

ACCELERATING THE USE OF RENEWABLE ENERGY IN INDIA

STRUCTURAL PROBLEMS IN THE POWER INDUSTRY HAMPER EFFORTS TO ACHIEVE THIS GOAL

Ram Giri

Asia, China & Oceania Dept., Global Economic & Political Studies Div.
Mitsui & Co. Global Strategic Studies Institute

SUMMARY

- The Indian government is promoting policies which aim to expand the use of renewable energy and to reduce the proportion of coal-fired power generation to address issues such as climate change and air pollution, and to meet the nation's increasing demand for electricity. It has set a target of introducing 510 GW of renewable energy power generation, centered around solar energy, by 2030. It also aims to reduce CO2 emissions per unit of GDP by 33% to 35% from 2005 levels.
- In order to achieve these aims, the following issues need to be dealt with: the privatization of the state-owned retail and distribution companies (DISCOMs) running large deficits; transmission and distribution losses of over 20%; weaknesses in the transmission infrastructure connecting consumption and generation areas; and the stabilization of grids.
- Although the Modi government is working on legal reforms to end the DISCOM monopoly of electricity retailing and enable the appropriate pricing of electricity, it will not be easy to expand the use of renewable energy as planned because opposition is expected from labor unions and other groups.

1. OBJECTIVE OF THIS REPORT

In India, the government of Prime Minister Narendra Modi, which took office in 2014 and is now in its second term, has set an ambitious target of generating 60% of total electricity from renewable energy sources on an installed capacity basis by 2030. Specifically, the plan aims for 175 GW by 2022 and 450 GW by 2030 (for a total of 510 GW if 60 GW of hydropower is included). The reasoning behind this target is based on the need to achieve sustainable economic growth by striking a balance between India's ever-increasing demand for electricity and the need to address climate change issues.

India's annual per capita electricity consumption in FY2020 was 968 kWh (Figure 1). This is lower not only than China's consumption, but also than the global average, indicating that there is significant scope for greater electricity consumption in the future. India's electricity demand is expected to rise by an average of 4-5% per year until 2030 due to an increase in the middle class, further urbanization, and the growing use of air conditioners and other home appliances as a consequence of economic growth.¹ Responding to such rising demand is an urgent issue.

Figure 1. China vs. India: energy-related economic scale (FY2020)

	India	China	How much China is larger than India
Population (billion)	1.34	1.45	About 1.08 times
GDP (billion dollars)	2,875	14,600	About 5.08 times
GDP per capita (dollars)	2,169	10,416	About 4.80 times
Foreign currency reserves (billion dollars)	545	3,142	About 5.77 times
Exports (billion dollars)	313	2,060	About 6.58 times
Installed power generation capacity (GW)	378	2,025	About 5.36 times
Amount of electricity generated (GWh)	1,365,519	7,159,127	About 5.24 times
Installed capacity of renewable energy generation (GW)	139	790	About 5.68 times
Electricity consumption per person (kWh/year)	968	4,914	About 5.08 times
Proportion of coal-fired power in power generation (%)	71.7	63.7	About 0.89 times

Source: Prepared by MGSSI based on data from CEIC and statistical bureau of each country

¹ Predicted by Institute for Energy Economics and Financial Analysis (IEEFA) and JMK Research.

Additionally, 22 of the 30 cities with the highest levels of air pollution in the world are located in India,² and the main causes are pointed out to be coal-fired power generation and automobile exhaust fumes. In 2019, CO2 emissions stood at 2.17 billion tons (cf. 1.15 billion tons in Japan), the third-largest amount in the world. Under the Paris Agreement, the Indian government has pledged to reduce CO2 emissions per unit of GDP by 33-35% from 2005 levels by 2030.³ Therefore, the government needs to take measures to address both the climate change issue and air pollution.⁴

However, these targets will not be easy to achieve. This report focuses on the Modi government's renewable energy policy, particularly solar power generation, and discusses the three challenges that stand in the way of achieving this goal.

