Governing The Atom for a Sustainable Future - Legal Challenges in India's Nuclear Energy Transition

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Abstract
India's nuclear-energy transition marks a decisive shift in the country's energy-governance paradigm, as nuclear power is increasingly positioned not merely as an instrument of energy security but as a component of a low-carbon and sustainable electricity system. Yet the proposed expansion from 8.78 GW of installed capacity towards 100 GW by 2047 raises a fundamental legal question: whether India's regulatory architecture can accommodate accelerated nuclear liberalization without correspondingly weakening accountability for catastrophic and intergenerational risks. This research examines the evolving legal framework governing India's nuclear transition, with particular emphasis on the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India Act, 2025 (SHANTI Act), nuclear liability, regulatory independence, environmental clearance, public participation and radioactive-waste governance. It interrogates whether the pursuit of investment certainty and private-sector participation can be reconciled with constitutional protection of life and environmental integrity, particularly in light of the ongoing judicial scrutiny concerning statutory liability limitations, constitutional compensation and the institutional independence of the Atomic Energy Regulatory Board. This research further contends that nuclear sustainability cannot be reduced to low-carbon electricity generation; it requires an enforceable allocation of financial, environmental and technological risks across the entire nuclear lifecycle. Against this backdrop, this research advocates a governance framework founded upon independent regulation, meaningful community participation, comprehensive financial security, lifecycle accountability and technology-neutral safety standards. It argues that India's nuclear transition will be legally sustainable only if the imperative of energy security is subordinated to neither constitutional accountability nor intergenerational justice.

Keywords: Nuclear Energy, Nuclear Liability, Sustainable Development, Environmental Law, Energy Transition, India

1. Introduction

India's energy transition is no longer confined to replacing coal and petroleum with renewable energy. It increasingly involves constructing a diversified electricity system capable of providing reliable, affordable and low-carbon power. Nuclear energy occupies an unusual position within this transition. Unlike intermittent renewable sources, nuclear power can provide continuous baseload electricity, but it carries distinctive risks involving radiation, severe accidents, radioactive waste and long-term decommissioning. Consequently, the legal governance of nuclear energy must reconcile energy security with environmental protection and intergenerational justice.

The concept of a just transition is particularly relevant. A transition is not sustainable merely because it reduces carbon emissions; its economic and social costs must also be fairly distributed (Bhushan & Banerjee, 2024). Nuclear energy has accordingly been described as potentially important to India's sustainable-development pathway because of its capacity to provide reliable low-carbon electricity (Khan, 2024). At the same time, India's nuclear programme has historically been shaped by strategic, technological and institutional considerations (*India's Nuclear Energy Program*, 2018).

The policy scale proposed in 2026 is unprecedented. India currently has 24 nuclear power plants in commercial operation, with installed capacity of 8,780 MW, and nuclear power accounted for about 3.1% of total electricity generation in 2025–26 (DAE, 2026a). The Government's roadmap envisages approximately 22 GW by 2031–32 and 100 GW by 2047 (DAE, 2026a). The central legal issue is therefore whether India's regulatory architecture can expand at the same pace as its nuclear ambitions.

India's nuclear-energy policy is entering a significant transition in 2026. The Government is seeking to expand installed nuclear capacity from 8.78 GW to approximately 22 GW by 2031–32 and ultimately to 100 GW by 2047, while simultaneously opening the sector to greater private participation under the Sustainable Harnessing and Advancement of Nuclear Energy for Transforming India Act, 2025 (SHANTI Act). In July 2026, the Government confirmed that 24 nuclear power plants with 8,780 MW capacity were in commercial operation and that nuclear generation contributed approximately 3.1% of total electricity generation in 2025–26. The transition nevertheless raises difficult questions concerning nuclear liability, regulatory independence, environmental clearance, radioactive-waste management, public participation and constitutional remedies.

Reframing India's Energy Transition: Can Nuclear Expansion Be Legally Equated With Sustainability?

