September 2026

Beyond 100 GW: How India is building the world's next nuclear market

Tenet Consulting – Nuclear Sector insights

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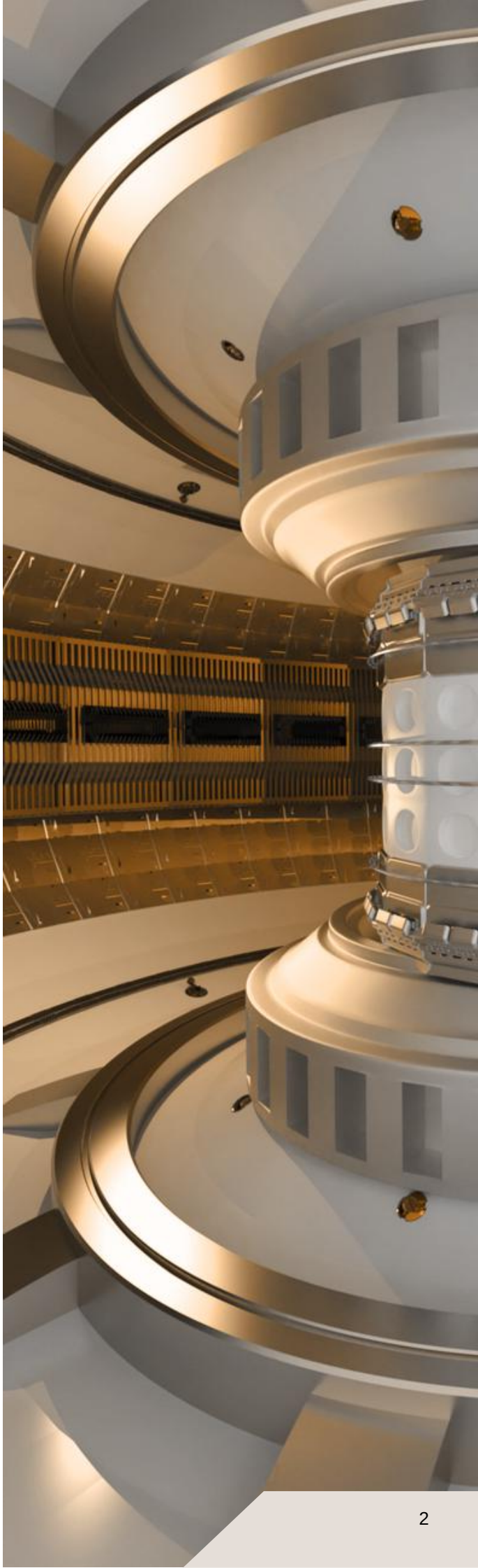

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AT A GLANCE

Country: India

Topic: Nuclear market liberalization and fleet expansion

Focus: Building a scalable multi-operator nuclear ecosystem to achieve 100 GW by 2047

Project stage: Market liberalisation and large-scale programme deployment

Key stakeholders:
Government • NPCIL • Private utilities • International reactor vendors • EPC contractors • Investors • Domestic supply chain

Key message:
India's greatest challenge is no longer choosing reactor technology, but building the institutional, industrial, financial, and human capabilities required to deliver one of the world's largest nuclear expansion programmes

Reading time: 12-14 min

Why it matters: India's transition from a state-led nuclear programme to a multi-operator market will create one of the most significant opportunities for reactor vendors, engineering companies, investors, and supply-chain partners over the next two decades

India's ambition to expand nuclear capacity from 8.9 GW to 100 GW by 2047 represents one of the world's largest nuclear infrastructure programmes. However, the challenge extends far beyond reactor deployment.
The country's success will depend on its ability to build new institutions, attract private capital, localise supply chains, develop thousands of skilled professionals, and create a scalable multi-operator ecosystem. For international vendors and investors, the opportunity lies not only in supplying technology, but in helping India transform nuclear power into a repeatable industrial delivery model.