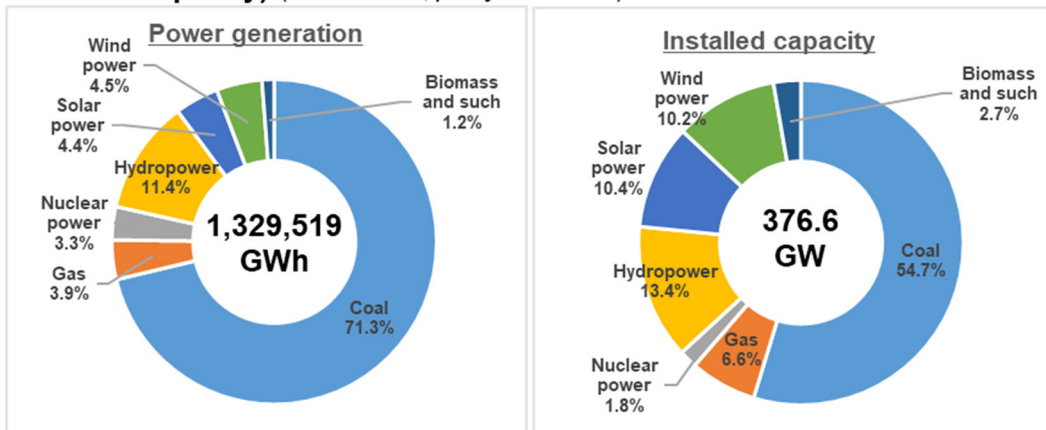
2. MODI GOVERNMENT PRIORITIZES EXPANSION OF RENEWABLE ENERGY

As mentioned above, the Modi government is rapidly promoting the introduction of renewable energy to strike a balance between its two objectives. As such, the government's policies are centered around two areas: solar power and its domestic production.

2.1 Shift from coal-fired power to solar and other renewable energy

India's power source composition in terms of estimated power generation at the end of 2020 showed that coal-fired power accounted for 71.3%, while renewable energy, including hydropower, accounted for only 21.5%. On the other hand, on the basis of installed capacity, the figures were 54.7% and 36.8%, respectively (Figure 2). The Indian government predicts that the share of coal-fired power in terms of electricity generation will decrease to 55% by 2030 and 34% by 2040. Although the demand for electricity is expected to grow substantially, the government aims to lower the proportion of coal-fired power generation in relative terms by introducing more renewable energy sources that will more than meet the rise in demand.

Figure 2. India power source composition (based on power generation / installed capacity) (end of 2020, partly estimated)



Source: Prepared by MGSSI based on data from CEA India

Furthermore, due to the high price of imported gas, the use of gas in power generation is not expected to expand in India. In addition, nuclear power is on the decline worldwide, and solar power generation costs have fallen sharply in recent years. Therefore, given that both nuclear and gas power generation are no longer economically beneficial methods, neither of these two sources have much relevance anymore for the Modi government's policies, and this has made solar power generation the focus of India's renewable energy strategy.

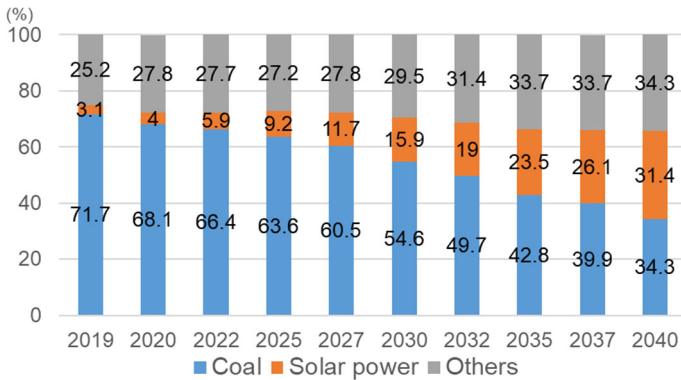
² Data from World Air Quality Report 2020.

³ Since March 2021, the government has also been discussing a target of net-zero greenhouse gas emissions by 2050.

⁴ In addition to the promotion of renewable energy, which is the topic of this report, the electrification of automobiles is an important pillar of the Modi government's climate change policy. The government has introduced measures to promote the scrapping of petrol-driven cars and has set a goal of converting 30% of new car sales to EVs by 2030. It also plans to promote domestic production of charging infrastructure and automotive batteries.

