CASE STUDIES ON INTEGRATED APPROACHES FOR CLIMATE MITIGATION AND DEVELOPMENT

Annex to the G20 ECSWG Technical Paper

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Authors
Chetna Hareesh Kumar, NewClimate Institute
Imogen Outlaw, NewClimate Institute
Anna Nilsson, NewClimate Institute
Sarah Jackson, NewClimate Institute
Lukas Kahlen, NewClimate Institute

Lead Reviewer
Andrew Marquard, Senior Researcher Officer, University of Cape Town

Review and funding
Nadja Emmanuel, Programme Director
Florian Postel, Advisor
Jonatan Steinig, Advisor
For GIZ on behalf of the German Federal Ministry for the Environment, Climate Action, Nature Conservation and Nuclear Safety through the International Climate Initiative

DFFE Reviewers and Contacts
Maesela Kekana, Deputy Director-General for Climate Change and Air Quality Management, Department of Forestry, Fisheries, and Environment (DFFE)
Sandra Motshwanedi, Director, Department of Forestry, Fisheries, and Environment (DFFE)

Communications
Lena Stüdeli, NewClimate Institute

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Introduction

This Annex of case studies is a supplement to the South African G20 Presidency Environment and Climate Sustainability Working Group (ECSWG) technical paper *"Integrated approaches for climate mitigation and development towards enhanced implementation"* (Hareesh Kumar, Outlaw, Nilsson, Jackson, & Kahlen, 2025).

An integrated approach in this context refers to a framework for pursuing climate mitigation and socioeconomic development objectives simultaneously, and each goal through the other. The technical paper builds on G20 consensus and makes the case for an integrated approach to socioeconomic development and climate mitigation policies to unlock joint opportunities and manage trade-offs. Drawing on a literature review and case studies from G20 members, it identifies required enablers—policy integration, finance mobilisation, technical capacity and international cooperation. The latter two enablers are cross-cutting, as they underpin and strengthen the former.

The case study analysis in the technical paper showcases real-world examples of integrated approaches to climate mitigation and socioeconomic development employed by G20 members with different development levels, socioeconomic contexts, and mitigation and SDG priorities. It presents cross-cutting findings on their use of key enablers, success factors, and challenges, linking each of these to the potential for G20 cooperation. The objective is to supplement the theoretical arguments presented in the paper with practical examples.

Four case studies are assessed – the ABC+ Plan or the Sectoral Plan for Climate Change Adaptation and Low Carbon Emission in Agriculture Seeking Sustainable Development 2020-2030 from Brazil, the European Union Green Deal from the European Union, the PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan) scheme from India, and the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) and South African Renewable Energy Masterplan (SAREM) initiatives from South Africa. Inputs for the case studies were provided by think tank experts from the respective countries (see Acknowledgements) and supplemented with secondary research.

This Annex contains the full text of case studies used as the basis for the cross-cutting analysis in the technical paper. Readers are encouraged to refer to the technical paper for the high-level findings and recommendations provided to the G20 ECSWG based on this analysis (Hareesh Kumar, Outlaw, Nilsson, Jackson, & Kahlen, 2025).

1 Brazil: ABC+ Plan

1.1 Introduction

The ABC+ Plan, also known as the Sectoral Plan for Climate Change Adaptation and Low Carbon Emission in Agriculture, aims to promote the widespread adoption of sustainable agricultural practices and technologies in Brazil, seeking sustainable development from 2020 to 2030. The agribusiness complex, including inputs, primary production, agro-industry and agro services across agriculture and livestock, accounted for over 23% of Brazil's GDP in 2024 (CEPEA, 2025). The sector is also associated with deforestation and land-use change, and emissions from both land-use change and agriculture account for approximately three-quarters of Brazil's total GHG emissions. In this context, by aiming to improve the resilience, sustainability, and emissions intensity of Brazilian agriculture while boosting its productivity and profitability for farmers and agribusinesses, the ABC+ Plan represents an integrated approach towards climate mitigation, adaptation, and socioeconomic development.

The ABC+ Plan promotes a range of science-based Sustainable Systems, Practices, Products, and Production Processes (SPPABC), including no-till farming, pasture restoration, integrated crop-livestock-forestry systems, biological nitrogen fixation, establishment of planted forests, manure management, efficient irrigation, and intensive livestock finishing. It thus builds on the strategies of its predecessor, the ABC Plan of 2010-2020, but also introduces new conceptual elements, namely an Integrated Landscape Approach to holistically address and account for the various uses of land and promote an ecosystem approach; synergies between climate change adaptation and mitigation, and Monitoring, Reporting and Verification (MRV) mechanisms to better track progress (Government of Brazil, 2021a). The implementation strategy is based on technology transfer and diffusion, training and technical assistance, applied research for development or improvement of SPSABC, market-based instruments (certifications, carbon credit trading), as well as direct fiscal (tax-related instruments) and financial incentives (credit lines) promoting adoption among farmers and businesses (Government of Brazil, 2021a).

