

Online First

International Organisations Research Journal, 2023, vol. 18, no 4, pp.

Original article

doi:10.17323/1996-7845-2023-04-04

India's Climate Mitigation Policy: Challenges and Prospects¹

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Abstract

India is one of the largest emitters of greenhouse gases in the world, largely due to its high dependence on coal. However, since the early 2000s, New Delhi has been introducing various tools to help reduce greenhouse gas emissions. In 2022, a new climate plan was adopted, which for the first time set a goal to achieve carbon neutrality by 2070. To achieve the goal of reducing greenhouse gases in the energy sector, India is using several market-based schemes, which will become the basis of the Indian emissions trading system in the nearest future. Environmentally friendly transport is actively developing. It is being research in the field of industrial decarbonization, carbon capture and storage systems, and forest protection and afforestation programs are being implemented. However, the implementation of the identified areas is being fraught with difficulties, which lead to the implementation of controversial measures on the part of the state, economically justified, but contrary to the climate strategy. This study examines the main directions of Indian climate policy, prospects and difficulties in their implementation to achieve the goal of carbon neutrality.

Keywords: India, climate policy, carbon neutrality, renewable energy sources, energy efficiency

Introduction

According to a report by the Ministry of Environment, Forests and Climate Change, India is the fourth largest greenhouse gas (GHG) emitter in the world, most of GHG comes from the energy sector (about 70 per cent) [MoEFCC, 2021].

India was one of the few countries to pass an Energy Conservation Act in 2001, and the first National Action Plan for Climate Change which was adopted in 2008 even before the Paris Agreement was signed. The plan aimed at mitigating and adapting to climate change and included eight areas: National Solar Mission, National Mission for Enhanced Energy Efficiency, National Mission on Sustainable Habitat, National Water Mission, National Mission for Sustaining Himalayan Ecosystem, Green India Mission, National Mission for Sustainable Agriculture, National Mission on Strategic Knowledge for Climate Change.

¹ This article was submitted 29.09.2023

In 2022, at the Glasgow summit, India announced strategic goal of achieving carbon neutrality by 2070. The appointment of a later date than even China accepted was due to a lack of funding for the implementation of large-scale climate projects. Prime Minister Modi stressed that the key is to fulfill the obligations of developed countries on financial tranches in the amount of \$1 billion annually [MoA, 2021].

In 2022, the Government approved a new climate plan in accordance with the UNFCCC's Nationally Determined Contribution (NDC). For the first time, it set out a goal to achieve carbon neutrality by 2070 and an interim goal to reduce the share of emissions in GDP by 45 per cent by 2030 [Government of India, 2022].

The new climate strategy highlights that India's actions to combat climate change have so far been largely funded from domestic resources. Therefore, the Government claims the responsibility of developed countries to provide financial resources and transfer technology, while India should receive its share of financial and technological support among other developing countries [MoEFCC, 2022b].

Also in 2022, the "India's Long-Term Low-Carbon Development Strategy" was adopted. It outlines the elements comprising the proposed transition to low-carbon development, the domestic and international context, as well as current policies and emission targets.

Its main elements are: expanding the use of renewable energy and strengthening the energy system; exploring the issue of increasing the role of nuclear energy and strengthening support for research on alternative energy resources such as hydrogen, biofuels and fuel cells; improving energy efficiency; rational use of fossil fuels; implementing measures to facilitate the transition to climate-sustainable development, including stimulating local production; optimal balance energy resources with the key role of renewable energy sources.

One of the new measures to achieve carbon neutrality is the development of carbon capture and storage (CCS) systems. The National Institution for Transforming India (NITI Aayog), a Government think tank, prepared a report in November 2022 proposing a policy framework and implementation mechanism for the development of CCS technologies in India. The project includes a business model and financial incentives for commercialization of the technology with the potential for India to achieve a CCS capacity of 750 million tons of carbon capture per year by 2050. The estimated investment size will be \$100-150 billion in the coming decades. The priority sectors are steel, cement, oil and gas, petrochemicals and chemicals, and fertilizers. The report states that India's theoretical carbon dioxide storage capacity is up to 600 Gt. Preliminary analysis shows that there is sufficient potential to establish regional CCS clusters in each of the five regions of India [NITI Aayog, 2022a].

The issue of increasing India's climate ambitions has been repeatedly raised at international summits, primarily at the summits of the UNFCCC Conference of the Parties. Developed countries insist on the need India to take stronger actions in the field of climate change as India is third (fourth, counting the European Union) largest emitter. The Group of Seven (G7) are negotiating with India regarding its accession in the so-called The Climate Club. The Club is an informal association launched by the Group of Seven and their partners to promote a common climate policy, a single trade and economic zone, to promote technologies, and to combat climate change. India's participation in this association is of particular interest to the G7. India's compliance with common norms and standards, on the one side, will allow the country to make major commitments in the field of climate, at the same time, the G7 expect that India will become one of the largest markets for climate technologies.

Nevertheless, India is not a hurry to agree to participate in the Climate Club. New Delhi is a firm supporter of the position that developing countries should be able to transit to climate neutrality at their own pace, in addition, India is determined to protect its market by promoting its own technologies and insists on the need for financial support from developed countries to implement a fair transition to "net zero".

The purpose of the study is to identify achievements, prospects and problematic areas of Indian climate policy. The article examines the current and developing climate norms and public policy directions aimed at reducing greenhouse gas emissions and stimulating the economy to transition to low-carbon development.

The policy of the energy sector decarbonization. Challenges of the energy transition

In accordance with the NDC of 2022 India has committed to achieve 50% of installed capacity from non-fossil sources by 2030 [Government of India, 2022]. The target is ambitious and India is already on track to achieve this goal, having announced in 2022 that it will reach 40% of renewable energy the installed capacity. Nevertheless, the energy sector still accounts for about 70% of emissions, primarily through the operation of coal-fired thermal power plants (TPPs) [NITI Aayog, 2022b]. The new Climate Strategy indicates that interruptions in supply of renewable energy is a serious problem, therefore India has to rely on coal-fired power plants, and they need to develop flexible operation of thermal power plants to meet electricity demand [MoEFCC, 2022b].

