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Net Zero Emissions and its Implications for India

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ABSTRACT

Concept of net zero emissions has gained currency in last few years. It is crucial to sustainability of earth systems. Net zero emission is primarily a scientific term that denotes state of carbon dioxide after strategies to cut down global greenhouse gas emissions are put in place. It is natural that cutting down greenhouse gas emissions and achieving net zero emissions cannot be visualised until it is included in the policies and programs of respective countries. Therefore, the term net zero emissions entered policy documents of the governments. From there, the term has disseminated to mainstream discussions in academia and businesses. In order to insulate human beings and the environment from the perils of climate change, it is imperative for every country to set targets to achieve net zero emissions and also to strive to achieve them through concrete plans and programs. In other words, net zero emissions signify decarbonisation of economy.

Climate change presents significant policy challenges for India, which must balance the need to improve living standards for its 1.4 billion citizens with the imperative to reduce global greenhouse gas (GHG) emissions. Despite the implementation of numerous policies aimed at promoting renewable energy manufacturing and usage and transitioning away from coal, substantial efforts are still required to achieve India's net zero goal by 2070. The government is focusing on several key policy initiatives to reach this goal, including decarbonizing the grid, industries, and transport sectors, as well as advancing carbon capture, utilization, and storage technologies. As of 2023, India is on the right track towards achieving its net zero target by 2070. This paper provides an in-depth review of India's current climate policy landscape and presents emissions trajectories under various policy initiatives aimed at reducing GHG emissions.

Keywords*: Greenhouse Gases, Carbon Neutrality, Net Zero, Carbon Sequestration, Carbon Capture and Storage.*

I. INTRODUCTION

Global warming is caused by CO_2 and other GHGs. However, global warming is expressed in terms of CO_2 emissions by the IPCC. Greenhouse gases include methane, nitrous oxide,

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hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride. Methane and hydrofluorocarbons are short-lived and therefore do not accumulate in the atmosphere for long. However, they act as powerful drivers of climate change. There is great deal of similarity among all IPCC pathways aimed at achieving 1.5℃ goal and achieving net zero for CO_2 emissions by 2050 and for GHGs by 2070. A variety of terms are in vogue with regard to terminology used for expressing net zero of emissions. Carbon neutrality refers to net zero emissions of CO_2 only while climate neutrality refers net zero emissions of all GHGs, that is both CO_2 and non-CO_2.

Global net zero emissions describe the state where emissions of carbon dioxide due to human activities and removals of these gases are in balance over a given period. It is often called simply net zero[2]. This can be possible by firstly reducing human-caused emissions (from fossil fuels-based vehicles and industries) and secondly by removing any leftover emissions by enabling increased forest areas to sequester carbon emissions and also by technological interventions namely direct air capture and storage (DACS)[3]. These left over emissions pertain to those actor's contribution to GHGs that is difficult to abate. These include sectors like farming, aviation, industries, and wastes. There is a subtle difference between carbon neutral and net zero emission. Carbon neutrality means removal of equal amount of CO_2 from the atmosphere as is being emitted. Net zero and carbon neutrality can be achieved by using offset credits, that can be traded in carbon markets. "Carbon markets have emerged to achieve emission reduction targets mainly residual emissions that cannot be removed from the atmosphere by the companies"[4]. The premise of carbon markets is that release of CO_2 and GHGs somewhere is offset by their sequestration anywhere in the world by suitable land-based carbon fixing activities. The agency involved in carbon fixing gains credit, and it can trade with agencies emitting carbon surplus CO_2 and GHGs.

Environmental, social and governance[5] (ESG) emerged in recent years and is increasingly playing important role in reducing emissions responsible for global warming. ESG indices play important role in investment and lending decisions of companies.