By 2030, the ABC+ Plan aims to reduce GHG emissions by approximately 1.1 $GtCO_2e$ through its SPSABCs, comprising 72.68 million hectares of land, 208.40 million cubic metres of animal waste treated, and 5 million head of cattle under intensive finishing systems (Government of Brazil, 2021b).

1.2 Policy integration

The ABC+ Plan illustrates the use of policy integration at all levels. Horizontal integration (across sectors) is facilitated by the involvement of various ministries representing the different integrated priority areas under the Plan, namely the Ministries of Agriculture and Livestock; Environment and Climate Change; Science, Technology, and Innovation; Economy; Agrarian Development and Family Agriculture; and Justice and Public Security.

The Plan has established a multi-level governance framework that further facilitates horizontal and vertical integration (across governance levels) by ensuring coordination and representation across federal, state, and sectoral levels. The governance framework includes a National Executive Committee (CENABC) to guide and monitor implementation, a Technical Committee (CTABC) to provide technical input, an Integrated Information System (SINABC) to collect data for monitoring, and State-Level Management Groups (GGE-ABC+) to align and implement state action plans. Vertical integration is also ensured between the national and international levels, as Brazil has fully integrated the ABC+ Plan into its NDC targets, thus reinforcing policy coherence and international accountability.

Temporal integration (over time) is also a key aspect of the ABC+ Plan. It has been included in Brazil's Pluriannual Plan (2024-2027) and NDC targets (2030), which serve to institutionalise its targets, secure

budgetary allocations, ensure continuity across administrations, and embed its goals into Brazil's medium-term development planning (Government of Brazil, 2023). Given its immediate adoption following the first phase of 2010-2020, the ABC Plans span a cumulative implementation horizon of 20 years, withstanding political changes and ensuring long-term policy continuity. This has further enabled institutional learning and capacity building, gradual scaling of sustainable agricultural practices, and investor confidence in sustainable agriculture projects.

Two key challenges emerged in policy integration efforts. Firstly, further efforts are required to integrate of local and traditional agro-ecological knowledge systems held by small farmers and traditional communities into the ABC+ Plan. Secondly, the use of holistic impact tracking beyond GHG emissions to include biodiversity, environmental pollution, or socioeconomic inequalities can be improved.

The Plan does not address the structural drivers that drive the emissions intensity of the Brazilian agricultural sector, which is largely shaped by an export-oriented monoculture model. Its focus on eight sustainable agricultural practices and technologies represents an incremental approach, missing the opportunity to drive a systemic transformation of food systems that reduces inequalities and shifts away from unsustainable patterns of production and consumption.

1.3 Mobilising finance

The ABC+ Plan is mainly financed with public resources, with a small component of private capital mobilisation. The Ministry of Agriculture and Livestock has allocated R$17.5 million (approximately USD 3.19 million) to cover the Plan's operational expenses, including coordination, communication, research support, and consultancy services required to ensure policy integration across levels and build technical capacity.

The adoption of sustainable agriculture practices and technologies is financed via the ABC Program credit line, through recurring budgetary allocations in Brazil's annual agricultural plan (Plano Safra). The credit line is set up by the Brazilian Development Bank (BNDES) to offer interest-subsidised loans for sustainable agriculture projects aligned with program objectives (Government of Brazil, 2025a; Government of Brazil, 2021b). Integrating the ABC+ Plan with the existing Plano Safra enables the mobilisation of public finance at scale. However, bureaucratic hurdles, such as complex project preparation, eligibility compliance, and approvals, can delay implementation and hinder access to finance through the credit line.

In addition, the Plan encourages farmers to finance some components of their sustainable agriculture projects by leveraging private capital markets (such as through green bonds and securities) wherever possible (Government of Brazil, 2021b). It also connects farmers with diverse financing instruments, including impact investors and agribusinesses, through partnerships with public and private institutions (Government of Brazil, 2025a). However, a lack of know-how among farmers as well as banks, insurance companies, and other private financial institutions assessing their projects for creditworthiness can create hurdles in accessing low-cost finance.

The financing plan incorporates a capacity building component for small and medium-sized agricultural enterprises (SMEs) to build financial literacy and develop investment-ready projects, for the banks involved in assessing technical criteria on the eligibility of projects, and for insurance agencies developing products for agricultural clients to build awareness on the risk mitigation benefits of sustainable agriculture practices.

