



INTRODUCTION

Over the last 50 years, India's economic transformation has been remarkable. Until the COVID-19 pandemic struck in early 2020, the country's economic story was defined by strong growth, an increasingly dynamic business environment, rising productivity and a well-documented boom in the tech industry. By 2019, India had become the fifth largest economy in the world, overtaking the UK and France.

In 2016, Shell, TERI and the Council on Energy, Environment and Water (CEEW) collaborated to produce *Energizing India: Towards a Resilient and Equitable Energy System*. In that report the collaborating partners explored the energy choices available to India's society and economy at a time of considerable uncertainty – and opportunity – in the global energy system. The report highlighted the opportunities and challenges in developing a robust but flexible set of strategies for meeting India's future energy needs, against the backdrop of making the energy system more resilient, driving India's economic growth and making energy access more equitable across all sections of society. This sketch can be seen as an extension of the scenarios presented in the *Energizing India* report, but with a focus on achieving a net-zero emissions energy system by 2050.

The 2016 report notes the national plan of the day to increase domestic coal production to 1,000 megatonnes (Mt) a year by 2021, but the country is now charting a course to a different future. Thanks to renewable energy being deployed rapidly across India, coal use is already being disrupted. Production in 2019 was 756 Mt, a slight fall from 2018 and only 12% higher than 2015, despite an 18% increase in power generation.

It is not just power generation where the outlook has changed. The *Energizing India* analysis concluded that through to 2050 transport will continue to rely on oil products for most of its needs, but today many commentators would not come to such a conclusion. An electric vehicle landscape is rapidly emerging globally, not just for passenger cars but for buses, delivery



vehicles, municipal trucks and potentially for some longer distance road haulage. For example, in the UK the government has every expectation that there will be no need for further sales of internal combustion engine passenger vehicles after 2030, and General Motors has announced its intention to stop producing internal combustion engine cars and trucks by 2035.

Today the government of India is focusing on maintaining strong growth to achieve its aim of being a \$5 trillion economy by 2025 and addressing the continuing inequality gap across the country. Its goals include increasing the manufacturing share of GDP to 25% by 2025, providing housing for all by 2022, doubling the income of farmers by 2024 and making substantial progress on universal access to healthcare by 2030.

Around the world, the transition of economies from agriculture to technology-based societies has typically seen energy growth by a factor of 10 or more. Eventual primary energy demand depends on local circumstances such as climate, social norms, industrial structures and whether compact or sprawling models of urban development have predominated.

Historical evidence – combined with future possibilities for improvements in structural and end-use energy efficiency and with detailed studies from developing economies – suggest that about 100 gigajoules (GJ) per capita per year of primary energy is needed for people to experience a decent, modern quality of life.³ Consumption in India in 2019 was 25 GJ per person.

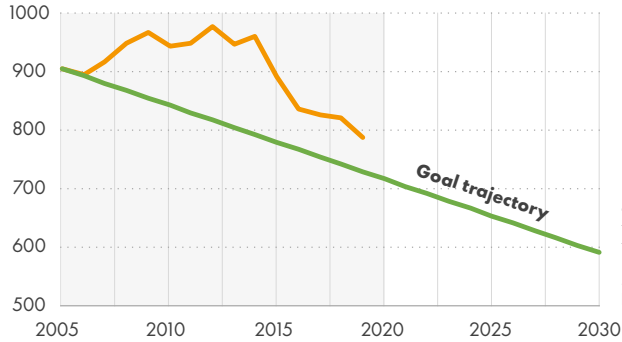
As has been the case for all countries, fossil fuels have enabled the energy demand required for industrialisation and in turn contributed to rising carbon dioxide (CO₂) emissions. India's per capita CO₂ emissions – at 1.8 tonnes per person in 2015⁴ – are around a ninth of those in the USA and around a third of the global average of 4.8 tonnes per person. However, overall, India is now the planet's third-largest emitter of CO₂, behind China and the USA. Some costs of the country's dynamic growth are increasingly visible, namely major congestion in urban centres and declining air quality.

In the early years of this century the international community was not focused on net-zero emissions. Instead, the emphasis was on substantial mitigation through efficiency, a reduction in coal use and the further

Figure 1: India is delivering on its first Paris Agreement NDC

Reduce carbon emissions intensity of GDP by 33-35% by 2030 from 2005 level

Fuel combustion CO₂ per GDP, grammes CO₂ per \$ (constant US 2010)

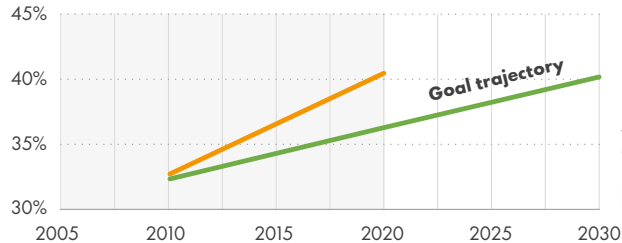


Note: Although the Nationally Determined Contribution (NDC) goal covers all emissions, we present here the progress for the energy system, the major component of the total.

