CEEW
THE COUNCIL

Report | November 2026

Accelerating Distributed Renewable Energy Transition

A Strategic Roadmap for BRICS Cooperation

Authors
Debanjan Bagui
Vidyapati Bajpai
Megha Chaudhary
Anuj Hemant Xess
Harshit Pandey
Neha Kumari
Bhawna Tyagi



Copyright © 2026 Council on Energy, Environment and Water (CEEW).

Open access. Some rights reserved. This work is licenced under the Creative Commons Attribution- Non-commercial 4.0. International (CC BY-NC 4.0) licence. To view the full licence, visit: www.creativecommons.org/licences/by-nc/4.0/legalcode.

Suggested citation: Bagui, Debanjan, Vidyapati Bajpai, Megha Chaudhary, Anuj Hemant Xess, Harshit Pandey, Neha Kumari, and Bhawna Tyagi. 2026. *Accelerating Distributed Renewable Energy Transition: A Strategic Roadmap for BRICS Cooperation*. New Delhi: Council on Energy, Environment and Water.

Disclaimer: The views expressed in this study are those of the authors and do not necessarily reflect the views and policies of the Council on Energy, Environment and Water.

Cover images: Front: A local man inspects his newly-installed solar panel, which provides electricity to light his home in Nepal. Climate Visuals. Back: Residential rooftop solar panels. iStock. For illustrative purposes only.

Peer reviewers: Benjamin Clarke, Director of Operations, Africa Solar Industry Association (AFSIA); Anjali Lathigara, Head of Market Intelligence, Global Solar Council (GSC); Rishabh Jain, Fellow CEEW, and Rishabh Kumar Singh, Programme Lead CEEW.

Publication team: Purnima P. Vijaya (CEEW); Alina Sen (CEEW); Shreyas Sharma; Twig Designs, and FRIENDS Digital Solutions.

Organisation: The Council on Energy, Environment and Water (CEEW)—**a home-grown institution** with headquarters in New Delhi—is among the **world's leading climate think tanks**. The Council uses **data, integrated analysis, and strategic outreach** to support public policy, transform markets, shape technology, and nudge behaviour. It addresses pressing regional and global challenges through an **integrated and internationally focused** approach. The Council prides itself on the **independence** of its high-quality research and strives to **impact sustainable development at scale**.

CEEW
THE COUNCIL

Accelerating Distributed Renewable Energy Transition

A Strategic Roadmap for BRICS Cooperation

Report | November 2026

Debanjan Bagui, Vidyapati Bajpai, Megha Chaudhary, Anuj Hemant Xess, Harshit Pandey, Neha Kumari, and Bhawna Tyagi



Contents

Section	Pg
Executive summary	1
1. What makes distributed renewables a strategic priority for BRICS cooperation?	6
2. A comparative approach to assessing country experiences	8
3. How have BRICS countries scaled distributed renewables deployment?	9
3.1 Brazil: Building a robust distributed renewables market through iterative policy reform	9
3.2 Russia: Distributed renewables as an enabler of energy access for isolated regions	13
3.3 India: From energy access to energy security, distributed renewables become central to the energy transition	17
3.4 China: Leading the global distributed renewable energy ecosystem	21
3.5 South Africa: Unreliable power supply and high electricity tariffs drove distributed renewable adoption	25
4. An indicative roadmap for BRICS to accelerate distributed renewable energy transition	30
Acronyms	33
References	34

Executive summary

The global power sector reached a major landmark in 2025. Renewable energy (RE) overtook coal marginally for the first time, supplying ~34 per cent of the global total electricity against coal's 33 per cent (EMBER 2026a). Total deployed RE capacity has crossed 5,000 GW (IRENA 2026). Solar and wind contribute the majority to that (~70 per cent). The recent conflict in the Middle East further exposed the vulnerability of import dependency across the countries and highlights the importance of diversifying the electricity mix. In this broader shift, distributed renewable energy (DRE)[1] makes a significant contribution, especially solar. In 2025, global distributed solar reached ~1,200 GW of capacity, contributing more than 40 per cent of total installed solar capacity (IEA-PVPS 2026).

Though distributed systems were initially treated as an instrument to provide energy access for remote areas, over time, the conversation has shifted to DRE being strategic infrastructure to improve energy security, grid flexibility, and demand-side decarbonisation. It complements utility scale solar by reducing transmission losses and enabling faster deployment. Beyond immediate outcomes, DRE also creates economic opportunities, supports livelihoods, and fosters an entire green economy around it.

Spanning over four continents and eleven members[2], BRICS provides a strong foundation for scaling DRE, bringing together diverse markets, skilled workforce, abundant resources, and technological capabilities. This report aims to explore how DRE uptake has evolved across BRICS, based on a review of literature, policy and regulatory documents, and secondary data. It maps the key drivers of deployment, policy and regulatory landscape, market maturity and compensation mechanisms, and forward plans to identify an indicative roadmap for collaboration, to accelerate the next phase of DRE growth.



Image: iStock

Distributed renewable energy turns consumers into producers, advancing energy security, grid flexibility, and green growth.

1. DRE refers to renewable energy systems located close to the point of electricity consumption and typically connected to the distribution network or operating off-grid. However, the definition and maximum capacity threshold used to classify a system as DRE may vary across countries, depending on national policies and regulatory frameworks.
2. Five original members: Brazil, Russia, India, China, and South Africa (joined in 2011); six new members: Egypt, Ethiopia, Iran, Saudi Arabia, the United Arab Emirates, and Indonesia. Additionally, BRICS has ten partner countries: Belarus, Bolivia, Cuba, Kazakhstan, Malaysia, Nigeria, Thailand, Uganda, Uzbekistan, and Viet Nam.

Distributed renewables already identified as priority area for BRICS collaboration

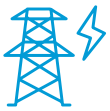
Since its first-ever summit in 2009, energy cooperation has been identified as a key area of BRICS collaboration. **Member countries acknowledged the need to diversify energy resources, supplies, and transit routes to reduce market uncertainty, and to cooperate on improving energy efficiency** (BRICS 2009). In 2015, energy was formally acknowledged as one of the core pillars of BRICS's economic partnership. This was followed by the establishment of the Energy Research Cooperation Platform (ERCP) in 2018, which reinforced the importance of advancing energy transitions and the implementation of sustainable development goals (BRICS 2025a). However, DRE has not been explicitly part of it until 2025. The Roadmap for BRICS Energy Cooperation 2025–2030, adopted in May 2025 under Brazil's presidency, marked an important shift by explicitly identifying DRE as a priority under the broader RE thematic area for the first time (BRICS 2025b). The group identified DRE as a critical instrument for expanding affordable and reliable energy access, particularly in remote and underserved regions, and enabling an equitable and affordable energy transition (BRICS 2025c). In 2026, the BRICS Energy Ministers' Meeting launched the BRICS Digital Centre of Excellence for Smart Grids and Energy Storage to strengthen cooperation among BRICS nations on grid modernisation, power system resilience, renewable energy integration, and improved energy access through digital technologies (PIB 2026f).

With DRE now explicitly recognised as a priority, considering the group's substantial economic, demographic, and energy footprint (Figure ES1), BRICS is well positioned to play an important role in strengthening global cooperation on the energy transition (BRICS 2026, EMBER 2026a).

Key enablers driving uptake of distributed renewables across BRICS countries

A review of the DRE landscape across BRICS indicates that countries have adopted distributed renewables in response to different national priorities. Four broad pathways emerge (Figure ES2).

Energy security and diversification: In Brazil, China, India, and Iran, DRE has emerged primarily as a response to energy security concerns, and the need to diversify the power sector. However, the underlying drivers differ across these markets—successive droughts and hydrological risks have increased the value of distributed resources in Brazil; coal dependence and the need to absorb growing domestic manufacturing capacity have supported DRE expansion in China; rising electricity demand and import dependence have strengthened the case for DRE in India; and a widening gap between electricity demand and available generation capacity has driven adoption in Iran.



47%
Contribution to global electricity demand (as of 2025)



54%
Contribution to global renewable energy installed capacity (as of 2025)



40%
Contribution to global gross domestic product (GDP)



49%
Contribution to global population

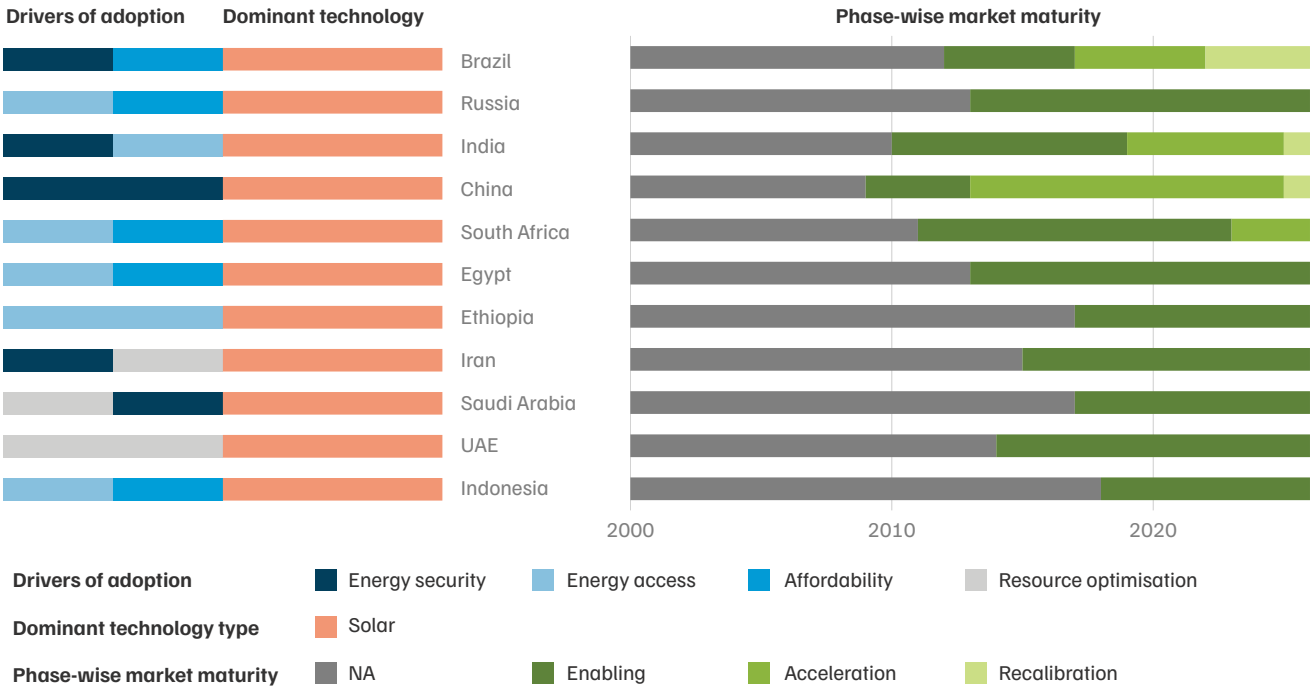
Source: Authors' compilation from EMBER 2026a and BRICS 2026.

Energy access and remote electrification: In Ethiopia, Indonesia, and Russia, DRE has been driven more by the need to extend energy access to remote and underserved populations where grid connectivity is limited or absent. These challenges reflect the specific geographic and infrastructure constraints of each country, including Ethiopia's substantial electrification deficit, Indonesia's dispersed archipelagic geography, and Russia's isolated northern communities that are difficult to connect to the main grid.

Reliability, affordability, and energy access: South Africa and Egypt represent a third pathway, where DRE adoption has been shaped by a combination of reliability, affordability, and energy access concerns. In South Africa, prolonged load shedding and high retail-electricity tariffs have strengthened the case for distributed generation, while in Egypt, subsidy removal and successive tariff increases have improved the economics of DRE.

System efficiency and resource optimisation: Saudi Arabia and the United Arab Emirates (UAE) form a distinct group, where the adoption of DRE is being pursued primarily to improve system efficiency and reduce reliance on fossil fuels (oil and natural gas) in the domestic power sector.

Figure ES1. Only three BRICS countries—Brazil, India, and China—have achieved mature distributed renewable markets



Source: Authors' analysis.

Note: Energy access: Providing electricity to remote/underserved populations or supply disruptions; Energy security: Diversifying supply and reducing fuel import or supply risks; Affordability: Adoption driven by high retail electricity tariffs; and Resource optimisation: Using DRE to reduce usage of domestic fuels (oil/gas) and improve system efficiency. Enabling: Formal introduction of a dedicated DRE framework/policy until deployment begins to accelerate; Acceleration: Rapid capacity growth; and Recalibration: When compensation arrangements are revised in response to impacts on utilities, networks or fiscal exposure. NA: No dedicated policy has been introduced;

Market maturity is assessed across three broad dimensions: the extent to which DRE has scaled, the degree to which it has diversified across consumer segments and technologies, and the strength of the enabling ecosystem and market frameworks supporting continued growth[3].

3. For example, China demonstrates significant scale in solar deployment; India has diversified DRE across consumer segments and technologies while building a supportive ecosystem; and Brazil has a significant and growing share of DRE in its electricity mix. The assessment also considers how countries are adapting market-driven approaches and recalibrating regulatory frameworks to sustain momentum as their DRE markets evolve.

Diverse energy landscapes and complementary capabilities create case for BRICS collaboration

The diversity of experiences across BRICS provides a basis for cooperation that can complement national efforts to scale distributed renewables. With DRE now explicitly recognised as a priority within BRICS energy cooperation, the group has an opportunity to build on existing institutional mechanisms and translate this recognition into practical areas of collaboration.

Three considerations particularly strengthen the case for such cooperation. First, BRICS members are at different stages of the DRE journey, creating a strong opportunity for cross-country exchange of learning. Countries such as Brazil, China, and India have already a matured market, while several newer members are still establishing their markets. This diversity creates an opportunity for structured knowledge exchange, with insights and best practices from leading economies providing a valuable roadmap for others to develop the DRE market.

Second, the next generation of DRE challenges is common across the group—grid integration and flexibility, demand aggregation, compensation mechanisms, financing, and consumer affordability are emerging priorities across member countries. These challenges create scope for joint work on technologies, business models, standards, financing mechanisms, and regulatory approaches, rather than each country developing solutions independently.

Third, BRICS brings complementary capabilities[4] that can be leveraged collectively. China offers manufacturing scale, India has experience in digitally enabled mass deployment, Brazil brings experience from an equitable energy accounting regulatory framework, South Africa has developed innovative market arrangements, and Russia has experience with hybrid systems for remote communities. Connecting these capabilities can help countries accelerate deployment while adapting solutions to their own contexts.

A common roadmap for BRICS cooperation can help translate these complementary strengths and shared priorities into a structured agenda for action, enabling members to accelerate and scale DRE while accounting for their diverse national contexts.

Strategic roadmap for BRICS collaboration to accelerate distributed renewable deployment

Developing a distributed renewables market rests on three foundations: a shared long-term ambition, an enabling ecosystem, and measures to scale as the sector matures (Figure ES3). The proposed roadmap sets out four action items. Each action leverages existing institutional mechanisms, areas of cooperation, and knowledge-exchange platforms, rather than creating new bodies. Progress is periodically reviewed through a biennial peer-review process that mirrors the group's established cycle.

Setting shared long-term ambition and measuring progress

- **Action 1—Establish a common distributed renewables data framework**: Develop a common data architecture, along with a set of indicators and a periodic reporting mechanism to generate reliable and comparable data on DRE deployment, technologies, consumer segments, and market development across BRICS. Building on existing data systems and institutional platforms can provide a sustainable basis for tracking progress and improving transparency.

Institutional anchor: ERCP

Key deliverables: Common DRE indicators; shared data repository; periodic BRICS DRE data report.

- **Action 2—Adopt a shared distributed renewables ambition**: Establish a shared BRICS ambition by aggregating nationally defined and voluntary DRE targets under a common monitoring framework. This can provide a shared direction for DRE development while allowing each member to determine its own level of ambition, based on its national context, resource availability, and market maturity. Progress can be reviewed periodically to strengthen mutual accountability.

Institutional anchor: BRICS Committee of Senior Energy Officials and BRICS Energy Ministers.

Key deliverables: Shared DRE ambition; common indicators for tracking progress; biennial peer review.

4. Members pursue different industrial and trade policies for clean-energy manufacturing; this roadmap focuses on deployment, data and regulation and leaves trade measures to national and WTO processes.

Enabling the ecosystem through knowledge exchange

- **Action 3—Establish a structured knowledge and skilling exchange**: Create a structured mechanism for sharing policy, regulatory, and implementation experience, financing and business models, and workforce skills. This can enable members to learn from approaches that have been tested elsewhere, build institutional and workforce capacity, and accelerate the adoption of proven solutions.

Institutional anchor: ERCP and the BRICS Digital Centre of Excellence for Smart Grids and Energy Storage, with relevant BRICS knowledge and skilling platforms.

Key deliverables: Knowledge exchange programme; training and practitioner exchanges; workforce skilling and certification initiatives.

Scaling the adoption

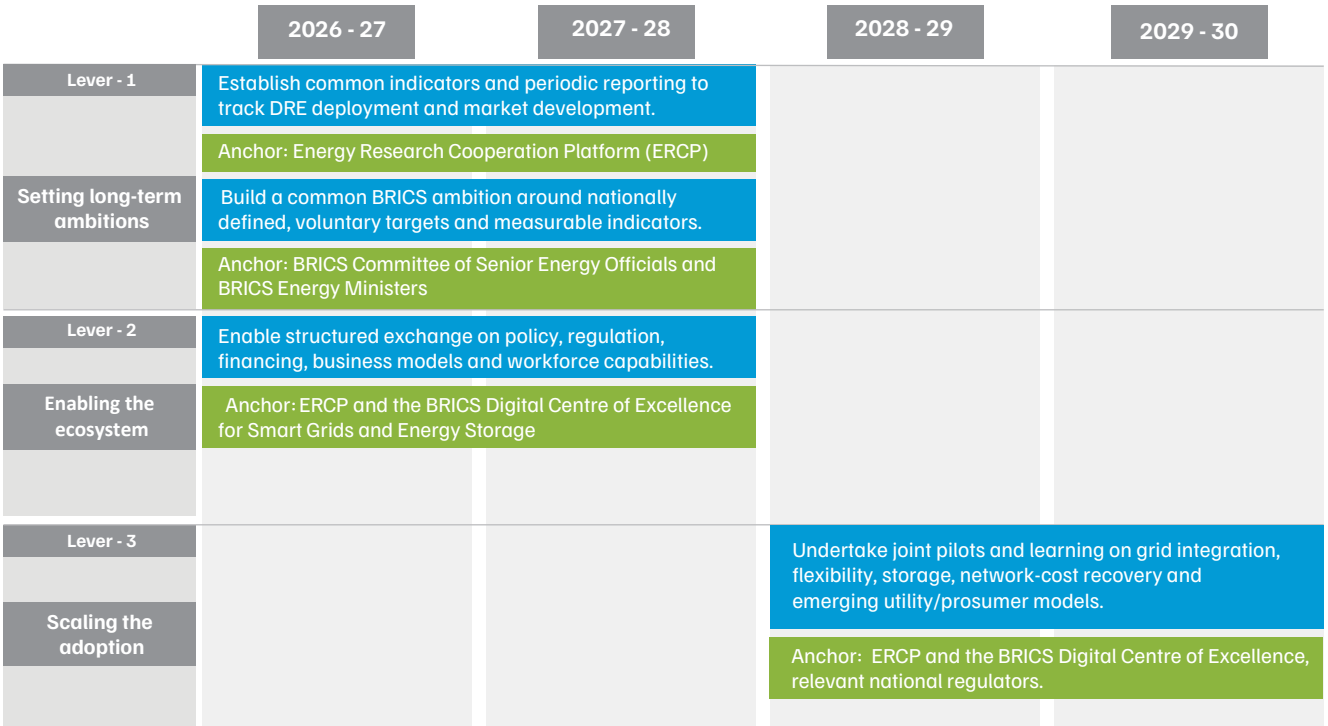
- **Action 4—Establish a common learning agenda on system integration**: Develop a joint learning and pilots agenda to address the emerging challenges of scaling DRE, including grid integration, flexibility, storage, network-cost recovery and new utility and prosumer[5] business models. The focus should be on practical learning and demonstration rather than harmonising national regulations, allowing solutions to be adapted to different power-system contexts.

Institutional anchor: ERCP and the BRICS Digital Centre of Excellence for Smart Grids and Energy Storage, working with relevant national regulators, utilities, and other institutions.

Key deliverables: Joint pilots; shared learning agenda; practical recommendations and implementation lessons.