1.4 Technical capacity

The ABC+ Plan includes several strategies aimed at building technical capacity among various stakeholders, recognising that the availability of low-carbon agricultural technologies and know-how on sustainable agricultural practices is key to its success.

A key strategy under the Plan is the Technical Assistance and Rural Extension (ATER), which includes Training and Technology Transfer, aiming to improve the technical capacity of agricultural workers, businesses, government agencies, and financial institutions involved in implementing sustainable agriculture projects. The Access to Credit and Financing Program also addresses technical capacity, specifically for stakeholders involved in providing or accessing funds through the ABC Program credit line (see mobilising finance section above) (Government of Brazil, 2021b). Challenges remain in improving access to credit for small farmers and across all geographies (Borschiver & Byrd, 2020; Souza & de Albuquerque, 2023).

The Plan also emphasises scientific innovation through another strategy on Research, Development and Innovation, coordinated by the Brazilian Agricultural Research Corporation (Embrapa). This strategy aims to promote the development and improvement of sustainable agricultural technologies and practices (Government of Brazil, 2021b).

Another key strategy on Governance, Monitoring, and Evaluation emphasises MRV mechanisms, building in mechanisms for data collection and reporting into the multi-level governance framework, providing training on data and monitoring tools, and transparently communicating progress through the ABC Platform (Government of Brazil, 2021b).

However, the various monitoring tools and reporting mechanisms appear to have gaps or challenges. At the time of research, data on progress towards ABC+ goals were only available for two out of eight SPSABCs on MAPA's Interactive Dashboard, and the Analytical Dashboard of the ABC+ Governance System (SIGABC) had not yet been updated (Government of Brazil, 2025b). The biennial evaluation report stipulated under the Plan's monitoring mechanisms was not publicly available. An ABC+Calc tool tracking GHG emissions was announced in 2025 but was also not publicly available and would only have partial GHG coverage (tracking methane and nitrous oxide emissions associated with animal production waste management only).

1.5 International cooperation

International cooperation has played a key role in the implementation of Brazil's ABC+ Plan, providing both technical and analytical support. Technical contributions to monitoring and evaluation include UNEP's support in developing the ABC+Calc tool for tracking emissions and the joint UNEP–University of São Paulo initiative assessing the Plan's socioeconomic and environmental impacts in areas like agroforestry and degraded pasture restoration (Government of Brazil, 2025c; UNEP, n.d.). Multilateral development banks like the World Bank and the Inter-American Development Bank have provided technical and financial support for project implementation at the federal, subnational and local levels (The World Bank, 2024; IADB, 2025).

2 European Union: Green Deal and Clean Industrial Deal

2.1 Introduction

The EU Green Deal (EUGD), announced in 2019, provides a comprehensive framework to align the EU's legally binding climate targets – a 55% reduction in GHG emissions by 2030 and climate neutrality by 2050 – with economic and social policy, delivering a just, competitive, and sustainable transition. The EUGD is a wide-ranging policy framework that integrates environmental, economic and social priorities to support a just and inclusive transition. It sets legally binding emission targets, mobilises substantial investments and aims to decarbonise all sectors of the EU's economy while ensuring fairness for workers and communities most impacted by the transition. In addition to its climate objectives, the EUGD seeks to improve health and quality of life by reducing air pollution, enhancing energy efficiency and expanding the use of renewable energy.

Progress on implementing the EUGD has been mixed. Success has been visible in energy and climate policy, while progress on biodiversity, mobility, agriculture and buildings has lagged. By 2024, the EU's Joint Research Centre reported that out of 154 tracked targets, only 32 were on track, while several lacked sufficient data (Marelli, Trane, Barbero Vignola, Gastaldi, & Guerreiro Miguel, 2025). Member State implementation remains the decisive factor in bridging these gaps.

The Clean Industrial Deal (CID), unveiled in early 2025, is positioned as the industrial policy arm of the EUGD, providing a strategy to pursue industrial competitiveness, innovation, and decarbonisation efforts simultaneously through regulatory certainty, public finance and investments, and demand-side incentives. The CID includes six key components: affordable energy, boosting demand for clean products, financing the clean transition, circularity and access to materials, economic partnerships, skills and quality jobs. It targets strategic clean tech sectors, such as solar photovoltaics, wind, heat pumps, batteries, electrolysers, and carbon capture and storage, as well as energy-intensive industries like steel, chemicals, cement, and aluminium. The CID is still in its early stages, with the EU set to publish sector-specific actions on automotive and mobility, as well as steel and metals.

Both the EUGD and CID rely on integrated policymaking and jointly pursue social and climate policies to gain domestic support.

