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Supporting Climate Policy for Indian States

Learnings from Long-term Modelling

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Image: Alamy

Executive summary

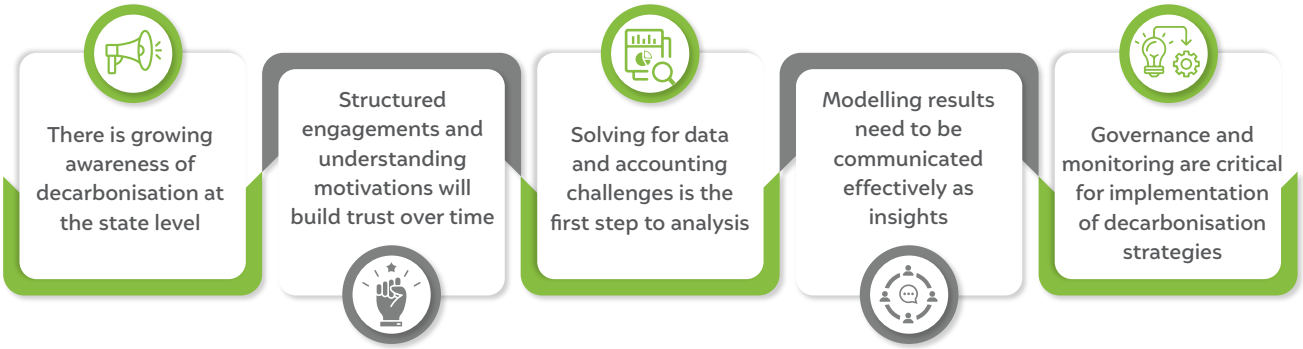
As India and its states move towards realising net-zero emissions, long-term energy and emissions modelling using integrated assessment models (IAMs) are necessary to institute and embed long-term planning in both national- and state-level policies. Outputs and insights from long-term-modelling-based analyses enable state stakeholders to engage and discuss the trade-offs and benefits of climate change mitigation policies and how they may ensure economic diversification.

Such engagement enables governments, civil society, and industry stakeholders to improve their understanding of the energy and climate change mitigation debate. Given India's focus on climate leadership at the global level, and the announcement of its net-zero goal, there has been a growing interest from states to better understand the implications of the net-zero target for themselves. Consequently, the Council on Energy, Environment and Water (CEEW) has undertaken long-term-modelling-based analyses to explore net-zero futures for various states.

In this issue brief, we highlight the key learnings from long-term modelling over the last three years for specific Indian states. These include learnings on (i) awareness of decarbonisation at the state level, (ii) understanding the motivations of state governments and building trust to enable decarbonisation strategy planning, (iii) solving for data-related challenges, (iv) communicating the results of the modelling effectively, and (v) criticality of governance and monitoring for effective mitigation strategies.

As India and its various states move towards net zero in the coming decades, these learnings will allow stakeholders such as civil society, academia, and others to better engage with states. They will also enable informed discourse and scientific research to inform long-term policymaking. These learnings are, therefore, critical for successfully shaping future state climate policy.

Figure ES1 Insights and learnings at the state level



Source: Authors' compilation

Image: CEEW

Dr Arunabha Ghosh, CEO, CEEW (2nd from right) in Patna with the former Chief Secretary of Bihar, Shri Tripurari Sharan and former Development Commissioner Shri Amir Subhani during a high-level meeting held jointly with other consortium partners, December 2021.

1. Introduction

Over the last decade, India has been leading the way in climate action. From creating the International Solar Alliance (ISA) and the Coalition for Disaster Resilient Infrastructure (CDRI) in 2015 and 2019, respectively, to the announcement of its net-zero target in November 2021 and its enhancement of its Nationally Determined Contribution (NDC) under the Paris Agreement, India is focused on mainstreaming climate action (PIB 2016; PIB 2021; PIB 2022). Further, India is championing the Mission Lifestyle for Environment (LiFE), which promotes sustainable consumption and behavioural change to benefit the environment (MoEFCC and NITI Aayog 2022).

