

# Indo-European Summer Academy on Non-Traditional Security, 2025

**Theme 2025: Energy Security**

*Working Paper Series*

007

## Co-developing a Fair and Effective Indo-European Energy Transition

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*Title*

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## **Executive Summary**

India finds itself at a critical cross road; the country must enhance energy access to boost its development agenda and at the same time live up to its commitments in achieving net-zero emissions by 2070. The geopolitical shock of the war in Ukraine has made the European Union (EU), which is geopolitically committed to becoming climate neutral by 2050, seek to secure and clean energy relationships. The structural difference, which the 2024 report by IEA highlights, is that the energy mix of the EU is 48.7% and 17.9% out of Renewable Energy (Hydro, Wind, Solar, Biomass, etc.) and out of nuclear energy, respectively, whereas the India figures are only 20.6% and 2.6%. India is putting in place strategic projects to achieve 500 GW of non-fossil fuel capacity by 2030 and at least 100 GW of nuclear capacity by 2047 in order to achieve its urgent developmental needs and meet its net-zero commitment. To the two partners, the joint effort in renewables, radical nuclear and grid developments would de-carbonise the two economies, unless it reinforces the current economic or technological disequilibrium. This memoir examines the existing position of India-EU energy relations and the general attitude to nuclear energy. It talks of financial and regulatory challenges and speaks of a logical, five-point approach of a just transition. This agenda includes a joint Indo-EU Clean Energy Finance Facility, a Regulatory Task Force to streamline standards, co-operation SMR and renewable - hydrogen demonstration projects, and structured technology transfer. Based on the idea of mutual benefit, transparency, and inclusivity, grounding the partnership will enable India and the EU to be at the forefront of decarbonising the world, as well as contribute to the development objective of India.

### **1. Problem Definition: Energy Transition Asymmetries**

The world energy transition does not take the same path. The developed economies have the privilege of having advanced infrastructure and state of the art technologies compared to most developing countries that have to face high costs of capital, weak regulatory ability and urgent development needs. A good example of such a dichotomy would be found in India. Its economy is growing at very fast rates but millions of its people cannot afford the energy of being certain that it is clean. Coal is still the prevailing electricity source and the renewable generation upscale is impeded by the storage capacity and grid constraints. The Indian administration has responded with ambitious goals: installing 500 GW of non-fossil fuel capacity by 2030 and increasing its nuclear capacity to at least 100 GW by 2047 to support its 2070 net-zero pledge (World Nuclear Association, n.d.). To drive this trajectory, the Nuclear Energy Mission (2025) has allocated ₹20,000 crore towards building the five indigenous SMRs and has suggested radical key amendments to the Atomic Energy Act 1962 as well as the Civil Liability for Nuclear Damage Act 2010, thus making the participation of the private-sector a possibility (NITI Aayog, 2023). This means that India has had to walk the fine line between its objectives of technical self reliance and the need to meet its net- zero target of 2070, and also fulfill the demands of energy security and universal access. Ensuring such grandiose clean-energy plans will require

high levels of foreign investment and state-of-the-art technologies specifically in the field of nuclear energy, which is an industry the growth of which will necessarily make the sector more vulnerable to external technological reliance.

In comparison, the European Union is one of the most developed energy systems, where there is a relatively high level of penetration of renewable resources and nuclear energy. European green deal expressly aims at achieving climate neutrality by 2050; however, member countries are still divided on their position with regard to nuclear energy. Others (especially France and Poland) are also already in planning new reactors or life-extensions, with Germany and Spain increasingly decommissioning their existing fleets (World Nuclear Association, n.d.). Taxonomy already used by the EU therefore admits power production through nuclear methods as a trans-activity provided strict compliance is made with strictly established safety measures as well as waste-management requirements (Dalton, 2022).

These relative positions give rise to a complicated asymmetry, not a straightforward donor/recipient relationship, but an arrangement of complementary strategic needs. Indian officials are worried about being stuck on the rut of relying on foreign technology and un-payable debts. On the other hand, EU associates should ensure that collaborative projects meet their precise safety and environmental requirement. The key issue, thus, in designing a partnership that would combine the beneficence of EU capital and technological prowess in accelerating the transition of India, and simultaneously satisfy the desire of the EU to have the long-term energy security it desires, and simultaneously providing India with the technological independence it requires.

