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Impact of Select Climate Policies on India's Emissions Pathway

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Executive summary

In this study, we assess the impact of a selection of policies adopted by the Government of India, within the framework of the Global Change Analysis Model (GCAM, CEEW version). However, instead of evaluating the impact of each policy separately, we assess the combined impact of key policies in the power (central grid-connected solar and wind-related), residential (lighting and air-conditioning efficiency related) and transport (private electric mobility and energy efficiency related) sectors. Our methodological approach has been designed for the same.

As per prior assessments, the incremental impact of the Government of India's *Perform, Achieve and Trade* (PAT) scheme on the country's industrial energy efficiency use has been marginal at best. Hence, for now, we have not considered its impact in our analysis. We find that the selected policies assessed in this study for the power, transport, and residential sectors have a significant impact on the electricity generation, energy demand, and emission pathway for India.

Policies focussing on solar and wind in the power sector have managed to propel the electricity generation mix towards these segments in a big way, instead of being dependent on coal as the only mainstay. India's push on solar and wind has managed to avoid 80 GW of coal-based power plants that would have otherwise been installed before 2030 to meet India's burgeoning power demand. The policy push towards electrification of two- and four-wheelers is on path to significantly reduce the dependence of passenger road transport on oil and gas. In the residential sector, however, while there is significant energy efficiency improvement in air-conditioning, the consumption of electricity to meet air-conditioning demand increases due to the rebound effect (i.e., higher consumption of a fuel as its effective price declines due to energy efficiency improvements). This essentially leads to a higher amount of electricity use, but it delivers even higher social welfare gains.

Finally, in terms of emissions savings, we find that India's current policies are decisively able to lower India's long-term emissions curve. In terms of cumulative carbon dioxide emissions saved, India's current policies in the three sectors have already saved 440 million tonnes of carbon dioxide (MtCO2) between 2015 and 2020, and are on track to save 3950 MtCO2 emissions between 2020 and 2030, 22,670 MtCO2 emissions between 2030 and 2050, and 44,700 MtCO2 emissions between 2050 and 2070, amounting to 23 per cent of India's cumulative emissions between 2015 and 2070, compared to the no policy scenario.

Future research would expand the ambit of policies to include other important, recently introduced policies related to the *National Green Hydrogen Mission, Carbon Credit Trading Scheme* (CCTS), *PM Suryaghar Yojna* (focussing on rooftop solar) and *PM-eBus Sewa Scheme*.

This study highlights that the adoption of the 2070 net-zero target has been a watershed moment in India's climate policy. While policies without an end goal in terms of a quantitative target are successful in pushing low-carbon technologies to a good extent, they still would not deliver on the climate ambition needed to achieve the goals of the Paris Agreement. India's recently announced domestic *CCTS*, in our view, would be instrumental in decisively bending the country's emissions curve on the path towards the 2070 net-zero target.

1. Introduction

The debate around climate change has evolved into one of the most defining debates of current times. Increasing impacts of global warming have pushed countries to accord this issue one of the highest priorities in global negotiations. The Paris Agreement in 2015 set an ambitious emissions mitigation target for the world. Assessments by the Intergovernmental Panel on Climate Change (IPCC) have highlighted potential global mitigation pathways (IPCC 2022). Essentially, mitigation policies will have to be adopted across sectors to achieve the goals of the Paris Agreement.

India has been playing a critical role in the global climate discourse. While it is the third largest greenhouse gas emitter, its per capita emissions are much lower than the global average (Arora, Das and Chaturvedi 2023). Given its growing economy and development concerns, modelling assessments have unequivocally shown that India's emissions curve would continue to rise in the next few decades in the absence of climate policy (Chaturvedi and Malyan 2022; Tibrewal and Venkataraman 2022), unlike the emissions curves of many countries in the developed world, which have peaked and are on a declining path.

India's updated Nationally Determined Contribution (NDC) aims to reduce its emissions intensity of GDP—the amount of greenhouse gases emitted for every unit of GDP—by 45 per cent between 2005 and 2030, and increase the share of non-fossil sources in electricity generation capacity to 50 per cent by 2030. It has unveiled its official Long-Term Strategy (LTS) that unveils the key elements of India's long-term low carbon development strategy on the path to net-zero by 2070 (MoEFCC 2022). Mitigation policies and actions have been adopted across sectors.

Within the energy production and use sectors, there have been policies aimed at pushing higher quantities of renewable energy in India's electricity generation mix, higher share of electric vehicles on the roads, higher share of biofuels, and higher industrial, building envelope and appliance efficiency, among other policies, to achieve the country's mitigation targets.

This study highlights that the adoption of the 2070 net-zero target has been a watershed moment in India's climate policy.

While the Government of India (GoI) has adopted a set of important policies, how effective have these been in bending the emissions curve, and how much emissions savings (if any) have they led to? This has not been assessed till now through an India-specific analysis. A recent Science study by Stechemesser et al. (2024) assesses the impact of climate policies across countries within a quantitative assessment framework.[1] For India, it argues that the policies adopted have not really bent the emissions curve, and there has been little emissions reduction impact. The policies studied by that assessment include *Generation-Based Incentives, Competitive Bidding and Renewable Purchase Obligations in the power sector, Faster Adoption and Manufacturing of Electric Vehicles (FAME)*, as well as energy efficiency-related schemes and *Bharat Stage VI* in the transport sector, and *Standards and Labelling (S&L)* and the *PM UJALA* scheme in the residential sector.

Our analysis has considered two scenarios. The first is the **'Current Policy Scenario' (CP sc)**, where it is assumed that there is a policy intervention aimed at reducing carbon dioxide emissions from the end-use sectors. We have considered policy interventions in the residential, transport, and power sectors. The major policy intervention in the industry sector for energy efficiency improvement since 2015 was the *Perform, Achieve and Trade (PAT)* scheme (Energy Efficiency | Government of India | Ministry of Power 2024). The incremental impact of the *PAT* scheme on India's industrial energy efficiency use has been marginal at best, as per available evidence (Giri and Sharma 2024), hence for now, we have not considered its impact in our analysis. The *Renewable Energy Certificates (REC)* market, as per published assessments (Sawhney 2022), has also not driven a meaningful increase in the share of RE, and hence, has not been included in our assessment. In future, if there is additional evidence suggesting a meaningful impact of the *PAT* and *REC* schemes, this analysis will be updated.

Other key policies of the government of India—the *National Green Hydrogen Mission, Carbon Credit Trading Scheme (CCTS), PM Suryaghar Yojna* (focussing on rooftop solar) and *PM-eBus Sewa Scheme*—are expected to significantly impact India's future emission pathways. However, these are in their initial stages, and hence, their impact has also not been included.

> **We assess the potential impact of the policies on the costs and efficiencies of specific technologies.**

The **'No Policy Scenario' (NP sc)** assumes no such policy intervention in the selected sectors. The comparison of electricity generation by fuel, energy consumed in the end-use sectors, as well as carbon dioxide emissions between the two scenarios helps us understand the impact of India's climate policies.

We assess the aggregate impact of the policies, as opposed to evaluating the impact of each policy separately, and our methodological approach has been designed for the same.

2. Methodology and data

Government policies play a pivotal role in shaping low-carbon technologies with the overarching target of achieving net-zero. It is critical to assess how these policies impact these technologies in practice. This will allow us to better understand the real-world effectiveness of these policies in driving towards a low-carbon economy. This considers both the market conditions and technological advancements of green technology.

2.1 Shortlisting policies for assessing aggregate impact

The Government of India (GoI) has implemented many emission reduction policies across sectors. Many of these policies have specific technology targets, such as 500 gigawatts of RE by 2030. We, however, do not use the government-specified target as given. We assess the potential impact of the policies on the costs and efficiencies of specific technologies (solar and wind-based electricity, LEDs, ACs, electric two- and four-wheelers, and oil-based cars, buses, and trucks) and let the model endogenously decide the penetration of these.

1. The methodological critique of this paper is presented by You (2024).

We choose specific policies based on the following two criteria: (i) policies that have had a clear impact on the ground, based on our discussions with sector experts and our own judgement; and (ii) policies where enough information is publicly available to help us model their impact on cost and efficiencies of low carbon technologies. Table 1 features the list of policies for which we assess the aggregate impact.

