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Climate Change and India: Balancing Domestic and International Interests

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In this paper, we analyze how India's climate change policy is framed, formulated and implemented and argue that it requires carefully balancing of domestic and international interests. Given the country's population size, composition and projected economic growth, India will, in the next few years, see its most significant energy demand upsurge along with a massive need for infrastructure. As projected by the International Energy Agency, "nearly 60% of its CO_2 emissions in the late 2030s will be coming from infrastructure and machines that do not exist today". As a result, policy choices made today by India's decision-makers and international negotiators will have severe implications for the world.

This paper analyzes global emission trends, climate change impacts and India's international and domestic climate policies—from Paris to Glasgow and New Delhi to rural India. Furthermore, we examine the core constraints that Indian policymakers face and draw attention to shortcomings in India's climate change policies, particularly concerning continued investment in coal despite the country's widely lauded efforts to embrace renewables. We argue that fossil fuel subsidies are a delicate political issue with significant implications for many election-determining poor citizens—hence accompanying "just transition" measures are essential.

Keywords: Climate change; impact; policy; mitigation; sustainable development goal 13 climate action.

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Introduction

Climate change is one of the most critical challenges of our time. Moreover, it is a challenge that requires an unprecedented change in a wide range of sectors, including energy production, heating, transportation, industry, construction and agriculture. The special responsibility of the largest emitters is highlighted by the cumulative carbon dioxide (CO_2) emissions from 1751 (nine years before the beginning of the Industrial Revolution) to 2017. The largest emitters are the United States (25% of cumulative global emissions), the European Union, EU-28 (22%), China (14%), Russia (7%) and Japan (4%) (Our World in Data, 2022).

The latest Intergovernmental Panel on Climate Change (IPCC) report, released in March 2022, pinpointed India as one of the vulnerable hotspots. Projections include several regions and large cities facing a very high risk of climate disasters such as flooding, rising sea levels and heat waves. (Intergovernmental Panel on Climate Change [IPCC], 2022) At the same time, "70 to 80% of the India of 2030 is yet to be built", estimated a report by McKinsey (2010, p. 207). In 2023, India will overtake China as the most populated country (BBC, 2022). By 2030, India will have a population of 1.5 billion, compared to 1.43 billion in China (World Bank, 2022). More than every 5.6th person on the planet will be Indian. So, it matters not only to Indians but to the World how sustainable India's infrastructure will be.

In this paper, we analyze how India's climate change policy is framed, formulated and implemented and argue that it requires careful balancing of domestic and international interests. The dilemma of fast economic growth versus sustainable development is considered, as well as the short-term versus the long-term. In this paper, we introduce India's emission trends and climate change impacts. We then analyze India's international and domestic climate change policies—from Paris to Glasgow and New Delhi to rural India—and some core constraints and opportunities that Indian policymakers face.

Global Emission Trends

India's share in global emissions was merely 6% in 2020 (see Table 1)—whereas the Indian population at the same time was nearly 18% of the worldwide population. This compares to the current global emissions share of 24% by China (18% of the world population) and 16% by the US (4% of the world population). These are current global emissions. The share of *cumulative* CO_2 emissions by geographic regions shows that from 1850 to 1990, Europe and the USA account for just over 70% of all

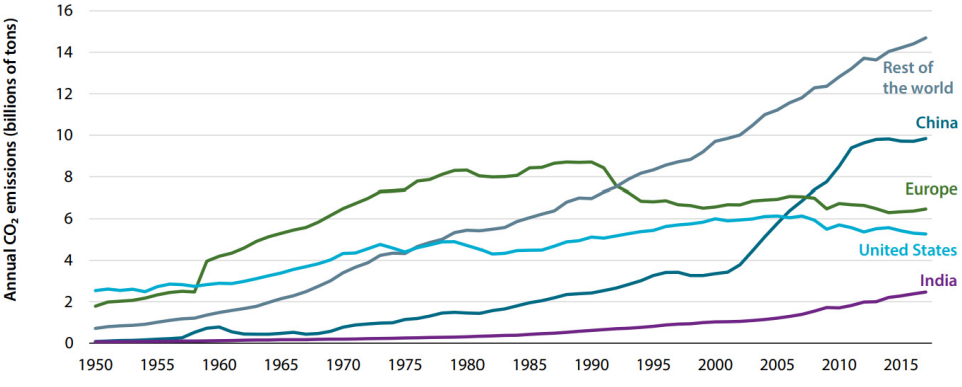
Table 1.
Biggest Emitters in 2021 (China, United States, EU, India, Russia, Japan): Global Share, Per Capita Consumption, Growth Rate and Primary Energy Consumption by Source

	Global Share (%)	Growth Rate per Annum 2011–2021 (%)	Gigajoule per capita 2021	Oil (%)	Coal (%)	Natural Gas (%)	Hydro Electric (%)	Renewables (%)	Nuclear Energy (%)
China	27	3.4	109	19	55	9	8	7	2
United States	16	0.05	280	38	11	32	3	8	8
EU	10	−0.6	135	35	11	24	5	13	11
India	6	4	25	27	57	6	4	5	1
Russia	5	0.7	215	21	11	55	6	0	6
Japan	3	−1.3	141	37	27	21	4	7	3
World	**100**	**1.3**	**76**	**31**	**27**	**24**	**7**	**7**	**4**

Data Source: (BP, 2022); Percentages: Authors' calculations.

historical emissions. (Stanford Institute for Economic Policy Research [SIEPR] & Brookings Hamilton Project, 2019 October) Since then, primarily China's emissions have increased substantially (see Figure 1)—so that for the period 1850–2017, Europe and the USA account for just over 50% of all historical emissions, China for just over 10%, India for around 3% and the rest of the World represents more than 25%. (ibid.)

The World is estimated to have a remaining "carbon budget" of 945 gigaton emissions to ensure a 66% chance of warming below 2°C above pre-industrial levels. (Borunda, 2021; Jan 19) Despite the substantial reduction in economic activities around the World due to COVID-19 restrictions, including full lockdowns, the World



Source: (SIEPR & Brookings Hamilton Project, 2019 October).

