India’s Energy Security Outlook

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Framing the Problem - Security, Dependence, and the Transition Illusion

- India’s energy problem is intrinsically multidimensional, since it needs to handle fast-paced increases in demand along with a considerable degree of import dependency while simultaneously transitioning towards new energy sources. In contrast to developed countries where transitions happened when demand became saturated, India is both growing and transforming its energy sector simultaneously, leading to a conflict between guaranteeing sufficient supply in the present and building a sustainable energy infrastructure in the future.

- The current policy discourse tends to assume that increasing renewable energy capacity automatically improves energy security, yet this assumption is overly simplistic. Increasing renewable energy capacity improves domestic production; however, it fails to tackle more fundamental problems like import dependency, vulnerability to international prices, and dependence on overseas production networks for renewable energy technology.

- Energy security should be viewed as a balancing act between supply, costs, and consistency. While renewable energy helps improve supply capacity, intermittency, stability issues, storage needs, and cost control remain significant concerns when it comes to consistently providing cheap energy.

- However, the critical question that needs answering is not about the pace of renewable development, but about resilience within the entire energy system to withstand any potential shock or stress to the system. This includes examining whether there are ways for India to mitigate its vulnerability to any kind of global economic instability.

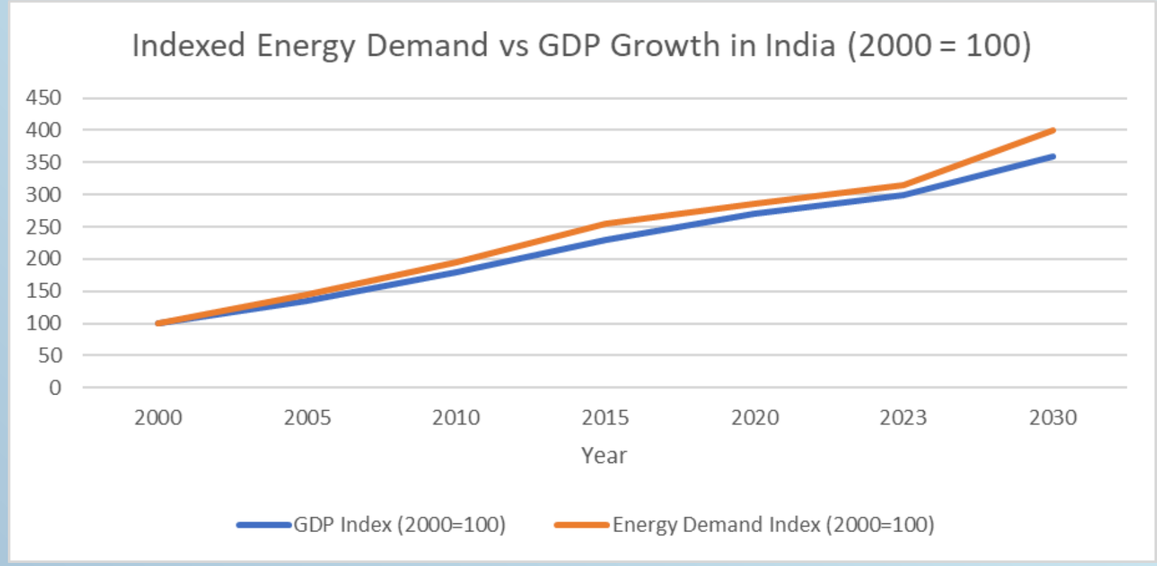
Demand Trajectory - The Scale Problem

- There are strong structural factors behind India's need for energy, including fast-paced urbanization, increased industrialization, rising per capita incomes, and the large-scale use of electricity. All these structural factors ensure a steady growth in energy demand regardless of changes in policies.

- Even with an increase in recent years, energy consumption per capita in India is much lower than that of many other countries, suggesting room for further increases. Given continued economic development and higher living standards, one can expect higher absolute as well as per capita energy consumption.

- In the near future, there would be low elasticity to the policy regarding energy consumption. This implies that even if policy changes help in reducing inefficiencies or substituting fuels, it may not result in lower energy demand due to its structural nature.

- Energy demand will continue to grow in tandem with the growth in GDP due to its strong correlation with the structure of GDP in the Indian economy. With the presence of high-energy-intensive sectors, it seems difficult to decouple energy consumption from GDP growth.



Source: International Energy Agency (IEA); World Bank – World Development Indicators; Energy Institute Statistical Review of World Energy

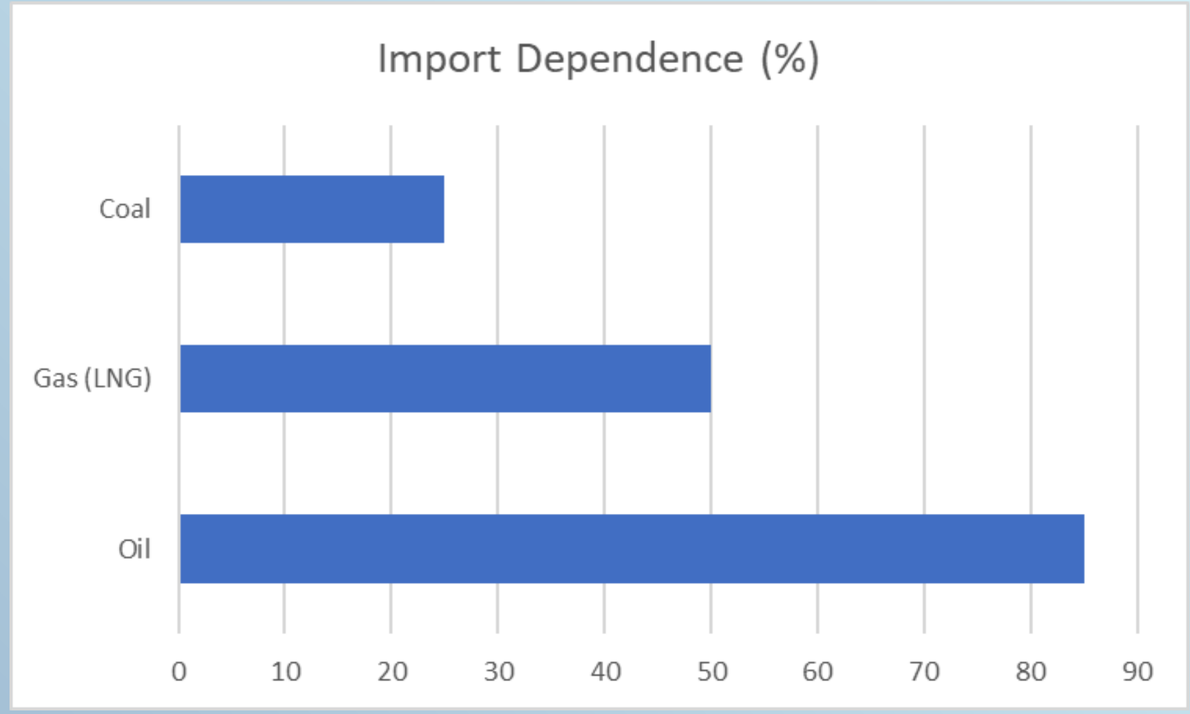
Import Structure - What India Actually Depends On