[2] Kelly Levin et al., *What Does "Net-Zero Emissions" Mean? 8 Common Questions, Answered* (March 20, 2023), https://www.wri.org/insights/net-zero-ghg-emissions-questions-answered.
[3] *Id.*
[4] Noah Miller, *Net Zero v Carbon Neutral*, Corporate Finance Institute (Mar. 29, 2024, 10:04 AM), https://corporatefinanceinstitute.com/resources/esg/net-zero-vs-carbon-neutral/.
[5] Environmental, social, and governance, is a set of aspects, including environmental issues, social issues and corporate governance that can be considered in investing. Investing with ESG considerations is sometimes referred to as responsible investing or, in more proactive cases, impact investing.

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II. HISTORY OF NET ZERO EMISSIONS

Myles Allen, Dave Frame, and other scientists publish a paper in 2009 highlighting that the eventual extent of global warming is largely determined by cumulative emissions of CO_2. Therefore, the problem of global warming lies in stock of accumulated CO_2 rather than the current flow. It was precisely for this reason that Susan Solomon and other scientists had demonstrated in 2009, that temperatures do not decline even after a complete stopping of CO_2 emissions. Damon Mathews and other scientists proposed in 2012, that cumulative carbon emissions represent an alternative framework that is applicable both as a tool for climate mitigation and for the assessment of potential climate impacts.

The IPCC Fifth Assessment Report 2013 stated that limiting global temperature change means limiting the cumulative (stock) of CO_2 emissions in the atmosphere. To eventually stop global warming, net anthropogenic additions of CO_2 into the atmosphere have to reach zero. Article 4.1 of the Paris Agreement 2015 stipulates parties aim to reach global peaking of greenhouse gas emissions as soon as possible so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of the century.

The IPCC Special Report 2018 on 1.5℃ scenario concludes that limiting temperature rise to around to 1.5℃ and preventing the worst impacts of climate change implies reaching net zero emissions of CO_2 by mid-century along with deep reductions in non-CO_2 emissions (greenhouse gases other than CO_2)[6]. Many countries of the world have made pledges to achieve net zero emissions.

(A) The Paris agreement and net zero emissions

The Fifth Assessment Report of the IPCC 2014 established that human influence on the climate system is beyond doubt, and it is driven by economic and population growth following the pre-industrial times. This led to unprecedented concentrations of greenhouse gases (GHG). It forewarned that is further negative impacts of global warming are to be avoided, it should follow a pathway of carbon reductions substantially so as to contain global warming to below 2℃ relative to pre-industrial levels over the next decade and near zero emissions of CO_2 and other GHGs by the end of the century[7]. Later in 2015, the Paris Agreement mandated upon the member states to limit global average temperature to well below 2℃ above pre-industrial levels and take steps to limit the temperature increase to 1.5℃ above pre-industrials levels. The IPCC

[6]John Lang, *Net Zero: A short history*, Energy and Climate Intelligence Unit (8 January 2021), https://eciu.net/analysis/infographics/net-zero-history.
[7] Fabiano de Andrade Correa & Christina Voigt, The Paris Agreement and Net-Zero Emissions: What Role for the Land-Sector?, 15 CCLR 1 (2021).

Special Report 2018 stressed that the pathway aimed to maintain global warming within 1.5℃ would require drastic reductions in anthropogenic gas emissions. It stated that achieving 1.5℃ scenario would require a decline of global net anthropogenic CO_2 emissions of around 40-60% from 2010 levels by 2030 leading to net-zero emissions to around 2050. However, this would result in net-zero emissions for non-CO_2 emissions to around 2070. This would require staying net-negative thereafter.

Following the Paris Agreement of 2015 and the IPCC Special Report 2018, net zero emissions have become an important target for the countries to achieve. Success in achieving net zero emissions will also depend on protection of carbon sinks and efficient methodology to undertake removal of GHGs from the atmosphere. Removal of GHGs from the atmosphere will therefore depend on efficient protections of soils, peatlands, mangroves, and forests.