Fig. 1. Annual CO_2 Emissions by Geographic Region, 1950–2017.

still added 40 gigatons in 2020—34 from fossil fuels (down from 36 in 2019) and six from land-use change such as deforestation. We would spend the total outstanding carbon budget in less than 25 years at this level of emissions. For a 66% chance to stay below the more ambitious 1.5°C target—which the Paris Agreement parties agreed to "pursue efforts" towards—the World has merely 195 gigatons left from its carbon budget. This translates to only five years to achieve net zero at the current emissions level.

Negative emissions—reforestation or carbon capture and storage—play an increasingly significant role in policy scenario planning. Net-zero means that total emissions are around zero—after accounting for carbon sequestration, another word for the long-term removal or capture of carbon dioxide from the atmosphere. Carbon sequestration helps to slow down or reverse CO_2 pollution in the Earth's atmosphere and thus to mitigate or reverse global warming. Carbon sinks retain carbon and prevent it from entering the atmosphere of the Earth. Forests, as well as oceans, are such carbon sinks. While deforestation leads to the release of stored carbon into the Earth's atmosphere, planting forests, on the other hand, is a form of carbon sequestration.

Most primary energy consumption[1] in the World (still) comes from fossil fuels—a stunning 82% in 2021 (See Table 1—columns oil plus coal plus natural gas). Oil (31%), coal (27%) and natural gas (24%) still contribute on a different scale than hydroelectric (7%), renewables (7%), and nuclear energy (4%). (BP Global, 2022)

In the US, energy consumption was 280 gigajoules per capita, compared to 109 in China and 25 in India. This is despite production having moved East. So a substantial part of China's per capita energy consumption is to produce exported goods. This is reflected in the data on the largest carbon dioxide emitters in 2021: China (27%), the United States (16%), European Union (10%), India (6%), Russia (5%) and Japan (3%) (BP Global, 2022). The largest emission growth rates for the period 2009–2019 (so before COVID brought many economies to a halt) have occurred in Vietnam (10.9%), Bangladesh (7.4%), the Philippines (6.5%), Oman (6.4%), Sri Lanka (5.8%), Qatar (5.6%), Iraq (5.5%), Turkmenistan (5.4%), Peru (4.9%), Indonesia (4.6%) and India (4.5%) (BP Global, 2021, p. 15). Economic growth and emissions go (still) hand in hand. Hence, it is unsurprising that (fast) emerging markets, including Vietnam, Bangladesh and India, also have some of the highest emission growth rates. This

[1]Eurostat (2021) defines: "Primary energy consumption measures the total energy demand of a country. It covers consumption of the energy sector itself, losses during transformation (for example, from oil or gas into electricity) and distribution of energy and the final consumption by end users. It excludes energy carriers used for non-energy purposes (such as petroleum not used for combustion but for producing plastics)."

highlights the increasing importance that large emerging markets with high economic growth rates, such as India or Indonesia, are central to addressing climate change. While the emissions in the US were stagnating in the last decade, those of China rose by 3.4% and those of India by 4%. (See Table 1)

So, we need to focus on climate change commitments and policies of these fast-emerging markets with large populations, not least India. But why should India bother? Apart from an arguably moral obligation of all countries to be part of the solution, and apart from co-benefits like cleaner air—a strong argument in a country with many of the World's cities with the highest air pollution[2]—there are vast economic opportunities in renewable energy, electrification and sustainability.

The World faces a massive challenge in achieving net zero emissions by 2050, which would provide a 50% chance of limiting global warming to 1.5°C above pre-industrial levels, according to the *World Energy Outlook* by the International Energy Agency (IEA) (2020). The 2016 UN Paris Agreement on Climate Change aims to avoid dangerous climate change by limiting global warming "to well below 2°C and pursuing efforts to limit the temperature increase to 1.5°C." (UNFCCC, 2015, Article, 2.1.a) But what would this entail? The IEA's 2020 World Energy Outlook "Net Zero Emissions by 2050" case requires a range of ambitious measures to be successful, including: (1) Solar photovoltaics investment increase fivefold by 2030. (2) Most major coal plants are shut down by 2030 or capture their emissions. (3) Electric cars make up 50% of the cars sold in 2030—in contrast to 9% in 2021 (triple the market share compared to 2019) (International Energy Agency, 2022). (4) The retrofitting of buildings progresses at an unprecedented pace. (5) Industrial production uses energy sources for heat that hardly exist today. (6) A range of 11 behavioral changes, including video conferencing instead of short-distance flights, reducing the standard temperature in buildings and limiting the speed of cars.

However, before we examine India's international and domestic responses to climate change, let us first look at India's predicted climate change impact.

[2]Of 30 cities worldwide with the worst air pollution in 2019, 21 were based in India. (AirVisual (2021); CNN (2021)) The Supreme Court rejected in June 2020 a request by power producers to extend a deadline to install emission-reducing equipment (Times Of India (June 22, 2020)). While utilities have missed earlier deadlines (at the end of 2017 and 2019), citing costs and technical difficulties, the Indian Ministry of Power asked for further extensions for coal-fired power plants around New Delhi in 2020. (Varadhan (January 10, 2020))

The Impacts of Global Warming on India

Human-caused climate change has increased the average global surface temperature by around 1°C since 1880, before the Industrial Revolution. (NASA, 2021b) Given the current policies, the latest projections by Climate Action Tracker (CAT) (2021) estimate a warming of 2.7°C by 2100. Suppose all the current 2030 targets (without long-term pledges) given by countries as Nationally Determined Contributions (NDCs) under the Paris Agreement are fulfilled. In that case, CAT estimates a 2.4°C warming by 2100. For the most optimistic scenario, CAT includes all net-zero targets (in addition to the Paris pledges) and their effect on non-CO_2 emissions. CAT estimates a 2.1°C warming in this best-case scenario.

What is so problematic about having higher temperatures?

First, heatwaves, droughts and wildfires—their number and devastation increased in the last decade, which was the hottest on record. 2020 is tied with 2016 as the hottest year on record, followed by 2019, 2017, 2021, 2015 and 2018 (World Meteorological Organization [WMO], 2022). Most recently, June 2022 was tied with 2020 as Earth's warmest June on record (Masters, 2022).

Second, extreme weather events become more frequent and intense. Hurricanes and typhoons get their energy from warm ocean waters and are predicted to become even more frequent, more intense, and longer lasting than the records set in the last decade. Changes in rainfall patterns are also expected. They are likely to lead to more flooding in some countries, not least those already heavily affected, like Bangladesh. And they are likely to lead to more desertification and droughts in other regions.

