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SHAKTI 10

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10 of ITNANH2



A DECADE IN CLEAN ENERGY AND
CLIMATE CHANGE MITIGATION

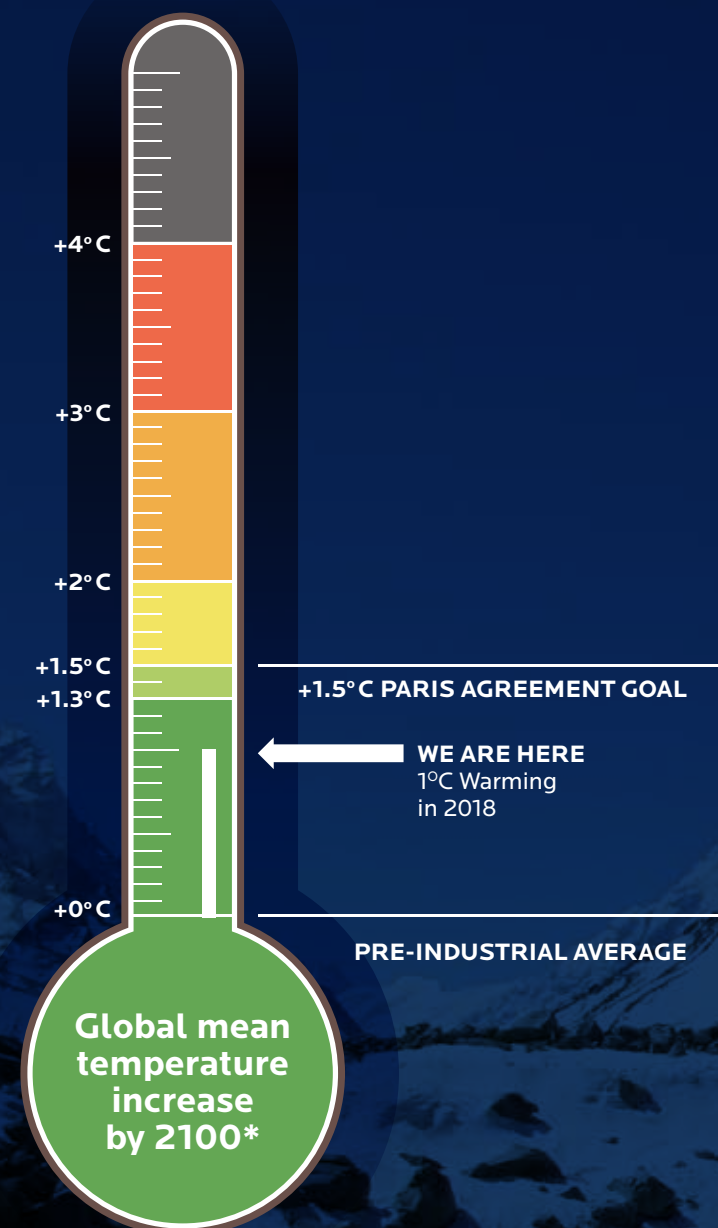


Energy and climate-related ambitions in India are scaling new heights as the government emerges as a global leader in the fight against climate change

The landmark Paris Agreement represents a collective global ambition to put energy and climate action on a transformational path.

India expects to play a key role in these efforts and is making steady progress in implementing new energy efficiency technologies; while also driving a large-scale transition to renewable energy and electric mobility. Many forward-looking businesses are recognizing their role in addressing climate change.

Shakti works within this evolving energy landscape to drive policy solutions for clean and efficient energy by aligning stakeholders, moving agendas forward and enabling change.



Even as scientists debate the rate of recession of the Gangotri glacier (pictured), the second longest of the more than 10,000 glaciers in the Indian Himalayas, lack of coordinated research and mitigation efforts could spell disaster for the millions dependent on the waters of Ganga river downstream

*Climate Action Tracker - CAT warming projections
Global temperature increase by 2100-December 2019 Update



10 years of creating an
ENABLING ENVIRONMENT
for clean energy and
low-carbon growth



Shakti's work in clean energy, sustainable cities, clean energy finance, energy efficiency and low-carbon development stitches together the big picture with national and global climate goals required for progressive policy developments



About Us

Shakti was established in 2009 to support India's sustainable development and clean energy objectives and this work was taken forward by partners who implemented the projects.

We seek to facilitate India's transition to a cleaner energy future by aiding the design and implementation of policies that promote clean power, energy efficiency, sustainable urban transport and climate action clean energy finance.

Advancing smart energy policies will be key to meeting our defining challenge: how to provide millions of Indians with reliable, affordable, secure access to

energy in a sustainable manner. The energy choices that India makes today will be of profound importance for our future. Meaningful policy action on India's energy challenges will strengthen national energy security, support development and preserve our environment.

We work collaboratively with policy makers, civil society, industry think tanks and academia, and catalyze transformative solutions to meet India's energy needs in clean and sustainable ways.

Our Vision

A clean and secure energy future

Our Approach

We believe robust energy policy frameworks are necessary for large-scale, transformative change.

We bring together experts from government, business, civil society and academia to craft robust energy policies.

We evaluate the results of our own work rigorously, measuring success using clear metrics based on quantifiable clean energy contributions.

We work through cross-sectoral strategies with the goal of achieving synergistic results and broad impact.



Our Programs



Clean Power

Our work seeks to energise the clean power transition across the generation, transmission and demand value chain. We do this by encouraging greater intergration of renewable energy in India's power mix through knowledge inputs, advancing business models and guiding the transition at national and sub-national levels.



Climate Policy & Air Quality

Our climate policy program supports efforts to transition India towards a low-carbon pathway to help mitigate climate change. We aim to foster sustained dialogue and engagement at the sub-national and national levels on climate and energy issues while working to strengthen greenhouse gas management capacities for informed policymaking. Our efforts have helped inform air quality monitoring in the country, assess mitigation options and advance evidence-based research, stakeholder capacity building and outreach.



Energy Efficiency

Our work with stakeholders in the govern-ment, academia, civil society, and industries aims to inform the design and implementa-tion of policies that lead to low-carbon growth in three sectors: Industry, buildings and cooling.



Clean Energy Finance

Clean energy finance emerged as cornerstone of the Paris Agreement with efforts to tackle climate change being stepped up to ambitious levels. Public funding alone is insufficient and private investment has so far been limited. While strong and effectively implemented policies can grow clean energy in India, financing solutions are critical to making these policies work. We work to enhance the investment required for meeting India's clean energy targets as well as to find solutions for catalyzing clean investment instruments.



Sustainable Transportation

Our work on sustainable transportation focuses on reducing emissions from land-based transport, facilitating interventions in the transport sector by informing the design and implementation of better transportation policies in cities, improved vehicle and fuel efficiency and energy efficient freight.



Electric Mobility

Our work aims for complete decarbonization of the transport sector in India by 2050 by accelerating the electrification of all vehicle segments. We work on facilitating policies supportive of manufacturing, creating mechanisms to incentivise adoption, supporting charging infrastructure roll-out and creating awareness among stakeholders.

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This volume was conceptualised and compiled by
Ms. Gayatri Ramanathan (Associate Director) on behalf of SSEF.

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Foreword

JAMSHYD N. GODREJ
Board Chair | Shakti Sustainable Energy Foundation

The last decade has seen India assume a leadership role in transitioning to cleaner and more efficient energy use. Our Nationally Determined Contributions have set us on a path towards lowering our carbon footprints without compromising on development imperatives.

Shakti has been at the forefront of India's progress to date, contributing technical expertise, engaging with policy makers to advance clean energy solutions, generating awareness, ambition and action on climate change mitigation. Over the past decade, Shakti has developed an approach relevant to India's climate needs, established the credibility of its work, and provided a platform for all stakeholders where they can leverage the knowledge and relationships that we have fostered.