PART I

India is building more than just Nuclear Power Plants

India's ambition to expand nuclear capacity from 8.9 GW today to 100 GW by 2047 is often described as one of the world's largest nuclear construction programmes. That description is accurate – but incomplete. The real challenge facing India is not simply building more reactors. It is creating an institutional, industrial, and financial ecosystem capable of delivering nuclear projects repeatedly, efficiently, and at unprecedented scale.

Key Performance Indicator (KPI)	2025 Target / Status	2047 Strategic Target
Annual Per Capita Electricity Consumption in India Average electrical energy consumed per person annually.	1.5 k kWh	4 k kWh
Annual Electricity Generation Total aggregate gross electricity produced nationwide.	2 trillion kWh	7 trillion kWh
Nuclear Power Capacity Total operational and grid-connected capacity of all NPPs.	8.9 GW	10 GW

Source: Tenet analysis

Unlike countries whose nuclear industries evolved gradually over several decades, India is attempting to compress multiple stages of market development into a single generation. Over the next 20 years, the country must transition from being a predominantly state-led nuclear programme to a more diversified ecosystem involving private investors, multiple project owners, engineering companies, equipment manufacturers, and international technology providers. In many respects, India is not merely expanding its nuclear fleet. It is creating one of the world's newest large-scale nuclear markets.

WHY 100 GW IS A DIFFERENT KIND OF CHALLENGE

Most discussions about India's nuclear ambitions focus on the headline number – 100 gigawatts. Yet capacity targets alone reveal very little about the complexity of what lies ahead.

Delivering 100 GW requires being able to replicate projects consistently across multiple sites, manage parallel construction programmes, develop industrial supply chains, train tens of thousands of specialists, and maintain regulatory oversight over a rapidly expanding sector. Many countries have announced ambitious nuclear targets. Far fewer have successfully built the organisational capacity required to sustain large-scale deployment over decades. India's programme will therefore be judged not only by the number of reactors it commissions, but by whether it succeeds in creating a delivery system capable of repeating that success over and over again. Part III examines in detail why this institutional transition, rather than reactor technology, has become the central bottleneck of the programme.