Third, sea level rise has already occurred—around 20 cm since reliable data became available in 1880. Different scenarios predict a further sea-level rise between 30 cm and 2.4 meters by 2100, depending on the increase in temperature. (NASA, 2021a) Why is this the case? Because of the additional water from melting land ice and the expansion of seawater as it warms.

Fourth, the Arctic is predicted to be ice-free. There will also be longer seasons without frost, which are expected to affect agricultural production—increasing food production in some countries (e.g., the US) and decreasing food production in many countries, not least those closer to the equator.

Fifth, the future impact on food security, conflicts (not least regarding resources like freshwater), and internal and international migration remain unknown, but the projections are not promising. The US Department of Defence, in its 2014 *Quadrennial Defense Review*, depicted the effects of climate change as "threat multipliers". It argued that climate change increases the stress of challenges "such as poverty,

environmental degradation, political instability, and social tensions–conditions that can enable terrorist activity and other forms of violence." (US Department of Defense, 2014, p. 8). Hence, resource conflicts and migration are likely to increase.

The United Nations predict various adverse climate change impacts for India, ranging from extreme heat to monsoon rainfall decline—while the heavy rainfall frequency increases. Depending on the region, this will lead to a rise in droughts and flooding. Melting glaciers and the rising sea level are visible effects. Less known is the decline of groundwater resources. The impact on agriculture will have profound implications for India, where this is still the largest sector for employment. The livelihood of most Indian rural households (70%) depends primarily on agriculture. Most farmers (82%) are classified as small or marginal farmers. (Food and Agriculture Organization of the United Nations [FAO], 2021) Moreover, most Indian agriculture (58%) is monsoon-dependent (IPCC, 2019, ch. 6, p. 17). This makes India particularly vulnerable to the impact of changes in rainfall patterns.

The IPCC (2019) warned that parts of India were already heavily affected by desertification and salinization. Desertification in India affected 81.4 million hectares in 2005—more than three times the size of the United Kingdom. Salinization refers to the accumulation of salts in the soil, which, if above a certain threshold (3,000–6,000 ppm salt), prevents most cultivated plants from taking water from the ground and growing. Salinization in India affected 6.7 million hectares in 2009—an area the size of Ireland. There are notable improvements in irrigation—with drip irrigation methods significantly reducing the water consumed in production. For instance, this can equate to a 45% reduced water consumption for cotton, 44% for sugarcane and 37% for grapes while increasing the overall yields by up to one-third. (IPCC, 2019, ch. 5, p. 25). Yet, such adaptation measures cannot make up for the overall decrease in the yield of certain water-hungry crops, such as wheat, which decreased by 5.2% between 1981 and 2009. (ibid.)

Severe droughts have occurred in 8 of the 15 years between 2002 and 2017—resulting in significant yield declines (IPCC, 2019, ch. 6, p. 17). The projected further increase in droughts, heatwaves, wildfires and extreme weather events will most likely negatively impact food production, food security and the livelihoods of millions of Indian farmers.[3] Policy solutions must address the interlinked challenge of poverty, inequality and climate change. Empowering women (Yadav & Lal, 2018) and increasing access to financial services (Pauli, 2019) is arguably essential to future policy

[3]For an insightful report on food security in the face of climate change, including policy recommendations, see Beddington et al. (2012).

solutions. Access to credit, insurance, and saving accounts—also for direct transfer of welfare benefits and emergency relief—can help with climate change adaptation, e.g., mitigate the negative impact of crop failure due to droughts or flooding.

Climate Change Negotiations: Paris & Glasgow

The significance of climate change as a global challenge has ultimately led to several international agreements. The main international treaty on fighting climate change is the United Nations Framework Convention on Climate Change (UNFCCC) from 1992, to which 197 parties have signed up (196 states plus the European Union). The 1997 Kyoto Protocol was the World's first legally binding tool for reducing greenhouse gas emissions. It was built on the principle of common but differentiated responsibilities of developed and developing countries, as laid out in Article 4 of the 1992 Framework Convention of Climate Change and the need for industrialized countries to act first. The Kyoto Protocol covered a mere 12% of global emissions (European Commission, 2020) because many major emitters did not participate or simply opted out, like the US in 2001, followed by Canada, Australia, Japan and Russia.

The 2015 Paris Agreement succeeded the Kyoto Protocol. It was adopted by all UNFCCC Parties and is the first legally binding global climate agreement. Clémençon's (2016) analysis points to the double victory of the United States in core international climate agreements, which in his view, "obstructed effective climate action for more than two decades". First, to get the US on board the Kyoto Protocol, the EU had to follow the principle of emissions *trading*. This contrasted with the EU's preference for scaling up carbon and energy *taxes*. Clémençon (2016) argues that this "set climate politics back by two decades". Second, the EU pushed since the late 1980s for binding emission targets and timetables, but—to get the Paris Agreement signed—finally gave in to the US demand for voluntary contributions. Hence, Nationally Determined Contributions (NDCs) are a core element of the Paris Agreement.

India's role and position in international climate change negotiations have changed substantially. Dubash (2009) identified three competing Indian climate change policy narratives: (a) Growth first stonewallers—focus on economic development and poverty reduction; equity as a principal and strategy. (b) Progressive realists—unfair international negotiations, but climate change is seen as a real threat, with opportunities for action and development with co-benefits. (c) Progressive internationalists—poorest countries most affected, opportunities for shaping the international process and moving to low carbon technology. Mohan (2017) argues that

India's climate policy positions evolved from growth first stonewaller (during the 1990s), via progressive realists (Copenhagen, 2009), to progressive internationalists (Paris, 2015). The latter policy is best understood as a subset of India's foreign policy agenda and towards playing a more prominent role "in solving global challenges and shaping the rules, norms and processes that guide those efforts." (Dubash, 2009).

Does the Paris Agreement's voluntary approach (in the form of *National Determined Contributions*) render it a failure? We must examine the discourse surrounding the Paris negotiations to answer this question. Many developing countries, including India, argued convincingly that for climate justice reasons, the main polluters should be obliged to reduce their emissions first, as was evident in earlier UN agreements. Industrialized countries were to carry the significant burden and help developing countries sustain their economic development.

