INDIA TARGETS ENERGY INDEPENDENCE BY 2047

— GREENER TECHNOLOGY SEEN AS KEY TO REDUCING EMISSIONS AND GAINING ENERGY INDEPENDENCE —

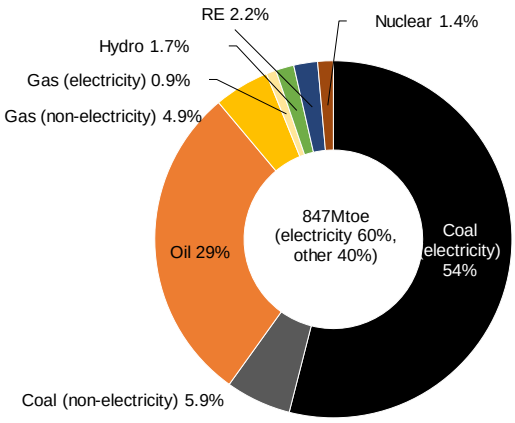
Ram Giri
Asia Pacific Dept., Global Economic & Political Studies Div.
Mitsui & Co. Global Strategic Studies Institute

SUMMARY

- India has set itself the goal of achieving energy independence by 2047 to achieve energy security, overcome its chronic trade and current account deficits, and realize decarbonization.
- To this end, the Indian government has given top priority to promoting greener energy. Specifically, it has worked to increase renewable energy, increase the installation of nuclear power plants, install large-scale storage batteries, secure stable transmission networks, and expand the use of EV and ethanol-blended gasoline.
- The Indian government has also been accelerating domestic production of components used in renewable energy facilities. It aims to realize the production, use, and export of green hydrogen (GH2) and green ammonia (GNH3).

India is the world's third-biggest emitter of greenhouse gases after China and the US, with four of the world's ten most air-polluted cities. Meanwhile, India's economy has maintained a high level of growth, recording annual growth in energy demand of 7%, the highest rate among major nations. This trend is forecast to continue for at least several years to come. India relies on coal for approximately 60% of its primary energy supply (2023), and on oil for approximately 29% (Figure 1). This report will clarify the Indian government's policy targets and specific measures for addressing these energy issues, the prospects for achieving its targets, and the challenges India faces.

Figure 1: Primary power supply mix in India (2023)



Note: Biomass excluded

Source: Compiled by MGSSI based on data from NITI Aayog

1. RULING BJP SETS TARGET OF ACHIEVING ENERGY INDEPENDENCE BY 2047

India relies on imports for 90% of its oil, more than 50% of its natural gas, and over 20% of its coal. In August 2021, Prime Minister Narendra Modi set out a target of achieving energy independence by 2047 as a way for India to pursue energy security, while also overcoming the economic vulnerabilities of its chronic trade and current account deficits. As part of India's efforts to cooperate with international society, India is also promoting decarbonization with the goal of achieving net-zero emissions by 2070.

Among the campaign pledges made by the ruling BJP, the winners in this year's general election, the greatest emphasis has been placed on a pledge to promote clean energy. Specifically, the BJP has promised to expand the use of renewable energy, secure stable transmission networks, promote EVs, and encourage the introduction of ethanol-blended gasoline.

New policies that have attracted particular attention include promotion of large-scale battery energy storage systems (BESS) and expanded use of nuclear power. India currently has 8.2 GW of nuclear power plants in operation, and further 15.3 GW new nuclear plants is currently being planned or already under construction. These are scheduled to commence operations by 2032.

2. POLICIES TARGETING GREENER ENERGY

2-1. Raising the target for introducing renewables

To promote greener technology, the Indian government has introduced feed-in tariffs (FITs[1]), priority power supply systems for renewable power (GEC[2]), and renewable energy purchase obligations (RPOs[3]).

In October 2023, the Ministry of Power notified designated power consumers[4] of its RPO targets up to March 2030 (Figure 2). As part of the efforts to achieve these targets, procurement of hydropower from neighboring countries (Nepal and Bhutan) is permitted, subject to central government approval, and a new category known as "distributed renewable energy" has been introduced.

