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Towards a Deep Climate Collaboration

Module 4: India

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EAERE
European Association of Environmental and Resource Economists

EAERE Magazine serves as an outlet for new research, projects, and other professional news, featuring articles that can contribute to recent policy discussions and developments in the field of environmental and natural resource economics. It is published quarterly in the Winter, Spring, Summer, and Fall. Contributions from the wider EAERE community, especially senior level researchers and practitioners, and EAERE Country Representatives, are included in the magazine.

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Colleagues and friends, this issue is in two sections. The first comprises the final module (India) in our series establishing the climate policy baseline for the 'Big Four'. Puncturing complacency is part of our job; the second section is a paper which provides valuable empirical underpinning as regards skill constraints that may inhibit or delay converting the promise of the European Green Deal into performance, and how they might be overcome. Before reading these papers, my knowledge in these areas was both incomplete and misinformed. If your understanding is also partial, below I provide a little more detail as to why it would be worth your while devoting a sliver of your very scarce time to digesting them.

SECTION I – THE INDIA CLIMATE POLICY MODULE

In the first issue of the 2021 series (Number 11), Cail and Criqui (2021)[1] provided an overview of past trends and future scenarios for all four of the world's biggest greenhouse gas emitters, and their economic performance judged by real GDP per capita. India's particularities are captured in their Figure 6.

India's per capita emissions are by some distance the lowest of the four, while its GDP per capita also lags. Not surprisingly, this context led to a climate policy rhetoric that focussed on those initiatives that are 'no regrets', i.e., that deliver substantial economic benefits, while also reducing emissions relative to the counterfactual. Lack of climate-specific ambition would also be expected from the fact that climate change and addressing it vigorously does not have a large and vociferous constituency. In his paper on climate diplomacy Somanathan notes that: "The drivers of Indian climate diplomacy are very different from those of high-income countries in which concerns about climate change are a significant part of the domestic political discourse". However, when I read the four papers, I found that (most unusually) modest rhetoric understated considerable performance. It recalled for me Nobel Prize Winner (1913) Rabindranath Tagore's (1861-1941) famous poem "*Where the Mind Is Without Fear*" (1910) in which he expressed to his

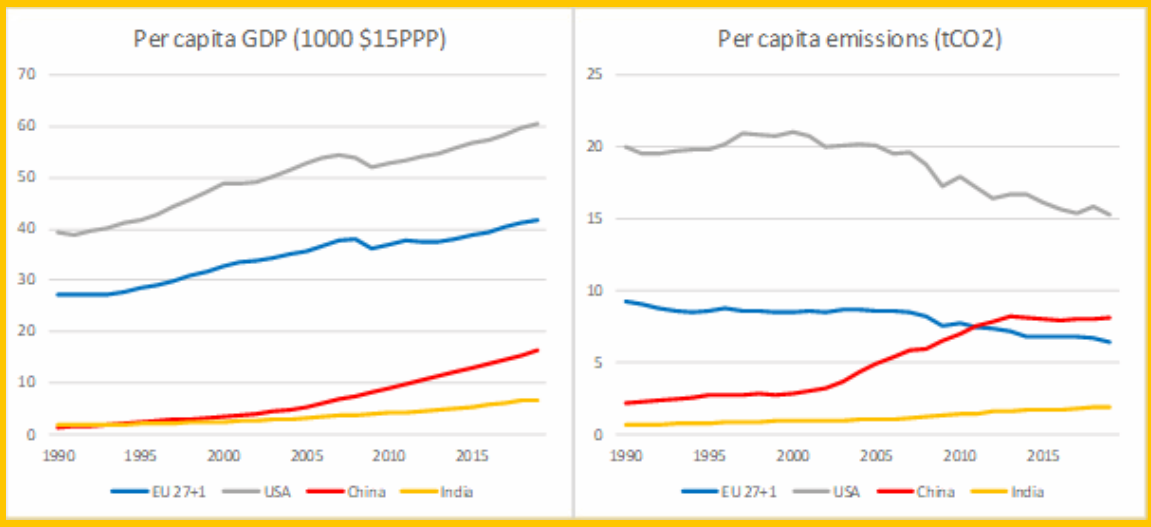

Figure 6a and 6b. Per capita GDP and per capita CO_2 emissions. Source: Enerdata, Global Energy and CO_2 Database, 2020

1 Cail, S., & Criqui, P. (2021). Carbon Dioxide Emissions by the Four Largest World Emitters: Past Performance and Future Scenarios for China, U.S.A. Europe, and India. *EAERE Magazine*, 11.

father his vision for an independent India.

"Where the mind is without fear and the head is held high
Where knowledge is free
Where the world has not been broken up into fragments
By narrow domestic walls
Where words come out from the depth of truth
Where tireless striving stretches its arms towards perfection

Where the clear stream of reason has not lost its way
Into the dreary desert sand of dead habit
Where the mind is led forward by thee
Into ever-widening thought and action
Into that heaven of freedom
My Father, let my country awake".

Given its daunting context, India can hold its head high when it comes to climate change policy. To remove fuel subsidies for road transport and impose significant excise duties took courage and skill, and this has been complemented by the introduction of Corporate Average Fuel Efficiency standards (CAFE) for passenger cars; it means that two key steps have been taken in managing this sector's transition to a low carbon future. India's policies for the electric grid – tax ('cess') on coal, requirement that utilities 'must run' renewable supply, the imposition of purchase obligations, creation of tradeable certificates - all begin to give parity of esteem to non-fossil fuels. Of course, India is still far from "where tireless striving stretches its arms towards perfection" but the first steps are often the most important ones.

Thanks

The four papers in this module were orchestrated by E. Somanathan of the Indian Statistical Institute. My request to him to take this on coincided with the peak of the Covid-19 epidemic in India, which added another layer of stress to the fulfilment of what was already a very difficult assignment. The following are the team he put together that delivered this volume: Climate Policy Architecture – Bhatt (Indian Statistical Institute) and Somanathan (Indian Statistical Institute); Climate Policy looking back – Choragudi (Divecha Centre for Climate Change, Indian Institute of Science); Climate Policy looking forward – Chakravarty (Divecha Centre for Climate Change, Indian Institute of Science); Climate Diplomacy – Somanathan. Their minds were without fear, and they all applied a 'clear stream of reason' to their contributions – Tagore (and his father) would be proud.

SECTION II

Eudora Welty observed that: "A sheltered life can be a daring life as well, for all seriousness starts within."

We know that being daring comes at a cost - it can be lonely advancing new ideas and challenging the status quo and for younger academics this can be particularly daunting. EAERE is proud to celebrate such intellectual achievement, and one of the ways it does so is to recognize seriousness that starts within. In this issue we celebrate the achievement of Giovanni Marin, Department of Economics, Society, Politics, University of Urbino the winner of the 2021 European Award for Researchers in Environmental Economics under the Age of Forty. There is a very comfortable correlation between the language of the European Green Deal and the vision of a vibrant economy that has also found ways that work to protect our environmental commons. But correlation is not causation. In "Fit-for-55: is the workforce 'fit' enough?" Marin critically interrogates whether the European workforce has the skills needed to drive the green revolution and explores how to improve the fit. Enjoy!

COP 26

Finally, we plan to compile all 16 of the Climate Policy Baseline papers (4 each for China, European Union, India and the U.S., addressing climate policy architecture, policy progress, policy prospects, diplomacy) into a single volume which will also include the framing papers by Convery and Sterner and Cail and Criqui which appeared in Issue 11, and a synthesis by myself. This volume will be available at COP 26, Glasgow (October 31-November 12, 2021) and will also be made available to all members of EAERE. Phoebe Koundouri and Simone Borghesi have decided to have EAERE join forces with UN SDSN (Phoebe is co-chair of SDSN Europe – https://sdsn.eu) who has submitted an application for the *virtual exhibition space* a week-long program/"space" in COP where we can feature our work. The application is for the first week of COP. Phoebe has generously suggested that our 'Big 4 Climate Policy Baseline' proposition could feature in this window (perhaps an hour) and this makes perfect sense to me.