Was India the roadblock to an agreement in Paris, as portrayed by the *New York Times?* In a cartoon titled "India at the Paris Climate Conference," the New York Times depicted India as an elephant blocking a steam engine train labeled "Paris Climate Summit"—with the caption: "The emerging economy could pose many demands on developed countries before agreeing to a deal." (Kim, 2015) The New York Times article "Narendra Modi Could Make or Break Obama's Climate Legacy" (Davenport & Barry, 2015) from a week earlier states these demands clearly: "India is expected to challenge the United States on three counts: To speed up emissions reductions by wealthy countries to compensate for emissions growth in poor countries, to pay more to poor countries to assist in mitigation plans and to provide clean-energy technology to poor countries."

All three are valid bargaining positions, given the historical and current per capita emissions. The arguments are also well considered, given that the US and other advanced economies have opted out of the Kyoto Protocol—and given the significant challenge of development and poverty reduction, the financing gap and the need for technology transfer to scale up and speed up mitigation and adaptation efforts of developing countries and especially of the least developed countries. Therefore, a more fitting depiction might be framing the situation as India joining the big party of economic growth and consumption late and being asked to share the burden of tidying up the emissions in equal measure.

The same New York Times article points to two crucial aspects of the politics of international negotiations: First, the role of individual leaders: Referring to Prime Minister Narendra Modi's book on climate change, titled *Convenient Action* (Modi, 2011); and quoting Anand Mahindra, the chairman of the Mahindra Group: "I believe that Modi wants to be remembered as the person who turned India green".

(Davenport & Barry, 2015) Second, the two-level game approach of climate change negotiations: Referring to editorials in India's newspapers "urging negotiators to stand their ground, even at the cost of being labelled obstructionists or spoilers". (Davenport & Barry, 2015) Quoting the former Indian environment minister, Jairam Ramesh: "The more criticism India comes under in Paris, the more applause [Prakash] Javadekar [India's environment minister] will get in Parliament and elsewhere. (...) This is the dichotomy of the situation." (Davenport & Barry, 2015)

What complicated the bargaining position of India was the 2014 joint statement by China and the US that China's CO_2 emissions will probably peak by 2030. Before, China was mainly taking climate change positions like other emerging markets such as India and developing countries—especially that developed countries must reduce emissions first before other countries are asked to do the same. However, given that China became the most significant contemporary GHG emitter around 2005, it started to share more climate change positions with the largest historical emitter, the United States. The pressure on India grew—not least from the US—to commit to a specific, near-term date for its emissions to peak. However, India made it clear that it could not commit to such a timeline, given its mandate to fight poverty and foster economic growth to enhance its people's living standards and overall well-being.

Developed countries promised US$ 100 billion in climate finance for developing countries per year. Unfortunately, by any measure, the reality is far from this pledge. Moreover, no clear international accounting standards exist that clarify what constitutes 'climate finance'. A controversial OECD report claimed that developed countries have made substantial progress towards this goal and mobilized US$ 62 billion in 2014, up from 52 billion in 2013. (Organisation for Economic Co-operation and Development [OECD] & Climate Policy Initiative, 2015) However, this claim was firmly rejected by the Indian government, pointing to severe problems with the report's accuracy, methodology and verifiability. (Climate Change Finance Unit, Ministry of Finance, Government of India, 2015)

In the account of one of the Indian negotiators involved in the Paris agreement, the 2015 agreement preserves India's core interests. First and foremost, the Paris Agreement is "firmly anchored in the UNFCCC (...) since it safeguards policy space underpinned by key principles such as equity and common but differentiated responsibilities and respective capabilities (CBDR&RC)." (Lavasa, 2019) In other words, India's core interest in (economic) development is not constrained by a top-down approach, as the contributions are nationally determined. That many developing and developed countries perceived the Paris Agreement as an overall success is often attributed to the French leadership of the conference.

Yet, the Paris agreement remains ambivalent. On the one hand, it arguably abandons the ambition of global equitable burden-sharing and of "multilaterally negotiated *binding* emissions *targets* and *timetables* for each country, the foundation of the 1997 Kyoto Protocol" (emphasis added) (Clémençon, 2016). This starkly contrasts the poster child example of successful international environmental agreements—the 1987 Montreal Protocol on ozone-depleting substances, which was built on binding reduction targets and timetables and differentiated responsibilities for developing and industrialized countries (Benedick, 1991). On the other hand, the Paris Agreement was an important milestone to legitimize and prompt more climate action effectively.

Attending the COP26 in Glasgow in person, Prime Minister Modi finally did commit the country to a net zero pledge (the last remaining G20 country to do so), although, unlike others, with a target of 2070. While this may have been a decision taken under international pressure, reports also highlighted how India and China were behind the last-minute watering down of the Glasgow Pact. This included altering the language to ensure it was a "*phase down* of unabated coal power" rather than "*phase out*" and the "phase out of *inefficient*" fossil fuel subsidies. Glasgow made progress in that it was the first U.N. climate agreement to mention coal as the fuel most responsible for warming the planet. However, India's stance and strategy blindsided negotiators and almost threatened to derail the final talks.

Climate Change Policies in India

The 2008 National Action Plan on Climate Change (NAPCC) was a significant step for India in addressing climate change. It is centered around the pursuit of co-benefits and is often seen as India's response to pressures from the international community. It includes eight missions; see Table 2.

The national missions initiated by the 2008 NAPCC are accompanied by additional institutions (see Table 3).

