POLICY BRIEF

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Energy Challenges for India:

Transitioning to a Low Carbon Economy

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List of Abbreviations

BP	British Petroleum
DISCOM	distribution companies
EPA	Environmental Protection Agency
EUR	Euro
GDP	Gross Domestic Product
GHG	greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOI	Government of India
GW	gigawatts
IEA	International Energy Agency
INR	Indian National Rupee
IRENA	International Renewable Energy Agency
ISBN	International Standard Book Number
LCM	Low Carbon Monitor
MNRE	Ministry of New and Renewable Energy
NDC	nationally determined contribution
NGO	non-governmental organisations
NIPFP	National Institute of Public Finance and Policy
NITI	National Institution for Transforming India
O&M	operations and maintenance
RD&D	research, development, and deployment
RTC	Round-the-clock
UK	United Kingdom
UNDP	United Nations Development Programme
USD	United States Dollar
WWS	wind, water, and sunlight

Abstract

This paper tries to establish the interrelation between the energy sector and the net zero emission goal, focusing on India's pathways to a low carbon future. It discusses the dilemma of choosing between growth and sustainability and the co-benefits of transitioning to a less carbon-dependent, renewables-based energy system from both, the global and Indian perspectives. In an emerging economy like India, the choice has never been clearer, and the case for choosing renewables and moving away from fossils, never stronger. The process of energy transition is complex and involves multi-sector reforms involving various stakeholders including civil society. The strategy to achieve the low carbon growth involves structural reforms, market reforms and institutional reforms.

Keywords: *India energy transition, low carbon, renewable energy, co-benefits*

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Energy Challenges for India: Transitioning to a Low Carbon Economy

Saon Ray and Kuntala Bandyopadhyay

1. Introduction

> *"Energy is the golden thread that connects economic growth, social equity, and environmental sustainability"*[1] *(Ban Ki-Moon, Secretary-General of the United Nations).*

Energy is the driving force of economic growth. Access to affordable, reliable, sustainable, and modern energy has impact on agricultural production and food security, can create jobs, reduce poverty and lead to women's empowerment. Other impacts include health and safety, education, water, food security, many of which are encompassed in the Sustainable Development Goals. During 2018, carbon emissions from energy use grew by 2.0%, which is the fastest expansion for many years. This amount is approximately equivalent to the carbon emissions associated with increasing the number of passenger cars on the planet by a third (BP, 2019a).

In order to limit global warming to 2ºC above preindustrial levels, transitioning to a low-carbon economy is key (Kathuria et al., 2018). To deliver on the international community's commitment to universal energy access by 2030 via the Sustainable Development Goals, the bulk of energy would need to be provided through sources that are non-conventional, and outside of large-scale or national power grids. This means the current heavily fossil fuel-dependent energy sources must be replaced by more sustainable renewable energy sources, such as wind and solar.

In this paper, we have tried to set up the connection between energy and growth, keeping India's energy journey in focus. This paper tries to establish the interrelation between the energy sector and the net zero emission goal, focusing on India's pathways to a low/zero-carbon future, using secondary information analysis. It sheds light on the dilemma of choosing between growth and sustainability, based on a literature survey and discusses the co-benefits of transitioning to a less carbon-dependent, renewables-based energy system from both, the global and Indian perspectives.

2. Energy transition: the case of India

The success of global transition will depend a lot on whether India and China[2] are successful in making an effective energy transition to a low- or zero-carbon growth path.[3] Most of the increase in global energy demand will be driven by India and China. These two economies are

1 https://in.one.un.org/page/sustainable-development-goals/sdg-7/ (last accessed on September 11, 2020)

2 China has recently announced that it will become carbon neutral by 2060 and it emissions will peak by 2030 https://www.theguardian.com/environment/2020/sep/22/china-pledges-to-reach-carbon-neutrality-before-2060 (last accessed on October 22, 2020)

3 https://www.hindustantimes.com/columns/india-s-energy-transition-is-now-the-world-s-energy-transition/story-T2q6NPG3LcunHeP3wR43YP.html (last accessed on September 11, 2020)

the world's fastest-growing major economies.[4] The energy sector accounts for more than 70% of greenhouse gas emissions.[5] Table 1 shows certain key energy parameters of India.