The four proposed actions need not be rolled out sequentially. Actions 1 and 3, focused on measurement, knowledge exchange, and skilling, are foundational and can begin immediately in 2026. Action 2, which defines the shared ambition, should follow once the first joint data report is available, since a target that cannot be measured cannot be meaningfully reviewed. Action 4, meanwhile, should be triggered as DRE penetration rises and members begin to face deeper system-integration challenges.

Figure ES2. A four-step indicative roadmap to accelerate distributed renewables uptake among BRICS countries (2026–30)



Source: Authors' analysis.

5. A prosumer is defined as an electricity consumer who also generates electricity, typically through rooftop solar, for self-consumption and, where permitted, exports to the grid.

1. What makes distributed renewables a strategic priority for BRICS cooperation?

For the first time in over a century, renewables overtook coal in the global electricity mix in 2025, accounting for more than a third of global electricity generation (EMBER 2026a). Historically, large-scale deployment has been at the forefront of the energy transition; over the last decade, distributed renewable energy (DRE) has emerged as an increasingly critical pillar. Faster deployments, reduced transmission and distribution losses, and greater affordability have not only improved energy access, energy security, and livelihoods through a people-centric transition, but also created economic opportunities and fostered an entire green economy. The recent energy access progress report also recognises DRE as central rather than supplementary to closing the remaining access gap, identifying mini-grids and distributed solar as the most cost-effective solution to reaching the ~655 million people still without electricity worldwide (ESMAP 2026).

Diverse national priorities have shaped the adoption of distributed renewable energy

The uptake of DRE across BRICS countries has followed different pathways, shaped by resource potential, national interest, and market conditions. In Brazil, China, India, and Iran, DRE has emerged primarily as a response to energy security concerns and the need to diversify the power sector. However, the underlying drivers differ across these markets: successive droughts and hydrological risks have increased the value of distributed resources in Brazil; coal dependence and the need to absorb growing domestic manufacturing capacity have supported DRE expansion in China; rising electricity demand and import dependence have strengthened the case for DRE in India; and a widening gap between



Image: iStock

BRICS countries adopt distributed renewable energy along distinct pathways, driven by energy security, access, affordability or system efficiency.

electricity demand and available generation capacity has driven adoption in Iran.

In Ethiopia, Indonesia, and Russia, DRE has been driven more by the need to extend energy access to remote and underserved populations where grid connectivity is limited or absent. These challenges reflect the specific geographic and infrastructure constraints of each country, including Ethiopia's substantial electrification deficit, Indonesia's dispersed archipelagic geography, and Russia's isolated northern communities that are difficult to connect to the main grid.

South Africa and Egypt represent a third pathway, where DRE adoption has been shaped by a combination of reliability, affordability, and energy access concerns. In South Africa, prolonged load shedding and high retail-electricity tariffs have strengthened the case for distributed generation, while in Egypt, subsidy removal and successive tariff increases have improved the economics of DRE.

Saudi Arabia and the United Arab Emirates (UAE) form a distinct group, where the adoption of DRE is being pursued primarily to improve system efficiency and reduce reliance on fossil fuels (oil and natural gas) in the domestic power sector.

Distributed renewables have already been identified as a critical enabler of BRICS cooperation

While DRE has been pursued by individual members to address distinct national priorities, BRICS as a group has also identified energy cooperation as a key area of collaboration since its first-ever summit in 2009. Member countries acknowledged the need to diversify energy resources, supplies, and transit routes to reduce market uncertainty, and to cooperate on improving energy efficiency (BRICS 2009).

However, the energy agenda remained peripheral to the grouping's initial focus on financial reforms and global governance. In 2015, energy was formally acknowledged as one of the core pillars of BRICS's economic partnership. This was followed by the establishment of the Energy Research Cooperation Platform (ERCP), which reinforced the importance of advancing energy transitions and the implementation of sustainable development goals (BRICS 2025a). The ERCP has supported cooperation among BRICS countries, which has led to the development of multiple joint reports and the establishment of work streams within the energy domain (BRICS ERCP 2020). The journey of energy cooperation with BRICS in the last fifteen years has been promising so far; however, DRE has not been explicitly part of it until 2025. The Roadmap for BRICS Energy Cooperation 2025–2030, adopted in May 2025, marked an important shift by explicitly identifying DRE as a priority under the broader renewable energy (RE) thematic area for the first time (BRICS 2025b). The group identified DRE as critical for expanding affordable and reliable energy access (particularly in remote and underserved regions), strengthening energy security and reliability, and supporting the decarbonisation of the energy sector (BRICS 2025c).

Diverse energy landscapes and complementary capabilities encourage BRICS collaboration

The energy landscape across BRICS countries is highly diverse in terms of electricity mix, energy efficiency, power-sector infrastructure, and operating environments. Member nations are also at different stages of DRE deployment, policy development, and institutional maturity. While some have scaled DRE into the mainstream part of their energy mix, others are still developing the policy, market, and institutional foundations to enable wider adoption. Yet, considering the group's substantial economic, demographic, and energy footprint, BRICS is well positioned to play an important role in strengthening global cooperation on the energy transition (BRICS 2026, EMBER 2026a). The diversity in experience and market development across nations creates an opportunity for peer learning, knowledge exchange, and collaboration to accelerate DRE deployment across BRICS.

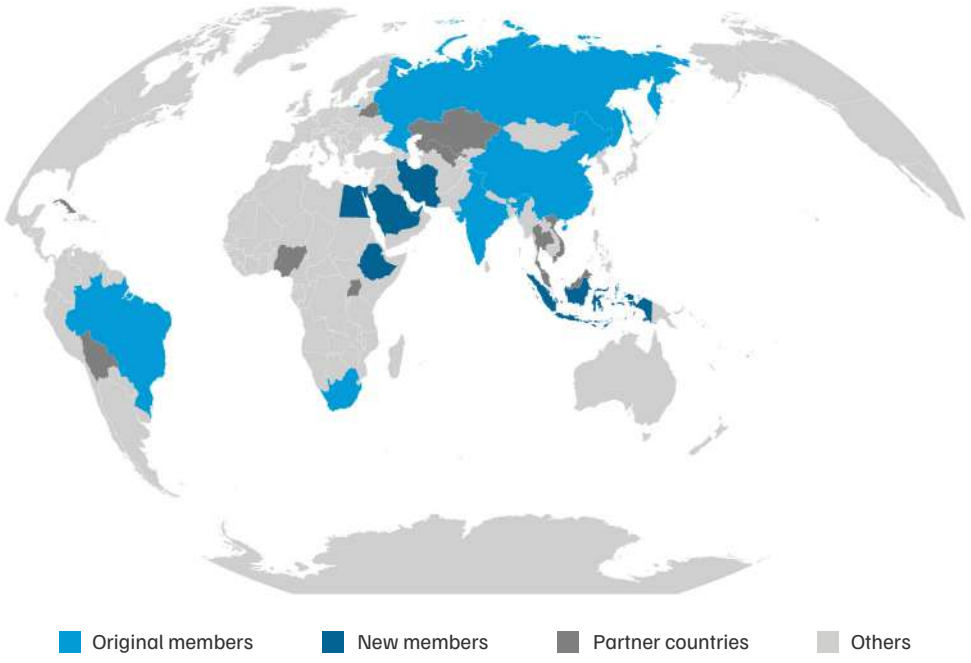
With DRE now explicitly recognised as a priority, there is a timely opportunity to build on this momentum and develop an indicative roadmap for BRICS cooperation on existing and emerging DRE technologies, innovative business models, financing and standards, alongside institutional responsibilities to translate recognition into coordinated action to scale distributed renewables.

2. A comparative approach to assessing country experiences

This report examines how DRE ecosystems have evolved across BRICS countries, based on a literature review of policy and regulatory documents, and secondary data. The analysis follows a common analytical framework covering the key drivers of DRE adoption, policy and regulatory frameworks, market and business models, financing mechanisms, and the way forward[6]. This consistent approach enables policymakers and practitioners to identify relevant parallels, common challenges, and potential thematic areas of collaboration. The objective is not to prescribe a single pathway for DRE deployment, but to develop an indicative roadmap that identifies priority areas for collaboration and opportunities for collective action, respecting national circumstances.

This report provides an in-depth assessment of the five original BRICS members (Brazil, Russia, India, China and South Africa); and a brief overview of the newer members (Egypt, Ethiopia, Iran, Saudi Arabia, the United Arab Emirates, and Indonesia) in the annexure. The depth of analysis is guided by the availability and comparability of secondary information across countries. The assessment does not extend to BRICS partner countries. We selected policies, programmes, and initiatives based on their direct relevance to DRE or their role in enabling the DRE transition, using publicly available data and information. We considered differences in market maturity and potential synergies across countries to draw relevant insights. While the broader BRICS agenda spans multiple energy-related themes, this report focuses specifically on the contribution of DRE in diversifying the electricity mix, increasing the share of renewable electricity, improving energy access and security, and strengthening power-system flexibility and resilience. Other aspects of the energy transition, including green fuels, electric mobility and related sectoral developments, are outside the scope of this assessment[7].

Figure 1. BRICS has expanded to eleven countries across four continents



Source: Authors' compilation from BRICS. 2026. About BRICS.

6. All policies, regulations, and relevant documentation have been reviewed through September 2026; developments post September have not been considered.
7. All currency conversions to USD use the exchange rate as of 30 September 2026, where applicable.

3. How have BRICS countries scaled distributed renewables deployment?

As outlined in the preceding section, to develop the roadmap, the following section explores the DRE journey of the five original BRICS countries (Brazil, Russia, India, China and South Africa). It examines the drivers of adoption, policy and regulatory interventions to scale, market instruments, the challenges encountered along the way, and mitigation strategies.



3.1 Brazil: Building a robust distributed renewables market through iterative policy reform

Distributed Renewable Energy (DRE) systems have played a pivotal role in Brazil's energy transition journey. Driven by favourable policies, innovative market instruments, and high electricity tariffs, the DRE sector has experienced rapid growth, with a compound annual growth rate (CAGR) of 90 per cent over the last decade, contributing to a more resilient power sector, greater energy security, and improved socio-economic and environmental outcomes (ANEEL 2026).



85%
of electricity comes from non-fossil fuel-based sources in 2026.



4.6 mn
of DRE systems have been installed, as of September 2026.



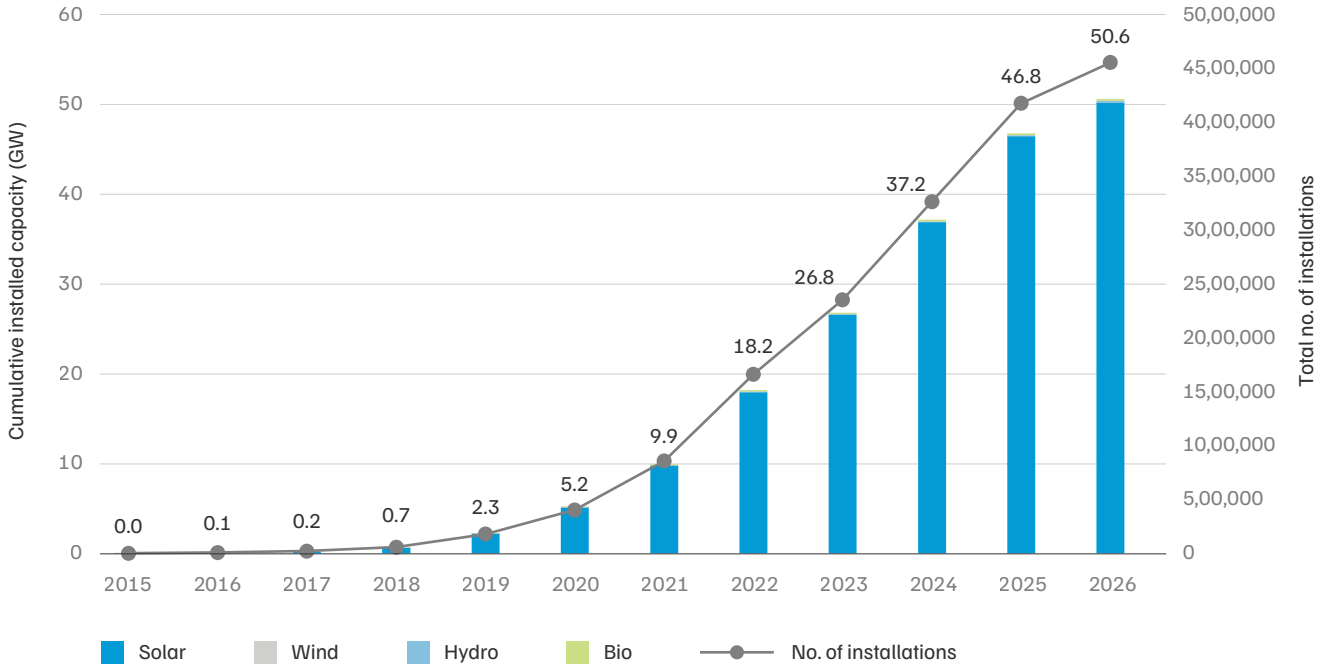
50 GW
of total distributed solar capacity as of September 2026.

Source: Authors' compilation from ANEEL. 2026. Distributed generation.

Decentralising the power sector to improve energy security

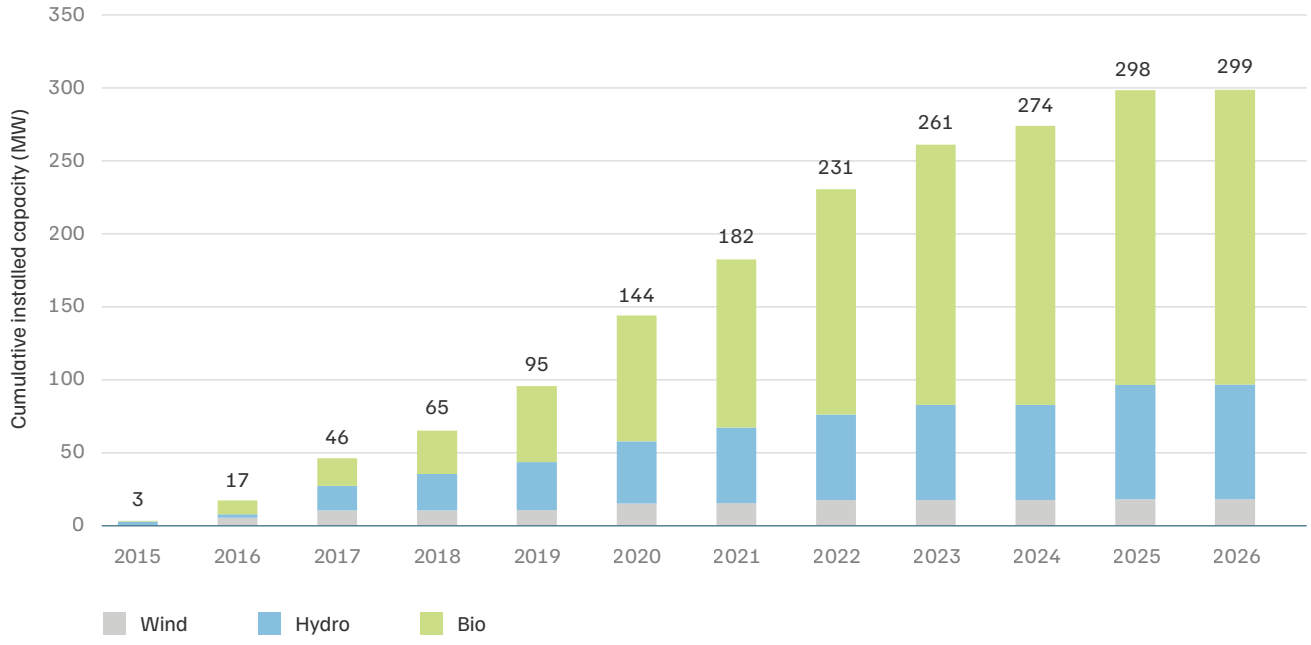
For decades, Brazil's power sector was heavily dominated by hydropower, with a contribution of 80 per cent in the electricity mix (Ministry of Mines and Energy 2012). While this enabled a clean electricity ecosystem, the heavy dependence on hydropower made the country highly vulnerable to climate variability and prolonged droughts (IEA 2021a). Deforestation and climate change are also affecting water availability, further stressing the resources. A few severe droughts caused energy shortages and an increased reliance on more expensive and polluting thermal plants. This prompted the country to shift its focus to distributed resources to diversify its power sector, enhance energy security, and improve energy access.

Figure 2. Brazil's distributed energy capacity grew at a CAGR of 90% over the past decade, as of September 2026



Source: Authors' compilation from ANEEL. 2026. Distributed generation[8].

Figure 3. Beyond solar, bioenergy and hydropower account for the largest shares of the remaining distributed renewable energy capacity in Brazil



Source: Authors' compilation from ANEEL. 2026. Distributed generation.

8. 2026 data updated as of September 2026

DRE[9] deployments are dominated by solar, which accounts for ~99 per cent of the total installed DRE capacity (Figure 2, 3), followed by bio and hydro (ANEEL 2026). More than 4.6 million DRE systems have been installed nationwide (ANEEL 2026; as of September 2026). The residential sector represents the largest share of installed capacity (Figure 4), primarily driven by rooftop solar (RTS). However, this rapid growth did not occur overnight. Targeted policy interventions, innovative market mechanisms, and technological advancements have collectively driven the expansion of the DRE segment.

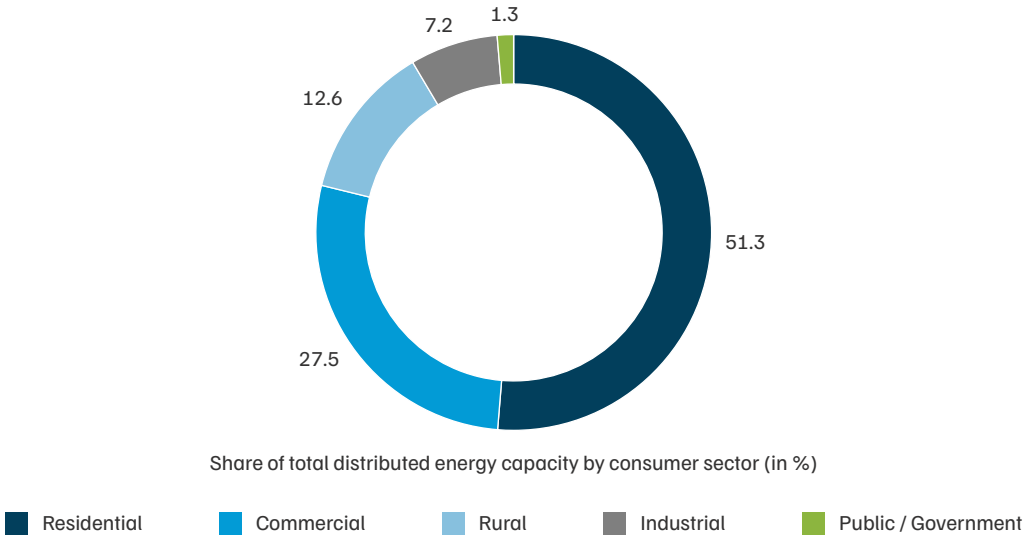
A dedicated policy framework laying the foundation for distributed generation

From the mid-1990s, Brazil aimed to liberalise the power sector by reducing state monopolies and encouraging private investment. Considering the heavy reliance on large hydropower in that era, the initial reforms focused on the segmenting hydro sector. As part of the reform, the government introduced a dedicated framework for small hydropower systems in 1998, creating a simplified licensing framework with lower regulatory and environmental compliance requirements (ANEEL 1998).

This enabled faster project development and laid the foundation for Brazil's transition towards a decentralised ecosystem.

Over the next decade and a half, the focus was on hydropower only. However, post-2010, the focus expanded beyond hydropower. In 2012, Brazil introduced the first-ever scheme for small-scale distributed energy systems as an instrument to diversify and decentralise the power sector (ANEEL 2012). Under the scheme, the electricity produced in these systems could be used for self-consumption; any surplus generated energy injected into the grid is banked and can be offset later against future consumption, effectively netting out their bill rather than creating a separate revenue stream (Figure 5). Credits could be used within the same distribution licensee area and come with a validity period. Initial uptake was slow due to taxation rules[11] and limited provisions for remote or shared generation. The 2015 regulatory revision addressed these barriers by exempting self-consumed electricity from taxation, enabling remote self-consumption and cooperative-based shared generation, and extending the surplus energy credit validity from 36 to 60 months (ANEEL 2015).

