DEEP DIVES

TARGETED ASSESSMENTS OF KEY CLIMATE POLICY IMPLEMENTATION CHALLENGES

CLIMATE POLICY LAB

Building on its **Implementation Gap Analysis** research and the accompanying set of six policy briefs on emerging economies published in 2025, Climate Policy Lab has developed a new suite of country-specific policy briefs that provide deep dives into implementation challenges and priority sectors in Brazil, China, India, Indonesia, Mexico, and South Africa. Drawing on in-depth expert interviews, the briefs examine in greater detail sector-specific barriers to effective climate policy implementation and offer tailored recommendations to address them. A comparative analysis of findings across the six countries is in progress and will be published in a peer-reviewed, open-access journal.

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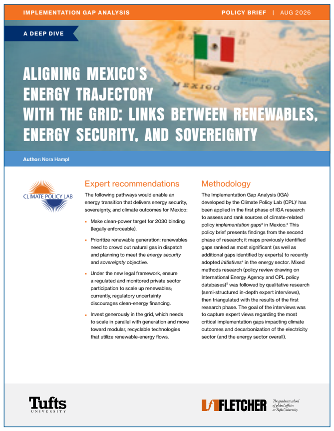

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A DEEP DIVE

ANTICIPATING POLICY OUTCOMES IN BRAZIL'S AGRICULTURE, FORESTRY AND OTHER LAND USE SECTORS: BEYOND CARBON METRICS

Author: Nora Hampl

CLIMATE POLICY LAB

Key Insights

- Weak transparency and traceability of sourced productive inputs (biomass, cattle) undermine policy integrity and cohesion, including carbon accounting.
- The cost of preventing deforestation is cheaper than reforesting and restoring landscapes afterwards – avoiding destructive extraction in the nine Amazonian states should be a key priority to avoid massive future losses posing multiple risks including to agriculture outputs.
- It is imperative that incentives and subsidies fund resilience to climate change rather than agricultural and farming practices that contribute to it (monoculture without soil regenerative practices that continue to push against forest boundaries).
- Agroforestry and agroecology – premised on the conservation of biodiversity-rich forest, land, and soil – need to be integrated in the framework of local [bio]economies and improve livelihood security of local communities.
- A regulated carbon tax imposed across sectors including agriculture can effectively mediate between economic industry interests and climate and environmental security, while endorsing the 'polluter pays' principle.

Methodology

The Implementation Gap Analysis (IGA) developed by the Climate Policy Lab (CPL)[1] was applied in the first phase of IGA research to assess and rank sources of climate-related policy *implementation gaps*[2] in Brazil. This policy brief presents findings from the second phase of research; it maps the previously identified gaps ranked as most significant (*Competing goals, Stakeholder engagement/coordination*, and *Political will)*[3] to recently adopted *initiatives*[4] in the Agriculture, Forestry and Other Land Use (AFOLU) sectors. A mixed-methods approach was used, starting with a review of recently adopted policies and AFOLU emissions inventories including SEEG, MCTI, MapBiomas, INPE, and CPL policy database,[5] and followed by semi-structured in-depth expert interviews. The goal of the interviews was to validate, disprove, or substantiate findings from the first research phase, but also to capture additional expert insights regarding the most critical policy implementation gaps impacting climate outcomes and net sinks in AFOLU sectors, particularly in the nine Amazonian states.

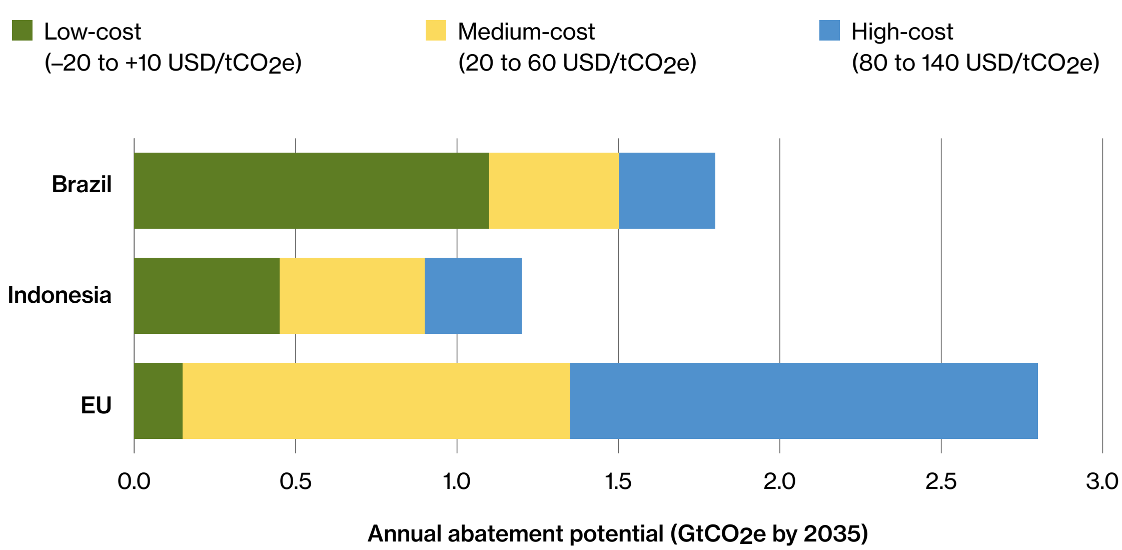
Country Context

The largest, fastest, and cheapest emissions cuts in Brazil are in the AFOLU sectors owing to the fact that 40–50% of the country's emissions are attributable to land use change (deforestation in particular). Altogether, however, the AFOLU sectors need to contribute a net sink, not merely zero emissions, which implies (a) the elimination of illegal deforestation, (b) reduction (or near-zero net) legal deforestation (not only in the Amazon, but also in Cerrado), and (c) a large-scale forest and land restoration with a view of making currently degraded lands productive and resilient to climate change. Sustainable land use management practices that underpin AFOLU policy packages are needed to deliver inputs for the rest of the economy and contribute to the supply chains of the emerging bioeconomy (PNDBio).

Because land use change dominates Brazil's emissions, forest and agricultural policies that impact land use management in the Amazon and Cerrado biomes are considered critically important for near-term mitigation. The Amazon biome and rainforest cover territories of nine Amazonian states, which contain protected areas where farming and ranching are prohibited. Regulation notwithstanding, cattle ranching has been the biggest driver of deforestation including in protected national forests (e.g., in the 1.3-million hectare Jamanxim National Park or in Serra do Cachimbo). Unresolved land titles and disputed federal lands complicate enforcement of forest and land use policies and manifest in registry irregularities and land ownership overlaps. Crucially, land irregularities facilitated fraudulent land titling favoring large and powerful land owners, leaving small-scale farmers 'stranded' (without land/land title), and thus susceptible and/or fully dependent on revenues from illicit activities for their survival.

Policy frameworks that have proved effective in slowing down the pace of deforestation, while simultaneously delivering economic benefits and the largest and fastest emission cuts, have been centered around land tenure and

Figure 1. A comparative marginal abatement cost curve in the AFOLU sectors



Data sources: seeg.eco.br, climateactiontracker.org, EU ETS prices, UNFCCC NDC documents responsible land use management including (i) Indigenous lands protection (e.g., via land titling), which in the past exhibited significantly lower rates of deforestation; (ii) forest restoration and natural regeneration resulting in increased carbon sinks; and (iii) incentives for agro-forestry practices targeting both medium and small land holders that stipulate forest and native vegetation protection. Equally important, however, have been (iv) incentives serving as poverty-alleviation strategies for landless peasants and indigenous communities to offset lost revenues from illicit activities. Forest-carbon mechanisms and carbon pricing – when closely monitored, and if reductions in deforestation can be verified – can also help redirect activities away from deforestation. Nevertheless, regulated and voluntary carbon markets and emissions trading schemes, while meant to protect forests and channel private finance toward reducing emissions, have not always delivered the anticipated outcomes. Currently, the largest carbon-credit investigation in Brazil, "Operation Greenwashing," is underway.[6]

Table 1. Marginal cost of Brazil's 2035 NDC (land use mitigation harmonized into 2030–2035 USD/tCO_2e range)

Abatement category	Annual potential (GtCO_2e)	Marginal cost (USD/tCO_2e)	Policy action	Anticipated policy outcomes
Avoided deforestation (illegal)	0.5–0.7	–20 to +5	Stricter enforcement, land regularization and governance involving state actors	Intact ecosystem services (hydrological systems); avoided intentional fires; reduced land conflict; reduced participation in illicit economies
Pasture recovery/ land intensification	0.3–0.4	0 to 15	Financial and technical support for adoption of precision agriculture, rotational grazing and integrated crop/livestock/ forestry systems, replanting/ reseeding, restoring soil health	Improved food security and profitability as land productivity increases (double-cropping, multiple harvests); improved crop varieties resilient against climate change; reduced pressure to convert forests, grasslands, or other natural ecosystems into farmland
Forest restoration/ natural regrowth (regeneration)	0.2–0.4	5 to 25	Financial and technical support to prevent and control forest fires (satellite monitoring); plant native trees in degraded areas; regenerate forests along rivers and water bodies	Improved carbon sequestration; moderated local temperatures and increased resilience to droughts; improved soil quality; improved watershed health and water quality; trees integrated with crops and/or livestock can restore ecosystem functions and productivity (if done sustainably)
Low-carbon agriculture (reduced CH_4, N_2O emissions)	0.2–0.3	20 to 50	Financial and technical support for improved livestock and manure management, nutrient precision, biological nitrogen fixation, no-till agriculture, and improved irrigation and crop management	Lower GHG emissions intensity per ton of agricultural output; increased productivity and improved soil quality; enhanced resilience to drought and climate variability
Energy & industry decarbonization	0.2–0.3	80 to 140	Transport and industry electrification	Reduced pollution and improved air quality contributing to better health outcomes

Marginal cost data sources: seeg.eco.br, climateactiontracker.org

Interview Findings

Along with policies that enforce zero-deforestation, the implementation of the Forest Code and land regularization (titling) have been noted as urgent short-term measures *(Interviewees 1–4)* to address illicit land uses (logging, slash-and-burn, cattle grazing, mining and farming in protected areas). Both incentives and penalties have been deemed essential for policy effectiveness, but incentives in particular have been noted as critical to policy success (e.g., PPCerrado, PLANAVEG, PNCPD) *(Interviewee 4)*. While certain incentives would have direct impacts on the delivery of the stated policy goals (e.g., incentives for farmers to shift from unsustainable to sustainable land use practices and maintain agricultural productivity without expansion, which implies recovery of degraded pastures or low-carbon agriculture eventually resulting in lower methane and nitrous oxide emissions), strict penalties would in parallel disincentivize illegal land use practices (slash-and-burn, cattle grazing) and redirect farmers toward sustainable, climate-resilient land use management practices. These incentives would need to include targeted financial and technical support, support for market integration of sustainably produced goods, and dedicated policy monitoring over the longer term (until the practices outlive project/policy duration and become localized) *(Interviewees 1, 3, and 4)*. Most interviewees expressed the view that better monitoring and oversight would benefit land use outcomes of all policies in the AFOLU sectors *(Interviewees 1–3).*

GAP 1: COMPETING GOALS

Competing goals across sectors

(crops for food versus energy, for exports versus domestic use, quantity versus quality)

Agricultural policy goals emphasizing commodity outputs such as cattle and monocrop production need to have clearly defined and monitored land management practices *(Interviewees 2 3, and 4).* Expansion of cattle ranching and monoculture have historically clashed with efforts to halt deforestation, fires and land/forest degradation. At the local level, such practices reduced water and food security for small farmers, landless farmers and indigenous communities *(Interviewee 1).* At the national and regional level, weak forest protections pose risks for Brazil's agriculture outputs and by implication, global food security, since intact Amazon rainforest guarantees rainfall on which the agriculture sector depends *(Interviewee 4)*. Imposing a regulated carbon tax across sectors would help moderate the competition over policy goals and likely improve policy outcomes, since polluters (rather than society at large) would pay for the damage their activities cause.

Weak traceability, *transparency* and *oversight* allow sourcing of material inputs to mostly pass unchecked for deforestation links (cattle and sugarcane) (*Interviewees 2–3*). In the energy sector, policies relying on forest residue and agriculture crops (e.g., RenovaBio) need to guarantee that biomass used to produce ethanol did not come from illegally deforested areas – before certified credits (CBIOs) are issued and transferred to fuel distributors. Similarly, cattle certified as raised in areas that have not been illegally deforested need to be traced along the entire life cycle (from birth to feed to production) *(Interviewees 2 and 3),* and certification should include meat quality rather than quantity (weight of the animal) *(Interviewee 3).*

Competing goals at national, state and local level

Policy ambition at the national level needs to be legislated at the state level (*Interviewee 2*) and subsequently become reflected in state agendas, eventually trickling down to local levels *(Interviewees 1, 2, and 3).* States can draw on national, regional, and local technical and research capacity (universities, research centers) to disseminate the latest advances in sustainable and climate-resilient land management, water and food security practices, as well as help promote low-carbon infrastructure development (sanitation, waste-to-energy systems, water testing and filtration, etc.). Conversely, such institutions should ensure their capabilities translate into impactful practice and reach remote Amazonian communities who live without access to livelihood security. In this sense, participation by licit economic actors and their support for local livelihoods could, if done right, outcompete interests of the growing illicit economy *(Interviewee 4)*.