Table 1: India's report card

Rank in the world	Parameter
1st	GDP growth (major economy in 2016 and 2017)
2nd	Population (in 2018)
3rd	Emitter of GHGs (3,571m tonnes of CO2 equivalent (MtCO2e) in 2015)
5th	Vulnerability in Global Climate Risk Index (Eckstein et al., 2019)
2nd	Coal consumption[6]
3rd	Oil consumption[7]
3rd	Coal plants (with 11% of global capacity)[8]

Source: *https://www.carbonbrief.org/the-carbon-brief-profile-india (last accessed on September 11, 2020)*

According to the BP Energy Outlook (2019b), there will be 156% growth in Indian primary energy consumption between 2017 and 2040, and India's share of global primary energy demand will rise from 6% in 2019 to 11% by 2040. Industry will be the strongest source of final energy demand growth (with an increase of 238 Mtoe) followed by transport (an increase of 144 Mtoe). Between 2017 and 2040, India could account for more than a quarter of net global primary energy demand growth, of which 42% would be met by burning coal, implying CO_2 emissions roughly double by 2040 (BP, 2019b).[9]

Dilemma between sustainability and growth

India remains an excellent case for studying a crucial dilemma facing many emerging as well as less developed countries today: the dilemma between environmental sustainability and economic growth. India's National Energy Policy acknowledges this dilemma. "While energy security and sustainability are mutually reinforcing, as India's energy imports are predominantly fossil based, the goal of accessibility will conflict with the goal of sustainability as long as fossil fuels are the cheapest source of energy" (GOI, Draft National Energy Policy, 2017). The challenge for policy is to eliminate the trade off.

4 For India's growth, the price of oil is crucial – an ideal situation is when it is neither too low nor too high.

5 Energy sector comprises of electricity generation, manufacturing industries, transport and fugitive gas emissions. https://www.dnaindia.com/business/report-energy-sector-emits-70-of-country-s-greenhouse-gases-2169900#:~:text=The%20energy%20sector%20in%20India,on%20climate%20change%20has%20revealed.&text=Methane%2C%20nitrous%20oxide%20and%20halogenated,GHG's%20emitted%20in%20the%20country (last accessed on September 11, 2020)

6 https://www.carbonbrief.org/the-carbon-brief-profile-india (last accessed on September 11, 2020)

7 https://www.iea.org/reports/india-2020 (last accessed on September 11, 2020)

8 https://endcoal.org/global-coal-plant-tracker/ (last accessed on September 11, 2020)

9 Some of these projections will have to be revised as a result of the COVID-19 pandemic.

The World Energy Council's Energy Trilemma Index tool attempts to capture this trade-off by ranking countries on their ability to provide sustainable energy on three parameters: (1) Energy security (import dependence, diversity of electricity generation, energy storage), (2) energy equity (access to electricity, electricity prices, gasoline and diesel prices), and (3) environmental sustainability (final energy intensity, low carbon electricity generation, CO_2 emissions per capita).

According to the Energy Trilemma Index, India scores 58/100 in terms of energy security. India's fossil fuel requirements, comprising nearly 90% of commercial primary energy supply, are increasingly being met by imports.[10] In terms of energy equity, measured on accessibility and affordability of energy, India scores 48/100. According to the National Energy Policy published by NITI Aayog, India is yet to provide electricity to nearly 304 million people, and clean cooking fuel to nearly 500 million people, who still depend on biomass. On the parameter of environmental sustainability, India scores a disheartening 42/100.

India's increasing dependence on carbon

According to the International Energy Agency (IEA), currently India's per capita emissions are 1.6 tonnes of CO_2, much lower than the global average of 4.4 tonnes and India's share of global total CO_2 emissions is only 6.4%. But there is no reason for complacency.

Global coal use continued rising for the second consecutive year in 2018 with China, India, Indonesia, and some other South and Southeast Asian countries, the main consumers. Despite the growth in renewables,[11] coal dominates India's power generation mix, and will account for a large proportion of power sector emissions even by 2040 (IEA Data Services). In the mid-1990s, India's carbon intensity of consumption had surpassed that of China's and was about 1/3 higher than China's by 2005 (Birdsall and Subramanian, 2009). India's coal consumption is also expected to grow at a faster rate than Chinese coal consumption between 2020 and 2040 (IEA. 2016). Due to a sharp increase in demand from household and industry consumers, experts do not see India's use of coal coming down in the near future.

India's possible gains from transition to a net zero-carbon growth path

India is one of the 185 countries to have ratified the Paris Agreement to combat climate change. In its nationally determined contribution (NDC), India pledges a 33-35% reduction in emissions intensity (i.e. emissions for each unit of economic output by 2030 compared to 2005

[10] Reducing import dependence on coal and natural gas, while increasing renewables could achieve many of India's energy objectives and help improve the current account deficit too (Mukherjee, 2019).