Table 1 Shortlisted policies assessed in this study for their aggregate impact

Policy title	Policy effect	Policy objective	Decision date
Power sector			
Jawahar Lal Nehru National Solar Mission (JLNNSM)	Creating policy conditions for deploying solar power through various fiscal incentives, and creation of dedicated solar parks	Solar power plants	2010
Auction of Solar Energy Corporation of India (SECI)	Reduction in solar power generation costs through auctions	Solar power plants	2017
Onshore wind energy auction India (2017)	Reduction in wind power generation costs through auctions	Wind power plants	2017
Residential sector			
Unnat Jeevan by Affordable LEDs and Appliances for All (UJALA)	Increasing LED penetration through demand aggregation	Energy efficiency	2017
Minimum Energy Performance Standards (MEPS) for ACs in India	Increasing energy efficiency of lights and ACs	Energy efficiency	2017
Transport sector			
Corporate Average Fuel Economy (CAFE) norms for passenger cars	Vehicle fuel economy and emissions standards to enhance vehicle fuel efficiency	Energy efficiency	2015
Scheme for *Faster Adoption and Manufacturing of (Hybrid) & Electric Vehicles* (FAME)	Grants and subsidies to incentivise adoption of hybrid and electric vehicles	Low-carbon technologies and fuel switch	2015
Light-duty: Fuel Consumption and Emissions Standards	Vehicle fuel-economy and emissions standards to enhance vehicle fuel efficiency	Energy efficiency	2017
Heavy-duty: Fuel Consumption and Emissions Standards	Vehicle fuel-economy and emissions standards to enhance vehicle fuel efficiency	Energy efficiency	2017
National E-Mobility Programme	Strategic planning	Low-carbon technologies and fuel switch	2018
Scheme for Faster Adoption and Manufacturing of Hybrid and EV II *(FAME-II)*	Grants and subsidies to incentivise adoption of hybrid and electric vehicles	Low-carbon technologies and fuel switch	2019
Bharat Stage (BS) VI Emission Standards	Vehicle fuel-economy and emissions standards that increase vehicle fuel-efficiency as a co-benefit	Energy efficiency	2020

Source: Authors' compilation from https://climatepolicydatabase.org/countries/india

2.2 Scenario framework: Establishing counterfactual through differentiating market-based evolution versus shifts due to climate policy

The fundamental part of any assessment that seeks to understand the impact of policies is to establish a credible counterfactual. The challenge with an assessment of climate policies is that the counterfactual is not a point in the past, but is an outlook of the future, if the specific climate policies had not been in place. The key to this process is understanding the difference between market trends across sectors that would have anyway led to additional emission reductions, even in the absence of dedicated policies, and the potential impact of dedicated climate policies.

Climate policies seek to change the behaviour of actors on the production and consumption parts of the value chain, in favour of low-carbon choices. These essentially seek to alter market trends if they are not in the direction of emission mitigation targets. The key to our assessment, hence, is to understand the future evolution of market trends for low-carbon technologies, even in the absence of dedicated climate policies, which is the underlying assumption in the NP sc. Once we understand that for specific sectors, we overlay these with the potential impact of sector-specific climate policies, which form the CP sc. This section explains the approach for the specific sectors that have been evaluated in this assessment.

We create two scenarios for answering the research question (Table 2). The first is an NP sc, where we only include the impact of market forces that would have anyway led to progress in key sectors. The second is the CP sc, where we include the impact of dedicated climate policies across sectors on top of the market-driven forces. We delve deeper into each of the key sectors further in this section to explain our scenarios and assumptions better.

Table 2 What the scenario would look like with and without government interventions

	NP sc	CP sc
Power sector	Declining cost trajectories* for solar- and wind-based electricity from 2020 onwards, assuming a continuous decline in global panel prices up to 2030. Same generation cost assumed between 2030 and 2070 due to limit on the decline of global panel prices.	Lower-cost trajectories for solar- and wind-based electricity from 2020 onwards as compared to NP sc, based on a lower financing cost due to reduced risk premiums as well as economies of scale achieved a result of dedicated government interventions.
Residential sector	Energy efficiency of ACs fixed at 2015 values up to 2070, in the absence of credible data for India-specific historical AC energy efficiency improvement trends prior to *S&L* scheme. No LEDs expected to penetrate the market due to high costs.	Energy efficiency of ACs assumed to increase at a higher rate compared to the NP sc due to the *S&L* scheme. A significant decline in LED costs assumed to reflect the gains made by the *UJALA* scheme.
Transport sector	Only the battery component of the cost of electric two- and four-wheelers is assumed to decline in the future. Efficiency of oil fuel-based cars, buses, and trucks assumed to stay constant at 2015 value.	In addition to the battery cost decline as in the NP sc, the non-battery component cost of electric two- and four-wheelers is assumed to decline relative to the NP sc directly and indirectly (economies of scale) due to the *FAME-II* policy. Efficiency of oil fuel-based cars, buses, and trucks assumed to improve relative to NP sc, due to the introduction of *BS VI* norms.
Industry sector	Based on literature, it has been assumed that there has been no additional impact of the PAT scheme beyond the market trends.	

Source: Authors' analysis

Note: Detailed assumptions are presented in Annexure 1.

For the analysis, 2015 has been chosen as the base year, and separate efficiency and cost parameter trajectories from 2015 to 2070 have been assumed for the two scenarios for specific technologies in the power, transport, and residential sectors, as mentioned earlier.

2.2.1 Power sector

The GoI has given a thrust to the power sector in the form of its policies, given its importance for India's carbon dioxide emissions. These range from incentives introduced through the *National Solar Mission* for solar electricity, incentives like *Generation-Based Incentives (GBI)* for the wind sector, as well as a series of measures aimed at reducing the risk of investments in India's solar and wind electricity generation sectors.

In terms of solar-based electricity generation, there has been a continuous decline in global panel prices. A detailed India-specific assessment of the cost of solar-based electricity (Chawla and Aggarwal 2016) presents the different components of this cost—module, operation and maintenance, balance of system, land, transmission system, and finance. The key finding of this assessment is that the cost of finance is the biggest component of solar-based electricity generation cost for India. This is where GoI policies have intervened by reducing the risks, and hence, the risk premiums (CP sc). However, in the absence of dedicated interventions as well, the cost of solar-based electricity generation in India would have declined due to the fall in global panel prices (NP sc). We present our assumptions related to the cost components of solar-based electricity generation for both scenarios in **Annexure 1**. It's the same case for developments in the wind sector.

We assume that the aggregate impact of these policies has been and would be continuously decreasing cost of solar- and wind-based electricity generation (including their integration cost) in the CP sc, while in the NP sc, the generation cost of both these technologies would still decline, but at a slower pace, based on market trends. We present some key policies related to the power sector in **Annexure 1**.

> **Our literature assessment shows that most of the big investments in EV manufacturing in India happened only after the announcement of the first phase of the *FAME* scheme.**

Image: Alamy

2.2.2 Transport sector

Post-2015, there have been rapid developments in India's transport sector, with the share of electric vehicles (EVs) rising rapidly. This growth has been most visible in the two-wheeler and three-wheeler segments. Early signs of a big transformation towards electric cars are also visible in the four-wheeler segment. In terms of separating the impact of market forces and government interventions, we assume that decline in cost of batteries has been a global phenomenon and has not been impacted by GoI policies. However, the policies related to financial incentives for two-wheelers and four-wheelers, through the *FAME* scheme, have been instrumental in creating an ecosystem for EVs in India, and a consequent decline in the non-battery component cost of electric vehicles. Our literature assessment shows that most of the big investments in EV manufacturing in India happened only after the announcement of the first phase of the *FAME* scheme. At the same time, the move towards *Bharat Stage IV* norms in 2017, and the subsequent leapfrog to *Bharat Stage VI* norms, while aiming to curb local pollutants, has led to a move towards higher energy efficiency of fossil fuel-based car, bus, and truck engines (Mattoo and Saxena 2023).