Competing goals at temporal scales

Political decisions follow political cycles and tend to be incompatible with long[er] term policy goals *(Interviewee 1 and 2).* Long-term resilience, water and food security, and the associated productive value of soil and standing forests are more often than not traded for short-term gains. For example, PPCerrado policy requires only 20–30% of the original native vegetation be set aside as a Legal Reserve, while the majority can be cleared; this is in contrast to PPCDAm where the reverse is the case (80% of the biome has to be preserved, and 20% can be deforested) *(Interviewee 2 and 4).*

GAP 2: STAKEHOLDER ENGAGEMENT/COORDINATION

It is imperative for AFOLU policies to be inclusive and ensure broad community participation. "Without participatory process, the policy goes nowhere – 8 out of 10 policies fail" *(Interviewee 1).* Multilevel stakeholder engagement, as well as coordination, have been noted as the most important sources of policy implementation gaps in the AFOLU sectors *(Interviewees 1, 2, and 3).* For example, the lack of state-level stakeholder engagement in the implementation of the Forest Code and land regularization enabled titling irregularities and environmental crimes, all while delaying enforcement. Since no specific timelines were in place for states to advance and legislate the Forest Code implementation (including mandatory land allocations for environmental protections), states failed to prioritize the agenda *(Interviewee 2 and 3).*

Discrepancy between national policy ambition and state interests can be further exacerbated by different priorities at the local level *(Interviewee 1),* where some communities are genuinely trying to build sustainable livelihoods around small-scale agroforestry and diversified local food production rather than grow monocrops for export markets, but receive very little policy or project support *(Interviewee 1 and 4)*. National and state support for livelihood projects of these communities is critical to the future protection of the intact Amazon biome *(Interviewee 1)*.

Cross-sector stakeholder engagement and coordination will also impact the effectiveness of the recently established regulated carbon market and its mandatory emissions-trading system. Crucially, agriculture, the country's second-largest emissions sector, has been granted an exception, raising questions about the stringency of agriculture policies and posing risks for land use emissions outcomes of policies such as PPCerrado, PLANAVEG, PNDBio, and PNCPD. As is, the greatest extent of legally permitted deforestation is currently taking place in Cerrado, where the weak conservation target of 20% (or 35% for Cerrado savanna areas within the Legal Amazon), almost guarantees a continued, large-scale clearing and future soil quality degradation.

GAP 3: POLITICAL WILL

Because long-term policy focus is key to successful policy outcomes, policy design and policy decision-making should be considered a continuous process that exceeds political terms *(Interviewee 1).* Relatedly, regulation does not work without effective governance *(Interviewee 2 and 3).* Given the fact that companies will always seek to cut their transaction costs including the cost of clean-up (negative externalities), voluntary rather than regulated markets may downgrade policy integrity and fail to deliver the anticipated outcomes (or may even contribute to higher emissions).

While some AFOLU policies focus on achieving national emissions targets, they should simultaneously account for their contributions to the water-food-energy-forest security nexus – a basic indicator of environmental security against which long[er] term policy outcomes in the AFOLU sectors can be measured. This requires political will to engage in a long-term, system-level land use planning involving different sectors, ministries, and agencies. Political will is also needed to pursue transparency and traceability requirements in the entire life cycle (i.e., tracing cattle from birth to feed to production; tracking the clearing of native vegetation for biofuel production), making it possible to establish a carbon footprint and links to deforestation *(Interviewee 3).* Upholding these standards will contribute to policy cohesion of the emerging bioeconomy (PNDBio) and its future outcomes *(Interviewees 1 and 3).*

Importantly, national priorities and deforestation policies (PPCDAm) need to address the pervasive and growing influence of the illicit economy (i.e., extra-local criminal organizations controlling extraction and trade in illegal commodities including logging) *(Interviewee 4)*, while subcontracting local communities as cheap labor. Combatting illicit economies and illegal activities requires a consistent, multi-level, and multidimensional approach, grounded in the long-term presence of trusted actors at the local level.

Recommendations

Policy design in Brazil's AFOLU sectors needs to approach land use planning as a systemic management priority that crosses multiple ministries and agencies, while requiring legislative coordination (the same laws need to be binding across sectors such as forestry, agriculture, energy & mining, wildlife and fisheries, urban development, bioeconomy, etc.).

> Crucially, protection of nature (forest and native vegetation across biomes) must become an integral part of all agriculture practices.

Land use planning in the AFOLU sectors should consider the interactions between policy goals and trade-offs (e.g., monocrop outputs versus biodiversity protection), related to the competing policy goals and respective land management practices (in agricultural production, forestry, small, medium and large scale farming). Agriculture policies in particular need to be cross-checked for compliance with the Forest Code. The value of such trade-offs and losses, even if difficult to quantify (e.g., medicinal value of novel biological compounds present in biodiverse rainforest), should be included in all land use planning, especially in Brazil's biodiverse biomes.

A consensus-driven, policy-coherent technocratic approach centered on carefully designed incentives and consistent over the long[er] term with respect to environmental management should be adopted and transcend political cycles. Incentives to establish conservation-minded farming communities of practice should be introduced and include both medium and small-scale farmers, landless peasants, and Indigenous communities. However, climate policies need to be expanded and go beyond carbon metrics (i.e., include broader benefits to the national economy or, at local levels, contributions to livelihood security). The focus on narrow emission metrics instead of broader social and economic indicators makes it difficult to evaluate 'beyond-carbon-metrics' policy outcomes.

An integrated database (combining data on land ownership, land use and management, environmental protections, funding, subsidies, penalties, taxation, participation in carbon markets and emissions trading, etc.) should be produced, widely shared and used in decision making across sectors. Based on most recent and relevant data, incentives in different sectors can be tweaked as necessary (e.g., incentives for landowners to practice agroforestry and conserve forests that would outcompete revenues from cattle production).

The regulated carbon market, which would include the agriculture sector, can be used to integrate circular bioeconomy supply chains (from local-state-regional-national) underpinned by a national public procurement strategy for sustainable development. Demand side levers, along with supply-side measures, can be introduced to shape local/state/national markets.

Endnotes

1. The IGA framework includes four broad categories of policy implementations, *(1) Governance and Institutional Capacity, (2) Political Economy and Interests, (3) Financial Constraints,* and *(4) Technical and Legal Constraints,* which are broken into additional subcategories. In the case of Brazil, the subcategories *Competing Goals, Stakeholder Engagement/Coordination, and Political Will* were identified as having the greatest impact on climate-related policy outcomes including net sinks.

2. CPL's definition of *implementation gap* is the discrepancy between intended and actual outcomes after policy adoption.

3. Nora Hampl, L. Yonaha, T. Stec, and N. Unterstell, *Bridging Reality with Brazil's Climate Aspirations,* Policy Brief (Climate Policy Lab, The Fletcher School at Tufts University, November 2025), https://bpb-us-e1.wpmucdn.com/sites.tufts.edu/dist/d/8478/files/2025/11/CPL_IGA_PolicyBrief-Brazil.pdf

4. *Initiatives* in this policy brief refer to current policies in the **forestry sector:** *Plan for Prevention and Control of Deforestation in the Legal Amazon* (PPCDAm) and *Cerrado* (PPCerrado), *National Native Vegetation Recovery Plan* (PLANAVEG), and *The National Bioeconomy Development Plan* (PNDBio); and to the following policies in the **agriculture sector:** *The new ABC+ Plan, National Program for the Conversion of Degraded Pastures into Production Systems (PNCPD), National Payment Policy for Environmental Services (PNPSA),* and *National Program for the Strengthening of Family Agriculture (PRONAF).*

5. Climate Policy Lab, *National Climate Policy Inventories* (2026), https://www.climatepolicylab.org/national-climate-policy-inventories.

6. Currently under investigation, "Operation Greenwashing" allegedly involves a criminal network spanning 22 companies, land registries and public agencies that falsified land titles and seized about half million hectares of Amazon land, then sold fraudulent credits worth 33 million USD to multinationals.

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CLIMATE POLICY LAB

A DEEP DIVE

BEYOND CAPACITY: THE NEW IMPLEMENTATION GAPS IN CHINA'S 15TH FIVE-YEAR PLAN

Authors: Hengrui Liu and Riley Liu

CLIMATE POLICY LAB

Key Insights

- **The object of planning is shifting from installed capacity to delivered performance.** The 15th Five-Year Plan (FYP) retains large capacity targets but adds indicators for firm renewable output, evening-peak contribution, regulation capability, demand response, and interregional transmission. The new implementation gap lies between building these capabilities and proving that they work together in real time.
- **Energy security is pushing technology choices in two directions at once.** Recent shocks have raised the value of electrification, renewables, storage, nuclear power, reserves, and diversified imports, but they also justify coal-fired backup and coal-based substitutes for oil and gas. The new implementation gap is the absence of clear rules separating time-limited security insurance from avoidable long-term fossil lock-in.
- **Provincial carbon targets appear to be moving toward differentiated, negotiated pathways.** Instead of receiving rigid mandates from the center, provinces may propose targets and pathways that reflect their industries, projects, and development stage. The new implementation gap is whether differentiated commitments can be verified and delivered, and whether less-resourced regions and firms receive enough support to comply.
- **Industrial emissions may fall for structural reasons even as electricity demand rises.** Lower steel and cement output can cut emissions without making production cleaner, while cooling, computing, electric transport, and industrial electrification add load. The implementation gap is that planning does not yet consistently separate activity-driven industrial decline, cleaner production per unit of output, and the emissions attributable to new electricity demand.

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Methodology

This brief compares three planning tracks across the 14th and 15th FYP periods: the national economic and social development outline, the national energy-system plan, and the renewable-energy plan. The analysis is supplemented by related climate-policy documents, official statistics, published research, and seven anonymized semi-structured expert interviews. An "implementation gap" refers to a disconnect between a new policy requirement and the institutional, technical, financial, or governance capacity needed to deliver it.

Country Context: Strong Momentum, Tighter Constraints

China's Five-Year Plan is a hierarchy of documents. The national outline sets broad priorities and headline targets; sector plans translate them into detailed goals; provincial plans shape implementation. Within these documents, a **binding** indicator creates a formal government obligation, while an **expected** indicator guides policy and investment but depends on multiple public and commercial actors. Neither label alone guarantees delivery.

China enters 2026–2030 from a high base. Renewable capacity reached roughly 2,340 GW by the end of 2025 – about 60 percent of total installed capacity – and renewable generation reached about 3,990 TWh, equal to 38.5 percent of total electricity consumption (National Energy Administration). The economy provides a more constrained backdrop: the International Monetary Fund (IMF) reported 5 percent real GDP growth in 2025 and projected 4.5 percent for 2026, alongside weak private demand, a prolonged property adjustment, trade uncertainty, and local fiscal pressure. These conditions do not demonstrate weaker climate commitment, but they raise the political weight of jobs, affordability, and fiscal cost (IMF).

Most existing analyses of the 15th FYP ask whether headline targets are ambitious enough, whether coal will keep growing, and whether clean-energy expansion will produce an absolute decline in emissions. This brief asks a different question: what has changed in the policy framework, what new implementation requirements do those changes create, and where are new gaps likely to emerge?

Findings

1. THE PLAN SHIFTS FROM BUILDING CAPACITY TO DELIVERING RELIABLE POWER

The 14th FYP already promoted a "new power system." The 15th FYP goes further: its dedicated energy plan is organized around building a "new energy system" that spans supply, security, grids, consumption, and markets. Capacity expansion continues as the renewable-energy plan sets binding 2030 targets of more than 2,800 GW of wind and solar capacity (over half of total installed capacity), with wind and solar expected to supply more than 4 trillion kWh a year, or about 30 percent of generation (14th FYP energy plan; 15th FYP energy-system plan; 15th FYP renewable-energy plan).

The most consequential additions, however, focus on measurable increases to what installed capacity can deliver. The renewable-energy plan targets an average **firm output** from wind and solar equal to 8 percent of their installed capacity, defined as the power that can be guaranteed at 95 percent confidence during supply-critical periods. It further requires wind and solar to supply more than 20 percent of electricity during summer and winter evening peaks and to add at least 300 GW of reliable renewable peaking capability. The energy-system plan raises West-to-East power transmission capacity from 340 GW to more than 420 GW, requires generation-and-storage regulation capability to grow by more than 40 percent, and lifts demand-response capability from 3 percent to more than 5 percent of maximum load.

These indicator changes are concentrated in the sector plans. The renewable-energy plan's formal indicator table expands from five expected indicators to 14 (12 expected and two binding) while the energy-system plan, whose 14th FYP predecessor assigned no formal attributes at all, now labels 12 indicators: three binding and nine expected (Figure 1).

The meaning of these changes matters more than the count. Many of the new indicators measure capabilities that no single institution can deliver: firm renewable output depends on generators, storage, grid operators, markets, and users acting together. Their expected status reflects a shift toward system outcomes that require coordination, and it raises new questions about responsibility, incentives, and how performance will be observed.

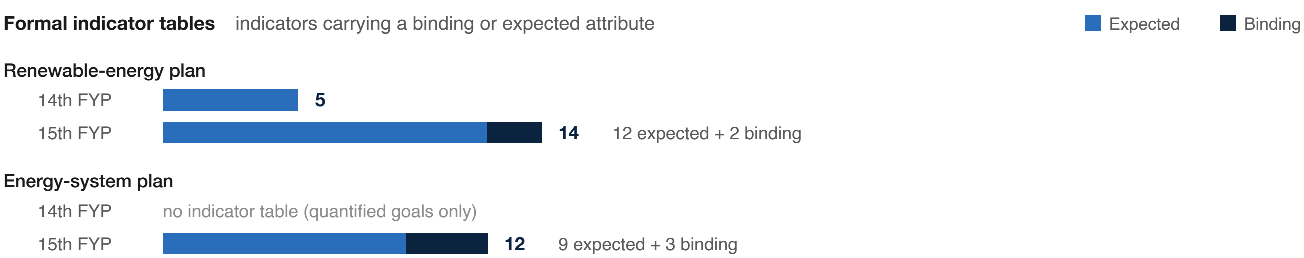
The new implementation gap is between building these capabilities and proving that they work together in real time. Storage may be commissioned but rarely dispatched; demand response may be contracted but unavailable during a peak; provincial contracts may limit a transmission line's actual use. Closing this gap depends less on another construction target than on clear responsibility, workable incentives, and evidence of delivered performance.

2. ENERGY SECURITY SUPPORTS CLEAN SUBSTITUTION AND FOSSIL BACKUP AT THE SAME TIME

The new energy-system plan makes secure and adequate supply, alongside economic feasibility, an explicit precondition for the transition. Its security portfolio includes domestic production, reserves, diversified imports, resilient grids, renewables, nuclear power, storage, and electrification. It also retains coal-production bases, coal reserves, oil and gas infrastructure, and strategic coal-to-liquids and coal-to-gas capacity.