(B) Global Net Zero Emissions and Need for Clean Technology Push

Many countries of the world and some businesses have pledged to achieve net zero emission target. Their number has grown to about 70% of global CO_2 emissions[8]. However, their pledges do not entail required strategies both in short term and long term to achieve the committed goal. Developmental activities in the government and businesses put heavy demand on energy. Therefore, energy hold the key to abatement of greenhouse gas emissions. Reduction in prices of renewable energy technologies give electricity an upper hand in achieving net zero. It is imperative that scale of operation of solar and wind energy is enhanced. Further, hydropower and nuclear energy can also contribute to speed up green energy transition. Following decarbonisation of electricity grids, electricity becomes greener and cleaner and can significantly contribute achieving net zero emissions targets by the end of 2050 as envisaged by the Paris Agreement and the IPCC Special Report 2018. Recent push in electric vehicles is an indication for global car sales to around 60%. "This may require further commitment and support from the government in phasing out fossil fuel subsidy, carbon pricing and other market reforms"[9].

Biggest innovation opportunities are possible in the areas of development of advanced batteries, hydrogen electrolysers, and direct air capture and storage. These three areas hold key to the success of achieving net zero emission by 2050 as envisages earlier. Two-thirds of total energy supply in 2050 (net zero emission year as envisaged) will come from wind, solar, bioenergy, geothermal and hydropower sources. Solar energy becomes the largest source of total energy

[8] IEA, *Net Zero Emissions by 2050 Scenario (NZE)*,
Global Energy and Climate Model, 13 (2023), https://www.iea.org/reports/global-energy-and-climate-model
[9] *Id.* at 14.

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supplies and will account for roughly one-fifth of total energy requirement. Share of fossil fuel will fall around one-fifth of today's total energy requirement from four-fifths currently. Fossil fuels surviving in 2050 will actually be required in goods where carbon is required in their making like plastics, in facilities supporting devices for carbon capture, utilisation and storage and in those sectors where low-emissions technology options are not readily available. Electricity will meet 50% energy demands in 2050. In net zero emissions state, no new oil and gas fields need to be approved and no new coal mines need to operated and expired leases should not be renewed.

(C) India and its Engagement with Net Zero

The COP 26 Summit at Glasgow is important for India with regard to announcement of net zero targets by the Indian Prime Minister. At this global summit, India committed to an ambitious "Panchamrit Pledge". Panchamrit is derived from Sanskrit language where pancha means five and amrit means "immortal" or "nectar of the gods". These five pledges were to be achieved by 2030. They included reaching 500 GW of non-fossil-based electricity, generating half of all energy requirements from renewable sources, to reduce emissions by 1 billion tonnes by 2030, to reduce emissions intensity of GDP by 45% and finally achieving net zero emissions by 2070. These commitments are vital in the global pathway to achieving 1.5℃ global warming target[10].

India's transition to net zero economy will be important in saving lives, support new industries, creating over 50 million jobs and contributing more than 15 $ trillion in economic impacts. India's strategy to achieve net zero emission signalling green growth must focus on greening operations in five key sectors that include energy, transport, industry, green buildings, and agriculture. These are the five pillars and concerted efforts would be required enabling India to move towards achieving 1.5℃ scenario by 2070.

Energy sector accounts for around 40 % of India's GHG emissions with coal occupying leadership role in meeting energy needs of the country. Actions to decarbonize energy sector will include a three-pronged strategy of replacing fossil fuels with renewable sources, reducing fossil CO_2 emissions from legacy infrastructures through enhancing efficiencies and removing unavoidable carbon emissions by carbon sequestration processes. Legacy infrastructures are those that were built up in past and still operational. However, they do not offer scope for structural changes to meet current challenges.

[10] World Economic Forum, *Mission 2070: A Green New Deal for a Net Zero India*, White Paper (WEF) 4 (Nov. 2021), https://www3.weforum.org/docs/WEF_Mission_2070_A_Green_New_Deal_for_a_Net_Zero_India_2021.pdf.