Originally set up as a small team in 2009 in New Delhi, with a deep understanding of where a difference could be made, Shakti has matured with a portfolio of interventions to address the country's low-carbon development challenges. Our work now straddles six distinct portfolios, each of which works towards developing sustainable climate mitigation strategies.

In the course of our work, India's renewable energy potential was assessed and greatly upscaled, laying the basis for increased policy ambition. A demand aggregation model for LED bulbs kicked off a successful nationwide program on LEDs, with the business model being adopted for other energy efficient products.

We have made tangible progress on key initiatives such as rolling out higher fuel quality standards, electric mobility, developing a national cooling efficiency policy and starting work on implementing power plants emission standards. We have also invested in high impact opportunities such as the introduction of sustainability norms into the national housing scheme and establishing the country's first low-cost air quality sensor networks.

When we started, the landscape of climate and clean energy focused think tanks was sparse. Shakti worked with the small start-ups in the civil society space, providing them support to grow this nascent eco-system. To seed the field, we established the first-of-its-kind clean energy incubator for non-profits.

Through this volume, Shakti has documented its journey of the past decade and shares its insights with sector stakeholders.

Much more remains to be done in order to keep India on the path of sustainable development. I am confident that Shakti will continue to play an important and leading role in this endeavour. I would like to extend my thanks to Shakti for its valuable contributions towards energy and climate action in India. I also thank all our stakeholders, both internal and external, grantees and collaborators, International and local foundations who have contributed resources to our success and, last but not least, employees, past and present, for their support and guidance.

Over the past decade, Shakti has developed a deep understanding of where a difference can be made



Shakti's early years were focused on laying the building blocks for long-term policy options in favour of a low-carbon pathway for India's burgeoning energy and development needs

The climate field in India has grown quickly in the span of a decade to deliver results belied by its size

Seeding Shakti

LEONARDO LACERDA
Environment Programme Director, Oak Foundation

In 2009, a combination of visionary Indian leaders and philanthropists, led by Jamshyd Godrej, and a few of the world's leading climate philanthropists joined forces to establish Shakti Sustainable Energy Foundation, to support India's climate and energy experts to help implement and further improve India's first National Climate Action Plan (2008). Oak Foundation is proud to have been, along with Hewlett Foundation and Packard Foundation, one of the founding philanthropic investors who helped conceive Shakti as an organization that would provide technical support to Government of India in the area of climate policy, while supporting the growth and involvement of civil society in this field.

India's current position and policies related to domestic climate action were starting to take shape then, with energy efficiency standards and a major national level policy thrust for solar energy announced by the government. This was a year when the world was evaluating the implications of the Copenhagen Accord, all eyes were on China and the EU, and on ways to revive the multilateral and democratic spirit of the global climate negotiations. In such an environment, there was little international interest in India's nascent domestic climate policies, often overshadowed by its rhetoric on climate. However, we saw tremendous potential in these policy signals. We decided to co-invest in creating a vibrant and diverse civil society field dedicated to climate and energy that would back the country's growing ambition to be a global climate leader. We saw Shakti at the helm of this, steering the direction of this field. To date, we remain a staunch supporter of Shakti and partner to a fast-growing ecosystem of national and sub-national not-for profit organizations that are now recognized globally for their contributions. Much of this would not have been possible without Shakti and its incredibly visionary and capable leadership.

Shakti's early years were focused on laying the building blocks for long-term policy options in favour of a low carbon pathway for India's burgeoning energy and development needs. The organization stood ready to support multiple policy reforms for utilities and harnessed opportunities to build efficiency of appliances and buildings, improve industry productivity and deploy renewable energy at scale. Shakti also stepped fully into the delicate role of nurturing a growing ecosystem of climate and energy organizations, while supporting an insatiable demand for research and feasibility studies from the government which was aiming higher on its climate ambition every year.

Within a few years, Shakti was able to use India's economic resurgence to make a case for deploying clean energy at unprecedented scale and help

realize India's efforts on multiple fronts including a massive energy efficiency initiative, that made India a world leader in LEDs adoption, as well as explore India's wind power potential.

In tandem with Shakti's growing support to national organizations on strategic contributions in four key areas - clean energy, energy efficiency, transport and climate policy - Oak Foundation was able to provide longer-term institutional support to some of India's leading climate think tanks. This includes Prayas Energy Group, Centre for Science, Technology and Energy Policy, Centre for Policy Research and many others. This association between Shakti's short-term, project-related funding and Oak's longer-term core organizational support enabled these partner organizations to explore newer areas for research and action. With Shakti's continual, indefatigable support the climate field in India grew and expanded within a short span of time to deliver much beyond its means.

Shakti has much to be proud of. Today India is one of the first nations in the world to have a national cooling action plan, one of the world's fastest growing renewable energy programme, a rapidly scaling up electric vehicles sector, stringent fuel quality and vehicle fuel efficiency standards and thermal power plant emissions norms. India's climate performance was ranked in the top 10 countries last year, and Shakti has a big part to play in this achievement.

India still faces serious risks from air pollution, which threatens the lives of millions in the country. There is also a concern that without proper reforms, the country may lose out its competitiveness on the renewables market and this might slow down overall deployment. In the coming years, we will be working with Shakti to find best ways to improve air quality, electrify mass transit and freight movement, improve cooling efficiency and decarbonize industry for the future.

The world today faces an enormous task of changing its developmental course in record time. We must re-think growth and distribution of wealth. Societies need to prioritize building resilience and eliminate fossil fuels from our energy mix in the next three decades. As we celebrate Shakti's 10th anniversary and congratulate its present and past staff, we wish it well in its effort to cultivate a vibrant civil society in India, to analyze and synthesize key evidence needed for decarbonization, and to encourage new leadership to find equitable climate solutions.

There is concern that without proper reforms, the country may lose out its competitiveness on the renewables market

Towards a Low-Carbon, Climate-Resilient Future

ANSHU BHARDWAJ

CEO, Shakti Sustainable Energy Foundation

In the past decade, Shakti Sustainable Energy Foundation has built a niche for itself, nurturing the clean energy and climate change mitigation civil society ecosystem in India. Our work spans the spectrum from supporting policy design and implementation to strategic convenings towards building capacity among a variety of stakeholders

Shakti will continue to look beyond the horizon to help mitigate the impact of climate change on Indian economy and society

Shakti Sustainable Energy Foundation is a unique civil society organization working at the confluence of government, civil society, businesses and academia, in crafting transformative solutions for India's clean energy and environment needs. As a system integrator, Shakti works with various partners, spread across the country, to facilitate this transition to a clean energy future.

Shakti's work enables policy design and implementation at national, sub-national levels. Our work involves working with partners to generate credible knowledge through research and then work closely with policymakers and other key stakeholders on implementation. Over the last decade, Shakti has made important policy contributions in sectors such as energy access, energy efficiency, renewables, electric mobility and air pollution.

India remains key to the global effort on climate change mitigation as its economic growth will impact global climate trajectory. It also is the most vulnerable to climate change, which can negatively impact the country's GDP growth. Hence, Shakti's work remains vital in ensuring a green future for India.

Shakti has been actively involved in supporting and informing various interventions such as the National Mission for Enhanced Energy Efficiency, National Solar Mission, National Mission on Sustainable Habitat and Draft Regulations for Off-grid projects. Shakti contributed significantly to the design and implementation of the Perform, Achieve and Trade (PAT) scheme, one of the largest industrial energy efficiency schemes in the world. We championed the cause of utilities and harnessed opportunities to improve the efficiency of appliances and buildings and enabled the deployment of renewable energy at scale. Shakti was also the first to advocate the use of innovative low-cost sensors to track air quality as early as 2016. Over the years Shakti has partnered with over 50 civil society organizations, non-governmental organizations, consultants and academic institutions, in over 500 projects.

