

Daily Editorial Analysis 2 July 2026

July 2, 2026 • vajiramandravi.com



The Case for Building India's Coal Chemistry Capability

Context

- The **2026 Strait of Hormuz crisis** tested India's ability to withstand a major disruption in global energy supplies.
- The country's effective response demonstrated that **energy security** depends not only on diplomatic engagement or diversified imports but also on **indigenous scientific capability, technological self-reliance**, and robust industrial institutions.
- While India successfully managed the immediate crisis, achieving long-term resilience requires reducing dependence on imported fuels through domestic technological innovation.

India's Successful Crisis Management

- **Refinery Flexibility and Technical Capability**
 - India's response was built on decades of investment in **research and development, process engineering, metallurgy**, and **workforce training**.

- Modern refineries developed the flexibility to process crude oil with different density, sulphur, and viscosity characteristics from multiple suppliers, including the Americas, West Africa, Russia, and West Asia.
- Within weeks of the disruption, non-Hormuz crude sourcing increased from 55% to 70%.
- Engineers rapidly adjusted refinery operations, optimized production processes, and maintained product quality without disrupting fuel supplies.
- During the LPG shortage, domestic refinery output increased from 35 to 54 thousand metric tonnes per day, reflecting India's strong technical capability, engineering expertise, and accumulated institutional knowledge.
- **Indigenous Capability as Strategic Insurance**
 - The crisis highlighted that lasting national resilience is built on **scientific capability** and **human capital** rather than temporary geopolitical arrangements.
 - Investments in research and industrial expertise enabled India to absorb external shocks with confidence.
 - However, although crude imports can be diversified, **LPG imports** remain concentrated among a limited number of exporting countries, leaving a significant structural vulnerability.

From Crisis Management to Structural Reform

- Strengthening long-term energy security requires replacing imported fuels with domestic alternatives.
- **Dimethyl Ether (DME)**, produced through **coal gasification**, is chemically similar to LPG and can be blended into existing cylinders and pipelines without major infrastructure changes.
- With abundant **coal reserves**, India possesses a significant comparative advantage. The **Bureau of Indian Standards** has approved blending up to 20% DME with LPG.
- Such blending could replace approximately 6.3 million tonnes of LPG imports annually and save nearly ₹34,000 crore in foreign exchange, while enhancing **strategic autonomy** and reducing exposure to global supply disruptions.

The Way Forward: Innovation Ecosystem and Policy Support

- An effective **innovation ecosystem** requires collaboration among **research institutions**, **government**, and **industry**.
- Indigenous DME technology developed by the **CSIR's National Chemical Laboratory** and its rapid scaling through the **Centre for High Technology** illustrate how scientific research can be transformed into strategic national capability.
- Recognising this potential, the Union Cabinet approved a ₹37,500 crore **coal gasification** programme targeting 100 million tonnes annually by 2030.
- The scheme provides financial incentives, long-term coal linkages, and policy certainty for industrial investment.
- However, challenges such as **high-ash coal**, limited gasification capacity, and the need for greater technical expertise require sustained **investment**, industrial discipline, and continuous technological advancement.

Conclusion

- The Hormuz crisis demonstrated that **indigenous capability** is India's most reliable safeguard against global energy disruptions.
- Decades of investment in science, engineering, and industrial capacity enabled the country to manage an immediate crisis effectively.
- Applying the same commitment to coal gasification and DME production can reduce import dependence, strengthen **energy resilience**, promote **innovation**, and enhance India's long-term **economic security** and **strategic independence**.

The Case for Building India's Coal Chemistry Capability FAQs

Q1. What did the 2026 Strait of Hormuz crisis reveal about India's energy security?

Ans. The crisis showed that indigenous scientific capability and technological self-reliance are essential for long-term energy security.

Q2. How did Indian refineries respond to the supply disruption?

Ans. Indian refineries adapted by processing crude oil from multiple sources through technical flexibility and engineering expertise.

Q3. Why is Dimethyl Ether (DME) important for India?