- The Indian energy sector relies extensively on imported crude oil, which satisfies the bulk of the domestic demand. Consequently, the oil import bill becomes an integral part of the total import bill, impacting the current account balance and making the country vulnerable to international prices.

- Natural gas also poses challenges for the energy sector. Domestic production has not kept pace with rising industrial and urban demand. Therefore, there has been a growing trend towards the importation of LNG, whose prices depend on international market trends, rendering the country unable to exert any influence over the prices.

- There are mixed prospects for coal. The country produces its own coal and imports it at the same time. While domestic coal is used for power generation, imported high-grade coal is used for the manufacture of steel.

- Each of these fuels comes with its own risks and dangers. Oil prices are volatile, and gas is infrastructure-dependent. The coal import bill is concentrated on certain geographical areas.



Source: International Energy Agency (IEA); Ministry of Petroleum & Natural Gas; Energy Institute

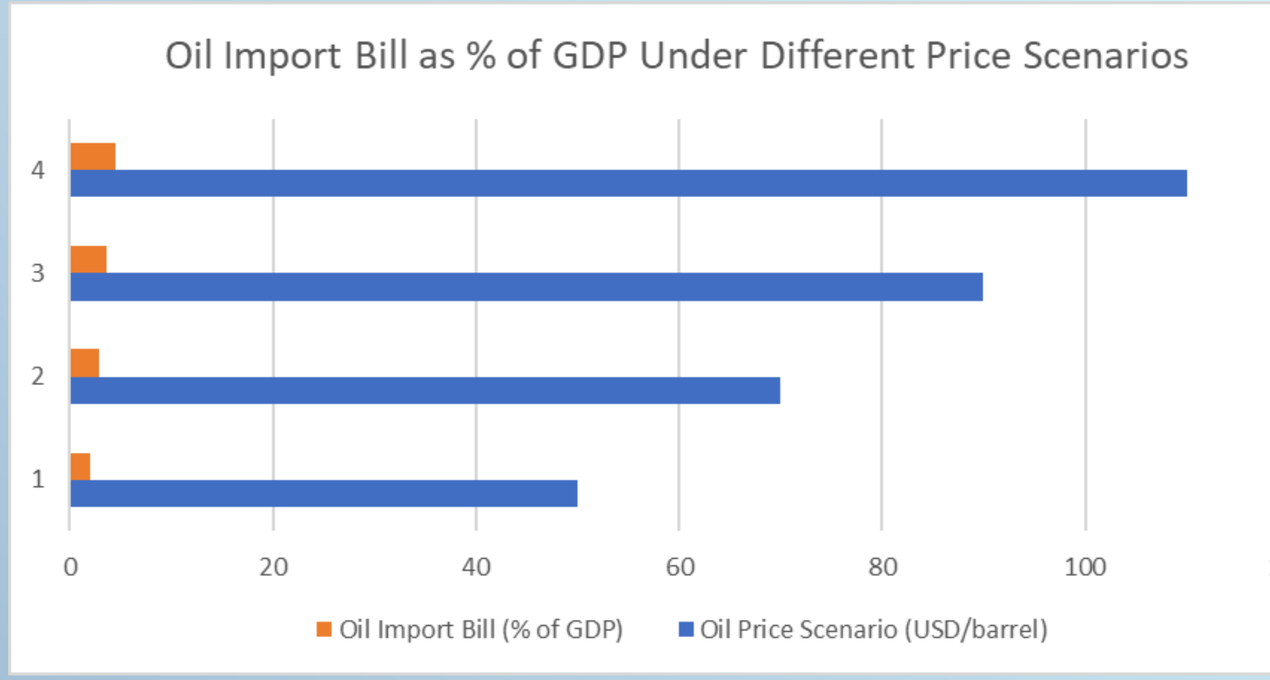
Macroeconomic Exposure - The Oil Import Bill as a Structural Vulnerability

- The cost of oil imports as a percentage of the Indian GDP depends mainly on two external factors beyond India's control. These factors include global oil prices and rupee-dollar exchange rates.

- Devaluation of the currency increases the effects of a rise in oil prices through a multiplying effect. An increase in global crude prices coupled with a depreciation in the value of the currency leads to an increased trade deficit and higher levels of inflation.

- However, in most cases, the impacts of oil price changes in international markets have been mitigated through various policies like subsidy and price controls for fuels. In doing so, the shock is transferred from consumers to the government.

- The effects of oil price shocks are characterized by asymmetry, meaning that any reduction in the prices of oil provides only minimal benefit to India, while an increase poses greater challenges.