Transport sector in India is heavily dependent on oil and account for roughly half of India's oil demand. There is need to bring about a green transformation in transport sector in India. This would include more and more use of rail networks and fuel diversification to encourage green fuels like biofuels, CNG and LNG on immediate basis, electrifying energy production in the medium term and hydrogen-based transport in the long term[11]. Industry contributes to India's GHG emissions. Indian industries manufacture key requirements of rapid modernization of the country like iron and steel, cement, chemicals, and fertilizers that make highest contribution to CO_2 emissions. These industries have to be decarbonized by measures like circular economy, energy efficiency improvements, more and more electrification of heating requirements, carbon capture, utilization and storage, low carbon fuels such as biomass and hydrogen etc.

India is expanding its physical and social infrastructures at a phenomenal rate. Cities are multiplying and villages are getting converted into sub-urban areas initially before their migration to becoming full-fledged cities in themselves. There would be need for promoting green infrastructure and green cities so that their carbon footprints remain lower. Agriculture sector is the largest contributor to nitrous oxide (N_2O) and methane emissions. There would be need to sensitise Indian farming community to go for sustainable animal husbandry. The above five are the pillars of India's strategy for its smooth transition to net zero emission.

Net zero will also bring notable benefits for the Indian people. The transition will see a net increase in employment opportunities, creating as many as 15 million jobs beyond a baseline scenario by 2047. Households could save as much as $9.7bn in energy costs by 2060[12].

(D) India's transformation to Net Zero Emissions Scenario

India is now the fifth largest economy in the world. The speed of her development far exceeds most countries. India has also surpassed China in terms of population. India is also home to a large number of young populations making it an ideal country for not only economic transformation but also for its rendezvous with net zero emissions. India is striving to achieve its net zero emissions target within the overall framework of its sustainable development agenda. India's National Action Plan on Climate Change 2008[13] with all its eight missions was an early statement to achieve economic development with twin objectives to achieve carbon neutrality and job creation in new opportunities to produce green and clean energy. "India

[11] *Id.* at 5.
[12] Asia Society Policy Institute, *Getting India to Net Zero*, 7 (2022), https://asiasociety.org/policy-institute/getting-asia-net-zero/country-report-india.
[13] Press Information Bureau, *National Action Plan on Climate Change (NAPCC)*, Ministry of Environment, Forest & Climate Change, 2 (Dec 1, 2021), https://static.pib.gov.in/WriteReadData/specificdocs/documents/2021/dec/doc202112101.pdf.

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submitted its first nationally determined contribution to UNFCCC in 2015 and has already shown significant progress in achieving reduction in emissions intensity in its economy by 33-35% compared to 2005 level. India also achieved 40% of its electrification from non-fossil fuel-based sources in 2022"[14].

India has taken strides in increasing electricity grid connections and last mile connectivity, providing sustained supply of electricity in rural areas, supplying LPG to households, and affording solar power to farmers in meeting the requirements of agriculture sector. Measures to enhance energy efficiency has also been put in place with necessary policy changes like providing LED lighting and to provide incentives for energy efficient initiatives by the businesses. Solar and bioenergy opportunities have also been given exclusive priority in meeting the energy demands of households. Decarbonisation of transport sector through measures like production of hybrid and electrical vehicles is likely to contribute to India achieving its commitment to achieve net zero emissions targets.

India is also on its path to achieve setting targets to produce green hydrogen to the tune of 5 million tonnes. The government of India approved carbon credit trading scheme which will benefit India to achieve low carbon economy. India has also envisaged developing a market for carbon-capture and storage (CCC) though suitable technology as per the detailed report published by the Niti Aayog.

(E) Pillars of India's Energy Transition to Net Zero by 2070.