Ans. DME can reduce India's dependence on imported LPG by serving as a domestically produced alternative fuel.

Q4. What role does coal gasification play in energy security?

Ans. Coal gasification enables the production of DME from India's abundant coal reserves, strengthening energy resilience.

Q5. What is the key lesson from the Hormuz crisis?

Ans. The key lesson is that sustained investment in research, innovation, and industrial capability creates lasting national resilience.

Source: **The Hindu**

A Unified Policy Architecture for India's Energy Future

Context

- As India aspires to achieve **energy self-reliance by 2047** and **net-zero emissions by 2070**, the next phase of its energy transition requires a more integrated and coordinated approach to planning and governance.
- Recognising this need, the **Indian National Science Academy (INSA)** released a policy brief in May 2026 proposing a **Unified National Energy Framework**.
- The framework aims to integrate diverse energy resources, technologies, and institutions to achieve energy security, affordability, sustainability, and long-term economic growth.

India's Energy Transition: Achievements and Emerging Challenges

• Major Achievements

- India has made significant progress in improving energy accessibility and sustainability through several landmark initiatives, including:
 - **Saubhagya Scheme**, which achieved near-universal household electrification.
 - **Pradhan Mantri Ujjwala Yojana (PMUY)**, which expanded access to clean cooking fuel for millions of households.
 - Rapid expansion of renewable energy capacity from approximately **40 GW in 2015** to nearly **260 GW by 2025**, making India one of the world's fastest-growing renewable energy markets.

• Emerging Challenges

- Despite these successes, India's energy sector faces several structural challenges:
 - Rising energy demand due to rapid industrialization, urbanization, and economic growth.
 - Continued dependence on imported crude oil and natural gas.
 - Balancing multiple priorities, including energy security, affordability, sustainability, and economic competitiveness.
 - Increasing complexity arising from the integration of conventional and renewable energy sources.

Need for an Integrated National Energy Framework

- The INSA policy brief argues that India's evolving energy landscape requires a holistic approach rather than fragmented sector-specific policies.
- An integrated framework seeks to:
 - Coordinate planning across all energy sources.
 - Improve collaboration among various institutions and stakeholders.
 - Integrate generation, transmission, storage, distribution, and emerging technologies.
 - Ensure long-term policy consistency.
 - Enhance energy resilience while supporting sustainable development.
- By viewing the energy sector as a single interconnected system, the framework aims to optimize resource utilization and improve policy effectiveness.

The Four Pillars of the Proposed Energy Framework

• Adequacy: Ensuring Reliable Energy Supply

- Adequacy focuses on maintaining a secure and diversified energy supply capable of meeting India's growing energy demand.
- Key strategies include:
 - Diversification of conventional and renewable energy sources.
 - Modernization of energy infrastructure.
 - Expansion of energy storage systems.
 - Adoption of digital technologies for efficient grid management.

- Strengthening national energy resilience and reducing long-term vulnerabilities.
- **Access: Providing Reliable and Equitable Energy**
 - Building upon India's achievements in electrification and clean cooking fuel access, this pillar emphasizes universal access to quality energy services.
 - Priority areas include:
 - Improving last-mile connectivity.
 - Enhancing reliability and quality of electricity supply.
 - Expanding decentralized and off-grid renewable energy solutions.
 - Ensuring equitable access for rural and remote communities.
- **Affordability: Making Energy Economically Accessible**
 - A successful energy transition must remain financially sustainable for consumers and industries alike.
 - The framework promotes:
 - Innovative financing mechanisms.
 - Efficient and competitive energy markets.
 - Consumer protection measures.
 - Cost-effective deployment of clean energy technologies.
 - Inclusive economic growth without imposing excessive financial burdens.
- **Appropriate Sustainability: A Context-Specific Approach**
 - Unlike a one-size-fits-all sustainability model, the framework advocates an approach tailored to India's developmental priorities and resource availability.
 - This includes:
 - Region-specific transition strategies.
 - Support for local communities.
 - Workforce reskilling and employment generation.
 - Environmentally responsible development aligned with socio-economic realities.
 - The concept recognises that sustainability must complement, not hinder, India's development goals.