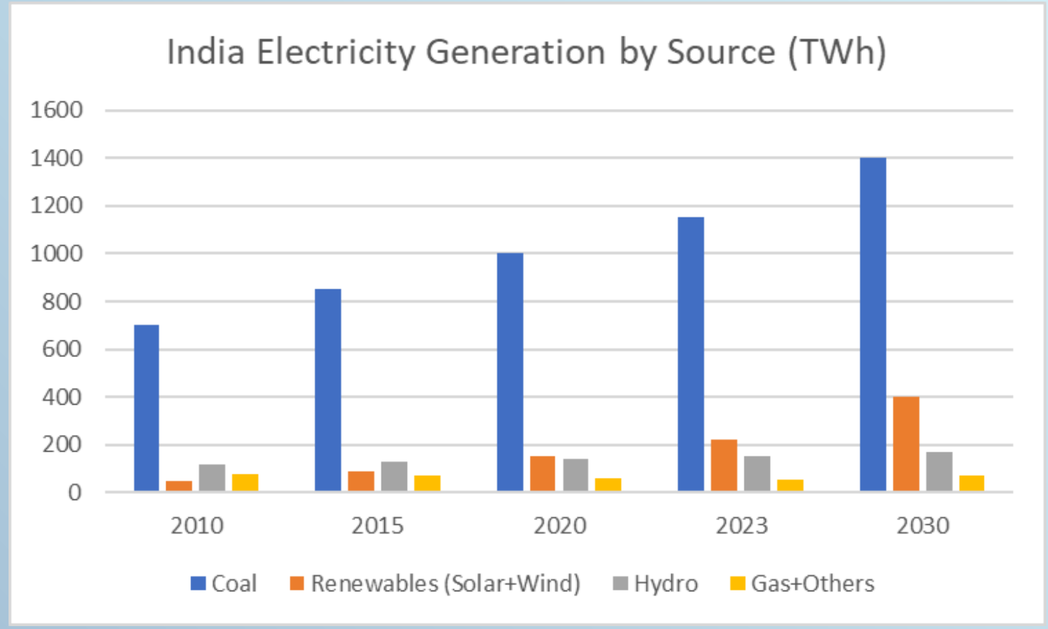
Source: Reserve Bank of India (RBI); International Energy Agency (IEA); World Bank

Energy Mix - Coal's Structural Persistence

- Coal will continue to be a dominant part of India's electricity generation fuel mix both in terms of percentage share and actual amount consumed. Although there is no doubt that the percentage share of coal will eventually decline as the use of renewable energies increases, the total amount of coal consumed will only increase to cater to increased base load demands.

- This means that India's energy sector has been expanding by developing additional capacities to meet increasing energy demands, leading to a diversification in the fuel mix rather than a complete transition to clean sources of energy. The country's position in international summits on climate change, such as its push towards a 'phase-down' and not 'phase-out' of coal, is an indication of this fact.

- Domestically, the Indian government views coal as an essential component of energy security and sustainable development, unlike other countries that consider it an environmental hazard. In essence, the "phase-out" of coal will only be possible if India develops renewable energy resources and creates alternative uses for industries.



Source: Central Electricity Authority (CEA); International Energy Agency (IEA); Energy Institute Statistical Review

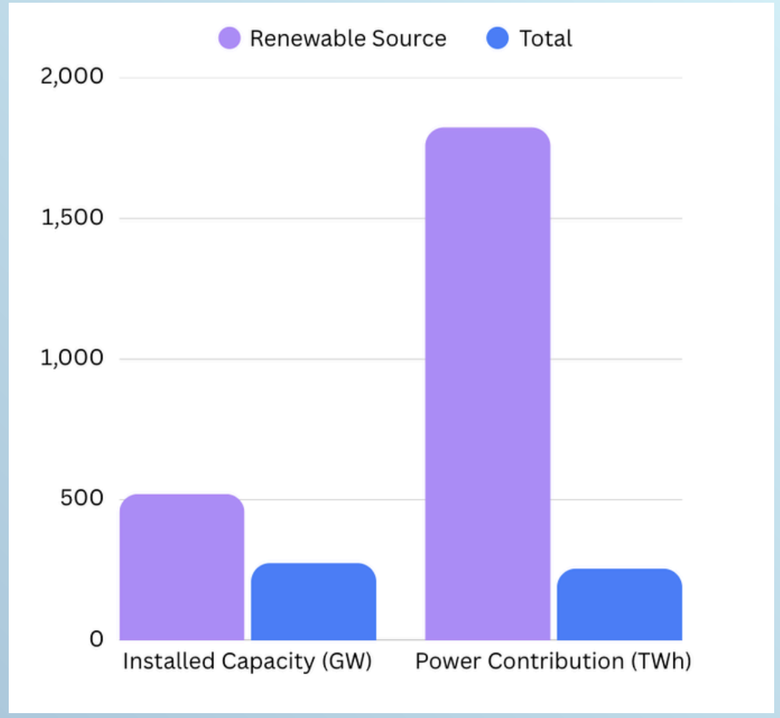
Renewable Expansion: What the Targets Reveal and Conceal?

- India’s renewable energy goals, notably the 500 GW non-fossil commitment by 2030, are designed in terms of installed capacity, which inflates the actual contribution to energy security. Installed capacity indicates potential output, not the actual electricity that can be reliably supplied to the grid. In practice, solar and wind operate at significantly lower utilisation levels than thermal power, with CUFs of roughly 20–35% compared to 65–75% for coal.

- The outcomes for each generation show this difference. More than 40% of installed capacity comes from sources other than fossil fuels, but actual electricity generation shows a much smaller contribution from these sources. Coal still makes up more than 70% of total generation. When renewable output changes, dispatchable sources like coal and hydro keep the system stable. This dependence doesn't go down as quickly as renewable capacity goes up.

- Targets stated in gigawatts can be met by mobilizing capital, but this does not directly lead to better reliability or resilience. The policy framing could mix up capacity expansion and energy security, even though the latter depends on having firm and dispatchable power. A system with a lot of installed capacity but constant variability limits may get bigger without becoming safer.

2025 - Installed Capacity vs Actual Electricity Generation in India



Source: CEA, PIB , Ministry of Power

The Substitution Illusion

Indicator	Addition Mode (India Today)	Substitution Mode (*Energy Secure System*)
Coal Consumption	~1,500 BU and rising (CEA, 2024)	Declining in absolute terms
Oil Import Dependence	~85% import dependence (MoPNG)	Reduced import exposure
Renewable Share (*Generation*)	~14–15% (CEA, 2025)	>40–50% firm contribution
Emissions Trend	Rising (slower growth)	Declining
Import Bill Exposure	High sensitivity to global prices (RBI)	Reduced vulnerability
Grid Reliability	Dependent on coal backup	Supported by storage + firm RE
System Outcome	Larger system, same structure	Structural transformation