I am also planning to be in Glasgow for some of COP 26 in person and would like to also use that opportunity to engage on the Big 4 Climate Policy Baseline proposition. Any advice or suggestions on this front would be very welcome!

Frank J Convery

Section I

The India Module

Climate Policy Architecture in India

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Introduction

India's economic and political backdrop sets it quite apart from the other three of the "Big Four" emitters. China's per capita income is more than two and a half times greater than India's. As a result, India faces serious pressures in the form of poverty and inequality. As traditional goals take precedence, climate change does not have much political salience. Climate policy in India is, therefore, largely driven by international pressures and is adjunct to developmental goals and foreign policy. While the latter are prioritized, often times the mitigation goals are integrated with them.

Institutions designed to address climate change in India have largely taken the form of sector-specific laws, organizations, and policies. Despite its ad-hoc nature, however, mitigation policymaking is quite active in India. Indeed, over the last decade, successive governments have come to acknowledge positive linkages in addition to trade-offs between development and mitigation. India is one of the few G-20 countries which managed to achieve most of their nationally determined contributions (NDCs) under the Paris Agreement.

Currently, the National Action Plan on Climate Change (NAPCC), launched in 2008, is the main program in the central government's climate policy architecture, with eight climate "missions" and several "sub-missions" under it. Directed by the Prime Minister's office, the NAPCC is in charge of coordinating with line ministries to implement the climate goals in its eight missions. The Executive Committee on Climate Change (ECCC) is a bureaucratic body charged with execution of policies pertaining to various missions.

Evolution of Climate Institutions in India over time

Until 2007, climate policy was considered fundamentally a diplomatic problem. The domestic narrative pertaining to climate policy in this period was based around the idea that being a low per-capita emitter, India bore little responsibility for cumulative historical emissions. The emphasis was on "differentiated" in the phrase "common but differentiated responsibilities" in the UN Framework Convention on Climate Change. It was felt that India had a limited role to play in mitigation action relative to developed countries. Except for the creation of a Clean Development Mechanism Authority within the Ministry of Environment and Forests, the environment and foreign ministries primarily attempted to shield India from making any mitigation commitments.

Over the next few years, international pressures gained momentum in the aftermath of the Bali Action Plan[1] (2007) and the Copenhagen Conference of the Parties on climate change (2009). Developing countries now faced increased pressure from their developed counterparts to expand their mitigation ambition. These developments triggered the creation of a Prime Minister's Council on Climate Change, which issued the National Action Plan on Climate Change (2008). A former Foreign Secretary was appointed to the newly created post of Special Envoy on Climate Change in the Prime Minister's office.

The introduction of these institutions was significant in that it represented a major shift in the national climate change narrative. The NAPCC announced eight sectoral "missions"[2] that required the bureaucracy to add a climate lens to their functions. The NAPCC's approach was to identify "measures that promote our development objectives while also yielding co-benefits for addressing climate change effectively" (Government of India, 2008). Although this meant that policies that linked development and climate change were welcome, bureaucratic capabilities were not updated to actively design and implement such policies. Ministerial interests remained unaltered, and traditional goals remained prioritized. Climate objectives were aligned to existing projects: missions were specifically designed so as to fit well with the ministries' interests.

Post 2009, the global narrative on climate change was characterized by the need for further expansion of the role of developing countries. Locally, this created a tussle over what position India should assume in this debate. This led to frictions between the existing climate institutions in India which culminated in closure of the office of Special Envoy on Climate Change in 2010. Meanwhile Jairam Ramesh, appointed as environment minister in 2009, introduced several initiatives: state level climate planning, an expert group within the Planning Commission (the government's think tank, renamed and restructured in 2015 as the NITI Aayog), and establishment of a climate science network. This was the first time that state governments were forced to think about climate policy. Since state governments have sole control over several areas which are important with respect to mitigation, this was a significant departure.[3] However, despite being somewhat ambitious, none of these institutions were sustained. With the change in government in 2014, all these institutions ceased to be functional, and so did the attempt to build institutions exclusively dedicated to climate governance.

India's climate policy since 2014

After the Bharatiya Janata Party (BJP) came to power in 2014, Indian climate politics have almost exclusively been driven by the co-benefits approach, with an active search for positive linkages. While a plethora of climate policies have been introduced since 2014, many important bodies introduced to address climate change have closed down. India's 2018 Biennial Update Report to the UNFCCC lists 35 national mitigation actions, going beyond the remit of the NAPCC (Government of India, 2018).[4]

Once again, climate politics was not a part of the BJP's election agenda in 2014. The new government's active engagement with climate politics sought to transform India's position in global climate diplomacy to a country that is a "part of the solution". To this end, many eye-catching initiatives were undertaken, with solar power playing a central role. The Ministry of Environment and Forests became the Ministry of Environment, Forests, and Climate Change (MoEFCC).

1 https://unfccc.int/resource/docs/2007/cop13/eng/06a01.pdf

2 The missions are: the 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 of climate change, and National Bio energy mission.

3 Some of these areas are: taxes on sale of crude oil and natural gas and other minerals, taxes on consumption or sale of electricity, road taxes, land improvement, and agriculture.

4 Besides the eight missions under NAPCC, some of the other significant actions were: the integrated power development scheme to avoid power distribution losses, the national clean energy fund which imposed a cess (dedicated tax) on coal produced and imported in India, afforestation and reforestation programmes under the Clean Development Mechanism, Improvement in energy efficiency through micro irrigation, Ethanol blending programme promoting 5% blending on ethanol in fuels, development of several monorail and metro rail projects, and promotion of power generation from biomass produced at sewage treatment plants.

The climate policy architecture in this current period is characterized by centralized decision-making by the Prime Minister's office with the Prime Minister's Council on Climate Change and other bodies becoming defunct. Moreover, state actions have been only sporadically supported by the centre. Therefore, even though mitigation policymaking has been active, the Prime Minister's office is its only focal point, and the institutional structure of Indian climate governance remains weak.

The efficacy of India's climate governance

It is quite evident that India's climate narrative is continually influenced by international climate politics as well as the development goals set by ministries. Even though there is no permanent institutional structure for climate policy in place, the political and economic backdrop of India has ensured that the bottom up, co-benefits approach remains dominant. Implementation has been usually delegated to the existing bureaucrats in the form of an added responsibility.

Despite the structural weaknesses in India's climate policy architecture, the co-benefits approach has nonetheless managed to keep the mitigation process apace. Of the eight missions in the National Action Plan on Climate Change, the National Solar Mission and the National Mission for Enhanced Energy Efficiency have perhaps been the most successful. A state-owned Solar Energy Corporation of India was created as part of the National Solar Mission and it helped to drive solar PV prices down through competition generated by procurement auctions with above market prices in the initial years. In the eight years since the inception of procurement auctions in 2010, utility scale PV costs fell fastest in India reaching 793 $/kw in 2018, compared to a global average of 1210 $/kw (IRENA 2018), and electricity from new solar PV had become cheaper than that from a majority of existing coal plants (Chakravarty & Somanathan, 2021). A Bureau of Energy Efficiency, created earlier in 2002 following the Energy Conservation Act of 2001, has pursued labelling and standards programs for many electrical appliances.

Whether the present institutions are sufficient is nonetheless a legitimate question. "The impact that an institution may have depends on its capacity to effect changes, its robustness to countervailing forces, and the accountability relations within which it is embedded" (Dubash & Pillai, 2021 (forthcoming)). Going by numbers of personnel in government offices with climate responsibilities, the capacity of existing climate institutions is meagre. Even more so since the additional responsibilities for climate missions are allotted to existing officials, instead of expanding bureaucratic capacity or inculcating climate specialization.

Given that there is not much dispute over climate politics within national politics, in the Indian case, robustness of climate institutions would require cross ministerial structures within the government to identify and exploit development-climate linkages, something which has largely been absent due to the lack of political impetus. Consequently, international pressures remain the sole determinant of mitigation politics; when international pressures fade, so do the institutions. Additionally, with the growing centralization in the Prime Minister's office, no mechanism has been introduced to ensure external accountability, while the Parliament plays a limited, inconsequential role.