2.2 Policy integration

The EU Green Deal and CID build on integrated policy frameworks. EU Governance Regulation 2018/1999 calls for Member States to develop integrated national energy and climate plans (NECPs) linked to emission reduction, renewable energy, energy efficiency, and electricity interconnection and which contribute to UN SDGs (European Parliament and Council, 2018). The first NECPs were published in 2020 and have been updated to incorporate the targets of the Green Deal, the Fit for 55 package, and the RePowerEU plan (European Commission, 2025b).

The EU pursues vertical, horizontal, and temporal integration of climate and economic development policy. Vertically, the Climate Law enshrines climate neutrality by 2050 at the EU level. Member State NECPs and long-term strategies bring climate plans down to the national level. Horizontally, this is accompanied by legislative packages, such as Fit for 55 and REPowerEU, that ensure integration across climate, energy, mobility, and agricultural policies. The CID bridges climate priorities for the industry sector with economic development and competitive goals. Temporal integration is ensured by linking binding 2030 and 2050 targets through mandatory long-term planning.

Despite ongoing efforts, challenges persist regarding data availability and policy coherence which have slowed implementation and progress towards targets (Velten, et al., 2025; Marelli, Trane, Barbero Vignola, Gastaldi, & Guerreiro Miguel, 2025). The EU is addressing this by employing better data tracking tools, revising NECP guidelines, and tightening monitoring mechanisms.

2.3 Mobilising finance

The EU Green Deal and the Clean Industrial Deal are financed through a combination of public finances and mobilised private capital. EUGD required coordination among diverse actors, including EU institutions, Member States, public banks, and private financiers.

Public finances are funded by the EU's budget. Under the 2021-2027 Multiannual Financial Framework (MFF), 503 billion EUR aims to support the EU Green Deal Investment Plan. Several economic recovery mechanisms and instruments that pool contributions from EU Member States, such as the Recovery and Resilience Facility (RRF), NextGenerationEU, and the Just Transition Mechanism (JTM), also include earmarked funds for climate action (Pons, Madec, & Alphalex, 2024; European Commission, n.d.-a). Revenues from the EU Emissions Trading Scheme (ETS) are also used to leverage private investment. Member State-level investments approved under State Aid rules further complement these funds (Pons, Madec, & Alphalex, 2024). Additional financing is provided through the Innovation Fund, as well as lending from the European Investment Bank (EIB) and the Industrial Decarbonisation Bank.

The EUGD includes an external dimension which notes the importance of development assistance and public climate finance, in addition to mobilising private finance. The EUGD funding instrument, Neighbourhood, Development and International Cooperation Instrument, included a target of 25% of its budget for climate-related objectives.

To mobilise private finance, the EU has developed the InvestEU programme, which utilises an EU budget guarantee to reduce risk for financial institutions, thereby increasing investment. Invest EU is expected to mobilise €110 billion to meet EU climate goals through risk guarantees. The Programme also supports sustainable and inclusive social investment, job creation through micro-entrepreneurship, social infrastructure, and education and training (European Commission, n.d.-b). The EU Sustainable Finance Taxonomy, adopted in 2020, also guides and incentivises investment in the sustainable, green transition. The Taxonomy includes minimum social safeguards, requiring compliance with OECD guidelines, UN human rights principles, and core ILO labour standards, thereby promoting sustainable development and responsible investment across environmental, social, and economic dimensions.

The CID builds on this framework and plans to support finance mobilisation through aligned action, such as the Clean Industrial Deal State aid framework, revisions to Public Procurement Directives, recommendations for national-level tax incentives, and the introduction of the Industrial Decarbonisation Accelerator Act. The EU also announced a EUR 100 billion initiative, the Industrial Decarbonisation Bank (IDB), to finance the industrial green transition (European Commission, 2025a). Finally, the EU announced the launch of Tech EU, an investment programme in collaboration with the EIB Group and the private sector. These aim to align funding, regulation and market incentives across multiple sectors.

Tracking climate spending has been a persistent challenge. Climate labels have sometimes been applied to projects without demonstrable reductions in emissions. In response, the EU has strengthened monitoring and guidance. Procedural complexity in aligning EU-wide climate mitigation goals with local priorities and collaborating on project selection and oversight has led to delays.

2.4 Technical capacity

The EU Green Deal ensures Member States' technical capacity for implementation through the Technical Support Instrument (TSI). It provides non-financial support, including expert advice, analytical tools, policy studies, and workshops tailored to the specific needs of Member State governments. The TSI had supported over 200 EUGD-related projects across all Member States by 2023. It provides expert advice, analytical tools, modelling support, workshops, and tailored policy studies, including for developing NECPs and long-term strategies.