India's energy transition involves competing objectives. Renewable energy has expanded rapidly, but intermittency, grid integration, storage requirements and dependence on critical minerals create additional challenges. Nuclear power can provide firm low-carbon electricity and reduce dependence on fossil-fuel generation. However, nuclear expansion requires substantial capital, long construction periods and specialized regulation. Earlier analysis of India's energy

challenges demonstrates the importance of diversification and energy security (Khan et al., 2023a). India's energy diplomacy is also influenced by geopolitical vulnerabilities affecting oil, gas, minerals and clean-energy technologies (Khan et al., 2023b). Dependence on imported solar equipment, for example, creates a different form of strategic vulnerability during the renewable transition (Chaudhary, 2025). Financing is similarly central because India's transition requires substantial investment across generation, transmission and storage (Bhandari & Dwivedi, 2024; Kushawaha, 2025).

This does not mean nuclear energy should replace renewables. India's transition is more appropriately understood as a portfolio in which nuclear, solar, wind, hydropower, storage and other technologies perform complementary functions. Hydropower remains relevant for flexibility and system balancing (Hangzo, 2022), while affordability must remain an important component of clean-energy policy (Snegapriya & Rajavenkatesan, 2023). Nuclear energy therefore provides an opportunity to address the reliability dimension of India's transition. Yet its sustainability depends on how its environmental and social externalities are regulated.

The 100 Gw Nuclear Ambition: Outrunning India's Existing Regulatory Capacity

The Government's 2026 roadmap represents a substantial increase over India's existing nuclear capacity. Approximately 32 GW of additional capacity is envisaged through NPCIL beyond 2032, taking NPCIL's capacity to around 54 GW. The remaining 46 GW is expected to come from other public-sector entities, State Governments, private companies and joint ventures (DAE, 2026b).

Table 1 - India's Nuclear-Energy Expansion in 2026

Indicator	**2026's Position/ Target**
Commercial nuclear plants	24
Installed nuclear capacity	8.78 GW
Nuclear share of electricity generation	Approx. 3.1%
Target capacity by 2031–32	Approx. 22 GW
Target capacity by 2047	100 GW
NPCIL capacity envisaged by 2047	Approx. 54 GW
Capacity envisaged through other entities	Approx. 46 GW
Indigenous SMRs targeted by 2033	At least 5

Source - Department of Atomic Energy, Government of India (2026a, 2026b).

The expansion is also technologically diverse. The Government has identified indigenous 700 MWe Pressurized Heavy Water Reactors, imported advanced reactors and Small Modular Reactors (SMRs) as components of the roadmap. Three indigenous designs under development include the 220 MWe Bharat Small Modular Reactor, the 55 MWe SMR-55 and a high-temperature gas-cooled reactor of up to 5 MWth intended, among other purposes, for hydrogen production (DAE, 2026b).

The Government reported in July, 2026 that 18 reactors totaling 13,600 MW were under implementation, while additional projects were planned as part of the 100 GW roadmap (DAE, 2026a). This scale creates a regulatory challenge because different technologies may generate different safety, waste and liability issues. The development of SMRs is particularly significant. Smaller reactors may potentially be deployed at retiring fossil-fuel sites, industrial facilities and other locations, making the conventional model of nuclear siting less straightforward (DAE, 2026b). Regulatory rules must consequently be technology-neutral while remaining sufficiently flexible to address different reactor designs.

The Shanti Act, 2025 And The Privatisation Of Nuclear Risk: Does Liberalisation Outpace Accountability?

The SHANTI Act, 2025 is the central legislative instrument supporting the Government's new nuclear strategy. In 2026, the Act is being operationalized as part of the Nuclear Energy Mission, with the objective of facilitating the expansion of nuclear generation and permitting wider private-sector participation (DAE, 2026b). The rationale for liberalisation is straightforward. Achieving 100 GW requires investment, technical expertise and project-management capacity beyond what a single public-sector operator may reasonably provide.