Source: TERI and Shell analysis based on historical IEA data and the World Bank data

40% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030

Percent non-fossil fuel based generation capacity

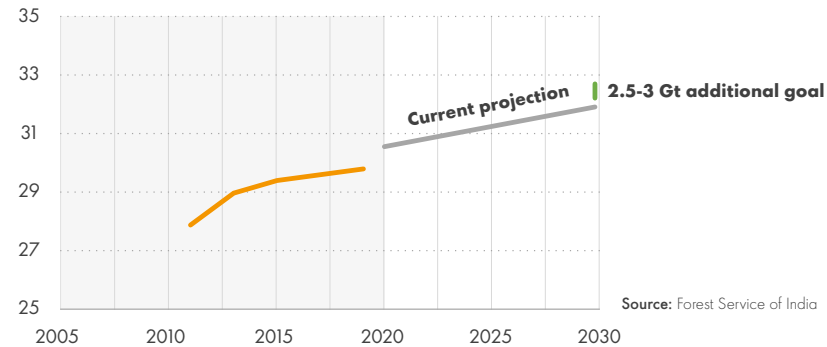


Note: Non-fossil generation includes variable renewables, hydro, nuclear and biomass.

Source: TERI and Shell analysis based on historical IEA data

To create an additional carbon sink of 2.5-3 billion tonnes CO₂ through forest and tree cover by 2030

Forest sequestration, Gt CO₂ per year



Source: Forest Service of India

development of biofuels. More recently, significant reductions in the cost of developing wind and solar power projects, the rollout of electric vehicles by most automobile manufacturers and the development of hydrogen projects has offered the opportunity to both discuss the need for a net-zero emissions society globally and envisage a clear, but still highly challenging, pathway to achieving it.

The government of India has already developed ambitious goals to manage emissions. In its first Nationally Determined Contribution (NDC) under the Paris Agreement,⁵ the country has pledged a 33-35% reduction in the emissions intensity of its economy by 2030, compared to 2005 levels. It also aims for 40% of its installed electricity capacity to be renewable and nuclear by 2030. In recent years, India has made progress in its transition to a lower-carbon energy system through a marked slowdown in the rate of construction of new coal-fired power stations and the emergence of a viable and large-scale solar photovoltaic (PV) sector.

Although India is delivering on its NDC (Figure 1), absolute emissions continue to rise and the current development trajectory could see greenhouse gas emissions more than double by 2050 (TERI baseline case), (Figure 2).⁶ A more focused policy intervention is required to steer the economy of India towards a much lower and ultimately net-zero emissions outcome.

In parallel, the international focus has shifted towards meeting the stretch goal of the Paris Agreement to limit the global average temperature increase to 1.5°C above pre-industrial levels this century. This follows the 2018 publication of the Intergovernmental Panel on Climate Change's (IPCC) Special Report on 1.5°C⁷ that set out the increase in climate impacts and risks between a 1.5°C and 2°C temperature rise. Building on the progress India has made so far, this sketch sets out what it would take for India to achieve a net-zero emissions energy system by 2050, what it would take for society as a whole - government, business, consumers and citizens - to make progress towards that goal and what India's energy system would look like in 2050.



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This pathway requires building widespread support to transform the diverse economic activities across India, from its remote farming communities to its rapidly expanding industrial sector. And it requires an emphasis on local benefits for India's people, industrial competitiveness and protection of the environment. Collaboration between participants within sectors – such as iron ore smelting and cement production – will also be essential, with pioneers needed in government, business and civil society.

Recognising growing demand and financial opportunities, many companies, organisations and entrepreneurs in India are already developing lower environmental impact industrial processes and lower-carbon mobility options. But there are also limits to what society can achieve without the policy frameworks needed to align, guide and motivate all those trying to contribute.

The broad objective of this report was to evaluate India's current options and limits across each of the energy sectors. A **Net-Zero Emissions (NZE)** scenario was designed to assess whether adequate solutions exist to fully decarbonise the sector and/or examine the level to which each of the sectors could theoretically move to net-zero emissions by 2050. The **NZE** scenario is ambitious and assumes that all social, infrastructural and behavioural barriers can be overcome if the required technologies are available. A second scenario, **Towards Net-Zero (TNZ)**, highlights the barriers to change that might emerge.⁸

THE COVID-19 IMPACT

It is important to recognise that this analysis incorporates pre-COVID-19 data and as such does not include the effects of the pandemic. Like so many countries, India's economy has been impacted, along with its energy system. While the near-term future remains uncertain,

the underlying trends outlined in this sketch remain in place and the pathway towards net-zero emissions continues to be possible. The COVID-19 pandemic has generated significant turning points with shifts across almost all societies and economies. It has exposed tensions and weaknesses in the global systems but it has also shifted policy and behaviour in ways that could accelerate change in the future.⁹

The way in which countries emerge from the pandemic could shape the course of the energy system. One initial response to the crises of 2020 is to repair the economy – a focus on wealth first. Other underlying societal and environmental pressures receive less attention initially until their relative neglect provokes backlash reactions. Then, moving quickly, but starting later than required to meet the goals of the Paris Agreement, society achieves an energy system with net-zero emissions – a fast but late transition.

Alternatively, governments and societies may decide to focus on their own security, with a new emphasis on nationalism threatening to unravel the post-World War 2 geopolitical order. The normal course of equipment and infrastructure replacement and the deployment of cleaner technologies bring progress and eventually net-zero emissions, but the world overshoots the timeline and does not achieve the goals of the Paris agreement – a slow transition.

Another possibility is that the response to the crises of 2020 could be a renewed focus on the broader issue of societal well-being – a health first approach. Lessons learned from shared best practices, alignments of diverse interests and institutional improvements help create a pathway to the welfare of people and society and the health of the environment, including meeting the goals of the Paris Agreement – accelerated decarbonisation now.