The EUGD requires the Member States to transpose a large volume of legislation within a short timeframe. Member States faced challenges in managing the scale of implementation required, including sufficient specialised expertise, integrated data systems and institutional resources. These were addressed through expanded technical guidance from the European Commission, improved EU-level monitoring and more funding under the TSI.

2.5 International cooperation

The EU and its Member States together are the world's largest providers of Official Development Assistance (ODA), including climate finance, with 35% of the external action budget going to climate projects in partner countries. This commitment extends to key instruments such as the NDICI–Global Europe and the Global Gateway, both of which are closely aligned with the objectives of the EUGD. Under the new Clean Industrial Deal, the EU is pursuing Clean Trade and Investment Partnerships (CTIPs), aiming to secure access to clean technologies, renewable energy, and critical raw materials, while supporting partner countries' clean industrial development and decarbonisation efforts.

Some EUGD-related policies (e.g., the Carbon Border Adjustment Mechanism or deforestation regulation) have extraterritorial implications on partner countries. Countries have raised concerns about the disproportionate implications of policies, their fairness, and the compliance costs they impose on trading partners. The EU has launched consultations with affected stakeholders to better understand implications and compliance challenges. It has also increased diplomatic outreach to partners on the design of policies. The EU has also established task forces to support capacity building in affected partner countries (e.g., the carbon pricing task force).

3 India: PM-KUSUM

3.1 Introduction

In 2019, India launched the PM-KUSUM (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyaan) scheme to increase the uptake of solar power for agricultural energy use. Farmers in India typically meet their irrigation needs by using either grid-connected electric pumps, which derive power from the coal-dominated national grid, or off-grid diesel pumps, which rely on expensive imported fuel. The scheme design targets both types of farmers, aiming to improve their energy security, crop yields, and income levels, while reducing the emissions footprint of the agriculture sector.

PM-KUSUM has several components designed to promote solar power uptake across different types of farmers. Component A targets large land-owning farmers, enabling them to set up decentralised ground- or stilt-mounted solar or other renewable power plants on their land. Component B targets smaller farmers without access to the power grid, providing capital subsidies to support the installation of off-grid solar irrigation pumps. Component C, which has two parts, drives the installation of grid-connected solar pumps, with C-IPS (Individual Pump Solarisation) targeting installations on individual farmer's land and C-FLS (Feeder-Level Solarisation) targeting installation at the agricultural feeder level (i.e., servicing a group of farmers connected to the same electrical substation).

PM-KUSUM targeted integrated mitigation and socioeconomic goals, namely improving agricultural productivity, energy security, farmers' income, groundwater conservation, fiscal sustainability, and emissions reduction. The uptake of decentralised solar power improves farmers' access to a reliable daytime power supply for irrigation, thus contributing to improved crop yields. Component B reduces farmers' dependence on imported diesel, contributing to energy security and reduced energy bills. Components A and C also generate additional revenue streams for farmers who lease land to developers or sell power to the grid. The scheme also addresses groundwater and fiscal sustainability by facilitating the transition from heavily subsidised agricultural electricity provision to farmers, which had incentivised excessive pumping, to self-generated solar power with an opportunity cost from surplus power sales. At the same time, the scheme contributes to India's national target of 500 GW of renewable power capacity by 2030 and reduces emissions from its agricultural power demand, thus integrating climate mitigation efforts into the pursuit of development goals.

By the end of its planned duration in March 2026, the scheme aims to install 10 GW of solar power capacity under Component A, 1.4 million standalone solar irrigation pumps under Component B, and over 3.6 million grid-connected solar irrigation pumps under Component C, with 0.6 million pumps sanctioned under C-IPS and 35.6 million under C-FLS (Government of India, 2025). While Component B has seen good uptake, progress has been slower than expected for other components. The scheme is likely to be extended beyond 2026 into PM-KUSUM 2.0, which may focus more on Component C-FLS and explore the potential for agri-photovoltaics (agri-PV).

3.2 Policy integration

The PM-KUSUM scheme involves vertical, horizontal, and temporal integration. Vertically, it integrates efforts across the national and subnational levels, as it is established and steered by the Ministry of New and Renewable Energy (MNRE) but implemented at the state level. The MNRE sets the operating guidelines at the national level and allocates different targets to different states based on their priorities, but the implementation is done flexibly at the state level by the respective State Nodal Agencies (SNAs).

The scheme also ensures horizontal integration across ministries responsible for relevant sectors. It involves coordination and collaboration among the MNRE, Ministry of Power, Ministry of Finance, and

Ministry of Agriculture and Farmers Welfare to effectively address the various priorities of the scheme. PM-KUSUM 2.0 will focus more explicitly on improving this coordination.