The proposed framework therefore seeks to bring private entities and joint ventures into nuclear development. The legal difficulty is that nuclear energy cannot be regulated like an ordinary infrastructure industry. The consequences of a major accident may extend across generations and geographical boundaries. Earlier international approaches to civil nuclear liability demonstrate why specialized rules concerning operator responsibility, compensation and financial security developed separately from ordinary tort law (Inter-American Nuclear Energy Commission, 1967). The long-term management of nuclear waste similarly requires dedicated legal, administrative and financial arrangements

(OECD Nuclear Energy Agency, 1984a, 1984b). The Government's draft SHANTI Rules, 2026 are consequently important. The draft framework addresses matters concerning liability, insurance and financial security and is intended to provide greater certainty to operators and investors while maintaining a compensation mechanism (DAE, 2026c). The central question is whether investment certainty can be achieved without weakening victim protection.

Nuclear Liability At The Constitutional Frontier: Can Statutory Limits Override The Right To Effective Remedies?

Nuclear liability represents the most difficult legal issue in India's transition. The problem is one of risk allocation, the operator must have sufficient liability to incentivise safety, but liability that is entirely unlimited may discourage investment in a capital-intensive industry. This balance has now reached court. In *EAS Sarma v. Union of India* (W.P. (C) No. 240/2026), the petitioners challenged several provisions of the SHANTI Act as violating Art. 14, 19 and 21 and sought, among other reliefs, greater supplier responsibility and an independent mechanism for appointment and removal of AERB members (*EAS Sarma v. Union of India*, 2026). Court's official record confirms that the petition specifically challenges various provisions of the Act. In May, 2026, court indicated that it was reluctant to second-guess the Government's broader nuclear policy but recognised the need to address concerns concerning judicial compensation in the event of an accident (*EAS Sarma v. Union of India*, 2026). The issue became more concrete on August 17, 2026, when court sought clarification from the Union Government on whether the SHANTI Act, 2025 restricts constitutional courts from determining "fair and just" compensation after a nuclear accident. Court also sought clarification concerning Sec. 17(4), dealing with appointments to the AERB (*EAS Sarma v. Union of India*, W.P.(C) No. 1217/2025).

This development is constitutionally important. A statutory compensation framework should not automatically eliminate the remedial jurisdiction of constitutional courts where fundamental rights are affected. Court's broader environmental jurisprudence has repeatedly connected environmental protection with constitutional rights, particularly Art. 21. In *M.C. Mehta v. Union of India* (Writ Petition (Civil) No. 13381/1984), court continued to examine environmental protection through the constitutional framework. Similarly, *Vanashakti v. Union of India* (Writ Petition (C) No. 1394 of 2023) demonstrates the continuing importance of environmental clearance and regulatory compliance in judicial review. The *EAS Sarma* proceedings therefore raise a deeper question, whether a statutory liability ceiling can operate as an absolute barrier to constitutional compensation.

Regulating The Regulator: The Structural Deficit Of Aerb's Independence

Regulatory independence is the second major challenge. Nuclear safety requires a regulator capable of scrutinizing operators even where those operators are economically or strategically important to the State. The issue has historical relevance. Nuclear regulatory literature has consistently identified institutional independence, technical competence and changing regulatory expectations as continuing challenges (OECD Nuclear Energy Agency, 1998). India's nuclear infrastructure has likewise evolved within a system where security, strategic autonomy and civilian nuclear governance have historically been closely connected (Høibråten & Enger, 2019). The concern becomes sharper with private participation. If the institutions responsible for promoting nuclear expansion are also closely involved in selecting or supervising the regulator, perceptions of conflict may arise.

Court has therefore specifically sought clarification regarding Sec. 17(4) of the SHANTI Act in *EAS Sarma*. The petitioners' demand for an independent appointment and removal mechanism for AERB members reflects a conventional regulatory-governance principle, the regulator should not be institutionally dependent upon the entities whose activities it is required to regulate. The problem is not necessarily solved by creating another statutory body. Independence requires transparent appointments, secure tenure, technical capacity, adequate financing and institutional separation from nuclear promotion. Without these safeguards, formal regulatory powers may not translate into effective regulatory independence.