Figure 4. The residential sector accounts for nearly half of the total distributed energy capacity[10] in Brazil



Source: Authors' compilation from ANEEL. 2026. Distributed generation.

9. Distributed renewable energy refers to renewable generation systems connected directly to the distribution network. Under the DRE framework, dispatchable sources (hydro, biomass and biogas, solar/wind+storage) are capped at 5 MW, while non-dispatchable sources (solar, wind) are capped at 3 MW.
10. Rural tariff category comprises registered consumers engaged in agricultural, livestock, aquaculture, and related irrigation activities. Rural households not undertaking these activities are billed under the residential category.
11. A tax levied on goods and services, including electricity. Early net-metering arrangements imposed tax on both electricity consumed from and injected into the grid, reducing the financial viability of distributed generation until exemptions were introduced.

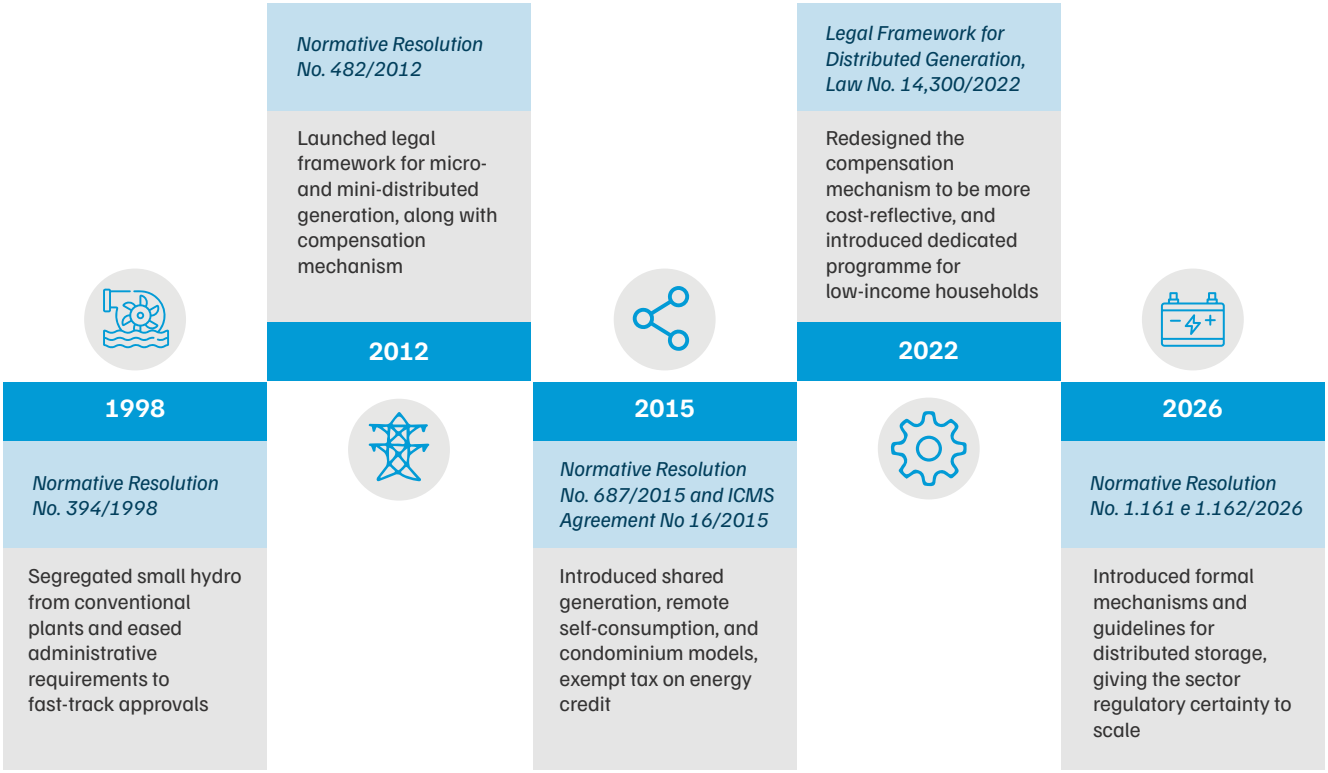
State-led initiatives accelerated adoption across consumer segments

Even after the policy reform, deployment has largely been limited to large commercial and industrial (C&I) and rural consumers. Between 2012 and 2016, biomass held a larger share of rural-segment distributed capacity than solar, reflecting farms' natural access to organic waste from livestock and crop residue. However, during the same period, the global reduction in solar module costs, largely driven by manufacturing scale-up in China, enabled solar to overtake biomass as the dominant technology.

Additionally, in 2017 utility-led initiatives[12] such as the Celesc PV Bonus Project helped build awareness of RTS among residential consumers (Antoniolli et al. 2022). The scheme offered a 60 per cent subsidy for residential RTS installations, generating significant public interest and media attention while demonstrating the viability of RTS to potential adopters. Coupled with consistently high electricity tariffs, these developments complemented the regulatory reforms and made RTS increasingly attractive for residential consumers, laying a strong foundation for the sector's subsequent expansion (Jornal de Brasília 2026).

In 2021, the *Paraná Rural Renewable Energy Programme*[13] was introduced to promote distributed energy deployment in rural areas, providing subsidies to farmers for installing distributed generation systems. Between 2021 and 2023, the number of distributed generation systems increased from 5,558 to 25,684, while total distributed generation capacity reached 1 GW by 2025 (RenovaPR 2020).

Figure 5. Iterative policy reforms accelerated distributed renewable energy deployment[14] in Brazil



Source: Authors' compilation from ANEEL 1998, 2012, 2015, 2022, and 2026.

12. A utility-led initiative in the state of Santa Catarina offered a 60 per cent subsidy for residential rooftop solar installations. Strong consumer response, including more than 10,000 registrations within 48 hours, generated significant interest, helping demonstrate the viability of rooftop solar, and build consumer awareness.
13. Paraná state government programme supporting rural distributed energy, particularly solar and biogas/biomethane, through interest subsidies on rural loans. Farmers borrow through participating banks and repay the principal and interest as usual, after which the state reimburses the eligible interest component. The programme has channeled USD 1.15 billion in loans, with USD 51 million in interest subsidies.
14. The timeline presents only the major policy milestones that had a significant influence on accelerating DRE adoption. Several complementary policy and regulatory measures have been omitted for brevity.

Redesigning policy frameworks to ensure fair compensation mechanisms

Brazil recorded more than ~1.5 million DRE system installations between 2017 and 2022, the majority of which were RTS (ANEEL 2026). However, millions of RTS systems connected to the grid started causing financial challenges for the utilities. What was envisioned to make consumers self-dependent started to erode the utilities' revenue base, as consumers were paying for the electricity commodity[15] but not for the distribution network they relied on. Consequently, in 2022, Brazil revised the regulation to make the DRE framework more cost-reflective, and introduced distribution network charges for distributed generation consumers (ANEEL 2022). However, to avoid disrupting the ongoing momentum, existing consumers remained under the previous rules, while distribution network support charges were introduced gradually for new consumers[16]. Additionally, the government also created the *Social Renewable Energy Programme* to promote DRE systems among low-income households.

The next phase focuses on building a flexible, resilient, and market-oriented ecosystem

As DRE deployment continues to accelerate, the focus is shifting from enabling adoption to integrating high shares of distributed resources into the grid. The next phase of Brazil's energy transition centres on building a more flexible, resilient, and market-oriented ecosystem. Use cases for DRE coupled with battery energy storage systems (BESS) are being actively explored to enhance grid flexibility and maximise the utilisation of DRE. Additionally, discussions are underway on the role of independent aggregators, microgrids, and virtual power plants (VPPs) in enabling the efficient integration of distributed energy resources and supporting active grid management. Looking ahead, the residential sector is expected to remain the primary driver of distributed energy deployment through RTS, with total DRE installed capacity projected to reach nearly 97 GW by 2035, attracting investments of approximately USD 31 billion (Ministry of Mines and Energy 2025).



3.2 Russia: Distributed renewables as an enabler of energy access for isolated regions

Russia's experience with DRE differs considerably from that of the other BRICS countries. Unlike Brazil, low retail electricity tariffs, extensive grid coverage, and the continued preference for centralised sources have limited the economic drivers for a people-centric transition. However, government-led initiatives have focused DRE deployment on remote and sparsely populated regions, where harsh weather, geographic isolation, and the high cost of grid extension constrain centralised supply.



36%
of electricity comes from non-fossil fuel-based sources.



~1%
of electricity generation from wind and solar combined.



15 GW
of estimated distributed solar potential.

Source: Authors' compilation from TASS 2026, and Shestopalova, Burykin, and Kovalev 2025.

15. Brazil's electricity tariff consists of an energy charge and network-related charges, including distribution and transmission costs, system losses, and sectoral levies. Under the earlier framework, distributed generation consumers were exempt from network-related charges.

16. Network charges for new distributed generation consumers are being introduced gradually, starting at 15 per cent of the applicable charges in 2023 and increasing annually until 100 per cent of the charges apply from 2029 onwards. Existing consumers continue under the previous compensation rules till 2045.

Historically centralised power system has limited the role of distributed generation

Historically, abundant domestic oil and gas resources shaped Russia's power system around large-scale, centralised generation. The 1920 *State Plan for the Electrification* of Russia laid the foundations for a system built around large power stations, interconnected through high-voltage networks, and designed to supply electricity to major population centres (Lenin 1921). More than a century later, the *Energy Strategy of the Russian Federation to 2050*, approved in April 2025, continues to reinforce this centralised model (Government of the Russian Federation 2025). While the centralised power sector continued to provide an affordable and reliable power supply, diversification was not a policy priority. Additionally, relatively low electricity prices have also reduced the economic benefits for consumers investing in distributed generation, unlike in countries such as Brazil where higher tariffs have strengthened the case for self-generation (Mitrova 2022).

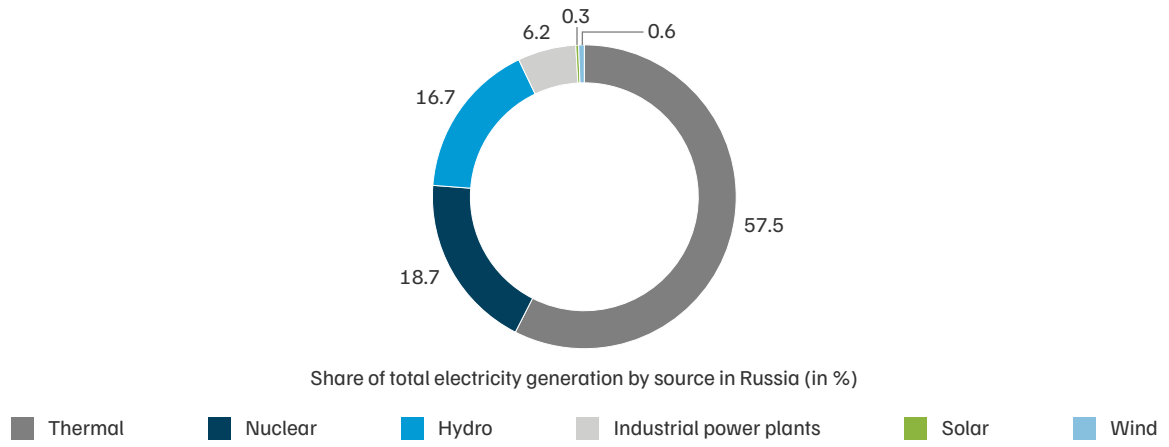
As of 2025, fossil fuel-based sources dominate the electricity mix (Figure 6); non-fossil sources only contribute ~36 per cent, comprising largely nuclear and hydro power. Wind and solar energy together contributed under 1 per cent (SO UPS 2026a).

However, Russia's vast geography and harsh climatic conditions leave some remote communities beyond the reach of the centralised grid and the unified power system (UPS), relying instead on isolated power systems (IPS) such as mini-grids, which are largely diesel-fed. For these areas, the focus has been on the development of DRE-based solutions[17] to provide affordable and reliable power.

Policy support has evolved, but distributed generation is yet to scale

Russia's formal RE policy journey officially began in 2007, almost a century after its initial 1920 electrification plan. The shift was marked by Federal Law No. 250-FZ, which amended the Federal Law 'On the Electric Power Industry' to introduce support for RE sources (Government of the Russian Federation 2007). However, the amendment did not translate into deployment immediately; real momentum came in 2013 with *Decree 449*, which established Russia's distinctive capacity based support mechanism, paying renewable investors for installed capacity rather than electricity actually produced, for wholesale[18] renewable projects (mandatory at 25 MW and above, and optional at 5–25 MW; (Government of the Russian Federation 2013). Later in 2015, *Decree 47* extended support to retail markets,

Figure 6. Thermal-based sources still dominate the generation mix in Russia (as of 2025)



Source: Authors' compilation from SO UPS. 2026a. The system operator has published operational data on the operation of the Unified Energy System of Russia in 2025. EES EAEC. 2026. Elektroenergeticheskiy kompleks Rossii [The electric power complex of Russia]. Compiled series drawing on Rosstat and System Operator data.

17. Russia does not have an official statutory term equivalent to 'distributed renewable energy'. The term is used consistently in this report for analytical purposes. Russian legislation instead uses related categories such as microgeneration (grid export of up to 15 kW until September 2026, now up to 50 kW for households and 150 kW for businesses and apartment buildings) and renewable energy facilities supported in retail markets up to 25 MW.
18. Under Russian electricity law, generating facilities are routed to one of two markets, based on capacity: plants of 25 MW or larger must sell into the wholesale and capacity market, where a national competitive auction awards long-term capacity supply agreements. Systems <5 MW must sell into regional retail markets, where competitive selections are run locally by individual Russian regions rather than nationally. Plants between 5–25 MW may choose either market.

for RE facilities up to 25 MW (Government of the Russian Federation 2015, Norton Rose Fulbright. n.d.). While the policy showed the intent of the government, the uptake remains limited because of a lack of economic incentives to invest in distributed systems.

To promote adoption, from 2016, the government began compensating grid connection costs for small renewable plants up to 25 MW (Government of the Russian Federation 2016, EuroSolar Russia n.d.).

The first-ever household-level intervention was introduced in 2019, legally defining microgeneration and allowing consumers to connect small-scale solar or wind installations up to 15 kW (Figure 7) to the grid (Government of the Russian Federation 2019).. This was the first time distributed generation had its own dedicated legal category, separate from the wholesale or retail capacity auctions market. Rules introduced in 2021 allowed system owners to sell surplus power to their local electricity supplier at a price capped at the wholesale level of about USD 0.022–0.026/kWh (Government of the Russian Federation 2019, 2021; Bellini 2021).

However, two limits then held the segment back. First, the price offered for surplus power was too low to attract investment. Second, the law prohibited distributed generation facilities from serving apartment buildings, where most Russians live, meaning that an exporting system could not serve more than one premises within a building. Consequently, the uptake was limited;.by the start of 2024, total microgeneration capacity stood at only 4.7 MW (Shestopalova, Burykin and Kovalev 2025). The Ministry of Energy has estimated the achievable potential of solar microgeneration at up to 15 GW (Shestopalova, Burykin and Kovalev 2025). The sector, however, is yet to realise this potential.

Hybrid distributed systems are emerging as a solution for remote power supply

The centralised grid accounts for ~98 per cent of the country's installed capacity. The remaining 2 per cent are officially designated as regional power systems in five geographically isolated territorial systems[19], with several thousand smaller off-grid systems heavily dependent on

Figure 7. Policy support for distributed renewables emerged relatively late in Russia compared to other BRICS countries



Source: Authors' compilation from Lenin 1921, Government of the Russian Federation 2013, Government of the Russian Federation 2015, Government of the Russian Federation 2019, and Government of the Russian Federation 2026a.

19. The five technologically isolated territorial systems are Kamchatka, Magadan, Sakhalin, Chukotka, and the Norilsk-Taimyr area of Krasnoyarsk Krai. They operate independently of the Unified Energy System because of distance, terrain, and climate. Off-grid settlements are supplied by standalone diesel plants.

diesel and oil (SO UPS 2026b). Many of these settlements are so remote that fuel must be delivered by rail, boat, or even helicopter. Together with seasonal demand, harsh operating conditions and shortages of skilled labour, this makes conventional power supply in these regions both expensive and unreliable. For these isolated systems, automated hybrid energy systems[20] have been envisioned, where each system pairs a high-efficiency diesel plant with a solar plant and battery storage, run by a single automated control system (TASS 2025). Yakutia's state utility, Sakhaenergo, piloted solar–diesel systems from 2011 and scaled them up with a 1 MW solar plant in Batagay in 2015; solar plants in the Far North have an average payback of seven to eight years (Northern Forum 2017). Under an energy service contract, the developer finances and installs the systems and is repaid from the fuel savings generated over an agreed term. This allows utilities to avoid upfront capital expenditure, while the risk of underperformance rests with the developer rather than the consumer. From 2021, a new system added battery storage and automated controls, starting with the Arctic settlement of Tabalakh (TASS 2025). Twelve systems commissioned between 2021 and 2024 saved a combined 3,596 tonnes of diesel over that period, followed by further installations in 2025–26. The region aims to deploy more than 70 systems overall (TASS 2025).

The technology mix extends beyond solar. The village of Tiksi runs a wind-diesel hybrid system with storage, saving an estimated 500 tonnes of diesel a year (RAWI 2018). Ust-Kamchatsk operates a 1.2 MW wind farm outside Kamchatka's central grid; geothermal plants supplied 23 per cent of Kamchatka's electricity in 2018 (RAWI 2020; Butuzov and Tomarov 2020).

> Distributed energy systems improve electricity access across Russia's remote islands, where extending the central grid is challenging and costly.

Scaling distributed energy through isolated hybrid systems and household participation

The *Energy Strategy of the Russian Federation to 2050* sets out a long-term vision for Russia's energy system, including an aim to increase renewable capacity by more than 40 per cent by 2050 (Government of the Russian Federation 2025; EL5-Energo 2025).After decades of reliance on fossil fuel-based generation, DRE is expected to play a growing role, spanning isolated hybrid systems in remote regions to greater household participation. . Estimates of the potential vary with scope. A 2018 study found that distributed energy resources could cover about 36 GW of Russia's capacity needs by 2035, but most of this would come from co-generation, self-generation and demand response, with only about 0.6 GW from renewable microgeneration (Khokhlov et al. 2018). The later estimate of up to 15 GW of achievable solar microgeneration potential points to greater scope for DRE (Shestopalova, Burykin and Kovalev 2025). The June 2026 amendment, which targets expanding the household-level distributed generation limit and including apartment buildings, could further broaden DRE adoption by households (Government of the Russian Federation 2026a). However, the eventual scale of adoption will depend on how settlement and other practical arrangements for household systems work in practice. The next phase will therefore depend on scaling hybrid systems in isolated regions while creating stronger pathways for consumer participation, helping align DRE deployment with Russia's broader energy-transition goals.

20. An automated hybrid energy system is a single installation pairing a high-efficiency diesel generator with a solar plant and battery storage, operated through one automated control system. The diesel unit is retained; solar and storage reduce fuel consumption rather than replacing generation capacity.



3.3 India: From energy access to energy security, distributed renewables become central to the energy transition

India's people-centric energy transition, particularly the rapid expansion of distributed solar, has gained significant momentum in recent years. Driven by flagship programmes, streamlined digital delivery mechanisms, and a rapidly scaling domestic manufacturing base, this transition is contributing to a more resilient power sector, strengthening energy security, and creating broader socio-economic opportunities for households and farming communities.



29%
of electricity generated from non-fossil fuel-based sources in FY26.



16 GW
of distributed solar capacity was added in FY26 alone.



6 mn
households have adopted RTS, as of September 2026.

Source: Authors' compilation from NITI Aayog n.d, Press Information Bureau 2026a, and MNRE n.db.