The share of coal-fired power in the 2022 fiscal year was 73.1%, which is 12.4% higher than the previous year. The productivity of fossil fuel-powered power plants increased by 11.2%, which is the highest growth rate in three decades [Reuters, 2023]. The problem of decarbonizing the energy sector in India in the absence of the necessary clean energy capacities is the lack of alternative backup generation during periods of peak demand and in particular in conditions of fluctuating natural gas prices. Natural gas price spikes on spot markets in 2021-2022 led to an increase in demand for thermal coal.

The reduction of greenhouse gas emissions is carried out within number of Government tools. Back in 2003 the Electricity Law was adopted [MoLJ, 2003]. It set the task of encouraging cogeneration and generation of electricity from renewable energy sources and the National Tariff Policy adopted in accordance with it in 2006 for the optimal use of both traditional and non-traditional sources [The Gazette of India, 2006]. The law has created a mechanism for *Renewable Purchase Obligations (RPO)*: distribution companies, open access consumers and "dependent" electricity consumers² are required to purchase a certain percentage of electricity from renewable energy sources.

In 2010, the mechanism of RPO was supplemented with *Renewable Energy Certificates*. A renewable energy producer can receive a certificate for each MWh of energy production. The received certificate can be sold on the open market, the buyers are organizations which ai to close their obligations to purchase renewable energy.

In 2022 were introduced certificate multipliers which depend on technology. They increase the validity period of certificates until the moment of sale, as well as eliminate the minimum price for trading certificates [CERC, 2022] which accelerates the introduction of new and expensive technologies in the field of renewable energy.

² Facilities created and operated by an industrial or commercial user for the use of energy, and its users are called "dependent consumers" because they cannot independently choose a supplier

In 2022, a draft National Electricity Plan for 2022-2027 was published, and in February 2023 was issued a decision to impose quotas for renewable energy for thermal power plants. Companies putting coal-fired thermal power plants into operation during the period from April 1, 2023 to March 31, 2025, must install renewable energy capacities must install renewable energy capacity of at least 40 per cent of the constructed thermal power plant capacity, the so-called *Renewable Generation Obligation*. The alternative is to purchase and supply consumers an equivalent amount of renewable electricity.

In 2022 the mechanism of *Renewable Generation Obligation*, was added by the mechanism of *Energy Storage Obligations*. This mechanism defines the storage requirements for a designated percentage of the total energy consumed, which is produced by solar, wind, hybrid solar-wind and hydropower. The percentage increases every tax year, for 2023-2024 storage obligations are 1 per cent, by 2029-2030 they will already comprise up to 4 per cent [MoP, 2022c].

However, in the midst of the energy crisis in May 2022, due to the shortage of coal and a sharp rise in its prices, the Ministry of Power published a document according to which 58 TWh of electricity generated by thermal power plants should be replaced by electricity generated on the basis of renewable energy by the 2025-26 fiscal year [MoP, 2022]. But already in early 2023, according to Reuters source the Ministry of Power demanded that utility companies extend the operation of aging coal-fired thermal power plants due to a sharp rise in electricity demand [Varadhan, 2023]. At the same time, according to the National Electricity Plan, 2018, it was planned to decommission coal-fired thermal power plants with a total capacity of 9.5 GW by the end of 2022 [CEA, 2018].

The draft National Electricity Plan for 2022-27 indicated an expected increase in the installed capacity of thermal power plants up to 16 per cent by 2032. The estimated demand for coal will increase by 40 per cent. It is noted that in addition to coal-fired power plants under construction with a total capacity of 25 GW, until 2031-2032, the required increase in coal-fired generation capacity may vary from 17 to 28 GW [CEA, 2022]. The decision not to decommission coal-fired power plants is forced in the face of a shortage of renewable energy capacity. The possibility of using natural gas as a transition fuel before reaching the required of renewable energy capacity is hampered by price hikes that do not allow increasing its share in the energy balance to 15 per cent, as expected in 2022. As of May 2023, the project is under discussion, however, has appeared the information that the item on the construction of new coal-fired thermal power plants will not be included in the the final document, however the new policy will not affect those are under construction [Singh, Varadhan, 2023].

Due to the fact that sharply limiting the number of coal-fired power plants or volume of their emissions is difficult due to the risks of further power cuts, the most compromise and successful solution to reduce greenhouse gas emissions in the energy sector for India is to increase renewable energy capacity.

Prospects and obstacles for the development of renewable energy in India

The most favoured instrument for reducing greenhouse gases in the Indian energy sector is the development of renewable energy and energy efficiency. India has been developing renewable energy since the 1980s. At the beginning of 2023, the installed capacity of renewable energy sources was about 170 GW or 40 per cent of the energy balance [Invest India, n.d.].

Initially, the development of solar and wind energy was carried out without subsidies from the state, it was facilitated by large-scale auctions. The growth in demand for electricity

contributed to a rapid increase in renewable energy sources and lower prices. The tariff for solar energy decreased by about 60 per cent between 2016 and 2021. [IRENA, n.d.]

One of the major incentives for the development of solar energy was the Jawaharlal Nehru National Solar Mission launched in 2010. The goal of the mission was to achieve 20 GW of grid-connected solar energy by 2022. In the 2020 budget, N. Modi increased the target to 100 GW. As a support measure, a compensation mechanism was developed: energy companies in different states bought more expensive solar energy from manufacturers and received compensation in the form of a certain percentage of more cheap coal-fired electricity from the central Government. The implementation of the program allowed to increase the installed capacity from 161 GW in 2010 to 46.3 TW in 2021 [CEA, n.d.] In addition, *Generation Based Incentive Scheme* was introduced in 2011, providing payments for 1 kWh of electricity supplied to the grid, in case to the sale of electricity at a tariff set by the state. In order to develop wind generation, a *National Offshore Wind Energy Policy* was launched in 2015. The development was promoted through competitive bidding, the creation of a "one-stop service" to simplify the development and registration of the project, access to tax benefits and incentives, etc.

India has introduced tax incentives and other incentive measures.