Phased Roadmap for Energy Transition

- **Short-Term Priorities**
 - Immediate focus areas include:
 - Strengthening energy infrastructure.
 - Accelerating renewable energy deployment.
 - Promoting emerging technologies such as green hydrogen.
 - Establishing institutional mechanisms for better coordination.
- **Long-Term Priorities**
 - Over time, emphasis will shift toward:
 - Greater integration of low-carbon technologies.
 - Increased use of bio-resources.
 - Development of resilient and interconnected energy systems.
 - Continuous technological innovation and digitalisation.

Conclusion

- India's energy transition extends **beyond increasing renewable energy capacity**; it seeks to build an integrated, resilient, affordable, and sustainable energy system capable of supporting future economic growth and environmental commitments.
- The **Unified National Energy Framework** proposed by the Indian National Science Academy provides a comprehensive roadmap by emphasizing the four pillars of adequacy, access, affordability, and appropriate sustainability.
- Through coordinated planning, technological innovation, and inclusive governance, India can strengthen its energy security, reduce import dependence, and successfully achieve its long-term goals of energy **self-reliance by 2047** and **net-zero emissions by 2070**.

A Unified Policy Architecture for India's Energy Future FAQs

Q1. What is the main objective of India's Integrated National Energy Framework?

Ans. The main objective is to create a secure, affordable, sustainable, and integrated energy system for India.

Q2. What are the four pillars of the proposed energy framework?

Ans. The four pillars are adequacy, access, affordability, and appropriate sustainability.

Q3. Why does India need an integrated energy framework?

Ans. India needs an integrated energy framework to coordinate diverse energy sources and ensure long-term energy security and sustainable development.

Q4. What role does renewable energy play in India's energy transition?

Ans. Renewable energy helps diversify the energy mix and reduce dependence on fossil fuels.

Q5. What are India's long-term energy goals?

Ans. India aims to achieve energy self-reliance by 2047 and net-zero emissions by 2070.

Source: **The Hindu**

Reimagining India's PPP Model - Why Capital Circulation is the Key to Infrastructure Financing

Context

- India's ambitious goal of becoming a developed nation by 2047, alongside achieving net-zero emissions by 2070, requires **unprecedented investment** in infrastructure.
- While the first generation of **Public-Private Partnerships (PPPs)** transformed sectors such as airports, highways and ports, their financing structure was fundamentally flawed.
- Instead of abandoning PPPs, India should adopt a **second-generation financing architecture** centred on capital circulation, enabling continuous recycling of public and private capital.

Need for a New Infrastructure Financing Model

- India's infrastructure pipeline had expanded to over 13,000 projects worth nearly ₹185 lakh crore by March 2025, yet this represents only a fraction of future requirements.
- Massive investments are needed in **renewable energy**, power transmission networks, green hydrogen, climate-resilient urban infrastructure, and adaptation and decarbonisation projects.
- Achieving net-zero by 2070 is estimated to require investments exceeding **\$20 trillion**. Such a scale cannot be financed solely through government expenditure or corporate balance sheets.

Lessons from the First Generation of PPPs

- The PPPs themselves did not fail; their financing model did.
- **Core problem - Asset-liability mismatch:** Infrastructure assets typically generate returns over 30-50 years, but many PPP projects were financed through bank loans with repayment periods of only 7-10 years.
- **Consequently:**
 - Debt servicing peaked during the early years when revenues were uncertain.
 - Following the Global Financial Crisis (2008) and domestic economic slowdown, project revenues declined while debt obligations remained fixed.
 - This led to rising Non-Performing Assets (NPAs), stressed infrastructure projects and declining investor confidence.
- **Key takeaway:**
 - Long-term infrastructure was financed using short-term capital, creating systemic financial stress.