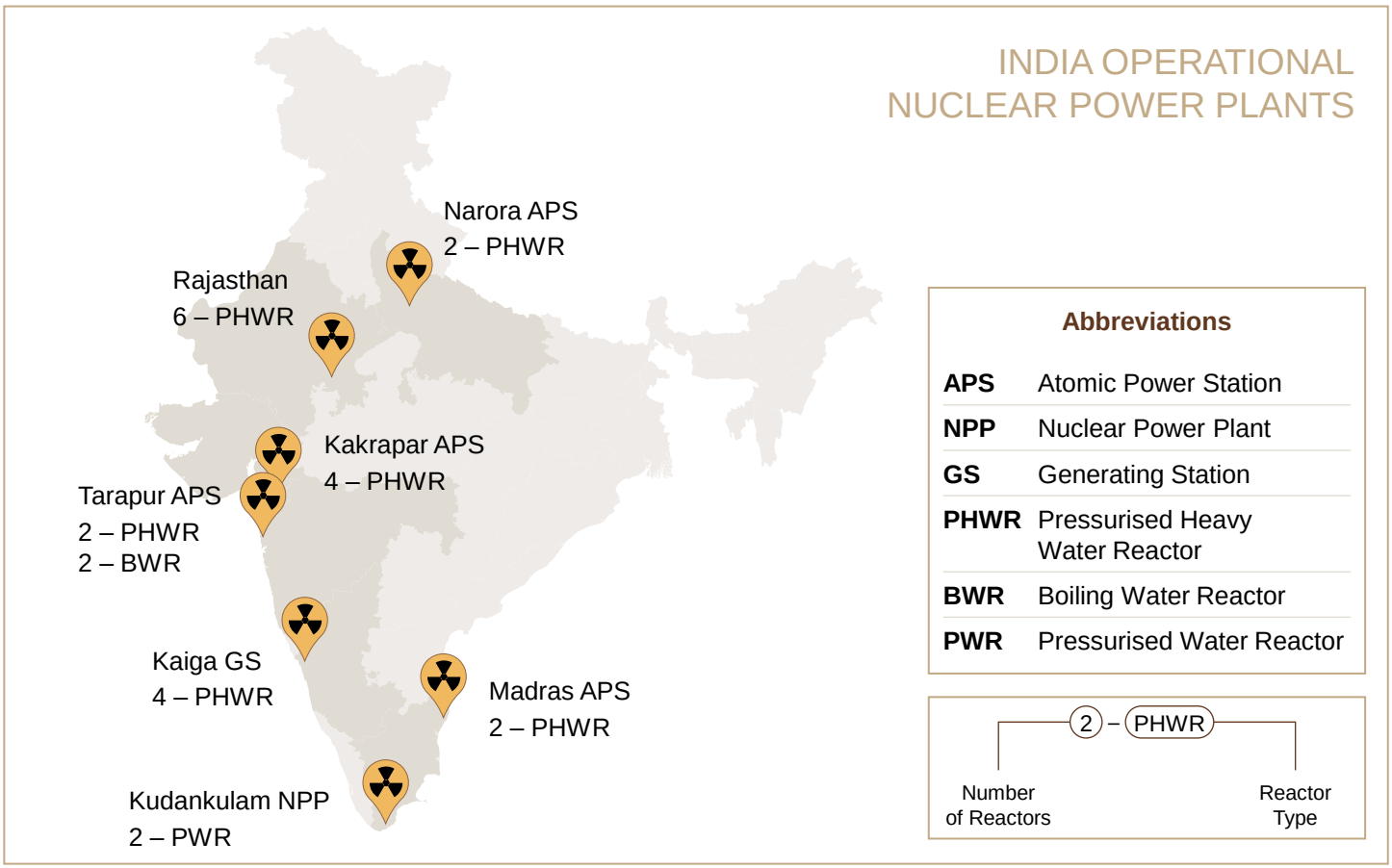
NUCLEAR AS A PILLAR OF INDIA'S ECONOMIC TRANSFORMATION

The scale of India's nuclear programme cannot be understood in isolation from its broader economic ambitions. Under the Viksit Bharat 2047 vision, India aims to become one of the world's leading economies by the centenary of its independence in 2047. Achieving that objective will require a profound expansion of the country's energy system.

Electricity demand is expected to rise dramatically as industrialisation accelerates, urbanisation continues, and living standards improve. Meeting that demand while reducing carbon emissions will require a diversified energy mix in which nuclear power plays a far more significant role than it does today. Within this context, nuclear energy is increasingly positioned as strategic national infrastructure – supporting industrial competitiveness, energy security, and long-term economic resilience. This broader perspective helps explain why the debate in India has shifted from whether nuclear power should expand to how that expansion can be delivered at scale.

FROM A STATE PROGRAME TO NATIONAL ECOSYSTEM

For much of its history, India's nuclear programme was built around a single institutional model: the state planned, owned, and operated nuclear projects. This centralised approach enabled India to preserve strategic control while developing indigenous capabilities under decades of international restrictions, and it helped establish strong technical institutions and a highly capable public-sector operator.



Source: https://mapsforupsc.com/nuclear-power-plants-in-india/

However, a model designed to deliver several reactors every few years is fundamentally different from one expected to support one of the world's largest nuclear build programmes. Recognising this reality, India is gradually reshaping its nuclear sector. Rather than replacing the state, the emerging model seeks to expand the number of participants capable of contributing to programme delivery while preserving government oversight of strategic functions. India is not privatising its nuclear industry, but broadening the ecosystem through which national nuclear ambitions can be achieved. The mechanics of this transition are explored in detail in Part II.