In addition to the Ministries, their respective national missions and the accompanying institutions, climate change policies are also spearheaded by the *Special Envoys Office on Climate Change* in the *Prime Minister's Office*, the *Prime Minister's Council on Climate Change* (which is leading the *National Action Plan on Climate Change*) as well as the *Executive Committee on Climate Change*. What is more, the multi-level climate governance also involves the sub-national governments in the states and cities. Some authors argue that a centralized command-and-control climate governance regime is required for a coordinated action plan—which, in practice, is contested by a decentralized governance structure and respective institutional

Table 2.
The Eight National Missions from the Indian 2008 NAPCC

Mission name [*Ministry in Charge*]	Start	Main objectives
(Jawaharlal Nehru) National Solar Mission [*Ministry of New and Renewable Energy*]	2010	"promote ecological **sustainable growth** while addressing India's **energy security** challenges (...) establish India as a **global leader in solar energy** by creating the policy conditions for solar technology diffusion across the country as quickly as possible. The Mission targets installing **100 GW grid-connected solar power plants** by the year **2022**." (Ministry of New and Renewable Energy, Government of India, 2022)
National Mission for Enhanced Energy Efficiency [*Ministry of Power*]	2011	"strengthen the **market for energy efficiency** through implementation of innovative business models in the energy efficiency sector. (...) consist of four initiatives to enhance energy efficiency in energy intensive industries which are as follows: Perform Achieve and Trade (PAT)—improving efficiency in energy intensive sectors; Energy Efficiency Financing Platform (EEFP); Framework for Energy Efficient Economic Development (FEEED)—development of fiscal instruments to promote energy efficiency; Market Transformation for Energy Efficiency (MTEE)—accelerating shift towards energy efficient appliances." (Bureau of Energy Efficiency, Ministry of Power, Government of India, 2022)
National Mission on Sustainable Habitat [*Ministry of Housing and Urban Affairs*]	2010	"aims at (i) Promoting **low-carbon urban growth** towards reducing GHG emissions intensity for achieving India's NDC and (ii) **Building resilience** of cities to climate change impacts and strengthening their capacities to 'bounce back better' from climate related extreme events and disaster risks" (Ministry of Housing and Urban Affairs, Government of India, 2021)
National Water Mission [*Ministry of Water Resources, River Development and Ganga Rejuvenation*]	2011	"(...) ensure integrated **water resource management** helping to conserve water, minimize wastage and ensure more equitable distribution both across and within states. (...) Optimize water use by increasing water use efficiency by 20% through regulatory mechanisms with differential entitlements and pricing. (...) ensure that a considerable share of the water needs of urban areas are met through recycling of waste water (...) adoption of new and appropriate

Table 2. (*Continued*)

Mission name [*Ministry in Charge*]	Start	Main objectives
		technologies such as low temperature desalination technologies that allow for the use of ocean water. (...) ensure basin level management strategies to deal with variability in rainfall and river flows due to climate change." (Ministry of Jal Shakti, Government of India, 2022)
National Mission for Sustaining Himalayan Ecosystem [*Ministry of Science & Technology*]	2010	"address some important issues concerning (a) **Himalayan Glaciers** and the associated hydrological consequences, (b) Biodiversity conservation and protection, (c) Wild life conservation and protection, (d) Traditional knowledge societies and their livelihood and (e) Planning for sustaining of the Himalayan Ecosystem." (Ministry of Science & Technology, Government of India, 2010a)
Green India Mission [*Ministry of Environment, Forest and Climate Change*]	2014	"protecting, restoring and enhancing India's **forest cover** and responding to Climate Change. The target under the Mission is **10 m ha** on forest and non-forest lands for increasing the forest/tree cover and to improve the quality of existing forest." (Ministry of Environment and Forests, Government of India, 2014)
National Mission for Sustainable Agriculture [*Ministry of Agriculture*]	2010	"promoting **sustainable agriculture** through a series of adaptation measures focusing on 10 key dimensions encompassing Indian agriculture namely; 'Improved crop seeds, livestock and fish cultures', 'Water Use Efficiency', 'Pest Management', 'Improved Farm Practices', 'Nutrient Management', 'Agricultural insurance', 'Credit support', 'Markets', 'Access to Information' and 'Livelihood diversification'." (Ministry of Agriculture and Farmers Welfare, Government of India, 2022)
National Mission on Strategic Knowledge for Climate Change [*Ministry of Science & Technology*]	2010	"serve as **Support mission for generating and providing strategic knowledge** to all other seven national missions (...) within built capacities for continuous and mid-course changes in trajectories to take into account of international developments in climate change related issues." (Ministry of Science & Technology, Government of India, 2010b)

Table 3.
Climate Change Institutions in India—Beyond Ministries and Missions

Name [*Ministry/Institution in Charge*]		Founded
AIPA	Apex Committee for Implementation of Paris Agreement	2021
NAFCC	National Adaptation Fund on Climate Change	2015
	Energy group [*Niti Aayog*]	2015
CCFU	Climate Change Finance Unit [*Ministry of Finance*]	2011
NSCCC	National Steering Committee on Climate Change [*Ministry of Environment, Forest, and Climate Change*]; task: "ensure that the SAPCCs were designed and implemented in accordance with the NAPCC [2008 National Action Plan on Climate Change] (...) composed of secretaries of various ministries and departments, and chaired by the environment secretary" (Dubash & Ghosh, 2019)	2011
LCSIG	Expert Group on Low Carbon Strategies for Inclusive Growth [*Planning Commission Government of India*]; terminated	2008–2014
SAPCC	State Action Plan on Climate Change; prepared by each of the 29 states and seven union territories.	2010
INCCA	Indian Network on Climate Change Assessment [*Ministry of Environment, Forest, and Climate Change*]	2009
CDMA	Clean Development Mechanism Authority [*Ministry of Environment, Forest, and Climate Change*]	2003
BEE	Bureau of Energy Efficiency [*Ministry of Power*]	2002

arrangement. Jörgensen et al. (2015) analyze multi-level climate governance in India and find that "Indian states do not act solely as mere implementers of federal top-down policies, rather India's states experiment with individual approaches to develop renewable energy, tailored to regional specifics." Finally, multi-level climate governance involves Indian civil society, think tanks and domestic and international development actors such as the Indian *National Bank for Agriculture and Rural Development* (NABARD), bilateral donors and international agencies.[4]

In India, several specific schemes have been implemented to address climate change in agriculture. The Consultative Group for International Agricultural Research

[4]For a depiction of the complex governance structure of climate change in India, see Dubash and Ghosh (2019) Figure 19.1 Institutions in India's Climate Change Governance.