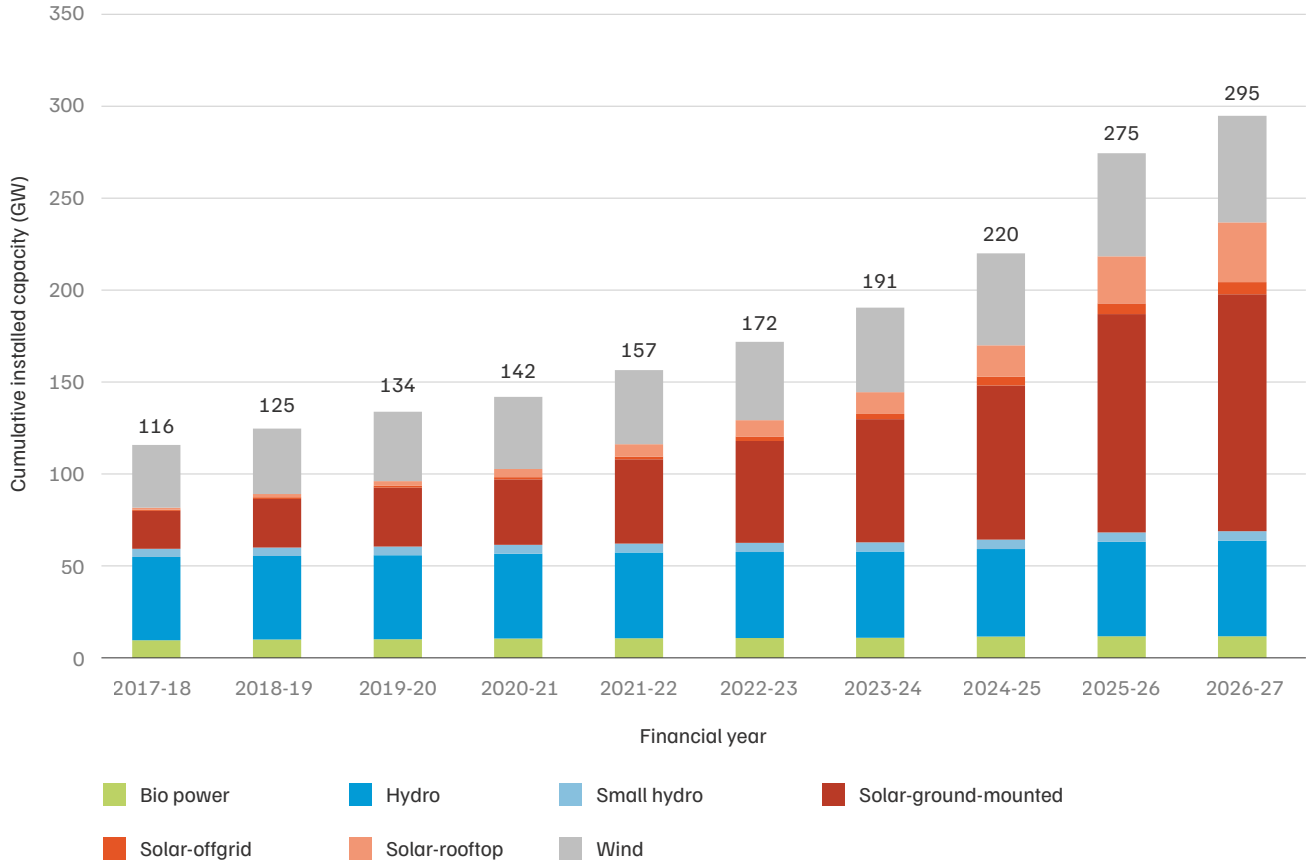
Promoting distributed solutions to improve energy access and strengthen energy security

Similar to other BRICS countries, India's power sector was historically centralised and fossil-fuel dominated. Even five decades after independence, nearly half the rural population lacked electricity access (Bilolikar and Deshmukh n.d.). The *Rural Electricity Supply Technology Mission* (REST) marked an early shift by combining off-grid solutions with grid extension, later formalised through the *Electricity Act, 2003*, which enabled stand-alone generation and distribution systems in rural and remote areas (Ministry of Power 2002, Ministry of Law and Justice 2003). The push towards DRE reflects a recognition that a just and inclusive energy transition cannot rely on centralised grid expansion alone. Off-grid systems were applied specifically to villages where grid connectivity was not feasible or cost-effective; rather than an alternative, they were pursued on equal footing with grid extension. While DRE was initially positioned as a means to expand energy access, the focus has increasingly broadened to include energy security and resilience. This is evident from the scheme objectives over the years—early programmes like REST were centred on rural electrification, while subsequent schemes such as *PM Surya Ghar and Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan* (PM-KUSUM) focus on empowering consumers to become energy independent, signalling energy security as an explicit objective.

Over time, DRE[21] solutions such as RTS, small-scale biogas, small hydro, livelihood applications, and off-grid systems have increasingly become mainstream sources of clean energy (Figure 8). Solar, however, remains the dominant technology. While C&I consumers initially drove DRE adoption, targeted interventions for residential and agricultural consumers have increasingly broadened participation, making DRE a key pillar of India's people-centric energy transition. In the financial year (FY) 2025–26 alone, 16 GW of distributed solar was added, accounting for 36 per cent of total solar capacity additions (PIB 2026a). The journey to this milestone unfolded in multiple phases.

21. DRE means non-fossil (renewable) electrical energy generated from all eligible non-fossil energy sources that are not more than 10 MW in installed capacity. DRE will also include grid connected solar and other RE installations under all configurations (net metering, gross metering, virtual net metering, group net metering, behind the meter (BTM) and any other configuration) Source: BEE, Operational Guidelines for Renewable Consumption Obligation Compliance Mechanism.

Figure 8. India's renewable energy capacity is dominated by solar, accounting for more than 50%



Source: Authors' compilation from NITI Aayog. n.d. India Climate & Energy Dashboard.[22]

Rooftop solar is the cornerstone of India's distributed energy transition

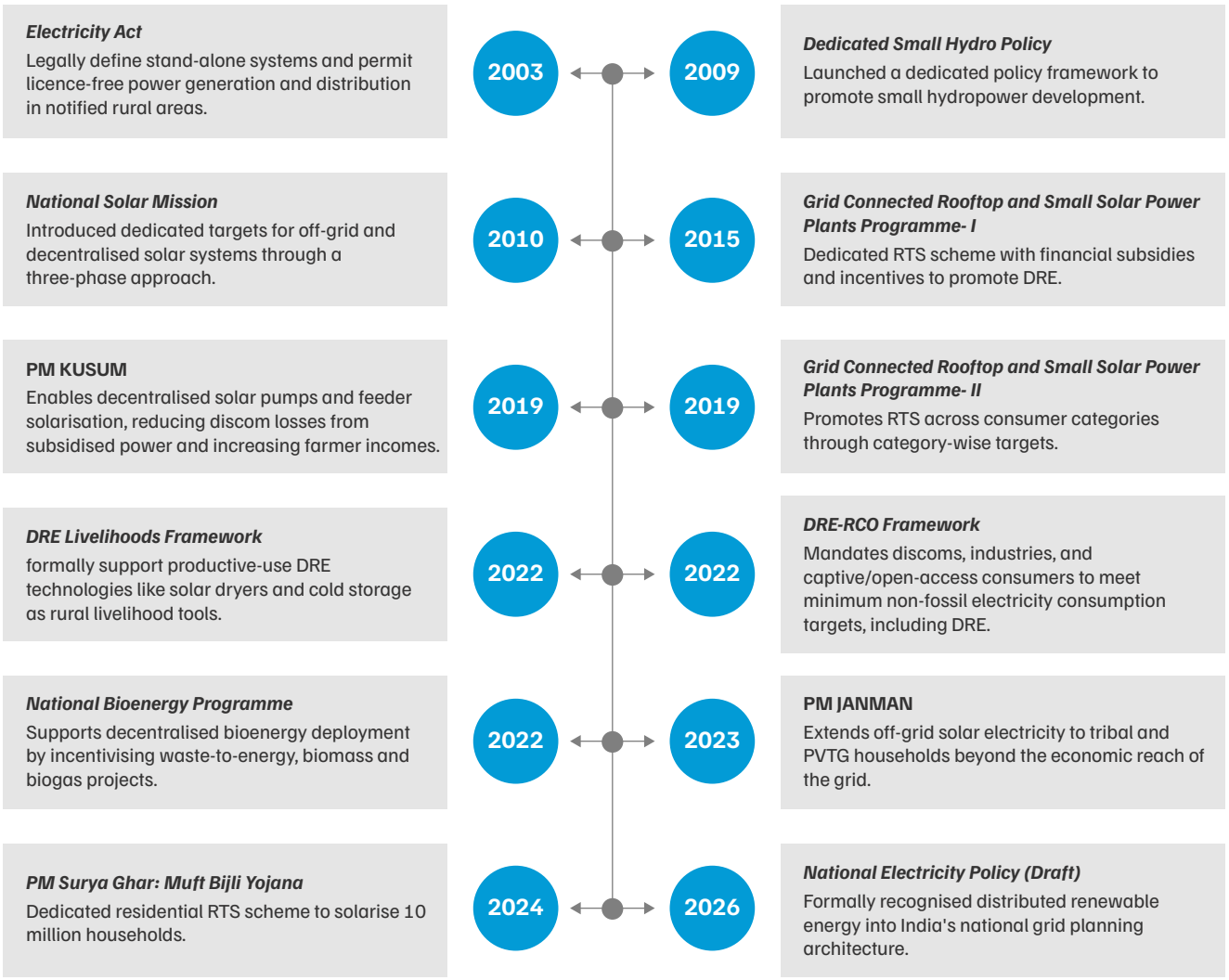
Upon legally recognising distributed energy systems, India launched its first dedicated distributed energy initiative through the *National Solar Mission* in 2010, initially targeting 2 GW of off-grid distributed solar capacity by 2022 (MNRE 2010). The mission evolved through three phases, scaling the overall solar target from 1 GW in 2013 to 20 GW by 2022 (SECI n.d.). Rapid capacity growth and decline in module prices prompted a major revision in 2015, raising the target to 100 GW, including 40 GW of RTS and 60 GW of medium-to-large scale projects. This revision marked the beginning of dedicated RTS-focused policies and schemes (PMINDIA 2015).

In the same year, 2015, the Government of India launched the *Grid Connected Rooftop and Small Solar Power Plants Programme*. The scheme aimed to deploy 40 GW of RTS by 2022 (MNRE n.d.a). The programme provided central financial assistance (CFA) of 30 per cent of the benchmark cost or actual project cost, whichever was lower, with 70 per cent support for special-category states (MNRE 2015). Around 2 GW of projects were sanctioned, of which 1.9 GW had been installed by 2020 (Tyagi et al. 2024).

The second phase expanded rooftop solar across all consumer categories and introduced category-wise targets, aiming to add 38 GW of capacity, 4 GW in the residential sector and 34 GW across C&I and institutional consumers (MNRE 2019a). However, delays in application processing and incentive disbursement, along with limited consumer awareness, resulted in sluggish growth.

22. FY 2026–27 data is up to September 2026 (excluding hybrid solar projects).

Figure 9. How two decades of phased policy brought distributed renewables into India's mainstream



Source: Authors' compilation from Ministry of Law and Justice 2003, MNRE 2009, MNRE 2010, MNRE n.d.a., MNRE 2019a, MNRE 2019b, MNRE 2022a, MNRE 2022b, Climate Change Laws 2022, MNRE 2023, MNRE 2024, and PIB 2026b[23].

To address these challenges, India launched *PM Surya Ghar: Muft Bijli Yojana* in 2024, aiming to solarise 10 million households by 2027 (Figure 9). The scheme combines targeted subsidies, low-interest financing, awareness campaigns, and a streamlined, fully digitised application process (MNRE 2024). This approach has driven unprecedented growth, with 17.6 GW of residential RTS added, covering nearly 6 million households as of September 2026 (MNRE n.d.b.). The scheme also supports solarisation of government buildings, underserved households, rural and livelihood applications as complementary components. Over 100,000 buildings have been solarised with a combined capacity of 2.32 GW across central and state government buildings by H2 2026 (PIB 2026c).

23. The timeline highlights only major policies and regulatory milestones that have significantly influenced the development of distributed renewable energy. Complementary measures have been omitted for brevity. For instance, the 2009 Small Hydro Power Policy was subsequently revised in 2026.

A dedicated programme to solarise agricultural electricity demand

While the initial focus was on the residential sector, India's DRE agenda expanded to agricultural solarisation in 2019. With agriculture accounting for around 15 per cent of electricity consumption and relying heavily on subsidised power, the focus shifted towards improving energy security and reducing the financial burden on DISCOMs (NITI Aayog n.d.). The *PM-KUSUM* scheme was launched to replace diesel pumps and unreliable grid supply with clean, affordable, and reliable solar power for irrigation, while also supporting farmer incomes and reducing emissions (MNRE 2019b). The scheme was projected to lead to an annual reduction in diesel consumption of 1.38 billion litres (PIB 2021). It has now benefited ~2.2 million farmers December 2025 (PIB 2026d), with over 10 GW of capacity and 2 million solar pumps deployed (PIB 2026e).

Beyond solar, biogas and small hydro are expanding the distributed energy landscape

India is increasingly diversifying its DRE mix to match technology choice with locally available resources and opportunity. Beyond solar, the journey has also expanded to technologies such as biogas and small hydro as important complementary solutions, particularly for rural and geographically challenging areas.

Rural and semi-urban areas with abundant livestock and organic waste offer a natural feedstock for biogas. The *National Biogas Programme*, implemented under the *National Bioenergy Programme*, supports decentralised biogas plants in rural and semi-urban areas, providing clean cooking energy, lighting, and power at the household and community level (MNRE 2022a). As of December 2025, 34,913 small/family sized biogas plants and ~4 MW of medium-sized plants had been deployed. Beyond improving energy access, these systems reduce dependence on firewood and fossil fuels, and improve air quality (MNRE 2026).

In hilly and water-abundant terrain, where grid extension is often the costliest, the *Small Hydro Programme* (SHP)[24], has an estimated potential of over 21 GW at over 7,000 sites located across India (MNRE 2009). Till December 2025, an aggregate capacity of over 5 GW has been achieved through 1,196 projects. Over 90 projects with capacity over 430 MW are at various stages of implementation. These projects minimise transmission losses, improve voltage stability, and ensure reliable power in geographically challenging areas, including border and hilly regions (MNRE 2026).

In parallel, India has expanded off-grid solutions to reach remote and underserved communities, solving the last-mile connectivity. The *Off-Grid and Decentralised Solar PV Applications Programme* supports solar lighting, street lights, and pumps, while the *DRE Livelihood Applications Framework* promotes productive uses of clean energy. The new solar power scheme under *PM-JANMAN* and *Dharti Aaba Janjatiya Gram Utkarsh Abhiyan* (DA-JGUA) further targets clean energy access for unelectrified households among tribal and particularly vulnerable tribal groups (PVTG) in remote areas (MNRE 2022b, MNRE 2023, MNRE 2026, Ministry of Tribal Affairs n.d.)

From adoption to sustainable growth: The next phase of distributed sector journey

Similar to Brazil, India's DRE journey has increasingly converged towards addressing balanced compensation mechanisms and integrating high DRE penetration into the grid. With the success of *PM Surya Ghar: Muft Bijli Yojana* and *PM-KUSUM*, India's next phase of DRE transition is shifting from deployment to integration and system flexibility. The focus is increasingly on developing balanced and cost-reflective tariff and energy accounting mechanisms, alongside leveraging distributed storage to support higher DRE penetration.

> India recorded an average of more than 3 lakh rooftop solar installations per month in FY 2026–27.

24. The SHP, administered by the Ministry of New and Renewable Energy, supports projects up to 25 MW, covering micro (up to 0.1 MW), mini (0.1–2 MW), and small (2–25 MW) hydro projects.



3.4 China: Leading the global distributed renewable energy ecosystem

China dominates the global DRE segment. Targeted policy interventions, including capital subsidies and feed-in tariffs, combined with strong manufacturing capabilities, technological advancements, market-based pricing, and the deliberate development of a domestic RE market and supply chain have driven rapid growth in China's renewable energy capacity and helped China to become world's largest RE manufacturer and installer.



42%
of electricity generated from non-fossil fuel-based sources in 2025.



530 GW
of cumulative installed distributed solar capacity, as of 2025.



1st
rank in terms installed capacity.

Source: Authors' compilation from EMBER 2026b and IEA-PVPS 2026.

From coal-dominated power sector to the world's largest distributed solar market

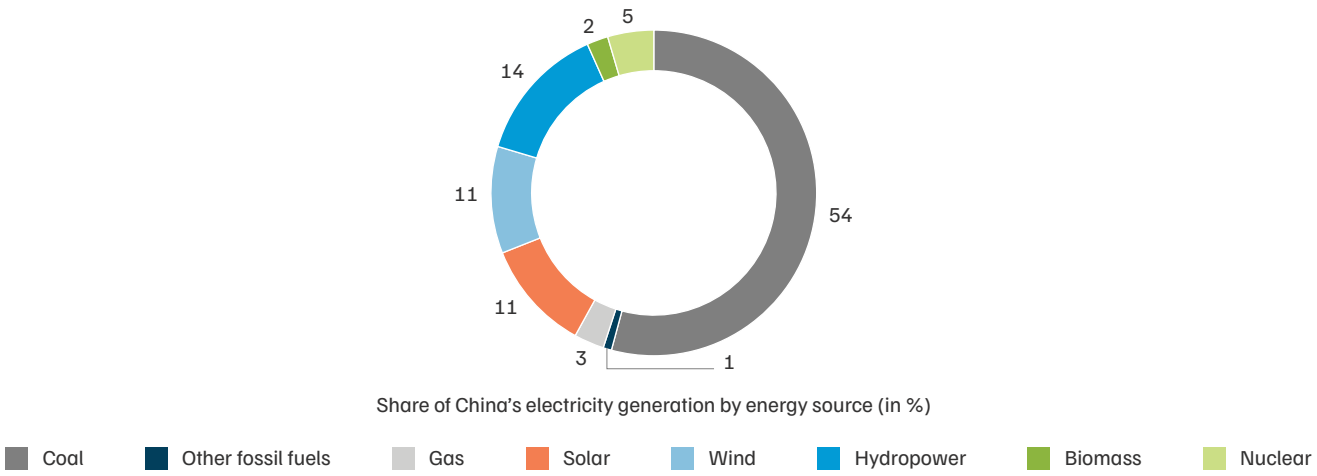
China's power system in the early 2000s was built almost entirely around coal. As the country's rapid industrialisation accelerated after it joined the World Trade Organization (WTO), electricity demand surged, growing at a pace rarely seen elsewhere in the world.. Domestic availability of coal and its relatively quick scalability made it the default source for meeting this growing demand. By 2000, coal accounted for around 77 per cent of China's electricity generation (EIA 2022), and its share stayed above 70 per cent through much of the following decade.

While this enabled rapid economic growth, it also came at a high cost. Heavy reliance on coal contributed to chronic urban air pollution, rising carbon emissions, and a power system highly dependent on a single fuel, leaving the economy vulnerable to disruptions in coal supply and price volatility.

From the mid-2010s, the scenario began to change quickly, as coal's share fell to around 60 per cent by 2023 and further to 54 per cent in 2025 (Figure 10), when coal-fired generation declined in absolute terms for the first time since 2015 (EMBER 2026b). Renewable capacity grew at an unprecedented pace during the same phase.

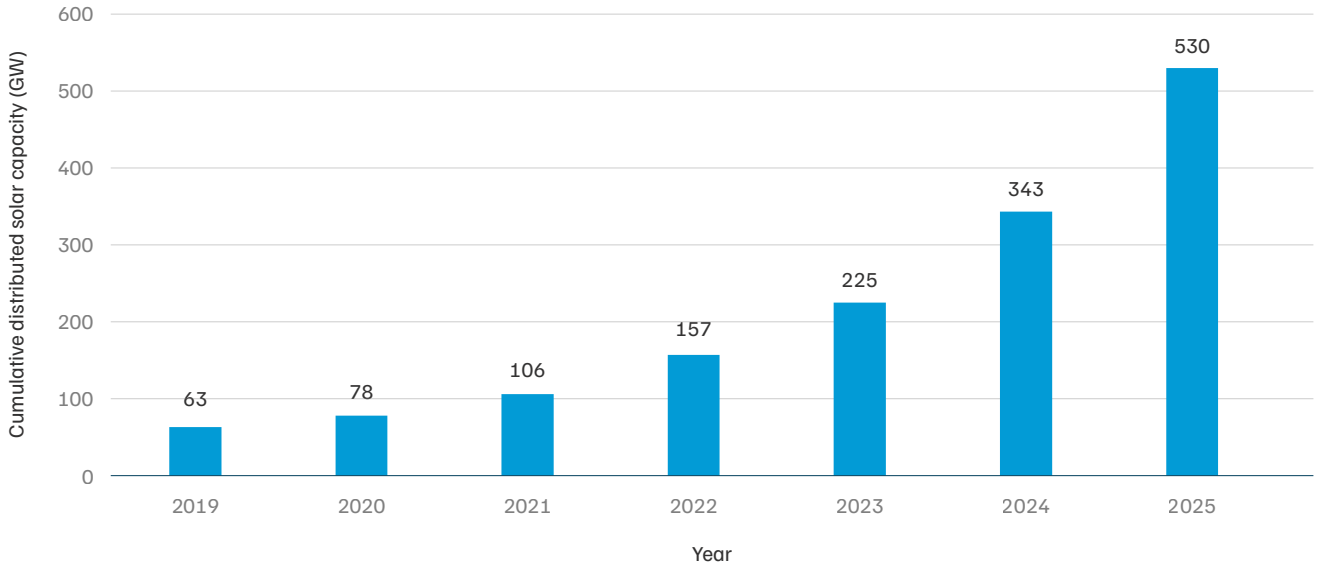
In distributed energy, solar accounts for the vast majority of capacity. By the end of 2025, total installed renewable capacity had reached 2,340 GW, close to 60 per cent of national power capacity (NEA 2026). Solar dominated the RE mix, with around 1,200 GW of installed capacity. As of 2025, distributed solar accounted for 44 per cent (Figure 11) of China's total installed solar capacity (NEA 2026). Beyond solar, bioenergy and hydropower also contribute to distributed generation, although clear distinctions between large-scale and distributed capacity are not readily available for these sources. Additionally, given China's vast solar potential, estimated at around 2,070 GW ((Wang, Luo and Kang 2017) of technical potential, policy efforts have largely focused on solar.