A MARKET THAT WILL SHAPE THE GLOBAL NUCLEAR INDUSTRY

India's transformation carries implications well beyond its own borders. Few countries offer the combination of long-term political commitment, sustained electricity demand, industrial growth, and programme scale that India does. For reactor vendors, engineering companies, construction firms, equipment manufacturers, fuel suppliers, investors, and consulting organisations, the country represents one of the most significant opportunities in the global nuclear market over the coming decades.

Yet success will depend on understanding what India is actually trying to build. The objective is not simply to procure reactors, but to establish a self-sustaining industrial ecosystem capable of supporting nuclear deployment for generations. Companies that view India chiefly as a technology export destination may struggle to align with this vision. Those that contribute to institutional development, supply-chain expansion, workforce capability, localisation, and programme delivery are likely to find opportunities that extend well beyond individual reactor projects.

This perspective also changes the questions that matter most. They are no longer "Which reactor technology will be selected?" or "Which vendor will win the next project?" Instead, the more pertinent questions are:

- Can India create a repeatable delivery model for large-scale nuclear deployment?
- Can new market participants develop the institutional capabilities required to become successful nuclear operators?
- Can domestic industry scale quickly enough to support serial construction?
- Can the country balance international cooperation with long-term industrial self-reliance?

The answers to these questions will determine whether India's 100 GW target becomes simply an ambitious aspiration, or the foundation of one of the world's most significant nuclear success stories.

PART II

Building a competitive nuclear market

If India's first phase of nuclear development was defined by technological self-reliance, the next phase will be defined by market design. Reaching 100 GW requires a delivery model capable of attracting capital, expanding industrial capacity, and enabling multiple organisations to develop, construct, and operate nuclear assets simultaneously. This represents one of the most significant institutional transformations in the history of India's nuclear sector.

WHY THE TRADITIONAL MODEL CAN NO LONGER SCALE

For more than five decades, India's civilian nuclear programme relied on a highly centralised governance model. Nuclear Power Corporation of India Limited (NPCIL) served as the country's principal owner, developer, and operator of nuclear power plants. This approach was well suited to an industry shaped by technology denial regimes, limited international cooperation, and the strategic importance of maintaining full state control over sensitive nuclear activities.

The model successfully delivered a domestic nuclear capability under difficult geopolitical conditions. However, it was never designed to support one of the world's largest nuclear expansion programmes. Scaling from fewer than 10 GW today to 100 GW by 2047 requires a level of investment, project management capacity, manufacturing capability, and human resources that exceeds the practical capacity of any single organisation. The challenge, therefore, lies not in replacing NPCIL, but in building an ecosystem around it.

LIBERALISATION WITHOUT LOSING STRATEGIC CONTROL

One of the most distinctive features of India's reforms is that they do not seek to reduce the government's role. Instead, they redefine it. The state is expected to continue to be responsible for strategic functions, including nuclear regulation, fuel-cycle policy, national security, and long-term programme governance.

At the same time, implementation is becoming increasingly distributed. Private companies may participate as project developers, investors, industrial partners, equipment manufacturers, engineering contractors, or operators under clearly defined regulatory frameworks. This creates a hybrid model that combines centralised strategic oversight with decentralised project execution – integrating the strengths of both a fully state-owned industry and complete market liberalisation.

SHANTI: LEGAL REFORM WITH STRATEGIC CONSEQUENCES

Institutional transformation requires both political ambition and legal certainty. For many years, India's legislative framework limited private participation in civilian nuclear power and created uncertainty for investors, technology providers, and financial institutions.

The introduction of the SHANTI Act is a turning point, as it establishes the legal foundations for broader participation while preserving government control over strategically sensitive parts of the nuclear fuel cycle. Its significance extends beyond legislative reform: it signals that India is moving from a programme designed around state implementation to one designed around ecosystem participation. For investors and international partners, predictable institutional rules are often as important as technology itself.