Source: CEA, RBI , MoPNG

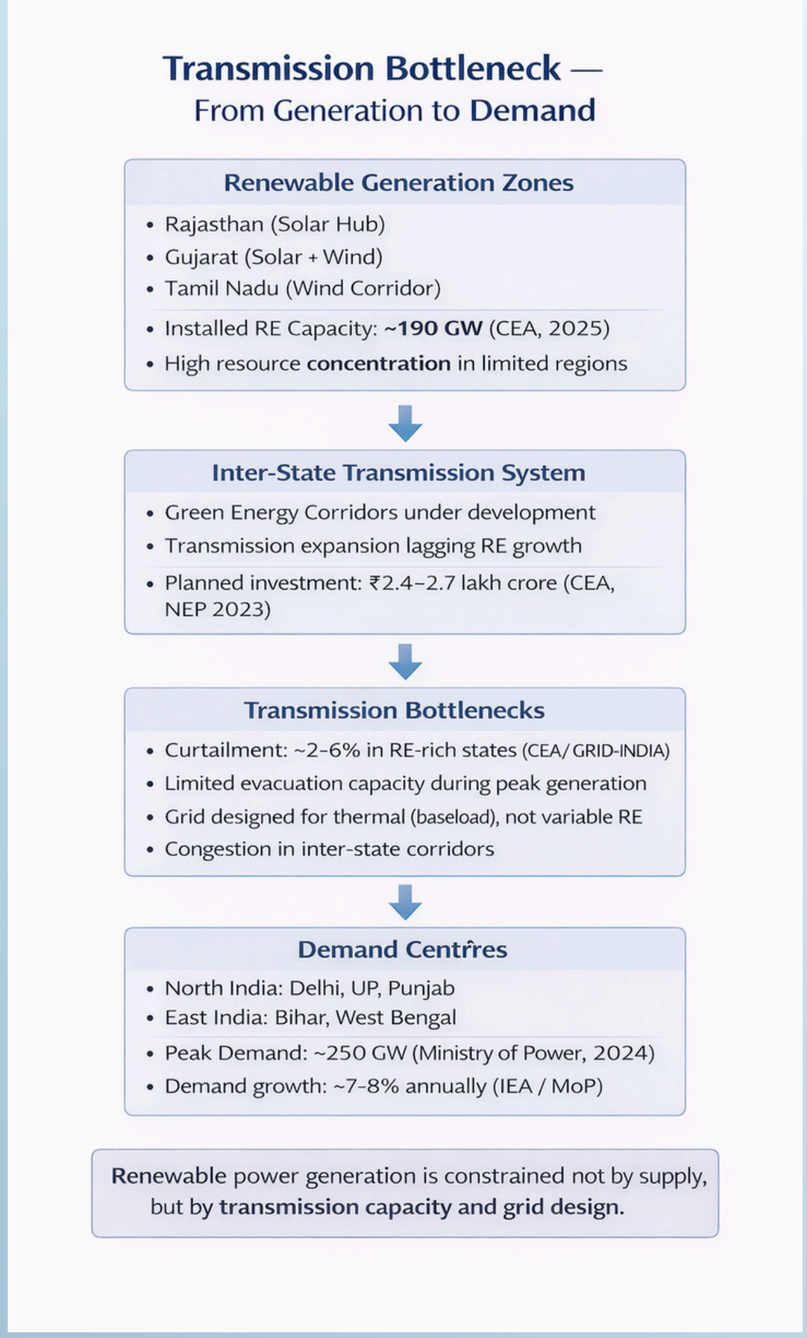
- India’s energy transition is currently in an addition mode, where renewable capacity primarily serves the new demand with little displacement of the existing fossil fuels consumption. Demand for electricity is growing rapidly, with peak demand exceeding ~250 GW in 2024 and India fulfilling a demand of 242.49GW in 2025. This is a demand driven by the broad and rapid structural expansion of the economy . This growth is driven by industrialisation, urbanisation, and rising household consumption, all of which create sustained upward pressure on energy demand.
- This growth dynamic means that renewable additions are absorbed into a continuously expanding demand base. Coal generation has therefore continued to rise in absolute terms, and still accounts for over 70% of electricity generation, indicating that renewable capacity has not displaced baseload thermal power . The persistence of coal reflects the need for stable, dispatchable supply to meet rising demand reliably.
- Consequently, even though the proportion of fossil fuels in the total installed capacity may decline, the absolute consumption of fossil fuels is unwavering. Because of this, we are witnessing a transition, however, there is no decline in the energy dependence on imports, no significant reduction in price exposure , and the predominant energy vulnerability in the system remains largely unchanged. The system expands in size, however, there is no change in the fossil fuel dependence of the system

Grid and Transmission Infrastructure

- India's renewable energy resources are geographically concentrated, while demand centres are distributed across different regions, creating a structural dependence on transmission infrastructure. Solar capacity is concentrated in western India, while wind resources are located in coastal regions, whereas major consumption centres lie in the north and east.

- Transmission expansion, however, has not kept pace with renewable capacity addition. With installed renewable capacity now approaching ~190 GW, bottlenecks in inter-state transmission have led to curtailment of renewable power in several regions. This results in situations where available renewable energy cannot be fully utilised, even when generation conditions are favourable.

- The grid itself was designed around centralised thermal generation and is not optimised for integrating variable renewable inputs. Expanding transmission infrastructure is capital-intensive and subject to regulatory and land constraints, making it slower to develop than generation capacity and turning it into the binding constraint on renewable integration. As renewable penetration increases, these constraints are likely to become more pronounced rather than diminish.



Source: CEA, PIB

Storage as the Critical Gap

- Energy storage is still a major problem for India's transition to renewable energy, making it hard for renewable energy to provide reliable power. Lithium-ion batteries are the most common type of battery used right now. They usually hold 2 to 4 hours of charge, which makes them good for short-term balancing but not for longer-term changes. This means they work well for dealing with short-term changes, but not for long-term periods of low generation.

- There are changes in renewable energy generation over different time periods, such as daily and seasonal changes. India has a lot of potential for long-term storage, especially pumped hydro, which is thought to be over 100 GW. However, it hasn't been widely used yet. New technologies like flow batteries are still in the early stages of being sold and haven't yet been used on a large scale in the grid.

- The current focus on short-duration storage addresses immediate balancing needs but does not resolve longer-duration reliability challenges. Without scalable long-duration storage, renewable energy cannot function as a substitute for coal in meeting continuous baseload demand. This creates a structural ceiling on how far renewable expansion can translate into system-level reliability.