Different shocks work through different channels. COVID-era disruption and trade tensions affected growth, exports, production, and investment. The Russia–Ukraine war and disruption around the Strait of Hormuz act more directly on fuel prices, import routes, inventories, and physical supply risk. These shocks amplified an existing security priority (Asia Society Policy Institute).

Figure 1: From capacity to system performance: what the 15th FYP sector plans newly measure



System-performance indicator (all expected)	14th FYP	15th FYP	Detail
Average firm output of wind and solar (with generation-side storage)	new	**8%**	of installed capacity; deliverable at 95% confidence in supply-critical periods
Wind and solar share of electricity during summer / winter evening peaks	new	**>20%**	of peak-hour electricity; about 10 points above the 2025 level
Reliable renewable peaking capability	new	**+300 GW**	or more, cumulative over 2026–2030
West-to-East power transmission capacity	no target	**>420 GW**	270 GW in 2020; 340 GW reached by 2025
Regulation capability of power sources and storage	new	**+40%**	or more; growth over 2026–2030
Demand-response capability	3–5%	**>5%**	of maximum load; >3% reached by 2025

Note: "New" means no counterpart indicator in the 14th FYP plans; "expected" indicators guide policy and investment, "binding" ones create formal government obligations.
Sources: NDRC and NEA, 14th and 15th Five-Year Plan energy-system and renewable-energy plans (2022; 2026).

The policy response can serve decarbonization and fossil investment simultaneously. Electrification reduces oil and gas exposure, while renewables, storage, and nuclear power strengthen domestic electricity supply. Yet the same security logic can justify coal-fired backup and coal-based substitutes for oil and gas. These assets insure against different risks over different time horizons.

The new implementation gap is the absence of clear boundaries around high-carbon security investments. Without a shared understanding of which risk an investment is meant to address, what lower-carbon alternatives exist, and how long the need is expected to last, short-term insurance can harden into long-lived fossil infrastructure.

3. DIFFERENTIATED PROVINCIAL PATHWAYS COULD REDUCE ONE-SIZE-FITS-ALL IMPLEMENTATION

Provinces are the gatekeepers between national goals and delivery: their resources, industries, fiscal positions, and power systems differ widely, and employment, investment, and reliability concerns shape local decisions (Columbia CGEP). The national framework has now provided a binding target of cutting carbon dioxide emissions per unit of GDP by 17 percent between 2025 and 2030, under the emerging system of dual control of carbon emissions.

Interview evidence suggests target-setting is becoming less mechanically top-down. Provinces may gain more room to propose carbon-intensity targets, annual trajectories, and decarbonization pathways that reflect their major projects, industrial structure, resource endowments, and development stage. The central government then aggregates local commitments, checks them against national goals, and negotiates adjustments or additional support where the total falls short. Five-year strategic goals stay fixed while annual paths flex with project timing and external shocks. Published policy supports a process that combines national direction with local conditions, but the full mechanism is not publicly documented.

Greater flexibility could reduce the abrupt power rationing, production shutdowns, and other campaign-style corrections seen near the end of past planning periods. But it also creates room for optimistic baselines, strategic under-commitment, and high-emissions projects framed as development needs. And capacity to comply is uneven: smaller firms and resource-dependent regions face higher financing costs, weaker technical services, and fewer alternative sources of employment and tax revenue.

The new implementation gap is whether differentiated local commitments can be verified and delivered. Flexibility requires credible data and effective oversight, and delivery depends on whether regions and firms have the financial and technical capacity to comply. The test is to preserve local flexibility without weakening national accountability.

4. INDUSTRIAL EMISSIONS MAY FALL AS ELECTRICITY DEMAND RISES

Two structural changes are underway at once. The first is the contraction of China's real-estate sector: housing sales, new construction starts, and property investment have fallen for several consecutive years, reducing demand for steel, cement, and building-material output. Because these sectors are large emitters, lower production pulls industrial emissions down. But this is a structural change, not necessarily decarbonization: production processes and emissions per tonne may change little.

Meanwhile, electricity demand keeps growing. Cooling, computing, electric vehicles, and industrial electrification add new load, but can cut economy-wide emissions when they displace less efficient direct fossil-fuel use. The emissions effect of new demand therefore depends on which sources supply the additional generation at the relevant hour and location.

AI illustrates the uncertainty. Its national share of electricity use remains small, but concentrated growth can strain local systems. One interviewee's research team estimates that AI- and data-related consumption could account for roughly 5 percent of national electricity use. In 2025, renewable generation grew by about

519 TWh while electricity consumption grew by about 516 TWh (Figure 2). Incremental renewable supply thus matched incremental demand for the first time, but this does not mean each additional unit of demand was served by renewables. The generation figure includes hydropower, wind, solar, and biomass, and supply and demand may occur in different provinces and at different hours ([2025 China Electricity Market Development Report; 2025 electricity consumption]).

Location adds another layer. Policy steers data centers, aluminum smelting, and some clean-technology manufacturing toward western renewable resources, but local industry, computing, other energy-intensive projects, and eastbound transmission compete for the same supply. Contracts, provincial reliability obligations, water and land constraints, and cost allocation matter as much as physical grid capacity.

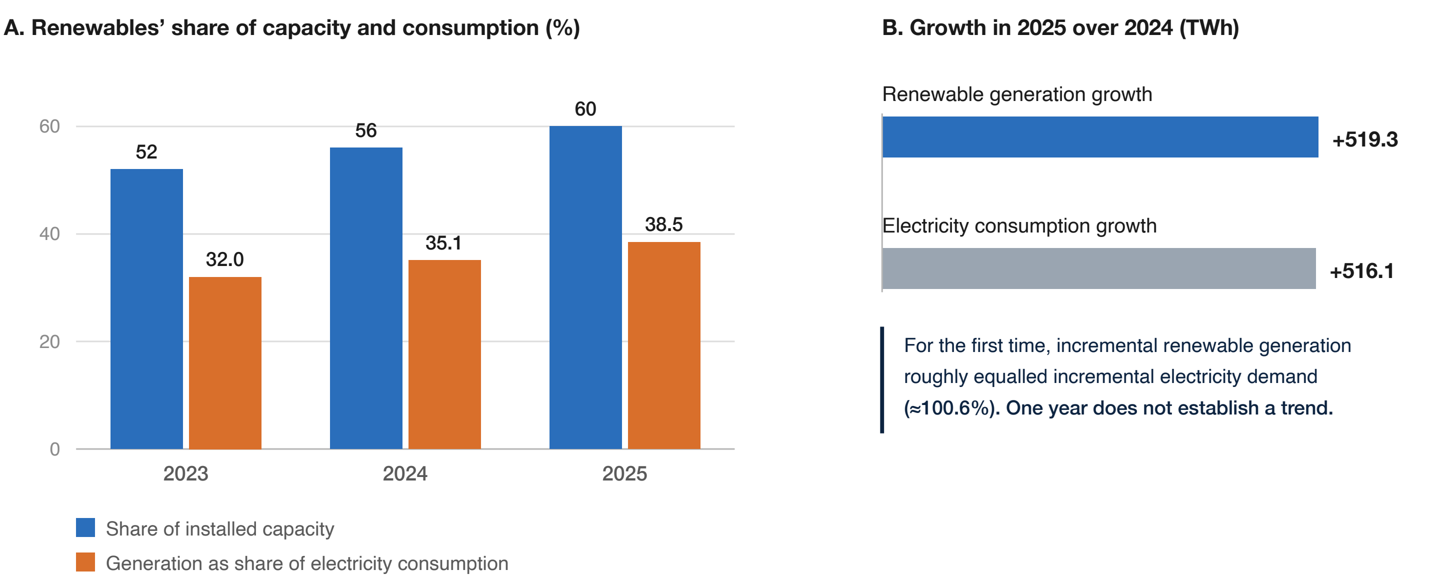
The new implementation gap is that planning does not yet consistently distinguish why emissions change. It should separate lower industrial output, cleaner production per unit of output, and the emissions attributable to new electricity demand – and then assess whether incremental clean generation matches new loads by sector, hour, and region. Otherwise, demand-led industrial decline may be mistaken for technological decarbonization, and rising electricity use may be wrongly treated as either inherently emissions-intensive or fully covered by renewables.

Recommendations

1. Make system performance observable. National energy authorities and grid companies could publish regular data on stressed-hour renewable contribution, storage dispatch, delivered demand response, and actual transmission utilization – not capacity alone. Visible performance data would reveal the coordination gap early.

2. Apply a necessity-and-duration test to high-carbon security investments. For major coal-power and coal-conversion projects, approval documents could identify the specific disruption being insured against, the lower-carbon alternatives considered, the expected duration of need, and a review date. The aim is to keep security insurance time-limited and reviewable.

Figure 2: Renewables' rising share and the 2025 growth match



Note: shares are renewable generation divided by electricity consumption; national annual totals mask provincial and hourly differences.
Sources: NEA annual renewable-energy and electricity-consumption releases (2024–2026).

3. Pair local flexibility with verification and support. Differentiated provincial pathways would be more credible if commitments disclosed baselines, major-project assumptions, and annual milestones under common accounting rules, matched by technical services, transition finance, and workforce support for smaller firms and less-resourced regions. A review in 2027–2028 could test whether the new approach is reducing abrupt enforcement without encouraging under-commitment.

4. Track structural decline and decarbonization separately. National and provincial reporting could distinguish industrial output, emissions per unit of output, and the emissions attributable to new electricity demand, and compare clean-generation growth with demand growth over multiple years and during periods of system stress. Without this separation, an emissions decline driven by the industrial slowdown could be mistaken for durable decarbonization.

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CLIMATE POLICY LAB

A DEEP DIVE

FROM ALLOCATION TO DELIVERY: CLOSING INDIA'S INDUSTRIAL DECARBONIZATION GAP

Authors: Siddharth Jain and Tarun Gopalakrishnan

CLIMATE POLICY LAB

Key Insights

- Most new iron and steel capacity is fossil fuel-based and planned expansion may double sectoral emissions by 2030.
- Large parts of the iron and steel and green hydrogen sectors are uncompetitive, and innovation investment is thin. A small number of steel firms have the resources to decarbonize. Key technologies are imported and research spending is below 1% of GDP.
- Constraints for both sectors are commercial, not technological, and green premiums are steep. Gas-based direct reduction of iron costs 2.5 times its coal equivalent to build and green steel carries a 6% premium. Just 8,000 of 862,000 tonnes of hydrogen capacity, for which subsidies were awarded to firms by the government, were actually built.
- Weak policy clarity depresses expected returns. No purchaser must buy certified green steel, so decarbonizing producers capture no premium while capital, skills, and demand signals stay uncoordinated.

Methodology

This policy brief is a part of the Climate Policy Lab's Implementation Gap Analysis (IGA) project, which examines the discrepancy between climate policies and their intended outcomes. A previous policy brief (Jain & Gopalakrishnan, 2025) assessed 31 Indian climate policies to identify which implementation gaps affected the most policies.

Building on the previous study, this deep dive draws on five semi-structured expert interviews conducted in 2026 with: an official at the Bureau of Energy Efficiency (1); a former Ministry of Steel official (2); an executive at a large integrated steel producer (3); a consultant advising the Ministry of Power and Bureau of Energy Efficiency (4); and a secondary steel association representative (5) in order to ask why three well-specified instruments – Perform, Achieve and Trade (PAT), the National Green Steel Mission, and the National Green Hydrogen Mission – have not delivered at scale, particularly in relation to the decarbonization of the steel sector. Evidence was triangulated against policy documents, official statistics, and the results of a previous report published by the Climate Policy Lab as part of the IGA.

Country Context

India has committed, under its Nationally Determined Contribution to the Paris Agreement, to reduce the emissions intensity of its economy by 47% below 2005 levels by 2035, to raise the installed capacity of non-fossil fuel energy to 60%, and to create an additional carbon sink of 3.5 to 4 billion tonnes of CO_2 equivalent by 2035, alongside a net-zero target for 2070.

The country is the world's second-largest steel producer, at approximately 151 million tonnes of crude steel in FY2024–25, with capacity targeted to reach 300 million tonnes by 2030–31. The sector accounts for 10–12% of national CO_2 emissions, roughly 260 $MtCO_2$ annually, and is among the most emissions-intensive globally at 2.54 tCO_2 per tonne of crude steel against a world average of 1.91 tCO_2. India has set a national goal of 2.2 tCO_2 per tonne by 2030.

Coal-based direct reduced iron (DRI), of which India is the world's largest producer, accounts for close to 30% of crude steel output at 2.7–3.1 tCO_2 per tonne and is concentrated in small standalone units clustered in the states of Chhattisgarh, Odisha, and Karnataka. Induction furnace production, largely dependent on coal-based DRI, has risen from 29.5% to 35.4% of output since 2019–20, while the electric arc furnace share has fallen from 26.0% to 21.9%. Because *nearly all announced new capacity is fossil-based,* sector emissions are projected to roughly double by 2030 even as intensity targets tighten. Draft emission-intensity targets covering 255 iron and steel units and 358.6 $MtCO_2e$ take effect under the Carbon Credit Trading Scheme from FY2026–27.

"Because nearly all announced new capacity is fossil-based, sector emissions are projected to roughly double by 2030..."

Three instruments govern this transition. First, the National Green Steel Mission, with an estimated outlay of ₹15,000 crore, brings together a production-linked incentive for green steel, renewable energy incentives, a mandate for government agencies to procure green steel, hydrogen pilot projects, and scrap recycling measures. Its analytical foundation is the September 2024 report, Greening the Steel Sector in India: Roadmap and Action Plan, prepared on the recommendations of 14 task forces; its measurement framework is the Green Steel Taxonomy of December 2024, which made India the first country to define green steel formally, setting a threshold of 2.2 tCO_2e per tonne of finished steel. The procurement mandate has not yet been enforced.