LEARNING FROM GLOBAL NUCLEAR PROGRAMMES

India is not moving into uncharted territory. Several of the world's largest nuclear programmes have demonstrated that successful expansion rarely depends on a single owner or operator. The United States built its commercial fleet through multiple investor-owned utilities operating under a common federal regulatory framework. Japan followed a similar model prior to Fukushima, with regional utilities developing nuclear assets under national oversight. China accelerated deployment by combining strong government direction with managed competition among several state-owned enterprises.

Country/era	Scale achieved	Peak build rate	Operating model
United States (1960s-1980s)	About 100 GW by 1990s	5-7 GW/year	Multiple private utilities under federal regulation
Japan (pre-Fukushima)	54 GW	3-4 GW/year	Several large private utilities under tight state oversight
USSR (1970s-1980s)	120 GW target across wider Soviet system	5-6 GW/year	State-controlled three-circuit structure
China (2000s-2024)	10 GW to 58 GW in two decades	6-8 GW/year	Several state-linked operators in managed competition

Source: Tenet analysis

Although these models differ significantly, they share one important characteristic: the government defines the strategic direction, while multiple organisations deliver the programme. India appears to be adapting this principle to its own institutional context, rather than replicating any single international model.

COMPETITION CAN ENHANCE CAPABILITIES

Opening a market does not simply increase the number of project participants; it also boosts capabilities. Competition encourages innovation in project delivery, construction management, procurement, digital engineering, and supply-chain performance, and also expands the pool of organisations able to execute complex nuclear projects. For a programme expected to continue well beyond 2047, this institutional diversity may prove as valuable as any individual technology choice.

Rather than concentrating expertise within a single operator, India has an opportunity to create an industry in which knowledge is distributed across utilities, engineering firms, manufacturers, research organisations, and service providers. Such an ecosystem is inherently more resilient.

BEYOND OWNERSHIP: CREATING A NUCLEAR INDUSTRY

The transition currently under way should not be interpreted as primarily being a change in ownership structures. Its broader objective is the creation of a mature nuclear industry – one characterised by competitive supply chains, specialised engineering firms, experienced operators, independent service providers, robust financial institutions, skilled contractors, and a regulatory system capable of supporting multiple concurrent projects.

In such an environment, nuclear power becomes less dependent on individual flagship projects and more capable of sustained industrial growth. This is ultimately what India needs if it is to transform an ambitious national target into a repeatable delivery programme.

A FOUNDATION RATHER THAN FINISH LINE

The institutional reforms now taking shape should not be viewed as the completion of India's nuclear transformation; rather, they signal only the start. Legislation can create opportunity. It cannot by itself produce experienced operators, qualified suppliers, skilled engineers, or mature project organisations. Those capabilities will need to be developed over many years via successful project executions.

Creating a competitive nuclear market is not the same as creating a competitive nuclear industry: the former depends on policy; the latter depends on execution. And it is execution – not legislation – that will ultimately determine whether India's vision of a 100 GW nuclear fleet becomes reality.

PART III

The real bottleneck is institutional capacity

Large nuclear programmes rarely fail because reactor technologies do not work. More often, they struggle because the institutions responsible for delivering them cannot scale at the same pace as political ambition. Having established why India is reshaping its market structure (Part II), this section examines the practical, operational capabilities the country must now build: workforce, localisation, site selection, and fuel security.

SCALING AN INDUSTRY IS DIFFERENT FROM BUILDING A PROJECT

Delivering a single nuclear power plant is an engineering challenge. Delivering dozens of reactors over two decades is an industrial challenge. Individual projects can often succeed through exceptional leadership, dedicated teams, and intensive state support. Industrial programmes require something different: repeatable processes, resilient supply chains, standardised engineering, mature project governance, predictable financing, and institutions capable of managing multiple complex projects simultaneously.

India's objective therefore is not simply to build reactors, but to create a delivery system that can build reactors continuously.

NEW OPERATORS WILL FACE A DIFFERENT LEARNING CURVE

A major consequence of market liberalisation is the emergence of new project owners. While India is an experienced nuclear nation, many future private participants will be entering the sector for the first time – a paradox in which the country has decades of nuclear experience while individual organisations may has almost none.