In the CP sc, we assume that the aggregate impact of these policies has been and would be continuously declining costs of EVs, as well as a rapid pace of increase in charging infrastructure. For the NP sc, we assume that the cost of EVs declines only due to the decline in the cost of batteries, which is unrelated to GoI policies. The cost of non-battery components of the vehicles has been assumed to be constant in the NP sc. We only focus on the electrification gains made in the two-wheeler and four-wheeler segments and efficiency gains for oil fuel-based cars, buses, and trucks for our assessment. The summary of the *FAME* scheme and *Bharat Stage* norms and the assumptions based on the same are presented in **Annexure 2**.

2.2.3 Residential sector

The GoI's policies in the residential sector have focussed mainly on enhancing the energy efficiency of appliances and lighting. The flagship programmes have been *Standards and Labelling (S&L)* as well as *Unnat Jyoti by Affordable LED for All* (UJALA). The *S&L* programme focusses on the star labelling of appliances and continuously enhancing the standards for energy efficiency for various star labels. The *UJALA* scheme focusses on promoting LED use in the residential segment.

In the CP sc, we assume that the aggregate impact of these policies has been and would be continuously increasing the efficiency of ACs as well as rapid penetration of LEDs in the Indian market, while in the NP sc, we assume that the efficiency of ACs is fixed at the 2015 value and that India's lighting needs continue to be served by incandescent and CFL technologies. For the *S&L* programme, we only focus on the gains made in the air-conditioning segment. The GoI also has an ambitious *Energy Conservation Residential Codes* programme to enhance the energy efficiency of residential envelopes. However, we don't include its impact in our assessment as its implementation and gains have been partial at best. The summary of the *S&L* and *UJALA* schemes and the assumptions based on the same are presented in **Annexure 3**.

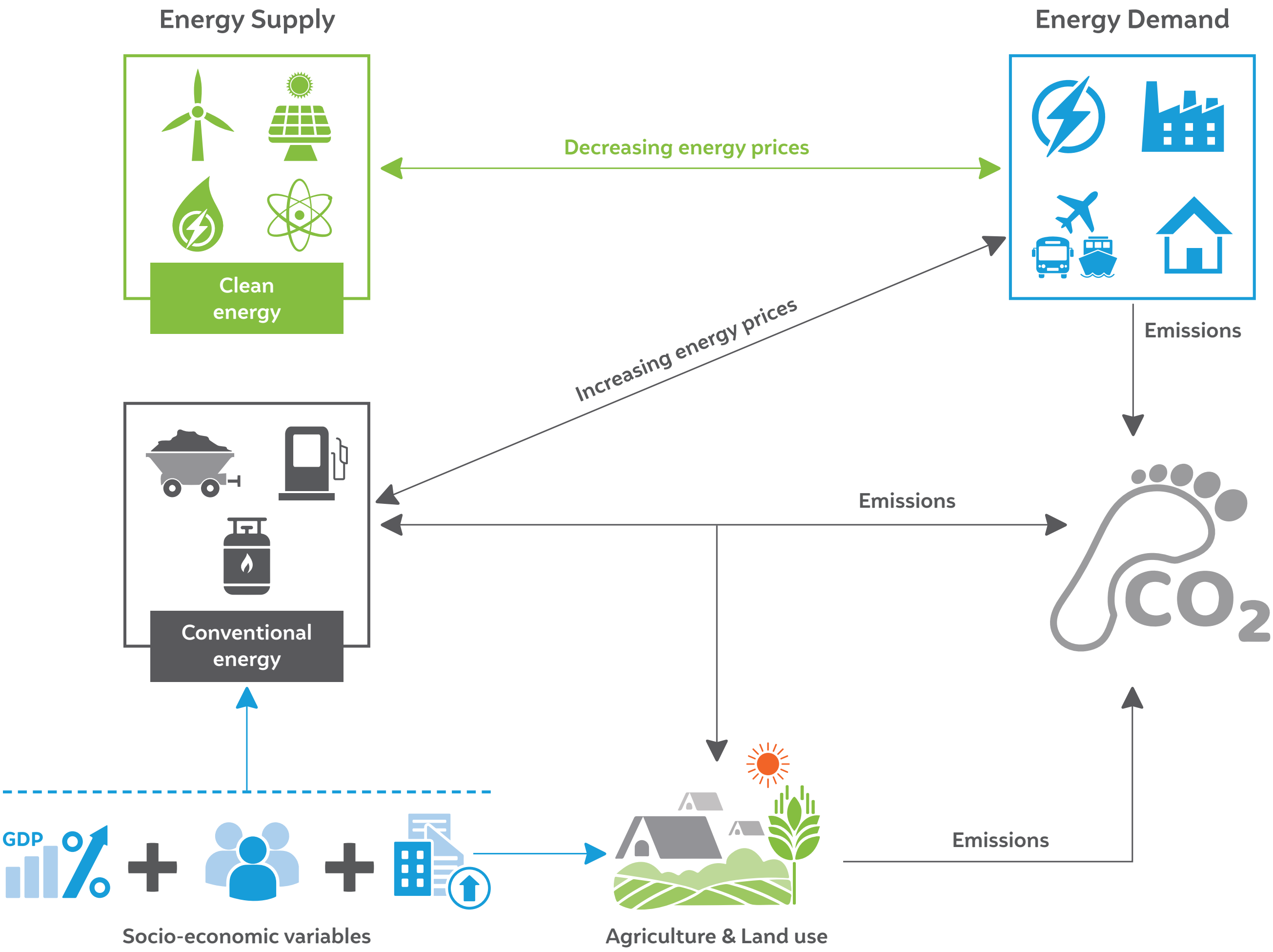
2.3 Modelling framework

This analysis has been undertaken within the framework of the Global Change Analysis Model (GCAM version 6.0, CEEW version), a widely used integrated assessment model (Chaturvedi and Malyan, 2022). The GCAM is a community model freely available for use in the research and academic community, and is one of the most-cited models in scientific literature.

Under the GCAM, the overall structure of the energy system includes three major components: energy resources, energy transformation, and final energy demands, and all the elements of the model interact with each other through market prices and physical flows. Energy demand is modelled for the key end-use sectors, which include residential (commercial, residential urban, and residential rural), transport (passenger and freight), industry (aggregate), and agriculture. The energy demands of these sectors are serviced by the energy supply sector, which includes the power generation sector and refining industries.

Figure 1 depicts the interaction between energy demand and supply, and how it is modelled within the GCAM. Key drivers of future sectoral energy demands are economic and population growth, urbanisation rate, consumer behaviour, technology costs, energy prices, and government policies. The model can explore various scenarios like the implications of increases and decreases in economic growth and urbanisation rates, solar/wind electricity generation cost trajectories, adoption rates of EVs, and rates of efficiency improvements, among others. In our analysis, we have used GCAM to model two scenarios—CP sc and NP sc—to assess the impact of policies implemented post-2015 in the Indian economy.

Figure 1 Schematic representation of GCAM



Source: Authors' adaptation from Joint Global Change Research Institute (JGCRI) and Pacific Northwest National Laboratory (PNNL) ("GCAM v6 Documentation: Table of Contents" 2024)

3. Key results

This section discusses sectoral results derived from our analysis, highlighting the impact of policies on advancing low-carbon technologies, which lead to overall emissions reductions. Through our results, we provide a clearer picture of the contributions of the selected policies towards green transition, and laying the path for a low-carbon economy in the long run.

3.1 Impact on electricity generation mix

India's power demand is growing at a fast pace, given the rise in its GDP. The increasing demand of air-conditioning, lighting, appliances, industrial goods and transport services, among other things, has led to a significant rise in power demand in the past couple of decades. We expect this to continue as the economy continues its growth momentum.

India's power demand, as per our projections, would increase 3.97 times between 2020 and 2050 in the NP sc. Increase in demand is directly correlated to increase in power generation, which would also increase by 3.63 times between 2020 and 2050 in this scenario.

In the CP sc, there are two simultaneous effects of India's climate policies on the long-term electricity demand. First, there is an increase in electricity demand due to rapid electrification of the transport sector induced by EV push policies. Electricity consumption induced by the EV push in the transport sector (CP sc compared to NP sc) increases by 9.4 terawatt-hour (TWh) in 2030, 103 TWh in 2050 and 440 TWh in 2070. Second, there is higher electricity consumption in the industry sector driven by lower average electricity prices, due to lower cost of solar- and wind-based electricity generation. Industrial electricity consumption increases by 154 TWh in 2030, 462 TWh in 2050 and 716 TWh in 2070 in the CP sc relative to the NP sc.[2] Third, there is an increase in residential AC use due to lower electricity prices along with higher energy efficiency improvement, essentially the rebound effect as explained later in section 3.3.