Second, the National Green Hydrogen Mission, approved in January 2023, targets 5 million tonnes of annual production by 2030 through the Strategic Interventions for Green Hydrogen Transition (SIGHT) programme, and has allocated ₹455 crore to pilot projects in the steel sector. As of May 2025, 19 companies held production allocations totaling 862,000 tonnes per year; commissioned capacity as of February 2026 stood at approximately 8,000 tonnes per year. Third, Perform, Achieve, Trade (PAT), launched in 2012 and now covering roughly 1,343 designated consumers across 13 sectors, is India's longest-running industrial efficiency instrument, with its large industrial sectors now transitioning to the Carbon Credit Trading Scheme.

Climate Policy Lab's previous policy brief addressing implementation gaps in Indian climate policies (Jain & Gopalakrishnan, 2025) found evidence that the National Green Hydrogen Mission suffered from *policy design, technology,* and *competing goals* related implementation gaps. The policy was found to reflect strong ambition but limited planning for market creation; it focusses too heavily on supply side measures and overlooks mechanisms to generate domestic demand; higher cost and risk means that private investment is confined to export markets. Further, electrolyzers were found to be largely imported with domestic manufacturing capacity absent and storage and transport infrastructure underdeveloped. Hydrogen production was also found to compete for limited renewable electricity, such that prioritizing it could exacerbate short term emissions. PAT was hindered by implementation gaps related to *policy design* and *data, communication, and information*. The policy was found to combine ambitious targets with inconsistent timelines and limited follow-through. It was also found that while monitoring is relatively strong among large industries, data collection from micro, small, and medium enterprises (MSMEs) remains inconsistent and often relies on self-reporting. Finally, results regarding the National Green Steel Mission were relatively inconclusive aside from the identification of technology as an important implementation gap.

Consequently, this deep dive aims to better understand the extent of and reasons for implementation gaps specific to the green steel and green hydrogen industries through the study of the aforementioned three policies. The brief asks the following questions: (A) What is the industrial structure of the sectors and how does it affect competitiveness? (B) Do the sectors invest in research, development, and demonstration (RD&D) and does the country have adequate policies in place for the incentivization of RD&D? (C) What are the chief factors holding back the decarbonization of the sectors and to what extent is technology really a binding constraint? (D) Do policies provide an adequate signal to firms and are they enacted compatibly?

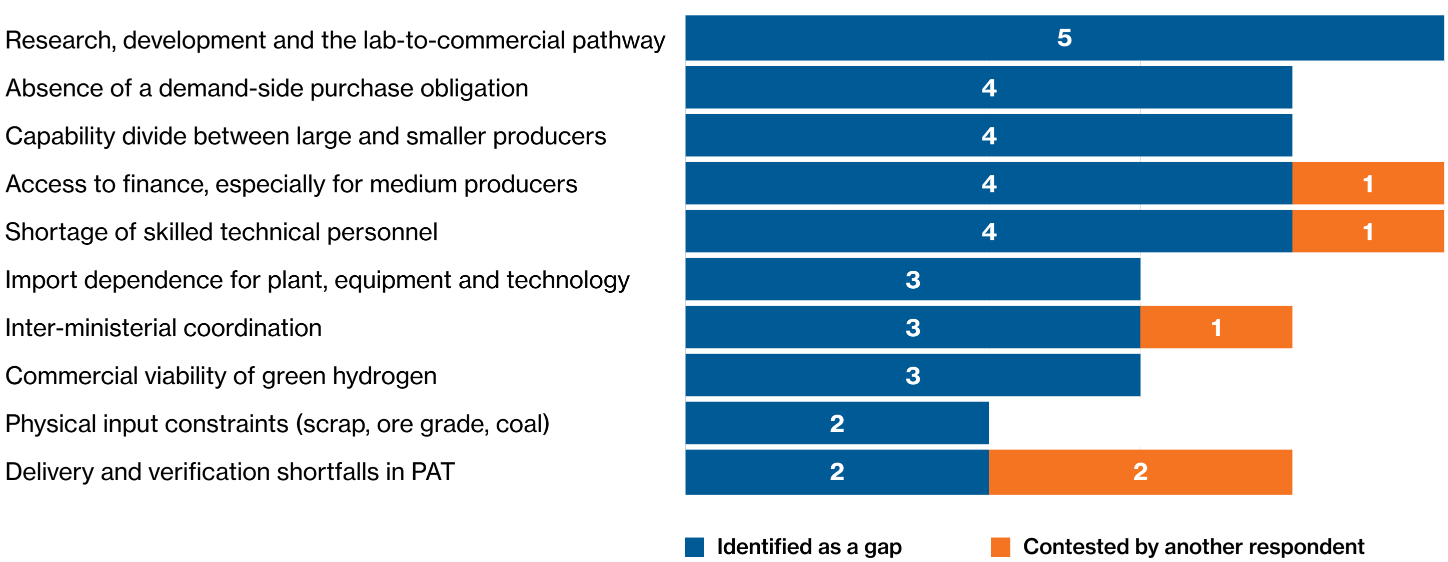
Findings

Large sections of Indian green industries are not globally competitive, and the sector as a whole is constrained by a lack investment in innovation.

Indian heavy industry is not one sector but two. Of roughly 1,200 entities in iron and steel, the top 30 to 40 possess the capital, technology access, and skilled personnel to decarbonize, are internationally partnered, and are already implementing measures; the remainder run older technology without monitoring, reporting, and verification systems. The latter segment often lacks reliable tax data, let alone emissions data, leaving these firms invisible to any instrument

Figure 1: Where the evidence converges, and where it does not

Implementation gaps identified in India's industrial decarbonization policies, across five expert interviews



premised on measurement and unable to compute embedded emissions for the EU's Carbon Border Adjustment Mechanism.

Both the relatively advanced organized section and the small firm section of Indian green industries, however, are technology receivers rather than innovators. Plant and equipment are overwhelmingly sourced abroad: complete plants from China for electric arc furnace and DRI routes, blast furnaces from Germany and France among other countries, and electrolyzer and advanced- technology vendors – from predominantly foreign vendors.

This is because India's RD&D ecosystem is inadequate – the one proposition on which every respondent agreed. Research expenditure remains below 1% of GDP and is concentrated in four or five large producers; the unorganized sector conducts effectively no RD&D, confining itself to process improvement. What research does occur is largely incremental rather than novel, and the technologies that reach Indian plants are typically imported. Of particular importance is the lack of funding for transitioning technologies to commercial scale – a lack of demonstration facilities, risk-sharing arrangements, and financing that persists across the time horizon a novel plant requires. The recent consolidation of research funding is a positive development but has yet to translate into manufacturing outcomes.

Industrial decarbonization is limited by commercial rather than technological concerns.

The binding constraint on India's industrial decarbonization is commercial rather than technological viability and is most visible in the distance between what has been funded and what has been built. What prevents adoption is cost and handling. A gas-based vertical shaft reactor, a vessel used to convert solid metal oxides into reduced metals – crucial for the production of steel – is 2.5 times as expensive to install as a coal-based system of equivalent capacity, so smaller producers will not convert voluntarily; and because they are steelmakers rather than gas producers, they cannot finance their own feedstock supply. Interviewee 3 locates the frontier further upstream, in low-cost electrolysis, hydrogen storage and transport, and carbon capture and long-duration storage, compounded by the geographic mismatch between renewable resources in the west and south and steel capacity in the east.

The green hydrogen incentive demonstrates the consequence. Under one SIGHT funding allocation tranche awarded for capacity expansion, ten companies accepted production awards; a single awardee has built, and then only partially, while the remainder have neither implemented nor retained the funds. The capital outlay, as designed, was insufficient to establish a viable business case: the instrument offered production support without a demand-side incentive, an offtake mechanism, supporting infrastructure, or sufficient industrial application. National figures follow the same pattern: only approximately 8,000 of the 862,000 tonnes per year of awarded capacity has been commissioned.

> "Policy interventions have failed to adequately coordinate capital, labor, and demand . . ."

Lack of policy and institutional clarity further constrain returns on decarbonization investment for firms.

Policy interventions have failed to adequately coordinate capital, labor, and demand – thereby slowing the pace of decarbonization. Capital is available but unevenly distributed: the largest five or six producers can fund their own transition, medium-scale plants cannot, and India has no equivalent of the innovation funds available under the European or Chinese schemes. Pilots lack viability gap funding, and private investment does not match public commitment. Skilled personnel are short at every level – senior, middle, and technician – and the pipeline is not being replenished. Engineering graduates entering manufacturing do not choose metallurgy, resulting in an inadequate supply of the engineering skills required to build and operate new process technology.

Nothing in India's industrial decarbonization architecture obliges anyone to buy the products whose production it attempts to incentivize. A green steel taxonomy is in force and certification available, but no purchaser, public or private, is required to buy against it. Firms therefore treat certification as desirable rather than necessary, and commercial organizations act on requirement or profitability before desirability.

> "A producer who decarbonizes consequently bears the cost without capturing a return."

A producer who decarbonizes consequently bears the cost without capturing a return. According to an interviewee from a large cement producer, the company earns no premium for manufacturing cement at roughly one-third of the global average embedded carbon intensity, only customer preference at parity pricing. Mandating green production without a buyer willing to pay the incremental cost (approximately 6% for green steel) transfers an unfunded liability to the producer. Respondents independently proposed similar remedies, differing only in instrument: public procurement through central construction agencies, a tax concession offsetting the premium, a green public procurement policy, and a compulsory purchase obligation on infrastructure and automotive buyers.

The contested assessments of the Perform, Achieve, Trade (PAT) scheme are illuminating. It is the one instrument on which this study records as much disagreement as agreement. The implementing agency's account presents the scheme as a success: compliance of 85–90% including through certificate purchase, coverage of roughly half of national final energy consumption, 110–120 $MtCO_2$ avoided annually, and targets set unit by unit rather than at flat sectoral rates (Interviewee 1). However, a different account from within the same institutional context describes a scheme that underperformed on institutional capacity – lapsed sector expert position contracts, vacant economist positions, limited delegated authority, and reports certificates issued for only the first three of seven officially declared cycles, which independent analysis corroborates (Interviewee 4).

Recommendations

The fundamental problem affecting Indian industrial decarbonization policy is a lack of coordination between demand and supply side incentives as well as between the different actors and stakeholders – capital, labor, innovation system, and institutions – in order to create the appropriate enabling conditions for successful green industrialization. These recommendations should be read in that context and applied in ways that allow policies to point in the same direction, building a coherent framework.

SUPPLY SIDE

Differentiate instruments by firm size. A single design cannot reach both a globally competitive top tier as well as the smaller segment that lacks basic reporting data. Concessional finance, standardized reporting templates, verifier training, and CBAM compliance support should target smaller producers explicitly.

Establish an industrial decarbonization innovation programme. A dedicated programme should combine commercial-scale demonstration plants for hydrogen-based reduction, carbon capture and storage, and iron ore beneficiation, funded through viability-gap support and sited in production clusters. It should establish differentiated appraisal and risk norms, so first-of-a-kind projects are not assessed on criteria designed for conventional capacity. It should also adopt removal of fiscal treatment that penalizes industry-funded research, including the treatment of sponsored RD&D as a taxable service; establish sector-specific allocation with defined manufacturing outcomes rather than generic research funding; and provide shared access for small and medium-scale producers, who conduct almost no research of their own.

Build the technical skills pipeline. Shortages extend from technician to senior engineering levels, and the pipeline is not being replenished. Expanding metallurgical and process engineering capacity in technical institutions, and funding industry-linked training for verifiers and energy managers, would address a constraint that tightens as capacity expands.

Develop shared feedstock infrastructure at cluster level. Requiring DRI producers to develop their own syngas or hydrogen supply means asking capital-constrained firms to enter an unrelated business. Merchant supply sited within existing clusters converts a firm-level capital barrier into a shared utility.

DEMAND SIDE

Enforce the green public procurement mandate. The procurement mandate within the National Green Steel Mission converts an existing taxonomy into a market and is the most widely supported measure in this study. Enforcement should be paired with a transparent cost-offset mechanism so that infrastructure agencies do not absorb the premium unfunded.

Use procurement to develop domestic equipment manufacturing. Plant, equipment, and advanced technology are predominantly imported. Attaching phased domestic content expectations to procurement and production incentives, supported by technology partnerships and public demonstration programmes, would convert guaranteed demand into manufacturing capability.

Link hydrogen incentives to commissioning rather than allocation. SIGHT presently rewards capacity. Tying disbursement to commissioned output, and pairing production incentives with offtake obligations in fertilizer, refining, and steel, would narrow the gap between allocation and production.

INSTITUTIONAL REFORM

Establish a standing inter-ministerial coordination platform. Implementation requires the Ministries of Steel, Power, New and Renewable Energy, Coal, Finance, and Commerce, among others, to act in concert, and overlapping obligations impose duplicative burdens on firms. A permanent body with a published mandate would resolve such conflicts and track whether task force recommendations are translated into instruments.