Figure 2: Renewable purchase obligation (RPO) targets from April 2024 to March 2030

Year \ %	Wind	Hydro	Distributed	Other	Total
2024-25	0.67	0.38	1.50	27.35	29.90
2025-26	1.45	1.22	2.10	28.24	33.01
2026-27	1.97	1.34	2.70	29.94	35.95
2027-28	2.45	1.42	3.30	31.64	38.81
2028-29	2.95	1.42	3.90	33.1	41.37
2029-30	3.48	1.33	4.50	34.02	43.33

Source: Compiled by MGSSI based on a notification from the Indian Ministry of Power

Each state needs to meet its own RPO target, and the ratio of renewable energy consumption varies from state to state (Figure 3). Potential and confirmed wind power facilities are concentrated in the top four states shown

[1] FIT (Feed-In Tariffs): A scheme in which power companies purchase renewable energy at a price set by the government for a fixed period of time. In India, the price of electricity is determined through reverse auctions, with the bidder offering the best (lowest) price winning. In most cases, power is purchased at a fixed price for 25 years.

[2] GEC (Green Energy Corridor): An intrastate system for prioritized transmission of renewable energy. India's target is to lay 10,750km of transmission lines by 2026.

[3] RPOs (Renewable Purchase Obligations): This system obliges consumers to purchase a fixed percentage of their power consumption in the form of renewable energy.

[4] Designated power consumers include state-level power distribution companies (DISCOMS), privately-run power distribution companies, private power-generating businesses, and large consumers.

in Figure 3, which account for more than 70% of India's total potential. The state of Rajasthan alone accounts for approximately 20% of India's solar power potential (Figure 4). Fines[5] are imposed on states that do not meet the prescribed volumes of renewable energy. This makes it necessary for some states to purchase renewable energy from those states producing surpluses, or from neighboring countries, when it appears unlikely they will reach their targets.

Figure 3: Percentage of RE vs. power consumption by state (2022-23)

Name of state	Annual power consumption (GWh)	RE (including large hydro) (GWh)	RE (%)
Himachal Pradesh	14,982	10,403	69.44%
Uttarakhand	17,694	8,459	47.81%
Karnataka	86,816	31,740	36.56%
Kerala	32,178	9,353	29.07%
Rajasthan	104,830	29,764	28.39%
Assam	12,424	3,213	25.86%
Punjab	70,787	16,912	23.89%
Delhi union territory	36,727	8,572	23.34%
Andhra Pradesh	81,984	18,936	23.10%
Haryana	66,319	15,199	22.92%
Madhya Pradesh	91,283	19,236	21.07%

Name of state	Annual power consumption (GWh)	RE (including large hydro) (GWh)	RE (%)
Bihar	34,893	7,212	20.67%
Telangana	77,966	14,631	18.77%
Maharashtra	165,190	28,946	17.52%
Uttar Pradesh	150,909	26,286	17.42%
Gujarat	138,763	23,137	16.67%
Tamil Nadu	112,817	18,319	16.24%
Jharkhand	27,571	4,449	16.14%
Odisha	92,346	9,774	10.58%
West Bengal	66,522	6,807	10.23%
Chhattisgarh	62,655	5,772	9.21%

Source: Complied by MGSSI based on data from NITI Aayog, ICED, and the Central Electricity Authority (CEA)

Figure 4: RE installation potential in India (as of 2023)

Name of state	RE installtion potential (GW)				Installed RE capacity	
	Solar	Wind	Other	Total	Installed (GW)	Installed (%)
Rajasthan	142.31	127.76	1.64	271.70	25.27	9.3
Gujarat	35.77	142.56	2.19	180.52	24.20	13.4
Maharashtra	64.32	98.21	6.07	168.61	16.98	10.1
Karnataka	24.70	124.16	6.88	155.73	22.29	14.3
Andhra Pradesh	38.44	74.91	4.00	117.34	11.00	9.4
Tamil Nadu	17.67	68.75	3.35	89.77	21.31	23.7
Madhya Pradesh	61.66	15.40	2.49	79.56	8.63	10.9
Telangana	20.41	24.84	2.72	47.96	7.56	15.8
Other	343.71	18.93	163.29	525.93	37.85	7.2
Total	748.99	695.51	192.62	1637.12	175.10	-

Source: Complied by MGSSI based on data from NITI Aayog and ICED

2-2. Plan to install rooftop solar panels

In this fiscal year's budget (2024-25), the Indian government announced PM Surya Ghar Muft Bijli Yojana (a rooftop solar panel installation plan). This plan includes a total budget of INR 750.2 billion for installing solar panels on ten million homes by fiscal 2026-27. The plan forecasts a maximum of 30GW installation of rooftop solar power.

2-3. Domestic production of renewable energy equipment

The Indian government is also rapidly promoting efforts to break away from reliance on China for renewable energy equipment by increasing the domestic production of such equipment. In addition to raising customs duty on products such as solar cells, it has applied the Production Linked Incentive (PLI) scheme to support domestic production to encourage the use of "Made in India" products.