From Clearance To Consent: The Democratic Deficit In Nuclear Siting And Environmental Governance

Nuclear projects also create difficult environmental-law questions. Environmental assessment must address not only routine emissions but accident risks, thermal impacts, water requirements, radioactive materials, emergency planning and long-term land-use consequences. The principle of sustainable development requires development and environmental protection to be considered together. The contemporary Indian environmental jurisprudence reflected in *M.C. Mehta v. Union of India* (Writ Petition (Civil) No. 13381/1984), and *Vanashakti v. Union of India* (Writ Petition (C) No. 1394 of 2023) reinforces the importance of regulatory compliance and environmental decision-making.

Public participation is particularly significant in nuclear projects because communities located near facilities bear risks that may not be reflected in electricity prices. Public acceptance is already an important factor in India's renewable-energy transition (Parashar & Hussian, 2025). Nuclear projects require an even stronger emphasis on transparency because public concerns may involve radiation, evacuation, health and livelihood. This is also where the idea of a just transition becomes practical. Affected communities should not receive only monetary compensation after decisions have been taken. Consultation should occur during sitting, environmental assessment, rehabilitation and emergency planning. India's nuclear policy must therefore reconcile national energy objectives with local environmental rights (DAE, 2026b).

The Unresolved Nuclear Legacy: Radioactive Waste, Lifecycle Liability And Intergenerational Justice

Radioactive waste presents perhaps the clearest example of intergenerational responsibility. Unlike ordinary industrial waste, certain radioactive materials require management for periods extending far beyond the commercial life of the facility that produced them. The legal challenge is therefore not simply where waste will be stored, but who will bear responsibility for monitoring, maintaining and financing its management decades after an operator has ceased commercial activity. Earlier OECD analysis emphasised the legal, administrative and financial dimensions of long-term radioactive-waste management (OECD Nuclear Energy Agency, 1984a, 1984b). Later work on geological disposal similarly identified long-term safety as a distinct regulatory challenge (OECD Nuclear Energy Agency, 2008). India should therefore require operators to make adequate financial provisions for decommissioning and waste management during the operational period rather than allowing these costs to become future public liabilities. The development of advanced reactors also makes regulatory flexibility important. Nuclear-energy transitions in other countries demonstrate that technological change can create new legal questions concerning licensing, safety and waste (Platonova, 2023). European experience similarly illustrates the interaction between energy-transition policy, political choices and regulatory design (Popescu et al., 2022).

Beyond Energy Security: Testing The Claim That Nuclear Power Is A Sustainable Transition Technology

Nuclear power cannot be evaluated separately from India's broader energy-security strategy. India's energy system is undergoing simultaneous changes in renewable generation, electric mobility, industrial demand and infrastructure. The expansion of electricity-intensive sectors makes reliable generation increasingly important.

Table 2 - Nuclear Energy In India's Broader Energy Transition

Indicator	Position
Installed nuclear capacity	8.78 GW
Nuclear share of electricity generation	Approx. 3.1%
Target nuclear capacity, 2031–32	Approx. 22 GW
Target nuclear capacity, 2047	100 GW
Indigenous SMRs targeted by 2033	At least 5

Source - Department of Atomic Energy, Government of India (2026a, 2026b).

