INDIA ENERGY FORUM

TOTAL ENERGY

Volume 19, Issue 9 December 2025

Shri Upendra Tripathy, Former Secretary, MNRE conferred with IEF Energy Service Award 2024

Impact of Geo Politics on Energy Security

R.V. Shahi

International relations on trade and business have experienced, during various periods, significantly different approaches. Prior to the emergence of globalization, commencing from early 80's of the last century, and then maturing till the first decade of the current century, the rules of international trade underwent substantial changes. It was felt that it would lead to balanced distribution of serving the interests of different countries. Role of international organisations such as United Nations and various Committees set up under its umbrella, provided a facilitating role to promote mutual understanding. Inter dependence in trade and business emerged as an important ingredient of economic growth of various countries. Over the years, this approach enabled and facilitated harnessing of resources, exporting and importing of goods and services, leading to enhancement of not only mutual interdependence but also maximization of international trade and business. This also facilitated global discussions on rationalizing the rule of business, discussions on tariff (Import Duty) deliberations and on climate change concerns etc. Industrial development processes followed in different countries were brought into focus to ensure balancing between industrial and GDP growth on the one hand and environmental sustainability on the other. Climate concerns deliberations under the COPE series of conferences focused on measures to radically reduce carbon emissions.

During last ten years, however, the energy security – in fact energy independence – has emerged as another dimension together with energy and economic development and environmental sustainability. During the same period, the approach and practices of globalization have been experiencing stresses and strains, and its intensity has been deepening. Geo politics, that is, the rules of games in diplomatic relations have been changing rapidly and unpredictably. In the recent past, this has further intensified in terms of the tariff declarations and discussions between USA and several other countries including India. The whole gamut of international trade and concept of mutual dependence through conduct of trade and business has become completely unpredictable, and for India, in many cases, unworkable. The uncertainties definitely have led to reduced volume of international trade and re-arrangement of these transactions between and among various countries.

Energy security for India, in the light of changing geo political situation does assume a challenging task. The country has to see how it plans its energy growth which is vital for its economic growth ensuring the best possible arrangement of mutual interdependence from the geo political point of view. The country has also to seriously look into how best its dependence to secure availability of energy is less dependent, ideally not dependent at all, on other countries. As a matter of fact, this task is relevant for many other commodities, which will also require restructuring of trade with other countries. What makes energy distinctly different is the intensity of impact which an unpredictable situation will create on all economic activities when the security of it availability gets into question. It is in this context that, while talking of India, various important international organisations and Government authorities have given their perspectives. With a view to having a proper appreciation of the challenge arising out of import, and the impact of uncertainty of availability and unpredictability of cost, the top ten most imported products in India is given below:

Top 10 Most Imported Products in India (2025)

By the year 2025, the Indian import basket is saturated with essential commodities and high-demand goods that serve industries, energize homes, and satisfy many daily needs.

1) Petroleum Fuels and Oils

- **Import Value and Share:** Approximately US$220.6 billion, accounting for 31.4% of total imports.

- **Primary Sources:** Russia, Iraq, Saudi Arabia, and the United Arab Emirates.

Usage in India: Important in energy production, transportation, and industrial activities.

2) Electrical Machinery and Equipment

- **Import Value and Share:** Around US$84.9 billion, representing 12.1% of total imports.
- **Key Components Imported:** Integrated circuits, smartphones, solar panels, and other electronic devices.
- **Major Exporting Countries:** China, Vietnam, and South Korea.

3) Gems and Precious Metals

- **Import Value and Share:** Approximately US$83.3 billion, making up 11.9% of total imports.
- **Cultural and Economic Significance:** Vital for India's jewelry industry and cultural practices, especially during festivals and weddings.
- **Primary Sources:** Switzerland, the United Arab Emirates, and South Africa.

4) Machinery Including Computers

- **Import Value and Share:** About US$61.6 billion, accounting for 8.8% of total imports.
- **Types of Machinery Imported:** Industrial machines, agricultural equipment, and IT hardware.
- **Leading Exporters:** Germany, the United States, and Japan.

5) Organic Chemicals

- **Import Value and Share:** Approximately US$26 billion, representing 3.7% of total imports.
- **Applications in India:** Used extensively in the pharmaceutical, agricultural, and manufacturing sectors.
- **Top Exporting Countries:** China, the United States, and Singapore.

6) Plastics and Plastic Articles

- **Import Value and Share:** Around US$21.9 billion, making up 3.1% of total imports.
- **Types of Plastics Imported:** Polyethylene, PVC, and other polymers.
- **Usage in Indian Industries:** Widely used in packaging, construction, and consumer goods.
- **Major Exporters:** China, Germany, and the United States.

7) Iron and Steel

- **Import Value and Share:** Approximately US$17.7 billion, accounting for 2.5% of total imports.
- **Demand Drivers:** Essential for infrastructure development and the automotive industry.
- **Primary Sources:** South Korea, China, and Japan.

8) Animal and Vegetable Fats & Oils

- **Import Value and Share:** Around US$17 billion, representing 2.4% of total imports.
- **Types of Oils Imported:** Palm oil, soybean oil, and sunflower oil.
- **Usage in India:** Crucial for the food industry and household consumption.
- **Leading Exporters:** Indonesia, Malaysia, and Ukraine.

9) Optical, Technical, and Medical Apparatus

- **Import Value and Share:** Approximately US$13.7 billion, making up 1.9% of total imports.
- **Types of Equipment Imported:** Diagnostic tools, surgical instruments, and laboratory devices.
- **Applications in India:** Used extensively in healthcare and research sectors.
- **Top Exporting Countries:** Germany, the United States, and Japan.

10) Aircraft and Spacecraft

- **Import Value and Share:** Around US$12.6 billion, accounting for 1.8% of total imports.
- **Importance for India:** Supports the country's defense and aviation sectors, contributing to technological advancements.
- **Major Exporters:** The United States, France, and Russia.

Top Countries from Which India Imports the Most (2025)

In 2025, the picture of India's imports is shaped by the various realities of the country's trading relationships with several nations that supply its most important imports. The following table illustrates the top 10 countries from which India imports goods, along with the respective import values:

Rank	Top Countries India Imports From	India Import Value (Approx.)
1	China	$121 billion
2	Russia	$67 billion
3	United States	$42 billion
4	United Arab Emirates	$37 billion
5	Saudi Arabia	$34 billion
6	Iraq	$29 billion
7	Indonesia	$24 billion
8	South Korea	$19.6 billion
9	Japan	$18.7 billion
10	Switzerland	$18.5 billion

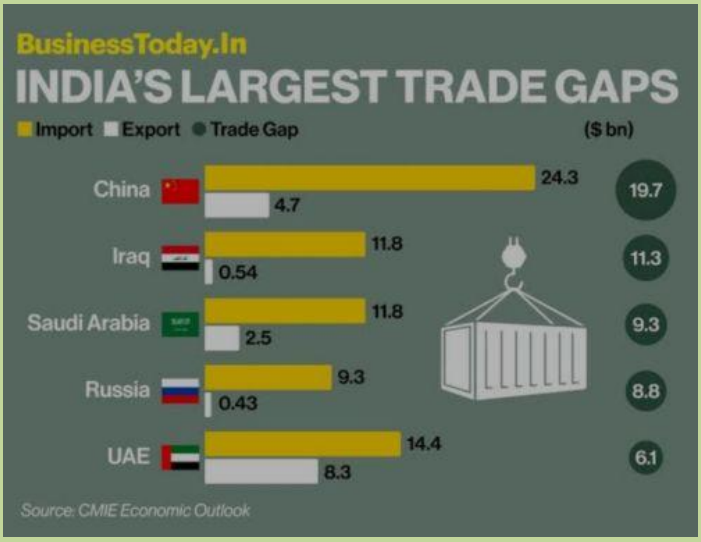
Conclusion

India's import market is increasing in both size and complexity, opening new opportunities for businesses across various sectors. For importers operating in this ever-changing environment, access to reliable trade data is not just helpful, it is essential. Whether you are monitoring high-demand products or searching for new suppliers, having accurate, real-time reports makes all the difference.

Dataverseeinc is a global import-export data provider. This platform offers specific Indian import/ export data tailored to needs, helping both experienced importers and new businesses discover fresh opportunities.

It may be seen from the above list that petroleum sector constitutes more than 31% of the import amounting to US $ 220.6 Billion. Obviously, the issue of energy security is most vital and alternate options need to be explored to minimize it to the extent possible. An idea of the impact of geo political dynamics can also be appreciated from the chart given below:

Another aspect of appreciating the impact of geo politics on economic activities and energy security may also be better understood by the following Chart.



It is considered important to analyse the comments and forecasts about impacts of geo political dimensions of a few important international and national organisations. The International Energy Agency, World Bank, and S&P have commented on this issue as given below:

Executive summary IEA

In a volatile world, energy security takes centre stage **Pressing threats and longer-term hazards are elevating energy to a core issue of economic and national security.**

Energy is at the heart of today's geopolitical tensions, with traditional risks to fuel supply now accompanied by restrictions affecting supplies of critical minerals. The electricity sector – so essential to modern economies – is also increasingly vulnerable to cyber, operational and weather-related hazards.

Decisions taken by energy policy makers will be crucial to address these risks, but they do so against a complex backdrop:

- **Geopolitical fragility coexists with subdued oil prices**. Ongoing conflicts and instability sit alongside oil market balances showing a large surplus of supply over demand.

- **Countries are prioritising energy security and affordability but are reaching for different levers to achieve them**. Some, including many fuel-importing countries, lean towards renewables and efficiency as solutions. Others focus more on ensuring ample supplies of traditional fuels.

- **There are fractures in the international system and uncertainties over the outlook for trade, but energy trade is more important than ever.** Abundant supplies of oil, solar panels, batteries and, before long, liquefied natural gas (LNG) create strong incentives for producers to seek out international markets.

- **There is less momentum than before behind national and international efforts to reduce emissions, yet climate risks are rising**. 2024 was the hottest year on record and the first in which global temperatures exceeded 1.5 degrees Celsius (°C) above pre-industrial levels.

RBI talks about geopolitical ripple effects on Indian economy

In recent years, geopolitical tensions have emerged as a significant global concern, profoundly influencing economies worldwide. Geopolitics plays a pivotal role in shaping trade policies, currency fluctuations, supply chains, investment flows, resource accessibility, and technological advancements. The global economic landscape is undergoing a transformative shift, marked by increasing protectionism, restrictions on technology transfers, the formation of geopolitical blocs, de-globalisation, and a resurgence of mercantilism (accumulating wealth through trade surpluses).

India is no exception to the influence of geopolitics. The Indian economy, deeply integrated into the global ecosystem, is particularly vulnerable to fluctuations in the geopolitical environment. For instance, the appreciation of the US dollar often triggers capital outflows, while tariff hikes adversely impact export performance. To mitigate these risks and understand their implications, it is essential to measure and analyse the impact of geopolitical tensions on the economy.

Understanding India's Geopolitical Risk Index (GPRI)

The Reserve Bank of India's (RBI) recent bulletin, titled *"Geopolitical Risk and Trade and Capital Flows to India"*, examines the influence of geopolitical tensions on India through the Geopolitical Risk Index (GPRI). This bulletin, authored by former RBI Deputy Governor Michael Patra alongside researchers Harshita Keshan, Sheshadri Banerjee, and Harendra Kumar Behara, uses geopolitical news events to assess India's domestic and global response to such risks.

Historical data highlights spikes in India's GPRI during events such as the Kargil War (1999), the Kashmir insurgency (1990), the Gujarat riots (2002), and the Mumbai attacks (2008). Notably, a strong correlation between India's GPRI and the global GPRI has been observed since 2014, indicating India's increasing connectivity to global geopolitical dynamics.

Economic impact of high GPRI

A heightened GPRI negatively affects India's economy, leading to:

- **Currency depreciation**: A depreciating rupee as foreign investors convert rupees into dollars to mitigate risk exposure.
- **Decline in capital inflows**: Reduced foreign investment as geopolitical risks make India a less attractive destination.
- **Trade disruptions**: Contraction in trade volumes and adverse shifts in trade terms due to higher costs and disrupted supply chains.

Increased geopolitical tensions also lead to rearranged trade routes, inefficient resource allocation, and higher export prices, which collectively diminish export competitiveness. The recovery of capital flows tends to be quicker compared to trade, which usually requires 6–7 quarters to rebound fully.

Quantitatively, a one standard deviation rise in domestic GPRI results in a 0.2 percentage point decline in capital flows and a 0.9 percentage point reduction in trade volumes. Similarly, global GPRI has a more pronounced impact, with a one standard deviation rise causing a 0.3 percentage point decline in capital flows and a 1.0 percentage point contraction in trade volumes.

Characteristics of geopolitical risks

Unlike conventional economic risks, geopolitical risks are persistent, long-lasting, and harder to mitigate. Domestic geopolitical risks undermine India's export competitiveness and disrupt supply chains, while global risks hinder capital flows and trade levels due to stricter policies and cautious foreign investment strategies.

Strategies to address GPRI

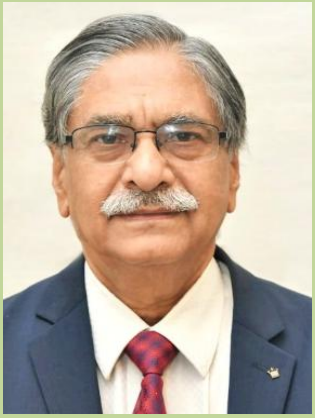
To counter the impact of geopolitical risks, India must adopt a multifaceted approach:

- **Trade diversification**: Reducing dependence on a few trade partners by expanding trade sources.
- **Bilateral and multilateral agreements**: Strengthening trade relations through bilateral swap agreements and partnerships with institutions like the World Bank and IMF.
- **Infrastructure development**: Enhancing domestic infrastructure to ensure efficient and secure trade.
- **Financial buffers**: Creating robust financial safeguards to cushion the economy against geopolitical shocks.