From Capital Scarcity to Capital Circulation

- India's challenge today is not merely raising more capital but efficiently matching different sources of capital with different stages of project risk.
- **Risk-based financing across the project lifecycle:**
 - Different investors should finance projects according to their risk appetite.
 - **Project stage (Appropriate investor):**
 - Project preparation, land acquisition, construction (Government/public sector).
 - Operational and revenue-generating stage [Developers and Infrastructure Investment Trusts (InvITs)].
 - Mature, low-risk assets (Pension funds, insurance companies, sovereign wealth funds).
 - This ensures that public capital is **recycled** instead of remaining locked in completed projects.

India's Existing Institutional Strengths:

- India has already developed important financing platforms, like,
 - **Infrastructure Investment Trusts (InvITs):** Enable monetisation of operational infrastructure assets.
 - **National Investment and Infrastructure Fund (NIIF):** Has successfully attracted global institutional investors.

- However, these mechanisms need to function within a continuous capital recycling framework, where ownership and financing shift as project risks decline.

The Concept of Circular Finance with Continuous Capital Recycling

- **Working:**

- Government and developers finance project construction.
- Once projects become operational and revenues stabilise, **InvITs** acquire these assets.
- Governments and developers recover capital and reinvest it in new infrastructure.
- Operational projects are refinanced through Infrastructure Debt Funds (**IDFs**).
- Eventually, mature assets are financed by pension funds, insurance companies and sovereign wealth funds, which seek stable long-term returns.

- **Implication:**

- This reduces financing costs while ensuring capital remains available for successive infrastructure projects.

Role of Financial Sector Reforms:

- **Dynamic risk-based loan repricing:**

- The Reserve Bank of India (RBI) must mandate dynamic risk-based repricing of infrastructure loans.
- Currently, banks continue charging interest rates based on construction-stage risks even after projects become operational. This discourages refinancing and delays capital recycling.
- Risk-based repricing would **lower borrowing costs** for de-risked projects and facilitate transfer of assets to long-term investors.

- **Reviving infrastructure debt funds:**

- Infrastructure Debt Funds should serve as intermediaries between operational infrastructure assets and institutional investors by –
 - Refinancing expensive bank loans.
 - Providing long-term, lower-cost capital.
 - Improving overall financial sustainability of infrastructure projects.

Why Capital Circulation Matters

- Keeping public funds or bank capital locked indefinitely in mature infrastructure reduces the economy's capacity to finance new projects.
- A robust capital circulation framework would:
 - Improve **efficiency** in infrastructure financing.
 - Reduce pressure on public finances.
 - Lower the cost of capital.
 - Attract global long-term institutional investors.
 - Support sustainable infrastructure expansion while maintaining **fiscal discipline**.

Conclusion

- India's infrastructure ambitions demand a shift from merely mobilising private capital to creating a financing ecosystem where capital circulation is as important as capital mobilisation in achieving the Viksit Bharat 2047 vision.
- Therefore, the second generation of PPPs must focus on risk-appropriate financing, refinancing, asset recycling and institutional participation.

Reimagining India's PPP Model FAQs

Q1. Why did the first generation of Public-Private Partnerships (PPPs) in India face financial distress?

Ans. Because long-term infrastructure assets were financed through short-term bank loans, creating an asset-liability mismatch.

Q2. What is meant by 'capital circulation' in infrastructure financing?

Ans. It refers to the continuous recycling of public, developer and institutional capital across different stages of an infrastructure project.

Q3. Why is dynamic risk-based repricing of infrastructure loans important?

Ans. It aligns borrowing costs with declining project risks, encourages refinancing, reduces the cost of capital, etc.

Q4. What is the role of the InvITs and Infrastructure Debt Funds (IDFs) in India's infrastructure financing?

Ans. InvITs monetise operational infrastructure assets, while IDFs refinance mature projects and connect them with pension and insurance funds.

Q5. How can a circular finance model contribute to achieving India's Viksit Bharat 2047 and net-zero goals?

Ans. By recycling capital into successive infrastructure projects, reducing fiscal pressure, attracting long-term institutional investment, etc.

Source: IE

Source: <https://vajiramandravi.com/current-affairs/daily-editorial-analysis-2-july-2026/>

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