Incentives for one type of low-carbon technology lead to a negative impact on another low-carbon technology, unless there is a dedicated push for that as well.

In terms of the impact of mitigation policies on the power generation mix, we see that in the absence of policies adopted by the GoI (NP sc), coal would have continued to be the only dominant source of electricity generation in India, given its abundance as a domestic resource, competitive prices, and the priority accorded to energy security and affordability. In the CP sc, the policies adopted by the GoI to push solar and wind in the electricity generation mix will yield significant dividends; the aggregate impact of policies evaluated will push the share of solar and wind to 43 per cent of India's electricity generation by 2050. This will mainly be at the expense of coal. Interestingly, the push for solar and wind will also lead to decline in the penetration of nuclear-based electricity. This interesting behaviour is similar to what has been highlighted in Shukla and Chaturvedi (2012), that incentives for one type of low-carbon technology lead to a negative impact on another low-carbon technology, unless there is a dedicated push for that as well.

While in the NP sc as well, solar and wind would have witnessed some growth in the future due to the global fall in panel prices, they would still have been a small part of India's electricity generation mix. Our projections show that in the NP sc, solar- and wind-based electricity would have been 571 TWh and 318 TWh respectively in 2070, and together, they would have still contributed less than a tenth of India's electricity generation mix. Compared to this, in the CP sc, solar- and wind-based electricity generation will be 2,568 TWh and 1,816 TWh respectively in 2070. The impact of India's push for solar and wind is also clearly visible in the short run. In 2030, cumulative solar and wind generation will increase to more than two and a half times due to climate policies (compared to NP sc), a significant jump.

2. Agriculture-related energy use is reported as a part of the industry sector numbers in this brief.

Figure 2 (a) Electricity generation mix by fuel (Exa-Joules [EJ]) (b) Electricity generation shares by fuel (%)

Source: Authors' analysis

In terms of impact on coal-based electricity generation, our assessment shows that India's push for solar and wind will lead to a decline in coal used in power generation by 24 per cent in 2030, and by 34 per cent in 2050 and 36 per cent in 2070, as compared to the NP sc. This essentially implies that 80 GW of coal based power generation capacity addition has been avoided due to India's climate policies. While the current mitigation policies have significant implications in terms of declining coal use for India's power generation, these will still fall short of pushing the power sector to a net-zero future by 2070.

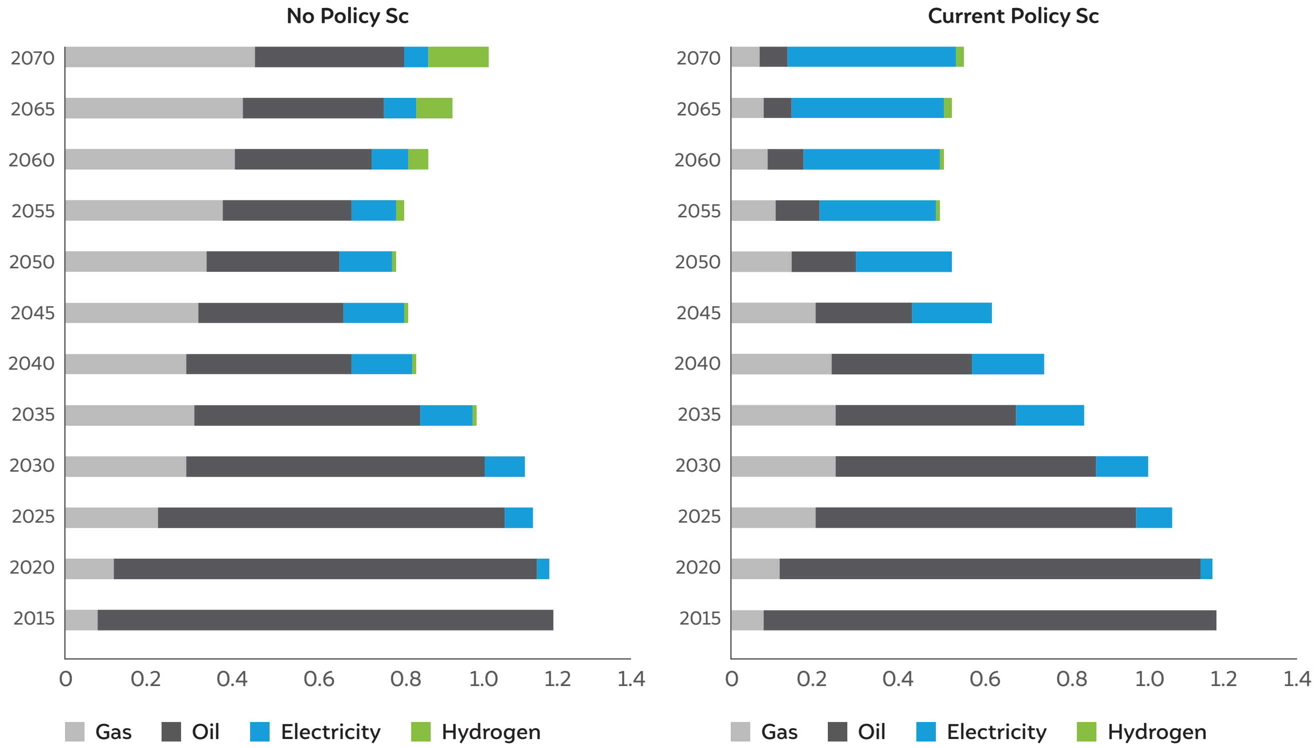
This highlights two realities. First, India's push on energy security and affordability would mean continued reliance on coal in the near future. Second, the adoption of the 2070 net-zero target marked a pivotal moment in India's climate policy. While mitigation efforts have successfully promoted low-carbon technologies to a significant degree, they will still fall short of delivering the level of climate ambition required to meet the objectives of the Paris Agreement without a clear end goal.

This is why the 2070 net-zero goal is so critical, and the mitigation policies that are being pursued post the net-zero announcement, particularly the domestic cap and trade market that is to levy a carbon price on emissions in the covered sectors, will be critical to decisively move towards the net-zero goal.

3.2 Impact on EV share and fuel mix in the road segment

India is witnessing a rapid growth in the ownership of private vehicles, both two-wheelers (2W) and four-wheelers (4W). Our results show that this growth would continue unabated for the next few decades within increasing per capita incomes. Interestingly, the pace of 4W additions would far outstrip the growth in 2W sales by 2050. As more and more Indians become rich, they will prefer using private 4W instead of 2W.

Figure 3 Changing landscape of passenger road transport energy consumption by fuel



Source: Authors' analysis

In terms of the fuel mix, we see a move towards battery electric vehicles (BEVs) both in the 2W and 4W segments, even in the NP sc, mainly in the 2W segment. This is because we are witnessing a decline in global battery prices that is not linked to Indian policy interventions. In terms of on-road stock, electric 2W and 4W would have accounted for 22 and 2 per cent respectively even by 2050 in the NP sc, which means the shift in 2W would have been much faster as compared to the 4W segment.

In the CP sc, we see a rapid increase in the penetration of EVs, particularly in the 4W segment. By 2050, the share of e-2W and e-4W in on-road stock will be above 65 per cent for both segments. The 4W segment, as per our assessment, will undoubtedly benefit from the concerted policy signalling and push in terms of moving towards EVs.

In addition to the policies related to pushing e-2W and e-4W within the passenger segment, increasing efficiency of oil-based cars, buses and trucks will have a significant impact in terms of reducing the potential demand of oil and gas in India's road transport segment. The aggregate demand of oil and gas consumed in the transport sector will reduce by 55 per cent in 2050 and 83 per cent in 2070 (relative to NP sc) due to the EV push, as well as energy use efficiency improvements due to the *BS VI* norms.