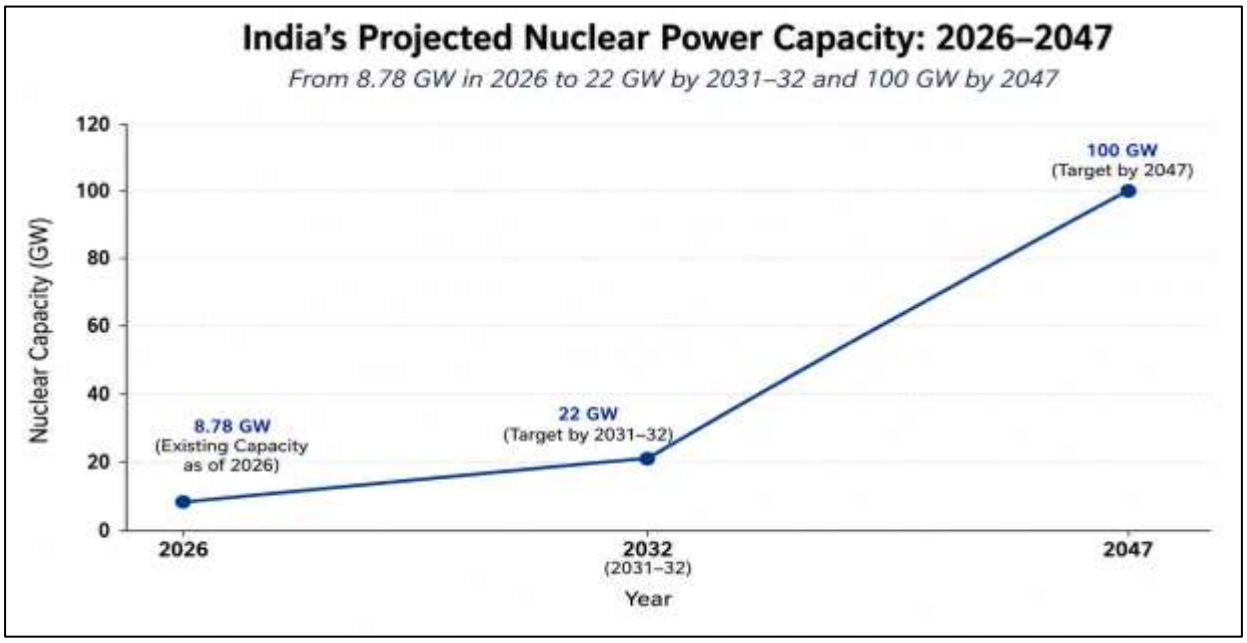

Figure 1 - India's Projected Nuclear Capacity

Source: Department Of Atomic Energy, Government Of India (2026).

Nuclear power can therefore strengthen energy security by providing dependable low-carbon electricity. Yet India's energy transition should not become dependent on a single technology. The challenges associated with renewable-energy supply chains, including solar imports, demonstrate the value of diversification (Chaudhary, 2025). The fiscal implications of the transition similarly require careful coordination of public and private investment (Bhandari & Dwivedi, 2024).

International experience also demonstrates that energy transitions create winners and losers. Renewable-energy commitments can generate political and investment risks (Mahapatra et al., 2021), while new financing models can be useful in mobilising citizen and institutional capital (Lowitzsch, 2019). These lessons apply to nuclear investment as well. India's strategic nuclear policy also cannot be ignored. Nuclear infrastructure has historically intersected with questions of national security and strategic autonomy (Sharma, 2021; Sethi, 2018). Nevertheless, security considerations should not become a justification for eliminating legitimate environmental or constitutional accountability.

From Fragmented Regulation To Lifecycle Governance: Reconceptualising India's Nuclear Legal Architecture

The current nuclear transition should also be understood against the wider background of India's energy challenges. Earlier assessments identified structural difficulties concerning energy availability, affordability and security (*India's Energy Challenges*, 2010). India's transition is consequently not simply a question of installing more generating capacity. The nuclear framework must also accommodate technological evolution. The transition from conventional thermal systems towards advanced nuclear systems raises questions concerning licensing, fuel cycles and regulatory adaptation (OECD Nuclear Energy Agency, 2009). The history of nuclear expansion also shows that regulatory and policy obstacles can become as important as technical constraints (Kampani, 2019).

At the same time, comparisons with other jurisdictions demonstrate that nuclear transitions are not legally uniform. Türkiye's nuclear programme illustrates how national legal systems adapt to international nuclear investment and regulatory obligations (Artantas, 2024), while Ukraine's experience shows the legal complications produced when nuclear infrastructure intersects with energy-transition pressures and geopolitical insecurity (Platonova, 2023). India therefore requires a framework capable of responding to changing technology without compromising basic legal principles.