As noted by Dubash and Pillai (2021, forthcoming), efficient climate governance requires addressing three challenges: 1) coordinating mitigation linkages across multiple governmental departments and sectors of the economy; 2) building national institutions to design long-term strategies for the energy transition; 3) effective political mediation between different interest groups, balancing embeddedness with independence. Each of these is briefly considered below.

For a short while when the Prime Minister's Council on Climate Change and the Special Envoy were both active, coordinated action did occur in Indian climate politics. While the former had the required convening power, the latter took care of implementation. However, with the dissolution of the office of Special Envoy and the Prime Minister's Council on Climate Change waning in influence in the context of increased centralization, climate politics once again became discordant. While design and implementation of mitigation action is possible without a coordi-

nating body, it might allow co-existence of activities which are at odds, as is the simultaneous pursuit of coal and renewable energy. With 35 ongoing mitigation activities (as of 2018), a coordination mechanism is needed more than ever. Another aspect of the coordination challenge is ensuring availability of implementation finance. No separate budget is allocated for mitigation activities. Climate budgets are embedded within the budgetary negotiations between line ministries and the Ministry of Finance, which creates an additional obstacle for implementation.

A strategic approach to a low carbon future can sometimes be at odds with a co-benefits approach which prioritizes development. Since mitigation activities are subordinate to development goals, it is difficult to implement mitigation plans that over the long term in the absence of a vision that sees mitigation as a necessary part of sustainable development. To achieve this, sectoral transformation which simultaneously brings about development and mitigation is required. Something like this can be identified with India's National Solar Mission, which attempted to serve energy security needs while employing innovative technology.

The inter-sectoral nature of India's climate narrative necessitates political mediation. While institutions can "open a pathway to mitigation consistent with the realization of co-benefits" (Dubash & Pillai, 2021 (forthcoming)), they are equally likely to be rendered weak due to lack of consensus on a long-term strategy. The latter is largely a consequence of a lack of compensation to the losers. Mediation is required to ensure regular and continual evaluation, updating, and re-structuring of incentives and costs, so as to establish consensus among various interest groups.

Conclusion

It is clear that India's co-benefits approach is the only sensible and feasible one that is consistent with the widely shared domestic consensus on the need for economic development. Unfortunately, it is also quite obvious that the contemporary climate architecture falls short of its potential. In order to harness the full potential of the co-benefits approach, India's climate architecture could benefit from a high-level institution that is responsible for designing climate strategy, identifying linkages, and continuously informing the public debate (Dubash, Pillai & Bhatia, 2021). If this body has representation from the Prime Minister's office and the Finance Ministry, then it could have the heft to serve as an institution that aligns line ministries' programs with a national climate policy.

Note

This article draws heavily on Dubash and Pillai (2021, forthcoming). We are grateful to Aditya Pillai for helpful comments and Navroz Dubash for useful discussions.

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India's Domestic Climate Policy – Looking Back

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Introduction

The idea of sustainability and environmental concerns were part of India's development story long before it accepted the global challenge of climate change. Environmental concerns, then, were local and often at loggerheads with the State (Gadgil & Guha, 1995). However, with the last two decades of climate policy in the making, the State interwove the emission challenges with its growth and development objectives. India's climate policy has been guided by growing awareness of the impacts of climate change, and associated vulnerability, along with the potential to align economic growth, green growth and climate action. Between 2005-2016, emission inventory analysis from different sources shows that India has reduced the emission intensity of GDP by 24-25 percent (CSE, 2021).

Governance Structures and Institution Building

Climate institutional structure took root in India's large and rather complicated bureaucratic set-up in an ad-hoc and impermanent manner, as pointed out by Bhatt and Somanathan in an accompanying piece. Climate action in India, once a diplomatic concern with policies being designed and implemented at the central level, over the years had begun to be planned and carried out at the sub-national level. Policies at the sub-national level are particularly formulated around and successful in the renewable energy sector, where few states reaped the benefit of locational advantages of wind and solar. Different ministries and departments have been made partners in India's climate action. However, these governing structures are primarily 'layered' on already existing ones rather than being designed and set up with strategic intent (Pillai & Dubash, 2021). Due to the complexity posed by climate change itself and its interconnectedness with the economy's idiosyncrasies, putting together an effective governing structure that brings fruition to climate goals is a mammoth task. Especially for the largest democracy in the world, several factors ought to be considered – the variety of relevant sectors, different operational and implementational layers, outcomes with varying degrees of development/welfare implications, and multiple players with diverse economic and political objectives. Building a seamless structure accounting for these factors is wrought with long learning periods and India is at the beginning of a steep learning curve.

The increasing visibility of climate issues has brought a set of non-State actors that bring complementary institutional support to the State. For example, NGOs and think tanks that are dedicated to environment and climate issues played a key role in India's climate action story. They not only acted as a much-needed critic but also offered policy insights. Non-State actors are also involved in knowledge generation and diffusion for the State to make informed and educated policy design. Private actors, especially industry are a key and a dynamic building block in India's climate change story as they view and exploit emission challenges as a viable growth option by developing, using and profiting by low-carbon technology. The State provided a congenial system to further this endeavour, especially in the energy sector. However, dedicated institutional support in terms of a legislative and executive framework is largely missing in India's climate action narrative. Also missing is an innovation and learning network that aims to understand what climate change means to

India's socio-economic and political demands and provide insights to integrate it with development processes.

India's progress in climate action

Through the National Action Plan for Climate Change or NAPCC (GOI, 2008), India identified priority sectors --encompassing both mitigation and adaptation actions-- to achieve its climate goals. These sectors remained a priority when India announced its Intended Nationally Determined Contributions (NDCs) prior to the COP15 in Paris (GOI, 2016). Here we shall discuss the progress of few key sectors.

Power Sector

Of all the sectors identified under India's climate change goals, the power sector received the most attention with a focus on renewable energy sources (RES). The initial impetus to the power sector came from the National Solar Mission (NSM), one of the eight Missions started by the NAPCC in 2010. The NSM was a policy initiative by the Central and State governments to promote rooftop and grid connected solar PV with a target of 20 GW installed capacity by 2020. In 2015, India announced a significantly more ambitious target of 175 GW of renewable energy by 2022 -- 100GW of solar, 60 GW of wind, 5 GW of small hydro, and 10 GW Biomass power. In 2019, the renewable electric capacity target was increased to 450GW by 2030 (Business Today, 2021). By April 2021, India's renewable capacity reached 95 GW. Non-fossil electricity generation[1] registered an annual growth rate of 10% in the last decade. The transformation of India's renewable energy sector in the last decade, especially wind and solar, is due to an impressive eco-system that has evolved to finance, innovate, manufacture, profit from and largely prioritize RES. Renewable sources have "must-run" status in the grid, state electricity distribution companies have Renewable Purchase Obligations set by State Electricity Regulatory Commissions, and there is a Renewable Energy Certificates scheme to allow distribution companies unable to meet their obligations directly, to do so via trade in certificates. Solar and wind, growing at a rate of 140% and 13% respectively in the last decade, together account for 84% of the total renewable energy capacity in India. Indirect measures were also taken to level the field for RES. Starting from 2010, in order to make RES competitive, a cess (tax with dedicated proceeds) has been levied on coal which has increased the cost of coal by 20-40%. A modest amount of this cess has been spent on clean energy and other environmental projects.

Energy Efficiency

Nearly 45% of India's commercial energy is consumed by the industrial sector (Sethi, 2019). Active steps had been taken and notable success was achieved in enhancing energy efficiency in this sector. Special attention was paid to micro, small, and medium enterprises (MSMEs). Since these units are less technologically advanced and capital intensive, they are largely energy inefficient. Programmes and schemes like the "National Programme on Energy Efficiency and Technology Upgradation in Small Medium Enterprises (SMEs)" are designed to hand-hold, skill, energy auditing, technology dissemination, finance and innovate to increase energy efficiency in these units. In 2012, energy savings, assessed form 988 SME units of 26 clusters quantified to 4934.45 toe / annum.