## **Geopolitical Trends**

The recent geopolitical shocks drive the need to have robust Indo-EU partnerships. The Ukrainian war demonstrated the precariously positioned Europe due to its dependency with imported energy (International Energy Agency, n.d.). This was followed by a post-shock trend of moving towards safe, low-carbon nuclear power which changed the geopolitical calculus of the continent. Many countries of the EU, such as France and Poland, have set out to build new reactors or make life extensions. As per the International Energy Agency (IEA), the supply disruptions are getting increasingly severe, probably due to imbalances, concentrated supply chains, cyber-attack, and triggering extremes of weather (International Energy Agency, n.d.). The IEA also highlights the need for secure critical-mineral supply chains for clean energy transitions (International Energy Agency, n.d.). The World Energy Trilemma 2024 by the World Energy Council further highlights how the pandemic and the war altogether contribute towards making it clear that the need to balance energy security, equity, and sustainability exists (World Energy Council, 2024). These issues explain why global upheavals and Indo-EU necessity are joined together, they need to work together creating resilient energy systems that are just and guarantee security in the critical-mineral supply chains.

## 2. Current State of Indo–European Energy Cooperation

### 2.1. Institutional Frameworks

The bilateral cooperation is based on the variety of the decisions made by the institutional frameworks that are currently deprived of the fiscal tools and control bodies that are required to implement wide cooperation but have managed to promote the high-grade political dialogue.

Framework	Year Established	Focus	Shortcoming/Status
<b>EU-India Strategic Partnership</b>	(2020-2025)	General cooperation in energy, climate, and sustainability	Top-level dedication, no specific co-finance strategy.
<b>Clean Energy and Climate Partnership (CECP)</b>	2016	Policy dialogue on renewables, green hydrogen, and nuclear energy	Much emphasis on dialogue; joint projects are small-scale.
<b>Euratom-India Agreement</b>	2008	Nuclear safety, waste management, and research	Older framework, insufficient in the modern emphasis on SMRs.
<b>India-France Declaration on SMRs</b>	2025	Co-design and development of advanced modular reactors	Preliminary bilateral template, should be incorporated into a larger EU mechanism.

The situation with Indo-European energy cooperation is incomplete and fails to meet the expectations despite all the agreements. The paradigms are skewed with excessive renewable energy, and sometimes fail to consider the nuclear synergies needed to have a viable strong and clean power portfolio. Also, no specified co-finance system is in place with respect to large-scale infrastructure and collaboration in the regulations is in its infancy. The current strategy threatens to create a permanent standards schism, whereby Indian interests and the EU norms continue to drift apart in the absence of a new and integrated strategic approach.

### 2.2. Research and Industrial Initiatives

This political trend has led to similar industrial and policy efforts. On the Indian side, in its 2023 report, the planning body of the government, NITI Aayog, proposed a regulatory map towards SMR licensing and involvement of the private sector, and recommended international cooperation with countries that possess the technology. The SMR Industrial Alliance in the European side aims to hasten the implementation of SMR,

identifying as possible technologies, linking supply chains and involving end-users (European Commission, n.d.).

Although, these similar initiatives manifest a conflict between standardisation and innovation. EU initiatives like the Nuclear Harmonisation and Standardisation Initiative (NHSI) and the ELSMOR project are meant to harmonise regulations and standardisation of designs in order to ensure safety and to minimize costs in member states (Tulkki et al., 2025). India's nuclear program has traditionally relied on its independent technological path, particularly its indigenous Pressurised Heavy Water Reactor (PHWR) designs and sovereign capability. In contrast, this new strategy prioritizes established, licensable technologies, raising a key question: Can a partnership framework be developed to support and integrate India's unique technological direction, or will it necessitate adopting standardized European designs?

### **2.3. Energy Mix and Policy Priorities**

India's power system is still dominated by coal, although the government is steadily scaling up solar and wind capacity under the National Solar Mission. Because renewable generation is variable, maintaining grid stability is becoming harder, which makes energy storage and other balancing solutions essential. Nuclear power currently plays a limited role in the overall mix, but the Nuclear Energy Mission aims to deploy at least five small modular reactors (SMRs) by 2033 (World Nuclear Association, n.d.).

The EU has a more diversified mix of renewables and nuclear (World Nuclear Association, n.d.). Its policy objectives are intensifying renewables, green hydrogen, and grid improvements as well as maintaining nuclear technology strategic independence. The current extension of reactors and the construction of additional reactors demand sizable investments and quality and safety and waste regulations to be referred to as sustainable (Dalton, 2022).

### **2.4. Public Perception and Resistance**

What do people think? In India, protests after the Fukushima incident highlighted concerns about earthquakes and safety measures (Gupta, 2025). A survey conducted in five states in 2025 reported that majority were considering nuclear as the most dangerous and least valuable type of energy (Gupta, 2025). Europeans are divided as well with countries being more supportive than others. Ecologist associations remain resistant, claiming expenses and untreated wastes. These perceptions influence the regulations and raise risk premiums on investment.