Accelerated depreciation contributed to the involvement of both large business, small investors, and "dependent consumers" of autonomous power plants in the industry. The maximum acceleration rate of depreciation of fixed assets is 40 per cent per year (at the normal rate of 15 per cent) [IEA, 2021].

The *National Clean Energy & Environment Fund* was established in 2011. Within the Fund, funds are allocated to the Indian Renewable Energy Development Agency and loans for renewable energy projects are issued with the participation of banks. The current interest rate is approximately 10-11%, 2-3% less than the market interest rate. Developers can use up to 40% of the project cost according to this scheme [PIB, 2011].

The *National Clean Energy Fund* was created in 2011. The fund allocates funds to the Indian Renewable Energy Development Agency and, with the participation of banks, issues loans for renewable energy projects. The current interest rate is approximately 10-11 per cent, 2-3 per cent less than the market interest rate. Developers can use up to a maximum of 40 per cent of the project cost under this scheme [PIB, 2011].

The *Green Energy Corridor* was launched by the Government in 2015-2016. By 2020, the project's goal was to build about 9.4 thousand cubic meters of power transmission lines and substations with a total capacity of 19 thousand megavolt-amperes (MVA). As of September 2021, only 6.2 thousand cubic meters were built. Solar and wind energy suppliers are exempt from interstate energy transfer fees, and the project should be operational by 2025 [Kumar et al. 2022].

Production Linked Incentive Scheme. In addition to increasing renewable energy capacity, the priority is to reduce import dependence on technologies, primarily from China. For this purpose, a Production Linked Incentive Scheme was established in 2020. Its main task is the development of domestic production. The first tranche of funding came to 45 billion rupees (\$605 million) to create 8.7 GW of fully integrated production facilities for the creation of solar photovoltaic modules [Invest India, 2020]. In 2022 the second tranche of financing in the amount of 195 billion rupees (\$2.4 billion) was approved [PIB, 2023a].

Ultra Mega Solar Parks projects was planned back in 2014. Each of them should have a minimum capacity of 500 GW [SECI, 2014]. A renewable energy park is a large piece of land built up with common infrastructure facilities such as transmission infrastructure, roads, water supply, etc. This initiative allows renewable energy producers to obtain permits for land acquisition in a simplified manner and reduce the cost of building communications. The provision of land and communications is based on the principle of "Plug and Play"³. The developer is eligible for centralized financial assistance in the amount of 20 lakh rupees/MW (about \$240) or 30 per cent of development cost for internal infrastructure development. The project is more focused on solar energy, but since 2020, land has been provided for installation of wind and hybrid solar-wind power plants.

However, the implementation of the intended plan to increase renewable energy sources is hampered by a number of difficulties. In particular, one of the effective incentives until 2021 was the exemption from customs duties on imported components. After the adoption of the Atmanirbhar Bharat ("Independent India") directive in 2021, the customs duty on solar modules was 40 per cent, and on components it was 25 per cent, benefits for wind power plants remained only until 2025. Along with the Requirement of internal maintenance, which implies the possibility of state subsidies and participation in public procurement of only solar photovoltaic cells and modules produced in India, these changes have led to an excessive increase in prices for components for solar installations. In addition, the young industry in the country does not have time to meet the growing demand. As a result of supply chain problems and material shortages, the implementation of many projects in 2022 was postponed. Together with the reduction in tariffs for solar energy, which energy companies carry out to encourage utilities to purchase energy from renewable energy sources, this has led to a decrease in manufacturers' interest in implementing some new projects, and there are significantly fewer participants in state auctions.

Another potentially problematic mechanism is the "required to operate" status adopted in 2010, which means that electricity generated from solar and wind installations must be diverted to the grid, and this diversion cannot be limited for any reason other than the safety of the network, equipment or personnel [CERC, 2010]. However, in practice, distribution companies sometimes decide to limit the use of renewable energy without specifying any reason. In reality, the priority of energy extraction is most often given to thermal power plants with cheaper energy, and technical problems at thermal power plants play a role when their base load is reduced.

Another significant obstacle to the construction of wind energy projects is land acquisition. The allocation of the land is the responsibility of the state, and the formalization of decisions is a complex bureaucratic mechanism in which numerous structures are involved. As a result, the process takes on average 6–9 months. Another difficulty is the lack of federal policy regarding land distribution in number of states.

Development of hydrogen and nuclear energy

One of the new directions for the development of clean energy in India is the National Mission to Produce Hydrogen from renewable energy sources. In its climate strategy, India has outlined a goal of promoting green hydrogen to decarbonize the energy sector, particularly in sectors where emission reductions are most difficult to achieve. In 2020, India's hydrogen

³ Plug-and-Play technology can be used immediately after connection, with minimal installation required. The systems are flexible and do not require complex infrastructure or large space. Moreover, since they can be installed individually and easily connected to a wider network, the proportion of connected installations can be significant.

demand was 6 Mt per year. By 2050, demand for hydrogen is expected to increase fivefold to 28 Mt, with 80 per cent of demand going to green hydrogen [PIB, 2022b].

The mission goal is to develop clean hydrogen production capacity with a production capacity of at least 5 Mt per year. To achieve the goal, it is planned to increase renewable energy capacity by approximately 125 GW, the initial costs will be 197.4 billion rupees (\$2.4 billion). The Government has estimated that hydrogen costs will drop by 50 per cent by 2030. The mission is expected to attract investment of more than 8 million (\$95.6 thousand) rupees and create more than 6 million jobs by 2030. By 2030, about 50 Mt of carbon dioxide emissions per year will be avoided [MNRE, 2023].

It is expected that the use of pure hydrogen will help to reduce emissions at thermal power plants. Initially, the calculation is based on the use of hydrogen and its derivative, green ammonia, for co-combustion with fossil fuels. In the future, the Government expects that increased demand for hydrogen and ammonia will contribute to the gradual replacement of coke and natural gas.

As for nuclear energy, in India's energy balance, nuclear power plants provide 3 per cent of electricity generation; as of 2023, the country has 22 nuclear reactors with a total installed capacity of 6.8 GW, and eight more units with a total capacity of just over 6 GW are under construction [AERB, n.d.]. The Government is supporting the expansion of nuclear power capacity as part of a major infrastructure development program. There are 21 nuclear reactors with an installed capacity of 15.7 GW at the implementation stage [PIB, 2019c].