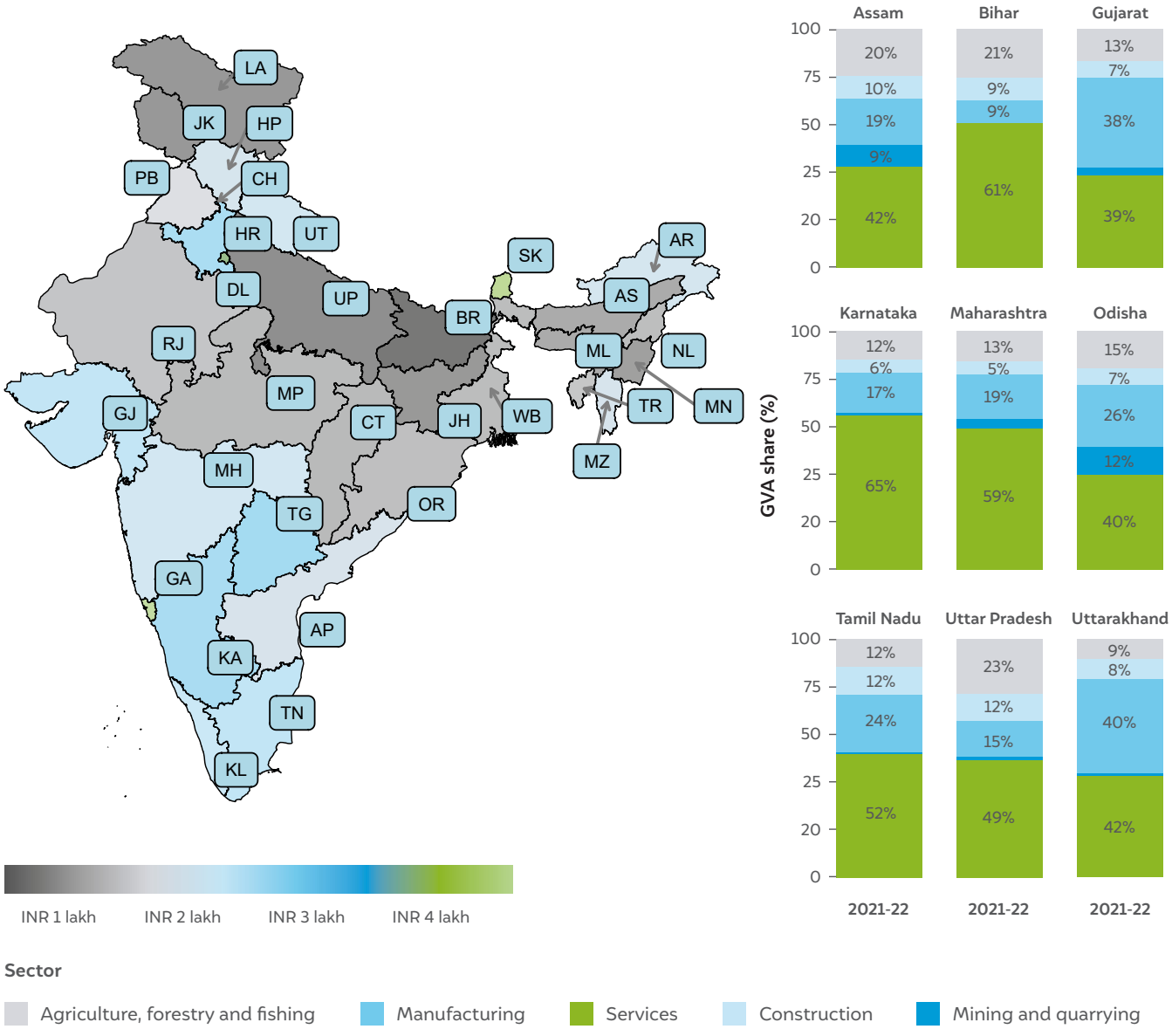
Given India's focus on global climate leadership, and its announcement of its net-zero goal, there has been growing interest amongst various Indian states to understand better what a net-zero future would look like for each of them.