By fostering diversified trade partnerships, improving infrastructure, and adopting precautionary measures, India can build resilience against rising geopolitical challenges and secure its economic stability amidst global uncertainties.

****

Dear Reader,



The December 2025 issue of Total Energy is with you now.

The much-awaited initiative of the Govt. in opening up the Nuclear Energy Sector to private sector finally has been taken with the passage of SHANTI (Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India) Bill by Parliament. It is expected to boost the utilisation of nuclear energy for base load power generation and will help in fulfilling the vision of 100 GW BY 2047. While 700 MW PHWR will continue to be the workhorse of nuclear power generation, the initiative will open foreign investment and new technologies specially in the small reactor segment. Meanwhile BARC's development work for 55MW SMRs and small 5MW HT gas cooled reactors is nearing completion and should help in meeting local, concentrated demands of power NIAS has already, thru an extensive survey, identified 38 new sites where nuclear power plants / SMRs can be installed. Safety concerns will remain and need to be addressed continuously. AERB- Atomic Energy Regulatory Board- status has been elevated to that of a Statuary Body enhancing its credibility and role.

There is no doubt, that the world is seeing renewed interest in Nuclear Power to meet ever increasing demand. Japan has recently announced its move to reactivate all existing NPPs, that were closed post Fukushima accident. It will help Japan in meeting 20% of its energy needs. India with 100 GW nuclear power generation will be meeting less than 5% of its requirement from nuclear energy sources

The new green energy revolution presents a unique opportunity for India and its entrepreneurs to accelerate economic growth, employment opportunities and clean environment for a more prosperous and vibrant India of the future. However, it offers challenges for appropriate and balanced energy mix with adequate storage capacity. Balancing the grid in an energy mix dominated by RE is a challenge with which the energy professionals are faced. These issues were the theme of the 24th Power Conference of IEF held in New Delhi on 23rd Dec 2025. Enclosed report in this issue of TE, gives brief report of the proceedings of the Conference. Detail report of the Proceedings and Recommendations of the Conference will be published in the next issue.

IEF will be holding its annual AGM on 17th Jan 2026 in IIC. All IEF members are invited to attend and give suggestions on future initiatives for IEF. We will continue debating the Energy Issues thru our Webinars, Energy Debates and Conferences.

Total Energy wishes all IEF members and their families a Very Happy, Healthy and Prosperous 2026.

S M Mahajan

India's commercial and industrial developers estimated to supply up to 80 GW renewable energy by 2030: MNRE Secretary

By 2030, India expects nearly 60-80 GW of renewable energy (RE) to come from commercial and industrial (C&I) developers, marking a major shift in how clean power grows in the country, said Santosh Kumar Sarangi, Secretary in the Ministry of New and Renewable Energy recently.

Speaking at the India Edge Event held by CII, Sarangi said, "RE through C&I installation trend is also seen. By 2030, we estimate around 60-80 GW of RE would be provided by the developers of C&I."

The Secretary noted that the developers in this segment would play a major part in meeting India's clean energy needs by 2030. He added that rooftop solar panels are also spreading in many regions, and this trend will continue in the coming years.

Sarangi said that states such as Madhya Pradesh and Gujarat are showing strong progress. He said Madhya Pradesh "is one of the progressive states in terms of Renewable Energy," adding that many states are now bringing out tenders that match their own needs. He explained that a clear pattern is emerging in which more states choose renewable paths that work for them.

He said the growth of renewable energy is now moving at a pace that will only get faster. He explained that India's electricity demand is set to rise quickly and, with that, the demand for renewable power will also rise. As states float more tenders, their role in supporting this shift will become more important.

Sarangi pointed out that some challenges remain, especially with integrating renewable energy into the grid. He said that solving these issues needs immediate attention.

According to him, adding battery systems to the transmission network and increasing storage capacity will be necessary steps.

On energy security, he said the country must ensure strong supply chains while also expanding storage. He highlighted that Indian companies should use the benefits available under the Production-Linked Incentive scheme to grow further in this field. He noted that India's solar module manufacturing capacity has reached nearly 140 GW.

Sarangi also mentioned the changing cost of grey ammonia, which has risen from 450 to 550 USD, partly because of the fall in the value of the rupee. He said the government is pushing many ports to set up bunkering facilities using Green Hydrogen Mission funds. These steps, he explained, will help build the country's green hydrogen production ecosystem.

He said the MNRE is working closely with the Central Transmission Utility, Central Electricity Authority, Ministry of Power and the power regulator. As per Sarangi, the ministry has strong engagement with industry, holding monthly meetings with the solar, wind and other sectors to support smooth renewable energy production.

Record 44.5 GW renewable energy capacity added till Nov this year: MNRE

नवीन एवं नवीकरणीय ऊर्जा मंत्रालय
MINISTRY OF NEW AND RENEWABLE ENERGY
सत्यमेव जयते

The country added a record 44.5 gigawatt of renewable energy capacity, including 35 GW from solar, till November this year, an official statement said recently. The total renewable energy installed capacity reached 253.96 GW in November 2025, registering an increase of over 23 per cent as compared to 205.52 GW a year ago, the statement from Ministry of New and Renewable Energy (MNRE) said.

The highest-ever renewable energy capacity addition has been made during 2025. The total renewable energy capacity added during the year (till November) is 44.51 GW, nearly double as compared to 24.72 GW during the same period last year.

Solar is the major contributor in this progress. Solar capacity addition is 34.98 GW as compared to 20.85 GW during the same period last year.

The overall solar energy installed capacity reached 132.85 GW in November 2025, registering an increase of over 41 per cent as compared to 94.17 GW in November 2024.

Wind capacity also registered a substantial growth with capacity addition of 5.82 GW compared to 3.2 GW during the same period last year. Wind energy installed capacity crossed 50 GW mark in March 2025. The wind energy installed capacity reached 53.99 GW in November 2025, which is an increase of over 12.5 per cent as compared to 47.96 GW in November 2024.

Meanwhile, in a post on X, Pralhad Joshi, Minister for New and Renewable Energy said the rooftop installations under PM Surya Ghar Muft Bijli Yojana has crossed the 25-lakh household mark.

"Guided by the visionary leadership of Hon'ble PM Shri @narendramodi ji, 25 lakh households are now empowered with rooftop solar under the @PMSuryaGhar Muft Bijli Yojana, bringing cleaner power, lower bills and a sustainable future to millions of families," he said.

India to become fastest-growing renewable energy market by 2030: WEF

India is set to record the fastest expansion in renewable electricity capacity and generation globally, according to a new World Economic Forum (WEF) report that values the global green economy at more than $5 trillion and forecasts it will cross $7 trillion by 2030.

The report, 'Already a Multi-Trillion-Dollar Market: A CEO Guide to Growth in the Green Economy', produced by the WEF in partnership with Boston Consulting Group (BCG), said the green economy sector has grown at a pace second only to technology over the past decade. It also stated that investment in clean technologies continues to break records despite global economic uncertainty.

Why is India set for the fastest renewable growth through 2030?
Between 2024 and 2030, India is projected to post annual growth of 16 per cent in renewable electricity capacity, ahead of China at 15 per cent. Renewable generation is also expected to grow fastest in India, at 13 per cent per year, compared with China's 12 per cent and a global average of 9 per cent.

How do India and China compare on clean-energy investment?
At $81 billion and $659 billion, respectively, India and China have increased their annual investment in clean energy at a rate of about 12 per cent between 2019 and 2024. The report also highlights that China spends more than any other region or country on clean energy investment.

What policy measures are supporting India's renewables push?
The WEF said India's policy push, including production-linked incentive schemes for solar modules, advanced batteries and low-carbon hydrogen, is designed to cut import dependence and build domestic manufacturing strength. The report said these measures are expected to help India double its solar capacity by 2030.

What do the latest government numbers say about renewables?
According to government data from October, India achieved the milestone of generating over half (256.09 GW) of its total energy capacity (500.89 GW) through renewable resources.

Which Indian company is featured in the WEF case studies?
The study features 14 case studies, among them Indian renewable energy company ReNew. The firm has built a diversified portfolio of more than 28 gigawatts (GW) across wind, solar, storage and emerging green fuels.

What did ReNew's Sumant Sinha say about India's strategy?
ReNew chairperson and chief executive officer Sumant Sinha said: "We are rich in renewable energy resources, so the more energy we produce domestically, and the more equipment we

manufacture to enable that, the safer and more resilient we become in the current context."

"India is thus increasingly focused on tapping all available local resources. That's why the government continues to advance low-carbon solutions like green hydrogen and green ammonia to reduce import dependence and enhance strategic autonomy," he added.

What does the WEF say about growth and valuations in green markets?

According to the WEF, companies deriving a substantial share of revenue from green markets typically grow twice as fast as conventional business lines. They also tend to face lower capital costs. Firms earning more than half their revenue from green activities frequently secure valuation premiums of 12-15 per cent, reflecting investor confidence in their long-term prospects.

Govt plans major ALMM overhaul with higher solar module efficiency norms from 2027

In a move that could reshape India's solar manufacturing landscape, the Ministry of New and Renewable Energy (MNRE) has proposed significantly higher efficiency thresholds for enlistment of solar PV modules in the Approved List of Models and Manufacturers (ALMM) from January 1, 2027, with further tightening from January 1, 2028. The proposal, released for public consultation on November 28, calls for a full revision of benchmarks across all categories of modules, including utility-scale, rooftop, off-grid and DRE applications.

The new framework will increase minimum efficiency requirements by 1 percentage point or more in 2027 and by an additional 0.5 percentage point in 2028. Officials said the objective is to ensure that ALMM reflects "commercially available high-efficiency modules" and that outdated, low-performing technologies are phased out of the domestic market.

Sharp efficiency jump across categories
Utility-scale crystalline silicon (c-Si) modules, which currently require around 20 per cent efficiency, will need 21 per cent from 2027 and 21.5 per cent from 2028 to remain in the approved list. For CdTe thinfilm modules, the threshold will rise from 19 per cent to 20 per cent in 2027 and 20.5 per cent in 2028. Rooftop and solar pumping categories will see minimum efficiency climb from 19.5 per cent to 20.5 per cent in 2027 and 21 per cent in 2028, while off-grid modules below 200 Wp will face a hike from 18 per cent to 19 per cent in 2027 and 19.5 per cent in 2028.

The ministry emphasises that these benchmarks apply uniformly across manufacturers and technology types.

Low-efficiency models to be removed from ALMM

The draft makes it clear that modules already included in ALMM but failing to meet the revised benchmarks after the effective date will be removed from List-I. "Modules … having efficiencies below the revised module efficiency thresholds … will be removed from the ALMM List-I once the new module efficiency thresholds become effective," MNRE states.

This marks one of the most consequential revisions of ALMM norms since its introduction, pushing manufacturers to upgrade cell technologies, improve production lines and accelerate the shift to higherefficiency architectures.

Industry executives say such thresholds will require rapid scaling of TOPCon, HJT and future cell technologies to remain compliant.

Stakeholder consultation open until December 27
MNRE has invited comments, technical inputs and objections from manufacturers, developers, testing agencies and state utilities by December 27, 2025. The final notification will follow after the ministry reviews submissions.

The draft order aligns the ALMM framework with global trends where key markets have moved to nearTOPCon-level efficiency standards. Policymakers said the updated benchmarks will also help ensure more consistent performance in government solar tenders, rooftop schemes and open-access projects.

Why the shift matters now
With India targeting 500 GW of non-fossil capacity by 2030, higher-efficiency modules directly impact land use, transmission design, project costs and long-term energy yield. Raising the minimum efficiency bar is intended to:

1. Increase output per panel
2. Improve system performance across utility and rooftop segments
3. Reduce project footprint
4. Prepare the domestic industry for export competitiveness

The ministry says the updated norms will create a “forward-looking, performance-oriented” list that matches India’s fast-advancing solar manufacturing ecosystem.

NTPC Green Energy Reaches 8,010 MW Milestone with New Solar Addition

NTPC Green Energy Limited (NGEL), the renewable energy arm of India's biggest power producer, has just hit a major goal. The company successfully started a new part of its massive solar project in Gujarat, making its green energy portfolio bigger than ever.

The Big News: Breaking the 8,000 MW Barrier
NTPC has added 13.98 MW of solar power to its project in Khavda, Gujarat. While 14 MW might sound small, it was the final piece needed to push the entire group's total capacity past a massive milestone.

Before this update, the group's capacity was 7,996.30 MW. With this new addition, the total installed capacity has officially reached 8,010.28 MW. This confirms NTPC's position as a leader in India’s race toward clean and green energy.

Project Details: The Khavda Solar Park
This new power comes from the Khavda-I Solar PV Project. It is a giant solar farm being built in the Kutch region of Gujarat. Here are the simple facts:

Location: Khavda, Gujarat (known for having some of the best sunlight in India).
Developer: The project is run by NTPC Renewable Energy Limited (a subsidiary of NGEL).
The Plan: This is part of a much larger 1,255 MW project being opened in small stages.
Official Start: The power started flowing into the grid at midnight on December 30, 2025.

Why This Matters for India
This project is part of a government scheme (CPSU Phase-II) that encourages using Indian-made solar equipment. By reaching 8,000 MW, NTPC is proving that India can build massive green infrastructure quickly.

e-Magazine Access
The parent company, NTPC, has an even bigger dream: they want to reach 60,000 MW (60 GW) of renewable energy by the year 2032. Today's update is a successful step toward that green future.

Government Buildings Achieve 1,825 MW Rooftop Solar Capacity Across 91,574 Installations

Over 1,825.62 MW of rooftop solar capacity has been installed on 91,574 government buildings across various Central ministries and states/UTs in India. The Ministry of New and Renewable Energy has urged states/UTs to utilize vacant rooftops for solar panel installation, part of the PM Surya Ghar Muft Bijli Yojana initiative.

Notably, no Central Financial Assistance (CFA) is provided for government buildings due to their financial viability in this regard. In contrast, individual households can receive CFA up to Rs 30,000 per kWp for the first 2 kWp and Rs 18,000 for additional capacity.