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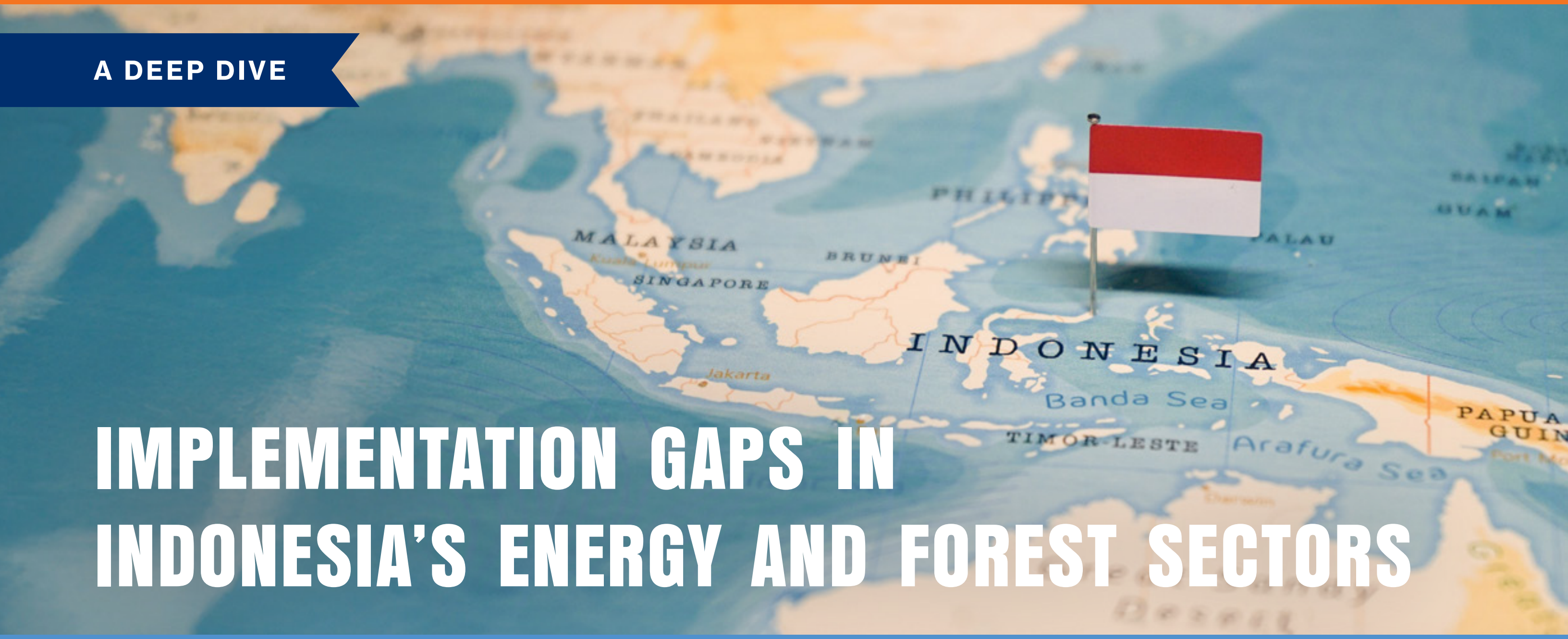

IMPLEMENTATION GAPS IN INDONESIA'S ENERGY AND FOREST SECTORS

Authors: Michael Kurniawan, Soyoung Oh, and Agus Sari

CLIMATE POLICY LAB

Key Insights

- Indonesia's implementation gap in energy and FOLU sectors is primarily driven by persistent financial, institutional, and political economy constraints that limit the ability of existing policies to deliver intended outcomes.
- In the energy sector, PLN's fiscal pressures, fossil-fuel subsidies, and electricity tariffs constrain the transition away from coal and increase risks for renewable energy investment.
- In the FOLU sector, financing gaps are compounded by fragmented land governance and competing land-use priorities. Rehabilitation and conservation programs face insufficient long-term funding, fragmented land data, and tensions among forest restoration, agricultural production, and economic objectives.
- Community-based approaches (cooperative solar, social forestry) offer an avenue for translating national policies into local outcomes, but viable operating and financing models are needed to scale them.

Methodology

This brief draws on 10 semi-structured interviews conducted across Indonesia's energy and forestry, land use, and other land use (FOLU) sectors, with interviewees from government, industry, and civil society. This deep dive is part of the Implementation Gap Analysis (IGA) project at Climate Policy Lab, which examines the gap between climate policies and the outcomes they are intended to achieve.

This analysis focuses on selected policies in the energy and FOLU sectors and examines why existing policy interventions have not consistently produced outcomes at scale. Each interview was assessed through three recurring diagnostic lenses: institutional capacity, incentive misalignment, and financial constraints to identify where reforms would close the implementation gap fastest. These lenses identify the mechanisms contributing to implementation gaps and potential reforms that could improve policy implementation.

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Country Context

INDONESIA'S CLIMATE AMBITION AND POLICIES

Indonesia has set ambitious targets and developed a broad portfolio of policy instruments, but implementation outcomes remain uneven and inconsistent across sectors. Under President Prabowo Subianto, who took office in October 2024, climate policy has increasingly intersected with broader priorities around energy security, food security, and economic growth.

Indonesia's climate agenda sits inside a dense set of overlapping policy frameworks, including a 2025 Second Nationally Determined Contribution (SNDC) that sets separate targets for forestry, food/agriculture, and energy without formally linking them; a 2060 net-zero target; and a 2025–2029 National Mid-Term Development Plan built around food-energy-water self-sufficiency ("Asta Cita 2").

A previous implementation gap analysis for Indonesia conducted by Climate Policy Lab in 2025 identified that the energy and forestry sectors face political economy and interest-based barriers, such as insufficient political will, competing goals, and industry lobbying or resistance. The 10 additional interviews conducted for this brief suggest that these political economy constraints interact with financing and institutional capacity constraints, limiting the outcomes of policies already being implemented.

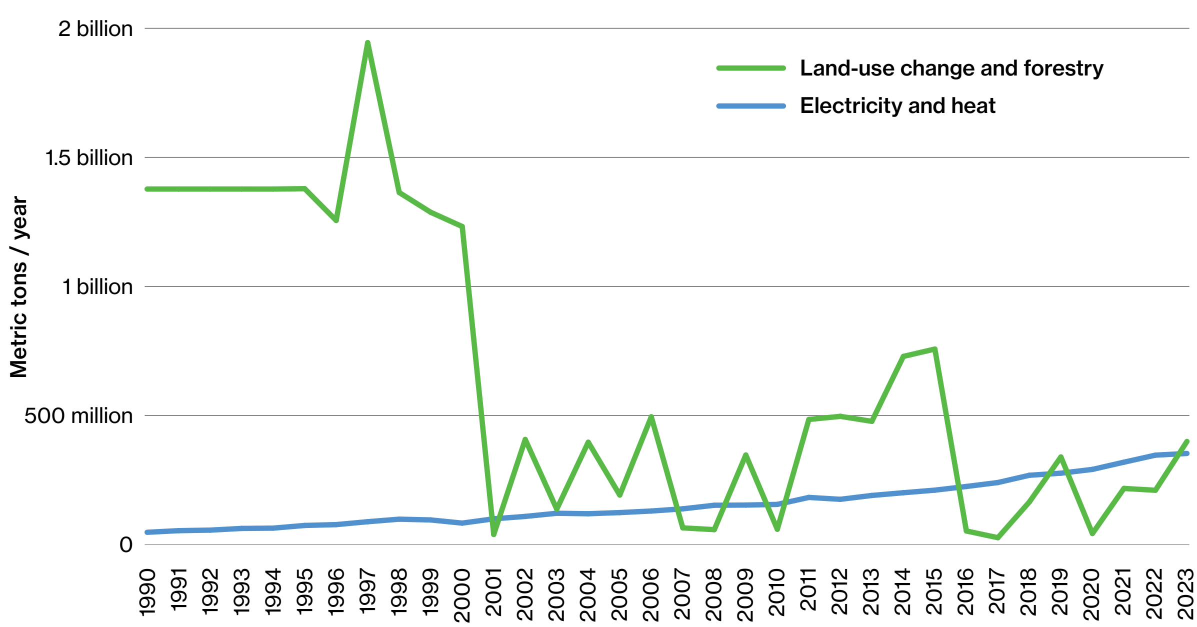
ENERGY SECTOR CONTEXT

This brief examines three areas of Indonesia's energy sector transition:

1. Phase-down and potential early retirement of coal-fired power plants;
2. 100 GW solar village solar initiative announced in 2025; and
3. Reforms to the structure and regulation of the power sector.

These policies illustrate the tension between Indonesia's growing renewable energy ambition and financial and institutional structures of a power system that remains heavily dependent on coal. The current Indonesian power strategy favors a gradual phase-down of coal rather than early retirement, given the financial

Figure 1. Emissions from land-use change & forestry and electricity & heat in Indonesia (tCO2e)



Source: Climate Watch (2026)

unattractiveness of shutting down power plants ahead of schedule. The government instead plans to reduce coal-related emissions by co-firing biomass and transitioning to hydrogen or green ammonia. The 100 GW village solar initiative, announced in 2025, envisions 20 GW of centralized solar and 80 GW of decentralized solar across 80,000 villages nationwide.

> The government's 100 GW village solar initiative envisions distributed solar deployment, but only an initial portion of this ambition has been incorporated into electricity planning…

However, none of this has been incorporated into the national electricity supply plan (RUPTL), with the first 17 GW planned to be announced in this year's upcoming plan. The operating model of the remaining capacity is still under development. Energy sector reform efforts center on structural bottlenecks stemming from the national electricity company's monopoly, aiming to create a more predictable environment for private investment in renewable energy.

PLN, the state-owned electricity utility, sits at the center of this implementation challenge. Its fiscal position depends heavily on government support within a system of administered electricity tariffs and energy subsidies. At the same time, Indonesia is pursuing a major expansion of solar power. The government's 100 GW village solar initiative envisions distributed solar deployment, but only an initial portion of this ambition has been incorporated into electricity planning, while the operating models for wider deployment remain under development.

FORESTRY (FOLU) SECTOR CONTEXT

The brief examines three dimensions of Indonesia's FOLU policy:

1. Forest-land rehabilitation under the FOLU Net Sink 2030 strategy;
2. Financing for national parks and conservation; and
3. Coordination across the food-energy-forest nexus.

The FOLU Net Sink 2030 strategy aims to make Indonesia's forestry and land-use sector a net carbon sink by 2030 by rehabilitating roughly 12 million hectares of degraded and critical land, though current funding covers only a small portion of this target every year. Financing for national parks and conservation includes newer mechanisms such as carbon credit "land-adoption" schemes, a new national carbon registry (SRUK), and a pilot Innovative Financing Task Force to close a financing gap currently allocated in the state budget. Coordination across the food-energy-forest nexus is anchored in the 2025 Water-Energy-Food (WEF) Nexus Roadmap, which seeks to align land-use decisions across forestry, agriculture, and energy at the national level.

Indonesia's forest estate, managed by the Ministry of Forestry, encompasses the protection, conservation, and production of forests, each serving distinct policy objectives and historically managed through separate administrative and data systems. A significant share of the 12 million hectares officially classified as "critical land" for rehabilitation may reflect classification mismatches.

Interview Findings

ENERGY

Coal Transition

The interviews point to a more fundamental constraint on coal phase-down. An interviewee from the Ministry of Energy and Mineral Resources mentioned that early retirement is not currently pursuing widespread early retirement of coal-fired power plants because compensation for plant owners, stranded assets, and fiscal implications for PLN make early closure financially unattractive. Instead, the current strategy emphasizes continued operation combined with a gradual reduction in emissions through cofiring – initially biomass and potentially hydrogen or ammonia in the future.

Industry respondents similarly questioned whether early retirement remains an active policy priority. Several emphasized that coal subsidies continue to weaken the commercial case for replacing coal with renewable electricity, even as solar costs decline.

International coal-retirement finance could offset some of the costs, but respondents identified a credibility challenge. Emerging carbon credit methodologies such as Verra and the Gold Standard generally require a forward commitment to stop building new coal plants, which is incompatible with PLN's plans to keep building coal plants through 2035.

100 GW Solar for Village

Indonesia's 100 GW solar program for villages illustrates the challenge of moving from an ambitious capacity target to a financially and institutionally sustainable deployment model. The program is beginning to be incorporated into the national electricity supply plan (RUPTL), but only 17 GW has been included so far, with later phases expected to be incorporated in subsequent revisions. A government respondent indicated that private investment is expected to finance a substantial share of the program.

> …the unresolved issue was not primarily solar technology, but who will own, operate, maintain, and pay for distributed systems over their lifetime.

Across interviews, the unresolved issue was not primarily solar technology, but who will own, operate, maintain, and pay for distributed systems over their lifetime. Respondents pointed to earlier village solar projects that were installed but later abandoned due to technical issues, as local communities lacked access to trained operators or maintenance services. Several interviewees therefore cautioned that expanding installed capacity without establishing long-term operating responsibilities could reproduce earlier implementation failures.

Further, demand also varies across villages. Experts cautioned against treating the target as a uniform allocation of roughly 1 MW across approximately 80,000 villages, particularly in lower-demand areas of Kalimantan, Maluku, or Papua. Matching system size to actual electricity demand and productive activities is therefore critical to avoiding underutilized assets. For large, centralized projects, land availability is an additional constraint, prompting some developers to explore alternatives such as floating solar.

Energy Sector Reform

On market reform, respondents identified broader power market conditions that affect the outcome of renewable energy policies. A solar developer highlighted a concrete regulatory bottleneck: applications for grid-connected solar projects are processed only twice a year. The respondent characterized it as a legacy of an earlier period of electricity overcapacity that now delays otherwise viable projects.

More broadly, PLN's financial and institutional position emerged repeatedly as a barrier to implementation across interviews. Respondents identified administered electricity tariffs, subsidies, PLN's growing fiscal exposure, and uncertainty surrounding PLN-linked projects as significant barriers to investment. One interviewee noted that PLN may require substantially greater government support in the coming years, while another described PLN-linked transactions as difficult to underwrite because investors must price political and regulatory risk alongside project risks.

Blended finance, guarantees, and a published de-risking roadmap can mitigate some project-level risks, but respondents stressed that these instruments cannot fully compensate for structural challenges. Fossil-fuel subsidies and administered tariffs continue to weaken the economic case for renewables, while uncertainty over tariffs and licensing raises financing costs.

FORESTRY AND OTHER LAND USE (FOLU)

Forest Rehabilitation

Interviews revealed that financing is a core bottleneck for forest rehabilitation. Indonesia has identified approximately 12 million hectares of critical land for rehabilitation, but current public resources allow rehabilitation of only a small fraction of this area annually. Government financing currently covers only the first three years of a roughly ten-year establishment period, while successful establishment can require full-length maintenance. An estimated $9 billion is required for forest rehabilitation, while interviewees estimated annual financing needs for national parks at approximately Rp75 trillion, compared with Rp8–10 trillion currently provided through the state budget.