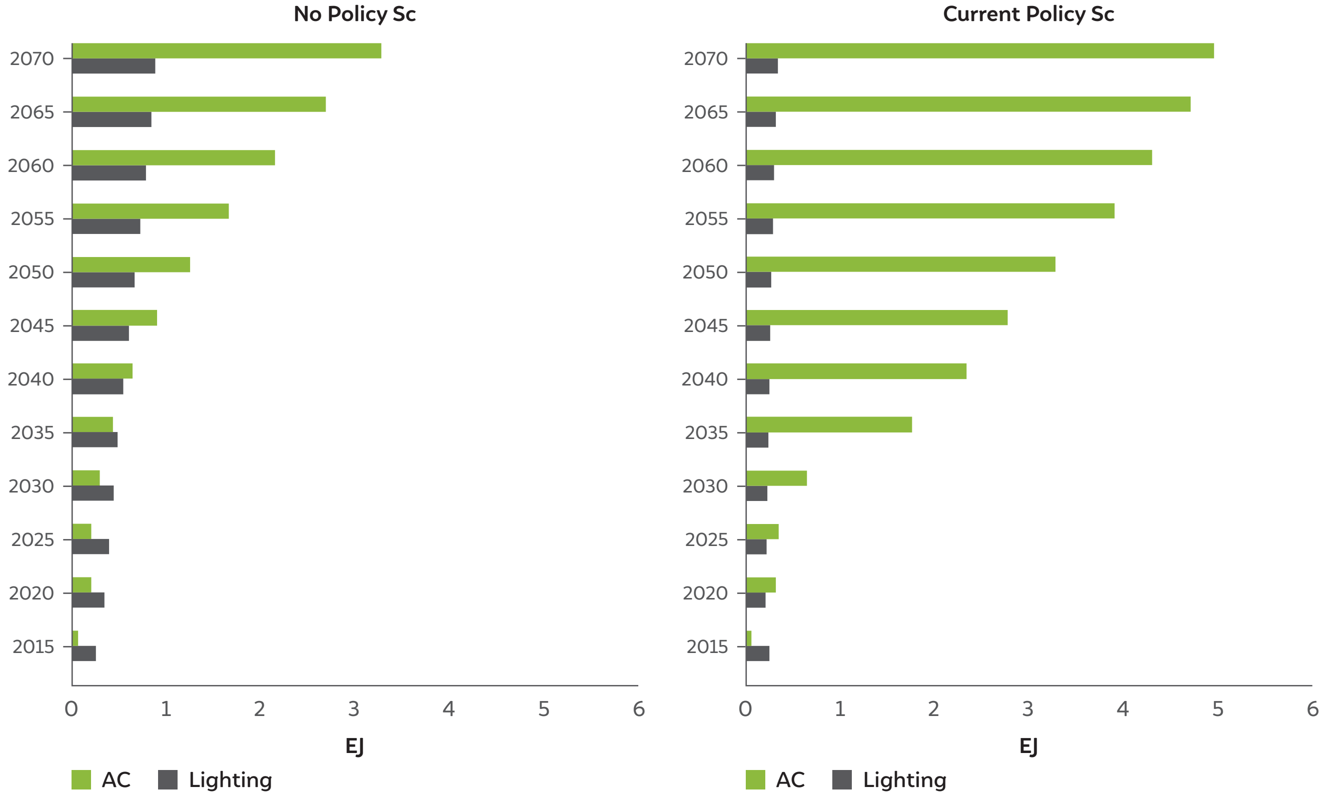
3.3 Impact of air conditioning and lighting electricity consumption in the residential sector

Air-conditioning use in India is continuously increasing, owing to higher temperatures and increasing affordability. No longer are ACs regarded as a luxury commodity. Our results show that even in the scenario with increasing efficiency (CP Sc) driven by the *Standards and Labelling (S&L)* programme, AC-related electricity consumption in India's households will increase by almost 10.2 times between 2020 and 2050, and further grow 1.51 times between 2050 and 2070. This is driven by not just higher incomes, but also lower electricity prices in the CP sc.

While the average energy efficiency of air-conditioning significantly improves, the overall electricity demand for cooling increases drastically in the CP sc relative to the NP sc, driven by lower electricity generation costs. Average costs of electricity generation are lower by 21% in 2030, 23% in 2050 and 30% in 2070. As ACs are significant power guzzlers, lower generation costs incentivise more AC ownership and use in the CP sc leading to a significant increase in the overall electricity consumption. Electricity consumed by residential ACs will end up increasing by 2.5 times in 2050, and 1.5 times in 2070 in the CP sc relative to the NP sc. This is the due to the rebound effect.

Image: iStock

Figure 4 Residential sector energy consumption by fuel



Source: Authors' analysis

The rebound effect means that people start consuming more of a fuel as its effective cost decreases, due to higher energy efficiency of equipment. The effect is shown as the air-conditioning service delivered in our model results is much higher in the policy intervention scenario (CP sc) as compared to the NP sc. The total cooling service delivered in the NP sc between 2020 and 2050 grows by 6.5 times, as compared to 17 times observed when ACs become more energy efficient (CP sc). This essentially implies that while the electricity consumption increases by 10.2 times between 2020 and 2050, the associated cooling delivered increased a lot more. Undoubtedly, AC efficiency increase will lead to positive welfare gains for users, who can effectively use cheaper electricity due to more efficient ACs as well as lower electricity costs.

The energy intensity effect, while not so visible in the headline AC electricity use number due to the rebound effect, can be observed in the cooling service delivered per unit of electricity consumed, which is only 3.81 EJ-output/EJ in 2070 in the NP sc, as compared to 7.35 EJ-output/EJ in the CP sc.

India's *UJALA* programme, which focuses on pushing LEDs in residential households, has been very effective. As per our assessment, this programme will lead to a decline in India's residential lighting electricity use by 48 per cent by 2030, 59 per cent by 2050, and 62 per cent by 2070 in the CP sc, relative to the NP sc. Even our NP sc assumes a high penetration of CFL bulbs based on market trends, which are already a lot more efficient compared to incandescent bulbs; LED lights further enhance efficiencies of lighting electricity use in India.

Interestingly, lower power prices also imply that electricity-based cooking becomes less expensive and more attractive for Indian households. In absence of any big non-economic barrier like a preference for flame-based cooking as against electric induction-based cooking, our results show a significant shift from liquefied petroleum gas to flameless cooking. This would lead to a decline in direct emissions from the residential sector, but a higher demand for electricity.

3.4 Impact of mitigation policies on India's sectoral and total carbon dioxide emissions

The aggregate impact of the mitigation policies analysed in this assessment will lead to a significant decline in India's carbon dioxide emissions from energy use across sectors. Current policies will have a decisive impact in terms of India's long-term emissions trajectory, with the total energy sector carbon dioxide emissions reducing by 634 MtCO2 in 2030, 1,693 MtCO2 in 2050, and 2,705 MtCO2 in 2070, compared to the NP sc.