Comparison of Storage Technologies

Technology	Discharge Duration (Hours)	Cost ($/kWh)
Lithium-ion	2–4 hours	~120–200
Pumped Hydro	6–24 hours (can go higher)	~50–150
Flow Batteries	10–100 hours	~200–400

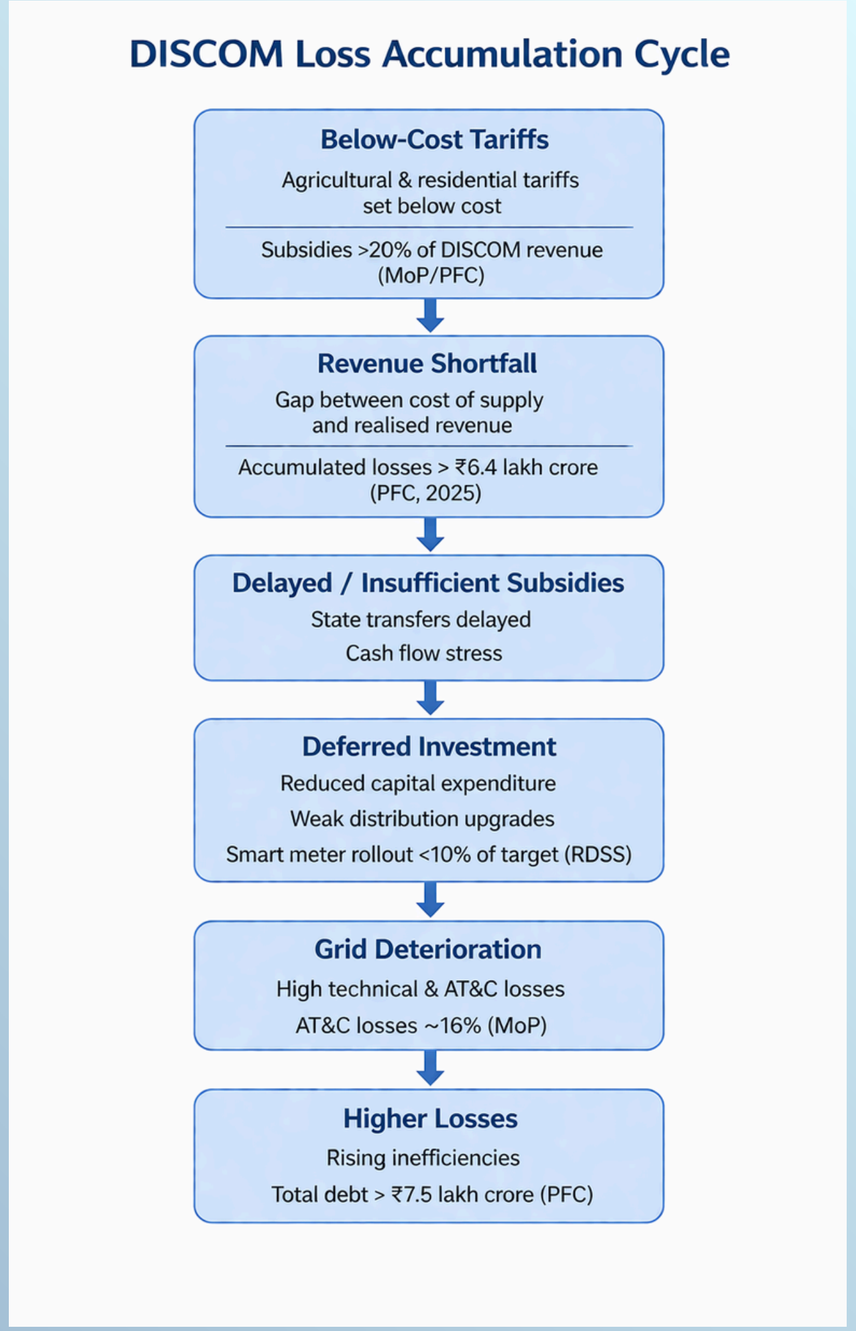
Source: IEA

DISCOM Finances: The Political Economy of Electricity Pricing

- Distribution companies (DISCOMs) are in charge of electricity pricing policy, subsidy obligations, and infrastructure investment. Their financial health is very important to the power sector as a whole. As the link between generation and end-users, their ability to buy and deliver power efficiently is what makes renewable energy deployment possible. But this role is limited by ongoing financial problems, which make it hard for them to help with the last-mile integration of renewables like rooftop solar and decentralized systems.

- The main reason for DISCOM's losses is that the prices are not in line with the structure of the market: power is bought at market-determined rates, but tariffs, especially for agricultural and residential customers, are set below cost for political reasons. As of 2024–25, total debt is over ₹7.08 lakh crore and accumulated losses are over ₹6.4 lakh crore. Subsidy support, which is often more than 20% of revenue, is often late or not enough. This causes gaps in recurring revenue that are moved to state finances or future debts.

- AT&C losses of about 16% are caused by not investing enough in distribution networks. This makes it harder to provide good service and connect distributed renewables and EV charging infrastructure. Even though there are reform programs like UDAY and RDSS, structural improvement is still limited because electricity is still subsidized, especially for farming. Because of this, DISCOMs continue to be a bottleneck further down the line, making it harder for broader efforts to transition to cleaner energy sources to work.



Source: IEA

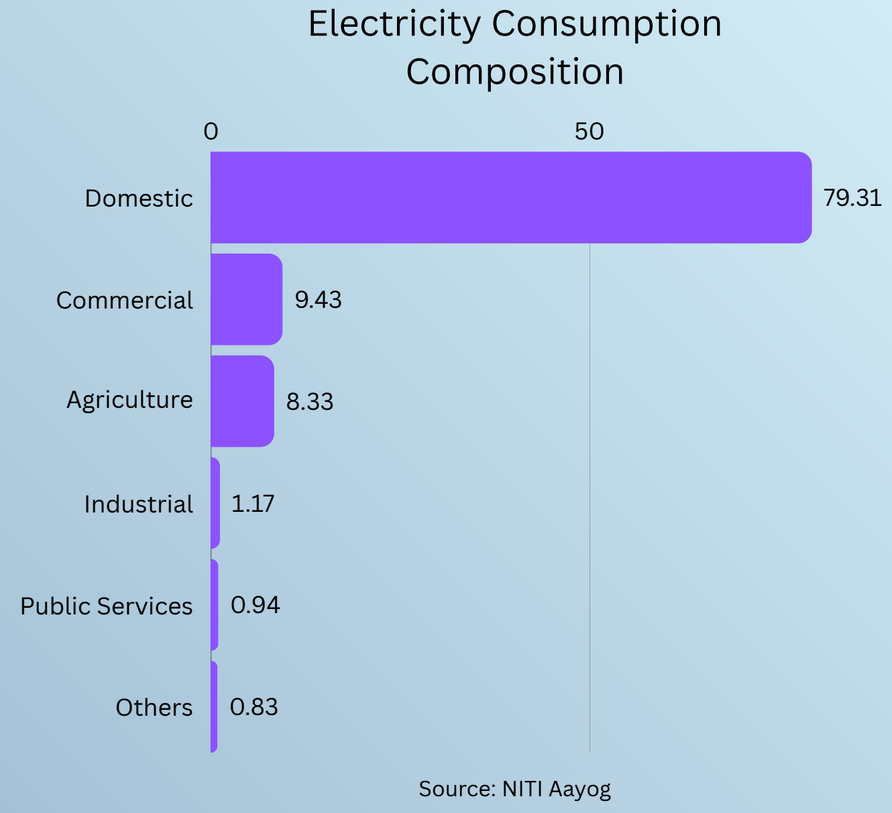
Electricity Subsidies - Fiscal Burden and Pricing Distortion

- The agricultural sector remains a primary driver of financial stress due to unmetered consumption. While it accounts for nearly 20% of India's total electricity consumption, due to subsidized power, its contribution to DISCOM revenue remains disproportionately low.

