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Report Part Title: India's Renewable Energy Deployment: Targets, Successes, and Gaps

Report Title: Accelerate: 175

Report Subtitle: A Plan for Targeted Renewable Energy Cooperation with Key Indian States

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Published by: Center for Strategic and International Studies (CSIS) (2023)

Stable URL: <https://www.jstor.org/stable/resrep48889.5>

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# India's Renewable Energy Deployment: Targets, Successes, and Gaps

Renewable energy is going to play a critical role in combatting global climate change. According to the International Energy Agency (IEA), in 2019, approximately 43 percent of India's carbon dioxide emissions came from the generation of electricity.<sup>5</sup> Coal-fired power plants comprised 78 percent of India's electric power generation as of 2015, and the IEA estimates that India's electricity demand is expected to grow by nearly 5 percent per year through 2040.<sup>6</sup> With these numbers in mind, global carbon reduction goals require dramatic shifts in India's electricity generation mix.

As chief minister of the state of Gujarat, Mr. Narendra Modi showed an early inclination to support the expansion of renewable energy generation.<sup>7</sup> His state became an early adopter in India—and indeed, in the developing world. Therefore, there was little surprise that when he became the nation's prime minister in 2014, he quickly began to focus on expanding the nation's own goals for renewable energy deployment.

At the 2015 COP21 in Paris, India announced a range of Nationally Determined Contributions to support global efforts in combatting climate change. Perhaps most significantly, the government pledged to reach 175 GW of renewable power generation capacity by the end of 2022.<sup>8</sup>

India's Ministry of New and Renewable Energy later laid out the state-by-state targets to help India achieve its national target, broken down into four main generation types: wind, solar, small hydro-electric, and biomass.<sup>9</sup> Wind and solar, combined, make up over 90 percent of this total target. Solar power generation was further divided into sub-targets of grid-scale solar (60 GW) and rooftop solar (40 GW).

At the Climate Action Summit in 2019, India offered an updated renewable energy pledge of 450 GW by 2030.<sup>10</sup> The United States and other partners eagerly welcomed this news and are looking for meaningful ways to support this objective. For example, the U.S.-based Lawrence Berkeley National Laboratory (LBNL) conducted

a groundbreaking study of India's Least-Cost Pathway for India's Power System Investments through 2030.<sup>11</sup>

The Union government adopted a range of policy measures meant to improve the financial health of state-run electric power discoms and incentivize the expansion of renewable power generation. Some of these policies predate the 2015 COP21 meeting. Among the most significant steps in recent years are:

- Tradeable Renewable Energy Certificates (RECs).<sup>12</sup> Created in 2010, the REC program is meant to create a market for trading credits for renewable energy generation.
- Solar Energy Corporation of India (SECI).<sup>13</sup> Created in 2011, SECI is a government-owned company under the Ministry of New and Renewable Energy (MNRE) that acts as a bridge between private solar power developers and state electric power utilities.
- The Jawaharlal Nehru National Solar Mission (JNNSM).<sup>14</sup> Rolled out in multiple phases, the JNNSM incentivizes the adoption of solar power, including local manufacturing. Ultimately, the program has envisioned 100 GW of photovoltaic (PV) solar by 2022.
- Ujwal Discom Assurance Yojana (UDAY) Program.<sup>15</sup> Approved in November 2015, the UDAY program incentivizes state governments to undertake operational and financial reforms in exchange for receiving incentives and relaxations from the Ministry of Power.
- Renewable Purchase Obligation (RPO).<sup>16</sup> Starting in 2016, the Union government adopted a policy where states are to establish targets for covered entities—primarily discoms—to procure minimum levels of renewable energy.
- Revamped Distribution Sector Scheme.<sup>17</sup> In June 2021, the Union government announced a revised program to strengthen India's ailing discoms. The program expands the use of solar irrigation pumps, prepaid smart meters, and other steps through a mix of incentives.
- Must Run Status.<sup>18</sup> In October 2021, the Union government tightened rules mandating that wind and solar projects must be prioritized by state governments ahead of other forms of generation.
- Electricity (Late Payment Surcharge and Related Matters) Rules, 2022.<sup>19</sup> The Ministry of Power passed a rule allowing the banning of state discoms from procuring electricity from India's exchanges if they are delinquent in paying dues to generation companies.