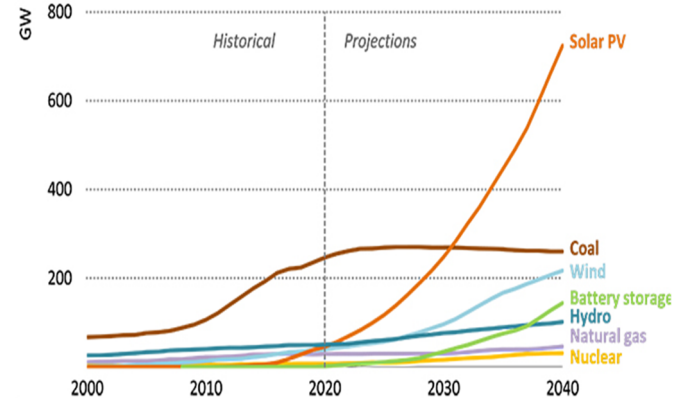
The share of solar power in total electricity generation is projected to grow from the current 4% to 16% by 2030, and 31% by 2040 (Figure 3). In terms of installed capacity, solar power is expected to expand to over 740 GW by 2040, compared to about 220 GW for coal-fired power, an increase of about 3.4 times compared to 2020 (Figure 4).

Figure 3. Projected power generation share of solar PV and coal-fired thermal power generation in India



Source: Prepared by MGSSI based on data from India Energy Outlook 2021

Figure 4. Forecast of solar power installation in India

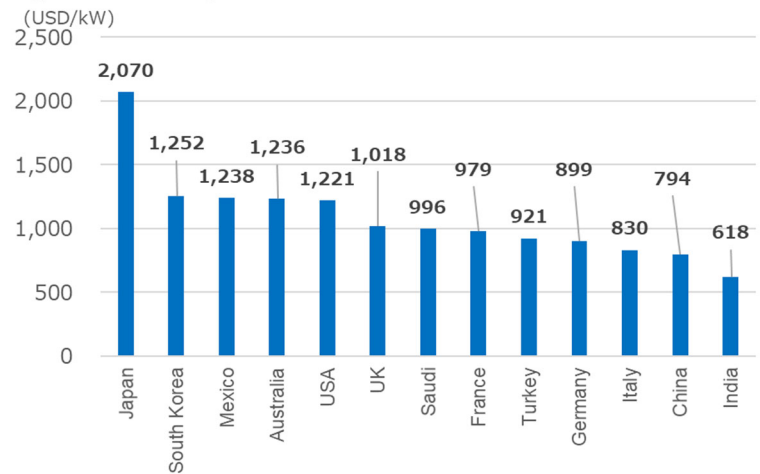


Source: India Energy Outlook 2021

2.2. Promoting domestic production of solar power-related industries

In recent years, winning bids for solar power projects in India have been unbeatably low at Rs. 2 per kWh (about 3 yen per kWh). This was premised on the introduction of cheap solar power generation-related products from China. India has the lowest installation costs among major countries (cf. one-third that of Japan), and its power generation costs are lower than those of China (Figures 5 and 6). Until now, the country's target for the introduction of solar power generation has been based on the use of such inexpensive imports from China. The current domestic production capacity of solar modules is only 35% of total annual domestic demand, and the capacity for producing silicon cells for solar modules is only 28% of demand. Therefore, a large part of Indian solar installations depends on Chinese solar panels and equipment.

Figure 5. Solar power installation costs (estimates for 2020)



Source: Prepared by MGSSI based on data from IEA (FS-UNEP) and IRENA (2020)

Figure 6. Cost of electricity generation (LCOE^{*1}) by sector in major countries (estimates for FY2020) Unit: US cents/kWh

	USA		Japan		Germany		UK		China		India	
	L ^{*2}	H ^{*2}	L	H	L	H	L	H	L	H	L	H
Solar power	3.7	5.6	7.0	20.9	4.4	6.2	5.2	7.6	2.7	4.8	2.2	3.8
Wind power (on shore)	2.6	6.2	8.8	15.2	3.9	7.0	3.5	5.3	3.4	5.4	2.6	4.6
Wind power (on shore + storage)	3.2	11.1	9.9	22.0	4.8	12.9	4.2	9.6	4.3	10.9	3.8	12.1
Offshore wind	9.1	11.3	-	-	7.7	14.0	5.5	9.2	7.0	10.9	-	-
Coal-fired thermal power	5.9	15.4	6.1	8.7	17.9	19.4	-	-	5.1	6.7	4.0	7.4
Gas-fired power	3.4	5.6	7.6	9.1	8.3	11.5	7.8	10.6	7.6	9.8	7.1	11.7
Storage battery facilities (4h)	12.1	12.9	15.0	16.9	12.7	13.6	12.9	14.1	11.3	17.2	15.1	17.8
Small hydropower	-	-	-	-	-	-	-	-	2.9	3.3	4.9	10.8

Note: *1 LCOE...Levelized Cost Of Electricity

*2 L and H represent Lowest (lowest price) and Highest (highest price), respectively.