Temporal integration is ensured by linking short-term implementation targets under the scheme with long-term national goals of renewable capacity installation and electricity subsidy reforms. The launch of PM-KUSUM consolidated and built on years of state-level experiences with solarising agriculture, providing a holistic national-level umbrella to scale up efforts. Extending the scheme beyond 2026 would provide continuity and further opportunities to build on the learnings from the first phase.

PM-KUSUM faced challenges in policy integration, particularly due to the number of institutions involved in coordinating and implementing the scheme which initially led to high operational costs and delays in implementation. States addressed this, for example, by formalising Standard Operating Procedures to clarify institutional roles and responsibilities and by setting up single-window clearance mechanisms to simplify approval processes.

3.3 Mobilising finance

PM-KUSUM facilitates the uptake of solar irrigation pumps by farmers through a mix of subsidies (co-financed by the central and state governments), preferential loans, and self-financing by farmers.

The central government has earmarked INR 34,422 crore (approximately USD 4 billion) for direct subsidies, covering 30% of the investment costs for both standalone pumps (Component B) and grid-connected pumps (Component C-IPS), with state governments providing at least a 30% additional subsidy. The remaining investment costs of the solar irrigation pumps (as well as the entire investment costs of solar power plants under Component A and C-FLS) are to be covered by the farmers themselves with self-financing as well as private lending options.

The government has facilitated access to private lending by mandating PM-KUSUM as a priority for financial institutions and by offering collateral-free loans with a 3% interest subvention, financed through the Agricultural Investment Fund. Several national development financial institutions, as well as commercial banks, have announced targeted financing and loan products for the scheme.

PM-KUSUM also provides supply- and demand-side incentives to align finance with scheme priorities. On the supply side, it requires subsidised standalone and grid-connected solar pump projects to source their components locally, thus indirectly promoting investments in local manufacturing capacity. On the demand side, it provides procurement-based incentives to electricity distribution companies (DISCOMS) that reduce the cost of power procurement and support the fulfilment of renewable purchase obligations (RPOs) (Rahman, Agrawal, & Jain, 2021).

Despite these measures, several challenges have arisen in mobilising finance under PM-KUSUM. For small and marginal farmers, the share of self-financing required after subsidies can be a constraint, and access to local bank finance remains limited due to concerns about creditworthiness and small loan sizes. Delays in subsidy disbursement have also introduced some uncertainty for both farmers and lenders. Several state governments are taking steps to address challenges of affordability and access by increasing subsidy contributions, partnering with national financial institutions to expand financing options, and providing techno-commercial training to local banks to improve their lending appetite, often with support from international partners.

3.4 Technical capacity

PM-KUSUM relies on its many stakeholders having the technical capacity to execute its goals. Involving local institutions like DISCOMs and SNAs allows the scheme to leverage their existing expertise, data systems, and networks, while private developers and equipment suppliers add execution capacity. State-level research institutions were also involved in aiding locally adapted innovation and problem-solving.

Digital support tools play a role in technical capacity building. The scheme utilised project support tools, such as for solar pump sizing, tariff analysis, cost-benefit analysis, and project monitoring, which aid decision-making and project implementation across stakeholders, including farmers, SNAs, DISCOMs, developers, and financial institutions. Land bank portals were also developed to support land aggregation and help developers identify suitable land for feeder-level installations.

Training and capacity building are also major components. National-level guidelines were established mandating vendors to provide training services to farmers and local personnel on day-to-day operations and minor repairs of decentralised solar power plants. Trainings were also provided for regulators to set tariffs reflecting factors affecting project viability and for bankers and financial institutions to improve technical evaluation capacity and lending appetite (see section on Mobilising finance).

Capacity challenges arising from the interaction of different stakeholders that normally do not work together (for example, SNAs have limited experience working with farmers, and DISCOMs do not usually interact with farmers, as agricultural electricity is either free or heavily subsidised in most states) were addressed in some states by involving state horticulture and agriculture departments with existing relationships with farmers.

3.5 International cooperation

PM-KUSUM benefited from international cooperation, mainly due to international partners playing the role of ‘knowledge brokers’ who co-designed solutions adapted to the local context based on international experiences and learnings. Partnerships with German institutions enabled Indian developers and state agencies to adopt tested practices in tariff setting, contract design, and digital monitoring, helping them avoid early pitfalls such as grid instability, unbankable PPAs, and weak monitoring. Co-design workshops and pilot field visits were organised with Indian states to adapt German technical systems to the Indian context, retaining technical learning while ensuring affordability and suitability for local farmers.

Cooperation is also emerging on financial aspects. For example, the Asian Development Bank (ADB) is planning to channel concessional lines of credit to Indian development finance institutions for distributed energy storage, enabling grid integration of agricultural solar projects, as part of a broader USD 200 million clean energy financing programme. This is expected to address the grid infrastructure challenges currently hindering further progress on Component C-FLS, which targets grid-connected pumps at the feeder level.