Developing a successful nuclear operator involves far more than acquiring engineering expertise. It requires governance structures capable of supporting decades-long investments, sophisticated regulatory engagement, rigorous configuration management, integrated risk management, quality assurance systems, long-term asset stewardship, and a deeply embedded nuclear safety culture. These capabilities cannot be purchased – they must be built. For many future market participants, organisational maturity may become a greater challenge than technology selection itself.

A WORKFORCE IS ABOUT MORE THAN JUST NUMBERS

Discussions about India's nuclear workers often focus on projected staffing requirements – thousands of engineers, tens of thousands of construction workers, large numbers of operators, inspectors, project managers, and technical specialists. However, the more fundamental issue is not simply workforce availability, but the ability to develop experienced multidisciplinary teams capable of delivering several major projects simultaneously.

Nuclear expertise accumulates slowly. It depends on practical experience, mentoring, institutional memory, and continuous learning across decades. Expanding educational programmes is necessary, and building experienced organisations takes time. As the pace of deployment accelerates, organisational learning may become one of the programme's most valuable strategic assets.

LOCALISATION IS AN INDUSTRIAL STRATEGY, NOT A PROCUREMENT POLICY

Localisation is frequently discussed in terms of domestic manufacturing content. In reality, successful localisation extends much further – to supplier qualifications, engineering abilities, digital design tools, quality management, construction methods, industrial standards, and lifecycle support.

The objective is not merely to manufacture components domestically, but to create an industrial ecosystem capable of supporting serial deployment while maintaining consistent quality and predictable schedules. Countries that have successfully expanded nuclear programmes have generally treated localisation as a long-term industrial development strategy rather than a contractual requirement imposed on individual projects. India appears to be moving in the same direction.

SITE SELECTION IS BECOMING A STRATEGIC CONSTRAINT

Identifying technically suitable locations for new nuclear power plants has always required balancing geology, hydrology, seismic conditions, environmental considerations, cooling-water availability, transmission infrastructure, and population density. As programmes expand, this challenge becomes progressively more complex: the most straightforward sites are typically developed first, and future projects often require more sophisticated planning, stronger stakeholder engagement, and greater integration with regional infrastructure development.

Site selection therefore evolves from being a technical exercise into a strategic planning component that impacts project economics, licensing schedules, public acceptance, and ultimately the pace of national deployment.

FUEL SECURITY WILL SHAPE LONG-TERM GROWTH

As reactor numbers increase, so too does the importance of the nuclear fuel cycle. Fuel security encompasses not just uranium supplies but enrichment services, fuel fabrication, transportation, strategic inventories, spent fuel management, and long-term resource planning.

For a country seeking to establish one of the world's largest nuclear fleets, these considerations become central elements within national energy security. This does not necessarily imply complete domestic self-sufficiency, but rather a diversified and resilient fuel strategy capable of supporting stable reactor operations over many decades. Fuel-cycle planning is hence inseparable from broader programme planning.

EXECUTION WILL DETERMINE SUCCESS

Workforce development, localisation, supply chains, site selection, fuel security, and operator capability may appear to be separate challenges. In reality, they are closely interconnected: delays in supplier qualification affect construction schedules, workforce shortages influence quality, site readiness impacts financing, and institutional capability shapes every stage of programme delivery.

Ultimately, the success of India's nuclear ambitions will depend less on solving individual technical problems than on integrating all these elements into a coherent delivery system. Mature nuclear programmes succeed not because every component is perfect, but because the entire system functions together.

India has already demonstrated long-term political commitment to nuclear energy. The next phase requires institutional endurance, industrial discipline, and organisational learning. The transition from 8.9 GW to 100 GW is therefore best understood not as a construction challenge, but as a delivery challenge – and India's experience may become one of the most important international case studies in how institutional capacity – not technology alone – determines the success of large-scale nuclear expansion.