Source: Prepared by MGSSI based on data from Bloomberg NEF

However, since 2020, the Modi government has been shifting away from its dependence on China as the two countries' relations deteriorated due to border issues. The Indian government is now promoting a policy of domestically producing photovoltaic-related products, ranging from modules to related equipment. In July 2018, India imposed safeguard duties of 25% on solar modules and 15% on solar cells imported from China and Malaysia, which was then extended to July 2021, at a rate of 15% each, to boost domestic manufacturing.⁵ Even bids for projects began to be made subject to a premium rate (Rs. 2.92/kWh) based on whether or not domestic products would be used.⁶ In addition, the government has also announced 600 million USD of Performance Linked Incentives (PLIS) to boost solar cell and module manufacturing in India, and an Rs. 25 billion (about 300 million USD) subsidy for Solar Energy Corporation of India Limited (SECI) and Indian Renewable Energy Development Agency Limited (IREDA), and is rapidly creating an environment for the expansion of solar power.

A further increase in tariffs on products related to solar power generation is proposed in the FY2021 budget, and India will introduce a basic customs duty (BCD) of 40% on solar modules and 25% on solar cells from April 2022. All this will lead to significant cost overruns for solar power producers, giving rise to the possibility that projects that have already been contracted to bidders cannot be implemented as planned, and may have to be postponed until domestic production of supplies catches up with demand.⁷ Although the tariff hike is part of the policy to promote domestic production in the industry, it may be difficult to timely implement the projects being planned at present, considering that it will take at least two to three years to build a production system that can meet domestic demand levels.

3. MOUNTING ISSUES AND THE GOVERNMENT'S SOLUTIONS

To achieve its renewable energy targets, the Modi government has introduced a feed-in tariff (FIT) system, as well as priority dispatching of electricity from renewable energy sources (i.e. priority over coal-fired power sources) and a renewable purchase obligation (RPO) system.⁸

The biggest challenge, however, is the issue of DISCOMs operating under state governments, which are responsible for retail and distribution in the Indian power industry (Figure 7). There are also the important issues

Figure 7. Composition of the Indian power industry

Sector	Public company		Private/PPP
	Under the central government	Under state governments	
Electricity produced (based on power generation)	24%	30%	46%
Operation of the grid system	Power System Operation Corporation (POSOCO)		Power Exchange India Ltd (PXIL), India Energy Exchange (IEX)
Electricity transmitted (based on total distance of power grid)	38%	54%	8%
Power distribution and retail (based on customer and market share)*	About 3%	About 94%	About 3%

Note: *Author's estimate

Source: Prepared by MGSSI based on data from PRS Legislative Research and other sources

⁵ The proposed budget for FY2021 (April 2021-March 2022) specified that tax rates will be hiked from 15% to 25% for solar cells, from 25% to a maximum of 40% for modules, and from 5% to 20% for inverters, but the government has since postponed the imposition of duties on cells and modules until April 2022.

⁶ The Adani Group, a local conglomerate in India, won the bid for a project with an installed capacity of 8 GW, and will set up a system to manufacture 2 GW of solar modules per year. The company will expand energy parks equipped with storage batteries, in addition to promoting hybrid renewable energy (wind and solar).

⁷ In 2021, a number of projects were tendered for at Rs. 1.99 per kWh. In February 2021, the Gujarat government announced the cancellation and re-tendering of a solar power project that was finalized in August 2020 at a selling price of Rs. 2.67 per kWh. If this is approved, it would mean that similar cancellations could happen in other cases as well.

⁸ In June 2018, the Ministry of Power made it mandatory for all states to introduce a uniform RPO. The RPO target for FY2019 was set at 17.5% (7.25% solar, 10.25% other), but the average adoption rate by states was only 10.77%. The central government is expected to impose fines on DISCOMs in the states that fail to meet their targets, with the aim of increasing the adoption of renewable energy.

of power transmission and distribution losses, and grid stabilization. These three main issues need to be overcome for the smooth introduction of renewable energy in India, and this report will now study them in more detail.