There are no plans to increase CFA further under the scheme. Through these initiatives, India aims to promote energy justice and empower marginalized communities.

CERC Issues Draft Tariff Framework for Integrated Energy Storage Systems in India

The Central Electricity Regulatory Commission has released a draft notification dated 1 December 2025 proposing a second amendment to the Terms and Conditions of Tariff Regulations, 2024. The draft focuses on introducing a comprehensive framework for the treatment of integrated energy storage systems within existing generating stations and transmission systems in India. The proposed changes have been issued under the powers granted to the Commission under Sections 178 and 61 of the Electricity Act, 2003. According to the draft, the amendments will take effect from the date of publication in the Official Gazette, except for the changes to Regulations 51 and 52, which will apply retrospectively from 1 April 2024.

A major feature of the draft is the introduction of detailed definitions and operational norms for the functioning of integrated energy storage systems. These include terms related to battery cells, state of charge, round-trip efficiency, auxiliary consumption, and plant availability factor. New regulatory terms, such as declared capacity of energy storage systems and maximum continuous rating, have also been added. These definitions aim to give clarity on how energy storage assets will be treated for tariff determination and how they will operate within the power grid. The Commission aims to create a transparent and structured approach for integrating storage systems into the energy sector.

The draft mandates that generating companies and transmission licensees installing integrated energy storage systems must apply for supplementary tariff determination within 30 days of the commercial operation date. The supplementary tariff will be calculated separately and include components for fixed storage charges and energy charges. The framework provides formulas for computing annual fixed cost, return on equity, depreciation, and working capital requirements related to storage assets. It also explains how supplementary energy charges will be calculated depending on the source of electricity used to charge the storage system, whether from the associated generating station, another generating station, the grid, or the open market.

To ensure performance accountability, the draft introduces clear norms for operation. The normative availability factor is proposed at 90 percent, round-trip efficiency at 85 percent, and auxiliary consumption at 5 percent. It also proposes an incentive of 25 paise per kilowatt-hour for energy discharged beyond the level corresponding to normative round-trip efficiency. Beneficiaries will have the first right to discharge stored energy, except in situations where grid safety considerations require different actions. Procedures for scheduling, dispatch, and energy accounting will be prepared by Regional Power Committees to ensure standardized operations across the system.
The draft also includes guidelines for additional capitalization related to energy storage assets. Companies will be required to justify technology selection, cost-benefit analysis, phased expenditure, and impact on consumer tariffs before approval. Approved expenditure will be included in the supplementary tariff computation after prudence checks. For transmission systems, special conditions address grid reliability, transmission deferral benefits, and using storage assets for other business applications.

The Commission has also amended tariff filing forms to include detailed technical information such as battery rack and module numbers, C-rate, cycle life, response time, and information on energy management systems. This will help ensure transparency and accurate tariff assessment. A special regulatory sandbox provision has been included, allowing innovation and research projects with extra cost support of up to 0.5 percent of annual fixed cost or ₹100 crore. These extensive revisions mark an important step toward mainstreaming energy storage in India’s regulatory and tariff framework.

SJVN Invites Bids for 250 MW/500 MWh BESS under VGF Scheme in Haryana

SJVN Limited has issued a Request for Selection (RfS) for setting up 250 MW/500 MWh standalone Battery Energy Storage Systems (BESS) in the state of Haryana under the Viability Gap Funding (VGF) scheme, supported through the Power System Development Fund (PSDF). The tender aims to accelerate storage capacity development to strengthen renewable energy integration and ensure grid flexibility.

The project will be executed through Tariff-Based Competitive Bidding (TBCB), where selected Battery Energy Storage Developers (BESSDs) will sign a long-term Battery Energy Storage Purchase Agreement (BESPA) with SJVN. The scheme includes financial support through VGF, which will be released in multiple tranches upon achieving project milestones. As per the document, the VGF disbursement structure includes 20% of the amount at the time of Financial Closure, 50% at Commercial Operation Date (COD), and the remaining 30% after completion of one year of successful operation.

To participate in bidding, developers must submit an Earnest Money Deposit (EMD) in the form of a Bank Guarantee. The EMD amount has been set at INR 2,40,000 per MWh of the bid capacity.

This amount ensures the seriousness of participation and will be returned after the reverse auction process to the unsuccessful bidders within 15 days. For successful bidders, the EMD will be returned once the Performance Bank Guarantee (PBG) is submitted and verified by SJVN.

The Performance Bank Guarantee requirement is fixed at INR 6,00,000 per MWh of the contracted capacity, to be submitted before signing the BESPA.

The PBG must remain valid up to nine months after the Scheduled Commencement of Supply Date (SCSD), and will be released within 45 days after successful commissioning of the project, subject to performance conditions. Developers also have alternative options to submit a Payment on Order Instrument (POI) from institutions like IREDA, PFC, or REC, or an Insurance Surety Bond instead of a traditional bank guarantee.

In case of delay or failure to commission the project, the PBG can be encashed, and the project may be cancelled. If the BESPA is not signed within the stipulated timeline after the offer, the entire EMD amount may be forfeited.

The project emphasizes system availability and performance, with strict penalties for non-compliance related to minimum energy output and round-trip efficiency. The agreement also specifies recovery of VGF in case of termination or reduced capacity.

This tender marks a significant step toward large-scale energy storage deployment in Haryana, which is expected to improve renewable power reliability and support India’s clean energy objectives.

Government Notifies Colliery Control (Amendment) Rules, 2025 to Simplify Approval Process for Opening Coal Mines - Empowers Board of Coal Companies to Approve the Opening of Mine, Seam or Section of a Seam

कोयला मंत्रालय
Ministry of Coal
सत्यमेव जयते

In a major effort to enhance ease of doing and to make the coal sector more business-friendly, the Government has amended the provisions governing approval for opening coal and lignite mines under the Colliery Control Rules, 2004. The amendment removes procedural redundancies and enables faster operationalisation of mines, while ensuring continued regulatory oversight.

As per earlier provisions of Rule (9) of the Colliery Control Rules, 2004, a coal/ lignite mine owner was required to obtain prior permission from the Coal Controller's Organisation (CCO) for opening a coal mine as well as for opening individual seams or sections of a seam. Permission of CCO was also required for starting a coal/ lignite mine if a mine was not operational for a period of 180 days or more.

To eliminate procedural redundancies, accelerate coal production, and improve efficiency in the approval process, the requirement of obtaining prior opening permission from the CCO has now been dispensed with through amendment of Rule 9 of the Colliery Control Rules, 2004 The Notification amending this Rule has been issued on 23.12.2025 and the details of this notification on Colliery Control (Amendment) Rules, 2025 may be seen at weblink https://coal.nic.in/sites/default/files/2025-12/26-12-2025a-wn.pdf or at https:// egazette.gov.in/ WriteReadData/2025/268804.pdf

Under the amended provisions, the authority to approve mine/ seam opening permission has now been entrusted/ vested with the board of concerned coal company. This reform would streamline the approval process, while ensuring that compliance responsibility remains firmly with the company's highest decision-making authority. This reform is expected to reduce upto 2 months in operationalization of mine.

As safeguard, it has been provided that (a) the Board of the concerned coal company can approve mine/ seam opening after the requisite approvals from Central/ State Government and statutory bodies has been obtained, (b) the company has to submit information about mine opening to CCO, and (c) for entities other than companies, such approval will continue to be through CCO.

The overall reform strikes a balanced approach by delegating operational decisions to company Boards while retaining regulatory oversight and statutory safeguards. By reducing approval timelines and placing accountability at the highest corporate level, the amendment is expected to enhance efficiency, expedite coal production, and reinforce confidence in India's coal regulatory framework.

Cabinet approves Coal SETU window: Auction of coal linkages for diverse industrial uses and exports, ensuring fair access and optimal resource utilisation

The Union Cabinet Committee on Economic Affairs chaired by the Prime Minister Shri Narendra Modi today has approved for the Policy for Auction of Coal Linkage for Seamless, Efficient & Transparent Utilisation (CoalSETU) by creation of new window named "CoalSETU window" in the NRS Linkage Policy to utilise coal for any industrial use and export. The new policy adds to the series of coal sector reforms being undertaken by the Government.

The Policy will allow allocation of coal linkages on auction basis on long-term for any industrial use and export by adding a separate window named CoalSETU in the NRS (Non-Regulated Sector) Linkage Auction Policy of 2016 wherein any domestic buyer requiring coal can participate in the linkage auction. The coking coal shall not be offered under this window.

The existing policy for auction of coal linkages for the NRS provides for allocation of all fresh coal linkages to NRS viz. Cement, Steel (Coking), Sponge Iron, Aluminium, and Others [excluding Fertilizer (Urea)] including their Captive Power Plants (CPPs) to be auction based. As per the present policy of NRS Linkage, the sub-sectors are for specified end users only.

Looking at the current & future market dynamics and for the purpose of ease of doing business and for accelerated utilization of existing coal reserves and reduce dependence on imported coal for meeting country's energy requirement, there was a need to have a fresh look at the current arrangements of coal supplies to the NRS, and extend the linkages in NRS to coal consumers without any end use restrictions. In line with the opening of the coal sector for commercial mining, which allowed allocation of coal blocks without any end use restrictions, this policy for auction of coal linkages for NRS has been modified for allocation of coal linkages on auction basis on long-term for any industrial use and export by adding another window/sub-sector. Traders shall not be allowed to participate in the proposed window.

The present auction of coal linkages for the specified end-user sub-sectors in NRS (Non-Regulated Sector) shall continue. The specified end-user (s), can also participate in this window.

The coal linkage obtained under this window shall be for own consumption, export of coal, or any other purpose (including coal washing) except resale in the country. Coal linkage holders will be eligible to export coal upto 50% of their coal linkage quantity. The coal linkage holders may flexibly utilize the coal obtained under this window as per their requirement amongst its Group companies. Considering the demand for washed coal, which would increase in future, the coal linkages to the Washery operators will result in increased availability of washed coal in the country and consequently reduce imports. Further, the washed coal will also find takers outside the country and therefore, the washed coal may also be used for the purpose of export.

Encouraging Participation witnessed in 14th Round of Commercial Coal Blocks Auction; 49 bids received for 24 Coal Blocks

The Nominated Authority, Ministry of Coal, recently opened the bids for the 14th round of Commercial Coal Blocks' Auction, witnessing encouraging participation from industry stakeholders. Bids were received for 24 coal blocks out of the 41 blocks offered in this round, reflecting sustained industry interest in India's commercial coal mining framework.

The online bids were decrypted and opened electronically in the presence of the bidders. Subsequently, sealed envelopes containing offline bid documents were also opened in the presence of bidders. The Entire process was displayed lived on the screen for the bidders, ensuring complete transparency. Under this round, 49 bids have been received against 24 coal blocks out of 41 coal blocks.

A total of 11 companies participated in the auction process, including five new entrants bidding for the first time under the commercial coal mining regime. The participation of new companies in commercial coal block auctions highlights growing confidence in the policy framework and the expanding opportunities within India's coal sector. The coal sector remains a key driver of economic momentum as India advances towards becoming the world's third-largest economy.

The bids will now be evaluated by a multi-disciplinary Technical Evaluation Committee. Technically Qualified Bidders will be shortlisted for participation in the electronic auction to be conducted on the MSTC portal.

The continued response to commercial coal block auctions underscores the coal sector's pivotal role in supporting industrial growth, strengthening energy security, and contributing to India's journey towards becoming the world's third-largest economy.

April–November Coal production dips 3.7 per cent

For the April–November period of FY26, CIL's cumulative production stood at 453.5 MT, down 3.7 per cent from 471 MT in the same period last year. Offtake for the eight-month period also declined 2 per cent, falling to 478.9 MT compared with 488.5 MT a year earlier.

During this period, subsidiaries SECL, MCL, NCL and CCL recorded moderate growth, while BCCL and WCL posted double-digit declines. NEC showed a small rise in production and stable offtake volumes.

The data was compiled from Coal India's ERP system as of December 1, 2025 at 9:30 AM and

disclosed under SEBI Listing Regulation 30 requirements.

Govt simplifies approval process for exploration of coal, lignite

The coal ministry has revised and simplified the approval process for exploration programmes and geological reports related to coal and lignite blocks, a move aimed at enhancing ease of doing business and giving a fillip to efficient and sustainable exploration.

The new process does not require a go-ahead from the government panel set up in 2022 for this purpose.

"The Ministry of Coal has reviewed the earlier methodology and simplified the mechanism for approval of exploration programs and Geological Reports (GRs) for coal and lignite blocks prepared by Notified Accredited Prospecting Agencies (APAs) accredited by QCI-NABET and peer-reviewed by another such APA," a statement from the ministry said. The country's increasing energy requirements demand faster, more efficient, and technologically robust exploration of coal and lignite resources.

In line with this national imperative, the coal ministry continues to introduce progressive reforms that enhance transparency, strengthen private sector participation, and reinforce the country's energy preparedness, it said.

In the recent reform by expanding and utilising the capabilities of Private Accredited Prospecting Agencies, the government has demonstrated strong confidence in private exploration entities.

This approach seeks to harness their efficiency, technological expertise, and innovation for the sustainable development of country's coal resources, while ensuring strict transparency and adherence to high technical standards.

Coal Ministry launches Arunachal Pradesh's first commercial coal block

The Coal Ministry has announced the launch of Arunachal Pradesh's first commercial coal block. The project is expected to produce 0.2 million tonnes per annum (MTPA) and generate nearly Rs 175 crore in annual revenue.

The initiative is also set to create hundreds of local jobs, boosting economic growth in the North East region. This project is part of the government's efforts to promote self-reliance and sustainable development under the vision of Viksit Bharat.

The announcement was shared by the Union Minister for Coal and Mines, highlighting the ministry's focus on advancing coal-based industrial growth while generating employment opportunities and enhancing regional infrastructure.

To make space for solar energy, India may tell coal plants to run at lower loads

India wants coal plants to invest in upgrades that would allow them to work regularly at a lower capacity, creating space for a greater share of renewables in the power mix, according to people familiar with the matter.