Figure 10. More than 50% of China's electricity comes from fossil fuel-based sources (as of 2025)



Source: Authors' compilation from EMBER. 2026b. China: China is rebuilding its industrial economy on a clean foundation as rapid renewable energy expansions begin to offload fossil fuels.

Figure 11. Over the past five years, distributed solar capacity has grown fivefold



Source: Authors' compilation from Tyagi et al. 2024, IEA-PVPS 2024, and NEA 2026.

Collapse of European demand pushed China to build its domestic market

Long before distributed solar scaled and became a policy priority, distributed energy in China served as a welfare tool. Off-grid solar, biogas digesters, and small hydropower stations brought electricity to remote communities the national grid had not yet reached. Programmes, such as the 1996 *Brightness Programme* and the 2002 *Township Electrification Programme*, extended power to millions of people in remote western regions using off-grid solar, wind-solar hybrid, and small hydro systems (IEA 2021b, State Development Planning Commission 2002). By the mid-2000s, China had achieved near-universal rural electrification, leading the world in these applications for decades, and as grid penetration saturated, the role of distributed generation shifted from energy access to energy security (Martinot et al. 2020).

During the early 2000s, China's solar module manufacturing industry began to expand rapidly (Tan 2021). The affordability and availability of Chinese solar modules helped the country capture a growing share of the global market. At the same time, European FiT incentives created strong demand for Chinese solar modules. Chinese manufacturers eventually captured more than 80 per cent of the European solar-module market, even as the domestic power system remained dominated by coal (McWilliams, Tagliapietra and Trasi 2024). However, the 2008 financial crisis exposed the fragility of this export-led model. As European incentives declined, manufacturers faced severe oversupply, prompting China to build its own domestic market. This served two purposes: creating the demand for its growing manufacturing base, and decarbonising the power system (Tan 2021). In 2011, the *12th Five-Year Plan for the Solar Photovoltaic Industry* laid a guiding roadmap for developing China's domestic solar manufacturing and application sector, introducing targets for production capacity across technologies and cost (Asia Pacific Energy portal 2012). Additionally, the focus was also on developing technical and research capabilities and skilled workforce across the value chain, from manufacturing and project development to installation and system operations.

Targeted policy interventions shaped evolution of China's distributed solar market

In 2009, the *Golden Sun Programme* was designed to create a domestic market for the growing solar module manufacturing base, along with expansion of clean energy generation (Figure 12). The programme offered 70 per cent capital subsidy for off-grid rural projects and 50 per cent for grid-connected ones (Ministry of Finance 2009). The scheme was designed to support both utility scale (>300 kW) and distributed solar projects (<6 MW). Although utility scale solar initially dominated, distributed solar began gaining ground from 2010 onwards, as large-scale solar is no longer covered under the scheme.

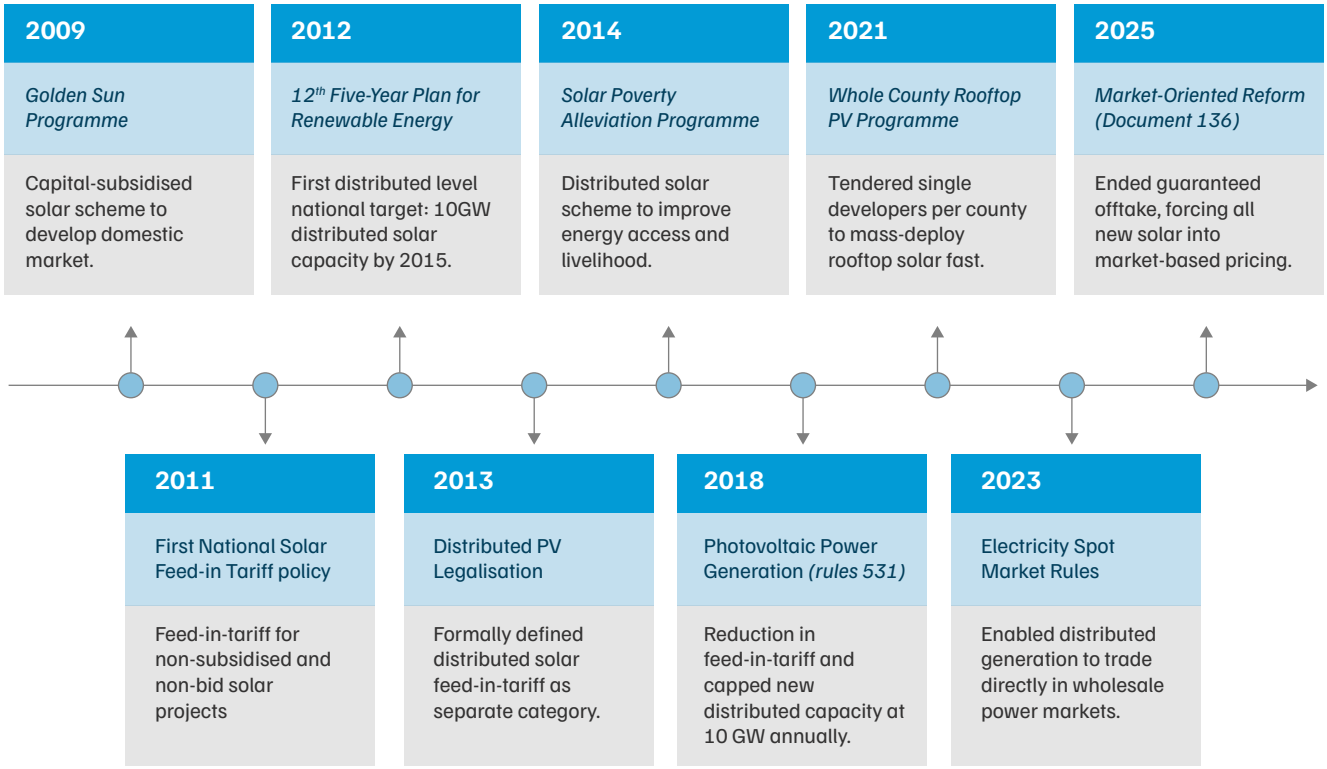
By 2012, the programme's final year, the installed capacity had reached 5,930 MW, with distributed solar accounting for 95 per cent of the capacity (Wang, Luo and Kang 2017). However, the programme encountered challenges due to design issues, a lack of clarity in the implementation plan, and regional governments' non-adherence to policy provisions, ultimately leading to its closure in 2013. In the same year, distributed solar was formally legalised as its own regulatory category.

Following the *Golden Sun Programme*, China launched the *Solar Energy for Poverty Alleviation Programme* (SEPAP), aimed at benefiting two million households across 35,000 rural villages (Global Law 2014). The policy was a major success, significantly exceeding its targets by installing 26 GW of solar capacity and benefiting more than four million households; more than double the original target (Jin and Ialnazov 2022). However, connecting thousands of individual rooftop systems proved slow and administratively costly, while overlapping agency mandates and uneven local implementation limited the programme's ability to deliver its intended outcomes.

The 2021 *Whole County PV Programme* solved exactly this; instead of contracting with thousands of separate owners, it tendered a single developer per county to build out solar capacity across the whole jurisdiction at once, trading SEPAP's household-level precision for speed and scale (NEA 2021). Under the scheme, the focus also extended across consumer categories. The government set targets to install RTS on at least 50 per cent of government buildings, 40 per cent of public buildings (including schools and hospitals), 30 per cent of commercial buildings, and 20 per cent of rural homes. The programme benefits 140 million people in 676 counties and has significantly increased distributed capacity in China (Jiang 2023, REGlobal 2023).

> China accounts for 42% of global distributed solar capacity.

Figure 12. Iterative policy reforms progressively shifted distributed solar from a subsidised niche to a market-priced mainstream in China



Source: Authors' compilation from Ministry of Finance 2009, NDRC 2011, Asia Pacific Energy Portal 2012, NDRC 2013, Global Law 2014, Zhang and Sirin 2024, NEA 2021, NDRC 2023, and NDRC 2026a.

Initially, China introduced capital subsidies to lower upfront costs and stimulate domestic demand, but gradually recognised that subsidies were not a sustainable long-term mechanism. It, therefore, shifted towards FiTs, introducing the first national benchmark FiT for solar PV in 2011 (NDRC 2011). In 2013, it introduced the country's first distributed solar feed-in tariff (NDRC 2013), providing a subsidy of USD ~0.07/ kWh for generated electricity (NDRC 2013). Rapid capacity growth and fixed 20-year subsidy commitments widened the funding gap as solar generation costs fell while the per-unit subsidy remained unchanged. This created a recurring fiscal burden, and by 2017, annual solar subsidy payments had exceeded USD 15 billion, prompting a policy correction in May 2018 that reduced tariffs and, for the first time, capped new distributed solar capacity at 10 GW annually (Chinese Climate Policy n.d.). By 2025, China had shifted towards market-based mechanisms, replacing abrupt local restrictions with a grid-connection queue, and phasing out guaranteed feed-in tariffs from June 2025 (Shaw 2024).

Inherent policy design has driven C&I consumers to lead China's distributed solar market

Similar to Indian India's tariff philosophy,. China also levied cross-subsidy charges on C&I consumers to compensate residential and agricultural consumers. China's residential tariff is among the lowest of any major economy (Qiu et al. 2024). Since China never adopted a net-metering mechanism, unlike most other countries, self-consumed electricity is offset at retail price, while exported surplus generation is compensated at a much lower wholesale price. Consequently, RTS has been more attractive for C&I consumers, who face higher retail tariffs and can consume a larger share of their generation on-site (Martinot et al. 2020).

In the early years, residential and agricultural solar depended heavily on capital subsidies and feed-in tariffs to become financially viable. As these incentives

were gradually reduced and phased out, adoption among limited incentives for residential and agricultural consumers to adopt distributed systems declined. Household adoption accelerated later when once falling module costs brought RTS to grid parity[25] nationwide by around 2019 (Xu et al. 2023). Despite late-stage momentum in the residential sector, C&I continues to lead, contributing 61 per cent of distributed solar capacity as of 2024 (CET 2024).

Expanding distributed renewable energy market beyond solar

For two decades, China's distributed policy was built around solar energy only. The 15th Five-Year Plan (2026–2030) marks the first shift towards treating DRE as a multi-technology category rather than a solar programme alone. It targets more than 300 GW of new distributed generation over 2026–30, roughly 60 GW a year (Patel and Liu 2026. The programme also focuses on diversification by introducing a distributed wind segment alongside solar for deployment in industrial parks, coal mines, and rural areas (NDRC 2026a).

In addition, the plan focuses on smoother grid integration of DRE by targeting grid upgradation and flexibility. It aims to expand grid capacity to support 900 GW of distributed renewables by 2030 and achieve 50 GW each of vehicle-to-grid (V2G) and virtual power plants (VPPs) by 2030. Both are designed explicitly to aggregate RTS, home batteries, and electric vehicles into dispatchable, grid-facing capacity, rather than treating them as passive generation, pairing China's DRE build-out directly with its EV fleet, the world's largest (Ostende 2026).



3.5 South Africa: Unreliable power supply and high electricity tariffs drove distributed renewable adoption

From the outset, distributed energy systems have been recognised as an important pathway to strengthening energy security and expanding energy access. Frequent load shedding and rising electricity tariffs initially pushed consumers to adopt decentralised solutions, particularly distributed solar. This adoption has been further supported by favourable policy and regulatory measures, declined module prices, along with targeted financial incentives that have improved the economic viability of distributed generation.



14%
of electricity comes from renewable sources in 2025.



~0.7 mn
households have adopted rooftop solar by 2025.



~9 GW
of installed distributed solar capacity as of September 2026.

Source: Authors' compilation from EMBER 2026a, SANews 2026, and NTCSA 2026.

Electricity supply crisis prompted shift towards DRE

For decades, South Africa depended on fossil fuels for its electricity needs, with coal contributing to more than 80 per cent of total electricity generation (IEA n.d.). Eskom, the state utility, held a near-monopoly over electricity generation (OECD 2025). With ageing coal plants and limited investment in system upgradation, the country's electricity system faced growing generation capacity constraints from 2007 onwards to meet the demand. This resulted in persistent supply shortfalls and rolling blackouts that continued for more than a decade. The contraction of the electricity supply has caused frequent load shedding and a steep rise in the price of grid-supplied electricity over the last decade and a half. Further, this has impacted commercial and industrial output and overall economic growth of the country (OECD 2025).

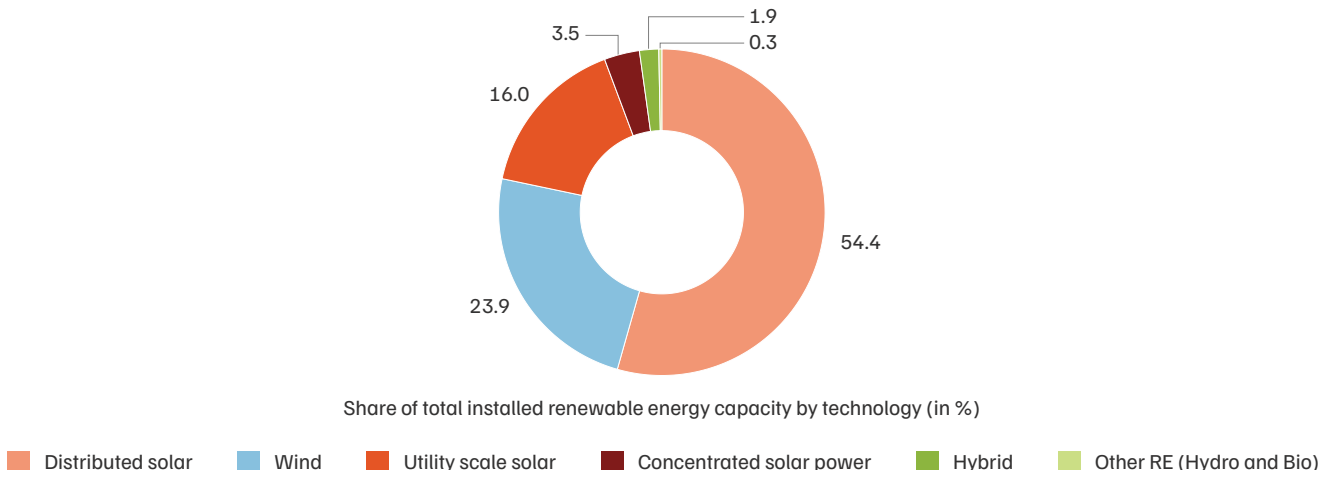
25. The point at which the cost of generating electricity from a renewable energy system, such as rooftop solar, becomes equal to or lower than the cost of purchasing electricity from the grid, making the system economically viable without subsidies.

Eskom's energy availability factor (EAF)[26] continued to decline from 77 per cent in 2017 to 56 per cent in 2023 due to a drop in the performance of aging coal units, while the inflation-adjusted average electricity tariff increased by ~28 per cent between 2018 and 2024 (NTCSA 2025; Poorun, Terblanche and Radmore 2024). Additionally, the average retail electricity tariff in South Africa stands at USD 0.157/kWh, among the highest among BRICS countries (GlobalPetrolPrices 2026). Consequently, consumers across segments increasingly sought cost-effective alternatives, accelerating the shift towards DRE solutions.

Distributed solar remains dominant DRE technology

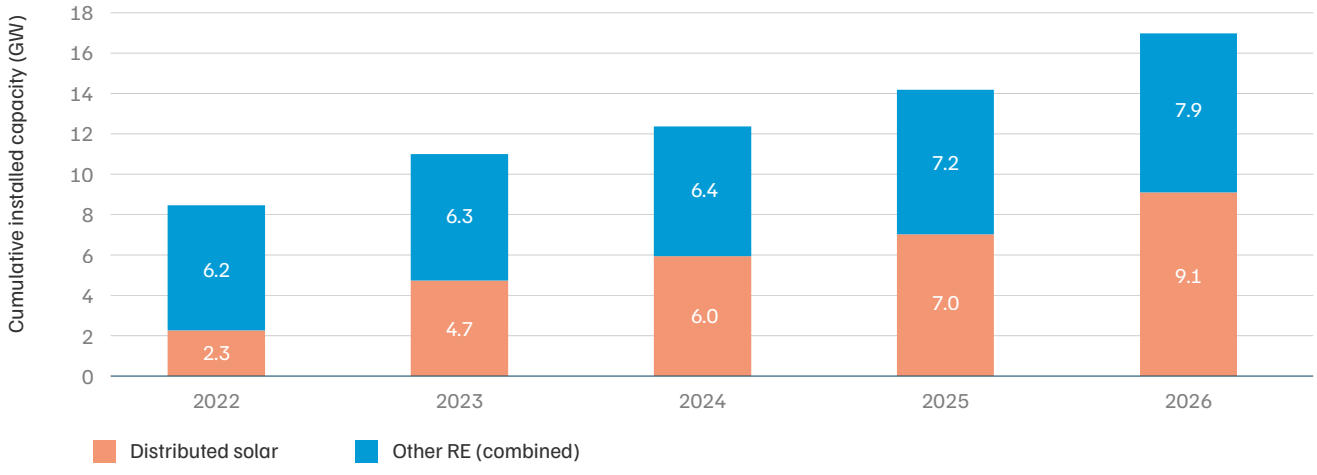
Distributed solar has emerged as the most preferred alternative to grid-supplied electricity, given that the country receives abundant solar radiation, with a technical potential of 72 GW for RTS alone (Senatla et al. 2020). Over time, supportive policies and financial incentives have further enabled DRE adoption and its integration into long-term energy and investment planning, helping advance energy security, access, and affordability.

Figure 13. Distributed solar contributes around half of total installed renewable energy capacity (as of September 2026)



Source: Authors' compilation from NTCSA. 2026. "System Status Reports." NTCSA.

Figure 14. Distributed solar capacity has grown more than fourfold over the past five years



Source: Authors' compilation from NTCSA. 2026. "System Status Reports." NTCSA.

26. The proportion of actual energy produced during a specific time frame compared to the maximum potential energy output for that same period.

As of September 2026, distributed solar[27] contributes more than half of total installed RE capacity. Beyond solar, the combined share of other DRE options, such as bio and small hydro, is less than 0.5 per cent, constrained by limited resource availability (Figure 13). Distributed solar has seen substantial growth over the past five years (Figure 14), largely driven by the C&I sector (more than 75 per cent) followed by the residential sector (AFSIA 2026). By 2025, 675,000 households had adopted RTS (SANews 2026).

Targeted interventions and financial incentives have shaped distributed renewable energy growth

South Africa's energy policy foundation was established with the 1998 White Paper on Energy Policy, which prioritised affordable energy access, supply security, and economic development (City Energy 1998). However, renewable and distributed generation remained largely outside the mainstream energy system.