India is a global leader in solar power capacity and leads international initiatives like the International Solar Alliance. There is potential to strengthen South-South cooperation on solar irrigation, particularly with countries in Africa or Southeast Asia. Similarly, there is potential for more North-South cooperation in developing agri-PV in India, which is an important solution to the land-use constraints facing its solar PV sector and is expected to be part of PM KUSUM 2.0.

4 South Africa: REIPPPP and SAREM

4.1 Introduction

In 2011, South Africa launched the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) to contribute to transforming the economy towards sustainable, low-emission energy growth that is inclusive and equitable. The REIPPPP is a competitive government procurement scheme designed to incentivise investment by Independent Power Producers (IPPs) in renewable generation capacity. It aims to: (1) expand renewable energy capacity in line with the government's climate change mitigation strategies, (2) expand green economy sectors, (3) reduce the cost of electricity, (4) generate employment gains, and (5) ensure community ownership.

The REIPPPP supports South Africa in achieving its climate mitigation targets set out in its NDC. To date, the government reports that electricity generated by REIPPPP projects have offset 128.1 Mt of CO_2 (Republic of South Africa, 2025a). It also supports the achievement of renewable capacity addition targets set out in a number of Integrated Resource Plans (IRP). The REIPPPP is structured into rolling bid windows with targets for total renewable energy procurement and specific targets for given technologies (e.g., solar photovoltaics, wind turbines, concentrated solar power [CSP], etc.).

The REIPPPP outlines an economic development framework that aligns with priorities outlined in the National Development Vision 2030, the Green Economy Accord, and the Broad-Based Black Economic Empowerment (B-BBEE) Act, among others. The programme requires renewable energy projects to meet stated minimum economic development conditions related to job creation, local content, ownership, and socioeconomic development. Bid rounds 1-4 were evaluated based on weighted criteria – 70% based on the price offer and 30% based on economic development criteria. Future rounds will be evaluated based on 90% price and 10% economic development criteria (Republic of South Africa, 2025a).

The programme has been successful in adding 6180 MW of renewable capacity to the grid by the end of March 2025. However, it also faced challenges, leading to 19% of planned capacity additions not materialising as scheduled (Republic of South Africa, 2025a). Reasons are multifaceted, ranging from policy uncertainty to insufficient grid capacity to localisation requirements. The REIPPPP was halted between 2015 and 2018. The programme's pause negatively impacted the local renewable energy value chain and local capacity to meet the economic development criteria under the REIPPPP, particularly in terms of local content.

The South African Renewable Energy Masterplan (SAREM) was launched in mid-2025, following a multi-year process, to address the industrial capacity gap. The SAREM was developed jointly by the Departments of Mineral Resources & Energy; Trade, Industry and Competition; and Science & Innovation, in consultation with domestic industry associations for renewable energy and battery storage. It is an industrialisation roadmap for localised renewable energy and battery storage value chains. It has four key targets: (1) to support local demand for renewable energy and storage by unlocking market demand and system readiness, (2) drive industrial development through the localisation of renewable energy and storage value chains and supportive trade and industrial policy, (3) foster inclusive value chains, and (4) build local capacities and technological innovation (Republic of South Africa, 2025b).

Together, the REIPPPP and the SAREM advance integrated climate mitigation and economic development goals. The REIPPPP drives the expansion of renewable energy capacity to support the energy transition, while the SAREM strengthens the domestic renewable energy value chain to meet localisation requirements under the REIPPPP, fostering green industrialisation, job creation, and local ownership.

4.2 Policy integration

The REIPPPP and the SAREM exercise horizontal and temporal integration. Horizontally, the REIPPPP procurement framework for bids ties together climate mitigation, energy security, and economic development priorities. Minimum requirements related to job creation, local content, ownership, and socioeconomic development advance priorities outlined in Development Vision 2030 and the Broad-Based Black Economic Empowerment (B-BBEE) Act. SAREM furthers this by linking green industrialisation goals and economic development goals, including job creation, to specific renewable energy value chains. SAREM consolidates key national policies and goals, including the National Industrial Policy, the Science, Technology and Innovation Decadal Plan, the Re-imagining Our Industrial Strategy for Inclusive Growth framework, and the Integrated Energy Policy and Integrated Resource Plan, into a single, coordinated programme of action spanning government departments and the industry value chain. The REIPPPP and SAREM's connection to long-term policies indicates temporal integration, linking near-term targets with long-term climate mitigation, energy security, and economic development goals.