Improved living standards have led to a rise in demand for electrical appliances and other durable goods, thereby increasing power consumption in the residential sector. Consequently, several policies were put in place to enhance the energy efficiency of the residential sector. These include supply-side policies that incentivize manufacture and supply of affordable energy efficient appliances (Market Transformation for Energy Efficiency Achievements) as well as demand-side policies like the Standards and Labelling Scheme, covering 26 appliances, to allow consumers to make informed choices. The energy saving achieved under this programme has been estimated to be 55.69 TWh, about 4% of electricity consumption in the financial year 2018-19 (MoEFCC, 2021).

1 Non-fossil refers to hydroelectric, nuclear, solar, wind and biomass power plants.

Transport

The Transport sector is the second-largest energy consumer in India after industry. The sector is largely oil dependent and accounts for 12.1% of the country's CO_2 emissions. Policy measures are in place to configure India's transport sector to run on clean energy, as well as to ensure efficient energy usage. Standards, norms and incentives for efficient fuel usage are in place for vehicles of different categories and classes -- light and commercial vehicles, heavy duty vehicles, and vehicles used in agriculture. For example, Corporate Average Fuel Efficiency norms (CAFE), for passenger cars were introduced in 2015 to reduce vehicular emissions. The first phase of CAFE targeted a fleet average of 133.1 gCO_2/km in 2018-19 which the industry exceeded by 8% (121.9 gCO_2/km); the second phase targets 109.4 g/km in 2022-23 (Deo, 2021). In 2013 the Indian government rolled out the National Electric Mobility Mission Plan 2020, where it aimed for 5-10% of the vehicles on the road to be electric-powered (i.e., 6.-7 million EVs) by 2020. During the first phase of the implementation, the programme focused on demand creation, technology platforms, pilot projects and charging infrastructure (PIB, 2019). However, the programme fell way short of the assigned goals at the completion of the first phase of this programme (only 0.28 million EVs). Given the well-established nature of the market for ICE, high upfront-cost, infrastructure incompatibility of EVs (KPMG, 2020), it is rather over-ambitious to aim to roll out 6-7 million EVs in just 7 years. However, it also needs to be noted that there is a sizeable segment of two-wheeler EVs that are exempted from registration which makes them unaccounted for thus running the risk of under counting. India also took a big step towards reduction in the usage of petroleum products via taxation. Starting in 2013, subsidies on oil were gradually removed and the tax on petrol increased by 150% in four years (Singh, 2017).

Forestry

Enhanced CO_2 sequestration through increasing forest and tree cover had been projected as one of the major actions to meet India's emission intensity reduction targets. The Green India Mission (GIM), envisaged in 2010 to be a 10-year program was eventually launched in 2015. It aimed to protect and restore forest cover with an afforestation target of 10 million hectares in a 10-year time frame. The mission was designed to operate through active coordination across different levels of governance- center, state, district and village level. Between 2015 and 2019, forest and tree cover increased by 1.3 million hectares or by about 1.6%, but only a fraction of this is likely attributable to the mission. GIM is one of the few missions, proposed under NAPCC, that does not have direct and immediate implications to the growth/development goals especially that reap economic gains. This is one of the major deterring factors for the mission's less than desirable progress. Actively linking this Mission to the livelihood and employment programmes and incentivizing the local implementation bodies, rigorous guidelines regarding habitat restoration or land reclamation projects will help reach the goal.

Knowledge generation

The National Mission on Strategic Knowledge for Climate Change is one of the eight missions commissioned as part of the NAPCC. The aim of this mission is to build human and institutional science and technology capacities and develop strategic knowledge in climate change science, adaptation, and mitigation. This mission aims to cater to three main knowledge requirements- Scientific and Technological elements, Technology-policy interfaces and Science and Technology inputs for international negotiations. Various arms of the Government earmarked resources for the development of strategic knowledge. So far, eleven Centers of Excellence, spanning different universities and educational institutions, were established to address diverse aspects of climate change. This mission facilitated network building and interactive learning across knowledge centers. This mission is also responsible for capacity building among personnel in the power sector- demand-side management of energy, energy efficiency; and training of the workforce for installation, commissioning, operation, and maintenance of solar projects.

What is missing?

Sectors identified for climate action have seen different degrees of success. Firstly, the clarity with which goals set varied significantly. While goals set for energy sector was in the form of targets, in others it was too general- a 'wish list-like' approach (Dubash & Ghosh, 2019). For example, the National Mission on Sustainable Habitat was drafted primarily as an idea "to build urban resilience to climate change, by integrating adaptation and mitigation aspects into the urban planning". This uneven approach- agenda and time specificity of the goals (Rattani, 2018) -- across sectors made all the difference in the intensity with which the sectors drew attention from wide variety of actors- industry, financial institutions, local governing bodies. Secondly, the policy attention was biased towards sectors that were perceived to have direct and immediate implications to India's growth necessities. Missions characterised by delayed socio-political, environmental, and technological consequences; timelines into the distant future with fading liability footprint were generally pushed to the back burner. For example, the Green India Mission was able to achieve tree plantation in only 2.8% of its target (10 million hectares of forest cover) by 2019. Further, little attention is paid to the details that entail in creating ideal ecological services- prevention of soil erosion, promoting biodiversity, providing livelihood etc. (Kukreti, 2019).

Conclusion

India is on the right path towards integrating its climate actions with its growth and development goals, although there is a need to bring clarity to the process. An element of ad-hocism and disconnectedness ails India's climate action. Programmes and schemes are often designed in isolation with some implication for climate change but fail to seamlessly connect with larger scheme of India's climate goals. India so far has succeeded in assimilating 'climate change' in its growth and development dialogue. Equally commendable is the success it achieved in few key sectors. However, India's climate change narrative has been far removed from its inclusive growth goals. The sectors, actors and direct benefits accrued through climate actions have limited implications for India's inequality, poverty and welfare concerns. Identifying and focusing on sectors that have a wider scope in terms of engaging and benefiting larger sections of population would bring more visibility, and better reception of climate change concerns. This would further aid in integration of India's climate and developmental objectives.

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India's Domestic Climate Policy – Looking Forward

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Introduction

India is strongly in favor of the Paris Agreement long term goal of limiting warming to 1.5°C as South Asia will likely be one of the regions more adversely affected by climate change. Over the last couple of decades India has implemented a diverse basket of policies that have contributed significantly to climate change mitigation while balancing the demands of economic development, energy security and social well-being. India is the only major economy whose emissions trajectory is in line with a 2°C goal under a broadly agreed upon "fair share" contribution to climate change mitigation (CAT 2020).

The Indian government is in favour of the global net-zero emissions by 2050 target but has stated that the national net-zero by 2050 targets by many developed countries do not go far enough to account for fair share contributions, or the needs of developing countries. India is most likely to continue with, and further strengthen and streamline, its "co-benefits led and development-centric approach". India will, very likely, refrain from a hastily drafted net-zero pledge which might disrupt a national climate policy consensus, and an evolving, but fairly successful, climate policy and implementation framework (Dubash 2021).

India has seen considerable success with (1) national targets, policy support and new market mechanisms for the uptake of new technologies like LED bulbs, EVs and solar PV, (2) regulatory standards for improved efficiency, and (3) fiscal support for clean energy and transportation. Going forward, India will continue and develop these policies. One weakness of the Indian climate policy architecture, as pointed out by Bhatt and Somanathan is its highly centralized nature. It is likely that considerable focus will be given to developing institutional mechanisms and building state capacity at different administrative levels to design and implement appropriate policies.

Adaptation should have an equally important role in Indian climate policymaking given the expected climate change impacts on agriculture, ecosystems and the lived environment. Two of the eight National Missions of the National Action Plan for Climate Change are focused on adaptation–the missions on Sustainable Agriculture and Sustainable Himalayan Ecosystems. These focus on climate resilient agriculture, sustainable livestock farming, research and sustainability of the Himalayan hydrological systems and ecology (MoEFCC, 2021).