Some of these policy steps have had limited long-term impact on states' discoms finances and related renewable energy deployment. Others, notably the Electricity (Late Payment Surcharge and Related Matters) Rules, 2022, have triggered a fast, sharp decline in arrears to generation companies.

The impact of these policy interventions and other market features has supported a massive deployment of renewable energy generation in India. Between 2015 and 2022, renewable energy generation capacity tripled from 40 GW to 121 GW, and the solar capacity grew twelvefold from 5.3 GW to 63 GW.<sup>20</sup> India also has installed biopower of around 10 GW, plus around 5 GW of small hydropower.

Despite these lofty numbers, India only achieved around two-thirds of its COP21 Nationally Determined Contribution target of 175 GW of renewable energy by the year 2022. While this may be disappointing on some level, India's global partners must also recognize India's past success—and the far larger target that lies ahead—and take advantage of the numerous opportunities to collaborate with India to help achieve its coming goals.

The challenge India faces in further accelerating the deployment of renewable energy target is not as geographically widespread as it may appear. Among India's 28 states and 8 union territories, most have only

nominal expected contributions to India’s renewable energy targets. Looking at which states had the largest share of the national total for the end-2022 target, more than 80 percent of the gap comes from just six states: Andhra Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu Uttar Pradesh, and West Bengal.<sup>21</sup>

State	End-2022 RE Target (MW)	End-2022 RE Installed (MW)	RE Gap
Maharashtra	22,045	11,676	10,369
Uttar Pradesh	14,221	4,727	9,494
Andhra Pradesh	18,477	9,350	9,127
Madhya Pradesh	12,018	5,875	6,143
West Bengal	5,386	602	4,784
Tamil Nadu	21,508	17,514	3,994

Note: RE stands for renewable energy.

Source: “Tentative State-Wise Break-Up of Renewable Power Target to Be Achieved by the Year 2022,” Ministry of New and Renewable Energy, Government of India, accessed February 22, 2023, <http://164.100.94.214/sites/default/files/uploads/Tentative-State-wise-break-up-of-Renewable-Power-by-2022.pdf>; and “State-Wise Installed Capacity of Renewable Power as on 31.12.2022,” Ministry of New and Renewable Energy, Government of India, accessed February 22, 2023, [https://mnre.gov.in/img/documents/uploads/file\\_s-1673341299172.pdf](https://mnre.gov.in/img/documents/uploads/file_s-1673341299172.pdf).

Importantly, a few states exceeded their COP21 renewable energy capacity targets. Included among the large states that overachieved in renewable energy adoption are Rajasthan (147 percent), Karnataka (110 percent), and Gujarat (108 percent). These states may hold important lessons for other states in India.

State	End-2022 RE Target (MW)	End-2022 RE Installed (MW)	RE Surplus
Rajasthan	14,362	21,171	6,809
Karnataka	14,817	16,336	1,519
Gujarat	17,133	18,561	1,428

Note: RE stands for renewable energy.

Source: “Tentative State-Wise Break-Up of Renewable Power Target to Be Achieved by the Year 2022,” Ministry of New and Renewable Energy, Government of India, accessed February 22, 2023, <http://164.100.94.214/sites/default/files/uploads/Tentative-State-wise-break-up-of-Renewable-Power-by-2022.pdf>; and “State-Wise Installed Capacity of Renewable Power as on 31.12.2022,” Ministry of New and Renewable Energy, Government of India, accessed February 22, 2023, [https://mnre.gov.in/img/documents/uploads/file\\_s-1673341299172.pdf](https://mnre.gov.in/img/documents/uploads/file_s-1673341299172.pdf).