The REIPPPP was halted between 2015 and 2018 because of political barriers; for instance, the national utility, Eskom, refused to approve renewable energy PPAs for IPPs approved under the REIPPPP. Eskom argued that the agreed tariffs with IPPs were too high, and signing the PPAs would put it at financial risk. Eskom also faced a surplus of generation capacity amid falling electricity demand, which reduced the utility's willingness to commit to new purchase contracts (Montmasson-Clair & Ryan, 2014).

4.3 Mobilising finance

The connection between the REIPPPP and the SAREM and long-term climate mitigation and energy policies provides certainty about the future role of renewable energy and the IPP procurement scheme for investors. The REIPPPP attracts IPP investment through competitive auctions offering 20-year Treasury-backed PPAs with bids evaluated based on price and economic development criteria– covering jobs, local content, ownership, and socioeconomic development. South Africa is partnering with the World Bank Group to develop a credit guarantee facility that will issue guarantees for private grid developers in place of the Treasury to address fiscal capacity concerns (Roelf, 2025).

The programme's economic development framework is aligned with the B-BBEE Scorecard, setting out commitments to be fulfilled over the lifetime of the IPP projects. Minimum thresholds ensure value capture for South Africans and local communities and oblige the private sector to contribute to economic and social transformation (Republic of South Africa, 2025a). Local content requirements have generated over R77.5 billion in financial commitments, representing 45% of the total project value sourced locally (Republic of South Africa, 2025a). Local content commitments represent a significant stimulus for local manufacturing capacity. However, localisation requirements can increase the cost of certain components by up to 30%, thereby raising project costs (Montmasson-Clair & Ryan, 2014). The SAREM works alongside REIPPPP to channel concessional, blended finance, and guarantees into renewable energy and battery value chains, aiming to boost local supply and demand and drive down costs through scale.

The REIPPPP has driven significant local and foreign investment in energy infrastructure, with total investment in bid rounds 1–6 reaching R239 billion, with only R43.1 billion (18%) from foreign sources (Republic of South Africa, 2025a). To maintain local ownership, the REIPPPP requires that South African entities own 40% of IPPs. Across bidding rounds, South African equity accounts for 54% and foreign equity for 46% (Republic of South Africa, 2025a). Local communities hold 8% of IPP shares through community trusts, receiving dividends for reinvestment in development projects (Republic of South Africa, 2025a).

Bureaucratic challenges have contributed to the delay of bid windows, introduced investment uncertainty and disrupted project pipelines. Additionally, the REIPPPP has faced challenges in engaging communities in ownership. Further, the cash flow structure of IPP projects prioritises debt repayment over equity dividends, meaning that local equity partners receive returns only once debt obligations are met. This sequencing can create delays in community benefits and, in some cases, lead to concerns around transparency and trust. (Ayala-Robles, 2025).

4.4 Technical capacity

While the REIPPPP aimed to contribute to economic development through the ramp-up of renewable energy capacity, the procurement quantities it set out were insufficient to stimulate sustained domestic industrial capacity. This challenge has been addressed by the SAREM, which sets out requirements and incentives for project companies to invest in supplier capacity development, with a particular focus on BEE and small, medium, and micro enterprises (SMMEs). The Strategic Partnership Programme (SPP), a cost-sharing programme by the Department of Trade, Industry, and Competition (dtic) and the South African Electrotechnical Export Council (SAEEC), will be extended under the SAREM. SPP offers cost-sharing support of up to 50:50 towards strategic manufacturing, thereby incentivising large private-sector enterprises to develop the capacity of SMMEs in their supply chain. The SAREM also introduces a biannual assessment of technical and non-technical skills needs across the renewable energy and storage value chains, coupled with a matchmaking platform to link capacity-building providers with sector actors (Republic of South Africa, 2025b).

Community trusts can hold equity in IPPs, however they may lack the capacity to engage effectively in community ownership. Trust engagement is crucial to support a Just Transition and to evolve community ownership from a compliance check box to a mechanism of development (Firfirey, Wlokas, Mabilu, & Pamla, 2024).

4.5 International cooperation

The REIPPPP benefited from early-stage donor funding for technical assistance for programme set up, and particularly to support the Department of Energy in developing the IPP office, an agency tasked with overseeing procurement under the REIPPPP (Eberhard, Kolker, & Leigland, 2014; Winkler, Keen, & Marquard, 2020). The programme also benefited from the engagement of development finance institutions for project funding and equity investments, as well as BEE and community ownership (e.g., the Development Bank of Southern Africa [DBSA] and the International Development Cooperation [IDC]). DBSA committed funding to 36 projects under the REIPPPP and provided R~17.5 billion in senior debt and R~3.5billion to BEE parties and local community trusts (DBSA, n.d.).

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