[11] Renewable energy consumption can surge from nearly 20 Mtoe in 2019 to nearly 300 Mtoe by 2040 but will be concentrated mainly in the power sector and driven by growth in solar capacity (https://www.bp.com/en/global/corporate/energy-economics/energy-outlook/country-and-regional-insights/india-insights.html) (last accessed on September 11, 2020)

levels). India also aims for 40% of its installed electricity capacity to be generated by renewable or nuclear sources by 2030.[12] [13]

Renewable energy is key to fulfilling India's agenda of ensuring access to sustainable energy to citizens. India had a cumulative renewable energy installed capacity of 84.4 gigawatts (GW) at the end of 2019. With a target of 175 GW by the year 2022, India looks set to comply with international commitments. Indeed, India has proved to be a forerunner in the renewable energy revolution (MNRE, 2020) and has increased installed renewable capacity nearly five-fold in the last nine years, from 17 gigawatts (GW) in 2009-2010 to over 80 GW in 2019-20 (including solar, wind, small hydro, and biomass power). Renewables now account for 22% of India's installed capacity (as shown in Table 2). The renewable energy sector deployed 11.8 GW in 2017-18 and 9.3 GW in 2018-19 and overall 21.2 GW in these years (Kuldeep et al., 2019). The Prime Minister has stated that, "India's renewable energy capacity would be increased to much beyond 175 GW, and later till 450 GW" (MNRE, 2020).

Table 2: Renewable Energy Capacity according to projects as on 17 December 2019

Sector	Installed capacity (GW)	Under Implementation (GW)	Tendered (GW)	Total Installed/Pipeline (GW)
Solar power	32.53	25.05	25.78	83.36
Wind power	37.28	9.64	2.20	49.12
Bio energy	9.94	0.00	0.00	9.94
Small hydro	4.65	0.55	0.00	5.20
Wind-solar Hybrid	0.00	1.44	0.00	1.44
Round-the-clock (RTC) Power	0.00	0.00	1.60	1.60
Total	84.40	36.68	29.58	150.66

Source: MNRE, 2020

3. Co-benefits of renewable energy

Energy growth and sustainability need not be mutually exclusive. A successful transition to renewable energy can result in economic and social co-benefits to a country, including lower fuel and electricity costs, increased grid reliability, better air quality, improved public health, and increased job opportunities for its citizens (EPA, 2018; Helgenberger and Jänicke, 2017). Focussing on the important co-benefits of climate adaptation and mitigation measures rather than looking at them from the perspective of "burden sharing" is encouraging and helpful. Direct job losses in the traditional fossil fuel-based energy sector can be compensated by job opportunities created in the renewable energy sector. A renewable energy policy consistent with the 1.5ºC warming goal, could trigger an estimated 68% increase in jobs in energy

[12] https://www.carbonbrief.org/the-carbon-brief-profile-india (last accessed on September 11, 2020)

[13] "..China's announcement does do is give the nation a key role in the COP26 climate discussions, which in turn could persuade other nations to follow the low-carbon trajectory." https://www.edie.net/news/9/China-s-carbon-neutral-target-for-2060--What-does-it-mean-for-global-climate-action-/ (last accessed on October 22, 2020)

operations and maintenance, manufacturing, construction, and installation by 2030, compared to current policies. (LCM, 2016). Worldwide, the renewable energy sector employed 11 million people at the end of 2018 as compared to 10.3 million in 2017 International Renewable Energy Agency (IRENA, 2019). Globally, there is evidence of countries at all stages of economic development gaining from embracing the renewable energy transition. The policy of promoting renewable energy and substitution of small inefficient coal-power plants with larger and more efficient coal-power plants has resulted in 472,000 net job gains in China (Cai et al., 2011). The Energy $mart Program (1999-2008) for advancing energy efficiency, renewable energy, and energy services to low-income residents led to increase in personal income of USD 293 million and USD 644 million in gross state product during the period 1999-2008 (EPA, 2015). Tunisia is expected to gain net savings of about EUR 4.6 billion between 2015 and 2030 from its planned renewable energy program with a feed-in tariff scheme for small- and medium-sized generation facilities (Quitzow et al., 2016; Meister Consultants Group, 2013). Estimates by Jacobsen et al. (2015), suggest that the renewables sector could generate 3.9 million 40-year construction jobs and 2.0 million 40-year operation jobs for the energy facilities. Renewable energy is more suitable for distributed generation, mini-grids, and off-grid applications compared to fossil fuel-based energy. It is also becoming increasingly cost-competitive with fossil fuel-based energy (LCM, 2016).

3.1 Co-benefits available to India from a transition to renewable energy

India will have direct benefits from renewable energy in terms of increased energy access, energy security, and energy equity. At the same time, there will be significant co-benefits such as reduced pollution and mortality.[14] Other co-benefits include:

Job creation: The renewable energy sector has the potential to emerge as the largest employee in the future Indian power sector. The workforce employed in the Indian renewable energy sector increased from around 19,800 workers in 2013-14 to almost 99,900 workers in 2018-19 (Kuldeep et al., 2019). Meeting India's target of generating 160 GW of wind and solar power by 2022 may require 330,000 jobs in construction, project commissioning and design, business development, and operations and maintenance (O&M) (Jairaj et al., 2017). Under the REmap scenario (which provides a power sector decarbonisation pathway for India to contribute towards limiting global temperature rise to well below 2ºC by 2100), more than 3.2 million people could be employed in the renewable energy sector by 2050 (IRENA, 2017).