## Center-State Management of Electric Power: Summits versus Voters

A core challenge to India’s climate goals, particularly as they relate to the generation of electric power, is the divide between the central government and state governments. Officials from the Union government will engage in global summits and attempt to set national targets in areas like renewable power generation—but the authority to take related actions largely lies with India’s 28 state governments. At the state level, political forces play a defining role in terms of how the electric power sector functions. Local voters are far more important than global summits.

The Seventh Schedule of the Indian Constitution outlines three models of government policy authority.<sup>22</sup> The first model is the Union List, which are issues primarily handled by the Union government. The second model is the States List, which are issues primarily handed by state governments. The third model is the Concurrent List, where authority is shared between the Union government and states. Electricity falls under the Concurrent List.

While the Union government and states are meant to jointly manage the electricity sector, states play a much larger role in defining how the sector operates. Most discoms in India are owned and administered by state governments. These discoms are responsible for signing Power Purchase Agreements (PPAs) with generation companies, building customer-related infrastructure, and managing billing and the collection of electricity tariffs. Electric power tariffs are set by state electricity regulatory commissions (ERCs), which have varying degrees of political independence from the state governments. State-level renewable energy programs and Renewable Purchase Obligations (RPOs) are also set by the relevant state electricity regulatory commissions, based on high-level guidance by the Central Electricity Regulatory Commission (CERC).

As noted in the earlier section on policy measures, the Union government has a range of tools that can impact state-level energy issues. However, some of these measures are difficult to enforce. Contrary to perceived wisdom, alignment between the central government and state governments seems to have little meaning when tracking the pace of renewable energy adoption. Most of Rajasthan’s renewable capacity addition came after the Congress Party won the state election in 2018. Two of the six states with the largest renewable energy gaps have been administered by the Bharatiya Janata Party (BJP) for multiple consecutive terms. Yet two states that over-achieved, Karnataka and Gujarat, have BJP chief ministers. And three states with large gaps—Andhra Pradesh, Tamil Nadu, and West Bengal—have never elected a BJP-led government. To summarize, there does not appear to be a correlation between a state’s political affiliation and its ability to meet the Union government’s renewable energy targets.

## The Financial State of India’s Power Grids

The most critical impediment to any surge in renewable energy investments in India is the precarious financial state of most discoms—particularly those run by state governments. In the Indian Power Finance Corporation (PFC) 2022 ranking of India’s discoms, the vast majority of state-run discoms servicing the bulk of citizens received grades of C or lower.<sup>23</sup> For the states that fell short of their COP21 renewable energy commitments, this is particularly true for the discoms servicing Andhra Pradesh (both received D grades) and the main discom servicing Maharashtra, MSEDCL, which received a D- grade. The overwhelming majority of discoms with high grades—including two smaller discoms in Maharashtra—are private discoms servicing limited metropolitan areas. The main exception is in Gujarat, where the four state-owned discoms each have A+ grades.

State	Discom	Customers	ACS-ARR (INR/kWh)
Andhra Pradesh	APEPDCL	6.3m	0.9
	APSPDCL	6.6m	0.89
	APCPDCL	4.5m	1.22

State	Discom	Customers	ACS-ARR (INR/kWh)
Gujarat	DGVCL	3.4m	-0.09
	MVGCL	2.4m	-0.19
	PGVCL	5.4m	-0.12
	UGVCL	3.8m	-0.09
	Torrent A'bad	1.8m	-0.52
	Torrent Surat	600,000	-0.51
Rajasthan	AVVNL	6.0m	0.51
	JDVVNL	4.4m	0.27
	JVVNL	4.74m	0.16
Madhya Pradesh	MPMaKVCL	4.7m	0.73
	MPPaKVCL	5.6m	0.7
	MPPoKVCL	6.2m	1.89
Maharashtra	MSEDCL	27m	-0.02
	Adani Mumbai	3.0m	-0.35
	Tata Power	700,000	-0.69
Tamil Nadu	TANGEDCO	30m	0.94
Uttar Pradesh	DVVNL	5.5m	0.54
	KESCO	6.6m	2
	MVVNL	5.0m	0.37
	PaVVNL	5.9m	-0.87
	PuVVNL	9.8m	1.52
	NPCL	107,000	-0.58
West Bengal	WBSUEDCL	20m	0.78
	CESC	2.9m	-0.23
	IPCL	6000	-0.26