Five reforms should form the core of India's 2026 nuclear-governance agenda. First, liability and compensation should be separated conceptually. A statutory operator-liability limit may facilitate investment, but it should not automatically prevent constitutional courts from granting appropriate remedies where fundamental rights are violated. Court's proceedings in *EAS Sarma* make this distinction particularly important. Second, AERB's institutional independence should be strengthened. Appointment, tenure, removal, funding and technical decision-making should be insulated from nuclear-development interests. Third, mandatory financial security should cover the entire nuclear lifecycle. Insurance and financial guarantees should address operation, accident response, decommissioning and waste management. Fourth, environmental participation should be substantive. Affected communities should receive accessible information and meaningful opportunities to participate in siting, environmental assessment and emergency planning. Fifth, regulation should be technology-neutral. SMRs, PHWRs, LWRs and future reactor technologies should not be forced into identical regulatory categories. At the same time, technological novelty should never become an excuse for weaker safety standards.

Conclusion

India's nuclear transition in 2026 represents a major shift from a predominantly state-led nuclear model towards a broader ecosystem involving public enterprises, private companies and joint ventures. The ambition is substantial, from 8.78 GW today to 22 GW by 2031–32 and 100 GW by 2047. The SHANTI Act provides the legislative foundation for this transformation, but the law's success will depend on its implementation. Nuclear energy cannot be governed solely through investment incentives. Liability, regulatory independence, environmental clearance, public participation and radioactive-waste management are equally central to sustainability.

The *EAS Sarma* proceedings demonstrate precisely why these issues matter. Court's decision to seek clarification on constitutional compensation and AERB appointments shows that nuclear liberalization remains subject to constitutional scrutiny. India's nuclear transition should not be judged simply by whether 100 GW is achieved. Its success should be measured by whether that capacity can be developed while protecting life, health, environmental integrity and future generations. Nuclear power can become an important part of India's sustainable-energy future, but only where expansion is matched by credible liability, independent regulation, transparent environmental governance and enforceable constitutional accountability.

References

1. Artantas, O. C. (2024). Türkiye's nuclear energy aspirations: Policy challenges and legal trajectory. The Journal of World Energy Law & Business. https://doi.org/10.1093/jwelb/jwae005
2. Bhandari, L., & Dwivedi, A. (2024). India's energy and fiscal transition. Journal of Globalization and Development. https://doi.org/10.1515/jgd-2023-0101
3. Bhushan, C., & Banerjee, S. (2024). A just energy transition. In India's energy revolution (pp. 15–41). Routledge India. https://doi.org/10.4324/9781003281818-2
4. Cai, H. (2025). Safeguarding India's energy security: Challenges and strategic approaches. Journal of Research in Social Science and Humanities, 4(1), 16–22. https://doi.org/10.56397/jrssh.2025.01.03
5. Chaudhary, Y. (2025). Solar import dependence and energy security: Geopolitical challenges in India's renewable energy transition. Journal of Multidisciplinary Knowledge, 5(2), 33–44. https://doi.org/10.36676/jmk.v5.i2.64
6. Fassihi, R., & Samouei, H. (2026). Nuclear energy. In F.A.C.T.S. flexibility, affordability, conservation, transition, sustainability (pp. 55–70). Elsevier. https://doi.org/10.1016/B978-0-443-52574-2.00001-X
7. Gulati, A. (2025). Just Energy Transition Partnerships: Pathway for India's green transition. In Intersectionality