A caveat here, is that jobs created by the renewable energy sector will be mostly contractual and do not offer job stability. To direct the employment gains towards poverty reduction, India has to focus on creating good quality jobs which poor people can perform (Jairaj et al., 2017).

Health: Jacobs et al. (2019) estimated that following the business-as-usual path, economic losses related to health costs could increase from INR 4.6 trillion (USD 64.6 billion) in 2020

[14] There are several types of possible co-benefits including economic, environmental, social, political and institutional apart from the climate related co-benefits. See https://www.iass-potsdam.de/sites/default/files/files/iass_2017_mobilizing_cobenefits_climate-change.pdf

more than two-fold in 2030 and more than ten-fold to INR 47 trillion (USD 660.3 billion) in 2050. However, by following the NDC PLUS (deeper decarbonisation over and above the NDC scenario pathway) economic losses in 2050 could be reduced by as much as INR 12 trillion (USD 168.6 billion).

Improvement in air quality: India has 21 of the 30 most polluted cities in the world. The pandemic which resulted in lockdown across many countries has also shown the correlation between air quality and health and reinforced the need international collaboration. The G20 could play an important role in facilitating this.[15]

4. Strategies for a successful energy transition

The process of energy transition is complex and involves multi-sector reforms involving stakeholders at various level of governance: it should also include civil society. Such reforms occurs through various channels and comprises of instruments, such as information technology, policy frameworks, and market instruments. IEA (2020a) discusses the key role of governments in the context of a toolkit with five core areas: 1. Tackle emissions from existing assets 2. Strengthen markets for technologies at an early stage of adoption 3. Develop and upgrade infrastructure that enables technology deployment 4. Boost support for research, development and demonstration and 5. Expand international technology collaboration.[16]

Here are some strategies available to India for successfully transitioning to a low- or zero-carbon economy.

1. Structural reforms: Such reforms include creating a cross-government framework for energy policy. Having a joint vision and a common reform roadmap among a broad range of central government agencies, and state and local authorities helps. Civil society and non-governmental organisations (NGOs) also need to be part of the roadmap.

2. Market reforms: The creation of well-functioning energy markets will ensure economic efficiency in the management of the coal, gas, and power sectors. This is critical to achieving energy security. These markets will also be helpful in efficient management of the coal, gas, and power sectors.

3. Price reforms: The IEA recommends that India's energy sector move towards market pricing for every energy commodity and enable appropriate price signals. For this, it is vital that a competitive wholesale power market is created. This market will help in improving the utilisation of India's electricity generation capacity. The current policy subsidises electricity prices for agricultural and residential consumers on the one hand and penalises commercial and industrial consumers on the other.

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15 https://g20.org/en/media/Documents/G20SS_PR_G20%20Health%20Ministers%20Meeting_EN.pdf

16 India has signed MoU with Saudi Arabia on energy cooperation. https://energy.economictimes.indiatimes.com/news/renewable/cabinet-approves-pact-with-saudi-arabia-for-renewable-energy-cooperation/72955837

4. Institutional reforms: The institutional factors refer to the sector and economy level legal and regulatory frameworks influencing the energy sector. In India, weak institutions like DISCOMs create a lot of inefficiency in electricity distribution. The political economy aspect needs to be considered as well. Overall institutional reforms and improved regulation have positively improved the electricity sector performance in Latin America (Balza, Jimenez, and Mercado, 2013).

5. Capital market reforms: Boosting the capital market, particularly the bond market, can lead to a massive improvement and usher in energy sector transition in India. Although over USD 6 billion has been raised via green bonds in India, much of the market's potential lies untapped (Chaturvedi, 2018).

6. Technological and innovation reforms: According to the IEA (2020b), the government budget for energy research, development, and deployment (RD&D) in India as a share of gross domestic product (GDP) is below the average of IEA member countries. Energy RD&D is key to the success of India's energy policy goals.[17]

5. Conclusion

The pandemic has served a warning to the world but it also presents us with an opportunity to transition to a sustainable growth path instead of a traditional fossil fuelled growth path, ultimately leading to greater economic growth and betterment of quality of citizens' lives. The co-benefits of doing so, have been highlighted above, make the case stronger. In an emerging economy like India, the choice has never been clearer, and the case for choosing renewables and moving away from fossils, never stronger. The IMF contends that only if the five countries/regions or the United States, China, the European Union, Japan and India act together, a significant dent can be made to global emissions.

[17] Specific examples can be found in IEA (2020), *India 2020*, IEA, Paris https://www.iea.org/reports/india-2020

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