PART IV

Competing in India's new nuclear market and what it means beyond India

India's nuclear transformation creates one of the most attractive opportunities in the global energy sector, but it also changes the rules of competition, both for companies entering the Indian market today and for other countries designing their own nuclear expansion in the years ahead.

→ THE MARKET IS BIGGER THAN REACTOR PROCUREMENT

Historically, success in international nuclear markets has often been associated with securing individual reactor contracts. India's emerging market suggests a different model: winning a single project may no longer be enough. For international companies, India's programme should not be viewed as a series of reactor tenders, but as the gradual creation of an entire industrial value chain – one requiring engineering services, construction management, digital tools, licensing support, supply-chain development, advanced manufacturing, workforce training, fuel-cycle services, quality assurance, and long-term asset management.

Many of these activities will continue throughout the programme lifetime, regardless of which reactor technologies are ultimately selected. This significantly broadens the range of organisations that can contribute to India's nuclear development, well beyond reactor vendors.

→ LOCALISATION WILL BE A COMPETITIVE ADVANTAGE

India has consistently emphasised that future nuclear expansion should bolster domestic industrial capability. This does not make international suppliers less important, rather, their role will evolve. The most successful companies are likely to be those that combine proven technology with a credible localisation strategy: investing in local manufacturing, developing domestic suppliers, transferring engineering knowledge, supporting workforce development, and helping establish long-term industrial capabilities.

Localisation is therefore no longer simply a contractual obligation: it becomes part of the value proposition. Companies that treat it as a strategic partnership rather than a compliance requirement are likely to be better positioned as the market matures.

→ TECHNOLOGY ALONE WILL NOT DETERMINE SUCCESS

Most Generation III reactor technologies offered by established vendors already meet high international safety standards, therefore India's future procurement decisions are unlikely to be driven by technical performance alone. Differentiation increasingly shifts towards project execution capability, construction schedule confidence, supply-chain maturity, financing solutions, industrial participation, operator support, lifecycle services, and long-term partnerships.

CAPACITY EXPANSION BY 2047, MW

Category / Developer	PHWR	PWR	FBR	BSR	BSMR	Total
NPCIL, BHAVINI and their JVs (Site identified)	7,000	17,628	1,000	-	-	**25,628**
NPCIL, BHAVINI other state-owned / private companies (Site not yet determined)	23,800	15,180	3,500	5,060	5,000	**52,540**

Acronyms & Abbreviations:

PHWR — Pressurized Heavy Water Reactor
PWR — Pressurized Water Reactor
FBR — Fast Breeder Reactor
BSMR & BSR — Small Modular Reactor (SMR) projects
NPCIL — Nuclear Power Corporation of India Limited
BHAVINI — Bharatiya Nabhiikiya Vidyut Nigam Limited (Fast Breeder Reactor Development Company)
CEA — Central Electricity Authority

Source: Tenet analysis

For project owners, selecting a reactor is only one part of a much larger investment decision. The ability to deliver projects predictably over several decades may become a more important differentiator than incremental differences between reactor technologies.

BUILDING CAPABILITY BECOMES STRATEGIC

As new operators enter the market – particularly companies from conventional power generation or heavy industry with limited exposure to nuclear-specific disciplines – demand grows for services that extend beyond engineering design: establishing governance structures, developing management systems, preparing licensing documentation, training personnel, and implementing project controls.

This creates opportunities for engineering consultants, owner's engineers, project management specialists, and organisations capable of transferring operational knowledge. In a rapidly expanding programme, institutional capability can become as valuable as technical ability.

A MULTI-VENDOR ECOSYSTEM REQUIRES INDEPENDENT EXPERTISE

As India's market becomes more diverse, project owners increasingly engage with multiple reactor vendors, equipment suppliers, EPC contractors, engineering firms, and financial institutions – a complex situation that creates growing demand for independent technical advice. Rather than advocating for a particular technology, independent advisors help project owners compare procurement strategies, assess implementation risks, evaluate localisation plans, strengthen governance, and coordinate among various stakeholders.