- The Cross-Subsidy Surcharge (CSS) forces industrial users to pay above-market rates to cover losses incurred from agricultural subsidies. High grid tariffs have accelerated the shift to Captive Power Plants. As of November 2025, India's total installed capacity reached 509.74GW, with a significant portion of new growth coming from private captive renewable projects seeking to bypass DISCOM charges.

- For the first time in over a decade, DISCOMs recorded a collective Positive Profit After Tax (PAT) of ₹2,701 crore in FY 2024-25, largely due to the Late Payment Surcharge (LPS) Rules.

- The RBI Report on State Finances warned that the combined debt of Indian states is estimated at 29.2% of GDP by March 2026. Subsidies for "free electricity" are flagged as a major risk factor that "crowds out" essential spending on health and education.



Private & State in the Energy Sector

India has achieved over 200 GW of non-fossil capacity as of early 2026, but the ownership remains starkly divided between the private and public sectors.

- Approximately 95% of new solar and wind capacity is driven by private capital (e.g., Adani Greeen, Tata Power).
- Thermal/Nuclear: Central and State Public Sector Undertakings (PSUs) like NTPC and NHPC own about 45% of total generation capacity, focusing on baseload power (coal and large hydro).
- In 2025–26, 93% of electricity distribution (by both revenue and volume) remains under state-owned DISCOMs.

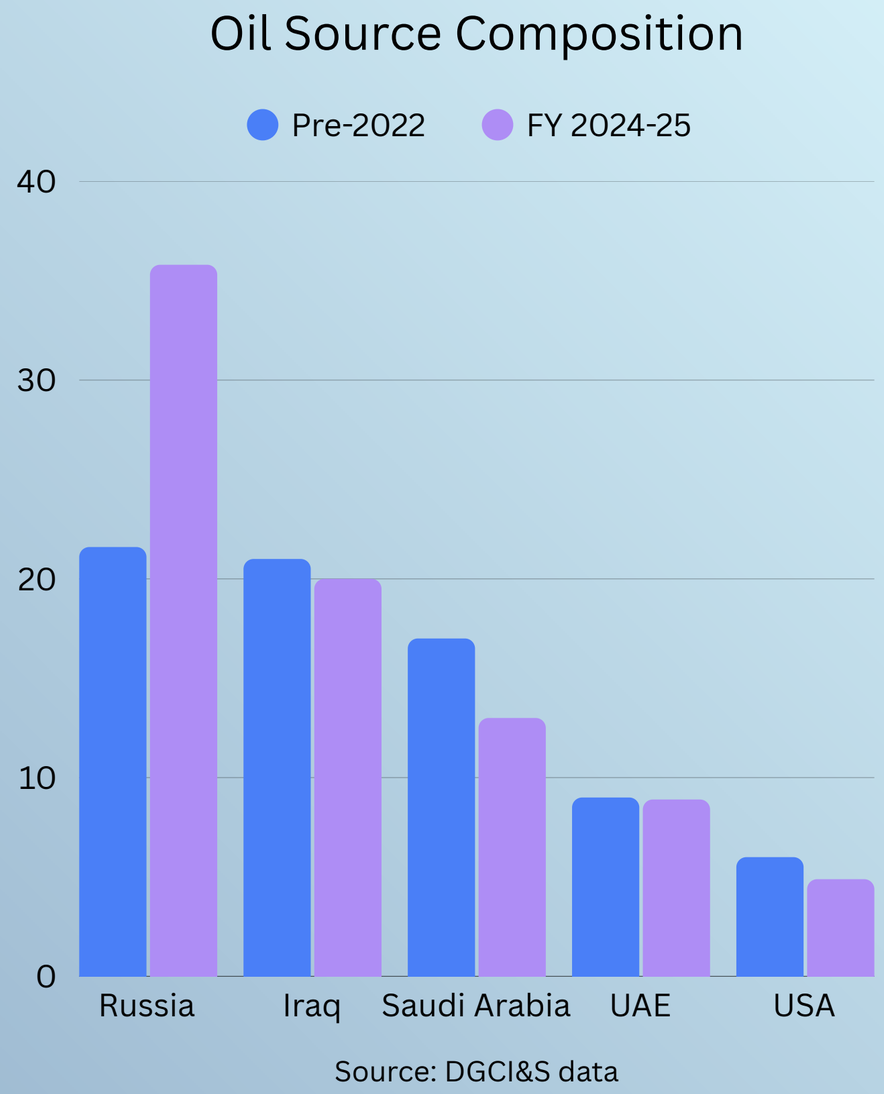
Private developers are legally tethered to state DISCOMs as "offtakers." If the state-owned DISCOM is financially weak, the private developer faces "curtailment" or "payment delays," which halts further investment.

Criteria	Private Sector	Public Sector
Generation	Dominant; leads in renewables such as solar/wind.	Base-load provider, focuses on large scale coal and nuclear.
Transmission	Increasing. Private players bid for specific inter-state projects.	Custodian. PowerGrid and STUs manage the backbone and 'Load Despatch'.
Distribution	Active in privatized hubs through Franchisee models.	Principal Operator. State DISCOMs control 90% of last-mile connectivity.
Fuel Supply	Selective. Captive coal mines and imported LNG.	Monopoly. CIL supplies 80% of domestic coal.

