSS), Liquidity infusion scheme.
- ⊕ **Transition to Renewable Energy:** Policy for Repowering of Wind Power Projects 2016, International Solar Alliance, PM KUSUM, Green Energy Corridors, etc.
- ⊕ **Other initiatives:** National Electricity Plan (NEP) for 2022-32, MAHIR scheme, PUSHp portal, Market coupling of power exchanges, etc

## Way Ahead

- ⊕ **Informed policy making:** Invest in long-term planning and climate-resilient infrastructure, improving energy efficiency not only at an industrial level but also at the household level.
- ⊕ **Improve fuel supply:** Transition to a gas-based economy, standardise coal quality post-washing.
- ⊕ **Efficient production and consumption:** New power plants with supercritical and ultra-supercritical technology, cut down the maintenance time and volume, etc.
- ⊕ **DISCOM reforms:** Increase private participation, smart and prepaid metering, phase out cross-subsidy charges, revise tariff and incorporate the dynamic nature of various inputs.

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