Disaggregated and decentralized climate policy started with the State Action Plans for Climate Change which are mostly focused on adaptation policies. But, financing at the state level, and institutional capacity to develop and implement policies is weak. Policy making and competition between states on renewables and electric vehicles have happened independent of the State Action Plans, and some of these have been very effective. Adaptation policies and implementation are best done at the local level. Future climate policies should focus on financial incentives for adaptation policies, local capacity building, and coordination and learning networks (Dubash & Ghosh, 2019).

Key climate policies going forward

India will exceed its Nationally Determined Contributions (NDCs) under the Paris Agreement; it will more than achieve a reduction in emissions intensity of 33-35% by 2030, and

exceed a 40% share of electricity generation capacity from non-fossil sources by 2030. The climate change mitigation successes have been primarily a result of the transformation of the electricity sector coupled with efficiency gains and structural transformation of the economy. With the right policies, the electricity sector developments can be accelerated. Similar policies can be implemented in other sectors like electric vehicles (EV) and appliances. Policies for hard to abate sectors like industry, cement, steel will be more challenging. Some of the policies discussed below will be part of a future net-zero pledge for India. Finally, India can be a source for affordable clean technology and climate policy innovation for the rest of the world.

Electricity and coal sector transformation

India's power sector had a capacity of 387 GW in July 2021, about 39.2% (151.6 GW) of the capacity and about 21% of the generation is non-fossil. The power sector was responsible for emissions of 1.15 Gt CO_2 in 2019 (50% of total emissions), these were primarily from coal power plants (IEA 2021). In 2015, India announced a target of 175 GW of new renewables (renewables excluding large hydro) to be installed by the end of 2022. In September 2019, the Indian Government set a more ambitious target of 450 GW of new renewables by 2030. Though India will miss the 2022 target (new renewables capacity in July 2021 was 98.9 GW), the 2030 target is feasible, and the share of non-fossil generation capacity will likely reach 60-65% in 2030 with a corresponding share in generation of 40-45%.

This remarkable transformation will be a success of the National Solar Mission, and the ambitious renewables targets set in 2016 and 2019. The innovative reverse auction process of price discovery coupled with rapidly declining technological costs have made the social cost of wind and solar cheaper than new coal power plants, indeed cheaper than the operating cost of more than a third of existing coal power plants[1] (Chakravarty & Somanathan, 2021b). Renewables with 4-8 hours of storage will likely be competitive with new coal plants by 2025 (Chakravarty & Somanathan, 2021b). Anticipating these developments, Indian policymakers have invited bids for supplying round the clock power from renewables with storage, and battery energy storage systems for energy storage as well as secondary and tertiary grid balancing services (Bridge to India, 2021). The International Energy Agency also projects that these developments will very likely lead to coal powered generating capacity peaking this decade (IEA, 2021). The Indian policymakers are yet to acknowledge this scenario but the continuing rapid decline in renewable and storage costs might soon force a change in outlook. Pollution from coal power plants is a major issue which will require expensive retrofits of sulphur dioxide and nitrous oxide control equipment on coal power plants. This will force the retirement of at least 25 GW of coal plants by 2030.

Carbon pricing through fuel tariffs

India does not officially have a carbon tax on fossil fuels. The tariff closest to a carbon tax is the clean energy cess (now called the GST compensation cess) of Rs 400/ton of coal. This is equivalent to 3-4 \$/ton CO_2. High railway transportation tariffs make Indian coal quite expensive, and net cost at the coal power plant is often 100-400% higher than the cost at the mine (a markup of 10-40\$/ton). These costs can only increase in the future as both the Indian government and Indian Railways are dependent on coal taxes and tariffs as important sources of revenue[2].

The federal and state taxes on petrol and diesel are 100-125% the supply cost at the retail gas station. This is equivalent to a carbon tax of 230-320\$/tCO_2. Petrol and diesel are 20-50% more expensive in India than in either the USA or China[3]. These taxes are a significant source of revenue and are likely to increase in the future.

These high fuel taxes and tariffs act like stiff carbon taxes. As a result, electric vehicles, es-

1 The private costs of new renewables are cheaper than the operating costs of more than half of existing coal plants (if externalities are not accounted for).

2 Rail freight revenue cross-subsidizes passenger rail in India.

3 Since incomes are much lower in India, the income effect of a given tax will also be much larger in India.

pecially electric two wheelers (E2W), are increasingly competitive with internal combustion vehicles (Rokadiya, Bandivadekar, & Isenstadt, 2021). And coal power plants are increasingly losing out to renewables in the electricity market. The impact of these incidental carbon taxes on India's energy transition has been significant, though underappreciated, and these will continue to rise.

Electric vehicles

A new and improved version of the Faster Adoption & Manufacturing of Hybrid and Electric Vehicles policy (FAME) announced in 2021 offers an upfront purchase cost subsidy of 10-20%, and a tax rate of 5% compared to 28% tax on equivalent internal combustion vehicles (Rokadiya, Bandivadekar, & Isenstadt, 2021). These will make the total cost of ownership of E2Ws comparable to conventional 2W, and is likely to make the upfront cost of purchase similar by 2025-30. For three wheelers (3W), primarily used as small taxis and commercial vehicles, EVs are economical even in the absence of any incentives (KPMG, 2020).

India is the world's largest manufacturer and exporter of 2Ws, the 2W/3W segment uses 65% of India's petrol and contributes about 2% of India's CO_2 emissions. This market is expected to double to 50 million units by 2026 (Rokadiya, Bandivadekar, & Isenstadt, 2021). Accelerated electrification of this important vehicular segment can significantly improve India's transportation emissions. It is estimated that in 2025, E2Ws will have only 23% of the emissions (per kilometer) of an equivalent internal combustion vehicle (Anup, Deo, & Bandivadekar, 2021), and this will improve as electric grid becomes greener. FAME will help build an EV and battery ecosystem with substantial spillover impacts on electricity storage, other EV segments, and other developing countries via exports. The FAME policy framework is likely to lead to 25-35% E2W share in the market. Mandating 100% electrification by 2030 of the 2W segment can be an ambitious "no-brainer" policy enhancement that can transform the Indian transportation sector (Chakravarty & Somanathan, 2021a).

Freight transportation by Indian Railways

Freight and passenger trains share the same network in India, often leading to low speeds for freight trains, and a steadily declining share of rail in freight over the past decades. Freight transportation by trucks is the single largest source of transport emissions in India. Expansion and efficient utilization of the Indian rail network and electrification of traction could potentially reduce cumulative CO_2 emissions by 4 $GtCO_2$ between 2020 and 2050 (RMI, 2021).

The Indian Railways, the State rail monopoly, plans to complete the electrification of its entire rail network by 2024. Rail network expansion to set up dedicated high speed freight corridors are being implemented, and are slated for completion this decade. About 3500 km of dedicated freight rail is under construction, and another 5000 km is being planned. These dedicated freight corridors will connect major ports, logistical and industrial hubs, and are expected to carry approximately half of India's freight. A shift to rail transportation, improved logistics, and future electrification of trucking could potentially save 10 $GtCO_2$ in the 2020-2050 timescale (RMI, 2021).

Transforming the industrial sector

The industrial sector is responsible for a quarter of India's emissions. Cement, steel, fertilizers and chemicals contribute 80% of industrial emissions, and most of these are likely to rise significantly (Biswas, Ganesan, & Ghosh, 2019). The high cost of energy and electricity in India has lead to significant improvement in energy efficiency of some sectors. The Indian cement industry, the world's second largest after China, is also one the of most energy efficient (BEE GIZ CII, 2018).

The primary regulatory instrument to reduce emissions in industries has been the Bureau of Energy Efficiency's Perform Achieve and Trade (PAT) scheme which set energy efficiency targets for specific industries and an associated market of tradable certificates of excess energy

savings (BEE GIZ CII, 2018). While successful, the emissions reductions have been modest.

In the long term, deep decarbonization technologies will be required in these 'hard to abate' sectors (Biswas, Ganesan, & Ghosh, 2019). Significant saving in the short term can be incentivized by pricing carbon, and promoting fuel switching to natural gas. Another policy driver could be the pricing of environmental externalities. If the cost of pollution from coal is internalized, it would add 20-30$/ton to the cost of coal (Chakravarty & Somanathan, 2021b).