India's pledge to the international community to achieve net zero emissions by 2070 would revolve around bringing fundamental changes that include grid decarbonisation, industrial decarbonisation, and transport transition in terms of energy production from green and clean sources[15].

a. Grid Decarbonisation Initiatives:

In order to achieve decarbonisation of grid, India needs to gear up its production of non-fossil-based sources of electrical energy. Currently, electricity accounts for 18% share in energy basket in India which has to increase to 50% by 2070. In order to achieve this tall commitment, there would be need to produce 2000 GW from renewable sources like solar and wind and 1000 GW from green hydrogen. Achieving these twin objectives, it is incumbent upon the central and state government to complete formalities related to commissioning of these projects by

[14] TERI, *India Transforming to a net-zero emissions energy system.* 17 (2023), https://teriin.org/sites/default/files/files/India-Scenarios-Sketch.pdf.
[15] FICCI, *India's energy-transition pathways A net-zero perspectives,* Deloitte, 7 (Sept. 2023).

fulfilling contract formalities. If required, trade restrictions may also be reduced until the newly commissioned projects in renewable energy is achieved. Hydropower and nuclear energy generation will play important roles in decarbonisation of grids.

India's achieving net zero emissions targets by 2070 will depend on phasing out coal-based power plants and early closure of coal mines. Energy storage currently is not adequate which will need to be augmented to meet energy storage capacity for six to eight hours of battery storage. Our petrol pumps would also need to have wherewithal to supply hydrogen as fuel obtained from non-fossil-based energy resources[16].

b. Imperatives of Industrial Decarbonization:

Industries account for roughly 30% energy related greenhouse emissions. Major sectors responsible for carbon footprints include steel, cement, aluminium, and fertilizers. Each industrial portfolio has to innovate in the areas of structural changes in designing the plant and machinery, economic and feasibility of scale of operations. Green hydrogen, carbon capture, utilization, and storage (CCUS[17]) will find differential usages in different sectors of industries. Green hydrogen will be increasingly finding place in industries like fertilizers, refineries, steel, and transport. A large part of energy requirement in these sectors will be met from green hydrogen (GH_2) by 2070. Carbon capture, utilisation, and storage is another potential area which will find their use in cement sector. The government needs to come forward with CCUS projects in the early years through policy support and incentives to private players.

c. Necessity of transition in Transport Sector:

The road transport sector accounts for 12% contribution to CO_2 emissions. This is due to the fact that a large percentage of powering motor transport in country is dependent on fossil-based energy sources. Therefore, it is incumbent upon India to bring about complete transformation of India's transport sector based on low emission technologies. These would include Battery Electric Vehicles (BEV), Fuel Cell Electric Vehicle (FCEV), Hydrogen Combustion Engine (H_2-ICE), and Biofuel etc. There would also be necessity to develop massive charging infrastructure supported with efficient urban planning for achieving low carbon economy by 2070. This could be done by encouraging Public-Private Partnership (PPP) to establish charging infrastructure across the country and also to meet the requirement of supplying hydrogen fuel. In addition to transport sector investment should be made in Indian railways in the areas of

[16] *Id.* at 13.

[17] Carbon capture, utilization, and storage (CCUS) is the process of capturing carbon dioxide emissions and either using them to make things such as building materials (utilization) or permanently storing them thousands of feet below the surface (storage).

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freight corridors, mass public transit towards low carbon economy. There should also be an elaborate battery recycling facilities developed on big scale along with necessary policy changes including incentives for the operators. Energy transition in respect of India will be costing dearly. There would be necessity of approximately US $ 15 trillion to achieve net zero by 2070. The government agencies, the private sector and multi-lateral development banks will have to come forward in financing measures aimed at achieving net zero emissions. Energy transition process is required to be supported by central government, state governments, and from captains of Indian industries and private resource persons.[18]

d. Carbon Capture, Utilization and Storage:

The power sectors only contribute to about one third of the aggregate CO_2 emissions, which is bound to decrease with the increase in the share of energy derived from renewable sources. However, there are some sectors of development where it will be difficult to reduce production of CO_2 and other greenhouse gases. In order to address these hard emissions that are difficult to abate technology of Carbon Capture, Utilization and Storage (CCUS) can play an important role in decarbonizing India's industries. In these hard sectors of economy fossil fuels are used not only as sources of energy but are also used in industrial applications as intermediates. Direct Air Capture (DAC) directly captures dilute carbon dioxide from the air and may be recognized as a tool to capture carbon. However, the concept of DAC is quite new, and its framework and feasibility are yet to be put in place[19].