Shakti was initially set up as a regional foundation of Climate Works Foundation in 2009. Seema Paul, our founding CEO, laid the foundations for Shakti to grow as a robust organization on a path that we continue to tread. Krishan Dhawan, who followed her and helmed Shakti for the next seven years, was a visionary leader who led from the front on the many big and relevant issues that Shakti has tackled. Under his leadership, Shakti provided knowledge support to our country's major policy initiatives in clean power, transport and industry. He developed a unique convening power, bringing together policymakers, think tanks, funders and businesses to discuss challenges and opportunities. He leadership, Shakti took a deep dive

Building blocks for a low-carbon future must include engaging with businesses and vulnerable and marginalized communities alike, to factor in climate risk across the socio-economic spectrum

into the sub-national level work on sustainable transport, GHG accounting and several innovative financing solutions for sustainability initiatives. Krishan was ably assisted by a passionate and resourceful team that developed the program verticals to align with national policy priorities. Shakti has been fortunate to have on its board of directors, philanthropists, climate professionals and economists of note, Mr. Jamshyd Godrej, Ms. Meher Pudumjee, Ms Naina Lal Kidwai, Mr. Nitin Desai, Mr. Suman Bery, Dr. Rajiv Lall and Dr. Harish Hande. I am also grateful to Mr Ramesh Kymal, Motushi Sengupta and Arvind Mahajan, advisors to the board, for their invaluable and timely guidance. I would also like to express my deepest gratitude to Shri Suresh Prabhakar Prabhu, Member of Parliament, and one of the founders of Shakti.

Along the way, the team also grew the network of funders that work with Shakti to create an enabling environment for climate mitigation work in India. We are deeply grateful to these donors including the Pisces, Bloomberg, MacArthur, IKEA, Good Energies and Rockefeller foundations, SDC and CIFF, for the continued confidence they have reposed in Shakti. Among the domestic philanthropies, we would like to express our deep gratitude to RDA Holdings, Pirojsha Godrej Foundation and Gamesa for their unstinting support.

As we move forward into the next decade, Shakti will continue to work for India to meet its development goals on a sustainable, low-carbon pathway. India has an enormous developmental agenda, which involves lifting millions out of poverty and providing quality of life to all. Equally, it is important to ensure that economic growth does not come with high environmental penalty. We

must prioritize making our cities live-able, the air breathable and our water potable. Fortunately, the rapid decline in the cost clean energy technologies provides an opportunity to achieve the developmental agenda in an environmentally sustainable manner.

The path to a low-carbon future must include engaging with businesses, and vulnerable and marginalized communities alike. As a nation, we must factor in climate risk across the socio-economic spectrum and work towards mitigating these risks equally for all. At Shakti, we will continue to focus on risk mitigation by building networks among Indian philanthropists to mitigate and adapt to climate change impacts and lead India's transition to clean energy and spearhead climate action towards climate resilience.

I sincerely thank my Shakti colleagues, funders, partner organizations and policy stakeholders for their faith and support in the last ten years. We look forward to working closely in the years ahead.

The Changing Climate Narrative in India

NITIN DESAI

Economist and Director, Shakti Sustainable Energy Foundation

The climate change narrative can be said to have begun when scientists started speculating about the appearance and disappearance of ice-ages and related changes in the average temperature of the earth changes. By the mid-eighties, when evidence of human induced temperature impacts was more evident, the narrative started to focus also on the policy options for mitigation of climate change and adaptation to the change, which was inevitable. The narrative moved to securing commitments for action and burden sharing when it was clear that the time had come to look beyond analyzing options.

The climate narrative in India has followed this sequence, albeit with a lag relative to the global debate. Atmospheric scientists in India were focused more on weather predictability issues, particularly with regard to the impact of the monsoon. Their engagement in the study of longer-term changes in climate came later in response to the emergence of global scientific processes like the Inter-governmental Panel on Climate Change (IPCC), though there were some pioneers like Dr. A. P. Mitra who headed the National Physical Laboratory (NPL), and later the Council of Scientific and Industrial Research (CSIR). He wrote a Nehru fellowship report on *The Changing Atmosphere: Future Trends and Options for India* in the late seventies. Today Indian scientists are more fully engaged in the long-term issues in climate science and the IPCC was headed by an Indian, Dr. R. K. Pachauri from 2012 to 2015 and many Indian scientists have been involved in its work.

The shift to a responsibility narrative and the global discussion on policy options emerged when the reality of climate change and the human impact on it became more widely accepted. It took place in the proceedings of the

UN negotiating process to agree on a Framework Convention on Climate Change (UNFCCC), which began in 1990 and culminated in a convention opened for signature at the Rio Earth Summit in June 1992. Initially, this dialogue focused more on better understanding and non-binding aspirational goals rather than any firm commitment to action. This changed in 1995 when the Berlin Mandate agreed at the UNFCCC-COP authorized the negotiation of firm

mitigation commitments by the industrialized countries (essentially the OECD and the former Comintern States).

In some ways the developing countries were peripheral to the mainstream of the negotiations, which remained a battle between Europe and the USA and between the climate sceptics and those who were convinced about the reality of human induced climate change. The main G-77 concern

Scientists in India began to focus on the longer-term changes in climate in response to the emergence of global processes such as the Inter-governmental Panel on Climate Change. The shift to a responsibility narrative and global discussion on policy options emerged when the reality of climate change and its human impact became more widely accepted

In 1990, developing countries accounted for 13 per cent of CO₂ emissions and developed countries for the balance. By 2017, their share had increased to 29 per cent



was to get the developed countries to recognize their historical culpability and primary responsibility. This was reflected in the principle of “common but differentiated responsibility” which has become absolutely central to the negotiating stance of China, India and the other large emerging economies. The Berlin Mandate also recognized “the fact that the largest share of historical and current global emissions of greenhouse gases has originated in developed countries, that the per capita emissions in developing countries are still relatively low and that the share of global emissions originating in developing countries will grow to meet their social and development needs”, so that developing countries were not part of the Kyoto Protocol.

Developing countries were brought into the process through the Clean Development Mechanism (CDM) that allowed the industrialized countries, which took on obligations, to buy carbon credits from entities in developing countries that undertook carbon mitigation measures. A market for carbon credits emerged and a commercial dimension entered the climate narrative. One important consequence of CDM was that it made energy intensive industrial enterprises in developing countries, particularly in China and India which were major suppliers of carbon credits in the CDM, more focused on energy saving.

On the basis of the promises made as part of the Paris Agreement, we are looking at a temperature increase of 3.2°C

The situation changed as we entered the new millennium. In 1990, developing countries accounted for 13 per cent of CO₂ emissions and developed countries for the balance. By 2017, their share had increased to 29 per cent. At the country level the big change was because of China's rapid growth and coal dependence. Moreover, countries like China and India were seen as serious competitors in the global market. Hence, the developed countries started to press for agreements that would bring developing countries into the mitigation commitment framework. This began in UNFCCC-COP at Bali in 2007 and culminated in the Paris Agreement in 2015.

The Paris Agreement marks two crucial shifts in the climate responsibility narrative - a shift from top-down negotiated commitments to bottom-up commitments, with each country pledging actions aimed at contributing to the agreed goal of containing likely temperature increase to 2 degree celsius and an aspirational goal of

keeping it below 1.5 degree celsius as well as the virtual elimination of any distinction between developed and developing countries in the pledging of commitments.

India responded to this change in orientation by trying to meet it halfway and yet trying to uphold the principle of “common but differentiated responsibilities”. At the 33rd G8 Summit at Heiligendamm in June 2007 prime minister Manmohan Singh announced that India would not exceed developed country per capita emissions at all times. Moving beyond this at the UNFCCC-COP in Copenhagen in December 2009, India announced that it would reduce its carbon intensity by 20-25 per cent relative to 2005 by 2025.