(CGIAR), a global partnership of organizations researching and promoting food security, fosters the so-called Climate-Smart Village (CSV) in India (IPCC, 6–17). Climate-Smart Villages focus on reducing carbon emissions (e.g., no-tillage, residue management), enhanced water management (e.g., direct-seeded rice, micro-irrigation), new technologies for weather forecasting, index-based insurances, and ICT-based agricultural services, as well as enhancing knowledge on nutrition (Hariharan et al., 2020)

The Indian government also implemented a range of emission mitigation policies—in addition to the before mentioned original National Missions. Examples from the transportation sector include: (i) The National Mission on Transformative Mobility and Battery Storage, which promotes the supply chain for electric vehicles and battery storage production in India. (Press Information Bureau, Government of India, 2019) (ii) The FAME-II scheme, which fosters demands for electric vehicles via supporting electric buses (7,000), Three-Wheelers (500,000), Passenger Cars (55,000 incl. hybrids) and Two-Wheelers (100,000)—with a USD 1.4 billion (Rs. 10,000 crores) for three years, till March 2022 (National Automotive Board (NAB), Department of Heavy Industry, Government of India, 2020). (iii) An example of mitigation policies in the build environment sector is the India Cooling Action Plan (ICAP), which aims at squaring the growing cooling needs with climate action needs such as energy efficiency and the phase-down of heat-trapping hydrofluorocarbons (HFCs)—as agreed in the Montreal Protocol and the Kigali Amendment (Jaiswal, 2019).

The Indian government submitted its Intended Nationally Determined Contribution (INDC) in 2015 (Government of India, 2015). The latest update regarding India's climate change commitments was announced in the context of the 26th UN Climate Change Conference (COP26) in November 2021 in Glasgow. They include:

(1) Reach a non-fossil energy capacity of 500 GW by 2030. This would be 60% of India's power capacity, well above the 40% committed by India under the Paris Agreement.
(2) Meet 50% of energy requirements with renewable energy by 2030.
(3) Reduce total projected carbon emissions by one billion tonnes from now to 2030. Prime Minister Modi pointed to the role of Indian Railways' energy efficiency.
(4) Reduce the economy's carbon intensity to less than 45% by 2030.
(5) Achieve net zero emissions by 2070. (Kwatra, 2021)

The last target has been widely criticized—that the year 2070 is not ambitious enough as the net zero timeline. The United Nations stated in mid-2022 that: "More

than 70 countries, including the biggest polluters—China, the United States, and the European Union—have set a net-zero target, covering about 76% of global emissions. Over 1,200 companies have put in place science-based targets in line with net zero, and more than 1,000 cities, over 1,000 educational institutions and over 400 financial institutions have joined the Race to Zero, pledging to take rigorous, immediate action to halve global emissions by 2030." (United Nations, 2022)

Given the perception of India as an obstructer in climate change negotiations, it seems surprising that the country ranks high in the Climate Change Performance Index (CCPI) by the NGOs German Watch, Climate Action Network (CAN) and the New Climate Institute. The CCPI is an independent, annual tracking of countries' climate change mitigation performance. The CCPI covers 57 countries, which account for 90% of global greenhouse gas (GHG) emissions. India is ranked 10th in the CCPI—behind Denmark, Sweden, Norway, the United Kingdom, Morocco and Chile. The first three ranks were left vacant as the authors did not rate any country's performance as "very high".

The countries with "very low" climate change performances are led by the worst performers—Kazakhstan, Saudi Arabia, Iran, Canada, South Korea, Australia, Taiwan, Malaysia, Russia and the United States (ranked 55 out of 64); followed closely by five EU member countries: Hungary, Poland, the Czech Republic, Slovenia and Belgium. (German Watch et al., 2022) The United States at least moved up from the last position in the ranking in the previous year, thanks to the climate change commitment of the Biden administration, based on the Plan for a *Clean Energy Revolution & Environmental Justice*, which echoes the proposed Green New Deal by Representative Ocasio-Cortez and Senator Markey, including a significant role for carbon capture and storage technology. (Krancer, 2021) The very low-ranked European countries will also likely improve their positions in the coming years. Not least due to the funding and pressure provided by the *European Green Deal*—"Europe's man on the moon moment", as the European Commission President, Ursula von der Leyen, called it. The *European Green Deal* aims for the EU's net-zero carbon emissions by 2050 and a 50–55% cut in emissions by 2030 (compared with 1990 levels) (Harvey & Rankin, 2020).

The *Climate Change Performance Index*'s scale goes from "very low" for countries with terrible climate change performance via "low", "medium" and "high" to "very high". The greenhouse gas (GHG) emissions ranking contributes 40% to the overall score. It captures the complication that large emerging markets like India embody. On the one hand, current levels of GHG emissions per capita are (still) minimal—hence the very positive ranking of India as "very high". While on the other hand, the current trend of GHG emissions per capita is a substantial increase of

emissions due to high economic growth (fuelled predominantly by fossil fuels)—hence the very negative ranking of India as "very low". On the positive side, the GHG 2030 Target is also ranked as "very high" and compatible with a well-below-two-degree benchmark.

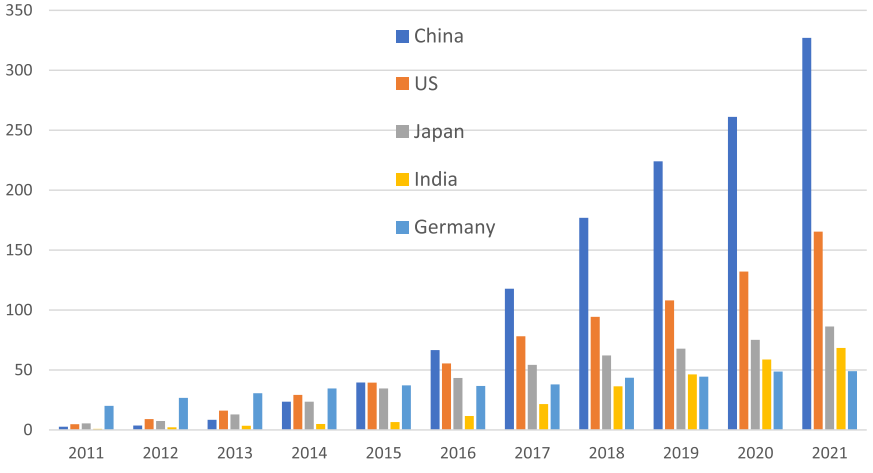
Similarly, while the current level of renewable energy is rated "medium", the corresponding trend is ranked as "high" (German Watch et al., 2022). The consulted experts praise the (i) Significant increase of renewables targets (450 GW renewable electricity capacity by 2030), (ii) the emphasis on *Nationally Determined Contribution* targets implementation, and (iii) the target of 30% electric vehicle share by 2030. The CCPI consultants, however, lament the lack of concrete plans to phase out coal—and that the "pipeline of proposed coal power plant development is the world's second-largest and one of the few that have increased since 2015" (German Watch et al., 2022).