Source: "Saubhagya Dashboard," Ministry of Power, Government of India, <https://saubhagya.gov.in/>; "Uday Dashboard," Ministry of Power, Government of India, <https://www.uday.gov.in/>.

Arguably, the most important indicator of a discom's financial health is the gap between the Average Cost of Supply (ACS) and the Average Revenue Realized (ARR), calculated in rupees per kilowatt hour (kWh). As noted in the PFC report highlighted earlier, this ACS-ARR gap has been increasing in recent years—indicating a worsening of the financial health of India's electricity sector. Considering the investments required in new power generation, along with the grid modernization that would be needed for a massive influx of renewable power generation, this trend must be reversed for India to hit national energy targets more easily. Outside of Gujarat, not a single discom among the states covered in this report with more than 3 million customers runs an operating surplus.

The financial stress of India's discoms has resulted in ongoing payment difficulties for power generation companies, hovering at over \$10 billion in late payments to generation companies for most of 2022.<sup>24</sup> ReNew Power, one of India's large renewable energy firms, noted in its March 31, 2022 annual report that the firm had over a half a billion dollars in receivables in March 2022, mostly with government customers.<sup>25</sup> ReNew provides a breakdown of counterparties with delayed payments in their November 16, 2022 earnings review.<sup>26</sup> State governments, compared to the Union Government and corporate customers, have significantly longer "Days Sales Outstanding (DSO)."

These dues have dropped dramatically in recent months primarily due to the aforementioned Electricity (Late Payment Surcharge and Related Matters) Rules, 2022. As of February 2023, the Ministry of Power's Payment Ratification and Analysis in Power Procurement for Bringing Transparency in Invoicing of Generators (PRAAPTI) dashboard shows that late payments are down by about 75 percent in recent months.<sup>27</sup> This should provide much-needed confidence to renewable power generation companies that their PPAs will be honored.

## India and COP21

Prior to the COP21 summit, India was already expanding renewable energy generation. As of March 2015, the country had 23 GW of installed wind capacity, nearly 4 GW of installed solar capacity, over 5 GW of small hydropower, and over 7 GW of biomass generation capacity.<sup>28</sup>

Early leaders among states included Rajasthan (4.4 GW), Uttar Pradesh (2 GW), Gujarat (4.6 GW), Maharashtra (7 GW), Andhra Pradesh (2 GW), Karnataka (5.2 GW), and Tamil Nadu (8.8 GW).

At the summit, India submitted a Nationally Determined Contribution with multiple domestic and international elements.<sup>29</sup> Chief among India's commitments were:

- **International Solar Alliance.** India proposed the creation of an "International Solar Alliance" to coordinate solar power policies and development among nations geographically between the Tropic of Cancer and Tropic of Capricorn (later expanded).
- **Emissions Reduction.** India pledged to reduce the emissions intensity of its gross domestic product (GDP) by 33 percent to 35 percent by 2030, compared to 2005 levels.
- **Natural Carbon Capture.** India would plan to remove 2.5 to 3 million tons of carbon dioxide from the atmosphere by 2030 through expanded forest and tree cover.
- **Renewable Energy.** India pledged to expand renewable energy capacity to 175 GW by 2022.

In August 2022, India offered an updated Nationally Determined Contribution.<sup>30</sup> In this update, it issued a new target for generating 50 percent of its electricity needs from non-fossil fuels and reducing the emissions intensity of its GDP by 45 percent by 2030.