The Indian states have diverse economic structures, socioeconomic profiles, population demographics, and natural resource availability. For example, Goa's per capita income is 3.2 times the national average, while Bihar's per capita income is a third of the national average (RBI 2022). Other examples presented in Figure 1 include Tamil Nadu, whose manufacturing sector contributes 24 per cent to its statewide gross value added (GVA), while for Bihar, manufacturing contributes only 9 per cent (RBI 2022). Meanwhile, the populous state of Uttar Pradesh depends on agriculture, with the sector contributing 23 per cent to the state's gross value add, while Kerala's economy is based on tourism, and agriculture only 11 per cent to the state GVA (RBI 2022). Thus, the decarbonisation pathway for each state must cater to its unique socioeconomic profile, demographics, and resource availability, even as it ensures jobs, growth, and sustainability.

Image: CEEW

The CEEW team in consultations with Shri Sanjeev Kumar, Principal Secretary, Forest and Environment Department at Ahmedabad, Gujarat, October 2024.

Figure 1 Per capita state GVA and structure of economy for selected states



Source: Authors' compilation

CEEW has been engaging with the states of Bihar, Gujarat, Maharashtra, Rajasthan, Tamil Nadu, and Uttarakhand to model long-term pathways and evaluate various aspects of the net-zero debate, including issues related to energy transitions, power markets, industrial decarbonisation, mobility, and climate risks. It aims to create a strategic vision for each state's long-term decarbonisation.

In this issue brief, we present CEEW's experiences working with various states to prepare a long-term development strategy for each of them through modelling-based analysis. To achieve this, we used the Global Change Analysis Model (GCAM), an integrated assessment model that helps to project possible scenarios into the future for states based on certain assumptions, to estimate their future energy requirements and carbon emissions. In this issue brief, we do not cover the modelling assessments for the states, but we look to shed light on what we have learned from working with them.

2. Key insights and learnings from state level engagements

The following section distils the key insights and learnings from our state-level long-term-modelling-based analyses and engagement.

2.1 Awareness at the state level

The first set of learnings pertains to the overall growing awareness that states have of the climate and decarbonisation discourse. It highlights aspects of the just transition that ensure that the benefits of decarbonisation will be made available to workers dependant on fossil-fuel-based sector. It also reveals a need to build state ecosystem capacities so that state departments, academia, civil society, and industries are made aware of decarbonisation strategies.

State-level environment departments are steadily becoming more familiar with the climate debate

One of the most interesting learnings from CEEW's work on state-level net-zero modelling has been the realisation that, traditionally, India's state environment and climate change departments have focused on forest and biodiversity conservation, wildlife protection, and ecosystem conservation, while state pollution control boards have focused mainly on issues related to local pollution, such as air and water pollution. Both the environment department and the pollution control board oversee environmental clearances and air and water pollution monitoring within the state – that is to say, these departments are primarily regulatory in nature.

On the subject of climate change, the most meaningful interface for the states has been the state action plan on climate change (SAPCC), a document mandated by the central Ministry of Environment, Forest, and Climate Change (MoEFCC). However, as discussions around climate change increase, so has the engagement of state environment departments. For example, Tamil Nadu launched the Tamil Nadu Green Climate Company, a special-purpose vehicle (SPV), to consolidate its efforts towards realising climate-smart development.

In terms of mitigation-related efforts, the announcement of the 2070 net-zero target in 2021 by India's prime minister (PM) has piqued tremendous interest across

Image: CEEW

The CEEW team in consultations with the Urban Development and Rural Development departments in Dehradun, Uttarakhand, May 2024.

India's states. In the last three years since the PM's announcement, many states have announced or shown interest in announcing state-specific net-zero targets (TNGCC and CEEW 2024; PTI 2024). This, to our understanding, has led to a proliferation of state-level think tanks, academics, and consulting organisations working with state environment departments to inform state-level actions for climate change mitigation. State governments are slowly and steadily becoming familiar with mitigation and adaptation processes, through inventory preparation, identification of emissions sources, and assessment of vulnerabilities, among many other aspects. They are also beginning to engage with other relevant state departments to mitigate climate change. Their role in implementing climate change mitigation actions will only become more important in the future, and the state climate change departments are gearing up for the same.

