



The **NZE** scenario for India illustrates a technically possible, but highly challenging, pathway for the country to achieve a net-zero emissions energy system by 2050. Below we look in more detail at how to make progress and, importantly, how to accelerate the actions already taking place in India.

UNDERSTANDING THE ECONOMIC AND SOCIAL IMPACTS OF THE ENERGY TRANSITION

The transition of India's energy system to net-zero emissions will require fundamentally changing how the country produces and uses energy. Today, India has a chance to deliver economic growth that is environmentally sustainable and socially inclusive rather than seeing issues emerge that have arisen historically in other economies. Take the UK where fossil fuels – particularly coal – underpinned the industrial revolution of the late 18th and early 19th century, creating negative environmental consequences, including air pollution and health issues. But new energy choices are available in the 21st century that were not viable options then. India can take a different development path, relying on less polluting sources of energy to deliver economic growth and improved standards of living. The energy transition also provides opportunities for balanced and sustainable economic development that delivers a better quality of life for all.

Macroeconomic impacts

With modest existing dependency on fossil fuels, India is well placed to pursue an energy pathway to net-zero emissions with minimal impact on longer-term economic output. This is due to the significant cost reductions seen in solar PV, wind and battery technologies in recent years, combined with the increasing availability of new practices, technologies and approaches that deliver much greater energy efficiency. The macroeconomic resource costs of making the transition to a lower-carbon economy could be relatively modest given the scale of the change. By one estimate, GDP is expected to be 4% lower in 2050 than it would be otherwise and with no significant impact on per capita consumption due to higher efficiencies and lower investment costs associated with the production of goods and services.²⁷

These costs are consistent with other estimates at the global level and in a country context. In its “Making Mission Possible: Delivering Net-Zero Emissions” report, the Energy Transitions Commission estimates that transition to a zero-carbon emissions economy will have a very modest – less than 0.5% – impact on 2050 living standards in developed and developing countries alike.²⁸ According to a TERI study, the country can achieve 30% of power generation from variable renewables and 45% of zero-carbon generation (including hydropower and nuclear) by 2030 at no extra cost to the system, as long as policies and other measures are put in place to increase system flexibility.²⁹

WHAT NEEDS TO CHANGE



HOW TO MAKE PROGRESS



NET-ZERO EMISSIONS ENERGY SYSTEM



Naturally, there are additional costs of building transmission and distribution networks to support this scale of electrification. However, investment in electricity infrastructure – to build new and/or expand existing transmission lines, enhance distribution networks and build a smart grid through digitalisation – can boost jobs and demand in the near term while increasing the economy's capacity for growth in the long term, through better and more access to energy. Renewable energy projects in India are already providing significant job opportunities. The International Labour Organization has estimated that by 2022 more than 300,000 workers will be employed in India's solar and wind energy sectors to meet the country's target of generating 175 gigawatts of electricity from renewable sources.³⁰ Moreover, much of the investment in electricity infrastructure will not require additional resources but a redirection of planned investments to support a lower-carbon electricity grid.

While overall resource costs of the energy transition may be relatively modest, it will require significant realignment and reallocation of investment, and not just in the electricity sector.

At the global level, supporting the energy transition will require significant investment in lower-carbon energy supply, from a little under \$1.6 trillion in 2018 to around \$2 trillion a year on average between 2025-30, according to the International Energy Agency's Sustainable Development Scenario.³¹ A significant portion of this can be met by reallocating capital within the energy sector, primarily from building new fossil fuel infrastructure and expanding the power sector. However, some additional investment will be required to drive energy efficiency improvements and to develop lower-carbon energy solutions.

Given the falling cost of new energy technologies, the investment needed to develop along a net-zero emissions pathway will not be significantly different to that required by conventional energy to transform India into a largely developed economy by the second half of the century. Unlike developed economies with large legacy (fossil-based) energy systems, India has an opportunity to build an energy system based on new lower-carbon technologies and fuels. Some legacy components exist but they represent a smaller

proportion of the system, thus reducing the risk for lock-in to traditional fossil fuel infrastructure and/or stranded assets. However, it will require clear targets and policies to level the playing field between fossil fuel and non-fossil fuel energy and redirect economic resources towards the latter. Delaying action will only add to the cost of making the transition.