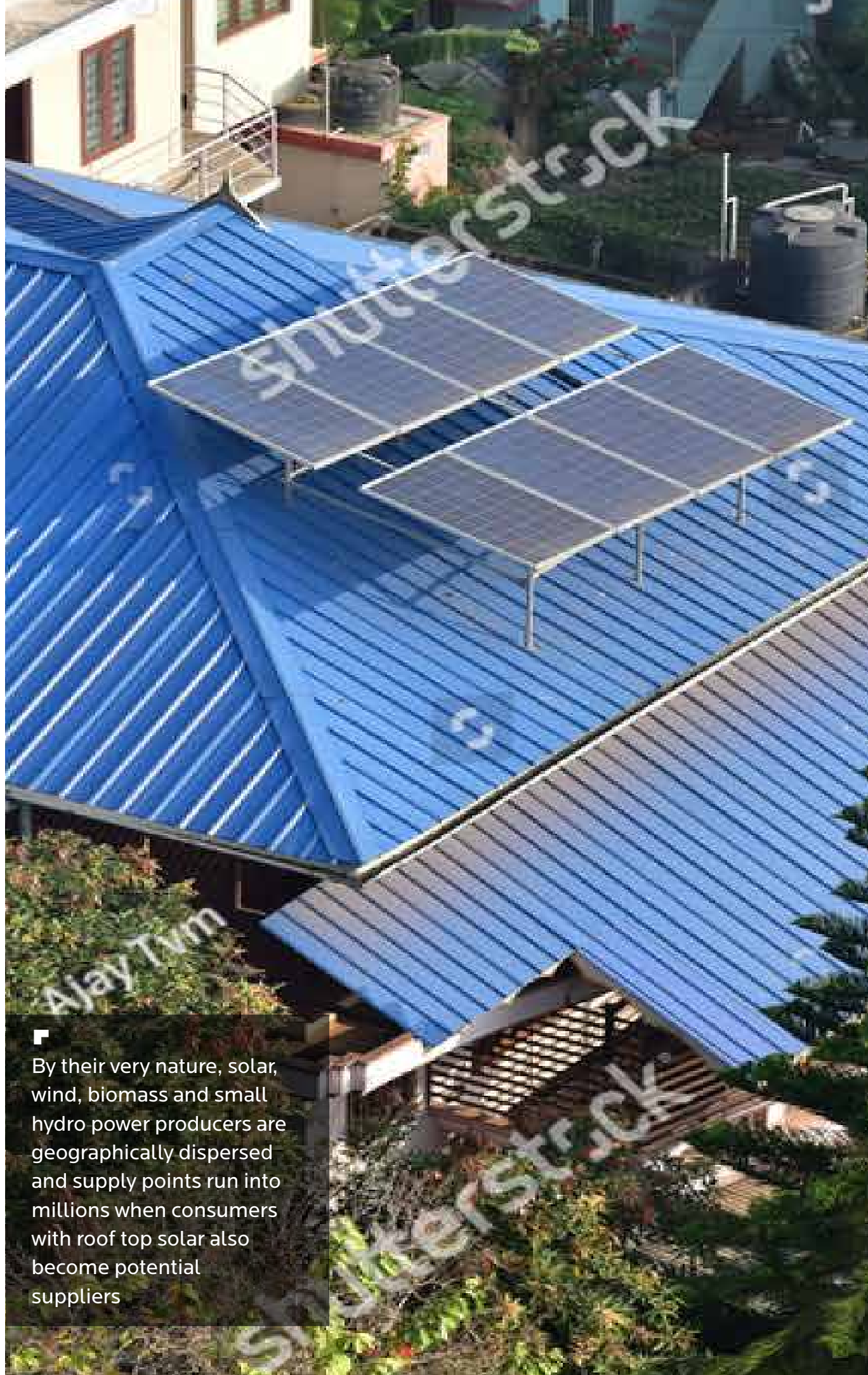
In June 2008, prime minister Manmohan Singh released the long-awaited National Action Plan on Climate Change (NAPCC). The statement of principles at the beginning of the NAPCC modulates growth and poverty reduction objectives by speaking of achieving “national growth objectives through qualitative changes in direction that enhances ecological sustainability, leading to further mitigation of greenhouse gases. The NAPCC is organized around eight

missions dealing with solar energy, energy efficiency, sustainable cities and villages, water, forests, agriculture, the Himalayan systems threatened by glacier melt, and support for climate change related

science and R&D. It marks an important shift of stance in that it accepts that the pursuit of growth must be done in a manner that reduces climate change risks.

India is now committed to fulfilling its pledges in the Intended Nationally Determined Contribution (INDC) that it has made as part of the Paris Agreement. In this INDC India has pledged to reduce the emissions intensity of its GDP by 33-35 per cent by 2030, below 2005 levels, to install 40 per cent of its total electricity capacity from non-fossil fuel-based energy sources, to create an additional carbon sink of 2.5 to 3 billion tonnes of CO₂ through additional forests by 2030.

India is now very much a part of the global responsibility narrative. But the truth is that the commitments made as part of the Paris Agreement, particularly by the developed countries, are inadequate. Moreover, the largest emitter, the United States of America, has



By their very nature, solar, wind, biomass and small hydro power producers are geographically dispersed and supply points run into millions when consumers with roof top solar also become potential suppliers

dropped out of the Paris Agreement. The current commitments fall short of what is required to attain the agreed 2 degrees celsius goal, leave alone the aspirational goal of 1.5 degrees celsius. According to UNEP's 2019 assessment, unconditional committed emission reductions by 2030 fall 15 billion tonnes short of what is required to be on the 2 degrees celsius target and 28 billion tonnes if we were to pursue the 1.5 degrees celsius target. On the basis of the promises made as part of the Paris Agreement we are looking at a temperature increase of 3.2 degrees celsius.

Clearly, continued pressure to raise mitigation efforts to a much higher level is necessary. The dissenting United States has to be brought into the commitment tent. This will not happen simply by traditional international negotiations based on protecting national interests. Climate ethics and a commitment to global responsibility is essential. Hence, while giving in to the demand to become part of the commitment network, India and other developing countries must continue arguing for culpability, capacity and impact-based apportioning of responsibilities between nations.

Having accepted some responsibility, an action narrative has to emerge. In India, this action narrative has been dominated by an ambitious program to promote renewable energy and drive to raise energy efficiency. Carbon sequestration through reforestation of degraded forests is yet another element in the action narrative.

India's promotion of renewable energy, particularly solar and wind power, started long before the climate responsibility narrative had emerged. It was initially driven by a desire to improve energy access and to reduce dependence on petroleum imports. The Department of Non-conventional Energy Sources was set up in 1982 and converted into the Ministry of Non-conventional Energy Sources (MNES) in 1992. In 1987, Indian Renewable Energy Development Agency (IREDA) was established to finance renewable energy projects.

The role of solar power in energy development in India increased substantially after the acceptance of responsibility by the government. Installed capacity of solar PV grew from 161 MW in 2010 to 37626 MW in 2020 and generation from these accounts now for about 4 per cent of

power supply. Wind power development started a little earlier and installed wind power generation capacity grew from 6270 MW in 2005 to 35626 MW in 2018. The interim target for 2022 is 175 GW of renewable energy capacity consisting of 100 GW of solar, 60 GW of wind, 10 GW of biomass and 5 GW of small hydro.

The main driving force behind the rapid expansion of solar capacity has been the sharp reduction in photovoltaic panel costs and substantial incentives provided to investors through viability gap funding, accelerated depreciation and other measures to improve investor returns. The improved viability of solar power is manifest in the sharp reduction in the average bids in reverse auctions which fell from ₹12.16 in 2010 to ₹3.15 in 2017.