(F) Progress of India's Nationally Determined Contributions (NDCs)

As a party to the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement, India submitted its first Nationally Determined Contribution (NDC) in the year 2015 comprising, *inter-alia,* of following three quantifiable targets:

i. To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.

ii. To achieve about 40 percent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030; and

iii. Creation of additional carbon sink of 2.5 to 3 billion tonnes of CO_2 equivalent through additional forest and tree cover.

First two targets have been achieved well ahead of the time. As on 31st October 2023; the

[18] FICCI, *supra note 15,* at 9.
[19] NITI Ayog, *Carbon Capture, Utilization and Storage (CCUS),* Dastur, 16 (Nov. 2022), https://www.niti.gov.in/sites/default/files/2022-12/CCUS-Report.pdf.

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cumulative electric power installed capacity from non-fossil fuel-based energy resources is 186.46 MW, which is the 43.81% of the total cumulative electric power installed capacity. As per the third national communication submitted by India to the UNFCCC in December 2023, the emission intensity of its GDP has been reduced by 33 percent between 2005 and 2019.

In August 2022, India updated its NDC according to which target to reduce emissions intensity of its GDP has been enhanced to 45 percent by 2030 from 2005 level, and the target on cumulative electric power installed capacity from non-fossil fuel-based energy resources has been enhanced to 50% by 2030[20]. In the NDC of 2022, the carbon sequestration target has remained unchanged. Carbon sequestered from forests is estimated to be 631.54 million tonnes of CO_2 e, and carbon sequestered from TOF is estimated to be 293.84 million tonnes of CO_2 e. Therefore, the total carbon sequestered in 2020 is 925.38 million tonnes of CO_2 e[21].

(G) **Exploring connections between the Paris Agreement and the Agenda 2030.**

The Paris Climate Change Agreement, signed on December 12, 2015, and the Sustainable Development Agenda, adopted in September 2015, are critical for sustaining human life and the environment on our planet. Currently, these two processes are advancing in parallel, with limited communication regarding their interface. Policies and action plan addressing climate change and sustainable development are being formulated independently, with little or no coordination to develop strategies that connect both agendas. National sustainable development strategies have been established to achieve targets outlined under the 17 Sustainable Development Goals (SDGs), while the Paris Climate Change Agenda aims to be realized through the implementation of rational and pragmatic Nationally Determined Contributions (NDCs) submitted by member nations to the UNFCCC Secretariat.

However, there is a lack of analysis to enhance our understanding of the overlaps and gaps between NDCs and SDGs. By addressing this, both agendas can more efficiently achieve their targets. Currently, there is institutional fragmentation in the governance of climate change and sustainable development at both global and national levels, creating an additional obstacle to coherent implementation processes.

To increase coherence in the implementation of both agendas, more knowledge is needed at both global and national levels. One possibility is to investigate the links between NDCs and

[20] PIB, *India achieves two targets of Nationally Determined Contribution well ahead of the time,* Ministry of Environment, Forest and Climate Change, (18 Dec. 2023), https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1987752.

[21] The Energy and Resources Institute, *Estimation of the Current Emission and Sequestration, As Well As Future Potential of Sequestration/Emission Reduction to Achieve Land Degradation Neutrality in India,* TERI, 10 (Sept. 2020), https://www.teriin.org/sites/default/files/2021-02/estimation-current-emission.pdf.