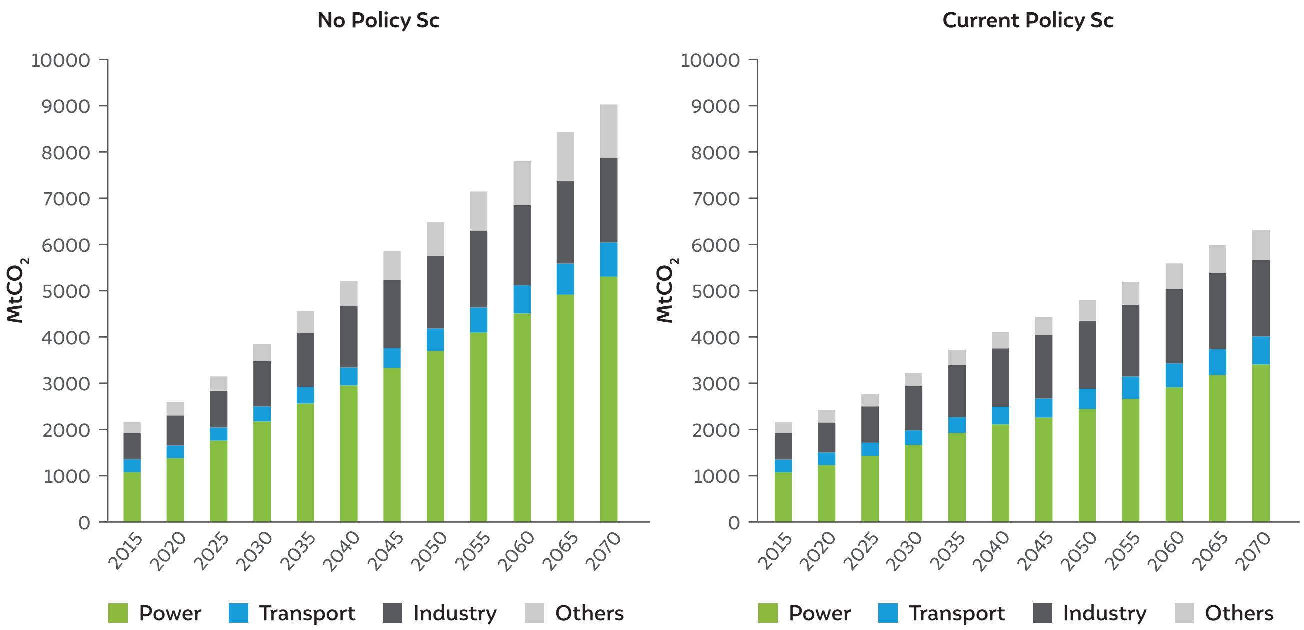
Our assessment shows that the largest mitigation impact will be on power sector emissions. This is not surprising as these constitute almost half of India's energy sector-related carbon dioxide emissions. Industrial sector emissions constituted almost 30 per cent of India's energy sector CO2 emissions in 2020, while transport sector emissions constitute around 12 per cent. Given that we have not included the impact of the *PAT* scheme on industrial energy efficiency reductions, the bulk of reductions in our assessment will happen in the power sector.

The GoI's mitigation policies will be able to reduce power sector emissions (relative to the NP sc) by 23 per cent in 2030 (507 MtCO2), 44 per cent in 2050 (1,257 MtCO2), and 46 per cent in 2070 (1,895 MtCO2). Thus, power sector emissions will decline significantly even though electricity generation increases at the same time.

Other sectors will also see a meaningful decline in direct emissions as a result of climate policy. Relative to the NP sc, industrial and transport sector emissions in the CP sc will reduce by 7 per cent and 9 per cent respectively in 2050; and 9 per cent and 19 per cent respectively in 2070. But the quantum of absolute emission reduction in these sectors will be far smaller than in the power sector, given the high emissions in the latter to begin with. Even though we do not test an industrial sector specific mitigation policy, we find that decline in electricity generation cost in the CP sc will lead to higher electrification of the industrial sector leading to decline in direct emissions.

Our assessment refutes the often-made argument that the push towards EVs in India is not a useful strategy as the country's grid is coal-heavy. Figure 5 shows that India's grid is also decarbonising fast, even as electricity generation is increasing to meet new end-use demands like energy efficient EVs. In terms of cumulative carbon dioxide emissions saved, India's current mitigation policies have already mitigated 440 MtCO2 between 2015 and 2020, and are on track to save 3950 MtCO2 emissions between 2020 and 2030, 22670 MtCO2 emissions between 2030 and 2050, and 44700 MtCO2 emissions between 2050 and 2070. This mitigation achievement is due to existing policies in the power, transport, and residential sectors, and we can expect that the new set of policies that have been introduced will lead to a further decline in India's carbon dioxide emissions.

Figure 5 India's carbon dioxide emissions by sector



Source: Authors' analysis

Note: Industrial sector emissions presented in this chart exclude IPPU emissions.

4. Conclusion

The GoI has been pursuing dedicated mitigation policies across sectors to reduce India's emissions impact for over a decade now. While it is clear that there has been momentum for mitigation actions across sectors, it is unclear whether this is the impact of market forces or government policies. This study has delineated the impact of market forces like the global decline in battery costs and selected dedicated mitigation policies implemented across sectors in India, and assessed the impact of these climate policies on electricity supply, energy demand and emissions.

Our assessment finds that the current policies can significantly impact the energy mix across sectors and decisively lower India's long-term emissions curve. The policies have pushed India on the path to a higher share of renewable energy in its electricity generation mix, a higher share of electric vehicles, and lower electricity consumption for ACs and lighting due to energy efficiency improvements.

In terms of energy sector carbon dioxide emission reductions, the highest reduction due to policy interventions is observed in India's power sector, given that its share of the country's carbon emissions is significantly higher than other sectors. There are sizeable emission reductions even in the transport and residential sectors.

We also observe that while these policies have been successful in lowering India's long-term emissions curve, it will still be a rising curve in the absence of additional mitigation policies (many of which have already been announced), given the powerful effect of economic growth and the GoI's efforts to ensure energy security and affordability to millions of households in a fast-growing economy. We emphasise that the adoption of the 2070 net-zero target has been a watershed moment in India's climate policy, as it has led to the continued quest for additional mitigation policies. Policies without a long-term mitigation target in sight, while successful in pushing low-carbon technologies to a good extent, still would not be able to deliver on the climate ambition showcased by India to achieve the goals of the Paris Agreement.

Future research would expand the ambit of policies to include other recently introduced schemes, such as the *National Green Hydrogen Mission*, *Carbon Credit Trading Scheme (CCTS)*, *PM Suryaghar Yojna* (focussing on rooftop solar) and *PM-eBus Sewa Scheme*. Many of these additional policies have already been unveiled—of particular importance, in our view, is the domestic *CCTS*, which will levy a carbon price on India's emissions from the key sectors and could further bend the emissions curve and reduce its peak emissions on the path towards the net-zero goal.

Image: iStock

Annexure 1: Power sector policies and assumptions

Policy scenario

For solar and wind levelized cost of electricity (LCOE), bid tariffs for new projects have been taken into account, and a profit of 10 per cent has been considered to determine the LCOE trajectory. (India RE Navigator 2024).

Table A1 Breakdown of cost components for solar LCOE

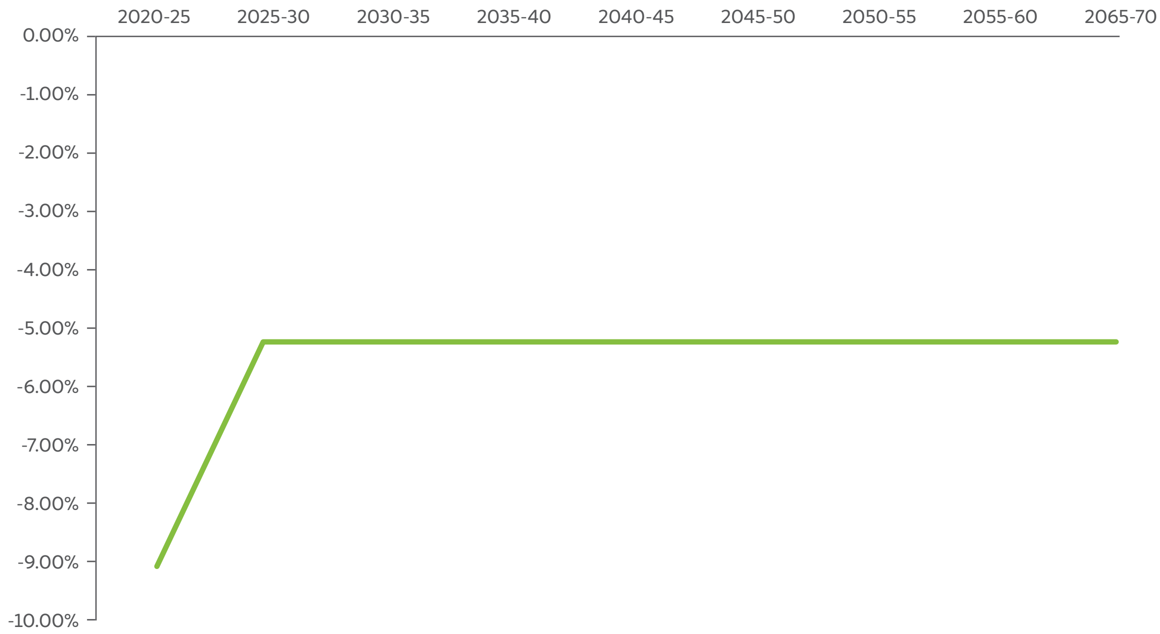
Cost component for solar LCOE	2015	2020
Operation & Maintenance	13.39%	15.55%
Photovoltaic module	22.17%	16.61%
Land lease/solar park charges	6.47%	11.31%
Balance of system	5.54%	7.77%
Financing costs	65.13%	48.76%
Accelerated depreciation benefit	-12.70%	0%

Source: Authors' adaptation from Chawla, Aggarwal and Dutt (2020)

Based on the share of the cost components and the overall LCOE for 2015 and 2020, which are 6.44 and 3.05 INR/kWh, respectively (India RE Navigator 2024), we calculated all the absolute values for the cost components. The cost trajectory in the CP sc for solar PV specifically has declined rapidly in 2015–20 (CAGR -13.9 per cent). Thereafter, the rate of decline in cost reduces, and the assumed rate is CAGR -0.53 per cent post-2030. The early decline in the cost is representative of the implemented policies, coupled with a global reduction in solar module prices. Additionally, there are accelerated depreciation benefits in 2015; however, these get removed in 2020. Chawla and Aggarwal (2016) have provided insights on the share of various components contributing to the overall LCOE for 2016 and 2017. We have assumed the decline in these cost components to be similar in 2015 and 2020 respectively (Table A1).