State governments are aware of the just transition debate, and this critical aspect should be included in the long-term transition plan for states

Indian states are very different in terms of their current economic status, future growth potential, and distribution of energy resources and energy production infrastructure. Some states have abundant coal resources, while others abound in solar or wind potential. The coal-rich eastern belt of India will find it hard to decarbonise in the long term, so ensuring a just transition for these states is critical. The literature on realising a just transition in India is growing and covers coal mining for livelihoods, and government revenues (from mining royalties and taxes) as well as a gender lens to just transition (Banerjee 2023; Chauhan and Swarnakar 2023; Bhattacharjee 2024; Anand and Narayanaswamy 2021) .

During the transition, while significant opportunities for solar PV-based electricity or green hydrogen production will be created and tapped, some states will continue to depend on fossil fuels and will find the transition arduous. While coal mining or coal-based power plants are obvious candidates for the just transition, our net-zero assessment in Bihar also pointed out the significant transformation the brick industry must make (Government of Bihar 2024). As far as the transition to a cleaner technology can be achieved without disrupting the existing industry dynamics; there would not be serious negative implications. However, if the nature of the brick industry changes due to decarbonisation, and a different kind of construction material starts being used, that would disrupt the industry, and concerns related to a just transition would become relevant.

Interestingly, our discussions revealed that many state-level officials are well aware of the challenges that transitioning to a net-zero future may pose. They realise that planning for a just transition is critical. Therefore, we need to include just transition aspects in the decarbonisation strategy that we prepare for various sectors within a state.

Focus on building capacity within the ecosystem, including civil society along government departments at the state level

The discussion above clarifies that climate change is beginning to take centre stage in state-level policy debates. While some individuals in state departments understand the far-reaching impacts of climate change, there is a need for more comprehensive systemic understanding of climate change mitigation and adaptation. There is, therefore, a need for continuous capacity building so that state players can take decisive climate action.

Local, national, and international civil society actors are well-positioned to play a critical role in bringing together ambitious visions and strategic opportunities for a state. However, while national and international civil society organisations may have the technical understanding and narrative-building skills to communicate an effective, tailor-made vision for the state, local civil society groups often have a limited understanding of climate change mitigation.

It is critical to build capacity in not just state government departments but also state-level civil society actors to create a healthy and continuous discourse between state departments and civil society. Ultimately, state departments will be crucial in achieving the state's vision and must be able to engage with national and international civil society organisations to bring together best practices and options to inform the state's climate and development vision.

> There is a need for a comprehensive understanding of climate change mitigation and adaptation among state actors.

2.2 Understanding motivations and building trust

While engaging with states to co-create a decarbonisation strategy, it is critical that we understand the motivations underlying the strategy. Only then will the engagement be fruitful. Moreover, understanding the motivation and ensuring sustained, structured engagement is key to building trust over time. This is essential for the vision to move from strategy to implementation.

The motivations and perspectives of state government departments constitute a critical starting point

The first step in creating a long-term decarbonisation vision for a state is understanding the motivation and perspective of various state departments, beyond just the environment and climate change departments. If the vision is limited to environmental concerns only, the state will not adopt it. There is a need to create a more holistic vision for the state that goes beyond environmental concerns. To create this vision, it is imperative to engage multiple departments – including industries, transport, agriculture, tourism, finance, and planning, among others. Which departments are involved will depend on the state and the importance of the various departments within a state's economic policy. This collective planning exercise will help create a shared vision that goes beyond simple decarbonisation. It will include all departments to enable an economic transformation of the state, and not just a green transition.

During such engagement, the state's specific priorities, challenges, and ambitions will come to light. Our experiences engaging with states showed that our modelling exercise focuses on energy and emissions, along with long-term visions and narratives – such as the criticality of the economic transformation. However, the state officials' focus is very often on the investments required, sources of finance for the policies that need to be implemented, potential for job creation in specific sectors, and land requirements. Aligning the research with the motivations of government officials is important. Communicating in their language and addressing their areas of interest help build their curiosity in the findings of the analyses.

Also, these interests vary from state to state. Some states will want to focus on growing their manufacturing, while others may be focused on their services sector, tourism, or agriculture. By understanding the motivations of various state departments, a vision for economic transformation can be co-created that the state can pursue as well.

Image: CEEW

The CEEW team in Jaipur, Rajasthan for consultations with the Department of Energy, July 2022.