### 3. Why a New Framework Is Needed

Although it has agreements, Indo-European energy cooperation seems to be divided and not leveraged. There is no joint R&D, no special co-financing of big infrastructure, no co-regulation even amongst regulatory teams. Devoid of a newly formulated strategy that is integrated, we will not be doing justice to ourselves because we will only find ourselves in a permanent standards schism. It is currently being done under renewables, and lacks nuclear synergy. Asymmetries - the absence of low cost capital and hi-tech in India compared to the regulatory costs implicated in Europe imply that European funds may only lead to increased dependence in India and not capacity development. Better still, inconsistent policies may frighten the investors in case EU sustainability conditions are not fulfilled. Three gaps that a new framework should address are: (1) mobilize scale of finance to reduce capital costs of clean tech in India; (2) harmonize standards of regulatory standards and liability regimes across cross-border projects; and (3) need to make sure that tech transfer enhances skills in the country, and equitable development, rather than dependency.

### 4. Proposed Strategies and SWOC Analysis

The five strategies that have been outlined below are supposed to play off in a virtuous cycle with each strategy serving to strengthen the others. **Regulatory Harmonisation (4.3)** is key because it makes investing much safer. Once we have clear, shared rules, the **Finance Facility (4.2)** can confidently bring in the necessary money. This funding then helps us with vital **Joint R&D (4.1)** and creates a fair foundation for **Technology Transfer (4.4)**. When all of this is successfully done, we build the trust and shared knowledge needed to take on big **Third-Country Collaboration (4.5)** projects.

#### 4.1. Joint Research and Demonstration Programmes

**Strategy:** India and the European Union should move beyond dialogue and collaborate in the co-design, co-development and co-financing of demonstration projects that comprise small modular reactors (SMRs), renewable-hydrogen hybrids and the development of advanced grid technologies. These programmes need to be placed in the Green and Clean Energy Program (GCNEP) in India and the European SMR Industrial Alliance relying on universities, state-owned ventures, and entities in the private sector. The India-France SMR agreement can be a pilot project that could be extended to other EU countries. Pilot projects could involve an SMR combined with a solar park to produce power and hydrogen to serve industry use or an offshore wind project in India utilizing European technology and Indian production capacities.

**SWOC Analysis:** This joint approach builds on complementary strengths: India brings large-scale manufacturing capacity and a fast-growing domestic market, while Europe contributes proven technology and project experience. Together, they can reduce the risks of first-of-a-kind projects and help build credible

investor pipelines that mobilize private capital. However, the partnership also faces clear weaknesses, including high upfront costs, long licensing processes in both jurisdictions, and the risk of execution delays that can weaken investor confidence. At the same time, it presents strong opportunities to position both sides at the forefront of SMR and renewable-hydrogen innovation, open pathways to third-country export markets, and develop deep, skilled supply chains that create quality employment. The main challenges will be managing land acquisition and clearances, securing public trust through transparent stakeholder engagement, aligning intellectual property arrangements so knowledge transfer remains fair and balanced, and putting in place open and accountable governance so the partnership is seen as equitable rather than extractive.

#### **4.2. Indo–EU Clean Energy Finance Facility**

**Strategy:** Creating a cooperative finance facility can be a solution to turn up concessional capital to clean-energy projects: SMRs, renewables, storage, and grid upgrades. The mechanism must include the element of results-based financing, guarantees, and concessional loans and equity. The facility would begin with the European Investment Bank and the National Infrastructure Investment Fund of India and would be accompanied by other global institutions that would support the facility in providing support to development projects that will not only be based on requirements of development of India but also on the industries of the EU taxonomy.

#### **4.3. Regulatory Cooperation and Dialogue**

**Strategy:** The task force can design mutual recognitions of each other by establishing an Indo-EU Regulatory Task Force that will focus on the harmonisation of safety, licensing and environmental standards of nuclear and renewable technologies based on the best practices of the National Health Security Initiative (NHSI) and the European Low-Carbon Sustainable Modelling methodologies (ELSMOR). Convergence of sustainable financing taxonomies should also be scrutinised by the Task Force to guarantee that SMR and renewable projects are in compliance with the Indian and the EU standards.

#### **4.4. Technology Transfer and Capacity Building**

**Strategy:** The joint venture should combine structured human-capital building and technology transfer. Implementing joint ventures and co-ownership, European companies can also license the Indian joint partners to the SMR and advanced grid technologies. Engineers, regulators, and emergency responders should be trained via scholarships, exchange programmes and also through Indo-EU Centers of Excellence. Such a

narrow strategy will ensure that technology transfer enhances domestic strength and discusses intellectual-property issues.