Cooperation with Russia remains the most important milestone in the development of Indian nuclear energy, also due to the Civil Liability Nuclear Damage Act (CLNDA) [CLNDA, 2010]. The law, passed in 2010, provides for supplier liability in case of nuclear incident caused by the supplier's actions, which has slowed India's talks with the US and France⁴. In addition, there are problems caused by high capital costs and high tariffs for electricity generated by plants designed by companies in the United States and France. For India, the fundamental issue is the mutual acceptability of commercial and technical conditions [Grover, 2015].

In 2014, the first unit of the Kudankulam nuclear power plant (NPP) was put into operation, the construction of which is being implemented by Rosatom's subsidiary, Atomenergoexport. By 2023, two nuclear reactors with a total capacity of 2 GW were put into operation, which is about 30 per cent of the installed nuclear power capacity in the country. Construction of four reactors is ongoing, it is expected to be completed in 2025, the installed capacity of NPP will be 6 GW, which almost doubling the share of nuclear energy in India [NPCIL, n.d.]. In 2014, a concept document was signed aimed at creating a total of 12 reactors in cooperation with Russia [Grover, 2015].

In addition to the construction of nuclear power plants, cooperation with Russia is carried out in the field of nuclear fuel supplies: both ore and concentrates. Russia is one of the largest suppliers - in 2019, the volume of Russian supplies amounted to about 40 per cent of the total volume of purchases (\$104.76 million from \$266.07 million) [MoC&I, n.d.]. In addition, in 2016, V. Putin said that Russia was moving to localize the production of components for nuclear

⁴ The law provides for supplier liability only under three conditions: if it is expressly provided in the contract or if the nuclear incident "results from an act or omission committed with the intent to cause damage." An Indian Nuclear Insurance Pool was also created to provide insurance coverage for both operators and suppliers. However, American and French companies perceived it as additional risk for cooperation [Grover, 2015].

power plants in India and was establishing technological cooperation with India in the field of uranium enrichment [President of the RF, 2016].

In 2010, India and France agreed on the construction of the Jaitapur nuclear power plant, which was to become the largest in the world. The project involved the construction of six nuclear reactors with a total installed capacity of 9.9 GW, and the supply of nuclear fuel for 25 years. The operator of the project Areva was on the verge of bankruptcy, the Jaitapur project was acquired by Électricité de France (EDF), which signed an agreement on industrial development prospects with the Indian Atomic Energy Corporation of India in 2018, under which EDF would act as the EPR⁵ technology supplier and will conduct all engineering studies and procure components for the first two of the six reactors [PIB, 2018]. The delay in the implementation of the project for more than a decade furthermore the designated law, was caused by the tariff conditions proposed by the French side. However, in 2023, after a meeting between N. Modi and E. Macron, it was announced that the parties had agreed to work towards establishing a partnership on small and medium power modular reactors or small modular reactors and advanced modular reactors [PIB, 2023b].

In 2016, India and the United States issued a joint statement on the development of a partnership that included the construction of six AP 1000 reactors by Westinghouse with financial support from the US Export-Import Bank. It was assumed that contract agreements would be signed in 2017, however, the project was never implemented [The White House, 2016]. The main contradiction was the CLINDA, even despite the insurance pool created by India. However, negotiations continue, and in 2023, an ongoing dialogue was announced between New Delhi and Washington on the construction of the six reactors, on the production of small modular reactors for both the domestic market and for export, as well as consultations between the US Department of Energy and the Indian Department of Atomic Energy about the possibility of Westinghouse developing a technical and commercial proposal for the Indian Kovvada NPP project [The White House, 2023].

The climate strategy notes that nuclear power saves 41 Mt of carbon dioxide emissions annually, which would be achieved with equivalent electricity generation from coal-fired thermal power plants. India is researching advanced nuclear reactor technologies, as well as the possibility of developing the so-called “pink hydrogen” which is a type of clean hydrogen produced with the usage of atomic energy. The strategy sets a goal of tripling nuclear energy capacity by 2032, including through the deployment of small modular reactors, but notes that it will require the sharing and transfer of relevant technologies.

Improving energy efficiency

Improving energy efficiency is also one of the priority tools for reducing greenhouse gas emissions. The Department of Energy and the Bureau of Energy Efficiency have launched a number of initiatives.

The Perform, Achieve and Trade (PAT) scheme, introduced in 2012, is designed to reduce specific energy consumption, i.e. energy expended per unit of production. It identifies consumers in selected energy-intensive industries that must achieve specified energy efficiency targets over a specified period of time. Those industries that consume more energy are given higher targets. The scheme covers enterprises from 13 energy-intensive sectors: thermal power plants, cement, aluminum, iron and steel, pulp and paper, fertilizers, chlor-alkali, oil refineries, petrochemicals,

⁵ EPR is a third-generation pressurised water reactor design. It has been designed and developed mainly by Framatome (part of Areva between 2001 and 2017) and Électricité de France (EDF) in France, and by Siemens in Germany.

distribution companies, railways, textiles and commercial buildings (hotels and airports). The sixth cycle of the scheme ends in 2023, with expected energy savings of 26 Mt oil equivalent or 70 Mt CO₂ [BEE, n.d.c].

The scheme involves the trading of *Energy Saving Certificates*, which are issued to enterprises that exceed targets. Enterprises that have not achieved the target indicators are entitled to purchase certificates. The Central Electricity Regulatory Commission acts as the market regulator, defining the regulatory framework for the trading of certificates, and the Power System Operations Corporation is responsible for the centralized registry of certificates.

The Energy Efficiency Financing Platform was created to ensure the interaction of energy efficiency project developers with financial institutions. The two main tools of the platform are the Investment Bazaar and the Training Program for Financial Institutions. The Investment Bazaar is an event organized by the Bureau of Energy Efficiency in collaboration with Government authorized agencies. The activities are aimed at raising awareness among stakeholders about various financing schemes, products and services in the field of energy efficiency, as well as ways of implementing energy saving projects by energy service companies [BEE, n.d.a].