Appliance standards and efficiency improvements

The Bureau of Energy Efficiency launched an appliance efficiency standard and labelling policy in 2006. This scheme now covers 23 products, and it is mandatory for major household appliances across the heating, lighting, cooling and entertainment segments. The minimum energy performance standards (MEPS) of various appliances and the star label segments are raised every few years (Kumar, Pandita, & Walia, 2020).

Around 150 million star labeled appliances were sold annually in 2017, and an estimated 162 $MtCO_2$ have been saved till 2017 with a 30-50% increase in the efficiency of air conditioners and refrigerators. Continuing with the appliance standards program, and accelerating the stringency of these labels, will be key to controlling the growth of residential electricity and energy demand.

India's cooling demand will skyrocket with rising incomes in a warming planet. The IEA projects India's annual space cooling demand in 2050 to be about 1300 TWh, comparable to India's total annual electricity generation this year (IEA, 2018). Improved efficiency standards could potentially save about 100 $MtCO_2$ (and, about 100 TWh) annually in 2027 (S. Kumar et al., 2018), and significantly more in future.

Carbon sequestration in forests

Cumulative sequestration of 2.5-3 $GtCO_2$ by 2030 is an important pledge of India's NDCs. While India likely has a positive forest carbon sequestration rate it will be difficult to verify and monitor the quantum of sequestration, or its residence time. Official estimates of sequestration rates vary from 68 $MtCO_2$ to 200 $MtCO_2$ (Lele & Krishnaswamy, 2019). Indeed, there is a lot of disagreement in what constitutes a forest and how carbon sequestration in forests is defined. Forests are an area of contestation in India with many claimants like forest dwellers, biodiversity, wildlife and the State. It is likely that this NDC pledge is driven by the most optimistic estimates of afforestation and forest carbon sequestration, and the assumption that these conditions would continue for the foreseeable future. Neither of these assumptions might be true (Lele & Krishnaswamy, 2019). If the Government is not mindful of these complexities and uncertainties, and tries to force a centralized top-down program it might be setting itself up for conflict and failure.

Conclusions

India's "co-benefits led and development-centric approach" and "opportunistic policy making", where developmental need and climate mitigation have an uneasy coexistence, have been a modest success (Pillai & Dubash, 2021). India could continue its successful policies, take on more ambitious targets that could incentivize innovation, new technologies and employment opportunities. At the same time, India will need to invest resources in State capacity building and regulatory infrastructure. Some of the policies discussed here should form the basis of a more ambitious NDC, and should feed into a process that develops India's net-zero trajectories in the near future. Decentralized adaptation policies and implementation institutions should form an integral part of the net-zero exercise.

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India's Climate Diplomacy

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In this article I present a brief critical assessment of India's climate diplomacy, which has thus far been driven mostly by foreign policy concerns with domestic concerns about adverse impacts from climate change playing only a small role. Climate diplomacy and climate policy more generally, have been subordinate to development concerns. Despite being one of the most vulnerable countries in the world, climate change has barely registered in domestic political debates in India. This is principally because climate impacts so far have not been dramatic, and mostly cannot be `seen with the naked eye'. Aggregate impacts have already manifested themselves, for example, wheat yields are a few percentage points lower than they would have been in the absence of warming (Gupta et al, 2017), and manufacturing output is about 2% lower than it would have been (Somanathan et al, 2021). But these are detectable only with sophisticated statistical analyses. Since two-thirds of Indian adults do not have a high school education (OECD, 2019), it is not surprising that knowledge of climate impacts would not be widespread.

India's per capita GDP was about $6000 in 2020, only slightly more than one-third that of China, and less than one-tenth that of the U.S. (adjusted for purchasing power parity). The distribution of income is highly unequal (Assouad et al, 2018), and, with the important exception of foodgrain subsidies for poor households, there is no social security to speak of – no unemployment insurance, no minimum income program, no universal pensions, minimal and patchy public health insurance, and only skeletal public provision of health care. Most people have to worry about day-to-day threats to their livelihoods and do not have the time or energy to engage with more distant and abstract ones. These facts explain why climate concerns are largely absent from political debate in India.

The drivers of Indian climate diplomacy, are, therefore, very different from those of high-income countries in which concerns about climate change are a significant part of the domestic political discourse. In high-income countries, climate policy and diplomacy have been driven by two opposing forces; environmental activists raising and harnessing public concern about the danger from climate change on one side, and the owners of industries dependent on fossil fuels trying to protect their financial interests on the other. While fossil fuel owners have been dominant in most developed countries, especially the United States, the other side has been gradually gaining strength. Developed country governments have, therefore, expressed rhetoric about the need to protect the climate in order to demonstrate to their public that they are protecting their safety, while being careful not to propose or agree to anything that would cause immediate harm to their own fossil-fuel dependent industries. It is impossible to understand India's stance on climate policy in international fora without keeping in mind that it was a reaction to this international situation.

A brief history of Indian positions

In climate negotiations prior to and up to the Rio conference in 1992 at which the UN Framework Convention on Climate Change (UNFCCC) was signed, India's position was that developing countries must have space to grow and that developed countries who accounted for most of the stock of CO_2 in the atmosphere at that time, bore primary responsibility to mitigate

climate change in accordance with the polluter pays principle. The emphasis was on equity in burden-sharing. Indian and other developing country negotiators worked to ensure that the phrase "common responsibilities" on climate change was changed to "common but differentiated responsibilities" to protect the climate system in the Convention (Sengupta, 2019).

The Indian strategy thereafter, from the signing of the UNFCCC in 1992 to the Conference of the Parties (COP) to the convention in Copenhagen in 2009 was aimed at avoiding taking on any binding mitigation commitments by referring to equity and development considerations. Another way of avoiding mitigation commitments was to give more importance to adaptation than mitigation. But this attention to adaptation was reflected in adaptation planning within India to a quite limited extent (Raghunandan, 2019).

In the fifteen years following the signing of the UNFCCC, China, India, and several other developing countries experienced rapid economic growth and became far more integrated and much more important parts of the world economy. While India's growth lagged far behind China's, it too was invited to attend the G8 summit in Heiligendamm in 2007. By this time, it was clear that the list of developing countries in the 1992 convention was out of date. Significant participation from at least the fast-growing large developing countries would be essential to the success of mitigation. The summit convinced Prime Minister Manmohan Singh that climate policy would have to be institutionalized in India. At the summit, he made the first official mitigation commitment by India – that its per-capita emissions would never exceed those of developed countries. This was a retreat from previous positions and a dilution of the polluter pays principle that India had previously insisted on, since it did not refer to the stock of greenhouse gases at all. Upon the Prime Minister's return, he ordered the drafting of a National Action Plan on Climate Change that included plans for emission mitigation in important sectors, and that has been influential in domestic climate policy thereafter. The Prime Minister also transferred leadership of climate negotiations from the foreign ministry to the Ministry of Environment and Forests, renamed the Ministry of Environment, Forests, and Climate Change. A new environment minister, Jairam Ramesh, was appointed in 2009 and tasked with updating Indian climate policy and diplomacy.

At the COP in Copenhagen in 2009, India agreed to take on mitigation commitments in a non-binding form, partly because it was losing allies among other developing countries, and partly because it was felt that the U.S. and EU were succeeding in their effort to portray India as an obstacle to a solution to the climate problem. Furthermore, since the U.S. and other countries had given up on binding commitments, the Indian leadership felt that this was an opportunity to present India as part of the solution rather than part of the problem, without tying Indian policymakers' hands.

This post-Copenhagen approach culminated in the Paris Agreement in 2015 in which all countries agreed to take on voluntary commitments with most of them being only a little more ambitious than business as usual (BAU). India committed to a reduction of 33-35% in emission intensity below the 2005 level by 2030, and to a non-fossil electric generating capacity share of 40% by 2030 in its Nationally Determined Contributions (NDCs) under the Paris Agreement. It appears that the first target will be met, while the second has already been almost achieved. These policies, as well as domestic targets for renewable generating capacity announced subsequently are motivated by economics, energy security, and domestic pollution reduction concerns in addition to their climate benefits. Going forward, it is likely that India will continue to project itself as part of the solution to climate change by announcing and pursuing policies that are commensurate with these development goals (Chakravarty, this issue).