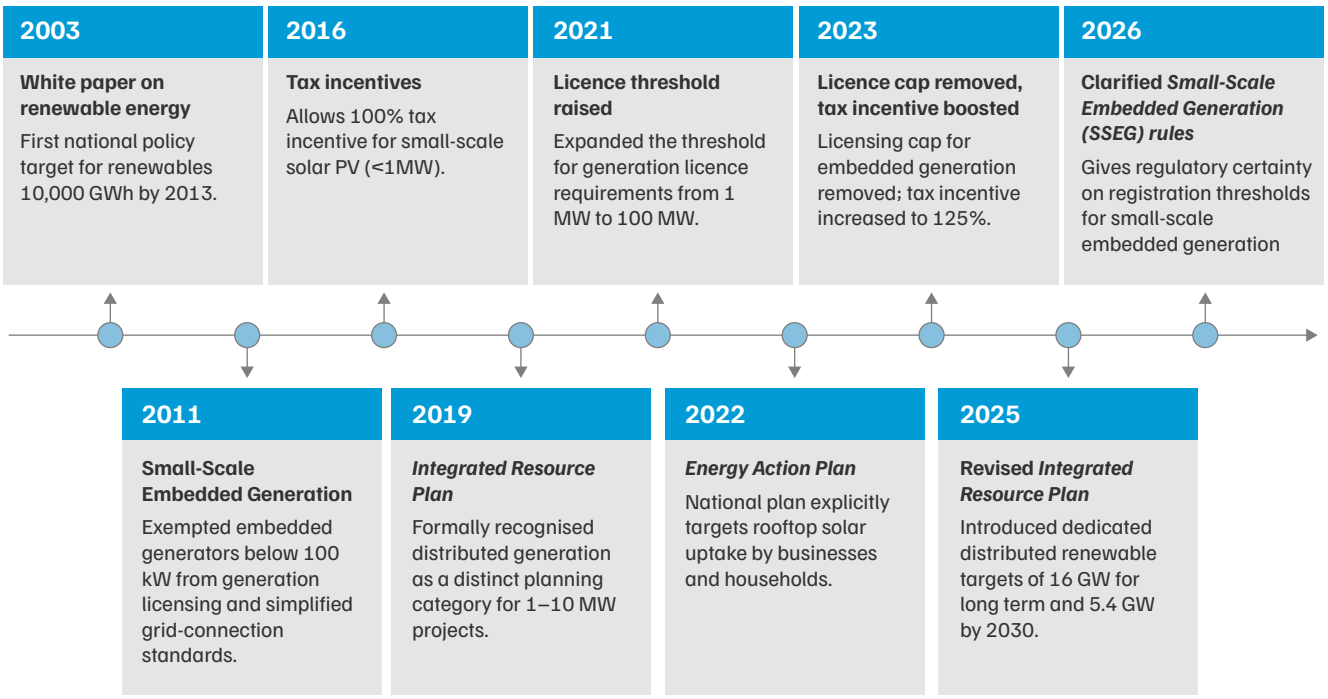
> Tax incentives, licensing reform and municipal innovation have together made distributed renewables a mainstream choice in South Africa.

The 2003 white paper on RE marked South Africa's first formal RE policy milestone, setting a target of 10,000 GWh of contribution by 2013 (Department of Minerals and Energy 2003). However, uptake remained limited due to inadequate grid infrastructure, underdeveloped markets and weak financial incentives. Later in 2011, the launch of the *Renewable Energy Independent Power Producer Procurement Programme* (REIPPPP) provided the delivery mechanism, translating the ambition into contracted renewable capacity through competitive procurement (NDC Partnership n.d.). However, the initial expansion was dominated by utility scale wind and solar projects. Distributed, behind-the-meter solar remained largely outside the policy and investment focus till 2015.

Nevertheless, government interventions at national and local levels since 2016 increasingly made distributed systems more favourable for consumers in South Africa (Figure 15). In 2016, the government introduced an upfront tax benefit[28] of up to 100 per cent for solar installations below 1 MW, improving project economics (Brundtland 2017). Local municipalities[29] also started implementing frameworks to safely connect local small-scale embedded generation (SSEG)[30] systems to distribution networks, strengthening grid safety and reliability, while improving the monitoring of distributed generation (Hermanus and Foster 2024).

27. Distributed solar includes rooftop, ground-mounted, and all other installations that do not have contracts with National Transmission Company of South Africa.
28. Before 2016, renewable energy assets were generally subject to a three-year 50/30/20 accelerated depreciation schedule, irrespective of project size or technology. From 2016, solar PV projects below 1 MW became eligible for a 100 per cent first-year deduction, allowing businesses to recover the tax benefit upfront rather than over three years.
29. Municipalities in South Africa distribute electricity to residential and commercial customers.
30. Embedded generation is distributed electricity generation through systems that connect to a local electricity grid. For regulatory purposes, these systems are divided into small-scale embedded generation (under 1 MW total capacity) and larger generation (over 1 MW). Larger systems are sometimes further split into large systems and utility scale systems (over 50 MW).

Figure 15. The policy and regulatory arc behind South Africa's distributed renewable energy growth[31]



Source: Authors' compilation from Department of Minerals and Energy 2003; NERSA 2011, Brundtland 2017; Department of Energy 2019; Richards 2023; Government of South Africa 2022; Liebenberg 2026; van Dyk et al. 2025 and SANews 2026.

The 2019 *Integrated Resource Plan* (IRP) marked a further shift towards recognising distributed generation (Department of Energy 2019). It formally defined distributed generation as small-scale electricity generation located close to the point of consumption, with projects between 1 MW and 10 MW (eligible under this framework). The plan also recognised technologies such as biomass, biogas, landfill gas, and co-generation along with solar. Before 2021, self-generation above 1 MW systems required a generation licence[32], which caused administrative delays and approval uncertainties, thus discouraging businesses and industries from developing their own generation capacity. To address this, the government expanded the licencing threshold to 100 MW in 2021 (Richards 2021) and later removed it altogether (Richards 2023).

South Africa experienced 205 days of load shedding in 2022 (8.1 million MWh shed), rising to 335 days in 2023 (16.6 million MWh shed) (FTI Consulting 2025). This escalation in load shedding, together with growing recognition of DRE, prompted consumers to shift towards distributed energy systems. To further accelerate DRE uptake, tax incentives were extended to 125 per cent in 2023 (Liebenberg 2026), along with provisions for financial support for the agricultural sector and a limited-period 25 per cent tax rebate on the cost of solar PV modules for individuals (Poorun, Terblanche and Radmore 2024).

Several municipalities and state-owned entities also introduced mechanisms to promote DRE adoption and enable greater consumer participation. In 2023, Cape Town's *Cash for Power programme* allowed residential and commercial owners of small-scale solar systems to receive cash payments or bill credits for electricity exported to the municipal grid (City of Cape Town, Media Office 2024). Municipalities such as Swartland have also explored remote generation and pilot programmes to facilitate electricity transfers across distribution networks; while Vodacom operationalised virtual power transfer in 2025, enabling multi-site commercial consumers to procure electricity generated at off-site locations through existing grid infrastructure (Swartland Municipality 2025; Miao 2025). In 2025, the revised IRP introduced a distributed renewable specific target of 16 GW by 2039, providing clear direction to consumers, stakeholders, and investors (van Dyk et al. 2025).

31. The timeline covers only the key developments with significant influence on advancing DRE adoption. Several other policy and regulatory interventions have been omitted for brevity.

32. Embedded generators with a capacity below 100 kW were exempted from licensing requirements in 2011 (NERSA 2011), a threshold that was increased to 1 MW in 2017 (Government of South Africa 2017, 21).

Four interconnected pillars shaping next phase of DRE growth

The *Just Energy Transition Investment Plan* (JET-IP), *Integrated Resource Plan* (IRP) 2025 and *South Africa Renewable Energy Master Plan* (SAREM) 2025 increasingly recognise DRE as an important component of South Africa's energy transition (The Presidency, Republic of South Africa 2022; van Dyk et al. 2025; Department of Electricity and Energy 2025). Together, these three national planning frameworks intend to strengthen the policy focus on DRE, moving it from a largely consumer-led response to an increasingly integrated element of the country's long-term energy planning.

The next phase of DRE growth is being shaped by four broad areas of planned action. First, expanding energy access to 1.6 million households and achieving universal energy access by 2030, using solar home systems and microgrids to reach underserved communities (Green Building Africa 2025). Second, strengthening grid flexibility and resilience through transmission and distribution network upgrades. To integrate 56 GW of new renewable capacity by 2034, South Africa plans to add 14,500 km of transmission lines and 133,000 MVA of transformer capacity, requiring ~USD 27 billion in investment (Molokomme and Mokwele, n.d.). Third, scaling energy storage to improve grid flexibility, reliability and DRE integration. South Africa is planning to deploy BESS alongside SSEG to manage renewable variability, reduce grid congestion, and strengthen resilience, including through large-scale storage deployment in grid-constrained provinces (Montiea 2026). And fourth, supporting sustainable DRE markets through electricity pricing and utility revenue reforms. As SSEG adoption grows and municipal finances face increasing pressure, the revised *Electricity Pricing Policy* proposes a shift towards more transparent, cost-reflective tariffs while protecting low-income consumers (Creamer 2026).


Image: iStock

4. An indicative roadmap for BRICS to accelerate distributed renewable energy transition

Developing a distributed renewables market rests on three foundations: a long-term ambition, an enabling ecosystem, and measures to scale as the sector matures. However, distributed renewables across BRICS have largely been a residual outcome of broad RE policy before a deliberate DRE policy objective was introduced. As discussed in preceding sections, BRICS countries are at different stages of DRE market maturity. To make DRE central to these countries' energy transition, we propose a voluntary, consensus-based collaboration roadmap. Targets and approaches are nationally defined, allowing each member to act according to its resource potential, national interest and market maturity.

The proposed roadmap sets out four action items (Figure 16), building on existing institutional mechanisms, areas of cooperation, and knowledge-exchange platforms rather than creating new bodies. Progress could be reviewed every two years through a voluntary peer-review process, with participating countries sharing implementation progress, experiences, and lessons. The findings could be consolidated by the designated coordinating body and discussed at the BRICS Energy Ministers' Meeting to inform future cooperation.

Setting shared long-term ambition and measuring progress (2026–28)

- **Action 1—Establish a common distributed renewables data framework**: Reliable and comparable data on distributed renewables is essential for assessing the scale, performance, and evolution of distributed renewables. Yet, data remains fragmented across BRICS members, with no single institution currently publishing it at the requisite scale and level of comparability. We propose leveraging an existing system rather than constructing a new one: BRICS can build on an existing model, Brazil's mature and openly accessible distributed-generation data system, operated by ANEEL. This offers a useful foundation for developing common indicators and reporting practices (ANEEL 2026). Additionally, India can contribute its experience with digitalisation and digital public infrastructure, while China can bring its expertise in advanced technologies and digital solutions. Other members can contribute based on their respective expertise, including their own data systems, institutional experience, and technological capabilities.

  The ERCP can bring these contributions together, host the data repository, and coordinate joint reporting, providing the institutional continuity and resources needed to sustain the initiative beyond individual BRICS presidencies. The ERCP can also draw on the ISA secretariat[33], a standing institution with established solar data portals, for technical and administrative support. The ISA's role would remain focused on solar, while the ERCP would retain the broader mandate for distributed renewables. Once regular reporting is established, BRICS can develop a shared dashboard to improve access to comparable data.

- **Action 2—Adopt a shared distributed renewables ambition**: BRICS members can collectively recognise their nationally defined and voluntary DRE targets as a shared ambition for the group. This approach would allow each country to determine its own level of ambition, reflecting differences in market maturity, resource potential, and national priorities, while creating a common direction of DRE transition. This approach is comparable to the COP28 pledge to triple global renewable capacity and the International Solar Alliance's (ISA) 1,000 GW goal, while allowing countries to determine their own level of ambition (IEA 2024).

33. Egypt, Ethiopia, Brazil, Saudi Arabia, the UAE and India are members of both BRICS and the ISA.

A shared ambition could serve as a long-term, presidency to presidency framework, rather than a one-time commitment. Once established, BRICS can track progress against each member's national target, using a common set of indicators. This would provide a consistent basis for monitoring progress and enable meaningful comparisons across countries with different market sizes and levels of maturity .It also draws on the comparability and fairness principles used for the SDGs (UN 2015), where each member sets its own target against a common framework of indicators.

The BRICS group can table the shared ambition once the first joint data report is in place, and seek endorsement through the Committee of Senior Energy Officials and the BRICS Energy Ministers' Meeting. Successive presidencies can carry the ambition forward by reviewing progress, highlighting emerging challenges, and identifying opportunities to strengthen cooperation and ambition. The ERCP can conduct a biennial progress review and institutionalise this process, ensuring that progress is measured consistently, lessons are carried across presidencies, and the shared ambition is periodically updated rather than becoming a static commitment.

Enabling the ecosystem through knowledge exchange (2026–28)

- **Action 3—Establish a structured knowledge and skilling exchange**: BRICS members sit at different stages of market maturity while facing largely common challenges, creating opportunities for targeted peer learning. Ethiopia shares energy access needs; Brazil and Russia face remote-area supply challenges; and India and China have comparable tariff approaches that shape the economics of distributed renewables. A structured exchange can help emerging markets adopt proven approaches rather than develop them independently, while a shared skilling effort can address workforce constraints across members. The exchange can draw on complementary strengths across BRICS: Brazil's experience in compensation and regulatory design, India's digitally enabled mass deployment and livelihood applications, South Africa's market arrangements, China's deployment and delivery experience, and Russia's remote hybrid systems.

  A standing exchange across four streams is central to delivering the shared ambition: policy, regulatory and implementation practices; financing and business models; workforce skilling, including installer and operations-and-maintenance (O&M) competencies and common certification standards; and science, technology, and innovation (STI). Under the financing stream, the ERCP could facilitate collaboration with the New Development Bank (NDB) and other relevant financial institutions to examine the cost of capital, improve access to finance, and identify financing models that can make DRE more affordable. The exchange must extend beyond solar to other distributed renewable technologies and livelihood applications. It can also explore the potential of distributed solar to serve local demand, avoid costly grid extensions or defer network expansion, and encourage BRICS policymakers to account for these benefits in grid and electricity mix planning alongside connection and integration costs.

  The exchange can leverage existing BRICS institutions, including the BRICS STI Working Group for joint research and development (R&D) and the BRICS Digital Centre of Excellence for Smart Grids and Energy Storage. The ERCP can lead knowledge exchanges on policy, regulatory, and financing practices, while the Partnership on New Industrial Revolution can support workforce skills and certification. Progress can be measured through the uptake of shared practices, the number of people trained and certified, and the exchanges and joint outputs delivered. Each member can nominate a focal point, with progress captured in the biennial review. This can provide an immediate starting point from 2026, and deepen as the shared data and cooperation mechanisms mature. Progress could be measured against the uptake of shared practice, the number of people trained and certified, and the exchanges and joint outputs delivered.

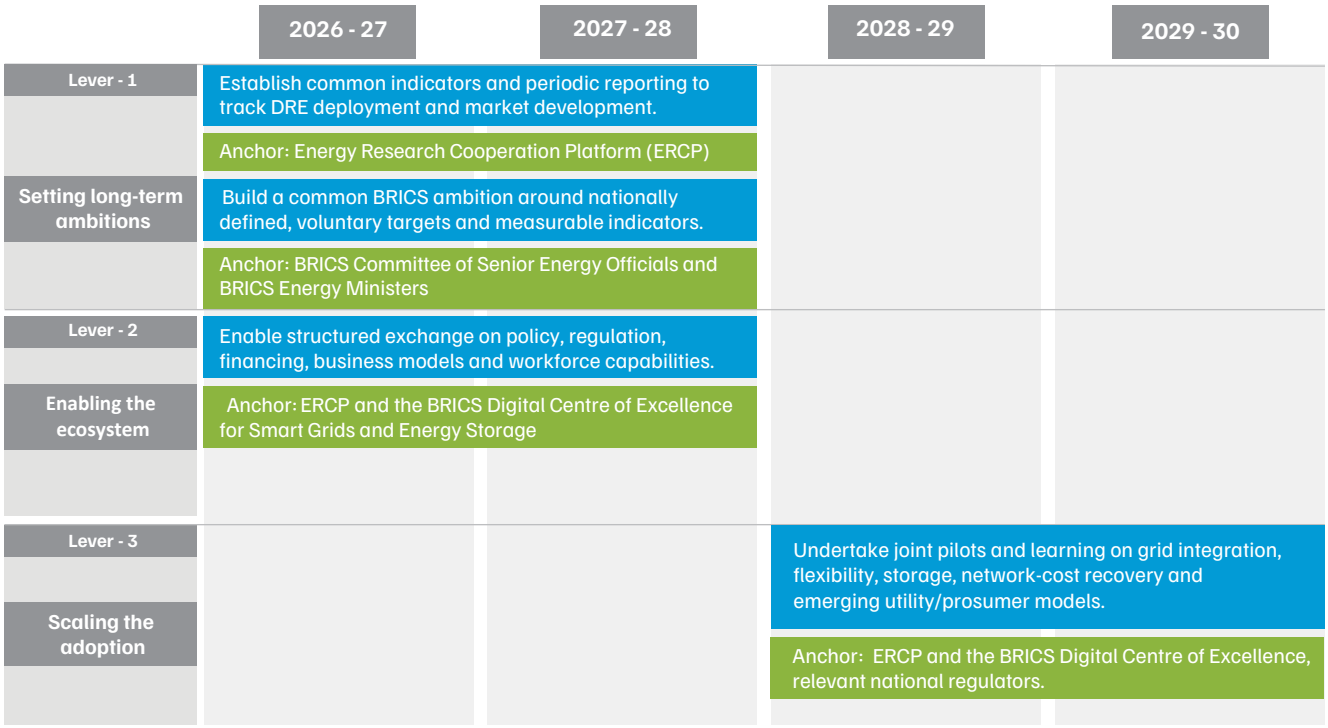
Scaling the adoption (2028–30)

- **Action 4—Establish a common learning agenda on system integration**: As distributed-renewables penetration deepens, members are likely to face similar technical and financial challenges, including grid integration (voltage management, frequency control, etc.), distribution-level grid flexibility, the recovery of network costs, and the erosion of utility revenue. Countries such as China, Brazil, and India have already started responding to some of these through investments in storage and reforms in tariff structure and compensation mechanisms. The BRICS group can establish a structured learning agenda that combines joint pilots with analysis, focusing on shared diagnosis and innovative approaches.

The objective would be to address next-generation challenges through knowledge exchange and practical demonstration rather than binding standards, since grid codes, cost-recovery mechanisms, and tariffs remain the responsibility of national and sub-national regulators. Furthermore, the agenda can extend the BRICS Digital Centre of Excellence for Smart Grids and Energy Storage to distribution-side challenges specific to distributed renewables. The action would become increasingly relevant as DRE penetration rises and could become active during 2028–30. The BRICS group can track progress through the rollout of joint pilots, adoption of shared approaches by member regulators, and deployment of distribution-level storage and flexibility measures.

The four proposed actions need not be rolled out sequentially (Figure 16). Actions 1 and 3, focused on measurement, knowledge exchange, and skilling, are foundational and can begin immediately in 2026. Action 2, which defines the shared ambition, should follow once the first joint data report is available, since a target that cannot be measured cannot be meaningfully reviewed. Action 4, meanwhile, should be triggered as DRE penetration rises and members begin to face deeper system-integration challenges.

Figure 16. A four-step indicative roadmap to accelerate distributed renewables uptake among BRICS countries (2026–30)



Source: Authors' analysis.

Acronyms

BESS	battery energy storage system
bn	billion
BRICS	Brazil, Russia, India, China, and South Africa
BTM	behind the meter
C&I	commercial and industrial
CAGR	compound annual growth rate
CFA	Central Financial Assistance
DA-JGUA	*Dharti Aaba Janjatiya Gram Utkarsh Abhiyan*
Discom	distribution company
DRE	distributed renewable energy
EAF	energy availability factor
ERCP	Energy Research Cooperation Platform
FiT	feed-in tariff
FY	financial year
GDP	gross domestic product
GW	gigawatt
IEA	International Energy Agency
ISA	International Solar Alliance
IPS	isolated power systems
IRP	*Integrated Resource Plan*
JET-IP	*Just Energy Transition Investment Plan*
mn	million
MNRE	Ministry of New and Renewable Energy
MVA	megavolt-ampere
MW	megawatt
O&M	operation and maintenance
PV	photovoltaic
PVTG	Particularly Vulnerable Tribal Groups
R&D	research and development
RE	renewable energy
REIPPPP	*Renewable Energy Independent Power Producer Procurement Programme*
REST	*Rural Electricity Supply Technology Mission*
RTS	rooftop solar
SAREM	*South Africa Renewable Energy Master Plan*
SDG	sustainable development goals
SEPAP	Solar Energy for Poverty Alleviation Programme
SHP	small hydro plant
SSEG	small-scale embedded generation
UAE	United Arab Emirates
UPS	unified power system
USD	United States dollar
V2G	vehicle-to-grid
VPP	virtual power plant
WTO	World Trade Organization

References

Africa Solar Industry Association (AFSIA). 2026. Africa Solar Outlook 2026. Kigali: Africa Solar Industry Association. Accessed September, 2026. https://sapvia.co.za/wp-content/uploads/2026/01/Africa-Solar-Outlook-2026-final-260114-2.pdf.