Market Transformation in Energy Efficiency aims to accelerate the transition to energy efficient appliances in certain sectors. The Ultra-Efficient Equipment Program provides financial incentives for manufacturers to develop, produce and sell ultra-efficient equipment and appliances at prices comparable to the average appliance.

Framework for Energy Efficient Economic Development involves the development of tax instruments to attract financing in the field of energy efficiency. Includes the Partial Risk Guarantee Fund for Energy Efficiency, a risk-sharing mechanism that allows participating financial institutions to partially cover the risks associated with lending to energy efficiency projects. The Venture Capital Fund for Energy Efficiency provides risk capital support for energy efficiency investments in new technologies, products and services. It guarantees up to 50 per cent of the loan amount or 100 million rupees per project (about \$1 million) [BEE, n.d.b]. The National Energy Conservation Awards is awarded industries or institutions that have made special efforts to reduce energy consumption while maintaining their operations.

Energy efficiency targets set within the climate strategy also include electrification, digitalization of processes, incentives for energy efficiency through the creation of a carbon market, alliances and collaboration between subsectors to promote a circular economy and sector linking approaches.

Just Energy Transition Partnership

Just Energy Transition Partnerships (JETPs) are a new financing model initiated by the G7 countries and their partners. The agreement involves the provision of large financial packages to support national energy sector decarbonization strategies of the largest emerging countries.

India was named among the potential beneficiaries of the partnership at the G7 summit in 2022, and it was suggested the possibility of signing an agreement by the end of 2023, but over the past period the negotiations have practically reached the standstill for two main reasons. First of all, the Indian Government insists that the coal phase-out plan envisaged in the agreement cannot be implemented for both energy security and economic reasons. Existing renewable energy capacity is not enough to cover increased demand, as demonstrated by the situation with numerous blackouts in 2021–2022 in the face of rolling heatwaves and a shortage of thermal

coal. In addition, the coal mining sector accounts for about 1.3 per cent of GDP [World Bank, n.d.], and also provides employment to more than 700 thousand people, and an even larger number of jobs indirectly related to the coal industry [Pai, Zerriffi, 2021].

India insists on the need for an energy transition that takes into account these conditions and allows time for the creation of new jobs for workers involved in the coal sector, as well as the reassignment of coal companies. Prime Minister N. Modi, in an interview before the G20 summit, emphasized that on the issue of energy transition, New Delhi insists not on a restrictive, but on a constructive approach and on diversity, including in the energy balance [Prime Minister of India, 2023]. Also important, the financial tranches provided under the JETP are mostly in the form of loans rather than grants. In particular, the German Government released information on additional funds allocated to the Republic of South Africa under the JTEP. 270 million euros of the total 320 million euros of funding will be allocated in the form of loans and only 50 million euros in the form of grants [FMECDG, 2022]. In addition, according to business media, about 97 per cent of the provided tranche consists of soft loans, commercial loans and investment guarantees, while grants make up less than 3 per cent [Climate Home News, 2022].

In February 2022, the Energy Committee of the Indian Parliament published a report on the estimated costs to achieve 500 GW of installed capacity of non-fossil fuel based power projects (including transmission projects). The committee estimates that by 2030 the country will need about 17 trillion rupees (\$207.63 billion), i.e. about 1.5–2 trillion rupees (\$18.32–24.43 billion) of investment annually. The committee noted that annual investment in the renewable energy sector over the past few years was estimated at just 750 billion rupees (\$9.14 billion), or about half of what is required.

The Indian Government's strict stance on the impossibility of abandoning coal capacity before achieving the required renewable energy capacity is explained by the constant increase in energy consumption in the country. During the period 2018–2022 electricity consumption increased by almost 25 per cent from 1061.2 TWh in 2017 to 1316.8 TWh in 2022 [MoP, 2023a], with a slight slowdown only in 2020–2021 due to the COVID-19 pandemic. India's power grid is still under strain, especially during peak demand periods in the summer. In this situation, the capacity of coal-fired thermal power plants serves at least as a backup source to avoid overloads and shutdowns. The Government of N. Modi insists that coal must maintain its position in the energy sector along with the expansion of renewable energy sources until an optimal balance of clean energy sources is achieved that can ensure stable energy consumption. A definite alternative for the transition period could be to increase the share of natural gas in the country's energy balance. In particular, another country that has concluded JETP deal intends to follow this path - Indonesia, which plans to convert existing diesel power plants to use gas. However, in addition to the fact that this approach is criticized by the agreement partners, India's own gas production covers less than half of the existing demand (in 2019, gas production was 30.3 billion m³, and imports were 33.9 billion m³) [MOP&NG, n.d.].

Given that situation, as well as the low likelihood of increased funding in the form of grants from partners, negotiations will be based on the backdrop of possible relaxations for the Indian coal energy sector for the transition period.

Thus, India has developed a significant number of Government programs to promote renewable energy and energy efficiency. Of greatest interest are market instruments such as Renewable Energy Certificates and Energy Saving Certificates, which can be considered as a pilot carbon market scheme. Despite the presence of various incentive programs, contradictions remain, primarily in terms of supporting coal energy in the country. Emissions from coal-fired

power plants account for the largest share of the energy sector and a significant share of the total greenhouse gas emissions in the country. The Government is forced to continue supporting coal to ensure energy security in terms of surges in electricity demand, fluctuating prices for other energy sources and the lack of other backup sources of generation during periods of peak demand. In general, the Government is more likely to rely on increasing renewable generation rather than reducing emissions from thermal power plants using traditional fuels.

Natural gas could be one of the likely backup fuels for the transition period. However, the low level of domestic production, coupled with the lack of pipelines, forces India to rely on expensive LNG. Increasing the share of gas in the energy balance is possible after the launch of the Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline, but the implementation of the project became more complicated after the coup in Afghanistan. Despite the fact that the Taliban leadership made statements guaranteeing the safety of the pipeline, during the construction process there were repeated incidents with militants attacking and killing workers preparing for the construction of the gas pipeline. Another challenge for India is its conflictual relationship with Pakistan and New Delhi's fears that the pipeline will be used by Pakistan to control India's energy security.