#### 4.5. Third-Country Collaboration and Market Development

**Strategy:** To demonstrate that the Indo-EU is the leader in clean-energy initiatives, India and the EU should collectively engage in these initiatives in third countries, specifically Africa and South Asia, and share the market risk. These endeavors may include renewable-powered microgrids, SMR facilities to serve industrial groups, or green-hydrogen hubs, funded by the Indo-EU Clean Energy Finance Facility. The project design will also be based around local capacity building and benefits at the localities, thus promoting sustainability in the host countries.

#### Strategy Table

Strategy	Strengths	Weaknesses	Opportunities	Challenges
4.1. Shared R&D & Demonstration	Both can utilize India's big manufacturing base and domestic market demand over Europe's strong technology skills, which reduces technological risk and strengthens the case for early participation.	It requires high upfront capital, involves long licensing timelines, and remains exposed to delays in approvals in either India or the EU.	Joint pilots can place both partners at the forefront of SMR and renewable-hydrogen innovation, while also building a skilled workforce and strong supply chains.	Success will depend on timely land access and clearances, earning public acceptance through open engagement, settling intellectual property terms that support fair knowledge sharing, and using governance structures that are transparent and accountable.
4.2. Clean Energy Finance Facility	A dedicated facility can provide a predictable flow of capital, lower financing costs, and signal long-term commitment to clean energy, including credibility with emerging and developing partners.	Complex institutional design and coordination across agencies may create bureaucratic delays.	It can attract multilateral lenders and crowd in private investment, while supporting early deployment of SMRs and hydrogen through blended and risk-sharing finance.	The facility must manage currency and regulatory risks across jurisdictions, keep decision-making transparent, and ensure fair allocation across nuclear and other clean technologies.

4.3. Regulatory Cooperation & Dialogue	Regular cooperation can reduce regulatory uncertainty, improve the approval pathway, and increase investor confidence by making expectations clearer and more consistent.	Dialogue can be time consuming, and differences in legal systems and institutional mandates may limit alignment.	A workable model of North–South regulatory cooperation can open new market links, reduce cross-border friction, and encourage new investment flows.	The partnership must balance India’s stated nuclear framework with the EU’s more market-driven structure, while maintaining high safety standards without creating rules that become impractical to comply with.
4.4. Structured Technology Transfer	A structured approach can strengthen domestic capability, improve safety practices, build a skilled workforce, and support co-development and shared intellectual property where appropriate.	Export controls and IP limits may restrict the depth of collaboration, and there is also some risk of talent loss unless retention measures are built in.	Strong capability and credible standards can increase the appeal of Indo–EU projects in third-country markets and help develop local teams that can adapt technology to on-ground needs.	Partners will need to protect sensitive data, ensure community safeguards during deployment, and retain trained expertise within institutions, including regulators and public-sector bodies.
4.5. Third-Country Collaboration	Expands market reach; shows global leadership; gains scale benefits; diversifies supply chains and improves resilience.	High coordination burden with host governments and other donors; may strain time and resources.	Well-designed projects can support regional stability and enable practical South–South cooperation, backed by Indo–EU financing and delivery capacity.	The partnership must avoid perceptions of extractive or neo-colonial behaviour and operate effectively in politically uncertain environments while keeping benefits, risks, and decision-making visibly fair.

## 5. Implementation Plan

Implementation should move in three clear phases. In 2026–27, the partners should set up the joint innovation fund and finance facility, formalize the India–France SMR agreement into a wider Indo–EU partnership, create

a Regulatory Task Force, and shortlist sites for demonstration projects. From 2027 to 2029, they should start building a hybrid SMR–renewables demonstration in India, launch an offshore wind pilot that combines European technology with Indian manufacturing, begin a co-funded renewable project in a third country, and roll out structured training and exchange programmes for regulators and engineers. From 2029 onwards, the partners should review pilot results, adjust regulatory frameworks based on lessons learned, scale up the finance facility to bring in private investors, and launch additional joint projects in third countries. Throughout all phases, strong monitoring and sustained public engagement should support transparency and track both development outcomes and climate impacts.

## **6. Conclusion**

The European Union and India are taking different routes in their energy transitions, but they share many of the same goals. India needs affordable and reliable energy to support industrial growth while also cutting emissions, while the EU needs secure low-carbon partnerships to meet its climate targets and strengthen its strategic autonomy. To sustain political direction and ensure coordinated delivery across finance, regulation, and technology initiatives, the partnership needs a dedicated institutional mechanism. A practical step would be to establish a permanent Indo–EU Energy Transition Council to guide priorities, resolve bottlenecks, and track progress. If designed with long-term intent and shared leadership, such a council can move the relationship beyond a donor–recipient mindset towards genuine co-development, creating a fair and effective platform for decarbonisation and shared gains in a more uncertain global environment.

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