- Coal India Limited (CIL) supplied a record 137 MT of coal to the power sector in FY26. To ensure "energy security," but the government has set a target for domestic coal production to reach 1.5 billion tonnes by 2030.
- India is currently the world's second-largest refining hub with 260 MMTPA capacity, and the Ministry of Petroleum aims to cross 300 MMTPA by 2030.
- State-owned Oil Marketing Companies (OMCs) and Coal India have massive physical networks and workforces. But decarbonizing too quickly threatens the state's own dividend revenue and social stability (employment), leading to a "pragmatic" transition that continues to expand fossil fuel infrastructure alongside renewables.

Oil Sourcing Diversification

- In 2022, Russia’s share of India’s oil imports was less than 2%. By March 2026, it has surged to nearly 44%, effectively replacing traditional Middle Eastern volumes.
- The OPEC Erosion: Iraq and Saudi Arabia have seen their shares collapse. In March 2026 alone, imports from Iraq plunged by 76% and from the UAE by 63%, highlighting a massive pivot toward the "Security of Last Resort".
- While India has saved billions through the "Urals Discount," the structural dependency on imports remains at ~87-88% of total demand. Despite discounts, the absolute high price of oil continues to exert inflationary pressure on India's GDP.
- The geographical vulnerability of India's imports has intensified due to the 2026 Hormuz and Red Sea tensions.
- Disruptions in the Strait of Hormuz (impacting Gulf oil) and the Suez Canal (impacting European/Russian trade) have forced rerouting via the Cape of Good Hope.
- This rerouting increases transit time by 10–15 days and distances by 26,000 km, spiking war-risk insurance premiums and freight rates, which erodes the "discount" benefit of Russian oil.



Maritime Chokepoints and Geopolitical Energy Risk

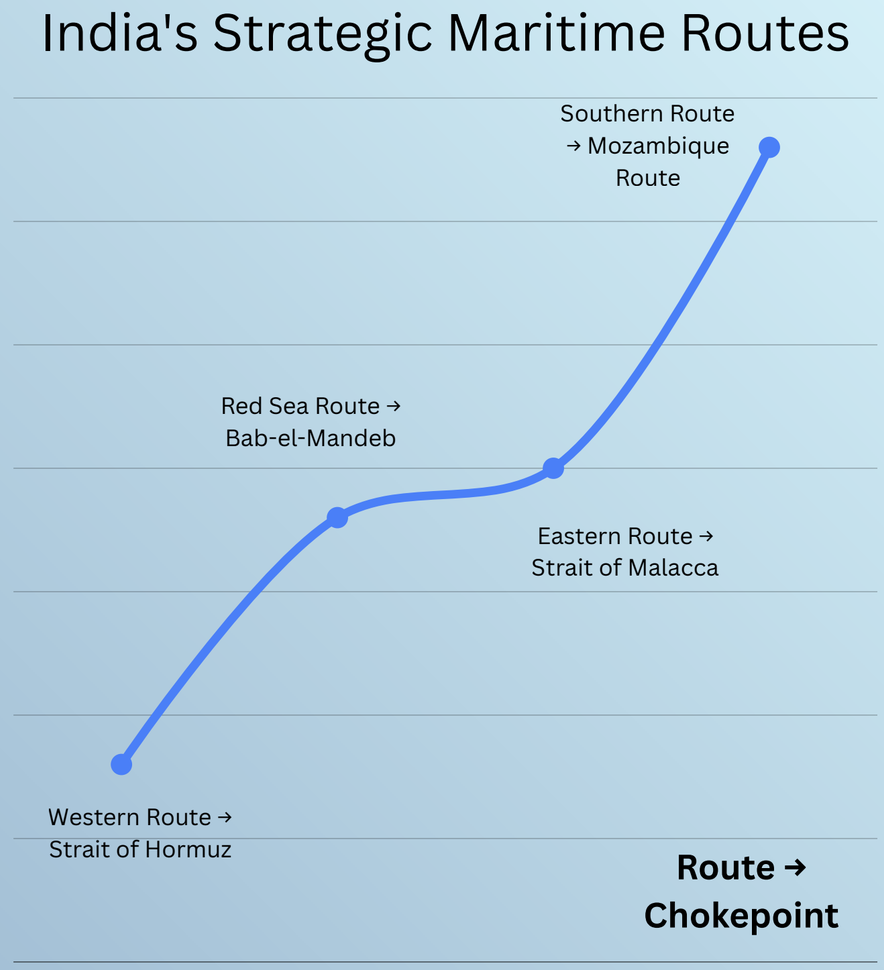
The Strait of Hormuz remains the single most critical and volatile chokepoint for Indian energy. As of early 2026, the geopolitical "interdiction risk" has transitioned into active operational disruption.

Volume of Exposure: Approximately 19 million barrels of oil per day (mbpd) pass through the Strait globally. For India, 80–85% of crude oil imports and a massive portion of its LPG and LNG supplies transit this 33-km wide passage.

Reports from March 2026 indicate that Iranian drone strikes and maritime tensions have effectively slowed commercial traffic, causing a 600% surge in LNG shipping rates due to risk premiums.

On March 27, 2026, the Indian Navy launched "Operation Urja Suraksha" to provide armed escorts and navigational support for Indian-flagged vessels (like the Jag Vasant and Pine Gas) carrying critical energy loads through the Persian Gulf.

While Hormuz handles the bulk of crude, Malacca is the lifeline for India's growing "Gas-Based Economy" ambitions. Roughly 16–20 million barrels of oil and significant LNG volumes from Australia and Indonesia pass through this chokepoint daily. The "Malacca Dilemma" which is the risk of a naval blockade during conflict, persists. India's dependency is increasing as it aims to raise the share of natural gas in its energy mix from 6% to 15% by 2030, necessitating secure routes for Australian LNG. To hedge this, India is exploring deep-water exploration in the Andaman Basin (a $20 billion tender was issued by ONGC in March 2026), but actual production remains a decade away.



Source: Indian Navy Annual Report 2025

EV and Electrification

India’s dependency on crude oil approx. ~88%, is being replaced by an almost 100% import dependency on critical battery minerals.

- In FY25, India imported over $2.8 billion worth of lithium-ion cells. Nearly 70–80% of these imports originate from China, which controls the global midstream processing of lithium, cobalt, and rare earth elements (REEs).
- Even as India auctions domestic blocks, actual commercial extraction remains stalled as of 2026 due to technical hurdles in processing "clay-based" lithium and failed auction tranches.

Strategic Risk: Unlike oil, which has a diversified global market, battery minerals are geographically concentrated. This shifts India's vulnerability from the Middle East/Russia to the China-dominated mineral supply chain.