However, in 2023, Pakistan and Turkmenistan signed a Joint Implementation Plan, which should accelerate the implementation of the project [Ministry of Energy of Pakistan, 2023]. Russia has repeatedly stated its readiness to join the project [TASS, 2023]. In addition, in 2019, the Chelyabinsk Pipe Rolling Plant announced the signing of a contract for the construction of the linear part of the TAPI gas pipeline (214 km) in Turkmenistan [Finam, 2019].

Another opportunity to increase gas imports to India is the Iran-Pakistan-India (IPI) gas pipeline project from Iran to Pakistan and India. However, the project's implementation has slowed down for a number of reasons. In addition to the Indo-Pakistani conflict, there are problems in Iran-Pakistan relations. Iran is ready to sue Pakistan for failure to fulfill a gas purchase contract and obligations to build a gas pipeline on its territory [Iran International, 2023].

Russia is also interested in taking part in the project. At the end of 2022, Russia began swap gas supplies to Iran. To the north of the country, where there are no deposits, 10 billion cubic meters will be supplied annually, the countries agreed that Iran will be able to supply these volumes from its southern deposits to Pakistan and India. In July 2022, a memorandum of understanding was signed between Gazprom and the National Iranian Oil Company on strategic cooperation. The document envisages cooperation in various areas, including the construction of gas pipelines.

Cooperation with Russia continues in the field of LNG. In 2021, information appeared in the business media about the interest of the Indian companies ONGC and Petronet LNG in acquiring a stake in the Russian company Novatek's Arctic LNG-2 project. ONGC also owns a 20 per cent stake in the Sakhalin-1 oil and gas project [Bloomberg, 2021].

Thus, India prefers bilateral cooperation on the supply of natural gas in the future and the development of the country's nuclear industry to a partnership that is not mutually beneficial. The development of both directions is fraught with a number of difficulties, but India continues to participate in negotiations to provide itself with fuel for the transition period.

Decarbonization of the industrial sector

Decarbonization of some industries is the most challenging task. These industries are primarily the steel and cement industries. Emissions from the Indian industrial sector are about 150 Mt or 4.6 per cent [Climate Watch, n.d.].

The climate strategy provides for several dimensions to reduce emissions from industrial sectors. To decarbonize the steel sector, implementation of best available technologies is being considered to improve energy efficiency and increase scrap recovery. However, it is noted that the introduction of low carbon technologies into the steel industry will require time and changes in R&D, while capital costs remain high and technology readiness is low. As alternative for the transition period, it is proposed to use technologies for optimizing energy consumption, reducing coke oven gas consumption by installing an exhaust gas purification system, optimizing the use of associated fuel gas, and introducing advanced technologies, including artificial intelligence. In addition, decarbonization processes in both the steel and cement sectors could be facilitated in the future by new alternative products with lower carbon production technologies.

In the long term, large-scale introduction of hydrogen into the industrial sector to replace fossil fuels is being considered. Initially, the steel industry is expected to use a mixture of hydrogen with other fuels, the mixing proportion may gradually increase as economic efficiency improves and technology develops.

Other ways to decarbonize industry includes electrification of the sector through renewable energy sources, as well as the use of biomass energy, including biofuels, which will help to prevent the increase in the use of coal in low-temperature thermal plants. In the cement sector, the use of waste-derived fuels is expected to increase. In addition, further development of energy efficient and low carbon technologies, trading schemes and other market mechanisms are planned to achieve these goals.

Reducing emissions in the transport industry

The share of greenhouse gas emissions from the Indian transport sector is about 9.7 per cent of the total emissions in the country. Vehicle ownership in India is below the global average, but the automobile sector accounts for about 87 per cent of passenger traffic and 60 per cent of freight traffic [MoEFCC, 2022]. There is a number of Government programs have been created to support the transition to clean vehicles.

The Ministry of Heavy Industries published the National Electric Mobility Mission Plan until 2020 in 2012 to promote hybrid and electric vehicles. The plan set a goal of achieving 6-7 million hybrid and electric vehicle sales per year starting in 2020 by providing tax incentives. To support the plan, the *Faster Adoption and Manufacturing of Electric Vehicles* (FAME) scheme was adopted in 2015. A reduced initial price was set as an incentive for buyers. For manufacturers and developers, incentives were provided in the form of grants for pilot projects, research, and components for charging stations. The total amount allocated to support the scheme was 8.95 billion rupees (\$1.08 billion) [PIB, 2019a].

The second phase of the scheme was introduced in 2019. The total budgetary support amounted to 100 billion rupees (\$1.2 billion). This phase was mainly aimed at supporting the electrification of public and shared transport. In addition, support was aimed at developing the domestic battery production sector to reduce their cost. The goods and services tax (the Indian version of VAT) on electric vehicles was reduced from 15 per cent to 5 per cent, and on chargers from 18 per cent to 5 per cent [MHI, 2022].

One solution for India's climate strategy for the transport sector is blending petrol or diesel with ethanol. The ethanol blending roadmap 2020–2025 outlines an annual plan to increase domestic ethanol production in line with the gasoline ethanol blending program to achieve 20 per cent of ethanol content in gasoline by 2025–2026. [NITI Aayog, 2021].

In 2021, the Government announced an allocation of about 260 billion rupees (\$3.5 billion) for an auto sector stimulus program aimed at increasing production of electric and hydrogen fuel vehicles. The introduction of the scheme was primarily an economic rather than an environmental decision: the 2019 economic downturn and subsequent COVID-19 pandemic saw demand fall to its lowest level in a decade. The program, which provides incentives ranging from 8 per cent to 18 per cent of the sale price of a vehicle or components, is provided to companies if they meet certain conditions, such as a minimum investment for five years and annual sales growth of 10 per cent [PIB, 2021].

In 2022, the Government approved the *National Program for Advanced Chemistry Cell Battery Storage* to achieve a production capacity of 50 GWh and expand India's manufacturing capabilities. The program provides investments that will stimulate domestic production and also help to create demand for electric vehicle batteries [PIB, 2022a].