[5] If a target is not met, in addition to fines of up to INR 1 million, states are fined a maximum of double the oil equivalent price for any power consumed beyond the standard.

The domestic production of solar power generation-related products and establishment of export hubs have fallen behind the original plan because of delays in the high-tech collaboration of technology and funding from overseas, but steady progress has been made. In addition to contributing to an expansion in the introduction of renewable energy domestically, there are signs that these efforts have helped India's export industry grow.

2-4. Supporting the production of green hydrogen (GH2) and green ammonia (GNH3)

The Indian government considers green hydrogen (GH2) and green ammonia (GNH3) to be key enablers in its efforts to achieve energy independence by 2047. In January 2023, the Indian Cabinet approved the National Green Hydrogen Mission (NGHM). It has allocated a total budget of INR 197.4 billion, and set a target of producing 5 million MT of GH2 annually by 2030. However, GH2 and GNH3 are still at the stage where industries need to be established for both production and use, and there are still outstanding issues to be resolved in terms of both technology and price. The government plans to require fertilizer producers and oil refineries to use a certain volume of GH2 and GNH3 to create a domestic market, and to gradually increase this mandatory volume.

Japanese companies have recently set out plans to import GNH3 from India (see reference at the end of this report).

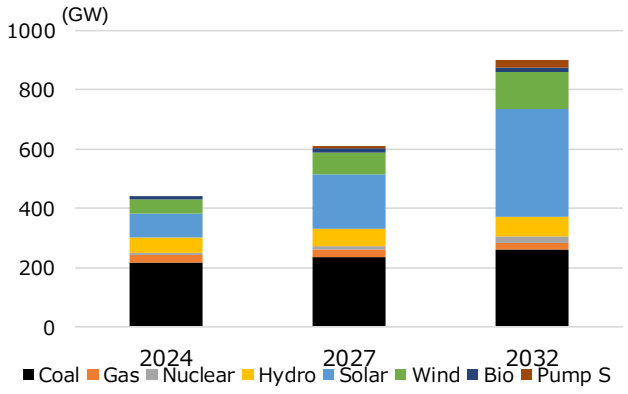
3. MEDIUM- TO LONG-TERM OUTLOOK FOR GREENER ENERGY

The Indian government has set its 2030 targets for increasing the installed renewable energy capacity from the current level of 190GW to 500GW, and for increasing the ratio of renewable power generation to 50%. As of March 31, 2024, India had already achieved an installed renewable energy capacity of 43.3%, representing an approximately 2.6-fold increase over ten years.

3-1. More renewable energy needed in terms of both installed capacity and power generation volume

Under its National Electricity Plan, the Central Electricity Authority (CEA) predicted the necessity to double the renewable power generation capacity from 440 GW as of March 2024 to 870 GW by 2032 (Figure 5). It has also calculated that further increases will be necessary in the future (Figure 6).

Figure 5: Results in installed capacity by power type as of 2024, and targets to 2032 under the National Electricity Plan



Source: Compiled by MGSSI based on data from the CEA's National Electricity Plan (2023)

Figure 6: Power facilities under construction and need for extra power capacity under the CEA's National Electricty Plan (unit: GW)

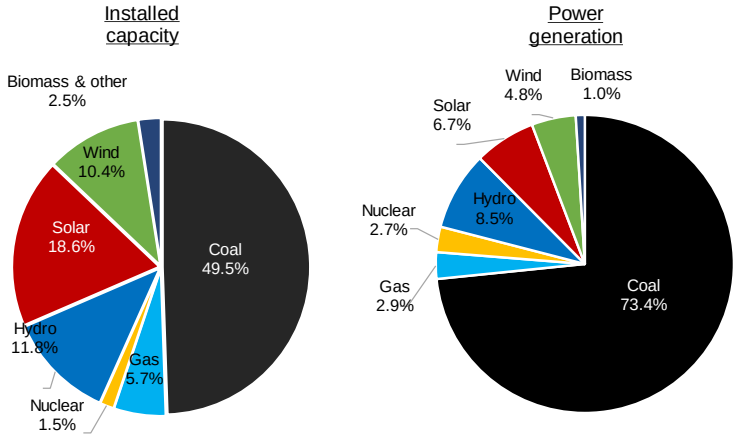
Years / Source	2022-2027		2027-2032	
	er construc	Extra need	Approved	Extra need
Coal	25.6		1.32	24.16
Gas				
Nuclear	6.3		2.4	4.2
Hydro	10.81		1.3	8.7
Solar	92.6	39		179
Wind	25	7.5		49
Bio	2.3		2.5	
Pump S	2.7		0.08	19.16
Total	165.31	46.5	7.6	284.22