So, what speaks in favor of India being a leader in climate change performance? India is projected to overachieve its 2030 emission reduction targets—including the more ambitious 40% non-fossil capacity share target. The "National Solar Mission", one of the major policies for renewable energy, was launched by Prime Minister Singh in 2010 with a 20 GW target by 2022. Prime Minister Modi increased the target to an ambitious 100 GW by 2022 in the 2015 budget. However, India will miss its 2022 solar target of 100 GW by about 27 GW. According to the Institute for Energy Economics and Financial Analysis (IEEFA) and JMK Research, this will be due to the slow growth of rooftop solar, which is likely to reach 15 GW instead of the target of 40 GW.

On the other hand, utility-scale solar is forecasted to achieve around 97% of the 60 GW target by the end of 2022 (PV Magazine, 2022). There have been delays in the installation in 2020 due to COVID-19 restrictions. Still, India is regarded by the IEA as the most significant contributor to the record renewables upswing in 2021. The last years' other major renewable capacity additions were in China, the EU, and the US (International Energy Agency, 2020 Nov, 2021 Dec).

How does solar production in India and other Asian countries compare? The global solar energy production share of the Asia Pacific was 56%, followed by Europe with 19% and North America with 18% (BP, 2022). The top five solar energy producing countries are China (world share: 32%)—with a gap—followed by the US (16%), which is followed—with a considerable gap—by Japan (8%), India (7%) and Germany (5%) (BP, 2022) (See Figure 2)

How does India's wind energy performance compare? The global wind energy production share of Asia Pacific was 42%, followed by Europe with 27% and



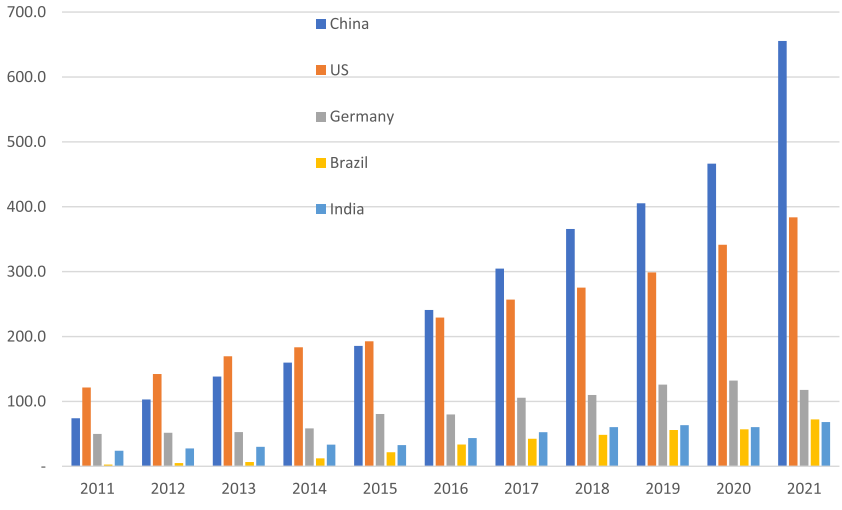
Data: World Bank 2022. Statistics are taken from national statistical agencies, international organizations and other proprietary sources.

Fig. 2. Global top 5 solar energy producing countries 2011–2021, in terawatt-hours.

North America with 24% (BP, 2022). The top five wind energy producing countries are China (world share: 35%)—with a gap—followed by the US (21%), which is followed—with a considerable gap—by Germany (6%), Brazil and India (both 4% world share) (BP, 2022) (See Figure 3) The country which plays a surprisingly marginal role—given its emissions share, advanced economy and potential for wind power generation—is Japan, with a 0.4% world share, behind Greece, Ireland and Chile (BP, 2022).

The IEA regards hydrogen as one piece of the puzzle to decarbonization. Why? The availability of renewable energy like wind and solar is often not well matched by energy demand. Therefore, energy storage is a fundamental challenge to solve. Hydrogen is regarded as one of the central solutions regarding its technology and forecast price competitiveness. Hydrogen and hydrogen-based fuels can transport energy from countries with renewables surplus to far-away areas with high energy demands (International Energy Agency, 2019, p. 13). However, today, hydrogen is still mainly used in oil refining and fertilizer production—and fossil fuels are used as energy for its production. For hydrogen to significantly contribute to decarbonization, it must be produced from renewable energy and widely adopted in various sectors beyond power generation, such as transport and buildings.

The Asia-Pacific region leads regarding announced hydrogen pledges, with China alone accounting for two-thirds of them. Like several other countries, India has embraced a hydrogen strategy. Half of the predicted demand increase in India comes



Data: World Bank 2022. Statistics are taken from national statistical agencies, international organizations, and other proprietary sources.

Fig. 3. Global Top 5 wind energy producing countries 2011—2021, in terawatt-hours.

from iron and steel production (International Energy Agency, 2021a, p. 64). It remains to be seen how much of this production will be based on coal and how much on renewables. However, there are hopeful policy initiatives under the National Hydrogen Mission (NHM) launched in 2021. They include auctions to produce hydrogen from renewables and mandatory quotas for utilizing renewable hydrogen in ammonia production (starting with 5% in 2023/24 and increasing to 20% within five years) and refining (beginning with 10% in 2023/24 and rising to 25% within five years) (International Energy Agency, 2021a, p. 197). Overserves expect the steel industry to be soon included in such mandatory quotas. The buy-in to low-carbon hydrogen production by the Indian industry sector is exemplified by the involvement of major companies such as Adani, Arcelor Mittal, the Indian Oil Corporation, NTPC, Reliance Industries and the Solar Energy Corporation of India (International Energy Agency, 2021a, p. 197).