India has prepared a zero-emission rail transport project. Achieving the carbon neutrality target by Indian Railways would result in emissions reductions of 60 million tonnes per year by 2030 [PIB, 2022c]. To address the issue of emissions from diesel trains, it is proposed to improve energy efficiency, use a 5 per cent biofuel blend in the diesel engine, plant trees to improve carbon dioxide absorption, introduce a PAT scheme, and complete rail electrification by 2030 [MoR, 2022].

Reducing aviation emissions in the short term appears difficult. India's opportunities to decarbonize the sector include the introduction of a new aircraft designs that can improve fuel efficiency by 25 per cent compared to the most fuel-efficient aircraft currently in existence. Another option is to use biofuels in the fuel mix up to 50 per cent. The prospect of hydrogen fuel for the aviation industry is being considered, but the authorities themselves consider its implementation in the near future is unlikely [MoEFCC, 2022].

Despite a package of measures to decarbonize transport, the Government is forced to take controversial actions to reduce excise taxes on petrol and diesel while reducing VAT in states to curb rising fuel prices amid a price spike in energy prices.

Emission Trading Scheme

Existing generation-based incentive schemes are created with the help of states that operate emissions trading systems and are therefore they are largely based on them. In particular, the design of the PAT scheme was based on the EU ETC. At the time of its launch in 2012, the Indian scheme remained the only such scheme launched in a developing country. The scheme was developed and launched with an ongoing assistance from the UK as part of a joint effort between the Department of Energy & Climate Change, the Foreign & Commonwealth Office, and the Department for International Development [UK Parliament, 2012]. It is structured on a cap-and-trade basis, such that industries whose annual energy consumption exceeds a threshold limit are eligible to participate. Organizations that have been able to achieve reductions in specific energy consumption below target levels can receive energy saving certificates traded on two energy exchanges.

By 2023, the scheme covers more than 1 thousand companies from 13 sectors (thermal power plants, cement, aluminum, iron and steel, pulp and paper, fertilizers, chlor-alkali, oil refineries, petrochemicals, distribution companies, railways, textiles and commercial buildings (hotels and airports) In the first decade of the scheme, the sectors covered were able to achieve a total of 24 Mtoe of energy savings, equivalent to an emission reduction of 106 MtCO₂ [MoP, 2023].

In August 2022, soon after the release of India's NDC, Indian Energy Minister R.K. Singh introduced a bill in Parliament to amend the Energy Conservation Act 2001 to empower the central government to determine a carbon credit trading scheme. The law was adopted in December 2022.

In October 2022, the Bureau of Energy Efficiency developed a comprehensive draft carbon market policy document that would implement the plan in three phases, starting with a voluntary market phase to generate demand. In the first stage, the market will include already traded renewable energy certificates and energy savings certificates with the aim of increasing demand, increasing their interchangeability, adding participants to the pool of buyers and connecting other markets to the voluntary carbon market. Demand is expected to initially come from designated customers of the PAT program and the Renewable Purchase Obligation Scheme, voluntary purchasers of certificates from both schemes, government agencies, distribution companies with RPO, and through inclusion of all airline sector.

The second phase will be aimed at increasing supply on the market. The third and final stage will focus on moving towards a cap-and-trade system for the sectors and specific companies that have received emission allowances. Expected sector growth over the next few years will be used to determine the baseline for the program's first lending period. To transition to a cap-and-trade system, a greenhouse gas emission intensity factor will be established for specific industries. Expected industry growth for subsequent years will then be used to determine "business-as-usual emissions" for the first credit period of the scheme as a preliminary benchmark. Lending will be based on actual production volumes (ex post determination) to which the ratio will be applied. To participate, each organization must create a greenhouse gas emissions inventory and a monitoring, reporting and verification scheme [BEE, 2022]. As the researchers note, the carbon credit trading market proposed by India is reminiscent of the Chinese market [S&P, 2022a], however, at the third stage, the proposed scheme will be similar to the EU ETC.

India is also working on a carbon market stabilization fund project that will benefit buyers and support prices. The fund will attract investor interest in effective technologies and processes and will also help the market develop at the required speed. It is expected that funding will be provided by contributions from institutions such as the World Bank and the UN. The project notes that the World Bank Partnership for Market Readiness announced an \$8 million grant to India to prepare and pilot carbon pricing tools. The fund's function is under development, but market participants say it could act as a price guarantee mechanism, intervening in purchases when prices fall below a certain minimum [S&P, 2023b].

Conservation and restoration of forest cover

India's climate strategy highlights that while about 24.62 per cent of the total area is covered by forests, the country's gross deforestation rate is one of the lowest in the world in absolute terms, per capita and on an annual basis. India noted 7,204 Mt of forest carbon reserves

in its strategy. At the same time, the goal of India's NDC is to create an additional carbon sink of 2.5 to 3 billion tons of CO₂ equivalent by 2030 [MoEFCC, 2022b]

India's forest protection and restoration policies include many programs with excellent results.

National Afforestation Program. It is carried out on degraded forest lands. The goal is to develop forest resources with the participation of people, with a focus on improving the livelihoods of forest communities, especially poor communities. From 2000–2002 until 2018–2019 there has been allocated 3,874.02 crore rupees (\$465.6 million) to various states, which is being used for cultivation or afforestation of a authorized area of 2.1 million hectares [PIB, 2019b].

The National Mission for Green India was launched in 2014 and aims to protect, restore and expand India's forest cover and respond to climate change. The mission target is to increase forest and tree cover by 5 million hectares and improve the quality of forest cover by another 5 million hectares (10 million hectares in total). The mission focuses on multiple ecosystem services such as biodiversity, water, biomass, conservation of mangroves, wetlands, critical habitats along with carbon sequestration. Mission goals from 2015–2016 to 2020–2020 were to restore and improve 167.2 thousand hectares, of which 117.5 thousand hectares were improved [PIB, 2022d].

The Afforestation Compensation Fund Management & Planning Authority is the program aimed at prioritizing the social aspects of forestry. Funds under the program are collected from public and private infrastructure developers as compensation for forest land converted to non-forest land through infrastructure projects. The fund is used to promote afforestation, reforestation and ensure the maintenance of ecosystem services. Overall achievement for 2021–2022 for compensatory afforestation plantations and penal compensatory afforestation at the national level is 938 hectares while the target was 1.063 million hectares, which is 88.24 per cent. [MoEFCC, 2022a].