The energy efficiency narrative has been built around programs to raise appliance and vehicle energy efficiency standards, perform, achieve and trade (PAT) standards for energy intensive industries, building codes that include energy savings and programs like consumer subsidies for LED bulbs to replace incandescent bulbs.

Our level of CO₂ emissions in 2016 was 2.533 billion tonnes of CO₂ (7 per cent of the global total, 1.9 tonnes per capital, one tonne of CO₂ per thousand dollars of GDP at 2010 prices). The power sector accounts for a little over half the emissions of CO₂, industry, mainly steel, aluminum and cement, account for a little under a quarter, transport for little over a tenth and buildings and other uses for the rest.

In 2005, the base year for the goal set in the INDC, CO₂ emissions were 1.263 billion tonnes and the GDP at 2010 prices was 1.194 trillion, giving a carbon intensity of 1.1 tonnes of CO₂ per thousand dollars of GDP. Given the level of carbon intensity in 2016, the goal of a reduction of energy intensity by 30-35 per cent by 2030 would give a target carbon intensity in 2030 of 0.71-0.77 tonnes of CO₂ per thousand dollars of GDP. This gives us a sense of the scale of effort needed.

In its recent study, Unlocking National Energy Savings Potential, the Bureau of Energy Efficiency has worked out the likely energy savings for a scenario in which moderate technological improvements and technology penetration is achieved as per government/other

agencies target and there is a moderate fuel mix shift from fossil fuel to RE/electricity-based consumption. This works out to a 10 per cent reduction in energy consumption relative to business as usual and would be sufficient to allow us to attain our INDC goal. A more ambitious program could raise the savings even higher to 15 per cent of energy consumption.

The third component of the current action narrative, reforestation is on weaker ground. According to the Forest Survey released in December 2019, the total forest and tree cover in India is 80.73 million hectares. The total carbon stock in the country's forests is estimated to be 7.124 billion tonnes of carbon, which in CO₂ equivalent terms would be 26.155 billion tonnes. The annual increase is estimated to be 78.2 million tonnes of CO₂ equivalent. Our INDC commitment of 2.5-3 billion tonnes of CO₂ sequestration through reforestation requires annual increases three to four times larger than this. Hence, we must assume some shortfall in the reforestation commitment. However, there is a reasonable prospect of the renewable energy goal being exceeded and India will probably fulfil its Paris Agreement pledge.

The real challenge lies in what we have to do for the years after 2030, which will require us to look beyond win-win supply side solutions. We have to look for a deeper change in the style of development as we will be aiming at a scale of emission reduction that is much higher than current commitment, given the objective of reducing CO₂ emissions to half by 2050 and zero by 2100. Moreover, in India, which is very vulnerable, we will need more systematic attention to the challenges of adaptation that will be required to cope with the climate change that is unavoidable.

The first point about a deeper look at how to contain needs and change how they are met can be illustrated with the example of space cooling, the demand for which may see a substantial increase with rising temperatures. Improving the efficiency of air-conditioners can take us some part of the way towards reducing the carbon impact. But in the longer term, we need a cooling program that looks at measures like building standards that can reduce the need for cooling, district level area cooling, using the capacity available in nature, like pumping air from underground tunnels to take advantage of the steady medium temperature available there. This will require much more than appliance standards and fiscal incentives.

Improving the efficiency of urban transport to reduce carbon impact is another example that illustrates the point about looking beyond incremental efficiency improvements. Till now we have focused on raising the standards of vehicle energy consumption. But that does not liberate us from the use of petroleum and we will have to do much more to promote electric vehicles. This will require not just technological

development, but also urban redesign and major changes in electricity supply systems.

Looking at transport emissions in isolation will not suffice. Transport demand is a derived demand that depends on how urban and settlement design affects the distances between residence, workplace, shopping, leisure areas, etc. Urban and settlement design will also have to take into account the rising risk of adverse weather events.

Besides urban development, another area that requires deep institutional change is power system management. Beyond 2030, the role of renewable energy sources is bound to increase rapidly in order to replace fossil fuels. By their very nature solar, wind, biomass and small hydro power producers are geographically dispersed and supply points run into millions when consumers with roof top solar also become potential suppliers. A centralized grid management system and local monopolies for power distribution will not be appropriate for such a decentralized power supply, owned mostly by private entities. We will need a hierarchy of grids, with balancing at multiple levels, a wholesale market in power rather than bilateral power purchase agreements and competition up to the last mile so that there is no distribution monopoly, except perhaps for village or precinct level consumer cooperatives. This is a radical departure from the present system of regulation. But without this, the scale of transition to renewables will not be possible.

When we look beyond 2030, preparing for heightened mitigation efforts will not be enough. We will be entering a phase when some of the changes in climate that are inevitable even with a 2 degrees celsius goal will become manifest. Some of the areas where deep changes of strategy may be required are agriculture, which is extremely climate dependent, water resource management, given the changes from past patterns of precipitation and snow melt that are likely, habitat location and design, which will have to take account of longer heat waves and greater risks of weather-related emergencies, forest and biodiversity protection.

When we add up all the areas that require deep changes of development strategy, either for enhanced mitigation effort or adaptation to climate change, we end up with virtually every sector of the economy. Hence, it must enter the agenda of all policy making ministries, particularly finance. Moreover, rethinking development strategy does not mean just the direction of public investment, but also technology development, price and fiscal incentives and regulatory and institutional redesign. Given this, the climate change narrative must move beyond its current focus on incremental changes in the present structure of production and consumption to a deeper discussion of climate change within the framework of sustainable development, which rests on sustainable lifestyles.

In India, which is one of the most vulnerable countries, we will need more systematic attention to the challenges of adaptation that will be required to cope with the changes in climate that are unavoidable

■ Agriculture is one of the areas in which deep changes in strategy will be required in the coming years



OVERVIEW

**Shakti supports India
at national, state and
city levels to ensure a
climate-resilient
future for all**



Reaching for the Sun

International Solar Alliance (ISA) was launched at United Nations Framework Convention on Climate Change (UNFCCC) in Paris in 2015 by India and France. A treaty-based coalition of 121 countries located between the Tropic of Cancer and the Tropic of Capricorn, with high annual average global horizontal irradiation (GHI), to address their energy needs through solar power. Fifty Six of these 121 countries have signed to be members of ISA since 2015.

Shakti supported Council on Energy, Environment and Water (CEEW) to provide a broad range of strategic inputs to ISA for reaching out to member countries, showcasing its value proposition, along with developing and implementing its work programs. Notably, CEEW offered strategic and operational support to the alliance, which contributed significantly to the ISA Framework Agreement being ratified by the members.

Shakti actively supported the interim ISA secretariat during the ratification process and

provided inputs to alliance's Interim administrative cell to help formalize the legal institutional structure.

Shakti also helped ISA develop a set of options to improve the value proposition of scaling solar applications for agricultural use program and create a template for member country solar roadmaps. In 2018, Shakti joined the International Solar Alliance Global Task Force of Foundations. The task force engages with the corporate sector, foundations, think tanks, chambers of commerce and industry and promotes innovation and risk mitigation and financing.

Shakti also supported TERI to host the ISA's Corporate Conclave at the World Sustainable Development Summit 2018. This brought together corporate stakeholders such as CEOs of Forbes 2000 companies and energy ministries to discuss global experiences around solar energy deployment to improve ISA's visibility.



A treaty-based coalition of 121 countries located between the Tropic of Cancer and the Tropic of Capricorn; with high annual average global horizontal irradiation (GHI) to address their energy needs through solar power

IMPACT

ISA harmonizes and aggregates demand for solar finance, solar technologies, innovation, research and development, and capacity building.