Building trust through a structured engagement process is key

To build an effective economic transformation strategy, a relationship of trust must be established, so that there is a clear channel of communication between researchers, and various line departments – the state distribution companies (discoms) and generators, the state renewable energy agency, and its transport, industries, and agriculture departments, among others. But building trust needs perseverance, time, commitment, and continuity. One of the first things we need to build trust with state departments is to be present when they make a request. This means that we must travel regularly for discussions and brainstorming with the state departments.

Further, it is very important that we engage with other organisations working within the state, so as to better understand the state's context and learn from the work of others. These organisations could include research institutes, grassroots organisations, universities, academia, and industries. Just as in the visioning exercise, we must build trust across key departments, not just the state's environment and forest departments. For this, we need to organise separate meetings and discussions with the relevant departments. Local civil society as well as industry representatives have an important role to play in this process. In addition, getting the buy-in of senior bureaucrats is essential for building trust, ensuring smoother engagement, and later, implementing the strategy.

Communication and close engagement are indispensable to setting a state-level economic transition plan into motion. They are key levers of vision- and trust-building. Instead of having ad-hoc meetings and communication with state officials, who are often preoccupied with other priorities, we need to ensure structured engagement with them. Figure 2 outlines the process we followed at the state level.

Figure 2 Engagement with state-level governments

Source: Authors' analysis

At the first kick-off meeting, sharing a vision for decarbonisation as a means of development should be the central agenda. Especially for a country like India, development and ensuring a better quality of life for its people are fundamental. The kick-off meeting should ideally include senior bureaucrats from each state department. An early buy-in from the senior bureaucrats will ensure smooth interactions with state-level officials throughout the process. During the meeting, therefore, it is important to understand the priorities of the state and the areas where the state needs a significant policy push. The meeting should also result in appointing a nodal officer, with whom the research team will be in close contact.

Further, there is also a need for some myth-busting about decarbonisation. While states may be interested in portraying themselves as leaders in decarbonisation, it is important to explain the decarbonisation process to them and how hard it really is. Ambitious decarbonisation targets will have significant implications for fossil fuel use across sectors. Moreover, it is important to establish the limits of carbon sequestration in the land-use sector – it cannot act as a silver bullet, as a tree that has reached maturity can only offer very limited additional sequestration. After the kick-off meeting, data requests and assumptions should be shared with each department for their vetting and inputs.

Next, the first set of analyses should be prepared, and the research team should begin the consultation process. These consultations serve as sites for sharing preliminary findings, receiving and incorporating feedback from experts at the department, and reviewing whether any significant aspects may have been missed. For example, projections of future electricity demand and solar potential could be shared with state departments to understand their views and disagreements if any. Such interactions are critical for aligning numbers, narratives, and storylines. Moreover, field visits and ground truthing of key data points will provide a more realistic picture and build trust with department officials. The consultations are an iterative process, with modelling assumptions revisited and results updated based on comments and suggestions from state officials.

Once the state officials agree with the assumptions and results, the research team may prepare the final draft of the plan for submission to the government. A final meeting must ensure that the state's findings are

disseminated to key stakeholders and the media to reach the wider society. During the preparation and launch of the final report, we must highlight the novel aspects of the decarbonisation strategy and launch flagship initiatives to ensure participation from the larger society in the decarbonisation process.

2.3 Solving for data, renewable energy potential estimations, and accounting challenges

It is challenging to obtain granular data for such analyses and reliable estimates of renewable energy potential at the state level. Further, there will be various ways of accounting emissions which need a detailed look for a clearer picture of the state's emissions. But even with these existing challenges, it will be possible to identify some areas where the flow of information needs to be strengthened and where reassessments may be required.

Energy demand and supply data at the sub-sector and technology levels are sparse, but can be addressed

As is famously said, the past is not often a good predictor of the future. At the same time, both historical and current data is critical to understand the current state of affairs, how progress has happened in the past, and what is the baseline scenario. For example, it is critical to know if the power sector is the largest emitter in a state or if is it the industry sector. Also, if the energy mix in the industry sector is dominated by electricity or fossil fuels and whether the manufacturing sector or the service sector is critical to the state's economy. Base-year data is also critical for setting up any quantitative model.