Under the plan, coal-fired plants would be asked to budget for improvements to boost flexibility and to prepare for additional maintenance, the people said, asking not to be named as the plan is still being finalized.

The additional costs would trickle down to consumers once approved by a price-setting regulator, in what would be a calculated trade off to help India make the most of its solar capacity.

After a decade of rapid expansion, India's grid is struggling to absorb all the clean energy it generates. Without batteries and grid-scale storage to help manage those curtailments, the nation is falling back on its coal-fired fleet.

The latest plan, currently being elaborated by the power ministry, involves mandating plants to run at load factors as low as 40% — a level which would hurt efficiency and cause faster wear and tear, the people said. To help individual operations to cope, power producers are being asked to plan for software updates, for a 20% increase in maintenance expenses and for incentive payouts to plants, to increase participation.

A spokesperson for the power ministry did not immediately respond to an emailed request for comment. India is not the first country to rely on flexible fossil-fuel power to integrate more renewables into the grid. In 2023, China agreed to compensate such plants for sitting idle, so it could increase the share of green electricity.

With gas plants dependent on imported fuel and hydropower heavily affected by seasonal variability, India has had to turn to coal to perform this role.

Impact of Coal Mining

The information below was given by Union Minister of Coal and Mines Shri G. Kishan Reddy in a written reply in Lok Sabha recently."

All India raw coal production target for the year 2025-26 is 1157 Million Tonnes (MT) out of which, the target of coal production of Coal India Ltd. (CIL) is 875 MT, for Singareni Collieries Co. Ltd (SCCL) is 72 MT, and that for Captive/ Commercial/ Others is 210 MT. The Ministry of Coal has set an ambitious domestic coal production target of about 1.5 Billion Tonne (BT) by FY 2029-30.

Coal producing Public Sector Undertakings (Coal-PSUs) follow strict environmental norms for coal mining. Before starting any new project or for expansion of a coal mine project, Environment Clearances (EC) are obtained for which Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) are prepared, and these are implemented in all the mines. Land reclamation is done as per approved Mining plan and EMP. Coal-PSUs have adopted a comprehensive set of measures to minimise the environmental impact of coal mining such as (a) strict enforcement of Environment (Protection) Act, Air Act, Water Act, and Mine Closure Guidelines; (b) Promotion of Sustainable and Green Mining Technologies; (c) Stringent Air Quality Compliance and Monitoring; (d) Mine Water Reuse and Conservation Measures; (e) Land Reclamation and Mine Closure Guidelines; (f) large-scale Plantation and Green Belt Development; (g) Monitoring and Compliance through PARIVESH Portal; (h) collaboration with CPCB, SPCBs and Ministry of Environment and Forests & Climate Change (MoEF&CC); (i) adoption of eco-friendly Technologies; and (j) adoption of pollution control measures.

To enhance coal quality while minimising environmental impact through the implementation of state-of-the-art beneficiation technologies, all newly commissioned and planned washeries are equipped with advanced technological solutions, including Heavy Media Cyclone, Teeter Bed Separator, Spiral Concentrator and Froth Flotation Technology. All new washeries have been designed to achieve zero effluent discharge. Additionally, modernisation and renovation of existing ageing washeries have been taken up to enhance operational efficiency and reducing the environmental footprint of coal washing operations.

As regards coal gasification, the Government approved a comprehensive financial assistance scheme on 24 January 2024, with an outlay of ₹8,500 crore, to support coal and lignite gasification projects. Under this initiative, seven projects have been selected and they are at different stages of implementation and it is expected that they would utilize approximately 11.755 MT per annum of coal once they are commissioned.

In just 5 years of auction policy, Ministry of Coal has auctioned 133 coal mines in 12 rounds of auctions with Peak Rated Capacity of 276.04 MTPA. Once operationalised, these 133 coal mines are expected to generate an annual revenue of Rs. 38,710 Crore with a capital investment of Rs. 41,407 Crore and provide employment to 3,73,199 persons.

Coal India Limited is implementing the revival of certain legacy and non-operational underground mines through the Revenue Sharing Model for abandoned and discontinued coal mines. In Revenue sharing mode, CIL/its subsidiary offers to re-open, salvage, rehabilitate, develop and operate any suitable discontinued mine through a mine developer and operator (MDO) for excavation/ extraction of coal and delivery thereof to CIL/its subsidiary and a percentage of the revenue from the coal mined are shared with CIL/its subsidiary based on highest rate quoted in the bidding.

Under the Revenue Sharing model, a total of 32 discontinued/abandoned mines have been identified so far. Letter of Acceptance (LoA) have been issued for 28 mines having 39.28 Mty capacity. 4 mines are in re-tendering stage. Coal production has started in 2 mines during FY 2025-26, namely, PB Project of BCCL and Gopinathpur Project of ECL.

India's installed power generation capacity crosses 5.5 lakh MW till Oct 31: Shripad Yesso Naik

The country's total installed generation capacity has crossed 5.5 lakh megawatt (MW) as of October 31, and the share of non-fossil fuel sources stood at 51 per cent, Union Minister Shripad Yesso Naik has said. Of the total capacity, 2,45,600 MW was from fossil-fuel sources (48.6 per cent), and 2,59,423 MW of non-fossil fuel sources (51.37 per cent), the Minister of State (MoS) Naik said in a written reply to Rajya Sabha recently.

The share of renewable energy sources was 2,50,643 MW in the non-fossil fuel capacity, according to the data shared by the Minister.

Naik said the government has taken several steps and initiatives to promote and accelerate renewable energy capacity in the country to realize the commitment of 500 GW non-fossil energy capacity by 2030. Waiving the Inter-State Transmission System (ISTS) charges, allowing 100 per cent Foreign Direct Investment (FDI), and the launch of a transmission plan are among the steps taken in this direction, the Minister noted.

Thermal plants' biomass shortfall in FY25 due to supply challenges, not intent: APP

The Association of Power Producers (APP) recently said the inability of several thermal power plants to meet biomass co-firing targets in FY 2024-25 was primarily due to limited biomass availability and technical constraints -- not a lack of intent or effort by generators.

This comes after the Commission for Air Quality Management (CAQM) issued show-cause notices to six thermal power stations within a 300-km radius of Delhi and proposed environmental compensation of Rs 61.85 crore for the reported shortfall, the Association said in a statement.

APP noted that the domestic market for torrefied biomass pellets -- mandated for plants equipped with ball and tube mills -- remains significantly underdeveloped.

The industry continues to face challenges such as insufficient supplier capacity, high rejection rates due to moisture or volatile matter, and the absence of OEM-validated solutions, it stated.

It cited the example of Talwandi Sabo Power Ltd (TSPL), a 1,980-MW plant in Punjab, which struggled to procure adequate torrefied biomass despite floating multiple tenders in FY25. TSPL supported local partners in setting up a torrefied biomass manufacturing facility near its Mansa plant, helping create a circular stubble-to-biofuel ecosystem in the region.

With improved pellet availability, TSPL's co-firing performance has seen a notable rise -- achieving 4.33 per cent co-firing in August of FY26, and reaching 5.07 per cent year-to-date by November 30, 2025 after co-firing 2,50,369 metric tonnes of biomass.

APP emphasized that such progress shows compliance improves as the biomass value chain matures, and that earlier shortfalls were driven by market immaturity rather than operational reluctance.

The Association added that penalizing generators for issues beyond their reasonable control -- under the Environment (Utilisation of Crop Residue by Thermal Power Plants) Rules, 2023 -- could create unnecessary financial stress without accelerating adoption.

APP has urged the government to consider available provisions for relaxation in cases of genuine difficulty, including a one-time waiver of environmental compensation for FY25 or allowing carry-forward of compliance to subsequent years.

India’s power demand to rebound to up to 5.5% in FY2027: ICRA

India’s electricity demand growth is expected to recover to 5 per cent to 5.5 per cent in the financial year 2026–27 (FY27), following subdued growth of 1.5 per cent to 2 per cent

estimated for FY26, according to ratings agency ICRA.

It added that the power sector remains central to economic activity as the country expands renewable capacity and strengthens grid infrastructure.

Electricity demand has begun to show signs of improvement. All-India demand rose by 5.1 per cent yearon-year between December 1 and 25, 2025, with average daily demand at 4.4 billion units. This follows a contraction of 0.8 per cent in November and a 6 per cent decline in October.

“India added 31.2 GW of renewable capacity in 8M FY2026, up 109 per cent year-on-year, supported by a strong project pipeline and favorable solar module prices. While bidding slowed with only 8.6 GW auctioned in 8M FY2026 amid delays in signing of PPAs/PSAs, transmission infrastructure remains a critical focus to sustain capacity expansion,” said Ankit Jain, Vice-President and Co-Group Head, Corporate Ratings at ICRA.

Net power generation capacity additions reached 29.8 GW between April and October 2025, more than double the 12.5 GW added in the same period last year. The rise was largely due to commissioning of renewable projects before the expiry of the full waiver on interstate transmission system charges on June 30, 2025. Net additions for FY2026 are expected to be about 46 GW, compared with around 33 GW in FY2025.

“Grid curtailments during peak renewable generation hours highlight the urgency for storage and grid strengthening. These measures are essential to ensure grid stability and enable the sector's continued growth momentum and will remain the key monitorable in FY2027,” Jain added.

Demand trends have varied widely across states in the first eight months of FY2026. Gujarat recorded growth of 8.5 per cent, while Karnataka and Bihar each grew by 6.5 per cent. Growth was weaker in Maharashtra at 1.2 per cent, Andhra Pradesh at 1.3 per cent, Tamil Nadu at 0.6 per cent and West Bengal at 1.2 per cent

Several states saw demand contracts, including Haryana at negative 4 per cent, Punjab at negative 6.2 per cent, Rajasthan at negative 2.1 per cent, Uttar Pradesh at negative 3.4 per cent, Madhya Pradesh at negative 2 per cent and Telangana at negative 2.5 per cent. The divergence reflects a high base from last year and weather-related disruptions, including heavy rainfall.

CERC mulls moderation in power trading fee to ease electricity prices

Power regulator Central Electricity Regulatory Commission is considering rationalising transaction fees on power trading exchanges, which aims to potentially lower electricity prices as the power sector gears up for market coupling

The development came as the power regulator moves ahead with market coupling, a reform expected to improve efficiency, deepen liquidity and promote price convergence across exchanges. The move could lead to a reduction in the overall cost of power for buyers over a period of time.

Market coupling, approved by the Central Electricity Regulatory Commission in July this year after more than two years of deliberations, is proposed to be introduced in a phased manner, beginning with the dayahead market (DAM) from January 2026.

Under the mechanism, buy and sell bids across all power exchanges will be aggregated to discover a single market-clearing price, replacing the current system of multiple prices across platforms.

An official said CERC has firmed up a staff paper on 'Review of Transaction Fee charged by the Power Exchanges' in December 2025.

The official, on the condition of anonymity, said the regulator is examining whether the current transaction fee framework, capped at 2 paise per unit, remains appropriate in a market that has seen a sharp rise in volumes and is moving towards a unified price discovery mechanism.

There have been suggestions for a fixed transaction fee of 1.5 paise per unit for most trading segments. Currently, as per the existing structure, exchanges typically charge close to the ceiling. Another suggestion under consideration is to lower the transaction fee to 1.25 paise per unit for termahead market (TAM) contracts, given the longer tenure and relatively lower operational intensity of such trades. India's exchange-based power market has expanded significantly over the past decade, with electricity traded on exchanges rising over 16 times since 2009-10 and total traded volumes crossing 120 billion units in 2023-24.

While the day-ahead market once accounted for nearly the entire traded volume, real-time, intra-day and term-ahead segments now form a growing share.

According to industry experts, market coupling is expected to reduce price differences across exchanges, improve utilisation of generation capacity and enable buyers to access power at more efficient rates.

"Since bids are aggregated across all exchanges, prices are expected to converge and soften to some extent, benefiting distribution companies and large consumers and eventually end-users," an expert opined.

Indian Energy Exchange currently accounts for nearly 90 per cent of exchange-based power trading volumes, while Power Exchange India Ltd (PXIL) and Hindustan Power Exchange Ltd (HPX) make up the rest.

Under the approved framework, all three exchanges will act as Market Coupling Operators on a rotational basis, with Grid-India serving as a backup and audit operator to ensure system integrity. Officials noted that transaction fee design will become increasingly important once exchanges stop competing on price discovery. With transaction fees contributing over 95 per cent of revenues for established exchanges, any recalibration is expected to have a material impact on the sector. The official stated that discussions on transaction fees are at a preliminary stage and any decision would follow stakeholder consultations, and align with the broader objective of improving efficiency, transparency and affordability in India's power markets.

India’s Power Capacity Hits 5.05 Lakh MW Amid Rapid Growth in Renewables

India’s installed power capacity has reached 5,05,023 MW, with 2,59,423 MW derived from non-fossil fuel sources, including 2,50,643 MW from renewable energy.

The government aims for 500 GW of non-fossil energy capacity by 2030, implementing measures like waiving Inter-State Transmission System charges for specific renewable projects and issuing bidding guidelines for various renewable sources.

The Ministry of New and Renewable Energy plans a bidding trajectory of 50 GW annually from FY 2023-24 to FY 2027-28 and allows 100% foreign direct investment.

Additionally, the Green Energy Corridor Scheme funds new transmission lines to support the renewable energy sector. India has notably achieved 50% of its installed capacity from non-fossil sources as of June 2025, surpassing its Nationally Determined Contributions’ timeline.

Power consumption down 0.8% in November

India's power consumption in November fell about 0.8 per cent year-on-year to 123.4 million units. Though the fall is marginal, it is the second consecutive month to see a decrease in consumption.

October saw a 6 per cent on-year decline in power demand, while September had witnessed a 3.2 per cent rise. The lower demand is majorly because of favourable weather conditions that have led to a decline in cooling demand, according to industry experts.