between climate change and sustainable development goals: A socio-legal perspective from India (pp. 175–194). CSMFL Publications. https://doi.org/10.46679/9788196780524ch11
8. Hangzo, P. K. (2022). India's energy transition: The case for hydropower. National Security, 5(2), 198–214. https://doi.org/10.32381/ns.2022.05.02.3
9. Høibråten, S., & Enger, E. (2019). India's nuclear infrastructure status and challenges. In India in global nuclear governance (pp. 1–21). Routledge. https://doi.org/10.4324/9781003005681-1
10. Inter-American Nuclear Energy Commission. (1967). Report on civil liability in the field of nuclear energy. Pan American Union.
11. Kampani, G. (2019). The challenges of nuclear operationalization (1999–2010). In India's nuclear proliferation policy (pp. 112–143). Routledge. https://doi.org/10.4324/9780429340734-5
12. Khan, A. T. A. (2024). Nuclear energy in India's sustainable development pathway. In India's energy revolution (pp. 88–99). Routledge India. https://doi.org/10.4324/9781003281818-5
13. Khan, A., Singh, S., Singh, B., & Kaur, A. (2023a). Identifying and addressing India's energy challenges: A policy assessment. In India's energy diplomacy in Eurasia (pp. 57–109). Springer Nature. https://doi.org/10.1007/978-981-99-8281-3_2
14. Khan, A., Singh, S., Singh, B., & Kaur, A. (2023b). Energy geopolitics of Eurasia: Challenges and options for India's energy diplomacy. In India's energy diplomacy in Eurasia (pp. 257–312). Springer Nature. https://doi.org/10.1007/978-981-99-8281-3_7
15. Khup Hangzo, P. K. (2022). India's energy transition: The case for hydropower. National Security, 5(2), 198–214. https://doi.org/10.32381/ns.2022.05.02.3
16. Kushawaha, D. (2025). Financing India's renewable energy transition. Economic & Political Weekly, 60(42). https://doi.org/10.71279/epw.v60i42.43068
17. Lowitzsch, J. (2019). The CSOP-financing technique: Origins, legal concept and implementation. In Energy transition (pp. 163–183). Springer. https://doi.org/10.1007/978-3-319-93518-8_8
18. Mahapatra, D., Sindhi, S., & Tripathy, A. (2021). India's renewables commitments: A political risk assessment. In Renewable energy transition in Asia (pp. 41–60). Springer. https://doi.org/10.1007/978-981-15-8905-8_3
19. OECD Nuclear Energy Agency. (1984a). Long-term management of radioactive waste: Legal, administrative and financial aspects. Nuclear Energy Agency.
20. OECD Nuclear Energy Agency. (1984b). Long-term management of radioactive waste: Legal, administrative, and financial aspects: A report by the NEA Secretariat. Nuclear Energy Agency.
21. OECD Nuclear Energy Agency. (1998). Future nuclear regulatory challenges: A report. OECD Publications.
22. OECD Nuclear Energy Agency. (2005). Housing finance markets in transition economies - Trends and challenges. Organisation for Economic Co-operation and Development.
23. OECD Nuclear Energy Agency. (2008). Regulating the long-term safety of geological disposal of radioactive waste: Practical issues and challenges. Nuclear Energy Agency.
24. OECD Nuclear Energy Agency. (2009). Strategic and policy issues raised by the transition from thermal to fast nuclear systems. Nuclear Energy Agency, OECD.
25. Pant, G. (2017). Global energy transition: Redefining India's energy roadmap. Studies in Asian Social Science, 4(2), 36. https://doi.org/10.5430/sass.v4n2p36
26. Parashar, H., & Hussian, M. (2025). India's renewable energy transition: Public awareness and acceptance. International Journal for Multidisciplinary Research, 7(3). https://doi.org/10.36948/ijfmr.2025.v07i03.44059
27. Pandurangan, B. (2023). Coal India Ltd: Role in India's energy transition. The Management Accountant Journal, 58(10), 26–28. https://doi.org/10.33516/maj.v58i10.26-28p
28. Platonova, Y. O. (2023). Nuclear energy of Ukraine in the context of the energy transition: Legal issues. Juridical Scientific and Electronic Journal, (7), 217–221. https://doi.org/10.32782/2524-0374/2023-7/49
29. Popescu, C., Panait, M., Palazzo, M., & Siano, A. (2022). Energy transition in European Union - Challenges and opportunities. In Energy transition (pp. 289–312). Springer. https://doi.org/10.1007/978-981-19-3540-4_11
30. Prakash, R. (2018). Energy and material constraints in India's economic growth. In Transition towards 100% renewable energy (pp. 343–349). Springer. https://doi.org/10.1007/978-3-319-69844-1_31
31. Sethi, M. (2018). Nuclear challenges to India's security and its response strategy. Artha—Journal of Social Sciences, 17(4), 1–15. https://doi.org/10.12724/ajss.47.1
32. Sharma, A. (2021). Challenges in nuclear posture and deterrence from India's perspective. National Security Journal, 3(4). https://doi.org/10.36878/nsj20211224.04
33. Snegapriya, V. S., & Rajavenkatesan, P. R. L. (2023). India's clean energy transition: Affordability over sustainability. International Journal of Advanced Research in Science, Communication and Technology, 914–917. https://doi.org/10.48175/ijarsct-12738
34. Vedanti, N., & Das, D. (2026). India's energy transition and geological CO2 storage opportunities. In Fifth International Meeting for Applied Geoscience & Energy (pp. 2957–2960). Society of Exploration Geophysicists. https://doi.org/10.1190/image2025-w05-02.1
35. Yadav, A. (2025). India's energy security scenario: Challenges and opportunities. International Journal for Multidisciplinary Research, 7(1). https://doi.org/10.36948/ijfmr.2025.v07i01.37028
36. India's energy challenges. (2010). In Energy issues in the Asia-Pacific region (pp. 103–121). ISEAS Publishing. https://doi.org/10.1355/9789814279291-009
37. India's nuclear energy program. (2018). Dialogue—Science, Scientists, and Society, 1(1).