Source: Compiled by MGSSI based on data from the CEA's National Electricity Plan (2023)

As of April 2024, coal-fired thermal capacity accounts for less than 50% of total power installed capacity, but coal accounts for 73.4% of total power generation (Figure 7), and there is an ambitious target to reduce the ratio

to less than 50% by 2031-2032. According to NITI Aayog's[6] India Energy Security Scenarios (IESS) 2047, Net Zero Scenario[7], India's power generation will increase by 1.5 times from the current level by 2032, and by 3.3 times from the current level by 2047, of which nuclear energy will account for 12% and renewable energy 73% (Figure 8). To increase the ratio of renewable energy in line with this plan, India will need to establish power supply stability through power interchanges with neighboring countries. The country is expected to import up to 15 GW of hydropower from neighboring countries and is also planning to install 25 GW of pumped storage power domestically; the progress of these plans will help achieve the above targets.

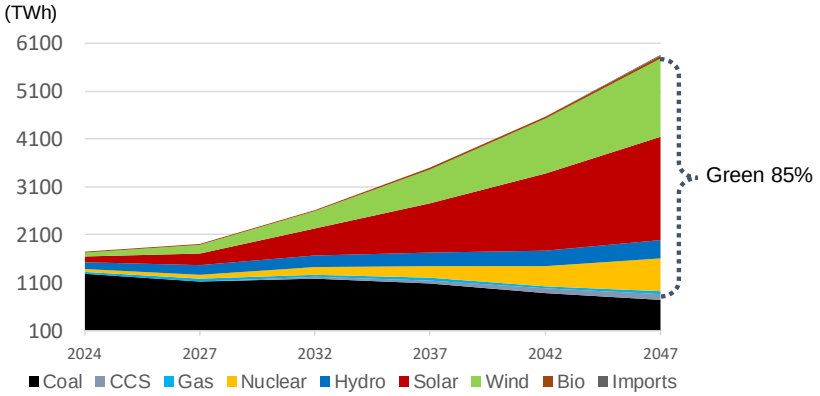
Figure 7: India's power mix (installed capacity/power generation)



Note: Data as of March 31, 2024

Source: Complied by MGSSI based on data from the CEA

Figure 8: Trends in power generation by power source from 2024 to 2047 under NITI Aayog's Net Zero Scenario



Source: Complied by MGSSI based on data from NITI Aayog (IESS)

3-2. Key to realizing energy independence

According to Figure 8, renewable energy is expected to account for 73% of total power generation by 2047. When combined with nuclear power, 85% of power generation is expected to come from green energy. Because coal demand can be met by using domestic coal only, it will be possible for India to achieve energy independence in both coal, which at that time will account for 28.6% of primary energy, and green energy, including nuclear, which will account for 40% of the total (Figure 9). In contrast, it is expected that India will still rely on imports for approximately 80% of its oil and approximately 60% of its natural gas as of 2047 (Figure 10). Achieving independence in primary energy as a whole will depend on the uptake of EVs and progress in

[6] NITI Aayog is a public think tank that formulates government plans and policy proposals.

[7] Net Zero Scenario is an analytical tool for seeking paths to net zero by taking into account the India Energy Security Scenarios (IESS). It assesses paths to a 2047 green energy transition.

switching to green power sources (hydrogen, NH3, and methanol) generated from renewable energy, as well as bioethanol.

4. SUMMARY

India faces many challenges in its efforts to switch to greener energy. To reduce its volume of oil usage, the country urgently needs to expand the introduction of ethanol-blended gasoline, while also replacing oil with green fuels such as hydrogen. More specifically, GH2 and GNH3 remain at the stage where industries need to be established for both production and use, and issues remain in terms of both technology and price. In India, there is also a particularly strong need to reduce prices.

To achieve the target of installing 500 GW of renewable energy by 2030, annual installation of approximately 50 GW will be needed. Some locations are suited to such development, while others are not. Close attention will need to be paid to how much progress is made with the installation plans. In India, locations where renewable energy infrastructure can be installed tend to be distant from locations where there is strong demand. Accordingly, there is a need to develop the country's transmission network when installing power generation facilities. In some places, plans are not progressing on schedule because land price hikes are occurring in locations where infrastructure is being developed, making land acquisition difficult.