Even in November, the climatic conditions were impacted by a storm in the eastern region and rainfall in the southern states as well as in Maharashtra and Gujarat, according to the India Meteorological Department (IMD).

Going forward, the upcoming winter season - December to February - will likely see normal to below normal minimum temperatures in most parts of central India and adjoining peninsular and Northwest India, as per the IMD.

NTPC commissions solar-hydrogen-based microgrid in India

Indian state-owned power producer NTPC announced it inaugurated a 3.7 MW solar plant that is a key component of the solar–hydrogen–battery energy storage system (BESS)-based microgrid project in Chushul, Ladakh, northern India.

The project was jointly developed by NTPC and the Indian Army. The microgrid comprises a 3.7 MW solar PV plant for supplying power to the 200 kW load and for hydrogen production, a proton exchange membrane (PEM) electrolyser for hydrogen generation, hydrogen storage facilities, a battery energy storage system (BESS) for short-duration continuous power supply and emergency operation, and a fuel cell system capable of generating 200 kW of electrical power.

NTPC noted that the project was commissioned in a record eight months despite the challenging, high-altitude terrain.

The solar–hydrogen-based microgrid will replace diesel generator sets currently used at remote Army locations, reducing carbon emissions and enabling a cleaner, more reliable energy supply for the region. By supporting local production and use of green energy, the project removes the need to transport fuel from the plains, strengthening energy security and easing logistical burdens, the Indian utility said.

For every three units of power generated, one litre of diesel otherwise transported to these remote Himalayan posts will be avoided.

“NTPC has designed a stand-alone microgrid using hydrogen as the storage medium to supply 200 kW of power at any time of the day, throughout the year. Located at an altitude of 4,500 m, where winter temperatures dip to –40 C, this is the world’s most unique project of its kind,” the company stated. “Once fully operational, it is expected to mark a major step towards decarbonising the defence sector in high-altitude regions.”

Indian Energy Exchange Records 11,409 MU Electricity Traded In November 2025, Up 17.7% YoY, While REC Trading Hits 4.74 Lakh Certificates

Indian Energy Exchange (IEX), India’s leading electricity exchange, reported a monthly electricity traded volume of 11,409 million units (MU) in November 2025, excluding TRAS, reflecting a 17.7% increase compared to the same month last year. During the month, a total of 4.74 lakh Renewable Energy Certificates (RECs) were also traded.

According to government data released in November 2025, India’s total energy consumption reached 123.4 billion units (BUs), slightly lower than the previous year, with a decline of nearly 1%. Higher generation from hydro, wind, and solar sources increased supply liquidity on the exchange, resulting in a decrease in electricity prices in both the Day-Ahead Market (DAM) and Real-Time Market (RTM).

The market clearing price in the DAM stood at Rs. 3.07 per unit, down 6.9% year-on-year, while the RTM price was Rs. 3.14 per unit, marking a 9.2% decline compared to November 2024. These lower prices provided an opportunity for distribution companies (Discoms) and commercial and industrial consumers to meet their electricity demand at competitive rates and replace costlier power procurement options. In the Day-Ahead Market, a total of 5,668 MU was traded in November 2025, a slight increase of 0.3% compared to 5,651 MU in November 2024. The Real-Time Market recorded a significant rise in volume to 4,233 MU, up 40.2% from 3,019 MU in the same month last year.

The Day-Ahead Contingency and Term-Ahead Market (TAM), which includes HPTAM, contingency, daily, weekly, and monthly contracts of up to three months, traded 693 MU in November 2025, compared to 202 MU in November 2024, representing a 243.1% increase year-on-year.
.

Government Enhances Natural Gas Availability to Support Power Generation

पेट्रोलियम एवं प्राकृतिक गैस मंत्रालय
MINISTRY OF PETROLEUM AND NATURAL GAS
Government of India

Government have taken various measures to enhance the availability of natural gas for power generation which, inter-alia, includes expansion of National Gas Grid to connect domestic gas sources as well as Liquefied Natural Gas (LNG) terminals to the power plants, introducing a unified tariff, setting up of LNG Terminals, allowing the domestic gas producers who have been granted pricing and marketing freedom to sell domestic gas up to 500 mmscm or 10% of annual production from their contract area whichever is higher, per year through gas exchanges authorized by PNGRB, etc.

Further, Government have placed Liquefied Natural Gas (LNG) under the Open General Licence (OGL) category. This allows buyers to freely import LNG as per their requirement on mutually agreed commercial terms with suppliers. Government have also made provisions for Nil customs duty on import of LNG, if it is used for generation of electricity by a generating company as defined in section 2(28) of Electricity Act, 2003 (36 of 2003) to supply electrical energy or to engage in the business of supplying electrical energy to the grid. Gas based power plants are free to import the LNG, generate power and sell it to customers.

Government have taken multiple steps to increase share of Natural Gas in primary energy mix. These, inter-alia, includes expansion of National Gas Grid Pipeline, expansion of City Gas Distribution (CGD) network, setting up of Liquefied Natural Gas (LNG) Terminals, allocation of domestic gas to Compressed Natural Gas (Transport) / Piped Natural Gas (Domestic) CNG(T)/PNG(D) as priority sector, allowing marketing and pricing freedom with a ceiling price to gas produced from high pressure/high temperature areas, deep water & ultra-deep water and from coal seams, Sustainable Alternative Towards Affordable Transportation (SATAT) initiatives to promote CBG etc..

For increasing domestic gas production, Government of India has notified Hydrocarbon Exploration and Licensing Policy (HELP) for the award of exploration acreages shifting from Production Sharing mechanism to Revenue Sharing mechanism. Government further notified policy framework for early monetization of Coal Bed Methane (CBM) (2017), Discovered Small Field policy (2018), policy reforms in 2019, where many of the processes and approvals were relaxed to promote “Ease of Doing Business”, Revenue Share from Category II & III type of basins were removed, except for windfall gains, 7 years Royalty Holiday for Deep & Ultra-deep blocks, concessional Royalty Rates for Deepwater and for ultra-deep water blocks, and fiscal incentives have been provided for early monetization of fields along with Marketing and Pricing freedom for natural gas. Further, Government in 2020 allowed market price discovery through e-bidding system and in 2023 permitted a premium of 20% over the Administered Price Mechanism prices for gas produced from new well and well interventions of Oil and Natural Gas Corporation Limited & Oil India Limited from their nomination fields.

Ministry of Power has informed that existing Gas-Based Plants (GBPs) in the country remain underutilized due to the high cost of electricity generation. To meet increased demand during crunch periods, the Ministry of Power implemented Schemes for procurement of power from GBPs during peak demand periods in 2023, 2024 and 2025 through competitive bidding. Selected GBPs have been provided with a Minimum Off-take Guarantee (MGO). During the crunch periods of 2023 (April–June 2023), 2024 (March–June 2024) and 2025 (March–October 2025), energy procured from the selected GBPs under these schemes was 317 MU, 482 MU and 1,477 MU respectively. This Scheme, inter-alia, helped in improving the utilization of gas-based assets, provided additional peak support to the grid, and contributed to maintaining system reliability during periods of elevated demand. The PLF of gas-based power plants has increased from 11.4% during 2022-23 to about 15 % during 2024-25.

In addition, Ministry of Power have issued directions under Section 11 of the Electricity Act for maximization of generation from gas-based stations during the periods 26th May 2025 to 30th June 2025 and 1st May 2024 to 30th June 2024.

Policy initiatives to boost gas-based power generation and improve Plant Load Factor (PLF) of gas-based plants are expected to strengthen energy security by diversifying the energy mix and reducing reliance on coal and oil.

This information was given by the Minister of State in the Ministry of Petroleum and Natural Gas Shri Suresh Gopi, in a written reply in Lok Sabha recently.

Year End Review 2025: Ministry of Petroleum & Natural Gas

The Ministry of Petroleum & Natural Gas is responsible for exploration and production of oil and natural gas, refining, distribution and marketing of petroleum products, as well as their import, export and conservation. Oil and gas continue to be critical inputs for India's rapidly growing economy. During the year 2025, the Ministry pursued a comprehensive and multi-dimensional approach to ensure affordable energy access, enhance domestic production, strengthen infrastructure, promote cleaner fuels and reinforce national energy security. These initiatives are aligned with the overarching national priorities of Energy Access, Energy Efficiency, Energy Sustainability and Energy Security.

Ensuring universal access to clean cooking fuel remained a flagship priority. Under the Pradhan Mantri Ujjwala Yojana, the number of beneficiaries reached about 10.35 crore as on 1 December 2025. To clear pending applications and achieve saturation of LPG access, the Government approved the release of 25 lakh additional LPG connections during FY 2025-26. The eligibility process was simplified through the introduction of a single Deprivation Declaration, replacing the earlier multi-point self-declaration system, thereby making access faster and more inclusive.

Affordability of LPG was supported through a targeted subsidy of ₹300 per 14.2 kg cylinder for up to nine refills per year for PMUY beneficiaries. This intervention resulted in a steady rise in LPG consumption. Average per capita consumption increased from about three refills in 2019-20 to 4.47 refills in FY 2024-25 and further to a pro-rated level of about 4.85 refills per annum during FY 2025-26, indicating sustained adoption of clean cooking fuel.

To improve subsidy targeting and transparency, biometric Aadhaar authentication was accelerated. As on 1 December 2025, biometric authentication covered 71 percent of PMUY consumers and 62 percent of non-PMUY consumers. A special nationwide drive was launched in November 2025 to enable consumers to complete authentication through simplified mobile-based processes, free of cost.

Consumer safety was strengthened through the nationwide Basic Safety Check campaign. More than 12.12 crore free safety inspections were conducted at customer premises, and over 4.65 crore LPG hoses were replaced at discounted rates, significantly enhancing awareness and safety standards in domestic LPG usage.

The Ministry also focused on strengthening petroleum marketing infrastructure. Over 90,000 retail outlets were enabled with digital payment facilities, supported by more than 2.71 lakh POS terminals. Door-to-door delivery services were expanded through the commissioning of over 3,200 bowsers, improving accessibility in remote areas. Under Swachh Bharat Mission, toilet facilities were ensured at nearly all retail outlets, with a large number providing separate facilities for men and women.

Electric mobility infrastructure expanded rapidly during the year. Under the FAME-II scheme, 8,932 EV charging stations were installed at retail outlets, while Oil Marketing Companies additionally set up over 18,500 charging stations from their own resources. The APNA GHAR initiative progressed with more than 500 truckers' wayside amenities established, improving road safety and supporting rural employment.

Public Sector Oil Marketing Companies are setting up 4,000 Energy Stations during 2024-25 to 2028-29 along major corridors and other feasible locations. These stations are being developed as integrated mobility hubs offering conventional fuels such as petrol and diesel along with alternative fuels including biofuels, CNG, LNG (where feasible) and

electric vehicle charging facilities. As on 1 November 2025, 1,064 Energy Stations have been set up across the country.
Significant progress was made in expanding the gas-based economy. The length of operational natural gas pipelines in the country has increased from 15,340 km in 2014 to 25,429 km as on June 2025, with another 10,459 km under execution. Completion of these pipelines authorized by PNGRB and the Government of India will result in a fully connected national gas grid, ensuring wider availability of natural gas across regions and supporting balanced economic and social development.

To address regional disparities in gas transportation costs, the Petroleum and Natural Gas Regulatory Board has implemented a Unified Pipeline Tariff regime under the mission of “One Nation, One Grid, One Tariff”. Introduced from 1 April 2023, the system standardizes transportation charges across the national gas grid, replacing the earlier distance-based tariff structure. At present, about 90 percent of operational pipelines are covered under the unified tariff regime, improving affordability and competitiveness of natural gas.

City Gas Distribution coverage expanded to 307 geographical areas. As on September 2025, PNG domestic connections reached about 1.57 crore and CNG stations increased to over 8,400. Revised domestic gas allocation guidelines improved alignment with actual consumption patterns and reduced exposure of consumers to price volatility.

Under the SATAT initiative, as on 1st November 2025, over 130 Compressed Bio Gas plants have been commissioned, with several more under construction. Mandatory blending obligations for CBG in CNG and PNG segments commenced from FY 2025-26, supported by financial assistance for pipeline connectivity and biomass aggregation.

Biofuels witnessed major gains during the year. Ethanol blending in petrol reached an average of 19.24 percent in ESY 2024-25, with cumulative foreign exchange savings exceeding ₹1.55 lakh crore and substantial carbon emission reductions. Advanced biofuels were promoted under the Pradhan Mantri JI-VAN Yojana, with operational second-generation ethanol plants at Panipat and Numaligarh marking key milestones.

Sustainable Aviation Fuel initiatives advanced during the year with the Government setting indicative blending targets of 1%, 2% and 5% SAF in Aviation Turbine Fuel for international flights from 2027, 2028 and 2030, respectively. In line with this roadmap, Indian Oil Corporation Limited became the first Indian company to receive ISCC CORSIA certification for SAF production at its Panipat Refinery, followed by the signing of an MoU between IOCL and Air India for SAF supply. Biodiesel blending also expanded during the year, supported by increased procurement volumes and diversification of feedstocks, strengthening the transition towards cleaner transport fuels.

The upstream sector underwent significant reforms with the enactment of the Oilfields (Regulation and Development) Amendment Act, 2025 and notification of the Petroleum and Natural Gas Rules, 2025. Under the Hydrocarbon Exploration Licensing Policy, 172 blocks covering more than 3.78 lakh sq km were awarded, attracting committed investments of about USD 4.36 billion. Exploration activity intensified through seismic surveys, drilling programmes and government-funded initiatives such as Mission Anveshan.

Strategic petroleum reserves were strengthened through renewed international partnerships and progress under Phase-II facilities, enhancing preparedness against supply disruptions. Overseas investments by Indian oil and gas PSUs continued to support energy security through diversification of supply sources.

Through sustained policy reforms, infrastructure expansion and clean energy initiatives, the Ministry of Petroleum & Natural Gas made significant progress in strengthening energy access, affordability, sustainability and security during 2025, supporting India’s journey towards a resilient and inclusive energy future.