Emerging financing mechanisms, including carbon-based "land adoption" schemes and a new registry (SRUK), are intended to close this gap. However, a respondent cautioned that there is also uncertainty about where rehabilitation should occur. Legal forest classification does not always correspond to actual land cover: significant areas legally designated as forest no longer contain forest, while actual forest cover also exists outside the formal forest estate. Respondents questioned how the approximately 12 million hectares designated as critical land intersect with other programs, including the roughly 12.7-million-hectare Social Forestry Program.

Technical capacity creates another constraint. Ministry respondents highlighted Indonesia's limited network of large-scale nurseries and the cost of moving seedlings across an archipelagic country. Expanding distributed nursery capacity across geographic areas could reduce logistics costs, improve the availability of suitable planting material, and ultimately enhance seedling survival.

The interviews suggest that the rehabilitation gap arises from a mismatch between the scale and duration of financing, the quality of underlying land information, and the biological and logistical requirements for successful restoration.

Financing for national parks and conservation

Regarding national park financing, a presidential decree has created an Innovative Financing Task Force to pilot a semi-autonomous revenue model (BLU) across 13 priority parks, alongside an emerging biodiversity-credit instrument. The two biggest risks mentioned in the interviews are a two-tier system in which only high-tourism parks become self-financing while ecologically critical, low-revenue parks stay budget-dependent, and the multidimensional, harder-to-standardize nature of biodiversity (versus a single CO_2 unit for carbon), which could let credits become a reputational instrument without rigorous, independently verified outcomes or community benefit-sharing.

Food-energy-forest nexus

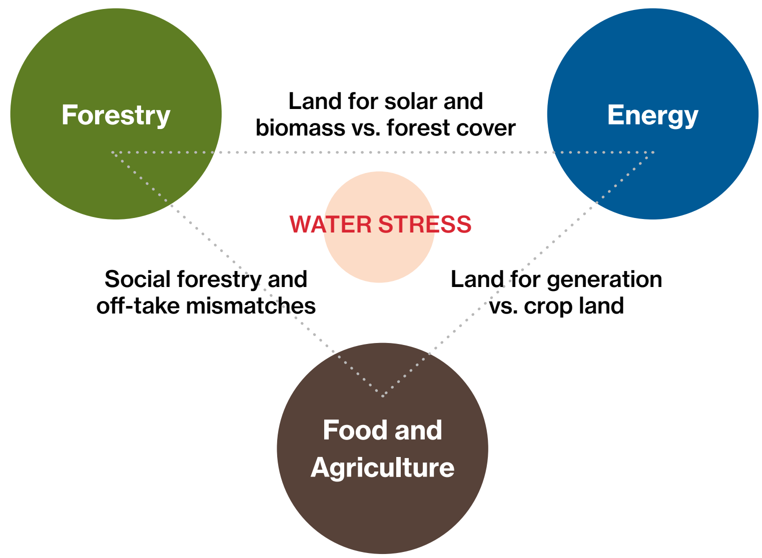
The food-energy-forest nexus illustrates an institutional implementation gap. Indonesia now has a national Water-Energy-Food Nexus Roadmap, but respondents distinguished between national coordination and the actual resolution of competing land-use claims. At the site level, forestry, agriculture, food security, renewable energy, and other development objectives can compete for the same land and water resources. Respondents identified no single institution with clear authority to arbitrate these trade-offs. As a result, sectoral programs can each be implemented according to their own objectives.

> Water availability was highlighted as an especially important missing dimension.

Water availability was highlighted as an especially important missing dimension. Respondents argued that land-use planning for food, energy, or forestry cannot be credible without incorporating water stress from the outset, particularly where agricultural expansion and energy development create additional water demands.

At the same time, interviews identified examples of more integrated local implementation. In East Nusa Tenggara, community-managed solar irrigation enabled previously water-constrained communities to expand year-round agriculture, aquaculture, and income-generating activities. Respondents contrasted this bottom-up model with more centralized approaches based on predetermined commodities and land allocation.

Figure 2. Indonesia's food-energy-forest nexus: three competing land claims and one shared water constraint



Recommendations

Across the ten interviews, respondents consistently pointed to a gap between the expected and actual outcomes of polices being implemented. Three main constraints appear across the energy and FOLU sectors: financial constraints, political economy incentives, and institutional capacity and coordination. These factors often reinforce one another. Financing is harder to mobilize when revenue models or institutional responsibilities remain uncertain, while fossil fuel incentives can make reforms politically difficult.

CROSS-CUTTING

- **Align financing to implementation needs, not just initial investments.** Public and blended finance could be designed for long-term operation, maintenance, and performance.
- **Prioritize transparent, publicly disclosed data, including land classification, monitoring, reporting, and verification (MRV), and licensing decisions,** as a precondition for scaling any of the financing instruments described above, since credibility gaps are what keep institutional capital on the sidelines in both sectors.
- **Treat institutional silos as the common root cause.** Creating a single cross-ministerial body to arbitrate land-use and financing trade-offs that currently fall between energy, forestry, food, and finance ministries could help fill the gap.

ENERGY

- **Establish a clear delivery model for the 100 GW village solar program.** Anchoring the 100 GW target in the 2027 update to the SNDC would give firmer legal footing than a ministerial regulation and broaden the political coalition behind reform.
- **Increase grid-connection licensing rounds beyond twice a year and publish a PLN de-risking roadmap** (tariff certainty, guarantee structures, transparent licensing) to unlock the private-sector pipeline currently sitting idle.
- **Pair distributed solar with productive economic uses and guaranteed off-take,** and fund the local operator/maintenance capacity needed to prevent installations from being abandoned.
- **Align coal policies with transition objectives.** Reducing policy incentives that favor continued coal generation and establishing a credible pathway for coal phase-down can unlock international transition finance.

FOLU

- **Resolve land-classification mismatches (forest area vs. actual land cover)** before allocating further rehabilitation spending, and publicly disclose location, methodology, and MRV results for both the 12-million-hectare program and BLU-financed parks.
- **Shift rehabilitation cost-sharing toward a polluter-pays model for landscapes with documented corporate deforestation footprints,** reducing reliance on state budget alone.
- **Build cross-sectoral, site-level authority to arbitrate competing land-use trade-offs for forestry, food, and energy**, with water-stress data built in from the start, and fund

community-controlled models (solar irrigation, social forestry-linked business development) alongside top-down commodity planning.

- **Replace discretionary, case-by-case forestry approvals** with clear management guardrails and continue building technical/commercial capacity inside the Ministry of Forestry.
- **In the near term, relax export restrictions on round logs and sawn timber** for high-performing Sustainable Forest Management operations and rationalize logging royalties, to raise industry activity and overall government revenue even at a lower rate.

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CLIMATE POLICY LAB

A DEEP DIVE

ALIGNING MEXICO'S ENERGY TRAJECTORY WITH THE GRID: LINKS BETWEEN RENEWABLES, ENERGY SECURITY, AND SOVEREIGNTY

Author: Nora Hampl

Expert recommendations

The following pathways would enable an energy transition that delivers energy security, sovereignty, and climate outcomes for Mexico:

- Make clean-power target for 2030 binding (legally enforceable).
- Prioritize renewable generation: renewables need to crowd out natural gas in dispatch and planning to meet the *energy security* and *sovereignty* objective.
- Under the new legal framework, ensure a regulated and monitored private sector participation to scale up renewables; currently, regulatory uncertainty discourages clean-energy financing.
- Invest generously in the grid, which needs to scale in parallel with generation and move toward modular, recyclable technologies that utilize renewable-energy flows.

Methodology

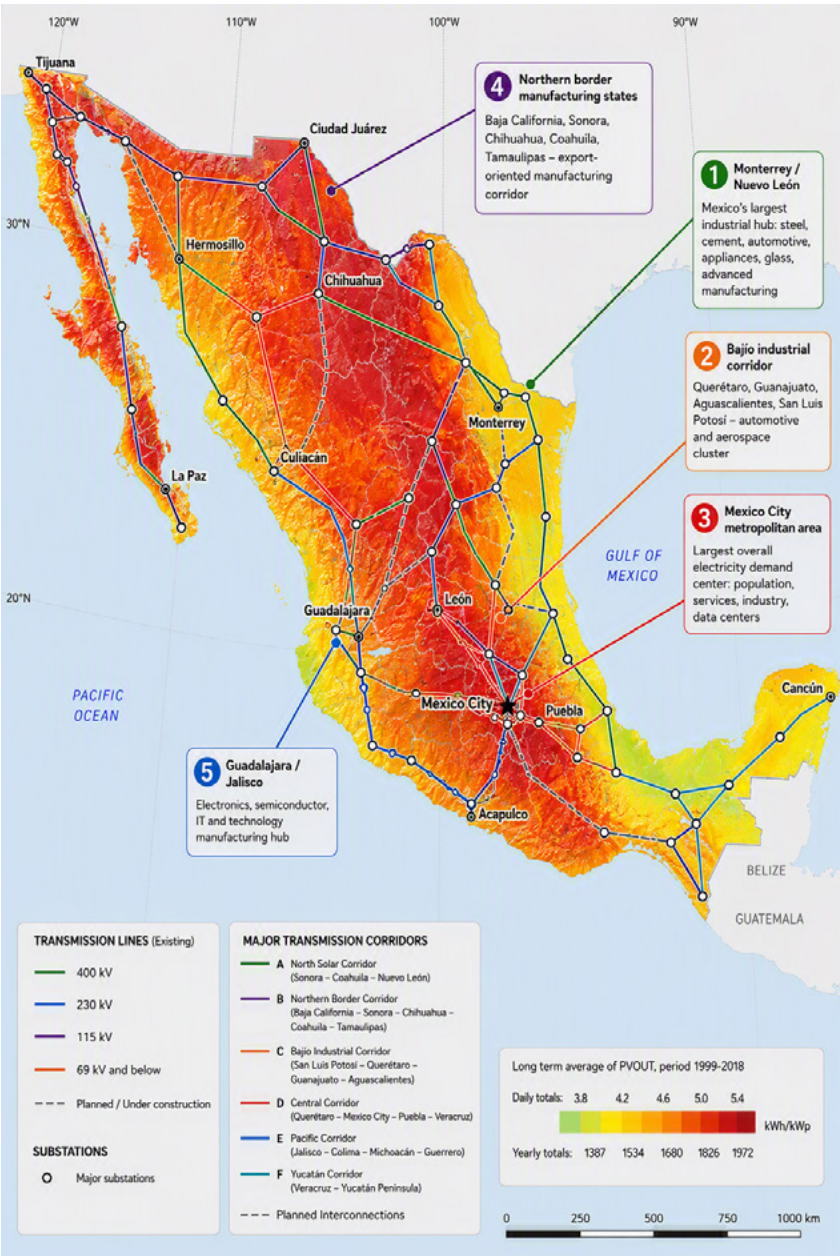
The Implementation Gap Analysis (IGA) developed by the Climate Policy Lab (CPL)[1] has been applied in the first phase of IGA research to assess and rank sources of climate-related policy *implementation gaps*[2] in Mexico.[3] This policy brief presents findings from the second phase of research; it maps previously identified gaps ranked as most significant (as well as additional gaps identified by experts) to recently adopted *initiatives*[4] in the energy sector. Mixed methods research (policy review drawing on International Energy Agency and CPL policy databases)[5] was followed by qualitative research (semi-structured in-depth expert interviews), then triangulated with the results of the first research phase. The goal of the interviews was to capture expert views regarding the most critical implementation gaps impacting climate outcomes and decarbonization of the electricity sector (and the energy sector overall).

The graduate school of global affairs at Tufts University

Country Context

In the broader context of Mexico's energy strategy, the current energy policy framework is expected to deliver the following outcomes: energy sovereignty and security, hydrocarbon self-sufficiency, electricity sector overhaul, and a diversified electricity matrix – in keeping with environmental and climate commitments. In November 2025, Mexico submitted a third Nationally Determined Contribution (NDC 3.0)[6] under the Paris Agreement, pledging an emissions cap of 364–404 $MtCO_2e$ by 2035 (unconditional) and net-zero emissions by 2050. These goals are premised on emission reductions in electricity generation by around 20%, and a major scale-up of renewable energy, energy efficiency improvements, transportation electrification, and gas flaring and methane leaks reduction.

Figure 1. Photovoltaic power potential, transmission corridors and key industrial demand centers (Mexico)



Source: Photovoltaic power potential (PVOUT) derived from Global Solar Atlas (World Bank Group, ESMAP, and Solargis). Industrial demand centers and transmission corridor overlay developed by the author based on major electricity demand centers and representative transmission pathways.

Since 2024, Mexico has enacted far-reaching constitutional and legal reforms in the energy sector that strengthen state control over the oil, gas, and electricity industries. The main pillars of the energy sector – Federal Electricity Commission (CFE) and PEMEX, now classified as state public enterprises – are guaranteed a majority share of the market. With priority power dispatch over private companies, CFE has to supply at least 54% of the country's electricity.[7] Moreover, PEMEX enjoys preferential rights in upstream, mid- and downstream hydrocarbon activities, from oil & gas exploration and production to petroleum refining, natural gas processing, fuel distribution, fuel imports/ exports, and petrochemical production (Hydrocarbon Law, 2025).[8] With oil production capped at 1.8 million barrels/day for the Mexican market, PEMEX's mandate is to serve the Mexican market first. Electricity transmission and distribution are exclusive state monopolies.

Mexico's industry competitiveness, uncertainties resulting from continuous negotiations over the United States–Mexico–Canada Agreement and fluctuating oil and gas trade flows have resulted in efforts to securitize of Mexico's energy economy. As articulated in the 2025–2030 National Development Plan (PND, 2025),[9] the role of the state will be to ensure energy security, sovereignty and affordability, but also to invest in clean energy in keeping with climate commitments. A total of 51 strategic projects are expected to generate an additional 22,000+ MW, reduce dependence on imports, and achieve equitable energy access. The plans include boosting oil and gas self-sufficiency, setting the target for clean energy to 38% by 2030 (from 25% today), and modernizing the grid and refineries.