India's new National Green Hydrogen Mission links 125 GW of renewable energy capacity addition to the success of this program.<sup>31</sup> However, the Union government has not yet clarified if this 125 GW goal for green hydrogen is part of the larger 450 GW renewable energy target. Nor has the government yet outlined state-by-state objectives for meeting this 2030 target.

## Domestic Drivers for India's Renewable Energy Targets

There is little evidence that India's voters are motivated by concerns about climate change, even as the government shows political desire to address the impacts of climate change. Some of the larger voter surveys in recent years, such as a 2018 survey by the Association for Democratic Reforms (ADR), show only modest voter interest in air and water pollution, with significantly higher interest among urban voters.<sup>32</sup> Another 2018 survey run by ADR and Daksh that focused on Karnataka voters indicated even lower levels of interest in "environment protection."<sup>33</sup>

Nonetheless, last year saw the hottest month in India's recorded history.<sup>34</sup> India's monsoons are becoming more erratic—and offering less average rainfall.<sup>35</sup> The rapid melting of India's mountainous glaciers is reported to be causing increased flooding, and it may increase water stress in the future.<sup>36</sup>

There is little evidence that India's participation in global summits and related commitments is a critical trigger for local change, either. As noted earlier, even state governments aligned with the central government have not proven to automatically become leaders in the adoption of renewable energy. The truth is more nuanced and driven by local political and economic factors—most notably, dramatic political pressure to maintain unrealistic pricing models for the delivery of electric power to agricultural and rural consumers, ostensibly offset by higher electric power rates for industrial users.<sup>37</sup> This implicit subsidy is not covered, which puts discom finances at a disadvantage from the start.

However, India does have important reasons to push for the fulfillment of its renewable energy goals. Among these are:

- **Energy Independence.** In 2021-2022, India imported \$122 billion in petroleum, \$26 billion in natural gas, and \$30 billion in coal (authors' calculation). That is roughly equivalent to 5.6 percent of India's GDP. Fluctuations in global energy prices from events like Russia's invasion of Ukraine can have a dramatic impact on India's energy imports.
- **Employment Creation.** As evidenced by its Production Linked Incentive (PLI) programs in areas like solar power, the Indian government wants to leverage its own grid modernization and expansion to trigger industrialization.<sup>38</sup>
- **Reduce Cost/Increase Availability of Electric Power for Agriculture.** As noted earlier, politically driven pricing of electric power for agriculture remains a key obstacle to the sector's financial viability. Farmers suffer frequent electricity cuts and are forced to use polluting diesel generators with high fuel prices. As the Council on Energy, Environment, and Water (CEEW) noted in late 2022, "Almost two-thirds of marginal farmers who own agricultural pumps still rely on diesel/ kerosene pumps."<sup>39</sup> The Union government is funding a significant program, Pradhan Mantri Kisan Urja Suraksha Evam Utthan Mahabyiyan (PM-KUSUM), to lower the up-front costs to farmers who want to utilize renewable energy for irrigation.<sup>40</sup>
- **Reduce Pressure on Water Systems.** As noted in a 2021 IEA paper, India will see increasing competition for freshwater resources in the future, which has already put pressure on thermal power projects.<sup>41</sup> Reducing reliance on thermal power will augment the availability of freshwater for consumer, agriculture, and other industrial uses.

Despite these factors supporting the adoption of renewable energy, progress is hard. As uncovered in the interviews with state-level agencies across India, the fast adoption of new types of electric power generation



requires the ability to remain abreast of fast-evolving technology shifts. This process can be difficult without large research teams. State governments require unbiased technical assistance and support from a wide range of partners.

The United States can do much more to unlock its role as a partner, such as leveraging its state governments, universities, foundations, and nongovernmental organizations. It must use the lessons leading up to 2022 as the playbook as India targets a more audacious renewable energy goal for 2030.