Keeping every other component same, we have assumed a declining trajectory of module costs (CAGR-based) between 2020 to 2030 to arrive at the solar LCOE (Takyar 2023). We have assumed that there is no decline in the module cost post-2030. Figure A1 shows the solar module costs CAGR over the base year of 2010.

Figure A1 CAGR of decline of solar module cost



Source: Authors' analysis based on (Takyar 2023)

Post-2030, we have assumed a decline in the overall trajectory by a five-year CAGR of 0.53 per cent between 2030 and 2070. All these steps provide us with the complete LCOE trajectory between 2015 and 2070, without the integration cost for solar and wind.

In the NP sc, it is assumed that accelerated depreciation benefits will be absent and global module price reduction is the sole actor. This would lead to an overall decrease in solar cost at 0.29 per cent CAGR between 2015 and 2030. Later, the cost of solar would remain constant up to 2070 (Table A2).

Table A3 shows the solar LCOE for both the scenarios, including the integration cost required to scale up and integrate solar power to the grid.

The actual numbers for wind LCOE for 2015 and 2020 are 5.5 and 6.01 INR/kWh respectively (India RE Navigator 2024).

Following a similar process as in the case of solar, the share of all the components contributing to the wind LCOE has been obtained, and based on the actual number, the absolute values for 2015 and 2020 have been calculated. Additionally, there are accelerated depreciation benefits in 2015, which get removed in 2020. Table A4 shows the 2015 and 2020 share of components in the total LCOE.

Table A2 Assumed solar LCOE trajectory without integration cost for CP sc and NP sc

Scenario for solar LCOE (INR/kWh)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	6.44	3.05	2.86	2.78	2.71	2.64	2.57	2.50	2.43	2.37	2.31	2.25
No Policy sc	6.44	6.54	6.27	6.16	6.16	6.16	6.16	6.16	6.16	6.16	6.16	6.16

Source: Authors' analysis

Table A3 Assumed solar LCOE trajectory with integration cost for CP sc and NP sc

Scenario for solar LCOE (INR/kWh)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	6.44	3.05	3.70	3.68	3.67	3.72	3.77	3.83	3.76	3.70	3.64	3.58
No Policy sc	6.44	6.54	7.11	7.07	7.13	7.25	7.37	7.49	7.49	7.49	7.49	7.49

Source: Authors' analysis

Table A4 Breakdown of cost components for wind LCOE

Cost component for wind LCOE	2015	2020
Operation & Maintenance	16.14%	14.78%
Wind turbine	21.33%	19.53%
Land lease/wind park charges	1.44%	1.32%
Balance of system	8.65%	7.92%
Financing costs	61.67%	56.46%
Accelerated depreciation benefit	-9.22%	0.00%

Source: Authors' adaptation from Chawla, Aggarwal and Dutt (2020)

The decline in the cost components and overall LCOE can be attributed to the intervening policy implemented by the GoI. Post-2020, we have assumed that the wind LCOE grows at 0.15 per cent CAGR in a five-year period.

In the NP sc, it is assumed that accelerated depreciation benefits will be absent and global module price reduction is the sole actor. This leads to an overall decrease in wind LCOE at -1.75 per cent CAGR between 2015 and 2020. Later, the cost of wind remains constant from 2020 up to 2070 (Table A5).

Table A6 shows the wind LCOE for both the scenarios, including the integration cost required to scale up and integrate solar and wind to the grid.

Policy perspective

The decline in the costs is not because of a single policy but of a series of key policies and initiatives mentioned below:

- The *National Solar Mission*, launched in 2010, played a crucial role by promoting large-scale solar projects. It did this through subsidies and competitive bidding processes, which helped reduce tariffs, making solar energy more affordable and accessible.
- The *Generation-Based Incentive*, introduced in 2013, provided financial incentives specifically for solar and wind power generation. These incentives encouraged greater efficiency in generating renewable energy, making it more attractive for investors and developers, indirectly resulting in cost reduction.
- Another key policy was the *2016 Tariff Policy*. This mandated competitive bidding for renewable energy projects and waived inter-state transmission charges. Competitive bidding ensured that projects were awarded to developers offering the lowest tariffs, thereby lowering costs for consumers and promoting efficiency in project execution.
- Residential on these foundations, the *2020 Tariff Policy* further strengthened *Renewable Purchase Obligations*. These obligations require entities to purchase a certain percentage of their energy from renewable sources. The policy also supported hybrid renewable projects and encouraged the adoption of new technologies. These measures have continued to drive down the costs of solar and wind energy in India, making them increasingly competitive with conventional energy sources.

Table A5 Assumed wind LCOE trajectory for CP sc and NP sc

Scenario for wind LCOE (INR/kWh)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	5.5	2.55	2.53	2.51	2.49	2.47	2.46	2.44	2.42	2.40	2.38	2.37
No Policy sc	5.5	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01	6.01

Source: Authors' analysis

Table A6 Assumed wind LCOE trajectory with integration cost for CP sc and NP sc

Scenario for wind LCOE (INR/kWh)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	5.5	2.55	3.37	3.41	3.45	3.55	3.66	3.76	3.74	3.72	3.70	3.69
No Policy sc	5.5	6.01	6.72	6.77	6.82	6.92	7.02	7.13	7.13	7.13	7.13	7.13

Source: Authors' analysis

Annexure 2: Transport sector policies and assumptions

FAME I & II

Policy scenario

Our assumptions in the CP sc showcase a conservative but steady declining trajectory in the cost of electric two-wheelers (2W) and four-wheelers (4W) from 2015 to 2070. The growth rate for the decrease in 2W and 4W costs is -0.49 per cent and -1.58 per cent respectively between 2015 and 2070. However, the trajectory for the NP sc has been assumed to have no change in cost; a 2015 constant value has been assumed.

The breakdown of the ex-showroom price of the most-sold EV four-wheeler in India, the Tata Nexon EV, is taken as the reference point. As per the CEEW-CEF report (Soman et al. 2020), the cost of a battery pack constitutes 40 per cent of the total cost; the rest is non-battery cost. Most Indian manufacturers import battery and related parts from China. Hence, the decline in the battery cost will be due to market forces around the globe (McKerracher et al. 2023). However, the decline in the rest of the components is due to policy intervention by the GoI. Accelerated indigenous manufacturing, coupled with the incentives under *FAME* scheme, have led to rapid cost reduction over the years (Kohli 2024).

Similarly, for EV two-wheelers in India, Hero Electric Optima is the most sold model. We have applied the same breakdown of cost of the ex-showroom price. The reduction in battery cost is 65 per cent from 2015 to 2020, which is visualised in the trajectory. The overall cost reduction of EVs is greatly influenced by battery cost reduction, followed by GoI incentives.