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SDGs. It is desirable to identify possible areas of conflict and trade-offs between the two agendas so that they may work in tandem. For example, the use of biofuels for energy production can reduce greenhouse gas emissions, but it may also negatively affect food prices due to competition over land resources used for food production. Additionally, biofuels may harm ecosystems and biodiversity through the increased expansion of monoculture. The use of fertilizers and pesticides for biofuels can also impact soil and water quality. Therefore, progress toward achieving SDG 7 (Affordable and Clean Energy) may negatively affect the achievement of SDG 2 (Zero Hunger), SDG 6 (Clean Water and Sanitation), and SDG 15 (Life on Land/Protect and Restore Ecosystems).

To achieve coherent implementation of both agendas, an adequate methodology to determine trade-offs must be developed. Improved understanding of these interactions is required to manage goal conflicts among economic, social, and environmental policy objectives[22].

III. CONCLUSION

India's net zero emissions target of 2070 represents a significant commitment to addressing climate change while balancing developmental needs. Achieving this target will necessitate transformative changes across multiple sectors, including energy, transportation, industry, and agriculture. This conclusion synthesizes the key findings and implications of India's net zero commitment, providing a framework for future policy and action. The 2070 net zero target underscores India's recognition of the urgent need to combat climate change and its readiness to contribute to global efforts. It aligns India with the broader international community's climate goals, reinforcing its role in global climate governance. This target, set for a developing nation with substantial developmental challenges, is both ambitious and critical for global climate mitigation.

To achieve net zero emissions, India must undergo profound transformations across various sectors. Energy Sector: A shift from fossil fuels to renewable energy sources is paramount. Expanding solar, wind, and other renewable energy capacities, coupled with advancements in energy storage and grid infrastructure, will be crucial. Transportation: Transitioning to electric vehicles (EVs), improving public transportation, and promoting sustainable urban mobility are essential. This includes the development of EV infrastructure and incentivizing clean transportation options. Industry: Decarbonizing industrial processes through technological innovation, energy efficiency measures, and the adoption of clean technologies will be vital. Industries must also focus on circular economy principles to reduce waste and emissions.

[22] Stockholm Environment Institute, *Connections between the Parties Agreement and the 2030 Agenda*, 6-7 (2019).

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Agriculture and Land Use: Sustainable agricultural practices, afforestation, and reforestation efforts will play significant roles in carbon sequestration and emission reductions.

Achieving the 2070 target will require a robust policy and regulatory framework. This includes Policy Coherence: Integration of climate goals into national development plans and policies to ensure coordinated efforts across sectors. Regulatory Measures: Implementation of stringent emissions standards, carbon pricing mechanisms, and incentives for clean technologies. Financial Mechanisms: Mobilizing domestic and international financing to support green investments and innovation. This involves leveraging public and private sector funds, as well as international climate finance.

The transition to a net zero economy presents both challenges and opportunities for India's socioeconomic landscape. Employment: The renewable energy sector and green technologies have the potential to create substantial employment opportunities. However, there will also be a need for reskilling and supporting workers transitioning from traditional sectors. Equity and Inclusion: Ensuring an equitable transition is crucial. Policies must address the needs of vulnerable communities and promote inclusive growth to avoid exacerbating social inequalities. Health Benefits: Reductions in air pollution due to decreased reliance on fossil fuels will have significant public health benefits, potentially reducing healthcare costs and improving quality of life.

Investing in research and development (R&D) is critical for achieving the net zero target. Innovation in clean technologies, energy storage, carbon capture and storage (CCS), and sustainable practices will drive the transition. Collaboration between government, academia, and the private sector will be essential to foster technological advancements. India's net zero commitment highlights the importance of international cooperation. Sharing best practices, technological transfers, and financial support from developed countries will enhance India's capacity to meet its climate goals. Strengthening global partnerships will be key to addressing the common challenge of climate change.

India's 2070 net zero emissions target is a bold and necessary step toward sustainable development and climate resilience. It sets a long-term vision that requires immediate and sustained action across all sectors of the economy. By embracing this target, India not only contributes to global climate stability but also paves the way for a sustainable and inclusive future. The journey towards net zero will be complex and demanding, but with strategic planning, robust policies, and collective effort, it is an achievable and transformative goal.

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