3.1. Problems caused by retail and distribution companies (DISCOMs) and their solutions

Almost the entire retail and distribution sector has long been monopolized and operated by DISCOMs⁹ that are under the state governments. For this reason, efficiency is low, and it has also been pointed out that the selling price of electricity is arbitrarily set at the will of the state governments. This results in the sale of electricity at a price that is lower than the actual purchase price from the power producers, the transmission cost, and other related costs. There have also been many cases of uncollected electricity bills. Many DISCOMs are running large deficits,¹⁰ which could potentially force them into bankruptcy if the state governments do not subsidize their losses. These deficits are the biggest challenge faced by the Indian power business. Unless this problem is resolved, it will be difficult to achieve the planned faster growth in new power generation.

To resolve this, the government announced a funding and reform plan for DISCOMs. It allocated Rs. 3 trillion (40.5 billion USD) for DISCOMs in the budget for FY2021 and decided to introduce a scheme¹¹ for reform. The funds will be used for installing smart meters, modernizing the system, and developing interstate transmission grids. The objective is to improve power distribution efficiency and build a stable power supply network. The government is also planning to amend the Electricity Act enacted in 2003 (Figure 8).¹² The FY2021 budget proposal clearly states that the government aims to liberalize the electricity retail market, which is monopolized by DISCOMs. It will also develop a framework to enable consumers to choose from among multiple power distribution companies when market is liberalized. Gradually reducing the difference between the cost of generating electricity and the selling price (currently averaging Rs. 0.42/kWh) to zero by 2025 will help solve the problem of unpaid bills by DISCOMs to power producers in each state.

Figure 8. Key points of proposed amendment to the Electricity Act, 2003

(1) Creation of an executive body	Creation of a power contract enforcement agency to oversee the performance of contractual obligations under power purchase and sale agreements (PPAs) between power producers and distribution and transmission licensees.
(2) National renewable energy policy	In particular, overseeing measures for a nationwide introduction of renewable energy policy currently formulated by each state, through the national renewable energy policy, to promote solar power and hydropower, and promoting the introduction of renewable energy by providing incentives and requiring the use of renewable energy.
(3) Establishing of a rate system that reflects power generation and transmission costs	Ensuring the financial health of DISCOMs by including cost-reflective electricity pricing in the revised bill.
(4) Privatization of retail and distribution of electricity	Opening up the areas that were previously monopolized by the state-run retail and distribution utilities to the private sector, and promoting privatization of public utilities. Reducing financial compensation from the government to power distribution companies and encouraging increased private sector investment in the transmission and distribution sector to stabilize the power supply, by reducing transmission and distribution losses, improving management efficiency through privatization, and setting appropriate power sales prices.

Source: Prepared by MGSSI based on BTG Legal "India: The Electricity (Amendment) Bill, 2020" November 20, 2020 <https://www.mondaq.com/india/renewables/1007944/>

⁹ Abbreviation for distribution companies.

¹⁰ As of December 2020, outstanding dues from DISCOMs to power producers stood at Rs. 1,369.6 billion (about 2 trillion yen), up about 24% YoY, partly due to the COVID-19 pandemic. Of the outstanding dues, the overdue portion beyond the 45-day grace period set by the power producers was Rs. 1,274.98 billion, which is 30 percent more than the Rs. 978.3 billion of a year ago. The overdue amount was reduced to Rs 745 billion in March 2021, after the release of a tranche of the liquidity infusion package by the government.

¹¹ It is named the "Reforms-Linked, Result-Based Scheme for Distribution" (RLRBSD).

¹² It has already been presented to the stakeholders in each state.

3.2. Transmission and distribution losses and infrastructure vulnerability

Transmission and distribution losses exceed 20% in India, compared to 4.7% in Japan and 5.6% in China. This is not only due to system losses in power transmission and distribution, but also due to electricity theft and incorrect meter readings. The government's goal is to reduce power transmission and distribution losses to 12-15%.

Another major issue is the weak transmission infrastructure connecting regions that produce electricity or have surplus electricity with regions that consume a lot of electricity. The installation of renewable energy, especially solar power, will be concentrated in mega solar parks in the western states of Gujarat and Maharashtra, and the southern state of Tamil Nadu. However, it will not be easy to transmit the power to the populated power-consuming regions and industrial corridors. There is an urgent need to deal with these problems, but DISCOMs, which are running at a loss, do not have funds to spare. Therefore, the government is also focusing on developing the power grid to resolve this problem. In September 2020, transmission lines for 6 GW were completed in Rajasthan, as part of a plan to develop dedicated transmission lines¹³ for solar (50 GW) and wind (16.5 GW) power in seven states rich in renewable energy. In December, bidding was completed for the construction, maintenance, management, and operation of an 8 GW power transmission line in Maharashtra using the BOOM method.