Interview Findings

The main concerns raised by the interviewees concerned key uncertainties relating to the future of Mexico's clean energy transition given the dominant position of PEMEX and CFE. Promoting strategic clean energy projects and upgrading electricity infrastructure, while fostering technological innovation to reduce environmental impacts and dependence on fossil fuels also implies promoting the integration of clean and renewable energy at all stages of the value chain and ensuring competitive renewable energy supply *(Interviewees 1–6).*

Given the market dominance of the state companies, all interviewees except one expressed concern that the energy market is not open to accommodate competition, which – according to the interviewees – has implications for outcomes of all initiatives surveyed in this policy brief.[4] Additionally, lack of competition and bank participation increases risk and project costs; the current strategic projects (20-year power purchase agreements) are much more expensive and less cost efficient than in the previous competitive environment (3-year power purchase agreements of 2015) *(Interviewee 3).*

> "The current risk is that the close relations between industrial strategy and CFE and Pemex will translate into more combined cycle gas and refining capacity while transmission – the real constraint to renewables – will remain under-funded." – Miriam Grunstein, Baker Institute, Nonresident Scholar

GAP 1: INDUSTRY LOBBY/RESISTANCE

While different industry groups maintain ties to and share interests with the government, only some actors in the energy industry will seek to expand their own economic power *(Interviewee 2).* The dissolution of an autonomous regulator, Energy Regulatory Commission (CRE), and National Hydrocarbons Commission (CNH), in combination with the powerful fossil fuel lobby,[10] pose a risk of collusion and unchecked influence over the energy transition including its pace *(Interviewees 2–6).* Additionally, "state fossil fuel buildout and hydrocarbon rescue systematically trade climate outcomes for short-term fiscal and political gains" *(Interviewee 2).*

GAP 2: INCENTIVE MISALIGNMENT

All interviewees expressed the view that current incentives are either misaligned, insufficient, or non-existent to attract the size and scale of investment needed to achieve timely climate-compatible energy transition as wished for in announced strategies and subsequent policy initiatives.[4] First, to improve grid reliability and capacity and resolve transmission bottlenecks, massive investment in the grid is required (in transmission, distribution and system flexibility), but it is unclear how much funding will be allocated for the upgrade. Second, no disincentives are in place to change status quo and induce change in hydrocarbon industry behavior (e.g., reduce emissions, invest in clean technology and decarbonize its operations) *(Interviewees 2–6).* Third, guardrails are missing to prevent climate and environmental targets from being sidelined and/or compromised (e.g., "polluter pays" principles such as a carbon tax or effective enforcement are largely absent) *(Interviewees 1, 3, 4, 5, 6).*

Additional gaps

POLICY DESIGN

The policy design, when backed by binding investment, will determine whether the energy transition will be aligned with both industrial expansion fueling over 3% annual growth in energy demand (some estimates refer to a 13.4% increase in electricity demand), and Mexico's clean energy and climate commitments. Low levels of transmission and grid investment will result in stagnation and system constraints. On the contrary, high levels of investment will enable high renewable penetration. But even with slower renewable growth, significant grid investment is needed to relieve bottlenecks and maintain reliability *(Interviewees 3, 4, 6).*

As confirmed by all interviewees, *stakeholder coordination* and their *competing interests* will inevitably affect the implementation progress of climate-compatible energy policies. However, *policy design* could moderate power asymmetries among stakeholders *(Interviewees 1–6)* and limit the extent to which they influence energy policy decision-making and exert control over climate mandates *(Interviewee 2).*

TECHNOLOGY

In Mexico's resource context, *technology readiness, maturity,* and *cost-effectiveness* involving solar, wind and storage are not perceived as significant constraints affecting the implementation progress in electricity matrix decarbonization. On the other hand, stalled investment in transmission, distribution and grid modernization, and system flexibility – alongside generation – have been noted as key pre-conditions for progress *(Interviewees 1–6;* see also Climate Transparency's assessment[11]). The future grid needs to integrate the latest technological advances including the new concept of base load power – instead of providing more inflexible supply at any price, it should deliver dependable capacity when required. If some generation capacity remains underused, renewable resources have no fuel costs and operating expenses are low. These cost savings need to be considered when making initial investment decisions in the *transmission* (long-distance, high-voltage lines), *distribution & grid modernization* (smart grid rollout, monitoring, demand management, local networks, digitalization), *system flexibility* (grid-side upgrades beyond storage: substations, reactive power, dynamic line rating, forecasting, etc.), and *generation* (solar, wind, storage).

PUBLIC AND PRIVATE INVESTMENT

Investing in grid and transmission is a pre-requisite to unlocking renewable generation and achieving full-scale energy transition aligned with industrial expansion *(Interviewees 1–6).* A carbon tax and removal of fossil fuel subsidies make renewables the least costly option for grid decarbonization, and can gradually phase out currently untaxed natural gas *(Interviewees 4 and 5).* With a balanced buildout, grid expansion should scale with renewables, enabling steady growth without major congestion ($50+ billion grid investment unlocks $100 billion in generation) (Table 1). To meet the investment targets (starting at $100 billion for the total system upgrade), creating conditions to attract private investment should become a priority *(Interviewees 1–6).*

In the high investment / high renewable penetration, a 210 billion USD total system investment would enable 200–300 TWh/year of additional renewable generation, while transmission, smart-grid, and storage investments would mainly help integrate that capacity, reduce curtailment and losses, and improve overall system utilization. Mexico currently generates 350–370 TWh of electricity per year, of which about 75% comes from non-renewable sources. Adding 200–300 TWh/year of clean electricity would mean the electricity matrix would become mostly renewable and domestically sourced, in line with the energy security and energy sovereignty policy goals. Moreover, clean electricity would be delivered to high-energy demand industrial and manufacturing hubs such as the Bajío industrial corridor, Mexico City metropolitan area, northern regions and Guadalajara – all in need of decarbonization. Simultaneously with the clean grid transformation, pollution levels, air quality and health outcomes of workers would substantially improve.

INSTITUTIONAL GAPS

Implementing guardrails that support the coherence of the energy and climate policy framework implies enacting reforms that address specific institutional gaps; to name a few – reliable data collection and sharing, market compliance and accountability, carbon tax enforcement, and regulator autonomy and oversight *(Interviewees 1–6).* These reforms would fulfill functions previously performed by autonomous, independent bodies such as the Federal Economic Competition Commission (COFECE), CRE, CNH or their equivalents *(Interviewees 3, 4, 6).* Simultaneously, these guardrails will act as levers the government can use to push for the

Table 1. A combined system investment (grid and generation): Low versus high levels of investment

	Low investment / low renewable penetration (in billions USD)	High investment / high renewable penetration (in billions USD)
Transmission	$5–10 (maintenance, not expansion)	$30–60 (expansion of long-distance, high-voltage lines); solar (North) and wind (Oaxaca) will reach demand centers in central Mexico
Distribution (smart grid rollout, monitoring, demand management)	$4–8 (minimal upgrades, grid patching)	$10–20 (smart grid rollout, monitoring, demand management, digitalization)
System flexibility	$1–3 (slow progress)	$10–15 (advanced grid technologies and grid-side upgrades beyond storage: substations, reactive power, dynamic line rating, forecasting)
Generation	$10–20 (allocated to specific projects)	$80–120 (solar, wind, storage)
Total investment	$20–35	$130–210
Projected outcomes	Insufficient investment will result in system constraints, stagnation and blackouts; Grid congestion will likely worsen, potentially impacting existing renewable projects.	Grid transforms from a bottleneck to an enabler, while supporting over 50% of renewable penetration; $50 grid investment unlocks $100 in generation (transmission needs to lead generation rather than vice versa).

stated outcomes of the adopted policies. Last but not least, two interviewees consider tackling *corruption* and the *informal economy* (including fuel theft) essential for the economic success of the 2025–2030 National Development Plan and the 2026 Energy Sovereignty Strategy *(Interviewees 4 and 5).*

ENERGY SECURITY AND SOVEREIGNTY (PND)

Specific questions were raised with respect to the implementation of the National Development Plan 2025–2030 (PND) and achieving energy security and sovereignty. According to the experts, these will be difficult to reach given the fact that 50% of Mexico's solar value chain is China-dependent *(Interviewee 5)* and 75% of its electricity mix (natural gas) comes from the United States *(Interviewees 1–6).* At the same time, ***energy security*** and ***sovereignty*** as strategic policy goals should not translate into an endorsement of the fossil fuel state monopoly crowding out renewable energy markets that can compete on cost basis *(Interviewee 6).* On the contrary, competitive energy market re-opening, with private investment regulated, monitored, and sanctioned, would facilitate rather than hinder the implementation of the stated policies[3] *(Interviewees 2–6).*

Recommendations

The administration's priorities are currently shaping investment conditions through 2030. Recent policies and reforms have disincentivized competition and broad participation in energy markets – the electricity reform favors the CFE, while the Hydrocarbon Law strengthens the market position of PEMEX. To offset the imbalance, (i) introduce supportive mechanisms for clean power deployment, (ii) integrate carbon pricing reform, and (iii) ensure private-renewables participation under the new legal framework.

Relatedly, the amount that will be allocated to the modernization of the entire electricity system including transmission, distribution, system flexibility, and generation, will determine the pace and scale of renewable penetration, particularly because the optimal solar and wind resources are located far from demand centers. Over the past decade, renewables including solar, wind, and utility-scale batteries became the lowest cost sources of new electricity, with solar decreasing by 70–90%. Annual global investment in wind, solar, and storage amounted to $807 billion (IRENA and CPI, 2025),[12] resulting in a fast pace of deployment, continued technological advancement, and evolving global supply chains. Given Mexico's lithium reserves and solar abundance, the country's domestic resources make it an ideal candidate for grid modernization to accommodate a fast uptake of renewables with advanced storage technology, integrating the latest design concept of baseload power. Solar, wind, hydro, storage, demand response, and grid management can be configured to provide such reliability, while being deployed incrementally, at a fast pace, and with less financial risk. High-level investment in high-renewable grid penetration would (i) advance the energy security and sovereignty policy goals, (ii) help decarbonize main industry hubs, and (iii) improve environmental and health outcomes.

Addressing the above noted sources of implementation gaps requires institutional reforms that focus on market compliance, accountability, autonomous oversight and enforcement (including combatting informality and corruption), resource mobilization across scales, multi-stakeholder coordination, and power-asymmetry moderation. Beyond regulation and enforcement, access to public data systems and digital infrastructure, as well as collection and sharing of reliable data (including between state operators and utility companies) will improve transparency and enable timely policy adjustments. Importantly, for energy policy implementation to succeed and achieve the articulated policy outcomes, it must be supported not only by robust finance and grid overhaul, but also coordinated governance across federal-regional-state-local levels capable of aligning planning with execution.[3, 13]

Endnotes

1. The IGA framework includes four broad categories of policy implementations, broken into additional subcategories: (1) Governance and Institutional Capacity, (2) Political Economy and Interests, (3) Financial Constraints, and (4) Technical and Legal Constraints. In the case of Mexico, *Industry Lobby/Resistance* and *Incentive Misalignment* were identified as having the greatest impact on climate-related policy outcomes. Closely ranked as slightly less important were *Competing Interests, Policy Design, Stakeholder Coordination, Public Investment,* and *Technology.*

2. CPL definition of implementation gap is a discrepancy between intended and actual outcomes after policy adoption.

3. Nora Hampl and Daniel Alegre, Achieving Mexico's *Climate Ambition Despite Institutional Weakness* (Policy Brief, Climate Policy Lab, The Fletcher School at Tufts University, November 2025), https://bpb-us-e1.wpmucdn.com/sites.tufts.edu/dist/d/8478/files/2025/11/CPL_IGA_PolicyBrief_Mexico.pdf

4. *Initiatives* in this policy brief refer to strategies, policies, programs, legislative acts, regulatory and planning instruments, etc. and include (i) The 2025-2030 National Development Plan, (ii) Electricity Sector Reform and regulatory oversight, (iii) The 2026 Energy Sovereignty Strategy, and (iv) climate-related actions (reducing methane leaks and gas flaring).

5. Climate Policy Lab, *National Climate Policy Inventories* (2026), https://www.climatepolicylab.org/national-climate-policy-inventories

6. Government of Mexico, *Nationally Determined Contribution (NDC 3.0),* submitted November 17, 2025, https://unfccc.int/documents/654344

7. International Trade Administration, "Mexico's Energy Sector Reform," April 10, 2025, https://www.trade.gov/market-intelligence/mexico-energy-sector-reform

8. International Trade Administration, "Mexico Energy Hydrocarbon Sector," March 10, 2026, https://www.trade.gov/market-intelligence/mexico-energy-hydrocarbons-sector

9. Government of Mexico, *The National Development Plan 2025-2030 (PND),* April 15, 2025, https://www.gob.mx/cfcrl/documentos/plan-nacional-de-desarrollo-2025-2030-396052?state=published

10. In oil and gas, the CARSO group, for example, proposes policy measures that will benefit the same while seeking to restrict competition; in the power sector, some companies have a preferential status in acquiring substantial deals and contracts.