Another data-related challenge at the state level is that of granularity. Our experience with state-level modelling shows that while data at higher level is often readily available (for example, on the electricity consumption of residential buildings), getting granular data for sub-sector or technology-specific level is a challenge, for example, on the electricity consumption of air conditioners in residential buildings. However, these gaps can often be addressed by making reasonable assumptions. Often, state data shows a mismatch with the data for that state reported at the national level. When the data available in the national accounts does not match the state's accounting, we need to recalibrate

> **Data-related challenges at the state level are that of granularity but this can be solved.**

the base-year data using the state numbers. In both these cases, however, there are ways to overcome the data challenge – for instance, careful selection and vetting of assumptions, with support from state department officials, can help resolve any conflicts. This is why it is important to share with stakeholders both the final data and the assumptions underlying them, so that they can make their own independent assessments to judge the quality of the data.

Renewable energy potentials at the state level are underestimated and must be reassessed

Assuming that 3 per cent of wastelands are available for establishing solar installations, the estimated solar potential of India is 748 GW (MNRE 2024a). Similarly, the wind potential at a height of 120 m is 695 GW, and at 150 m, 1164 GW (MNRE 2024b). While these are rough estimates, research based on national and international assessments suggests that the solar potential may actually be an order of magnitude higher within the state (Deshmukh et al. 2019; Lu et al. 2020). A CEEW analysis estimates that rooftop solar alone has a technical potential of 637 GW (Zachariah, Tyagi, and Kuldeep 2023).

Renewable energy has a critical role to play in our trajectory towards a net-zero goal as electricity consumption is much higher than in a reference scenario, while end-use sectors work to electrify and decarbonise (Chaturvedi and Malyan 2024). The power sector will play a critical role in long-term decarbonisation, implying that renewable energy generation must be ramped up significantly.

Given the limited potentials stated by the Ministry of New and Renewable Energy (MNRE), some states have overlooked in their long-term planning the scope to tap into higher solar and wind potentials within their boundaries. The MNRE and state governments must jointly reassess each state's renewable energy potential. If indeed the potential for solar and wind energy is as limited as has been described, it has profound implications for India's long-term strategy and pathways to a net-zero future.

State-level assessments require a reconsideration of emissions accounting practices

Two interesting questions came up during CEEW's state-level net-zero discussions. First, should the emissions of centrally owned power plants be accounted for as state-level emissions? Secondly, if a state is importing coal-based electricity but has no coal-based power plants within its boundaries, should that state's power-sector emissions be considered zero or not? The answer to both these critical questions lies in the emissions accounting paradigm adopted by the state.

The Intergovernmental Panel on Climate Change (IPCC) uses a methodology that accounts for emissions at source. This is also the approach used in international emissions inventory reporting to the United Nations Framework Convention on Climate Change (UNFCCC) (Franzen and Mader 2018). This approach is well suited for application at the level of countries. However, interesting implications emerge when this approach is applied to states within a country.

As per this production-based accounting approach, if Odisha generates electricity from a thermal power plant within its administrative boundary and sells that power to Sikkim, the emissions are in Odisha's account and not in Sikkim's. Accordingly, emissions from thermal power plants operated by the National Thermal Power Corporation (NTPC) – India's leading public-sector undertaking, with a 76 GW power-generating capacity, of which 70 per cent is from thermal power plants (NTPC 2024) – are allotted to the accounts of states where these power plants are situated, not where the power is used.

Our state-level modelling analysis showed that many states are buying coal-based electricity, as they have very limited local installed capacity. In the production-based accounting approach, the emissions from the coal-based electricity they consume are not accounted for. As per our assessment of sub-national emissions accounting, this approach is only partially correct at best and it fails to incentivise states to minimise their use of purchased coal-based power. A possible solution is to account for 'scope 2' emissions for each state, or the embedded emissions from imported coal-based electricity, and report this along with traditional production-based emissions. This will give a holistic picture as well as send the right message to the states about their progress towards their net-zero goals.

2.4 Communicating modelling results and creating a positive narrative of the economic transformation

Decarbonisation is very often seen as a challenge, but it can also be an opportunity for economic transformation, offering a new paradigm of growth across sectors such as renewable energy, electric vehicles, semiconductors, and critical minerals. Further, communicating modelling results as insights is key to better understanding the potential future trajectory of a state. This helps state governments visualise their long-term future, and with time, this long-term thinking becomes institutionalised.