Criteria	Before	After EV
Primary Resource	Crude Oil	Critical Minerals
Dependency Level	85-87% consumption is imported	95-100% for Lithium, Cobalt, and Nickel while it is 70-80% REEs
Supplier Concentration	Top 3 (Iraq, Russia, Saudi) cover 60% of supply	China controls 70% of Lithium and 80% of Cobalt
Geopolitical Risk	Physical transit risk for Middle Eastern crude	Risk of export bans from mineral-rich nations

Source: NITI Aayog

The financial health of state DISCOMs is the single biggest barrier to the mass-market adoption of EVs.
Private Charge Point Operators (CPOs) report utilization rates of under 25% in 2026. High "fixed charges" and "demand charges" imposed by DISCOMs make the business model unviable without heavy government subsidies.

As of March 2026, EV penetration in India reached ~7.5%, dominated by 2-wheelers and 3-wheelers.
NITI Aayog’s target of 30% EV sales by 2030 is currently being tested by the "Infrastructure Gap." While urban high-income segments are adopting 4-wheelers, the lack of a reliable public charging network (stalled by DISCOM grid constraints) prevents rural and long-distance adoption.

System-Level Evaluation: Risk Profile Across Four Vectors

- India achieved 50% non-fossil fuel electricity capacity in July 2025, five years ahead of schedule. However, fossil fuel dependence persists: coal still accounts for 74% of electricity generation, and oil demand grew by 142% between 2000 and 2023.
- Energy intensity improved by 36% (2000–2023). While EV sales are rising (reaching 1.97 million units in FY25) marginal growth is offset by existing carbon-intensive assets. For example, 80 million new LPG connections reduced biomass use but increased dependence on a fuel that is 60% imported.
- DISCOMs reported a collective profit of ₹2,701 crore in FY 2024-25, their first in a decade. However, structural fragility remains with accumulated losses of ₹6.47 lakh crore and incomplete storage procurement, with utility-scale deployment lagging.
- Sourcing diversification led to Russia providing 35–40% of imports after 2022. Yet, maritime risks are constant: half of crude and 90% of LPG still transit the Strait of Hormuz. New frontiers emerge as India is 100% import-dependent for Lithium, Cobalt, and Nickel.

Dimension	Policy Intervention	Risk Type Addressed	Residual Risk (System-Level)
Supply	500 GW Non-Fossil Target	Supply Shortage/Carbon Risk	VRE intermittency;continued coal reliance
Demand	PM E-DRIVE/FAME Schemes	High Fossil Fuel Growth	High uprfront costs for EVs; carbon-intensive industrial stock
Infrastructure	RDSS/Smart Metering	DISCOM Inefficiency/ Losses	Technical capacity gaps in DISCOMs; slow storage rollout
Geopolitics	Critical Mineral Mission	Midstream Supply Chain Risk	China’s dominance in mineral processing (70-90%)

Criteria Comparison Table

System-Level Evaluation: Risk Profile Across Four Vectors

- Reforms like tariff rationalisation are deferred because they impose high costs on electorally significant groups, such as farmers who rely on free or heavily subsidized electricity for irrigation.
- Energy governance is fragmented across multiple ministries (Power, Coal, Petroleum, MNRE) and state governments, which political actors exploit to defer reform.
- High-profile capacity targets (e.g., 500 GW by 2030) generate political credit without requiring immediate, painful changes to pricing or subsidy models.
- The federal structure enables "blame diffusion," where the Centre sets policy frameworks but states control distribution, allowing both tiers to attribute reform failure to the other.

Category	Measures	Political Economy Rationale
Implemented	RE capacity targets; Infrastructure expansion	Provides “visible wins” and nationalist credit with low direct voter cost
Deferred	Subsidy targeting; Tariff rationalisation	High concentrated costs for farmers and urban low-income groups
Structurally Avoided	Coal transition planning; Cross-subsidy elimination	No existing mechanism to compensate “losers” of reform; reliance on redistribution

Energy Policy Interventions Table

System-Level Evaluation: Risk Profile Across Four Vectors

Genuine Achievements: India has reached significant milestones, including:

- Non-Fossil Capacity: Reached 50% of cumulative electricity capacity in July 2025, five years ahead of the 2030 NDC target.
- Universal Electrification: Near-universal access achieved through the DDUGJY and SAUBHAGYA schemes.
- Source Diversification: Successfully diversified crude oil sources, with Russian crude accounting for approximately 22.5% of imports by February 2026.

Intact Structural Drivers: Despite these gains, fundamental vulnerabilities remain:

- Coal Reliance: Coal still accounts for 74% of actual electricity generation (FY 2024-25).
- Import Exposure: Crude oil import dependence remains high at over 85%.
- Fiscal Strain: Electricity subsidies reached an all-time high of ₹2.10 lakh crore in FY24, increasing by 18% and widening the gap between cost of supply and revenue realized.

The Verdict

- Emerging Vulnerabilities: The transition is introducing a new "critical mineral frontier" and infrastructure challenges:
  - India is 100% import-dependent for Lithium, Cobalt, and Nickel, with global processing dominated (60–90%) by China.
  - Utility-scale Battery Energy Storage (BESS) deployment remains far below the volume needed to stabilize a renewables-dominated grid.
  - Coal-dependent states face a "double whammy"; for example, Jharkhand derives 30% of its own revenue from fossil fuels and faces massive reskilling costs.
- The Honest Verdict: India is becoming "differently vulnerable":
  - The transition is occurring in "addition mode," the energy system is larger and more complex, but it has not substantially reduced exposure to price shocks or geopolitical leverage.
  - While old risks like the Strait of Hormuz (which still carries 40% of India's crude) persist, they are now joined by midstream supply chain risks and fiscal fragility in the distribution sector.

Dimension	Pre-Transition (2000-2015)	Current (2024-2026)
Oil Dependency	High (Middle East concentration)	Persistent (Russian concentration + Middle East route exposure)
Grid Reliability	Poor (Rural access gaps)	Improved access but fragile (VRE integration + DISCOM debt)
Geopolitical Exposure	One dimensional (Hormuz)	Multi-dimensional (Hormuz + Sanction risk + Mineral midstream)
Fiscal Burden	Consumption subsidies (LPG/Kerosene)	“Double Whammy” (Legacy subsidies + RE support + Transition costs)
Infrastructure	Under-investment in generation	Strong generation; Unfinished distribution and storage

Energy Security Risk Profile Summary

Thank You!

For inputs, comments or clarifications please contact
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