India's growth in electricity demand is the highest among major countries, and there is a need to increase baseload power sources to meet maximum demand. There are strong expectations for major growth in the installation of solar power generation facilities, but this brings a problem because solar plants does not generate much electricity in the morning or evening, when demand is highest.

To meet the ongoing increase in demand for baseload power sources, in addition to coal-fired and pumped storage power generation, India will likely need to develop battery-equipped hybrid solar and wind-powered generation systems, and to strengthen power interchange with neighboring countries, for example by procuring hydropower from Nepal.

Even when faced with these challenges, there are still sound reasons for India to expand the renewable energy capacity. These include decarbonization, as well as realizing the ambitious goal of using surplus renewable energy to produce GH2 and GNH3 for domestic use and export, which will lead to significant decarbonization, reduce dependence on fossil fuel imports and will promote energy independence. Although the direct and indirect financial support from government is not so huge amount compared to developed countries, India has a huge potential to become the world leader in green hydrogen, green ammonia related industries because of its low-priced renewable energy and installation costs. As a non-oil producing country, there are high hopes in India that it will become an exporter of GH2 and GNH3 in the future.

<Reference> Details of interviews with local experts in India

SN	Domain	Details
1	Green hydrogen, green ammonia, ethanol	● **Plans to export green ammonia to Japan:** Sembcorp (Singapore), Sojitz, and Kyushu Electric Power will procure **200,000MT of green ammonia annually from India by 2030**, and sell this in Japan (mostly in Kyushu). **JERA** (Japan) and **ReNew** (India) have concluded a joint development contract to manufacture green ammonia in the state of Odisha in eastern India. They plan to generate **100,000 MT annually for export to Japan**. ● **Plan to supply blended fuel to Indian coal-fired thermal power plant: Adani Power has teamed up with JERA** and made a plan to **co-fire green ammonia up to a maximum of 20%** at Mundra Thermal Power Station. The plan involves receiving finance from JICA.

		● **Prospects for lower prices:** According to Adani, the price of green ammonia is USD 10-11/kg, but this **needs to be reduced to USD 4/kg**. Government subsidies are around USD 400/MT in total, and Adani believes that using carbon pricing and facility subsidies will **make it possible to reduce prices**. ● **Low level of government subsidies**: Under its National Green Hydrogen Mission, the Indian government aims to realize global exports of hydrogen manufactured using cheap renewable energy. According to experts, **the level of hydrogen-related government subsidies in India is low** compared with semiconductors. ● **Expanded introduction of bioethanol**: The Indian government is promoting bioethanol and biomass, and has already achieved **E12 for bioethanol**. It aims to achieve **E20 by 2026**.
2	Renewable energy	● **Buying and selling electricity through regional collaboration**: The Indian government has promoted regional collaboration, and **plans to purchase hydro electricity generated in Nepal (a maximum of 10GW over the next ten years)**. There are also plans to export to Bangladesh and Sri Lanka. ● **Securing stable renewable energy**: Numerous pumped storage power generation projects are being planned to ensure a stable supply of renewable energy, and JICA has provided finance. **It will be difficult to achieve 500 GW by 2030**, but steady progress is being made towards the target. ● **SECI guarantee scheme**: Some experts have expressed concerns about the losses at states' power distribution companies (DISCOMS), and doubts that progress may not be made with renewable energy because of difficulties paying IPPs. However, this is not a concern, because SECI takes responsibility via a guarantee scheme. ● **JICA support: JICA is offering support in drafting India's 2070 roadmap to net-zero emissions**, which will be drawn up over the next two years. Work is currently underway to establish an order of priorities. ● **No plans for new natural gas power plants:** To reduce the country's reliance on imports of natural gas, **the Indian government does not plan to build any new natural gas power plants**. ● **Challenges with installing renewable energy facilities in India**: The main challenges are as follows: (1) **Construction of transmission lines is not quick enough;** (2) **it is difficult to acquire land**; (3) **negotiations are sought** for the prices agreed during bids for power purchase agreements (PPAs); (4) there are delays in payments from electricity off-takers; and (5) government **tariffs have been increased** on solar and wind power generation-related equipment.
3	Bilateral credits (JCM)	● **The Japan side wants to conclude an agreement as soon as possible** and the joint committee wants to reach an agreement on which projects to adopt, but the Indian side wants to make a decision after assessing each project. ● The Indian side wants to limit the scope of JCM to **13 domains (including domains with advanced technology, domains that are currently not economically feasible, and domains where India has yet to establish technology)**. However, the Japanese side is **negotiating to avoid limiting the scope to these 13 domains**.

Source: Compiled by MGSSI based on interviews carried out in India