What next?

Given that there was little appetite among most developed-country governments for doing much more mitigation than would have occurred under business-as-usual, it is unlikely that a different Indian negotiating stance on climate policy would have achieved better results in terms of global mitigation efforts, or in securing international help for financing mitigation or adaptation.

However, in the course of this decade, as fossil fuels lose market share and climate impacts in the form of floods, fires, heatwaves and cyclonic storms accelerate, it is likely that all countries, including the developed countries and China, will undergo major changes in the domestic politics of climate change. Fossil fuel interests have already lost their political dominance in some countries, and the number of countries in which this is the case will grow rapidly. Fossil fuel interests will cease to have as much influence over climate policy in these countries, who will then pursue more aggressive mitigation actions domestically, while also attempting to pressure low and lower-middle income countries into doing more mitigation. This process will work itself out in India as well, and the Indian approach will become heavily conditioned by the need to avoid domestic impacts of climate change.

The need for an international agreement on geo-engineering

Increased climate impacts will trigger much more comprehensive adaptation planning in India. However, it is already clear that unless the temperature increase is halted, the impacts on India will be unimaginably severe. To give just one example, recent work predicts that large parts of Mumbai and Kolkata will be below high tide as early as 2050 (Kulp & Strauss, 2019; Climate Central, 2021). Some of the most valuable real estate in the country could lose most of its value and huge migrations could be triggered. Of course, major cities in other countries will also be affected.

The Paris commitments and even much greater global mitigation efforts will not be sufficient to prevent these dire impacts. It follows that India should be pressing for immediate international preparation for geo-engineering despite its risks, since the risks of not doing it could be even worse (Rahman et al, 2018). If research and experimentation suggest that geo-engineering up to some level is likely to have the net effect of reducing severe damages, then implementation could go ahead.

A return to conditionality

Since the level of geo-engineering is a continuous variable, and since the negative side effects will probably be increasing in the amount of geo-engineering, the importance of increasing mitigation will remain.

India will need to adapt its negotiating stance to offer deeper emission cuts beyond its updated NDCs, *conditional on other countries doing the same and on receiving international financial assistance*. India should get together with other low and lower-middle income countries to push for something in the spirit of Raghuram Rajan's proposed Global Carbon Incentive scheme (Rajan, 2021). Under this scheme, countries that are above global average per-capita emissions would pay into a fund a per-capita amount that is in proportion to their deviation from the world average, while countries below the average would receive an amount that is in the same proportion to their deviation from the average. Since per-capita emissions are highly correlated with per-capita incomes, such transfers would be progressive. Of course, under such an agreement, all countries would have an incentive to reduce their own per-capita emissions. As a practical matter, it is hard to conceive of poorer countries doing more than token mitigation without the resources and incentives generated by such transfers.

Globally, the appetite for an agreement with conditionality, both in terms of reciprocal emissions cuts, and in terms of financial assistance to less developed countries, will only increase, and India would do well to take the lead in pushing for it. But Indian policy-makers need to do so differently than they have in the past. The case needs to be made not solely as a matter of justice, but also as a simple matter of necessity for getting the job done.

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Section II

Celebrating EAERE Researcher in Environmental Economics under the Age of Forty Awardee

Fit-for-55: is the workforce 'fit' enough?

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On 14th July 2021, the European Commission released the communication "*'Fit for 55' - delivering the EU's 2030 climate target on the way to climate neutrality*" (EC, 2021). Its declared objective is to pave the way for the binding target of reducing European greenhouse gas emissions by 55% by 2030 (compared to 1990), which is a crucial milestone towards the objective of a climate neutral Europe by 2050, as set by the European Green Deal (EGD henceforth, see EC, 2019). To attain such an ambitious target, that will call for carbon removal and substantial abatement across all sectors, the European Commission defined a policy mix that combines market-based instruments with other measures (e.g., standards). This mix combines a tightening of existing policies (e.g., the Emission Trading Scheme) and new legislation (e.g., Carbon Border Adjustment Mechanism).

Jobs, labour and skills constitute a core theme both in the European Green Deal and in the 'Fit for 55' communications. To illustrate, in the 'Fit for 55' strategy, the word "labour" appears 1 time, "employment" 2 times, "jobs" 9 times and "skills" 10 times.

In this respect, jobs are at the same time considered as crucial enablers of the sustainable transition and as a critical dimension in terms of addressing adverse distributional consequences of the transition. For this reason, the European Commission wanted to emphasize the need to increase the supply of jobs with the 'right' set of skills and, on the other hand, to build a comprehensive strategy to compensate the losers (e.g., by means of the Just Transition Fund).

Besides general statements about the importance of jobs and skills, the communication also makes reference to specific instruments to boost skills. Among these, the "*European Skills Agenda for sustainable competitiveness, social fairness and resilience*" (EC, 2020), drafted and proposed by the European Commission right after the EGD approval, should represent the core strategy to develop the right set of skills for the twin green/digital transition and create job opportunities for losers. However, while there are clear ideas and targets about how to improve skills to facilitate the digital transition (e.g., target of 70% of adults aged 16-74 having at least basic digital skills by 2025), the plan for the creation of skills for the green transition remains vague (e.g., "*defining a taxonomy of skills for the green transition*", EC, 2020, page 12).

Skills for the sustainable transition: input-perspective vs output-perspective

Input perspective

Jobs that require specific skills represent a crucial input to enable, drive and implement the sustainable transition (*input-perspective*). To "*deliver the transformational change needed across our economy, society and industries*" (EC, 2021, page 1) there is need for a radical change in production technologies and business models and for reshaping the industrial composition to respond to changing consumption patterns. These radical transformations require a deep change in the tasks performed by workers and, consequently, in the skills required for new and existing jobs. In this respect, skills represent a crucial input to make the transition happen.

What are these skills? As briefly discussed earlier, while there seems to be a quite clear understanding of the set of digital skills needed, when it comes to green skills, there was no consensus at the EU level on what is the set of skills required

for the green transition. In a recent paper with Francesco Vona, Davide Consoli and David Popp (Vona et al., 2018) we tried to tackle this issue by identifying the set of skills that were specifically needed for selected green occupations compared to other similar non-green occupations for the US.[1] Our results pointed to the relevance of four groups of what we labelled as Green General Skills: i. engineering and technical skills; ii. science skills; iii. monitoring skills; iv. operation management skills.[2] These skills turned out to be in higher demand in regions with more stringent environmental regulations (air pollution control in that case) than in other areas. Our results were particularly large in magnitude for engineering and technical skills, as also confirmed by analysis on European industries when considering energy prices as a proxy for environmental regulatory stringency (Marin & Vona, 2019). While interesting and evocative, however, these results are just a first step towards a more detailed understanding of the different sets of skills that are required for each and every environmental technology and sustainable business model.

Output perspective

Skills are also a channel through which changes in the demand for heterogeneous jobs influence employment levels, the distribution of income and, ultimately, living conditions (*output-perspective*). The existing availability and allocation of skills is what determines winners and losers from the green transition. Recent analysis on the U.S. (Popp et al., 2020) provides interesting evidence about the effectiveness of a green fiscal stimulus to boost local employment. Based on the green component of the U.S. American Recovery and Reinvestment Act of 2009, results show that regions whose initial endowment of Green General Skills was the highest were the ones where green public spending was most effective in creating new jobs, thus reinforcing existing green specialisation at the expenses of non-green specialised regions. However, green specific training seems to be a substitute for existing green skills specialisation (Chen et al., 2020).

COVID-19 crisis and recovery in U.S. and Italy: was it (green) skill biased?