Communication of modelling results should focus on insights, not just numbers

One of the biggest challenges for teams working on state-level modelling is communication. As noted earlier, modelling results for the future are hard to communicate. They are often viewed as predictions, which they are not. They are scenarios based on a given set of assumptions, and the modelling results can change if the underlying assumptions are changed. Long-term IAM modelling also captures the non-linearity of growth. For example, high growth in incomes may suddenly lead to higher ownership of vehicles, air conditioners and manifold increase in electricity consumption. This non-linearity is difficult to grasp, as historical behaviours may have been very different and state officials are used to only decadal planning.

The only way to overcome such communication barriers is consistent engagement. Once the state-level stakeholders get used to seeing results from alternative scenarios and, more importantly, discuss the emerging insights several times over, we can expect that they will adapt to long-term thinking to scenario-based insights and institutionalise this approach in the larger state-level ecosystem. Such engagement should not be confined to the 'project' period alone, but should be undertaken continuously, building a coalition of like-minded organisations that are instrumental in informing policies through long-term scenario planning.

The narrative of economic transformation is much more powerful than the narrative of co-benefits

Our modelling analysis at the state level has shown that the transition to a net-zero future must involve various sectors. This will open up many opportunities to aid the economic growth and development of each state, as briefly discussed in Section 2.2.1. There will be structural shifts in how electricity is produced, how industrial goods are manufactured, and how people and goods move from one point to another, among other things.

States such as Tamil Nadu and Gujarat are investing in green hydrogen production for exports (Nair 2024; Business Standard 2023). Bihar is investing in ethanol production for a biofuel-based economy (Government of Bihar 2021, Government of Bihar 2023). Rajasthan is gearing up to become a powerhouse for solar electricity generation in the country (Government of Rajasthan 2023). All these will lead to manufacturing opportunities in solar panels, batteries, and electric vehicles, as well as other economic opportunities.

Hence, the discourse around climate change mitigation is not just an environmental debate. Environmental debates are critical for the country, but most environmental movements mainly focus on specific local areas. The climate change mitigation debate is an economy-wide discourse. Significant changes are unfolding in global energy markets that will impact India and its states. It is imperative that stakeholders start framing this discussion as one of economic transformation and start communicating the same to various state departments. Our experience discussing the co-benefits narrative (for example, health benefits from the reduction in local air pollution) as well as the economic transformation narrative for net-zero initiatives at the state level shows that the latter is much more powerful. It forces decision-makers to take notice of the paradigm shift that climate change mitigation will bring.

The goal of modelling should be to move from an incremental approach to institutionalising long-term thinking for policymaking

Visions are critical and actors cohere around visions. Long-term net zero plans based on stakeholder-driven modelling are critical for this purpose. Since India's independence, the five-year plans have been the backbone of the country's strategy and planning exercises. However, after the 13th five year plan, the five-year planning exercises were halted (MOSPI 2018). Since then, the government has been communicating long-term goals, e.g. the goal of a 2047 Viksit Bharat (A Developed India by 2047, the 100th year of independence). On similar lines, to meet India's net zero 2070 target almost 5 decades away, there is a need for long-term thinking, strategizing and planning. If India needs to meet its target, its states will need to plan for the long term.

While progress and change on the ground are and will always be incremental (be it in renewable energy deployment or electric vehicle charging infrastructure), we need a shift in mindset from incremental thinking to long-term envisioning. For a net-zero transformation, a paradigm shift will be required across sectors as well as in mindsets. For example, renewable energy requirements will be much higher in net-zero scenarios, as transport, industries, and buildings decarbonise, and this implies that there will need to be a deep reform in the way the power sector operates in the future (Chaturvedi 2021).

Thus, the goal of long-term modelling exercises at the state level should be to foster conversations within a long-term vision framework that forces decision-makers to think and respond to such an approach. Modelling is not just about providing numbers; it is a process of creating space for discussions around long-term targets and the reforms needed to achieve them. Such a process would bring a significant change in the approach of state-level decision-makers as well as operational staff and would create a conducive ecosystem to move towards the net-zero goal.