PNGRB expert panel for sweeping reform to unlock free gas market

A high-level expert committee set up by the Petroleum and Natural Gas Regulatory Board (PNGRB) has called for sweeping structural reforms to create a free, competitive natural gas market in India, arguing that market-driven pricing and open access are essential for the country's clean energy transition.

In its report, Vision 2040 - Natural Gas Infrastructure in India, the panel led by former PNGRB chairperson D K Sarraf said a liberalised gas market would enhance transparency, spur investment, improve resource allocation and deepen liquidity. A competitive system, it said, would remove current market distortions and attract new players across exploration, pipelines, LNG terminals and city gas distribution.

Natural gas, extracted from underground and offshore reservoirs, is used to generate power, produce fertiliser, turned into CNG to power vehicles, piped to household kitchens for cooking and serve as feedstock across several industries. Seen as a key transition fuel as India shifts from fossil fuels to renewables, its role in the energy mix is set to expand.

The government aims to raise the share of natural gas in the country's energy basket to 15 per cent by 2030, up from the current 6.2 per cent. India's present pricing framework - an assortment of government-regulated gas, market-linked domestic production and LNG imports - creates inefficiencies, the committee noted. It flagged resale restrictions in regasified LNG (RLNG) contracts, lack of an Independent System Operator (ISO), limited open access to infrastructure, and the absence of contract-path transmission tariffs and location-based taxation as major hurdles.

Although India is among the world's fastest-growing gas markets, it still lacks a liquid trading hub for price discovery. A robust market would bring the country closer to global hubs such as Henry Hub, NBP and TTF, enable flexible contracting and support better hedging mechanisms, the panel said. The panel suggested the creation of a neutral, not-for-profit ISO to manage pipeline capacity, system balancing, scheduling and settlements. The proposed ISO would ensure transparent, non-discriminatory access to the transmission network and curb monopolistic practices.

It also proposed a unified online platform for real-time pipeline capacity booking under PNGRB oversight, along with a real-time bulletin board integrating SCADA data to publish capacity, flows, maintenance schedules and outages. To boost liquidity, the committee urged a ban on resale restrictions and destination clauses in RLNG contracts, allowing buyers to freely resell gas in response to market conditions - bringing India in line with mature markets in Europe and the US.

For liquefied natural gas (LNG) import terminals, it recommended a transparent third-party access framework, including clear tariffs, rule-based operating procedures, 'use-it-or-lose-it' provisions and secondary capacity trading on authorised exchanges. The panel backed a shift from route-based to entry-exit gas transportation tariffs.

To strengthen market liquidity, the report called for greater participation of large consumers such as fertiliser, power, CGD, refinery and petrochemical companies on gas exchanges. It also sought the removal of caps on high-pressure, high temperature (HP-HT) gas trading, phased inclusion of administered price mechanism (APM) gas, and the launch of Gas Release Programmes mandating a portion of domestic or LNG supplies be sold through exchanges.

The panel further recommended aligning gas and power markets by synchronising gas and power days and introducing a day-ahead gas market with four six-hour trading blocks to facilitate flexible bidding. Highlighting ongoing decarbonisation efforts, the committee proposed a Renewable Gas Certificate (RGC) mechanism for compressed biogas. A regulated, market-based trading system would allow obligated and voluntary entities to meet renewable gas blending targets through tradable certificates.

.

.

Proposed nuclear energy Bill caps operator's liability at ₹3,000 crore

The government recently introduced in Parliament a Bill that seeks to finally open up the Indian civil nuclear energy sector to private sector players, except in uranium mining, after amending specific provisions dealing with thorny issues like the supplier's liability and compensation in case of a nuclear accident.

The Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India (SHANTI) Bill 2025 proposes to repeal the Atomic Energy Act, 1962 and the Civil Liability for Nuclear Damage (CLND) Act, 2010.

The Bill essentially proposes two major changes. One, it allows private sector entry into key areas like building, owning, and operating nuclear plants, uranium enrichment, and transportation and storage of nuclear fuel, apart from import and export of equipment and technology. The Bill has also omitted a provision in the existing CLND Act that allowed right of recourse to the operator in case a nuclear incident results from an act of supplier including the supply of defective equipment or sub-standard services.

“It is desirable to harness the potential of nuclear energy through active involvement of both public and private sectors, and to leverage the participation of the domestic industry to contribute to and benefit from the global nuclear energy ecosystem, including research, technology, manufacturing, finance, insurance, and skill development," the Bill states.

The draft legislation is part of the government's efforts to align the country’s nuclear power legislation with internationally accepted norms, and remove key bottlenecks that have deterred private sector involvement so far.

The larger aim is to ramp up domestic nuclear power generation capacity from the existing 8,900 megawatt (Mw) to 100,000 Mw by 2047.

The Bill caps the operator's liability at the rupee equivalent of 300 million Special Drawing Rights (SDRs), supplementary foreign exchange reserve assets defined and maintained by the International Monetary Fund (IMF). The existing legislation, too, has the same provision. However, the SHANTI Bill has added a new clause, stating that in case the compensation amount exceeds the rupee equivalent of 300 million SDRs, the central government may take additional measures, including seeking funds under the Vienna Convention (convention on supplementary compensation for nuclear damage signed at Vienna in October, 2010). India is a signatory to the convention.

The Bill stated that the operator's liability in the case of an incident is limited to ₹3,000 crore for reactors with thermal power above 3,600 Megawatt; ₹1,500 crore for reactors with thermal power between 1,500 Mw and 3,600 Mw; ₹750 crore for reactors with thermal power between 750 Mw and 1,500 Mw; ₹300 crore for reactors with thermal power between 150 Mw and 750 Mw; and ₹100 crore for reactors having thermal power up to 150 Mw, fuel cycle facilities other than spent fuel reprocessing plants and transportation of nuclear materials.

Introducing the SHANTI Bill in Parliament, Minister of State for Science and Technology Jitendra Singh said it proposes a revised and pragmatic civil liability framework for nuclear damage, confers statutory status on the Atomic Energy Regulatory Board, and strengthens mechanisms related to safety, security, safeguards, quality assurance, and emergency preparedness.

"It provides for the creation of new institutional arrangements, including an Atomic Energy Redressal Advisory Council, designation of Claims Commissioners, and a Nuclear Damage Claims Commission for cases involving severe nuclear damage, with the Appellate Tribunal for Electricity acting as the appellate authority," Singh said.

Speaking at a media briefing, Commerce and Industry Minister Piyush Goyal said the Bill would encourage private participation, and boost public-private partnership in the nuclear energy sector. He also said nuclear energy would be key to the government’s ambition of increasing the country’s capacity of data centres, which require both reliable power and renewable source of energy.

Experts hailed the SHANTI Bill as a move towards energy security. "India's energy transition cannot rely on intermittency alone. A reformed Atomic Energy Act that enables private investment and rationalises nuclear liability is critical to building safe, scalable nuclear capacity and strengthening long-term energy security," said Debasish Mishra, Chief Growth Officer, Deloitte South Asia.

India can meet 28% of power demand with next-gen nuclear by 2050, study finds

India could meet as much as 28 per cent of its electricity demand through next-generation nuclear technologies by 2050, per a new study conducted by Bayesian Energy with support from The Rockefeller Foundation.

The study, titled 'The Role of Nuclear Energy in Powering Universal Energy Abundance for Emerging Economies' models power-system pathways for eight emerging economies from 2025 to 2050. It states that combining advanced nuclear with India's ongoing renewable-energy expansion could reduce total system costs by 10–21 per cent compared with a renewables-only approach.

According to the findings, India could build 168–328 GW of nuclear capacity by mid-century. Nuclear generation would supply 13–28 per cent of total electricity, acting as firm, zero-carbon power to complement solar and reduce the need for large-scale storage and transmission additions.

"Philanthropy can play a catalytic role in advancing India's nuclear future - from fostering informed public dialogue and strengthening institutional readiness, to de-risking early projects and enabling international collaboration for safe and responsible deployment," said Deepali Khanna, Senior Vice President and Head of Asia at The Rockefeller Foundation.

The report notes that advanced nuclear technologies — including small modular reactors (SMRs) — could help smooth daily dispatch, lower peak loads and ease grid-integration pressures associated with high renewable penetration.

India already operates large-scale nuclear plants and has a long-term expansion strategy, the study noted.

It added that accelerating next-generation nuclear alongside renewables could help the country avoid overbuilding storage and ensure reliable, low-carbon power for industrial sectors such as steel, fertilisers, manufacturing and data centres.

Dept of Atomic Energy Seeks Sops to Put N-Power on a Par with RE

The Department of Atomic Energy (DAE) is advocating for the extension of tax breaks and green incentives to nuclear power, akin to those available for renewable energies like solar, wind, and hydro. This proposal aims to place nuclear power on an equal footing with other renewable energy sources.

Proposed Incentives and Current Disparities

- The DAE has proposed waiving the Goods and Services Tax (GST) for ongoing and upcoming nuclear projects.
- The department seeks access to green financing and renewable purchase obligations (RPOs) for nuclear projects.
- Inclusion in the national green taxonomy and removal from the Central Pollution Control Board's 'Red' category is also requested.

Currently, nuclear power does not enjoy the same incentives as wind, solar, and hydro, which benefit from cheaper finance options due to their renewable classification. Despite nuclear power's low operational carbon emissions, it faces higher environmental risk classification and a higher GST rate of 18%, whereas renewables average around 8.9%.

Legislative and Regulatory Context

- The Shanti Bill, 2025, facilitating private investment in nuclear energy, has recently been enacted.
- Previously, nuclear projects enjoyed excise duty exemptions under the pre-GST regime, which are no longer available.
- Customs duty exemptions have been extended until September 30, 2027, but conditions apply.

Current and Future Capacity Goals

- India's nuclear energy capacity currently stands at 8.78 gigawatts.

- The goal is to achieve 100 gigawatts by the year 2047.

Small Nuclear Reactors: Why India Needs Russia Now

India announced something big in the Union Budget 2025. Finance Minister Nirmala Sitharaman unveiled a 20,000-crore Nuclear Energy Mission to develop Small Modular Reactors, or SMRs as they're called. The government wants at least five Indian-made SMRs running by 2033. This might sound like just another government scheme, but it's actually a game-changer for our country's energy future, and it's directly connected to Russian President Vladimir Putin's upcoming visit to India.

Let me explain why this matters to you and me. Right now, the world gets 82% of its energy from fossil fuels like coal, oil and natural gas. These fuels are slowly destroying our planet through pollution and climate change. Everyone talks about solar panels and wind turbines as the solution, but here's the catch: they only work when the sun shines or the wind blows. What happens at night? What happens when there's no wind? We still need electricity 24x7, don't we? This is where nuclear power becomes crucial. Unlike solar or wind, nuclear reactors work round the clock, in any weather, producing clean electricity without releasing carbon dioxide into the atmosphere.

But traditional nuclear power plants have their own problems. They're massive, incredibly expensive, take 10 to 15 years to build, and if something goes wrong, the consequences can be catastrophic. Remember Chernobyl or Fukushima? That's why the world is now excited about Small Modular Reactors. These are like the smartphone version of nuclear reactors compared to the old landline telephones. They're small, producing only 30 to 300 megawatts of electricity per unit, while regular nuclear plants produce 500 MW or more. More importantly, these reactors have a modular design, meaning their parts can be manufactured in factories and assembled on-site, just like building with LEGO blocks. This makes them faster to build, cheaper, and much safer.

Think about Bengaluru, our tech capital. The city currently needs 157 million units of electricity per day, which translates to about 6,542 MW of average power demand. That's the electricity requirement for just one city. Now multiply that across India's growing cities and industries. The International Atomic Energy Agency says the world must more than double its nuclear energy by 2050 to have any real chance of reaching net-zero carbon emissions. India cannot afford to miss this opportunity.

Here's where Russia enters the picture. Only two small modular reactor projects in the entire world are actually working right now. One is Russia's Akademik Lomonosov, a floating nuclear power plant that started operating in May 2020. It sits on a ship-like platform with two small reactors producing 35 MW each. The second is China's HTR-PM, which started commercial operations in December 2023. Russia has decades of experience with nuclear technology and has already proven that these compact reactors can work in real-world conditions. India has been Russia's trusted partner in nuclear energy for years, with Russian help building the Kudankulam nuclear plant in Tamil Nadu.

During Putin's visit, India will likely push for deeper cooperation on small reactor technology. Why the urgency? Because India is calling its program "Bharat Small Modular Reactors" and wants to become a world leader in this technology. It's not just about generating electricity at home. If India can master this technology with Russian partnership, it can export it to other developing countries facing similar energy challenges. This becomes a powerful tool in foreign policy, helping India increase its global influence while also supporting its clean energy goals.

The government is also changing two important laws, the Atomic Energy Act and the Civil Liability for Nuclear Damage Act, to allow private companies to participate in nuclear power generation. This means more investment, faster development, and quicker deployment of these small reactors across the country. They can be installed on old thermal power plant sites, using the infrastructure that already exists. No new land acquisition, no displacing people from their homes, just smart reuse of what we already have.

Nuclear Power Future

Need to align policy, technology and safety priorities

Ravi B Grover, Member, Atomic Energy Commission

Many of us in the Department of Atomic Energy (DAE), working on the research-energy policy interface, have been examining India's energy mix, its current composition, and how it should evolve in the future. This evolution should factor in country's resource position, development priorities, and the need for decarbonising the economy. At the beginning of this century, it became clear to us that nuclear energy must play a significantly larger role than it does at present. At that time, there were constraints and challenges in achieving this. The primary constraint was India's modest uranium reserves and the impossibility of importing it due to the prevailing international nuclear regime. The situation arising from the low availability of uranium was so critical that nuclear power plants operated by the Nuclear Power Corporation of India Limited (NPCIL) were functioning at very low-capacity factors. After a lengthy negotiating process with the gatekeepers of the international nuclear regime, India was able to change the nuclear regime in its favour in 2008. Following this, we started importing uranium, which improved the capacity factors of our nuclear power plants. I will return to this point later.