Table A7 Component CAGR for 2W and 4W EVs

Mode	Component CAGR	2015–20	2020–25	2025–30
2W/4W	Battery	-18.61%	-6.72%	-6.67%
4W	Non-battery component	-6.37%	-6.37%	-6.37%
2W	Non-battery component	-1%	-1%	-1%

Source: Authors' adaptation from Chawla, Aggarwal and Dutt (2020)

The cost structure of EVs in India, particularly the most-sold models like the Tata Nexon EV and Hero Electric Optima, is heavily influenced by battery costs, which constitute around 40 per cent of the total ex-showroom price (Soman et al. 2020). Indian manufacturers primarily source these batteries and related components from China, making global market forces a critical driver of cost trends. According to McKerracher et al. (2023), lithium-ion battery pack prices hit a record low of INR 11600/kWh as of September 2024, primarily due to technological advancements and economies of scale in global production(McKerracher et al. 2023).

For two-wheelers such as the Hero Electric Optima, a similar cost breakdown applies, with a significant reduction in battery prices—65 per cent from 2015 to 2020—highlighting the substantial impact of global market dynamics. However, the non-battery costs, which make up the remaining 60 per cent of vehicle costs, have seen a decline primarily due to domestic policy interventions by the government of India.

The *FAME* scheme, coupled with incentives for local manufacturing, has accelerated the indigenous production of components, thereby driving down costs (Kohli 2024).

The GoI's proactive policies have been instrumental in reducing the overall costs of EVs, beyond just battery prices. Incentives for local manufacturers, import duty reductions, and subsidies under the FAME scheme have stimulated domestic production of EV components, reducing reliance on imports. This dual approach—leveraging global battery cost reductions while fostering local manufacturing—has led to a significant decrease in the overall cost of EVs in India (Table A8).

Table A8 Assumed cost trajectory for 2W and 4W EVs

2024 INR/ VKM	Vehicle Category	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	Elec 2W	9.17	5.47	4.94	4.94	4.94	4.94	4.94	4.94	4.94	4.94	4.94	4.94
	Elec 4W	201.09	91.72	67.03	67.03	67.03	67.03	67.03	67.03	67.03	67.03	67.03	67.03
No Policy sc	Elec 2W	9.17	6.7	6.35	6.17	6.17	6.17	6.17	6.17	6.17	6.17	6.17	6.17
	Elec 4W	201.09	149.93	141.11	135.82	135.82	135.82	135.82	135.82	135.82	135.82	135.82	135.82

Source: Authors' analysis; VKM = Vehicle kilometre

Policy perspective

Based on the available literature, the declining cost assumption of these vehicles has been attributed to the *FAME I* and *FAME II* schemes, aggregated with ongoing technological advancements in the market for the policy scenario. FAME I, launched in 2015, provided direct subsidies to reduce the purchase price of EVs, thus enhancing affordability. FAME II, which followed in 2019, expanded these incentives and supported the development of charging infrastructure and local manufacturing.

These policies catalysed the initial market adoption of EVs and facilitated economies of scale. As a result, EVs have become increasingly accessible, have reduced costs, and are practical for a broader range of consumers. As the technology matures until 2070, a slower decline in the cost trajectory has been assumed.

BHARAT STAGE

Policy scenario

In the CP sc, an increasing efficiency trajectory of oil fuel-powered passenger cars, buses, and trucks has been assumed from 2015 to 2070. Efficiency improvement CAGRs in this scenario for passenger cars, buses, and trucks are 0.47, 0.82, and 0.16 per cent respectively between 2015 and 2070. The NP sc has no change in the efficiency of the vehicles and remains constant between the periods. Table A9 shows the efficiency improvements for both the CP sc and the NP sc between 2015 and 2070.

Policy perspective

The increasing efficiency of these vehicles in India has been influenced by implementing the *Bharat Stage (BS) III* and *BS IV* norms. Introduced in 2010 and 2017 respectively, these emission standards set stringent limits on pollutants such as NOx, CO, HC, and PM, pushing manufacturers to adopt advanced technologies and improve vehicle efficiency (Mattoo and Saxena 2023). Compliance with these norms necessitated significant advancements in vehicle technology, which led to a significant increase in vehicle efficiency over time. This regulatory push and technological advancements ensured a continuous improvement trajectory in vehicle efficiency, aligning with global trends toward more sustainable and fuel-efficient transportation systems.

The *BS V* and *BS VI* norms, implemented in 2020, further tightened emission limits and aligned Indian standards with Euro 6 norms, promoting the adoption of cleaner fuel and advanced emission control technologies. These stages continue to drive innovation in engine design, contributing to lower emissions and better fuel efficiency.

Table A9 Assumed efficiency for passenger cars, buses and trucks from 2015 to 2070

	Mode (vkm/l)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	Cars	10.23	10.58	10.95	11.34	11.76	12.12	12.52	12.93	13.01	13.09	13.17	13.25
	Buses	2.89	3.01	3.13	3.27	3.4	3.54	3.69	3.84	4	4.17	4.35	4.53
	Trucks	5.56	5.6	5.65	5.7	5.74	5.79	5.84	5.89	5.93	5.98	6.03	6.08
No Policy sc	Cars	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23	10.23
	Buses	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89	2.89
	Trucks	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56	5.56

Source: Authors' analysis; vkm/l = vehicle kilometre per litre

Annexure 3: Residential sector policies and assumptions

Standards & Labelling scheme

Policy scenario

Recent analysis (Singh and Phore 2020) provides projections and historical data for *S&L* scenario and *Frozen Technology* scenario from 2015 to 2050. We have assumed the S&L numbers for our CP sc and Frozen Technology for our NP sc. The efficiency of residential air-conditioners (RACs) in India has been assumed to increase steadily from 2015 to 2050 in the CP sc, with a CAGR of 15.62 per cent for the *S&L* scheme. Post-2050, the efficiency improvement has been assumed to be constant through 2070. In the NP sc, there is an efficiency improvement of 3.13 per cent CAGR between 2015 and 2020, showcasing market interventions by the GoI through the usage of low global warming potential refrigerants. Post-2020, the efficiency improvements remain constant till 2070. Table A10 showcases the efficiency improvements between 2015 and 2070 for both scenarios.

Policy perspective

Research indicates that, among others, efficiency improvements for ACs resulted from implementing the *Standards & Labelling* scheme. Introduced by the Bureau of Energy Efficiency, *S&L* sets minimum energy performance standards (MEPS) and provides star ratings to ACs based on their energy efficiency.

The scheme compelled manufacturers to improve the energy efficiency of their products to meet these standards and achieve higher star ratings. This led to the adoption of advanced technologies. The regulatory framework of the *S&L* scheme created a competitive market environment that encouraged innovation and the use of more efficient technologies.

UJALA scheme

Policy scenario

In our analysis, we have assumed high-efficiency LED bulbs to have a share weight of 1 between 2015 and 2070 for the CP sc, indicating that there is no non-economic barrier for these bulbs in the market. This is an implication of the *UJALA* scheme, which has resulted in higher market penetration of high-efficiency LED bulbs. In the NP sc, the share weight is constant at 0.01 between 2020 and 2070, indicating that there is no policy implication, resulting in less uptake of high-efficiency LED bulbs (Table A11).

Policy perspective

The Prime Minister of India launched the *UJALA* scheme on 5 January 2015. This programme aims to provide energy-efficient LED bulbs to domestic consumers at an affordable price. The overarching objective is to promote the use of the most efficient lighting technology at cheap rates, and create a market for energy efficient appliances.

Moreover, this scheme is aimed at enhancing consumer awareness of the financial and environmental benefits of using energy efficient appliances. Bulk procurement of LED bulbs and distribution to domestic consumers helped achieve economies of scale, which resulted in the cost reduction of LED bulbs from INR 300–350 in 2014 to INR 70–80 per bulb in a short span of less than two years.

Table A10 Assumed Indian Seasonal Energy Efficiency Ratio (ISEER) for RACs

Scenario for wind LCOE (INR/kWh)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	3.18	4.02	4.5	5.08	5.48	6.07	6.32	6.57	6.57	6.57	6.57	6.57
No Policy sc	3.18	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71	3.71

Source: Authors' analysis based on Singh and Phore (2020)

Table A11 Share weights for high-efficiency LED bulbs

Scenario for wind LCOE (INR/kWh)	2015	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
Current Policy sc	1	1	1	1	1	1	1	1	1	1	1	1
No Policy sc	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Source: Authors' analysis based on Singh and Phore (2020)

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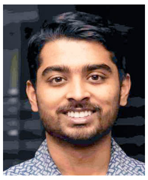

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