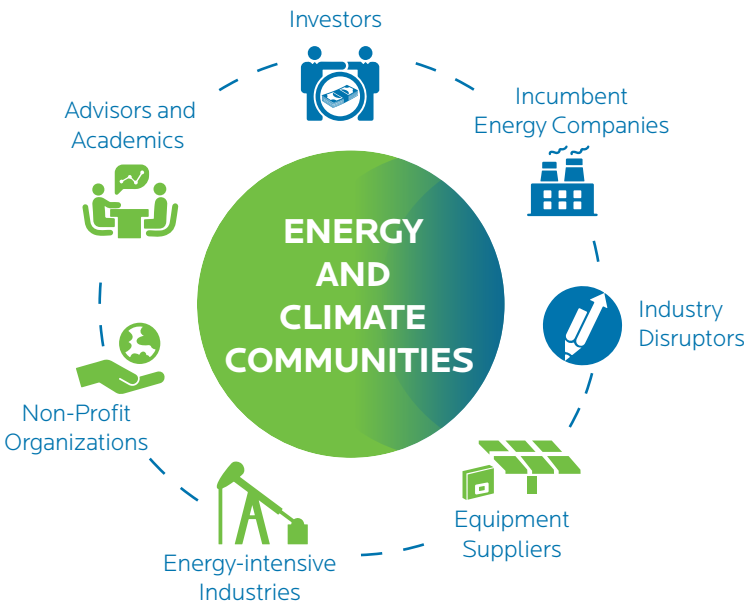
Energy Transitions Commission (ETC) aims to accelerate the change towards low-carbon energy systems that enable robust economic development and limit the rise in global temperatures to well below 2 Degrees Celsius

Towards Low-Carbon Energy Systems

Energy Transitions Commission (ETC), a European Union initiative, brings together a diverse group of individuals from the energy and climate communities: investors, incumbent energy companies, industry disruptors, equipment suppliers, energy-intensive industries, non-profit organizations, advisors and academics from across the developed and developing world. Their aim is to accelerate change towards low-carbon energy systems that enable robust economic development and limit the rise in global temperature to well below 2 degrees celsius.

Shakti is one of the entities supporting Energy Transitions Commission India (ETC India), a high-level, multi-stakeholder platform

on energy and electricity sector transitions, which focuses on developing decarbonization pathways for the power sector. ETC India aims to foster the adoption of low-carbon pathways through intense and informed discussions between Indian partners, key policymakers and others concerned with technology options and investment opportunities for evolving the policy. ETC India has initiated research on decarbonizing industrial sectors, with a particular focus on the 'harder-to-abate' sectors such as iron and steel, cement and petrochemicals. ETC India is currently developing scenarios for demand, supply and flexibility requirements of the power sector in 2030.



IMPACT

ETC provides objective and fact-based insights to inform decision-makers, both public and private, that help in accelerating low-carbon transition, while aligning India with global energy transition trends.

Raised Ambitions

In recent years, the government has dramatically increased its ambitions on renewable power and has been a positive influencer in international climate agreements such as Paris and Kigali. Shakti has been a backroom aide in this transformation

US-India Track II Dialogues

India and the US are among the top five carbon emitters in the world and therefore, important stakeholders in the global discourse on climate change. An independent platform, India-US Track II Dialogue, was supported by Shakti to enable discussions and dialogues on mutually relevant issues and engage with civil society, academia and government stakeholders. These dialogues have helped improve engagement and facilitate free flow of ideas between the countries on mitigation efforts. The networks and relationships forged as part of the dialogue played a critical role at Conference of the Parties (COP) at Paris in 2015.

Kigali and Beyond

In a landmark step to combat global warming caused due to emission of hydrofluorocarbons (HFCs), India, along with nearly 200 other countries, adopted an agreement in Kigali to phasedown the use of HFCs along with improvement of the energy performance of air conditioning and refrigeration systems by amending Montreal Protocol. Efforts facilitated by Shakti have informed India's stance on the global phasedown of HFCs and led to a more informed policy discourse in the country to address technology, regulatory, cost and market-related challenges, and to facilitate HFC phasedown. It has also helped in enhancing energy efficiency of air conditioning and refrigeration systems.

As India geared up for the Kigali Montreal Protocol Meeting in October 2016, the question of feasible pathways for phasing down HFCs became more pressing. Early-action efforts supported by Shakti provided credible and reliable information solutions required for India to take a more informed stance on the HFC

The civil society-led dialogues identify areas for joint action for both countries and bring together thought leaders to explore bilateral and multilateral opportunities. As a strategic partnership, the dialogues present a unique opportunity to deliver gains on both sides, including job creation and enhancing energy security. For more than seven years now, India-US Track II Dialogue on climate change and energy has played a key role in fostering greater bilateral cooperation between the two countries.

phasedown, while enhancing energy efficiency. At Kigali, India agreed to advance its proposed freeze year for HFCs by three years from 2031 to 2028 and its proposed baseline by four years from 2028-2030 to 2024-2026.

Shakti supported a set of technical research and analysis starting with the first modelling exercise to project India's future HFC emissions under various policy scenarios, which estimates HFC emissions across various sectors until 2050. Subsequent studies and sustained stakeholder consultations helped build consensus on the feasible pathways to an HFC phasedown and generated shared perspectives on the opportunities surrounding this transition.

A roadmap to implement the Kigali Amendment in India, supported by Shakti, suggested measures to be taken for India to deliver on its commitments, highlighting key challenges surrounding the HFC phasedown such as the uncertainties related to the cost of transition and the availability of alternate low-GWP refrigerant gases.

Parties to the Montreal Protocol October 2016, Kigali, Rwanda



At Kigali, India agreed to advance its proposed freeze year for HFCs by three years from 2031 to 2028 and its proposed baseline by four years from 2028-2030 to 2024-2026



IMPACT

The overall impact of Shakti's initiatives is a heightened sense of collaboration between the government and civil society to inform policy. Over the years, the government has actively begun to involve civil society actors to inform its position at UNFCCC.

The collective knowledge held by the civil society on various aspects of the climate crisis provides constructive feedback to government entities, which usually strengthens their position at international forums. Shakti's support to its grantee partners to attend Kigali and other international meetings held under the Montreal Protocol and COPs, resulting in stakeholders being continuously informed about India's position and being able to bridge the knowledge gaps with robust research and analysis and findings on ozone-friendly, climate-friendly refrigerants. This participation enabled the grantees to move beyond the focus of the Montreal Protocol and look at making sustainable and clean cooling more accessible.

Enabling an Ecosystem for DRE

Catalyzing finance for clean energy access in the decentralized renewable energy sector has the potential to bridge India’s energy gap. But these enterprises often face challenges in accessing finance due to a high risk perception and longer paybacks. To address this challenge, Shakti commissioned the development of a multi-pronged program aimed at driving investments to this sector

A Business Model for DRE Entrepreneurs

In the last few years, decentralized renewable energy (DRE) based mini-grids have emerged as an effective solution to provide clean and reliable power to consumers using locally available resources. These localized grids cater to productive and commercial loads, accumulate future load and connect with the grid feeding surplus power to it as and when required. Mini-grids have gained prominence with a few states developing policy, regulations and implementation frameworks.

A more integrated approach that brings together the Discom grid, DRE systems and energy efficiency can drive energy access and provide affordable, reliable, clean and resilient electricity to all. State-level interventions that aim to build a better ecosystem for mainstreaming DRE solutions will complement the main grid by allowing access to cheaper and reliable locally sourced power. Outsourcing collection to local entrepreneurs will also help create local jobs.

Shakti supported policy design through research and analysis, improving planning and implementation capacities, expanding stakeholder engagement, and evolving market financing mechanisms for DRE.