From constraint, let me move on to the challenge, we have been facing on the technology front. India first developed 220 MW pressurised heavy water reactor (PHWR) technology, upgraded it to 540 MW, and then began working on 700 MW units. This process is now complete, and NPCIL is actively engaged in the construction of several 700 MW PHWRs. The Indian industry is manufacturing all the equipment for the 700 MW PHWRs and has the capacity to expand infrastructure for manufacturing equipment as needed.

In 2017, the Government of India approved the construction of 10 PHWRs of 700 MW capacity each, based on a proposal by the DAE. This was a significant development for nuclear power in India and indicated that the Government has confidence in the DAE, NPCIL and the manufacturing industry. The DAE prepared the proposal following an internal study that indicated that the share of nuclear energy in the energy mix needed a significant increase.

The central government commissioned studies by independent experts. A study by the Indian Institute of Management (IIM), Ahmedabad, was released in April 2024 and was cited in the Economic Survey presented to the Parliament in July 2024. Meanwhile, within the DAE, we continued our research and our study on the overall energy needs of the country was referenced in the Economic Survey presented in the Parliament in January 2025.

Projections by most energy experts indicate that (i) India's energy needs are substantial, (ii) the electrification of end-use is the way forward, (iii) energy needs cannot be met by renewables alone, (iv) nuclear should be exploited to the maximum extent, (v) fossil fuels cannot be wished away for a long time, (vi) the increasing penetration of renewables is challenging for grid stability, and (vii) it is necessary to have a significant percentage of share from baseload stations.

Further evolution of the legislative framework

As a result of these insights, the government announced the goal of 100 GW of nuclear power by 2047 and has initiated the task of amending the legislative framework to allow the private sector to own and operate nuclear reactors. Amending any legislative framework is a

complex process, specially for nuclear energy, due to its strategic, safety, and security implications. The Atomic Energy Act was enacted in 1962. Since then, there has been a significant evolution in the international nuclear regime, and there have been advancements in nuclear science and technology.

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) came into force in 1970, which was eight years after the Act was passed by Parliament. The NPT designates only five countries as NWS: Nuclear Weapon States. The remaining countries are classified as Non-Nuclear-Weapon States (NNWS). India has not signed the NPT.

The NPT mandates that signatory countries supplying nuclear fuel or equipment must ensure that the recipient's nuclear facilities – which have benefitted from any international cooperation – are placed under the safeguards of the International Atomic Energy Agency (IAEA), especially if the recipient is an NNWS or not a signatory to the NPT. Safeguards refer to a system of accounting for nuclear material, where every gram of nuclear material must be accounted for. To implement safeguards, elaborate techniques have been developed, including on-site surveillance. In India, since the nuclear material is handled by the Government or a PSU, the instructions issued by the Government are followed, and India consistently complies with international commitments. However, the term 'nuclear safeguards' is notably missing from the Atomic Energy Act.

The early reactors set up in India in collaboration with other countries are under IAEA safeguards, which are specific to those facilities. After the Peaceful Nuclear Explosion (PNE) by India in 1974, the Nuclear Suppliers Group (NSG) was established. The NSG, acting as gatekeepers, refused to give India the option of going for the facility-specific safeguards and sought to impose comprehensive safeguards, that is, safeguards on all facilities in India, an option that was not acceptable to India. As a result, India was unable to buy uranium from the international market and expand its nuclear installed capacity.

In 1998, India conducted nuclear tests, which led to intense diplomatic activity. Consequently, the NSG revised its guidelines to facilitate international trade with India with only facility-specific safeguards.

Nuclear safeguards are a result of the intertwining of strategic and peaceful applications of nuclear technology. Every gram of nuclear material that is uranium has to be accounted for. One can mine it in India or import it. One can own it or it can be given by the Government on lease. However, control over its use and proper accounting are essential.

The next important point relates to the physical security of nuclear materials and facilities. This has become very important in the current geopolitical scenario, where non-state actors are engaged in violent activities around the world. The term 'nuclear security' is missing from the Act. IAEA has issued guidelines on nuclear security, and experts from India have participated in the drafting of these guidelines. Adherence to these guidelines is crucial.

Nuclear reactors have a long lifespan, and the company that has supplied the reactor may not be operational for the entire duration. Therefore, the responsibility for safety lies with the operator of the plant, a position widely accepted in the nuclear industry. Based on experience, the nuclear industry has developed the concept of 'design authority,' which is located within the operating organisation. The design authority is responsible for ensuring that the knowledge base is established, preserved and expanded with experience. It is responsible for ensuring that the necessary design knowledge is available to all parts of the operating organisation.

Switching gears, many issues have arisen from developments in nuclear science and technology. For example, the Act provides for the DAE determining the tariff for electricity. Nuclear reactors are now being designed to provide process heat for producing hydrogen or desalinating seawater. There is no provision for determining the tariff for process heat in the Act. The same applies to the production of radioisotopes and radiopharmaceuticals.

There are also issues related to the nuclear fuel cycle, radioactive waste management, and decommissioning that need to be addressed by the Act. The way forward is to undertake a comprehensive amendment of the Act. This is a time-consuming exercise and requires brainstorming among stakeholders and legal experts to determine what to include in the Act and what to include in the Rules.

The way forward

While the Government is working on amending the Act to encourage private sector investment in nuclear power, NPCIL is going ahead with its plans of constructing PHWRs. A few months ago, CMD, NPCIL, announced that the company was seeking approval for 10 reactors of 700 MW rating each in addition to the 10 that were announced in 2017. The DAE has also released vision documents outlining how the target of 100 GW of installed capacity will be achieved by mid-century. The vision documents are available on the DAE website.

A comment on SMRs. They are yet to be developed, and it is premature to bet on them. One should recall Gartner's hype cycle, a framework introduced in 1995. It has its adherents and critics. Figure 1 provides details and is self-explanatory (Ref: B K Sovacool, 9 Oct 2024, Nature Reviews Physics). With regard to SMRs, we are perhaps near the peak of expectations. It is better to go for 220 MW PHWR rather than reactors whose technology is not yet established and whose economic viability remains unproven. SMRs should, of course, be developed; however, attention must be paid to all aspects, including economics, manufacturability, fuel cycle, waste management and decommissioning.

Before closing, I would like to comment on one important issue regarding safety regulation and nuclear culture. Some have suggested that we should accept a design once it has been certified by a regulator of another country. To know its implications, please study the Boeing 737 Max saga. In the realm of advanced technology products, quick fixes do not work. Boeing implemented a software update to address a specific issue. However, according to a study by Bill George, Harvard Business School, this was not disclosed to the Federal Aviation Authority or described in the Pilot's manual. The result was two mishaps that claimed 346 lives.

The nuclear industry can thrive only if we pursue it as a well-regulated engineering endeavour.

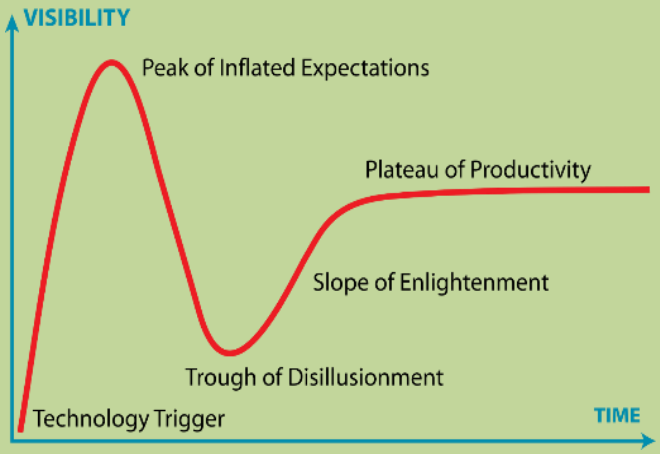


Figure 1: A schematic of Gartner's hype cycles, which accounts for the rise and fall of expectations as they coevolve with technical development (From Wikipedia).

(Note: This article was first published in Power Line, Oct 2025. It is reproduced here with permission.)

24th National Power Conference
23rd December 2025

Theme: "Towards Net-Zero: Ensuring Reliability and Resilience in a high Renewable Power System"

India Energy Forum recently organized its annual flagship event, 24th National Power Conference on the theme "Towards Net-Zero: Ensuring Reliability and Resilience in a high Renewable Power System" on 23rd December 2025 at Hotel Le Meridien, Janpath, New Delhi. The Conference was inaugurated by Shri Pankaj Agarwal, IAS, Secretary, Ministry of Power, and Shri Ghanshyam Prasad, Chairperson, CEA delivered the key-note address (online). The Knowledge Partner of the Conference was BDO India with the Team led by Shri Rakesh Jha, Partner.

Dr H. L. Bajaj, Chairman, Power Group, IEF, Former Chairperson, CEA and Ex Officio Secretary to the GoI, Ex Member, Appellate Tribunal for Electricity delivered the welcome address and set the context for the meeting by emphasizing electricity as the central enabler of India's climate commitments and long-term economic growth aligned with the 2030 and 2047 visions. He highlighted the importance of balanced discussions on energy transition challenges and outlined the agenda to encourage constructive dialogue across policy, regulation, and industry.

He also introduced the IEF Energy Service Award for year 2024 which has been presented to Shri. Upendra Tripathi, Former Secretary, MNRE.

Shri R. V. Shahi, President, IEF highlighted that India's power sector is at a critical transition point where rapid renewable energy expansion is outpacing grid readiness. While non-fossil capacity has crossed the 50% mark, power demand growth linked to GDP, manufacturing expansion, and per-capita consumption will require the sector to grow tentatively at 7% annually. He stressed that grid management, rising transmission costs, rural decentralised generation, DISCOM viability, and nuclear expansion under the SHANTI Bill are now central to sustaining economic growth while managing renewable integration.

Shri Pankaj Agarwal IAS, Secretary, Ministry of Power, GoI, was the Chief Guest of the Conference and in his Inaugural Address**,** outlined the government's reform agenda spanning taxation, labour codes, nuclear liberalisation, and the proposed Electricity Amendment Bill, aimed at improving sector viability and reducing litigation. He highlighted the scale of renewable additions, emerging challenges of balancing high RE shares, and the urgent need for indigenous forecasting, demand-side management, and storage. He stressed that high power costs, cross-subsidies, inefficient transmission utilisation, and rising RoW costs threaten industrial competitiveness, making storage-linked RE, transmission optimisation, and market reforms essential.

Shri Ghanshyam Prasad, Chairperson, CEA, was the Guest of Honour, while delivering the key-note address (online) presented CEA's long-term planning perspective, reaffirming India's net-zero target for 2070 and projections up to 2047. He flagged growing grid instability risks due to RE concentration, equipment cost escalation, and quality-of-power issues, citing frequent disturbances in high-RE states like Rajasthan. He emphasized the need for synchronous condensers, grid-forming inverters, major scale-up of pumped storage, and strengthening both inter- and intra-state transmission to ensure reliability during the transition.

Shri Upendra Tripathy, Former Secretary, Ministry of New and Renewable Energy and Recipient of the IEF Energy Service Award 2024 delivered the Special Address, offered a strategic perspective on leadership and energy evolution, stressing that transformational governance is critical for the energy transition. He highlighted the untapped biogas potential, pending subsidies, and the generational shift from conventional power to renewables and advanced storage technologies. He emphasized the importance of achieving grid parity and extending affordable, clean energy access comparable to traditional fuels like kerosene.

Session I: Panel Discussion on "Towards Net Zero: Policy & System Readiness for High Renewable Integration

Shri Ajay Shankar, Sr Fellow, TERI and Former Union Secretary, GoI, drew on international experience to show that high renewable penetration creates real economic costs, such as negative prices and demand incentivization, as seen in Germany. He argued that transmission planning must precede RE build-out, given the geographic concentration of solar in states like Rajasthan and Gujarat. Highlighting falling storage costs, he stressed that Solar + BESS is now competitive with thermal power, but cautioned against premature deregulation, underlining the central role of DISCOMs in planning, reliability, and consumer protection.

Shri A. Balan, Member (Planning), Central Electricity Authority**,** highlighted the growing uncertainty in demand forecasting driven by EV adoption, lifestyle changes, and government schemes, making capacity planning increasingly complex. He noted that while long-term models may show declining coal usage, conventional power remains essential until renewables become dispatchable. He emphasized fast-response resources under 5-minute scheduling, the finite life and replacement cost of batteries, and the need to gradually move from least-cost to least-emission planning frameworks.

Shri S. K. Chatterjee, Chief, Regulatory Affairs, CERC, stressed that managing about 180 GW of renewables is already challenging and that transmission is the most critical enabler of further RE integration. He highlighted rising transmission costs, connectivity bottlenecks, and the problem of speculative booking of grid access. With

the duck curve deepening, he emphasized that the system now needs downward reserves and demand-side flexibility, advocating Virtual Power Plants and improved ancillary service frameworks to maintain grid security.

Shri Ravindra Kumar, Director (Opr), NTPC emphasized that coal plants, originally designed for baseload, are now bearing a disproportionate share of system flexibility, which risks reducing asset life. While NTPC is enabling partial flexibilization, he stressed the need for all generators to share this responsibility under a level playing field. He warned that demand overestimation could destabilize the system and called for clear assignment and pricing of round-the-clock (RTC) responsibility.

Session II: Adapting Conventional Generation for Reliability in Renewable rich power

Shri Rakesh Jha, Partner BDO India, in his Theme Presentation, traced global climate commitments and India's response through the Panchamrit goals, highlighting that India has already achieved 50% non-fossil installed capacity ahead of schedule. He emphasized coal's continued role as the system backbone, major gains in energy efficiency, and wide-ranging policy interventions across hydrogen, agriculture, and electricity markets. He underscored that while renewables scale rapidly, thermal, nuclear, hydro, and storage must work together, supported by AI, AGC, and forecasting for operational excellence.