To summarize: At the 26th *Conference of the Parties* (COP 26) in Glasgow in November 2021, Prime Minister Modi announced India's target of Net Zero by 2070, with the interim goal of an emissions reduction of 33–35% by 2030 compared to 2005 levels. While this commitment is less ambitious than that of OECD countries, it reflects India's concern about how fast the triangulation of poverty reduction, sustainable growth and climate change action is feasible. Therefore, the Indian

government reemphasized the essential role of climate finance in supporting developing countries in their transition to net zero.

India: Constraints and Opportunities

One of the main caveats regarding India's climate change ambitions is the country's plan for coal mining and the construction of additional coal power plants. While no new coal power plant was constructed in 2020, there are still plans to do so in the future. This is despite the share of coal in India's power mix having fallen for the second year in a row and, as some analysis suggests, peaked in 2018 (Rathi & Singh, 2021). Energy analysts use the levelized cost of energy (LCOE) to compare the price of electricity generation through different technologies of unequal life spans, project size and capital costs—e.g., natural gas, wind and solar. LCOE measures lifetime costs (construction, maintenance and operation of a power plant over an assumed lifetime) divided by energy production (US Department of Energy & Office of Indian Energy). Such LCOE analysis shows that—thanks to the dramatic cost reductions—utility-scale solar and onshore wind "became cost-competitive with conventional generation several years ago on a new-build basis" (Lazard, 2020). Given this price competitiveness of renewables and the (likely further increasing) public pressure regarding climate change mitigation, energy analysts warn about newly built coal plants turning into stranded assets.

A few key facts stand out in India's energy future. India will surpass China as the most populous country already in 2023, according to the United Nations (BBC, 2022). Given India's population size and projected economic growth, India will see the "largest increase in energy demand of any country over next 20 years" (International Energy Agency, 2021b). The IEA points out the following: "India's energy future depends on buildings and factories that are yet to be built, and vehicles and appliances that are yet to be bought (...)—nearly 60% of its CO_2 emissions in the late 2030s will be coming from infrastructure and machines that do not exist today." (International Energy Agency, 2021b)

This provides an excellent opportunity for sustainable investment. The IEA estimates that over the next 20 years, further financing for clean energy technologies of around US$ 1.4 trillion is required. It also projects that "the benefits are huge, including savings of the same magnitude on oil import bills." (International Energy Agency, 2021b) The switch from fossil fuels to renewable energy requires a substantial surge in power system flexibility. Electricity grids must become "smart", and storage capacity must increase. In early 2022, India's Ministry of New and Renewable Energy entered a

strategic partnership agreement with the International Renewable Energy Agency (IRENA) to broaden its renewable technology base, including investment in green hydrogen (International Renewable Energy Agency [IRENA], 2022).

According to the IEA, India is well suited for this challenge as it is becoming a global leader in battery storage. The energy transition also requires fading out the substantial fossil fuel subsidies. In India, fossil fuel subsidies are multiple times higher than those for renewables. India has the fifth largest fossil fuel subsidies in the World —around US$ 22 billion—behind Iran (US$ 86), China (US$ 31), Saudi Arabia (US$ 29) and Russia (US$ 24). (Urpelainen & George, 2021)

As a G20 member, India committed in 2009 to phase out "over the medium term inefficient fossil fuel subsidies, while providing targeted support for the poorest." (G20, 2009). Recently, India committed to a G20 peer review of its fossil fuel subsidies. Of course, fossil fuel subsidies are a highly political and politicized issue with strong-vested interest groups. This explains why subsidies for fossil fuels (oil, gas and coal) were more than seven times higher (US$ 12.4 billion) than subsidies for renewables and electric mobility (US$ 1.7 billion) in the financial year 2019 (FY2019) (International Institute for Sustainable Development [IISD], 2020, p. 5) In general, consumption subsidies are rising as more people access energy. Under-priced electricity at the state level is India's costliest—and not well-targeted—subsidy policy, with US$ 9.5 billion. Many people, including vulnerable groups, benefit or depend on fossil fuel subsidies. That is why reforms must be designed carefully and phased in gradually.

Developing countries cut back subsidies as energy prices declined during the pandemic. Also, India increased taxes on diesel and gas fuel. Yet, the significant rise in energy and living costs in 2022—not least due to the war by the Russian regime—triggered a revision of some of these subsidy cuts. The trend in reduced fossil fuel subsidies—by half from 2019 till the start of the war in Ukraine—was primarily driven by lower oil prices and (to a lesser degree) also by policy reforms and increased renewable energy and electric vehicle subsidies—a 3.5 times increase since 2019.

Conclusion

Our paper has sought to understand the Indian position of coming late to the economic growth and consumption party and being asked to pay the price of tidying up (emissions) in equal measure. Given the well-grounded concern of developing countries with poverty alleviation and job creation for their increasing population, this paper sought to counter the common, often Western narrative of India as an irrational, counterproductive roadblock in climate change negotiations. We argued that those

countries with the most significant cumulative CO_2 emissions—the USA (25%), the EU-27 plus the United Kingdom (22%) and China (14%)—have a special responsibility to address climate change.

This responsibility goes beyond domestic climate change policies and refers to transferring funds and technology to developing countries to foster climate change mitigation and adaptation. While promises in this regard have been made (US$ 100 billion in climate finance for developing countries per year), the reality is still far from it.

We elaborated on the negative impacts of climate change on countries with already high temperatures, agrarian crises and limited resources for adaptation. India is particularly vulnerable, given that more than two-thirds of its rural households depend on agriculture for their livelihoods. Droughts, heatwaves, wildfires, extreme weather events, desertification and salinization threaten food production, livelihoods and food security. On top, climate change works as a "threat multiplier"—aggravating stressors like poverty, social tensions and political instability, potentially fostering terrorism, violent conflict and forced migration.

India arguably can be seen as a leader in climate change performance, as reflected in its top rating in the CCPI. We showed that the current government shows ambition regarding climate change mitigation, which is, among other things, reflected in the raised goals of the *National Solar Mission*, initially initiated by the then Prime Minister Manmohan Singh.

However, we also drew attention to the substantial shortcomings of Indian climate change policies: First, coal—the current role of and, worse, the (still existing) plans for increasing coal mining and coal power plant construction. Second, fossil fuel subsidies are multiple times higher than subsidies for renewables. This is a delicate political issue with significant implications for many election-determining poor citizens—hence accompanying "just transition" measures are essential.

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