3.3. Toward grid stabilization: The problem of energy mix

In India, there are still many weak grid areas, and grid stabilization¹⁴ is a major issue. Solar and wind power involves large output fluctuations and frequency adjustments, as well as the impact of natural conditions, large daytime output, and generation of surpluses. In contrast, power shortages during the peak time in the evenings have become a frequent problem along with a lack of electricity storage infrastructure. The imbalance in electricity supply and demand and grid instability are likely to continue in the future.

Moreover, if the utilization rate of thermal power generation facilities declines while renewable energy expands, a decline in the profitability of these facilities will be unavoidable. If this happens, their operators will also need support. In order to stabilize the grid, the government is expanding energy parks equipped with hybrid renewable energy sources (solar and wind) and storage batteries. Accordingly, bidding has already taken place in Gujarat. Additionally, the announcement of the FY2021 budget plan included the promotion of a green hydrogen production plan that uses surplus daytime electricity generated by the rapid expansion of renewable energy.¹⁵ Currently, the production of fertilizer and steel depends on ammonia produced from imported natural gas, but the government will promote the use of solar power to produce hydrogen feedstock for ammonia. It is also expected to put forward a plan that requires companies to purchase a minimum amount of green hydrogen.

4. FUTURE OUTLOOK: COORDINATION AND IMPLEMENTATION

CAPABILITIES REQUIRED TO CARRY OUT REFORMS

As mentioned above, reform of DISCOMs is essential for expanding the use of renewable energy. However, many of the problems associated with DISCOMs are rooted in the structural challenges of Indian society, where populist policies with an eye to electoral success are essential. State assembly elections often raise the issues of using electricity for irrigation and providing free electricity in rural areas as a means of winning rural votes. This is one of the reasons for the worsening financial condition of DISCOMs.

Various reform plans have been announced and implemented since the Modi government came to power, but

¹³ Transmission lines for 20 GW of solar and 9 GW of wind power are planned for Phase I, while 30 GW of solar and 7.5 GW of wind power are planned for Phase II.

¹⁴ When a large number of power sources with widely fluctuating output, such as grid solar power generation, are introduced, they frequently lead to large-scale blackouts due to reduced inertia and frequency instability in the power system. In preventing this, it is necessary to stabilize the grid by introducing an appropriate energy mix (a mix of stable and unstable power) and control technology.

¹⁵ The government has indicated that it may hold its first green hydrogen auction within three to four months.

not all of them have progressed as planned. For example, major reforms aimed at economic growth, such as the revision of land acquisition bill and labor reforms, have not been achieved due to opposition from farmers and workers, as well as the opposition parties supporting them. In recent times, an amendment made to agriculture-related laws in September 2020 is unlikely to be enforced because farmers are vehemently opposing it. Furthermore, the government has long been promoting the privatization of public enterprises and the sale of assets as a way to deal with the growing budget deficit, but there is strong opposition from labor unions and other groups due to concerns about continued employment and services after privatization.¹⁶ It is true that the government is trying to liberalize electricity retailing, amend the Electricity Act, and privatize DISCOMs. Against this, the All India Power Engineers Federation (AIPeF), which consists of members working for DISCOMs and other organizations, has suggested a general strike, as with the agricultural sector and such. The possibility of a nationwide opposition movement emerging cannot be denied.¹⁷

In the state elections held in five Indian states, the PM Narendra Modi-led BJP managed to hold power in Assam state but failed to make major gains elsewhere. It will be worth watching how the BJP will respond to such opposition after the elections. The introduction of renewable energy is not only a long-term energy strategy, but also part of India's medium- to long-term industrial policy, including the industrialization of solar power. It is also a major market opportunity for the private sector. Some DISCOMs have already succeeded in reducing power losses to single digits due to increased operational efficiency through PPP¹⁸ schemes, in which the private sector holds a 51% stake, or privatization. Carrying out reforms will not be easy due to the complex web of strong vested interests that are connected to politics, but if the Modi administration can accomplish such reforms and accelerate the adoption of renewable energy, it will have made a significant contribution to India's growth strategy.

¹⁶ In March 2021, a banking union went on strike against the privatization of two public banks.

¹⁷ Fifty-one percent of the shares in DISCOMs have been sold to private companies, and the law is being revised to improve efficiency based on market principles.

¹⁸ Public-private partnership