Shri Praveen Gupta, Member (Thermal), CEA and Chairperson of the Session highlighted that India's planning approach is evolving from five-year cycles to mid-term assessments to manage rising uncertainty. He emphasized the continued need for coal capacity up to 2035, nuclear expansion under the SHANTI Bill, and the critical role of coal flexibility in reducing renewable curtailment. He flagged gaps in compensation mechanisms, uneven SERC implementation, and stressed the importance of scaling BESS, PSP, CCUS, biomass co-firing, and fly ash management to meet net-zero goals.

Shri Anil K Pandey, Advisor, Jindal Power Ltd emphasized that coal-based generators have a system responsibility to facilitate renewable integration, as RE must remain a must-run resource. He noted that technical capability for 55% minimum load exists, but compensation gaps discourage compliance. He argued that flexibility

mandates should be compulsory, market prices are adequate, and profit maximization must be balanced against climate goals, while microgrids and decentralized RE offer a practical flexibility pathway.

Shri Sanjeev Singh, GM (OS-SIIS), NTPC, reinforced that thermal power remains indispensable despite rapid non-fossil growth, with NTPC units actively meeting ramping requirements. He stressed that flexibility should be a collective responsibility across GENCOs and IPPs. Highlighting the role of gas plants in meeting peak ramps, he argued for pooling gas assets to fairly recover fixed costs and noted that falling BESS costs and government VGF support are making large-scale storage increasingly viable.

Shri Sanjay Bansal, GM, BHEL, provided a technical perspective, explaining that frequent ramping and cycling place severe stress on coal plant components originally designed for baseload operation. He highlighted creep and fatigue as key damage mechanisms and stressed the importance of advanced materials and design changes to enable flexibility. While technical solutions exist, he cautioned that improved flexibility comes at a higher capital cost and requires updated standards.

Session III: Hydro Power (Both Conventional and PSP) as Balancing Resources

Shri M G Gokhale, Member (Hydro)**,** CEA and Chairperson of the Session, emphasized that pumped storage will be central to India's energy transition, with both fixed-speed and variable-speed technologies having a role. He highlighted clearance delays, lack of a clear PSP roadmap, financing gaps, and market design uncertainty as key bottlenecks. Stressing that PSP offers multiple grid services beyond storage, he called for appropriate compensation, faster approvals, and long-term planning to scale PSP to 100 GW by 2047.

Shri Ashish Mamgain, GM**,** THDCIL, gave elaborate presentation and highlighted the increasing mismatch between renewable generation and demand patterns shaped by seasonal, weekly, and cultural factors. Using domestic and international examples of price collapse and negative pricing, he demonstrated the urgent need for

storage. He strongly advocated variable-speed pumped storage plants as a superior solution for managing the duck curve and providing fine-grained grid balancing.

Shri Nitin Sabikhi, Sr Vice President, ReNew highlighted the requirements of infrastructure fixed amount allocations for doing due diligence for DPR which is essential for investment decisions. He mentioned that although CA clearance for off the river PSP has been eased out yet forest and environment clearance becomes critical for investigations required for bankable DPR. He touched upon the rationalisation of allocations for off the river PSP in the bidding process.

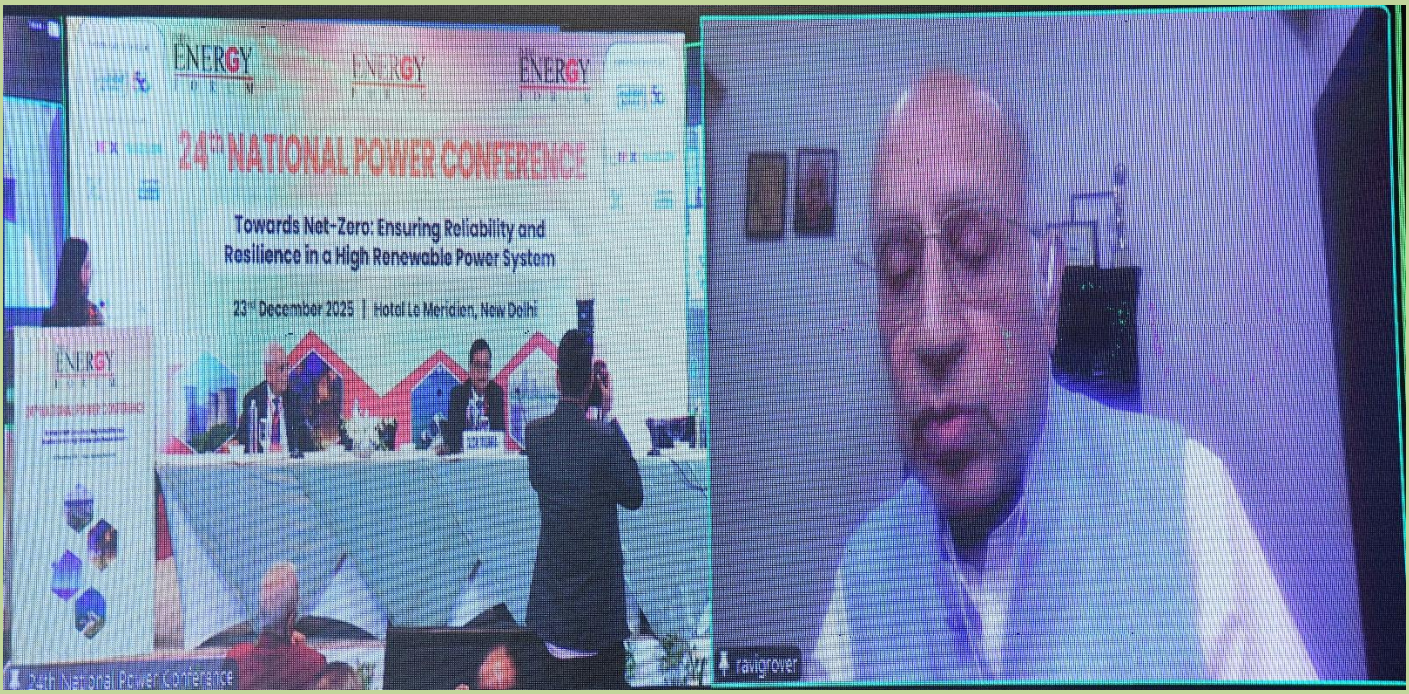
Prof (Dr) Arun Kumar, Emeritus Fellow, Hydro and Renewable Energy Department HRED (Deptt of Hydro & Renewable Energy) IIT Roorkee, highlighted that decentralised renewables are reducing system inertia, increasing reliance on ancillary services. He emphasized hydropower and PSP as critical for frequency control, black start, and system stability, while noting India's lag behind China in storage deployment. He advocated repurposing existing dams, investing in R&D for reversible turbines, and developing hybrid business models combining RE with PSP through structured financing mechanisms.

Session IV: Role of Nuclear Power in a High Renewable Power System

Prof R Srikanth, Head (Energy, Environment and Climate Change), NIAS, Bangalore, noted that nuclear may contribute only 36–50% by 2070 despite CO_2 reduction goals, while China dominates energy mineral supply due to sustained R&D, leaving India far behind. He stressed the need for firm baseload power alongside storage, highlighting nuclear's limited flexibility and high ramping costs compared to coal. He emphasized reducing water consumption in future nuclear designs and improving public perception through better outreach and policy support. He pointed to seismic constraints at identified sites and supported SMRs for their site flexibility, staged construction, and public acceptance. He concluded that SMRs should complement large reactors and that repurposing coal plant sites for nuclear merits consideration.

Dr Alok Mishra, Director India Offers and Country Director, Westinghouse India, stated that SMRs are a proven technology with lower costs, simpler licensing, and faster construction. He highlighted enhanced safety and standardized designs as key advantages. He emphasized SMRs' load-following capability, making them suitable to complement renewable energy. He referenced the AP300 design as a leading example in global SMR deployment.

Dr R B Grover, Member, AEC and Chairperson of the Session (online) complimented the deliberations supporting the role of nuclear power as a strategic source of firm, low carbon capacity, with small modular reactors offering potential advantages in siting flexibility, safety and load following capability, subject to policy support and public acceptance. He emphasised the need to couple hydrogen electrolyser with the grid. He noted that grid connected electrolysers can reduce operational expenditure and improve flexibility.



Session V: Enhancing System Flexibility & Dispatch Efficiency in Renewable Rich Grids

Shri I S Jha, Former Member, CERC & Former CMD, PGCIL and Chairperson of the Session, observed that the Australian blackout was a consequence of insufficient flexible assets, compounded by multi-level failures, low system inertia, and transmission outages that significantly aggravated the situation. He drew parallels with Germany, where high renewable penetration concentrated in the northern regions has led to persistent congestion and large-scale redispatch challenges. He noted that such systemic conflicts highlight inadequate infrastructure and resource planning. He emphasized that future power systems must prioritize flexibility to manage morning peak demand and ensure adequate inertia to maintain grid stability.

Shri V S Verma, Former Member, CERC & CEA and Co-chairperson of the Session, stated that thermal generation will continue to play a role in the power system, as no complete alternative currently exists. He highlighted carbon capture, utilization, and storage as a critical emerging technology for decarbonizing thermal assets. He noted that battery energy storage is becoming increasingly viable, particularly when complemented

by pumped storage. He emphasized that grid management is becoming progressively complex, while power exchanges still handle a relatively small share of total electricity. He stressed the need to strengthen market mechanisms to support system flexibility and reliability.

Shri S K Soonee, Former MD, POSOCO (now Grid India) while delivering his views online emphasized that amendments to the Electricity Act are not essential; instead, scheduling and dispatch frameworks must be distinctly redesigned to accommodate renewable energy. He advocated for transparent dispatch by system operators and called for the development of a flexibility matrix to define how flexibility is measured, valued, remunerated, and incentivized. He stressed the importance of rigorous modelling to quantify the marginal value of flexibility. While supporting decentralized mechanisms, he underscored the need for a centralized coordination layer. He highlighted locational marginal pricing signals for optimal battery deployment and identified ancillary services as a critical but underdeveloped pillar requiring urgent attention.

Shri Samir Saxena, CMD, Grid India highlighted that high renewable penetration during solar hours presents significant operational challenges. He noted that all resources must become more flexible, but each faces constraints. Thermal plants require higher ramp rates and faster start capabilities, while hydropower flexibility remains seasonal and limited. He pointed out that inflexibility in balancing demand and supply has led to a substantial rise in ancillary service requirements. He stressed that without adequate flexible resources, system balancing costs will continue to increase in high-renewable scenarios.

Shri S N Goel, CMD, Indian Energy Exchange (IEX) emphasized that integrating renewable energy at scale is essential to meet future demand growth. He highlighted that battery energy storage system costs have declined by nearly 75%, significantly improving their viability. He stressed the critical role of demand side management in renewable integration, citing electric vehicles, vehicle-to-grid applications, and air-conditioning loads as major flexibility resources. He noted that power exchanges enable wider geographic balancing and improved efficiency, and observed that volumes in the real-time market have increased by over 40%, reflecting growing system reliance on short-term balancing mechanisms.

Concluding Remarks: Across sessions, there was strong consensus that conventional generation will remain indispensable during the transition. Coal, hydro, nuclear, and gas-based assets continue to provide critical flexibility, inertia, and reliability services that are not yet fully substitutable by variable renewables. Coal plants, in particular, are increasingly required to operate flexibly, well beyond their original baseload design, raising concerns related to technical stress, asset life, and the absence of adequate compensation mechanisms. Nuclear power was recognized as a strategic source of firm, low-carbon capacity, with Small Modular Reactors offering potential advantages in siting flexibility, safety, and load-following capability, subject to policy support and public acceptance.

Energy storage emerged as a central enabler for a renewable-rich power system. Pumped storage plants were repeatedly emphasized as system-critical assets, capable of providing long-duration storage, frequency control, inertia, black start capability, and peak balancing. Battery energy storage systems, supported by sharply declining costs, are becoming increasingly viable for short-duration flexibility, although their finite life and replacement costs necessitate careful planning. Speakers underscored the need for clear roadmaps, streamlined approvals, and appropriate market-based remuneration frameworks to scale storage deployment at the pace required for system stability.

The conference also highlighted that system-level reforms in scheduling, dispatch, and market design are now as important as capacity addition. Transparent, system operator-led dispatch, strengthened ancillary service markets, improved forecasting, and active demand-side participation were identified as immediate priorities. International experiences from high-renewable systems reinforced that inadequate flexibility, insufficient inertia, and delayed transmission planning can significantly increase balancing costs and system risks. Consequently, transmission expansion, congestion management, and optimal siting of generation and storage must proceed in parallel with renewable build-out.

The deliberations reinforced that India's net-zero transition is fundamentally a system transformation challenge rather than a technology substitution exercise. Achieving a reliable, resilient, and affordable power system will require coordinated action across policy, regulation, planning, markets, and operations. A balanced and integrated portfolio comprising renewables, flexible conventional generation, storage, robust transmission infrastructure, and demand-side resources, supported by rigorous modelling and institutional coordination, will be essential to sustain economic growth while ensuring a secure and orderly energy transition.

Shri Satish C Sharma, Convenor, Power, IEF and Former Director (T), THDCIL presented the Vote of Thanks at the Conference. He specially Thanked Shri Pankaj Agarwal IAS, Secretary for having grace the occasion and delivering the Inqugural address. He also thanked Shri Ghanshyam Prasad, Chairperson, CEA for joining online as Guest of Honour and delivering the key-note address. He expressed his gratitude to Shri R V Shahi, President, IEF, Dr H L Bajaj, Chairman, Power Group, IEF; and Chairpersons and Speakers of the different session who participated and shared their experience and expert professional views. He appreciated the generous support of all the sponsors and thanked the Organising Committee.

He thanked Shri Rakesh Jha and his Team for sharing in-depth knowledge on the theme.

The Detailed Report of the Proceedings and its Recommendations of the 24th National Power Conference will be shared in the next Issue of the TOTAL ENERGY.

GLIMPSES OF 24TH NATIONAL POWER CONFERENCE