11. Climate Transparency, "Assessment of Financial Instruments for Mexico's Energy Transition: Cases of FOTEASE and FIDE" (2025), https://www.climate-transparency.org/wp-content/uploads/2025/04/Assessment-of-financial-instruments-for-Mexicos-energy-transition_-cases-of-FOTEASE-and-FIDE.pdf

12. International Renewable Energy Agency (IRENA) and Climate Policy Initiative (CPI), *Global Landscape of Energy Transition Finance,* (Abu Dhabi, 2025). https://www.irena.org/Publications/2025/Nov/Global-landscape-of-energy-transition-finance-2025

13. Grantham Research Institute on Climate Change and the Environment and London School of Economics, "Strengthening Mexico's Climate Law: Policy Lessons from Subnational and International Experience," (2025), https://www.lse.ac.uk/granthaminstitute/publication/strengthening-mexicos-climate-law-policy-lessons-from-subnational-and-international-experience

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CLIMATE POLICY LAB

A DEEP DIVE

ASSESSING SOUTH AFRICA'S TRANSPORT SECTOR DECARBONIZATION POLICY IMPLEMENTATION

Authors: Seth Owusu-Mante, Kate Hua-Ke Chi, and Kwame Ababio

CLIMATE POLICY LAB

Key Insights

- Road transport decarbonization has become both an industrial and an economic imperative for South Africa, particularly as key export markets transition to electric vehicles (EVs).
- The Green Transport Strategy and Electric Vehicles White Paper establish a clear policy direction but provide limited guidance on implementation, institutional responsibilities, financing arrangements, and government support.
- Political will and competing socioeconomic priorities continue to shape the implementation of South Africa's road transport decarbonization policies. Unemployment, safeguarding employment in the automotive industry, fiscal pressures, and fuel tax revenues, among others, remain central considerations in government decision-making.
- Limited public and private financing remain a key constraint across South Africa's road transport decarbonization value chain, constraining investment in charging infrastructure, limiting access to vehicle finance, and slowing broader EV adoption.
- South Africa's established automotive industry, critical mineral endowment, and growing access to international climate finance create a strong foundation to accelerate road transport decarbonization, provided implementation challenges are effectively addressed.

Introduction and Country Context

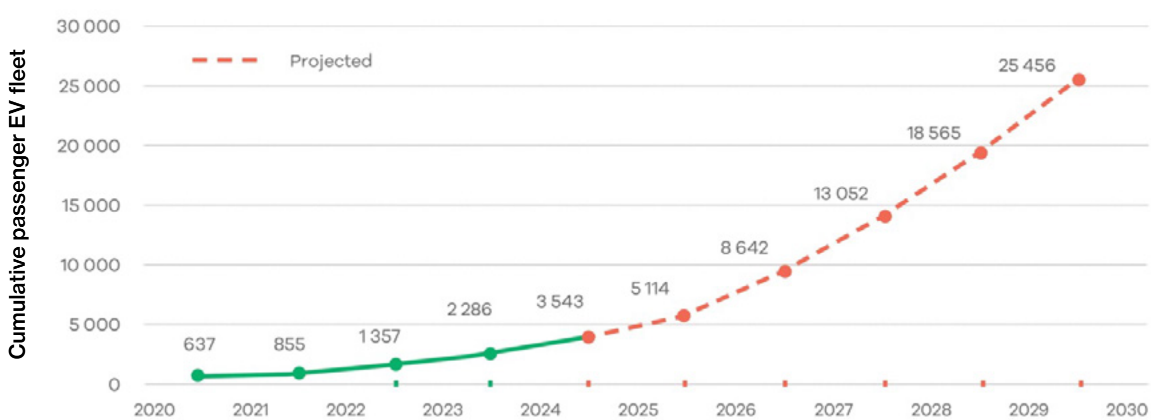
Road transport decarbonization has become a central component of South Africa's climate and industrial policy agenda. The transport sector is the country's third-largest source of greenhouse gas (GHG) emissions, accounting for approximately 12.5% of national emissions, with road transport responsible for more than 90% of transport-related emissions (DFFE, 2026). The sector's significance also extends well beyond its role in reducing emissions, as transport is central to the country's economic growth, trade, employment, and access to social services. South Africa's automotive industry is one of the country's largest manufacturing sectors. It is deeply integrated into global value chains, exporting vehicles to more than 150 countries, with 46% of domestic vehicle production destined for the European Union (EU) and the United Kingdom (UK) (DTIC, 2023). Because close to half of South African vehicle production is exported to markets that are themselves transitioning away from internal combustion engine (ICE) vehicles, road transport decarbonization has become a climate, economic, and industrial imperative, requiring South Africa to decarbonize the sector while safeguarding manufacturing, exports, employment, and international competitiveness.

Recognizing these challenges, South Africa has progressively strengthened its transport decarbonization policy framework. The country's transport decarbonization agenda is principally guided by two national policies: the Green Transport Strategy (2018–2050) and the Electric Vehicles White Paper (2023). The Green Transport Strategy provides the overarching framework for reducing emissions across the transport sector through investments in public transport, electric vehicles (EVs), cleaner fuels, modal shifts, and alternative vehicle technologies. The strategy further commits the transport sector to a 5% reduction in emissions by 2050. The Electric Vehicles White Paper complements this framework by positioning South Africa's automotive industry for the global transition to electric mobility through domestic EV production, investments, localization, export competitiveness, employment protection, and the development of the domestic EV market.

To support implementation, South Africa's government announced in the 2024 Budget the introduction of a 150% investment allowance for qualifying investments in electric and hydrogen-powered vehicle production (NAAMSA, 2024). Originally scheduled to take effect from March 2026, the incentive will allow manufacturers to claim 150% of qualifying investment expenditure in the first year.

However, early evidence suggests that progress in decarbonizing South Africa's road transport sector remains modest. Despite the existing policy framework, passenger EVs are projected to reach 25,456 vehicles by 2030, representing 0.3% of South Africa's passenger vehicle fleet (see Figure 1). While South Africa produces approximately 600,000 vehicles annually, only

Figure 1. Cumulative number of passenger EVs from 2020 to 2024 and projected up to 2030



Source: Green Cape (2025)

about 9%[1] are new energy vehicles (NEVs)[2], most of which are manufactured for export rather than the domestic market. Using the Climate Policy Lab's Implementation Gap Analysis (IGA) framework, this policy brief identifies and examines the most pressing implementation gaps constraining the decarbonization of South Africa's road transport sector, with particular focus on passenger EVs, in line with the implementation of the Green Transport Strategy and the Electric Vehicles White Paper.

Methodology

This study adopts the Climate Policy Lab's (CPL) Implementation Gap Analysis (IGA) framework to assess the implementation of South Africa's Green Transport Strategy and the Electric Vehicles White Paper. The IGA framework provides a structured approach to assess factors influencing the extent to which climate change mitigation and adaptation policies achieve their intended outcomes. The framework is organized around four broad categories: (i) governance and institutional capacity, (ii) political economy and interests, (iii) financial constraints, and (iv) technical and legal constraints, comprising 17 implementation challenges (Owusu-Mante & Chi, 2025).

A previous study (Owusu-Mante & Chi, 2025) using the IGA framework identified several implementation challenges that constrain climate policy delivery in South Africa, such as weak vertical and horizontal coordination, competing political priorities, limited public and private financing, inadequate institutional capacity, inelastic consumer behavior, and insufficient incentives. While this earlier study provides a broad assessment across multiple sectors, this policy brief narrows the analysis to the road transport sector.

To complement the policy analysis and offer in-depth insights, five semi-structured interviews were conducted with transport decarbonization experts representing academia, industry associations, consulting, and non-profit organizations in South Africa (Table 1). Interview findings were analyzed using the IGA framework to identify key implementation gaps, assess the barriers influencing policy implementation, and identify opportunities to strengthen policy implementation.

Table 1: Interviewees and Organizations

Interviewee	Organization Type
#1	Academia
#2	Industry Association
#3	Academia
#4	Consulting
#5	Non-profit organization

Key Findings

IMPLEMENTATION GAPS

Previous application of the IGA framework (Owusu-Mante & Chi, 2025) identified several implementation challenges affecting South Africa's transport decarbonization, including vertical and horizontal coordination, political will and competing goals, public and private financing, institutional capacity, consumer behavior, and insufficient incentives. The interview findings for this policy brief largely corroborate these earlier findings. Among the implementation challenges identified, political will and competing goals, policy design, and public and private financing emerged most consistently as the principal constraints to implementing South Africa's road transport decarbonization policies.

Political will and competing goals

While the South African government has articulated a clear policy direction through the Green Transport Strategy and the Electric Vehicles White Paper, interviewees noted that transport decarbonization continues to compete with broader socioeconomic priorities. These include addressing the unemployment crisis, protecting jobs in the automotive industry,

1 New energy vehicles (NEVs) collectively refer to battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), hybrid electric vehicles (HEVs), and fuel cell electric vehicles (FCEVs).

2 Interviewee #2

reducing the budget deficit, and maintaining government revenues from fuel taxes. South Africa's unemployment crisis remains a dominant political priority, with a national unemployment rate of 32.7% in 2026, including 60.9% among those aged 15–24 and 40.6% among those aged 25–34 (Statistics South Africa, 2026). In this context, policymakers are often required to balance decarbonization objectives with broader socioeconomic priorities, including employment creation, education, healthcare, economic development, and fiscal sustainability. Interviewees emphasized that the ICE vehicle industry remains a significant source of employment. However, South Africa's lack of domestic EV manufacturing capacity constrains opportunities for new job creation, local value creation, and supplier development, limiting the economic gains that could otherwise support the transport decarbonization agenda. These competing socioeconomic priorities constrain the political will required to pursue more ambitious transport decarbonization measures. As a result, policymakers have adopted a more cautious approach to reforms that could adversely affect employment in the auto manufacturing sector and government revenues or worsen fiscal pressures before viable alternatives are established.

Policy design

South Africa's Green Transport Strategy provides insufficient guidance on institutional responsibilities, financing arrangements, and practical timelines required to achieve its objectives. Uncertainty over long-term government support, regulatory standards, and the respective roles of national, provincial, and local governments has contributed to a "wait-and-see" approach among both public agencies and private investors.

Similarly, interviewees noted that the Electric Vehicles White Paper is primarily designed to support industrial development and export competitiveness rather than domestic EV adoption. However, even with this industry focus, interviewees observed that the policy lacks clarity regarding institutional responsibilities, and the nature and extent of government support available to manufacturers, despite industry's repeated calls for greater certainty. Consequently, the policy provides inadequate direction not only for accelerating domestic EV uptake but also for supporting the industrial transition it seeks to promote. In addition, limited research and empirical evidence on EV performance, freight applications, and low-carbon transport technologies in South Africa further inhibit evidence-based policy design. As a result, the policies and their targets are not always based on sufficient empirical evidence to establish a more practical and achievable pathway for South Africa's transport decarbonization.

Public and private finance

Fiscal factors constrain public investment in South Africa's transport decarbonization, particularly in charging infrastructure and financial incentives to support EV adoption and industrial growth. Interviewees noted that the government's challenging fiscal position reduces its capacity to make the necessary investments and provide meaningful financial support for the transition.

The limited availability of public financing has also affected private sector investment. Interviewees further noted that policy uncertainty and the absence of a clear implementation pathway have reduced investor confidence in charging infrastructure and related investments. Access to affordable financing for vehicle purchases remains a challenge, further slowing EV adoption, while the high upfront cost of EVs continues to discourage consumers. These financing constraints have slowed investment across the road transport decarbonization value chain, particularly in charging infrastructure, vehicle uptake, and supporting services.

OPPORTUNITIES

While these constraints are substantial, several developments create favorable conditions for accelerating road transport decarbonization.

First, South Africa possesses a well-established automotive manufacturing sector that contributes significantly to exports, employment, and industrial development. The sector accounted for more than 5% of the country's GDP in 2025, with vehicle and component exports responsible for 15.6% of total exports and the industry sustaining 498,000 jobs across the formal economy (NAAMSA, 2026). As global vehicle markets move increasingly towards electric mobility, the need to preserve this position creates a commercial incentive for both government and industry to support the transition.

South Africa is also endowed with several minerals critical to global clean energy value chains, including manganese, platinum group metals (PGMs), and other minerals used in battery and fuel cell technologies. The country holds an estimated 88% of global PGM reserves and 80% of manganese reserves (DMPR, 2025). The Critical Minerals and Metals Strategy identify these endowments as an important lever for shifting from raw material exports to local value addition and advanced manufacturing in support of EV, battery, and hydrogen technologies (DMPR, 2025). This resource base therefore offers a route to deeper participation in regional and global electric mobility value chains while advancing domestic industrial development objectives.

Additionally, international climate finance and private sector interest in electric mobility present opportunities to mobilize resources for charging infrastructure, vehicle financing, and industrial upgrading. South Africa's Just Energy Transition Investment Plan identified new energy vehicles as one of three priority investment sectors (JET IP, 2022), and total pledges to the partnership have since risen to US$13.7 billion, with a dedicated NEV program management office established under the Industrial Development Corporation (IPG, 2025). Directed through well-designed policy and investment frameworks, these resources could address part of the financing shortfall identified above.

Policy Implications and Recommendations

The implementation challenges identified in this policy brief point to several areas where targeted policy action could accelerate the implementation of South Africa's transport decarbonization agenda as discussed below:

1. Strengthen policy design and implementation planning: The Department of Transport (DoT), in collaboration with the Department of Trade, Industry and Competition (DTIC) and other relevant agencies, could develop a coordinated implementation roadmap for the Green Transport Strategy and the Electric Vehicles White Paper. The roadmap should clearly define institutional responsibilities, implementation timelines, financing arrangements, and monitoring mechanisms across national, provincial, and local government. Greater investment in transport decarbonization research would strengthen the evidence base underpinning future policy design, particularly on EV performance, freight applications, charging infrastructure, and consumer adoption.

2. Better align industrial and transport decarbonization objectives: The DoT, in collaboration with the DTIC, could consider updating the Electric Vehicle White Paper to strengthen the link between industrial development and transport decarbonization; that is, by complementing measures that support domestic vehicle manufacturing with policies that stimulate domestic EV adoption. Greater policy certainty regarding government support for manufacturers, charging infrastructure, and related investments would also provide clearer signals to industry and investors.

3. Strengthen financing for road transport decarbonization: Expanding transport decarbonization will require greater public and private investment in charging infrastructure, domestic EV manufacturing and assembly, and supporting services. The government can explore financing mechanisms that leverage private capital, strengthen industrial investment for manufacturers, and improve access to affordable financing for EV purchases. Providing greater policy certainty and clearly defined public financing and investment pathways would further strengthen investor confidence and support long-term private sector participation.

4. Support a just and economically competitive transition: Transport decarbonization policies should continue to recognize South Africa's employment and industrial priorities by supporting domestic manufacturing, protecting jobs, and facilitating workforce transition along with emissions reduction objectives. Policy objectives that strengthen the economic benefits associated with the transition will be important for sustaining political support and long-term policy implementation.

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