The recent crisis and subsequent recovery due the outbreak of COVID-19 implied unprecedented changes in labour markets, both in terms of speed and magnitude of job destruction and in terms of heterogeneity across industries,

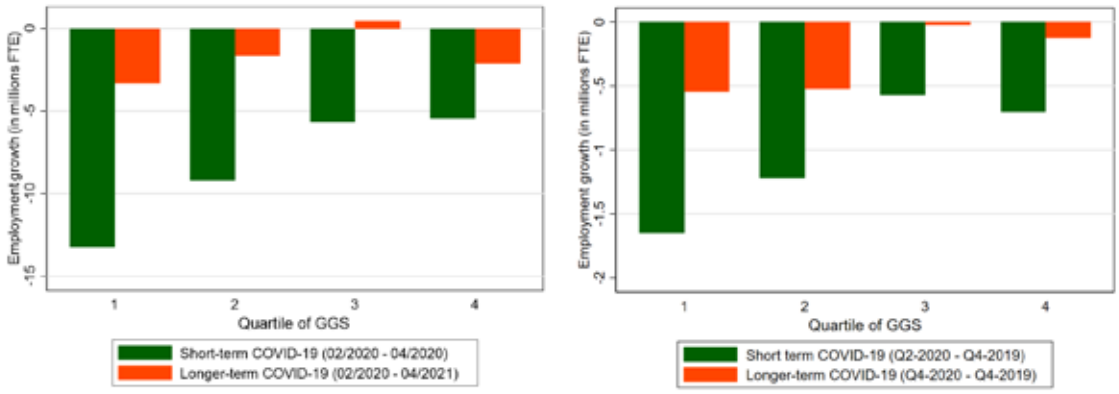

Figure 1. Response of employment to COVID-19 crisis and recovery by quartile of Green General Skills (US and Italy).
a. COVID-19 crisis and recovery in US employment by quartile of Green General Skills (GGS). Own elaboration on data from O*NET and Current Population Survey microdata accessed through IPUMS.
b. COVID-19 crisis and recovery in Italian employment by quartile of occupational Green General Skills (GGS). Own elaboration on data from Indagine Campionaria sulle Professioni (ISFOL) and Labour Force Survey microdata from ISTAT

1 Green occupations were identified by the Occupational Information Network (O*NET) as the ones that were performing at least one green specific task, irrespectively on their industry.

2 Engineering and technical: Engineering and Technology; Design; Building and Construction; Mechanical; Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment; Estimating the Quantifiable Characteristics of Products, Events, or Information. Science: Physics; Biology. Monitoring: Law and Government; Evaluating Information to Determine Compliance with Standards. Operation management: Systems Analysis; Systems Evaluation; Updating and Using Relevant Knowledge; Provide Consultation and Advice to Others. Similar results were also found by Rutzer et al. (2020) with more sophisticated methods.

Green general skills	Share on total number of skills mentioned (average Q2-2020 Q1-2021)	Change Q1-2021 - Q1-2020
Engineering & technical	5.2%	62.2%
Operation management	0.8%	87.9%
Monitoring	0.9%	11.0%
Science	1.0%	296.1%
Total GGS	**7.9%**	**88.5%**

Table 1. Demand for green general skills in EU27. Own elaboration on data from Skills-OVATE: Skills Online Vacancy Analysis Tool for Europe developed by CEDEFOP (available at www.cedefop.europa.eu/en/data-visualisations/skills-online-vacancies).

occupations and regions. As a response to the exceptional collapse of GDP and employment levels, the European Commission as well as the newly established U.S. administration decided (or planned) to use public spending to stimulate the recovery by means of green spending. On the EU side, for example, in addition to the pre-pandemic spending plan of 1 trillion euro within the EGD, the NextGenerationEU plan adds (at least) 277.5 billion euro of green spending (37% of the 750 billion euro plan).

These stimuli, however, should also take into consideration the type of jobs that were displaced by the crisis. Figure 1 offers a view from the lenses of green skills by showing absolute changes in employment by quartile of occupational Green General Skills (GGS), as described earlier, for the U.S. (panel a) and Italy (panel b).[3] Interestingly, even though quartiles were by definition equally sized in terms of employment in the base period (February 2020 for the U.S., fourth quarter of 2019 for Italy), the absolute decrease in employment was greatly heterogeneous for occupations with different levels of GGS. In both countries, the bulk of job destruction both in the short and longer run was concentrated in occupations with low levels of GGS (first and second quartiles), while the recovery in the two top quartiles was almost complete by the last observed period.

The implication of these patterns is that the jobs that will be in high demand thanks to green recovery plans did not experience relevant job losses and, at the same time, the jobs that were destroyed might not possess the adequate set of skills to take advantage of green fiscal stimulus. Similar patterns were observed when considering data on online vacancies data from CEDEFOP (European Centre for the Development of Vocational Training). The first column of Table 1 reports information on the share of online job vacancies that were mentioning green general skills (over total online vacancies) in EU27: these represent as much as 7.9% of the total, mostly with respect to engineering and technical skills (5.2%). Even more interestingly, the demand for all these green general skills is growing very rapidly: the growth rate between the first quarter of 2020 and the first quarter of

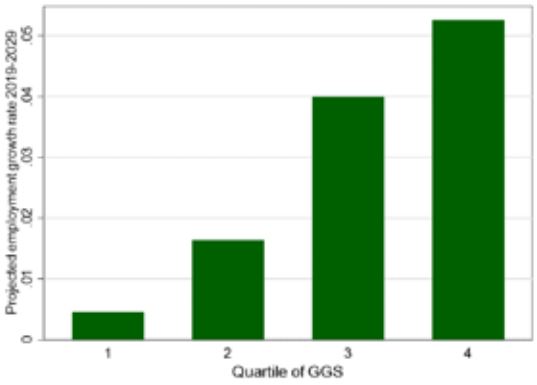

Figure 2. Occupational projections for the US labour market 2019-2029 by quartile of Green General Skills. Own elaboration on BLS Occupational Projections data.

2021 was 88.5%, that is almost 9 times as large as the average growth rate in the demand for any skills over the same period (10.2%). Again, even before the bulk of green spending related to the EGD and the green part of the NextGenerationEU plan, Green General Skills were in high and growing demand in labour markets.

3 Both the U.S. and Italy have very detailed and openly available data on labour markets and both countries experienced very deep GDP and employment crisis as a consequence of the COVID-19 outbreak.

Finally, employment projections for 2019-2029 for the U.S. (Figure 2) highlight a very pronounced "green skill bias", with a monotonic relationship between the quartile of occupational Green General Skills and the projected trend in employment.

Conclusions

Is the EU workforce 'fit for 55'? Given the evidence, it seems like that the answer is 'not yet'. On the one hand, it is not yet clear to policy makers what are the skills needed for the green transition. This is evident from the absence of specific targets and plans in this respect within the European Skills Agenda. An acceleration on gaining a better the understanding of what is the set of relevant green skills is thus urgently needed to implement concrete actions to increase the supply of these skills and to target specific groups of workers.

On the other hand, there seems to be no 'idle capacity' of green skills in the pool of workers who lost their jobs during the recent crisis. Indeed, jobs requiring high levels of green skills are the ones that were among the least affected by the crisis and the ones that are right now in high demand. However, it is not obvious that the high demand for green skills is motivated to a growing demand for 'green tasks', but it could well be that these skills are also useful for other types of work activities. This issue might exacerbate the competition for green skills in a context of growing green public spending, leading to high wages for those workers endowed with these scarce skills and to an unequal distribution of the benefits from the transition. Large wage premia for workers with high levels of green skills might be an important signal for unemployed or students to invest (time and money) in the development of (highly rewarded) green skills. At the same time, however, high wage premia paid to jobs with high levels of green skills will make the sustainable transition more expensive due to skill shortages, imposing a potentially large cost on the society as a whole.

In sum there is urgent need to match the expected growth in the demand for a set of green tasks (as a consequence of EU climate and environmental targets) with the relevant set of (green) skills to identify the most relevant gaps. Next, there is an equally urgent need to fill these gaps by means of active labour market policies, training support and educational policies to make the transition possible, cheap and equitable.

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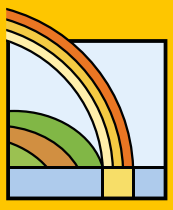

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