Finally, the transition to a lower-carbon system can increase self-sufficiency and reduce the risk of macroeconomic instability as a result of India's reliance on energy imports. Energy imports as a share of total energy use have risen almost continuously since the 1990s. According to the National Institution for Transforming India (NITI Aayog), India imported about 46% of its total commercial³² primary energy needs in 2015-16.³³ The large volume of energy imports has triggered balance of payments concerns during past periods of high oil prices and contributed to macroeconomic instability. Based on the **NZE** scenario, total primary energy demand

is expected to double between 2020 and 2050. India's abundant renewables potential can help the country achieve greater energy self-sufficiency in meeting this demand. Electrifying many energy end uses - and meeting demand through domestic renewable resources such as solar, wind and hydropower - can reduce the need for oil and gas imports. Similarly, a transition to lower-carbon fuels, such as green hydrogen and biofuels, can further reduce dependence on fossil fuel imports.

Energy transition business opportunities

As the world shifts towards lower-carbon energy, there are new growth industries in lower-carbon fuels, technologies, products and solutions. India has a relatively young population, with an average age of 29 years in 2020 and with half the population under 25. Combined with the country's strong focus on technical education, India is well placed to be at the forefront of these new growth sectors.



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As the preceding analysis illustrates, the industry and transport sectors generate the largest emissions. Developing new lower-carbon industrial production processes and mobility solutions will not just reduce domestic emissions but could also position India as a global market leader in these areas. The country is already seeing a boom in the shared economy, which had grown into a \$2 billion industry by the end of 2020³⁴ and could potentially be leveraged into a range of global products and services. Moreover, the scale of electrification and deployment of renewable generation required to decarbonise India's energy system could position India as the leading producer of technologies, such as energy storage and demand-side response solutions, to address intermittency issues.

Harnessing this opportunity will require an integrated and ambitious industrial policy to:

- promote new industries such as the manufacture of solar panels, wind turbines, batteries and hydrogen electrolyzers;
- develop lower-carbon industrial processes such as green steel produced using green hydrogen;

- install carbon capture, utilisation and storage at cement production facilities;
- steer the automobile industry towards lower-carbon vehicles; and
- apply innovative digital solutions to reduce emissions from urban transport.

Setting a clear strategic direction, supported by measures to create a business friendly environment, will help foster business creativity and innovation in developing lower-carbon solutions. The scale of the domestic market, combined with ease of doing business and a skilled labour force, will also be attractive to foreign investment, bringing capital and technology to support decarbonisation of high growth sectors such as transport and construction.

Social impacts

According to the Intergovernmental Panel on Climate Change's 1.5°C report, climate mitigation actions have significant synergies with the United Nation's 17 sustainable development goals (SDGs).³⁵ For example, transforming energy supply to lower carbon can help deliver SDG 7 on access to affordable, reliable, sustainable and modern



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energy for all. Transforming energy demand through lower-carbon consumer and business choices has significant synergies with: SDG 3 on healthy lives and well-being for all ages; SDG 9 on building resilient infrastructure, promoting sustainable industrialisation and fostering innovation; and SDG 11 on making cities inclusive, safe, resilient and sustainable.

India already has ambitious goals to improve access to energy and bring electricity and modern energy services to the whole population, with a focus on investment in rural communities to enable them to play a role in the transition and generate sustainable rural development. Moreover, using electricity earlier in the development pathway can avoid later issues such as air quality deterioration that can emerge as villages develop into towns and then cities. The digitalisation of the economy also offers greater and more efficient access to energy services and their delivery.

Making the most of the synergies between the climate and sustainable development objectives will help to sustain progress in the energy transition. In the long term, a net-zero emissions energy system will produce significant societal benefits – for example, through more efficient energy

consumption and better environmental outcomes. However, given the scale and scope of the change, economic activity and resources associated with the energy transition will not be equally spread across states, industries and people of different economic means. Making progress requires that the economic, social and environmental benefits of the energy transition are shared by all of India's diverse society, especially those most impacted by the transition. For example, lower income groups spend a higher share of their income on energy and can therefore be disproportionately affected by higher energy costs during the transition. Around half a million people are currently employed as coal miners in India³⁶ and many more have jobs in associated industries and businesses. As jobs and livelihoods change, retraining and reskilling workers will be important for a smooth transition.

The energy transition is also likely to lead to regional shifts in economic activity. The decline in fossil fuels in the energy mix will require resources and economic activity to be reallocated at the state and regional level. For instance, coal mining tends to be concentrated in various eastern states where entire economies, societies and livelihoods