https://doi.org/10.29195/dsss.01.01.0008
38. India's nuclear energy renaissance: Stuck in the middle? (2013). Journal of Risk Research, 17(1), 43–60. https://doi.org/10.1080/13669877.2013.822921
39. The nuclear phase-out. (2017). In Drivers of energy transition (pp. 141–255). Springer. https://doi.org/10.1007/978-3-658-17691-4_5
40. Challenges of innovation: Summer overheating in an administrative building. (2019). In Energy transition (pp. 143–158). John Wiley & Sons. https://doi.org/10.1002/9781119426837.ch12
41. Schill, W.-P., Zerrahn, A., & Kunz, F. (2019). Solar prosumage: An economic discussion of challenges and opportunities. In Energy transition (pp. 703–731). Springer. https://doi.org/10.1007/978-3-319-93518-8_29
42. Lizikova, M. (2020). Nuclear energy prospects and legal challenges towards achieving sustainable development goals. E3S Web of Conferences, 208, 02009. https://doi.org/10.1051/e3sconf/202020802009
43. Cagdas Artantas, O. (2024). Türkiye's nuclear energy aspirations: Policy challenges and legal trajectory. The Journal of World Energy Law & Business. https://doi.org/10.1093/jwelb/jwae005
44. Malaviya, S., Tewari, D., Sahay, V., Tagotra, N., & Gangwar, P. (2025). How cities can support India's clean energy transition. World Resources Institute. https://doi.org/10.46830/wrirpt.21.00105
45. Anudev, B., Abhishek, R. S., Malik, G. R., & Nalinakshan, S. (2026). Evaluating India's EV transition: Challenges, infrastructure needs, and sustainability considerations. In 2026 International Conference on Electronics and Renewable Systems (pp. 309–315). IEEE. https://doi.org/10.1109/ICEARS67481.2026.11416722
46. T. Ajmal Khan. (2024). Nuclear energy in India's sustainable development pathway. In India's energy revolution (pp. 88–99). Routledge India. https://doi.org/10.4324/9781003281818-5
47. OECD Nuclear Energy Agency, Committee on Nuclear Regulatory Activities. (1998). Future nuclear regulatory challenges: A report. OECD Publications.
48. Department of Atomic Energy. (2026a). Parliament question: Nuclear power generation capacity. Government of India.
49. Department of Atomic Energy. (2026b). Parliament question: Nuclear energy mission for Viksit Bharat. Government of India.
50. Department of Atomic Energy. (2026c). Draft SHANTI Rules, 2026. Government of India.