Shakti worked with Uttar Pradesh to develop a comprehensive guidebook for mini-grids outlining policy, regulation, operational and technical aspects, and develop the institutional capacity in the state for developing the DRE sector. In Bihar, Shakti supported the development of mini-grid regulations and the adoption of an operational guidebook by Bihar Renewable Energy Development Agency. In Odisha, mini-grid regulations were finalized and notified with Shakti’s assistance, while in Jharkhand, Shakti provided knowledge inputs towards developing a mini-grid policy, regulations and operational framework, in consultation with Jharkhand Renewable Energy Development Agency (JREDA).



State-level interventions that aim to build a better ecosystem for mainstreaming decentralized renewable energy solutions will complement the main grid by allowing access to cheaper and reliable locally sourced power

A Tool to Catalyse Finance

Catalyzing finance for access to clean energy through DRE has the potential to bridge the considerable gap in access to energy. But these enterprises often face challenges in accessing finance due to technology-related risks, off-taker risks and longer payback periods owing to the intermittent nature of renewables. From the financial institution’s perspective, monitoring mini-grid enterprise performance in India is uncertain, given the lack of adequate data.

To address this challenge, Shakti commissioned a multi-pronged program aimed at driving investments to the DRE sector. Decentralized Renewable Energy Evaluation and Monitoring (DREEM) Tool, an online evaluation platform (www.dreemtool.com), was launched in 2017 to connect DRE enterprises with financial institutions.

DREEM provides a framework to standardize the monitoring and evaluation processes for DRE enterprises. Evaluations are based on sector related developments and enterprise performance parameters. The tool provides standards for data monitoring considering the enterprise’s limitations around data availability and accessibility. It is relevant for DRE enterprises as a self-evaluation tool, while allowing financial institutions to assess the performance of specific DRE enterprises and make informed investment decisions.

DREEM allows financial institutions to assess the performance of specific DRE enterprises to make informed investment decisions

DREEM helps off-grid enterprises as well as financial institutions assess the potential of a given business by evaluating the geography of operations, intended or current energy resources utilized and the mini-grid product/solution offered. The tool displays this information by way of interactive maps, which may be used to identify key areas for expansion or products for diversification. DREEM aims to facilitate

capital for the mini-grid sector in India by providing financial institutions an easy mechanism for evaluating impact, assessing operational performance, and undertaking credit assessment for various products and solutions. It allows financial institutions to undertake complete and contextual evaluations of the sector and provides enterprises with a defined set of metrics.





An integrated approach that brings together the distribution grid, DRE systems and energy efficiency can provide clean, reliable and affordable power to all

A Policy and Investment Tracker

As focus shifts from providing electricity connections to reliable and quality power supply, DRE-based interventions will play a complementary role to the grid. Distributed Renewable Energy Investment Policy Tracker (DIPTI), an online platform was launched in 2019 and is the country's first comprehensive knowledge repository for the DRE segment.

DIPTI is designed to empower investors and other DRE players with data, resources and insights required for informed decision making on investments

and potential opportunities in the sector. The tool also provides comprehensive view of the policy regime on investments in the DRE energy access space.

Going forward, DRE solutions are likely to evolve and expand to newer sub-segments such as micro-cold storage and DC appliances. The tracker has been created to help inform market progression, investment flows, policy and regulatory framework, while reflecting the ecosystem changes which, directly or indirectly, impact capital availability for the sector.

A Knowledge Portal for Renewable Energy

As India makes steady progress in developing renewable energy sources, information on current trends and growth trajectories, policy and regulatory reforms, financing and market updates pertaining to renewable energy become imperative for ecosystem development. However, these are not easily available; and if available, are dispersed, resulting in conflicting data and a lack of authenticity.

Shakti supported the development of a comprehensive knowledge portal on the renewable energy sector-www.allaboutrenewables.com. The portal addresses data gaps and inaccuracies and provides insights to stakeholders for informed decision making by providing access to the latest developments in the sector.

The portal provides the latest statistics on installed capacity, capacity addition targets and data on grid-tied rooftop solar as well as crosslinkages with the conventional energy sector, enabling a comparative analysis of the two sectors, based on authentic and credible data. The portal tracks the current status of DRE, including data and policy on micro and mini-grids, decentralized rooftop solar and home lighting systems. The policy and regulation sections on the portal provide summaries of 200+ policies, programs and regulations, both at the central as well as state/UT levels. Data and statistics of manufacturing related to the four major technologies viz. wind, solar, small hydro and biomass are also provided on the portal. Data on investments in the renewable energy sector is also covered in depth. Important data parameters include external commercial borrowings, foreign direct investments, debentures, bonds and acquisition.

As an extension to the portal, the Shakti-supported sector report takes a deep dive into the progress of the DRE sector, serving as a useful reference point for the performance of over 100 DRE enterprises. It expands the sector's fact base to support the development of recommendations for enhancing energy access.

IMPACT

A Business Model for DRE Entrepreneurs

Capacity building of various state-level stakeholders along with structured focus on innovative policy and regulations has supported better penetration of DRE solutions to provide quality and reliable electricity to last mile consumers.

Supportive policy and regulatory developments are paving way for innovative business models, which are being validated through on-ground implementation and pilots. For instance, Shakti is currently supporting pilots in Uttar Pradesh and Assam to test the technical operability and feasibility of interconnection between mini-grids operational in these states with the main grid. Study findings will build confidence among Discoms and mini-grid developers, opening avenues for replicability and scale.

A Tool to Catalyse Finance

DREEM is a holistic evaluation tool for energy enterprises and financial institutions to enter the mini-grid market in a more informed manner. This would gradually lead to the availability of historic enterprise and investment performance data in the public domain, along with improved access to capital for these enterprises.

The tool was developed based on suggestions from financing institutions like Maanaveeya, IREDA, industry bodies such as Sa-Dhan and several regional level banks. They were familiarized through workshops on financing for DRE enterprises, organized at Indian Institute of Bank Management, Guwahati and Banker's Institute of Rural Development, Lucknow, in November and December 2019, respectively.

A Policy and Investment Tracker

DIPTI is expected to influence policy makers and other relevant stakeholders to take concrete actions towards addressing impending bottlenecks that impede investment inflow into the DRE sector. It will help identify emerging segments in the DRE sector and catalyze financing and allow enterprises to expand their operations.

The quarterly newsletters circulated to key stakeholders present a SWOT analysis on the current policies and regulatory frameworks, and have readership of 500+ from government, NGOs, CSOs, financing institutions and philanthropic sectors.

A Knowledge Portal for Renewable Energy

The portal tracks policies dating back over a decade and has emerged as a go-to platform to collect updated data on RE policies and regulations, leading to informed decision making at the central and state level.

Shakti worked with Bihar State Pollution Control Board to upgrade technology in a sector that is hardly ever grabs eyeballs, bricks. This resulted in a first-of-its kind notification requiring all brick kilns in the state to upgrade to the less polluting zig-zag technology

Baking Better Bricks

India's brick sector, although unorganized, is the second largest producer of bricks globally and is continuously expanding on account of increased demand from infrastructure and housing sectors. It is also a significant source of GHG and black carbon emissions. Over the years, Shakti has facilitated technical assistance and administrative support to the inter-departmental task force constituted by Government of Bihar to reduce emissions from the sector.

Our support informed the development of the first-of-its-kind notification, by Bihar State Pollution Control Board (BSPCB), directing all brick kilns in the state to upgrade to the cleaner zig-zag technology. As a result, by 2019, approximately 2,000 brick kilns out of the 7,000 operational ones in the state made this transition. This success laid the groundwork for the central government to come up with draft emission standards for brick kilns.