This role is not unique to India. As nuclear programmes elsewhere grow larger and involve more participants, governments and project owners will increasingly require independent expertise capable of integrating technical, commercial, regulatory, and institutional perspectives – providing continuity across political cycles, procurement phases, and changes in project participants.

THE FUTURE MARKET WILL REWARD ECOSYSTEM BUILDERS

The most important lesson from India's transformation is that future competitiveness will depend less on individual products than on being able to strengthen the broader programme. International companies that contribute to workforce development, localisation, supplier qualification, engineering capability, digital transformation, financing, and long-term institutional resilience are likely to build deeper and more durable relationships than those focused solely on equipment supply.

No single vendor is likely to define India's nuclear future. Success will depend on how effectively technology providers align their offerings with India's long-term industrial objectives – and, increasingly, this is the model other rapidly developing economies are likely to follow.

WHAT THIS MEANS FOR INTERNATIONAL VENDORS

Dozens of countries are considering nuclear power as part of their long-term energy transition, yet few possess the institutional foundations that supported earlier generations of nuclear expansion in North America, Europe, Russia, or East Asia. Many of these countries face remarkably similar issues:

How should responsibilities be divided between government and industry?

How much of the programme should remain under state control?

When should private capital be introduced?

How can domestic industrial capability be developed without delaying deployment?

How should international vendors be integrated into long-term national strategies?

These questions cannot be answered through technology selection alone – they require institutional design. India is one of the first large economies attempting to answer these questions while simultaneously pursuing industrial-scale nuclear expansion, which is why its experience is going to be closely watched by governments planning their own programmes in the coming decades.

KEY TAKEAWAYS

India's journey towards 100 GW is best understood as being an institutional transformation rather than simply a construction programme. The country's long-term success will depend on its ability to create a competitive nuclear ecosystem that combines strong public governance with private-sector participation, industrial localisation, and organisational competence.

For international stakeholders, the greatest opportunities may lie not in supplying reactors alone, but in helping build the institutions, supply chains, engineering capabilities, and delivery models that facilitate sustained programme growth. More broadly, India's experience highlights an important lesson for the global nuclear sector: as the industry enters a new era of expansion, competitive advantage will increasingly depend not only on technology, but on being able to build resilient ecosystems capable of delivering complex nuclear programmes over generations.

CLOSING THOUGHTS

The twentieth century was defined by countries that learned how to build nuclear power plants. The twenty-first century may be defined by countries that learn how to build nuclear industries. India is attempting exactly that.

Whether India ultimately reaches 100 GW by 2047 will be an important benchmark. But the programme's lasting legacy may prove to be something even more valuable: a demonstration of how ambitious national targets can be translated into durable institutions, competitive markets, and long-term industrial capability. For governments embarking on their own nuclear journeys, that may become India's most significant export – not a reactor design, but a new model for programme development.

HOW TENET CAN SUPPORT STAKEHOLDERS

India's nuclear transformation is creating challenges that extend well beyond reactor technology. Governments, new project owners, investors, and international vendors will increasingly need support in designing institutional frameworks, managing complex interfaces, and building long-term delivery capabilities.

Tenet supports clients across the early stages of nuclear programme development, including:

Nuclear programme strategy and delivery models

Helping governments and project owners define governance structures, implementation roadmaps, and institutional responsibilities..

Procurement and vendor strategy

Supporting procurement model selection, bid evaluation methodologies, contract strategy, and technology-neutral decision-making.

Owner's capability development

Assessing organisational readiness and designing capability-building programmes for emerging owner-operators.

Programme management and project controls

Establishing PMO structures, governance processes, interface management, and integrated project controls for multi-project environments.

Localisation and industrial development

Developing supplier qualification strategies, localisation roadmaps, and industrial participation programmes.

Independent technical advisory

Providing technology-neutral support to governments, investors, and project owners throughout major decision-making processes.

Our focus is not only on helping clients select technologies, but on helping them build institutions that are capable of delivering successful nuclear programmes over the long term.

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