2.5 Governance and monitoring are critical for implementation of decarbonisation strategies

Decarbonisation will take decades, and robust governance and monitoring are required to ensure that these strategies materialise. Both the centre and the states will have to play complementary roles so that continuous efforts are made to decarbonise, and support is provided for efforts towards this goal.

> **Long-term modelling helps state stakeholders to visualise possible futures.**

A governance structure with representation from all departments is crucial for success

Decarbonisation is a long-term process. It requires a robust governance framework and integration into the existing structure of various state departments. As a union of states, India makes some decisions at the state level and others at the national level. While working with state governments, we built an understanding of what state governments can push and what national governments need to take care of. For example, state governments can push for solar and renewable energy deployment, but deployment of large thermal power plants are decided by NTPC at the central level. Similarly, the central government is implementing the Product Linked Incentive (PLI) scheme, but state governments can give additional preferential treatment to green industries in their respective industrial policies. Many decisions towards the decarbonisation of a state will, therefore, need to be made in consultation with the national government.

For decarbonisation to succeed, we need a dedicated, institutionalised structure of governance. It needs to be headed by the senior decision-makers of the state and must have representation across departments. This will ensure a coherent decision-making process overall. In particular, involving the state planning commission and the finance department could provide the strongest leverage for action. The governance structure must also ensure regular meetings of the members to better align decision-making across departments. Moreover, monitoring progress against the targets provided in the transition plan is critical for taking corrective action when required.

While the benefits of implementing some actions towards decarbonisation are easily visible, others may need more careful monitoring. For example, the deployment of renewable energy and electric vehicle charging infrastructure is visible, but improvements in energy efficiency may not be visible upfront. Therefore, strong governance must be put in place to ensure regular monitoring of progress across sectors and reviews of policy targets and instruments to deliver on the state's decarbonisation agenda.

Net-zero strategies and plans are just the beginning – a system for regular measurement, reporting, and verification (MRV) has to be created and owned by the environment departments

Many states have created, and many others are in the process of creating, while others are contemplating creating long-term-modelling-based net-zero strategies and sectoral decarbonisation action plans. This is a great starting point. However, just because there is a plan does not mean that it will be implemented. A progress monitoring and review system is critical so that the state is informed regarding its progress towards the targets proposed in the plan, once various departments accept it. While various departments, like the power and mobility-related departments, are also likely to be tracking progress on their own, information from various departments must be pulled together and collated to provide a fuller picture of the progress on emissions-related variables. In our assessment, state environment departments are best placed and most suited for this task, as reporting emissions inventories and emissions mitigation are under their purview. An MRV system has to be created for the states to regularly assess progress across time, take corrective actions as needed, as well as communicate their progress and challenges to the larger set of local, national, and international stakeholders.

> **The prepared net-zero transition plan requires a robust governance framework and integration into the existing structure of various state departments for its successful implementation.**

3. Conclusion

Long-term modelling is a useful tool that can be used to create spaces for informed and meaningful deliberations at the state level to inform long-term climate change mitigation strategies. Each state is likely to develop its own unique decarbonisation strategy, which must be tailor-made in consultation with state governments and their respective line departments.

Even though these plans are unique to each state, the strongest common thread will be that the decarbonisation strategy is essentially an economic transformation strategy that will ensure jobs, growth, and sustainability for each state. For state stakeholders to buy in, the close link between decarbonisation and opportunities for economic transformation must be established. Only then will state actors and governments be able to prioritise decarbonisation. Otherwise, decarbonisation will be done in silos, in an ad-hoc manner, and treated as a burden upon growth.

Therefore, early vision-sharing with state stakeholders and continued engagement with them throughout the planning process will help build trust and acceptance of the transition strategy to net zero. While several challenges exist in engaging with states, it is an opportunity for modelling-based scientific research to be translated into policy and, eventually, action.

Image: CEEW

The CEEW team with Smt. Supriya Sahu, former Additional Chief Secretary for the Department of Environment, Climate Change, Tamil Nadu in Chennai at the launch of the study *Tamil Nadu's Greenhouse Gas Inventory and Pathways for Net-Zero Transition*, February 2024.

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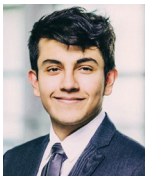

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