ANEEL. 1998. "RESOLUÇÃO Nº 394, DE 04 DE DEZEMBRO DE 1998 ." www2.aneel.gov.br. Accessed September, 2026. https://www2.aneel.gov.br/cedoc/res1998394.pdf.

—. 2012. "RESOLUÇÃO NORMATIVA Nº 482, DE 17 DE ABRIL DE 2012." www.leis.org. Accessed September, 2026. https://leis.org/institucionais/br/aneel/lei/resolucao-normativa/2012/482/resolucao-normativa-n-482-2012-estabelece-as-condicoes-gerais-para-o-acesso-de-microgeracao-e-minigeracao-distribuida-aos-sistemas-de-distribuicao-de-energia-eletrica-o-sistema-de-c.

—. 2015. "RESOLUÇÃO NORMATIVA Nº 687, DE 24 DE NOVEMBRO DE 2015." www.refeel-brasil.com.br. Accessed September, 2026. https://refeel-brasil.com.br/wp-content/uploads/2024/07/RN-687-Aneel.pdf.

—. 2022. "LEI Nº 14.300, DE 6 DE JANEIRO DE 2022." www.planalto.gov.br. Accessed September, 2026. https://www.planalto.gov.br/ccivil_03/_ato2019-2022/2022/lei/l14300.htm#:~:text=LEI%20N%C2%BA%2014.300%2C%20DE%206%20DE%20JANEIRO%20DE%202022&text=Institui%20o%20marco%20legal%20da,1996%3B%20e%20d%C3%A1%20outras%20provid%C3%AAncias.

—. 2026. Distributed generation. Accessed September, 2026. https://app.powerbi.com/view?r=eyJrIjoiY2VmMmUwN2QtYWFiOS00ZDE3LWI3NDMtZDk0NGI4MGU2NTkxIiwidCI6IjQwZDZmOWI4LWVjYTctNDZhMi05MmQ0LWVhNGU5YzAxNzBlMSIsImMiOjR9.

Antoniolli, Andrigo Filippo, Helena Flávia Naspolini, João Frederico de Abreu, and Ricardo Rüther. 2022. "The role and benefits of residential rooftop photovoltaic prosumers in Brazil." Renewable Energy (ELSEVIER). Accessed September, 2026. https://doi.org/10.1016/j.renene.2022.01.072.

Asia Pacific Energy Portal. 2012. "12th Five-Year Plan for the Solar Photovoltaic Industry." Asia Pacific Energy Portal. Accessed September, 2026. https://policy.asiapacificenergy.org/sites/default/files/chinas-five-year-plan-for-solar-translation.pdf.

Bellini, Emiliano. 2021. Russia introduces net metering for small-sized PV. Accessed September, 2026. https://www.pv-magazine.com/2021/03/10/russia-introduces-net-metering-for-small-sized-pv/.

Bilolikar, Rajkiran, and Ravi Deshmukh. n.d. "Rural Electrification in India – an overview." www.rise.esmap.org. Accessed September, 2026. https://rise.esmap.org/sites/default/files/library/india/India%20Rural%20Electrification%20Policy.pdf.

Jornal de Brasília. 2026. Brazil has higher electricity bills than 77 other countries, and reforms could reduce costs by up to 32%. Accessed September, 2026. https://jornaldebrasilia.com.br/noticias/economia/brasil-tem-conta-de-luz-mais-cara-que-77-paises-e-reforma-poderia-diminuir-custos-em-ate-32/.

BRICS. 2009. "Joint Statement of the BRIC Countries' Leaders." Accessed September, 2026. https://d2jiw2zrmmyqt8.cloudfront.net/wp-content/uploads/2025/12/26170835/1st-BRIC-Joint-Statement-2009-1.pdf.

—. 2025a. "BRICS Committee of Senior Energy Officials." Accessed September, 2026. https://d2jiw2zrmmyqt8.cloudfront.net/wp-content/uploads/2025/12/30061924/2025-issues-note.-brics-committee-of-senior-energy-officials.pdf.

—. 2025b. "Roadmap for BRICS Energy Cooperation 2025-2030." Accessed September, 2026. https://www.gov.br/mme/pt-br/atos-internacionais/organismos-internacionais/brics/RoadmapforBRICSEnergyCooperation20252030Final22.pdf.

—. 2025c. "Report on Access to Energy Services." Accessed September, 2026. https://www.gov.br/mme/pt-br/atos-internacionais/organismos-internacionais/brics/brics_livro2.pdf

—. 2026. About BRICS. Accessed September, 2026. https://www.brics2026.gov.in/about-us/.

BRICS Energy Research Cooperation Platform (BRICS ERCP). 2020. *BRICS Energy Report 2020*. Accessed September 2026. https://www.ief.org/_resources/files/events/brics-russia-2020-energy-research-cooperation-platform-/brics-energy-report.pdf.

Brundtland. 2017. Section 12B Tax Act – A 100% Allowance for Small Scale Solar. Accessed September, 2026. https://www.brundtland.co.za/renewable-energy/section-12b-tax-act-a-100-allowance-for-small-scale-solar/.

Butuzov, V. A., and G. V. Tomarov. 2020. "Geothermal Energy of Kamchatka." Thermal Engineering 67 (11): 820–32. Accessed September, 2026. https://doi.org/10.1134/S004060152011004X.

CET. 2024. Summary of China's energy and power sector statistics in 2024. Accessed September, 2026. https://www.cet.energy/2025/03/13/summary-of-chinas-energy-and-power-sector-statistics-in-2024/.

Chinese Climate Policy. n.d. Solar Power. Accessed September, 2026. https://chineseclimatepolicy.oxfordenergy.org/book-content/domestic-policies/renewable-power/solar-power/.

City Energy. 1998. White Paper on Energy Policy 1998. Accessed September, 2026. https://www.cityenergy.org.za/white-paper-on-energy-policy-1998/.

City of Cape Town, Media Office. 2024. "Cash for Power: Over 400 Cape Town Households Apply." City of Cape Town. May 3. Accessed September, 2026. https://www.capetown.gov.za/Media-and-news/Cash%20for%20Power%20Over%20400%20Cape%20Town%20households%20apply.

Climate Change Laws. 2022. Order F. No. 09/13/2021-RCM re Renewable Purchase Obligation (RPO) and Energy Storage Obligation Trajectory till 2029-2030. Accessed September, 2026. https://climate-laws.org/documents/order-f-no-09-13-2021-rcm-re-renewable-purchase-obligation-rpo-and-energy-storage-obligation-trajectory-till-2029-2030_553a.

Creamer, Terence. 2026. Cabinet approves release of revised electricity pricing policy and market transformation paper for comment. Accessed September, 2026. https://www.polity.org.za/article/cabinet-approves-release-of-revised-electricity-pricing-policy-and-market-transformation-paper-for-comment-2026-07-30.

Department of Electricity and Energy. 2025. South African Renewable Energy Masterplan. Pretoria: South African Government. Accessed September, 2026. https://www.gov.za/documents/other/south-african-renewable-energy-master-plan-02-apr-2025.

Department of Energy. 2019. Integrated Resource Plan (IRP2019). Government Notice 1360. Government Gazette 42784, October 18, 2019. Accessed September, 2026. https://www.gov.za/sites/default/files/gcis_document/201912/42784gon1360.pdf.

Department of Minerals and Energy. 2003. "White Paper on Renewable Energy." Accessed September, 2026. https://unfccc.int/files/meetings/seminar/application/pdf/sem_sup1_south_africa.pdf.

EES EAEC. 2026. Elektroenergeticheskiy kompleks Rossii [The electric power complex of Russia]. Compiled series drawing on Rosstat and System Operator data. Accessed September, 2026. https://www.eeseaec.org/elektroenergeticeskij-kompleks-rossii.

EIA. 2022. China increased electricity generation annually from 2000 to 2020. Accessed September, 2026. https://www.eia.gov/todayinenergy/detail.php?id=53959.

EL5-Energo. 2025. The Energy Strategy of the Russian Federation until 2050, one of the key documents for the fuel and energy complex, is approved. Accessed September, 2026. https://www.el5-energo.ru/en/media/news/2025/21042025/.

EMBER. 2026a. Global Electricity Review 2026. Accessed September, 2026. https://ember-energy.org/latest-insights/global-electricity-review-2026/.

—. 2026b. China: China is rebuilding its industrial economy on a clean foundation as rapid renewable energy expansions begin to offload fossil fuels. Accessed September, 2026. https://ember-energy.org/countries-and-regions/china/.

ESMAP. 2026. "Tracking SDG7 the Energy Progress Report." Accessed September, 2026. https://trackingsdg7.esmap.org/sites/default/files/download-documents/SDG7-Report2026-0623-V4-4Web.pdf.

EuroSolar Russia. n.d. Zakonodatelstvo [Legislation]. Accessed September, 2026. https://eurosolarrussia.org/en/o-partnerstve/zakonodatelstvo/.

FTI Consulting. 2025. "Out of the Darkness: The Lasting Economic Costs of Load-Shedding." Published October 28, 2025. https://www.fticonsulting.com/insights/articles/out-darkness-lasting-economic-costs-load-shedding.

Global Law. 2014. "Notice from the National Energy Administration and the State Council Leading Group Office of Poverty Alleviation and Development on Issuing the Implementation Plan for the Photovoltaic Poverty Alleviation Project." www.policy.mofcom.gov.cn. Accessed September, 2026. https://policy.mofcom.gov.cn/claw/clawContent.shtml?id=6289.

GlobalPetrolPrices. 2026. “Electricity Prices.” GlobalPetrolPrices.Com. Accessed September, 2026. https://www.globalpetrolprices.com/electricity_prices/.

Government of South Africa. 2017. *Government Gazette*, vol. 629, no. 41237 (November 10). Accessed September, 2026. https://archive.opengazettes.org.za/archive/ZA/2017/government-gazette-ZA-vol-629-no-41237-dated-2017-11-10.pdf.

Government of South Africa. 2022. President Cyril Ramaphosa: Address to the nation on energy crisis. Accessed September, 2026. https://www.gov.za/news/speeches/president-cyril-ramaphosa-address-nation-energy-crisis-25-jul-2022.

Government of the Russian Federation. 2007. Federal Law No. 250-FZ of 4 November 2007 on Amending Some Legislative Acts of the Russian Federation in Connection with Implementation of Measures Aimed at Reforming the Unified Energy System of Russia. Accessed September, 2026. https://www.wto.org/english/thewto_e/acc_e/rus_e/wtaccrus58_leg_49.pdf.

—. 2013. Decree No. 449 of 28 May 2013 on the Mechanism for Stimulating the Use of Renewable Energy Sources on the Wholesale Electricity and Capacity Market. Accessed September, 2026. https://documents1.worldbank.org/curated/en/898211480317256904/pdf/110538-Energy-Suppor-Scheme-Eng.pdf.

—. 2015. Decree No. 47 of 23 January 2015 on Amendments to Certain Acts of the Government of the Russian Federation Concerning the Stimulation of the Use of Renewable Energy Sources on Retail Electricity Markets. Accessed September, 2026. https://base.garant.ru/70853050/.

—. 2016. Decree No. 961 of 23 September 2016 on the Procedure for Granting Federal Budget Subsidies in Support of the Grid Connection of Generating Facilities Operating on the Basis of Renewable Energy Sources. Accessed September, 2026. http://government.ru/docs/24684/.

—. 2019. Federal Law No. 471-FZ of 27 December 2019 on Amendments to the Federal Law “On the Electric Power Industry” Concerning the Development of Microgeneration. Official Internet Portal of Legal Information. Accessed September, 2026. http://publication.pravo.gov.ru/Document/View/0001201912280019.

—. 2021. Decree No. 299 of 2 March 2021 on Amendments to Certain Acts of the Government of the Russian Federation Concerning the Specific Features of Legal Regulation of the Operation of Microgeneration Facilities. Official Internet Portal of Legal Information. Accessed September, 2026. http://publication.pravo.gov.ru/Document/View/0001202103060015.

—. 2025. Energy Strategy of the Russian Federation to 2050. Approved by Government Order No. 908-r of 12 April 2025. Accessed September, 2026. http://static.government.ru/media/files/LWYfSENa10uBrrBoyLQqAAOj5eJYlA60.pdf.

—. 2026a. Federal Law No. 208-FZ of 26 June 2026 on Amendments to the Federal Law “On the Electric Power Industry” and Certain Legislative Acts of the Russian Federation. Accessed September, 2026. http://www.kremlin.ru/acts/bank/53366.

—. 2026b. Order No. 2675-r of 26 September 2026 on the Maximum Volume of Electricity Supplied to the Grid by Microgeneration Facilities. Accessed September, 2026. https://ppt.ru/obzory/vstupaet-v-silu/rasporyazhenie-pravitelstva-rf-26-09-2026-2675-r.

—. 2026c. Resolution No. 1242 of 26 September 2026 on Amendments to Certain Acts of the Government of the Russian Federation. Accessed September, 2026. https://www.kontur-extern.ru/info/normativ/document/1/508488-postanovlenie-pravitelstva-rf-ot-26-09-2026-n-1242.

Green Building Africa. 2025. “South Africa to Repurpose Integrated National Electrification Programme to Reach 1.6 Million Households.” Green Building Africa. October 29. Accessed September, 2026. https://www.greenbuildingafrica.co.za/south-africa-to-repurpose-integrated-national-electrification-programme-to-reach-1-6-million-households/.

Hermanus, Lauren, and Kevin Foster. 2024. “The Impact of Changing Embedded Energy on Metropolitan Energy Systems and Planning.” Report. Just Urban Transitions. Accessed September, 2026. https://justurbantransitions.com/wp-content/uploads/2024/01/Embedded-Generation-Report.pdf.

IEA. 2021a. “Climate Impacts on Latin American Hydropower.” Accessed September, 2026. https://www.iea.org/reports/climate-impacts-on-latin-american-hydropower.

—. 2021b. Brightness Programme. Accessed September, 2026. https://www.iea.org/policies/3079-brightness-programme.

—. 2024. COP28. “Tripling Renewable Capacity Pledge”. Accessed September, 2026.https://www.iea.org/reports/cop28-tripling-renewable-capacity-pledge.

—. n.d. “South Africa: Electricity.” IEA. Accessed September, 2026. https://www.iea.org/countries/south-africa/electricity.

IEA-PVPS. 2024. “National Survey Report of PV Power Applications in China 2024.” Accessed September, 2026. https://iea-pvps.org/wp-content/uploads/2025/10/IEA-PVPS-Task-1-NSR-China-2024.pdf.

IEA-PVPS. 2026. “Snapshot of Global PV Markets.” Accessed September, 2026. https://iea-pvps.org/wp-content/uploads/2026/05/Snapshot-2026-FS.pdf.

IRENA. 2026. “Renewable Energy Statistics 2026.” Accessed September, 2026. https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2026/Jul/IRENA_DAT_RE_Statistics_2026.pdf.

Jiang, Wen. 2023. “Cost–Benefit Analysis of China’s Whole County PV Program: A Case Study of Julu County, Hebei Province.” Journal of World Economy. Accessed September, 2026. https://www.pioneerpublisher.com/jwe/article/view/536.

Jin, Zhe, and Dimiter S. Ialnazov. 2022. “Sustainability assessment of individual-level solar energy poverty alleviation program-A case on Jinzhai County, China.” Accessed September, 2026. https://doi.org/10.3389/frsus.2022.1072141.

Khokhlov, Alexey, Yuri Melnikov, Fedor Veselov, Dmitry Kholkin, and Ksenia Datsko. 2018. Distributed Energy Resources in Russia: Development Potential. Moscow: SKOLKOVO Energy Centre, Moscow School of Management SKOLKOVO. Accessed September, 2026. https://energy.skolkovo.ru/downloads/documents/SEneC/Research/SKOLKOVO_EneC_DER_2018.10.09_Eng.pdf.

Lenin. V I 1921. “Integrated Economic Plan.” www.marxists.org. Accessed September, 2026. https://www.marxists.org/archive/lenin/works/1921/feb/21.htm.

Liebenberg, Chris. 2026. “Section 12B Tax Incentive for Solar: The 2026 CFO Guide.” Elite Energy Solutions. May 19. Accessed September, 2026. https://www.eliteenergy.co.za/blog/articles/section-12b-tax-incentive-cfo-guide.html.

Martinot, Eric, Miao Hong, Hu Runqing, Zhang Mofan, and Yuan Min. 2020. “China’s Distributed Energy Development: A Review and Outlook 2020-2025.” Accessed September, 2026. https://wri.org.cn/sites/default/files/2021-11/distributed-energy-in-china-review-and-perspective.pdf.

McWilliams, Ben, Simone Tagliapietra, and Cecilia Trasi. 2024. “Smarter European Union industrial policy for solar panels.” Accessed September, 2026. https://www.bruegel.org/system/files/2024-02/PB%2002%202024_3.pdf.

Miao, Chris. 2025. “Vodacom’s Pioneering Virtual Wheeling Solution Goes Live in South Africa.” Energy News Network. November 24. Accessed September, 2026. https://energy-news-network.com/industry-news/vodacoms-pioneering-virtual-wheeling-solution-goes-live-in-south-africa/.

Ministry of Finance. 2009. Ministry of Finance, Ministry of Science and Technology, National Energy Administration Energy Administration, Notice on the Implementation of the Golden Sun Demonstration Project. Accessed September, 2026. https://www.mof.gov.cn/gkml/caizhengwengao/2009niancaizhengbuwengao/caizhengwengao200907/200911/t20091118_233416.htm.

Ministry of Law and Justice. 2003. “The Electricity Act, 2003.” Accessed September, 2026. https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2024/02/20240219885780629.pdf.

Ministry of Mines and Energy. 2012. “Brazilian Energy Balance.” Accessed September, 2026. https://www.epe.gov.br/sites-en/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-131/topico-103/Relat%C3%B3rio%20Final%202012.pdf.

—. 2025. “Distributed Generation & Behind-the-Meter Battery Energy Storage.” www.epe.gov.br. Accessed September, 2026. https://www.epe.gov.br/sites-en/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-275/%5bEnglish%5d%20DG%20and%20BESS%20Report%20PDE%202035.pdf.

Ministry of Power. 2002. “Annual report 2001-02.” Accessed September 2026. https://www.powermin.gov.in/static/uploads/2025/06/cac500e86117d53e86e19aad8f250958.pdf.

Ministry of Tribal Affairs. n.d. Accessed September, 2026. https://tribal.nic.in/dajagua.aspx.

Mitrova, Tatiana. 2022. “Energy and the Economy in Russia.” In The Palgrave Handbook of International Energy Economics. Accessed September, 2026. https://doi.org/10.1007/978-3-030-86884-0_32.

MNRE. 2009. www.mahaurja.com. Accessed September, 2026. https://www.mahaurja.com/meda/data/off_grid_small_hydro/PG_OffGridWatermillMHP.PDF.

—. 2010. “Jawaharlal Nehru National Solar Mission.” Accessed September, 2026. https://digital.library.unt.edu/ark:/67531/metadc29365/m2/1/high_res_d/India_solar_mission.pdf.

—. 2015. “Operational Guidelines for Grid Connected Rooftop and Small Solar Power Plants Programme.” www.cbip.org. Accessed September, 2026. https://www.cbip.org/a_ireda_norms/IREDA%20NORMS/16%20Grid%20Connected%20Rooftop%20and%20Small%20Solar%20Power%20Plants.pdf.

—. 2019a. “Guidelines on implementation of Phase – II of Grid Connected Rooftop Solar Programme for achieving 40 GW capacity from Rooftop Solar by the year 2022.” Accessed September, 2026. https://pmsg-production-public.s3.ap-south-1.amazonaws.com/notifications/145_notification.pdf.

—. 2019b. “PM KUSUM.” www.static.pib.gov.in. Accessed September, 2026. https://static.pib.gov.in/WriteReadData/specificdocs/documents/2021/oct/doc202110110.pdf.

—. 2022a. Bio Energy Overview. Accessed September, 2026. https://mnre.gov.in/en/bio-energy-overview/.

—. 2022b. “Promoting Decentralised Renewable Energy Livelihood Applications.” Accessed September, 2026. https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2022/12/2022122711.pdf.

—. 2023. PM JANMAN: New Solar Power Scheme (for PVTG Habitations/Villages) under PM JANMAN. Accessed September, 2026. https://mnre.gov.in/en/pm-janman/.

—. 2024. “Guidelines for PM-Surya Ghar: Muft Bijli Yojana.” Accessed September, 2026. https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2024/07/202407021768035484.pdf.