The Forest Fire Prevention & Management Scheme provides financial support to states and union territories under the scheme for protection against forest fires. During 2020–2021 under the scheme was authorized 32.86 crore of rupees (\$3.95 million) for various states and union territories [MoEFCC, 2022a].

Conclusion

Thus, the main directions of Indian climate policy instruments are reducing greenhouse gas emissions in the energy sector, including the development of renewable energy sources, increasing energy efficiency, supporting the development of nuclear energy and research in the field of hydrogen technologies; development of environmentally friendly transport, including electric vehicles, phased introduction of fuel mixtures to reduce emissions, electrification of railway transport and research in the field of decarbonization of aviation. One of the priority areas for the government is the creation of an Indian emissions trading scheme, which in the first stage will include already proven schemes (RPO and PAT); One of the most developed policy areas is the protection and restoration of forest cover.

The most popular area of climate policy remains the increase in renewable energy capacity, which is primarily due to economic reasons. Reducing emissions in India's power sector poses several challenges. In the renewable energy sector at the state level, the acquisition of land for renewable energy sources is linked with competition with agricultural producers,

while available land is scarce. Difficulties were created by the new protectionist policy regarding components for renewable energy sources, which led to the return of import duties on low-cost Chinese components, and a shortage of components, which led to the delay in the commissioning of number renewable energy projects. Cheaper tariffs for renewable energy, coupled with falling prices for renewable energy certificates, have led to a decrease in interest from producers. Another problem remains the policy of distribution companies, which often give priority to cheaper energy from thermal power plants and limit the use of renewable energy sources.

The possibilities for increasing the share of natural gas are limited by the low level of domestic production, the lack of pipelines and high prices on the LNG spot market. A likely solution could be the construction of two gas pipelines, but the participation of Pakistan and Afghanistan in both projects, coupled with conflicts between other participants in the negotiation process, is unlikely to allow the projects to be launched in the nearest future. Another potential opportunity for India is participation in the Russian Arctic LNG-2 project and increasing supplies of liquefied gas, but in general, replacing coal with natural gas soon seems unlikely.

Nuclear energy projects have been hampered by interactions with the United States and France, primarily due to CLINDA and high electricity tariffs, and major projects have been delayed for more than a decade. However, thanks to cooperation with Russia, in the near term there will be a more than twofold increase in the installed capacity of nuclear power plants in the country.

Decarbonization of the industrial sector is one of the most labor-intensive areas of climate policy. The measures proposed by the Indian government are designed more for the long term, while at the current stage there are no systemic measures to reduce emissions in the industry. The most significant remains the energy efficiency policy and participation in the PAT scheme, which reduces emissions by saving energy consumed by enterprises. The introduction of renewable energy sources also makes it possible to reduce emissions through the consumption of clean energy. However, the transition to climate-neutral technologies in hard-to-reach industries such as cement and steel is still a distant question and will largely depend on funding, including support from foreign partners.

India is implementing a variety of measures to encourage greenhouse gas reduction in the transport sector. However, in 2023 and for the next decade, the dominance of internal combustion engine vehicles will continue. Moreover, a rapidly growing economy and increased spending on infrastructure projects will continue to support growth in the transportation sector, primarily driving sales of diesel-powered medium- and heavy-duty trucks. An increase in the number of vehicles on Indian roads will inevitably lead to an increase in the demand for fossil fuels. Due to its dependence on imported oil and petroleum products, India is forced to resort to economic measures to maintain petrol and diesel prices amid surges in energy prices. Despite the presence of many projects for the electrification of transport and the introduction of alternative fuels, the most likely scenario for the near future is the introduction of biofuel mix to reduce emissions. The cost of electric vehicles remains relatively high and significant investment is required in infrastructure deployment. As with other sectors, India relies heavily on financial and technological assistance from developed countries.

India has accumulated a certain experience in introducing market mechanisms that help to reduce the negative impact on the climate. However, their functioning poses challenges, the main is the incomplete implementation of obligations at the state level, in particular, this is demonstrated by the implementation of RPO. The challenge with the PAT scheme is the barriers to attracting finance for energy efficiency projects. The low interest of banks is due to the lack of

financial confidence in these projects and insufficient awareness of the banking community about the benefits of investing in energy efficiency, which is reflected in the value of securities and leads to high price fluctuations. Another problem remains the lack of continuous monitoring by the Bureau of Energy Efficiency, as well as rapid assessment of policies and plans, which does not allow the necessary adjustments to be made quickly to the operation of the scheme.

The carbon emission trading scheme project can go a long way towards addressing the shortcomings of existing market-based schemes in India. However, some questions remain unanswered. In particular, the governing body envisaged by the Ministry of Power project does not include such interested sectors as industry, agriculture, small and medium-sized businesses. The presence of a governing body that is not burdened with a bureaucratic component, on the one hand, will allow a prompter response to market issues, on the other hand, it leaves many interested industries without the opportunity to express their position on the most significant issues. The structure does not provide a mechanism for interaction between the board and the Paris Agreement Implementation and Compliance committee. In the stated program documents at the first stage, there is no interrelation and offset of energy saving and renewable energy certificates that are presented on the market. The interaction between the voluntary segment and obligated organizations is not taken into account.

India's forestry and reforestation policies are among the most developed climate policies. With some of the world's best forest conservation records and some of the lowest forest fire rates, India continues to develop forestry at all levels, from federal to municipal, and continues to develop new programs. In addition to conservation and restoration of forests, green spaces, parks and urban forests in cities are being increased.

In general, positive trends in climate policy largely depend on continued project financing, which is emphasized in all strategies. In the absence of external support in the face of internal obstacles, the implementation of the goal of achieving carbon neutrality may require more time than the stated goal of 2070. Moreover, by financial support, India does not mean loans, albeit on a preferential basis, but gratuitous grants, which are not fully partners from developed countries are ready to provide. An alternative is to increase the investment attractiveness of Indian projects and implement a quota trading system project, which will help attract additional financing.

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