—. 2026. “MNRE Annual Report 2025-26.” MNRE. Accessed September, 2026. https://cdnbbsr.s3waas.gov.in/s3716e1b8c6cd17b771da77391355749f3/uploads/2026/07/20260723515585394.pdf.

—. n.d.a. Grid Connected Rooftop Solar Programme. Accessed September, 2026. https://mnre.gov.in/en/grid-connected-solar-rooftop-programme/.

—. n.d.b. PM Surya Ghar: Muft Bijli Yojana. Accessed September, 2026. https://pmsuryaghar.gov.in/#/state-ut-wise-progress.

Molokomme, Mahlatsi, and Mpho Mokwele. n.d. “Transmission Infrastructure: Investment Models.” Development Bank of Southern Africa. Accessed September, 2026. https://www.dbsa.org/transmission-infrastructure-investment-models.

Montiea, Bruce. 2026. “BESS and Small-Scale Embedded Generation Are SA’s Guarantee against Blackout.” ESI-Africa.Com. June 8. Accessed September, 2026. https://www.esi-africa.com/news/bess-and-sseg-sas-guarantee-against-blackout/.

National Transmission Company South Africa (NTCSA). 2025. “Medium-Term System Adequacy Outlook 2026-2030.” Report. Generation System Adequacy for the Republic of South Africa. Accessed September, 2026. https://www.ntcsa.co.za/wp-content/uploads/2025/10/Medium-Term-System-Adequacy-Outlook-2026-2030.pdf.

—. 2026. “System Status Reports.” NTCSA. Accessed September, 2026. https://www.ntcsa.co.za/system-status-reports/.

NDC Partnership. n.d. “South Africa’s Renewable Energy Independent Power Producer Procurement Programme.” NDC Partnership. Accessed September, 2026. https://ndcpartnership.org/knowledge-portal/good-practice-database/south-africas-renewable-energy-independent-power-producer-procurement-programme.

NDRC. 2011. “Notice on Improving the Feed-in Tariff Policy for Solar Photovoltaic Power Generation.” www.ndrc.gov.cn. Accessed September, 2026. https://www.ndrc.gov.cn/xxgk/zcfb/tz/201108/t20110801_964803.html.

—. 2013. “Notice from the National Development and Reform Commission on Leveraging Price Mechanisms to Promote the Healthy Development of the Photovoltaic Industry.” www.ndrc.gov.cn. Accessed September, 2026. https://zfxxgk.ndrc.gov.cn/web/iteminfo.jsp?id=19566.

—. 2023. National Development and Reform Commission, National Energy Administration. Accessed September, 2026. https://www.gov.cn/gongbao/2023/issue_10846/202311/content_6917342.html.

—. 2026a. National Development and Reform Commission and National Energy Administration on Issuing Notice on the “15th Five-Year Plan for Renewable Energy Development”. Accessed September, 2026. https://www.ndrc.gov.cn/xxgk/zcfb/tz/202607/t20260723_1406641.html.

—. 2026b. Notice on Deepening the Market-Oriented Reform of On-Grid Electricity Prices for New Energy to Promote High-Quality Development of New Energy (NDRC Price Document [2025] No. 136). Accessed September, 2026. https://www.ndrc.gov.cn/xxgk/zcfb/tz/202502/t20250209_1396066.html.

NEA. 2021. Notice from the General Office of the National Energy Administration on Announcing the List of Pilot Projects for Rooftop Distributed Photovoltaic Development in Entire Counties. Accessed September, 2026. https://www.gov.cn/zhengce/zhengceku/2021-09/15/content_5637323.htm.

—. 2026. Renewable energy grid connection status in 2025. Accessed September, 2026. https://www.nea.gov.cn/20260212/742b8c6a078347b0b39de676c05c5d58/c.html.

NERSA. 2011. Standard Conditions for Small-Scale Embedded Generation within Municipal Boundaries. Pretoria: NERSA. https://www.cityenergy.org.za/nersa-standard-conditions-for-embedded-generation-within-municipal-boundaries/.

NITI Aayog. n.d. India Climate & Energy Dashboard. Accessed September, 2026. https://iced.niti.gov.in/.

Northern Forum. 2017. Report on the development and introduction of renewable energy sources in the Republic of Sakha (Yakutia). Accessed September, 2026. https://www.northernforum.org/en/news/298-the-government-of-sakha-republic-yakutia-considering-high-rates-of-development-and-introduction-of-renewable-energy-sources-in-yakutia-believes-that-further-work-in-this-area-is-useful-indeed.

Norton Rose Fulbright. n.d. "Country Snapshot: Russia." Accessed September, 2026. https://www.nortonrosefulbright.com/en/knowledge/publications/ed442ce2/country-snapshot-russia.

OECD. 2025. "Reforming South Africa's Electricity Sector." In OECD Economic Surveys: South Africa 2025. Paris: OECD Publishing. Accessed September, 2026. https://www.oecd.org/en/publications/oecd-economic-surveys-south-africa-2025_7e6a132a-en/full-report/reforming-south-africa-s-electricity-sector_05fdccb6.html.

Ostende, Richard Van. 2026. China's 15th Five Year Plan for a New Energy System. Accessed September, 2026. https://china-insights.org/2026/07/chinas-15th-five-year-plan-for-a-new-energy-system/.

Patel, Anika, and Lekai Liu. 2026. Q&A: What does China's 15th 'five-year plan' for renewables mean for climate change? Accessed September, 2026. https://www.carbonbrief.org/qa-what-does-chinas-15th-five-year-plan-for-renewables-mean-for-climate-change.

PMINDIA. 2015. Revision of cumulative targets under National Solar Mission from 20,000 MW by 2021-22 to 1,00,000 MW. Accessed September, 2026. https://www.pmindia.gov.in/en/news_updates/revision-of-cumulative-targets-under-national-solar-mission-from-20000-mw-by-2021-22-to-100000-mw/.

Poorun, Argon, Ulrich Terblanche, and Jack Radmore. 2024. "Energy Services Market Intelligence Report 2024." GreenCape. Accessed September, 2026. https://greencape.co.za/wp-content/uploads/2024/08/Energy-Services-MIR-2024-digital.pdf.

The Presidency, Republic of South Africa. 2022. South Africa's Just Energy Transition Investment Plan (JET IP) for the Initial Period 2023–2027. Pretoria: The Presidency. Accessed September, 2026. https://assets.bbhub.io/company/sites/63/2022/11/south-africa_s-just-energy-transition-investment-plan-2023-2027.pdf.

Press Information Bureau (PIB). 2021. Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan (PM-KUSUM). Accessed September, 2026. https://www.pib.gov.in/FactsheetDetails.aspx?Id=148576&lang=2&reg=3&.

—. 2026a. India Ranks third globally in Renewable Energy Installed Capacity: Shri Pralhad Joshi. Accessed September, 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2250039&reg=3&lang=1.

—. 2026b. Draft National Electricity Policy (NEP), 2026 Released for Public Consultation with Stakeholders. Accessed September, 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2216661&reg=3&lang=2.

—. 2026c. "PM Surya Ghar: Muft Bijli Yojana Achieves Milestone of Over 50 Lakh Rooftop Solar Installations." Press Information Bureau. Accessed September, 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2294208&reg=48&lang=2.

—. 2026d. "PM-KUSUM Benefits Reach Over 21.77 Lakh Farmers Across the Country." Press Information Bureau. Accessed September, 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2244667&reg=3&lang=1.

—. 2026e. "Union Minister of State Shripad Yesso Naik Interacts with Beneficiaries of PM-KUSUM, PM-JANMAN and DA-JGUA." Press Information Bureau. Accessed September, 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2218252.

—. 2026f. "India Hosts the 11th BRICS Energy Ministers' Meeting in Gurugram under BRICS Chairship 2026." Accessed September, 2026. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2277751&reg=3&lang=1

Qiu, Yue, Suyang Zhou, Wei Gu, and Xiao-Ping Zhang. 2024. "Analysis of China's Electricity Price and Electricity Burden of Basic Industries under the Carbon Peak Target before 2030." CSEE Journal of Power and Energy Systems. Accessed September, 2026. https://www.csee.org.cn/pic/u/cms/www/202502/08112548u6wy.pdf.

RAWI. 2018. "In the Arctic Village of Tiksi, Unique Wind Power Plant Went Operational." November 2018. Accessed September, 2026. https://rawi.ru/en/2018/11/in-the-arctic-village-of-tiksi-unique-wind-power-plant-went-operational/.

—. 2020. "Brand New Wind Turbine to Come Online in Kamchatka in 2021." September 2020. Accessed September, 2026. https://rawi.ru/en/2020/08/brand-new-wind-turbine-to-come-online-in-kamchatka-in-2021/.

REGlobal. 2023. "Outlook for solar power growth in China and Japan." Accessed September, 2026. https://reglobal.org/solar-power-growth-andoutlook-for-china-and-japan/.

RenovaPR. 2020. Accessed September, 2026. https://www.subnacionaisnoclima.org/en/solucao/37.

Richards, Matthew. 2021. "New 100MW Licensing Threshold for Embedded Generation Creates Opportunities for Self-Generation." White & Case, June 16, 2021. https://www.whitecase.com/insight-alert/new-100mw-licensing-threshold-embedded-generation-creates-opportunities-self.

Richards, Matthew. 2023. "South Africa Exempts Private Generators from Generation Licence Requirements." White & Case, January 27, 2023. Accessed September, 2026. https://www.whitecase.com/insight-alert/south-africa-exempts-private-generators-generation-licence-requirements.

SANews. 2026. "NERSA Clarifies Small-Scale Embedded Generation Regulations." SAnews, February 3, 2026. Accessed September, 2026. https://www.sanews.gov.za/south-africa/nersa-clarifies-small-scale-embedded-generation-regulations.

SECI. n.d. "Jawaharlal Nehru National Solar Mission." Solar Energy Corporation of India, Government of India. Accessed September, 2026. https://www.seci.co.in/upload/static/files/mission_document_JNNSM(1).pdf.

Senatla, Mamahloko, Ramesh Bansal, Raj Naidoo, and Unarine B. Mudau. 2020. "Estimating the Economic Potential of PV Rooftop Systems in South Africa's Residential Sector: A Tale of 8 Metropolitan Cities." IET Renewable Power Generation 14 (4): 542–551. Accessed September, 2026. https://doi.org/10.1049/iet-rpg.2019.0946.

Shaw, Vincent. 2024. China's NEA unveils new draft rules to reshape distributed solar market. Accessed September, 2026. https://www.pv-magazine.com/2024/10/22/chinas-nea-unveils-new-draft-rules-to-reshape-distributed-solar-market/.

Shestopalova, Tatyana A., Dmitry S. Burykin, and Valery V. Kovalev. 2025. "Voprosy tekhnologicheskogo prisoedineniya obektov mikrogeneratsii na osnove VIE v Rossii i " [Grid connection of renewable-based microgeneration facilities in Russia and Germany]. S.O.K., no. 10:76-79. Accessed September, 2026. https://www.c-o-k.ru/articles/voprosy-tehnologicheskogo-prisoedineniya-obektov-mikrogeneracii-na-osnove-vie-v-rossii-i-germanii.

SO UPS. 2026a. The system operator has published operational data on the operation of the Unified Energy System of Russia in 2025. Accessed September, 2026. https://www.so-ups.ru/news/press/press-release-view/news/29416/.

—. 2026b. Unified Energy System of Russia: structure and operating parameters, 2026. Accessed September, 2026. https://www.so-ups.ru/functioning/ups/ups2026/.

State Development Planning Commission. 2002. "Power Transmission to Townships." www.faolex.fao.org. Accessed September, 2026. https://faolex.fao.org/docs/pdf/chn149817.pdf.

Swartland Municipality. 2025. Draft Wheeling Framework. Malmesbury: Swartland Municipality. Accessed September, 2026. https://www.swartland.org.za/assets/municipal-services/Swartland%20Draft%20Wheeling%20Framework%202025.pdf.

Tan, Huizhong. 2021. Solar Energy in China: The Past, Present, and Future. Accessed September, 2026. https://chinafocus.ucsd.edu/2021/02/16/solar-energy-in-china-the-past-present-and-future/.

TASS. 2025. "Hybrid Energy Complexes to Start Working in Yakutia's 3 Remote Villages in 2026." TASS, December 26, 2025. Accessed September, 2026. https://tass.com/economy/2065289.

Tyagi, Bhawna, Debanjan Bagui, Arohi Patil, Kumaresh Ramesh, Aryadipta Jena, and Megha Chaudhary. 2024. "Global Perspectives on Rooftop Solar Energy: A Deep Dive on How Leading Economies Advance Rooftop Solar Energy Adoption." Accessed September, 2026. https://www.ceew.in/sites/default/files/global-rts-issue-brief-clean-copy-final.pdf.

UN. 2015. Transforming Our World: The 2030 Agenda for Sustainable Development. General Assembly resolution A/RES/70/1, Accessed September, 2026. New York: UN. https://sdgs.un.org/2030agenda.

van Dyk, Jurg, Nombasa Mazwai, Njabulo Gumede, and Thandeka Mashonganyika. 2025. “South Africa’s IRP 2025 Presents Transformative Renewables Roadmap.” Pinsent Masons, December 3, 2025. Accessed September, 2026. https://www.pinsentmasons.com/out-law/analysis/south-africa-irp-2025-renewables-roadmap.

Wang, Yonghua, Guoliang Luo, and Huang Kang. 2017. “Successes and Failures of China’s Golden-Sun Program.” 2017 6th International Conference on Energy, Environment and Sustainable Development (ICEESD 2017). Accessed September, 2026. https://doi.org/10.2991/iceesd-17.2017.109.

Xu, Kewei, Yueting Ding, Zhaohua Wang, and Jianwei Yin. 2023. “What drives residential rooftop solar growth in China? A spatial analysis using city-level data.” Accessed September, 2026. https://doi.org/10.1016/j.ecolind.2023.110778.

Zhang, Alex Hongliang, and Selahattin Murat Sirin. 2024. “Overall review of distributed photovoltaic development in China: process, dynamic, and theories.” Global Sustainability. Accessed September, 2026. https://doi.org/10.1017/sus.2024.33.

The authors



Debanjan Bagui
Programme Associate
debanjan.bagui@ceew.in
Debanjan Bagui



Vidyapati Bajpai
Programme Associate
vidyapati.bajpai@ceew.in
Vidyapati Bajpai



Megha Chaudhary
Programme Associate
megha.chaudhary@ceew.in
Megha Chaudhary



Anuj Hemant Xess
Programme Lead
anuj.xess@ceew.in
Anuj Hemant Xess



Harshit Pandey
Consultant
Harshit.pandey@ceew.in
Harshit Pandey



Neha Kumari
Senior Engagement Associate
neha.kumari@ceew.in
Neha Singh



Bhawna Tyagi
Senior Programme Lead
bhawna.tyagi@ceew.in
Bhawna Tyagi



Image: iStock

Council on Energy, Environment and Water

INTEGRATED | INTERNATIONAL | INDEPENDENT

The Council on Energy, Environment and Water (CEEW)—**a homegrown institution** with headquarters in New Delhi—is among the **world's leading climate think tanks**. The Council uses **data, integrated analysis, and strategic outreach** to support public policy, transform markets, shape technology, and nudge behaviour. It addresses pressing regional and global challenges through an integrated and internationally focused approach. The Council prides itself on the **independence** of its high-quality research and strives to **impact sustainable development at scale**.

CEEW IN NUMBERS

16 years
16 research teams
400+ team members
680+ peer-reviewed studies

240+ policies & plans informed
80,000+ livelihoods enabled

770+ convenings
800+ opinion articles
52 mn reached via films & documentaries

CEEW'S LEADERSHIP

Board: Mr Jamshyd Godrej (Chairperson); Dr Suresh Prabhu; Mr Amitabh Kant; Dr Janmejaya Sinha; Mr Montek Singh Ahluwalia; Dr Naushad Forbes; Mr S. Ramadorai, and Ms Vinita Bali

CEO: James Abraham

CEEW'S STRATEGIC PILLARS

Clean electricity penetration
Low-carbon industrialisation & circularity
Security of fuels of the future
Quality of life
Green economy & livelihoods
Sharing lessons from India

SELECT POLICY ENGAGEMENTS

NATIONAL/INTERNATIONAL

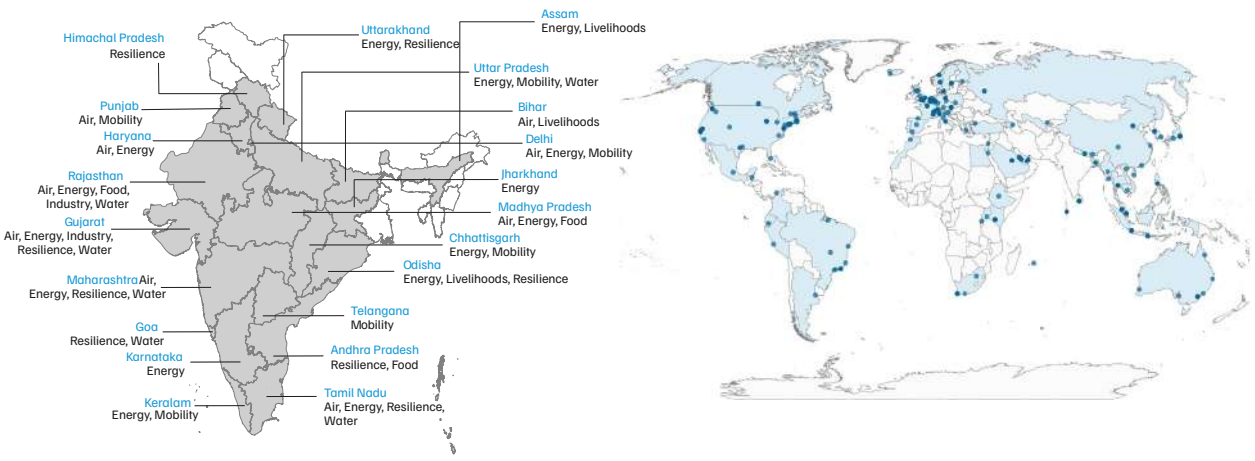
2011 | National Water Resources Framework
2014 | 175 GW renewables target
2015 | International Solar Alliance
2016 | PM *Ujjwala Yojana*
2017 | *Saubhagya Scheme*
2019 | *India Cooling Action Plan*
2021 | Net Zero by 2070
2022 | *Mission LiFE*
2022 | *National Bioenergy Programme*
2022 | E-waste (Management) Rules
2023 | G20 Green Development Pact
2023 | *National Green Hydrogen Mission*
2024 | Green Steel Taxonomy
2024 | *PM Surya Ghar Yojana*
2025 | *National Critical Mineral Mission*
2025 | Rajya Sabha Guidelines on Crop Residue Burning
2025 | India's Carbon Credit Trading Scheme (CCTS)
2025 | IFSCA's Framework for Transition Bonds
2026 | Disaster Risk Index for 16th Finance Commission
2026 | India's NDC 3.0
2026 | India's Scenarios towards Viksit Bharat and Net Zero

STATE

2022 | *Rajasthan Organic Farming Mission*
2022 | *Jharkhand State Solar Policy*
2022 | *Uttar Pradesh Vidyut Sakhi programme*
2023 | *Rajasthan Renewable Energy Policy and Green Hydrogen Policy, 2023*
2023 | *Uttarakhand Solar Policy*
2025 | Green Odisha Initiative
2025 | *Maharashtra Climate Action Plan 2.0*
2025 | *Delhi Clean Air Action Plan*
2026 | *Delhi EV Policy 2.0*
2026 | Bihar Promotion of New and Renewable Energy Sources
2026 | Gujarat Integrated Renewable Energy Policy and Green Hydrogen Policy
2026 | *Uttarakhand Mukhyamantri Saur Swarojgar Yojana*
2024-26 |
Directives of Commission on Air Quality Management
Net Zero Roadmaps (BH, GJ, TN, UK)
Agroforestry Roadmaps (AS, MH, OD)
140+ Heat Action Plans (GJ, MH, OD, TN)
Treated Used Water Reuse Plans (MH, UP)
Flood Risk Mitigation Plans (GJ, MH)

COLLABORATIONS SINCE 2010

21 Indian states | **60+** countries | **230+** global institutions/forums





Council on Energy, Environment and Water (CEEW)

ISID Campus, 4 Vasant Kunj Institutional Area
New Delhi - 110070, India
T: +91 (0) 11 4073 3300

info@ceew.in | ceew.in | @CEEWIndia | ceewindia

Scan to download the study