In 2016, BSPCB passed an order mandating the brick kilns in all five blocks of Patna district to upgrade to cleaner brick technologies. This was a first for any state pollution control board to ask brick-makers to move away from traditional high-carbon emitting technologies.

By 2019, approximately 2,000 brick kilns out of the 7,000 in Bihar had transitioned to zig-zag technology

Several efforts facilitated by Shakti over a five-year period helped move towards this notification, the most concrete measure taken by a state pollution control board to promote cleaner brick-making technologies and to control air pollution from brick kilns. The next step was to work with various actors in the state to support its implementation. Shakti supported an early intervention effort that provides technical assistance to brick-makers on available technologies and operational best practices. This information was necessary to help them make the right technical decision and to increase compliance to BSPCB order.

Shakti also worked with partners to inform the development of new emissions standards for brick kilns. Based on a significant amount of technical work completed through Shakti's support, the ground was laid for the central government to come up with draft emission standards for brick kilns in 2018. These efforts have helped shape the design of a sustained capacity building program for brick entrepreneurs and state officials to become cognizant of cleaner technologies and for kilns owners to upgrade their existing brick kilns to more resource-efficient ones. Shakti also supported the development of a detailed manual written by experts from the brick sector, designed to help brick entrepreneurs navigate the requirements of the notification.

IMPACT

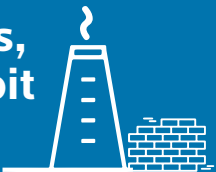
As a result of above interventions, nearly half the brick kilns in Patna district have upgraded to cleaner technologies. Many of these kilns are already showing a 15 per cent reduction in fuel consumption and lower emissions. This has set a strong precedent for BSPCB to pursue compliance of its notification in other parts of the state.

Recognizing the need to adopt efficient raw materials in brick production, Shakti supported efforts to promote the large-scale adoption of fly ash brick technology. In 2017, Government of Bihar notified 100 per cent procurement of fly ash bricks for public sector projects. This was followed by a ban on traditional red clay bricks. In 2018, Shakti helped launch a quality audit rating of fly ash bricks to address issues related to poor quality of fly ash bricks.

NOW IMPLEMENTED IN

BIHAR 17 Districts

Evaluating 49 Enterprises, of which 11 Exhibit improved fly ash brick quality.



Shakti supported an early intervention that provided technical assistance to brick-makers on available technologies and operational best practices

Climate Centric Public Policies in India:

Learnings from the past to identify upcoming opportunities

DR AJAY MATHUR
Director General, International Solar Alliance*



The National Action Plan of Climate Change (NAPCC), announced in 2008, marked the first time that any public policy in India was explicitly linked to climate action. The NAPCC included eight missions. Seven of those missions focused on subjects which were already of policy importance to Government of India: renewables, energy efficiency, sustainable habitat, forests, water management, the Himalayan eco-system, and sustainable agriculture. The eighth mission, on strategic knowledge for climate change, supports the knowledge needs of all other missions.

The focus areas of NAPCC brought a greater degree of priority and attention to all these seven areas. It is also helped create new policy interventions that have inter alia promoted renewables and energy efficient technologies in the country.

A similar trend can be seen in a number of other policies which advance climate action – the promotion of energy-efficient air conditioners, LED bulbs, electric vehicles, solar powered agriculture pumps, energy efficient housing, etc. All of these policies have emphasized the delivery of an increasing amount of services (whether for space cooling, lighting,

mobility, water for agriculture, or housing for all) - in our society where there is both a shortage of supply of these services, as well as a latent demand for them.

However, it is recognized that providing lighting services through LED bulbs (rather than incandescent bulbs) or providing electricity for agriculture pumps through solar panels (than grid electricity) or generating electricity from renewables (instead of fossil fuels) provides additional benefits as well. These additional benefits could be related to improved urban air quality, reduced energy import dependence, or enhanced reliability of electricity supply - and increasingly can be related to economic benefits as well, because the increasing scale of applications have also led to decreasing prices, and in many cases (such as solar electricity) to prices that are lower than those at which same services are offered by fossil fuels.

Climate change is, therefore, the untalked-about elephant in the room. There is a broad recognition, both political and empirical, that the adverse impacts of climate change are deleterious and costly for India. However, this does not necessarily mean that India needs to adopt climate friendly technologies and policies immediately. Correctly, it is argued that the adequate supply of the many services that have been listed earlier, at affordable prices, is far more important than ensuring that they are based on non-carbon sources; consequently, the challenge is to ensure that carbon-free electricity, mobility, industrial goods (e.g., cement and steel) and agricultural products can be provided at prices that are no more than the prices at which these services are provided by the existing (high-carbon) options. In other words, the provision of these services to accelerate development and enhance livelihoods has been, and continues to be, the public-policy goal; climate change is seen as an important co-benefit.

The good news is that we are seeing a convergence of goals – enhanced provision of services and carbon-free production of these services. Already energy efficiency is a cheaper option than the provision of greater amounts of fossil fuel based energy, and renewables are now the cheapest sources of electricity (when the sun is shining and wind is blowing).

In the years ahead, the importance of technologies that provide energy related services without carbon emissions will become stronger, both for economic and environmental reasons. The recent Solar Energy Corporation of India (SECI) tenders have indicated that, in three years from now, round-the-clock electricity from renewables would be cheaper than electricity from coal. In our country, where electricity demand is expected to continue to increase to nearly four times the

The good news is that we are seeing a convergence of goals - enhanced provision of services and carbon-free production of these services

current demand over the next three decades, this implies that policies for the large-scale manufacturing of solar cells, wind turbines, and batteries are of overwhelming importance, and consequently policies to encourage the rapid scaling up of solar and wind generating facilities are of importance as well.

We are already seeing a large interest in enhancing the use of solar energy for water pumping for agricultural applications. KUSUM¹ and its future operations would drive the speed and scale of the solar pumping market. Similarly, we are seeing an increasing policy interest in the establishment of electricity charging stations, which are essential to enable electric mobility. And we are also seeing policies to promote the manufacturing and sales of electric vehicles, especially buses and two wheelers, would have strong urban pollution reduction benefits.

For long distance road transport, as well for zero/low carbon emissions for high temperature applications in industries and for zero-carbon steel production, it seems that hydrogen could emerge as an important fuel. However, to enable adequate production of hydrogen, electrolysis that utilizes solar / wind electricity would be of importance. Hence, policies to promote the development and installation of electrolyzers for hydrogen generation would be of importance.

Where does this leave us? I think that past experience indicates there are three factors that contribute to the success of climate-centric policies in India. The first is that a successful public policy promotes a broad developmental goal, aimed at enhancing services (such as electricity or mobility or nutrition) to the economy. The second is that the provision of these services is through mature and commercially available low/zero carbon technology in an application where they provide strong social benefits (such as lower costs, or reduced air pollution). And finally policies that have been successful in promoting zero-carbon technologies are those which are based on the scaling up and acceleration of successful business models.

Successful implementation of climate centric public policies, therefore, depends on the creation of successful business models around zero-carbon technologies where there are strong benefits (other than zero carbon) to users and on outreach to help bring together the diverse set of stakeholders who could convert the isolated pockets of technological success into thriving economic ecosystems.

¹ Kisan Urja Suraksha evam Utthan Mahabhiyan; approved in February 2019, the scheme aims to install 17.5 lakh off-grid and 10 lakh on-grid solar pumps and 10 gigawatt of solar power plants capacity in rural areas by 2022.

*This article was written when Dr. Mathur was DG, The Energy and Resources Institute.

SPOTLIGHT

From a model for successful conversion to LEDs and innovative green financing options, Shakti's work has had a geographically widespread impact



Lighting a Sustainable Future

A small but strategic intervention in tiny Puducherry paved the way for a national revolution in energy-efficient lighting

In 2012, the potential for energy saving through an efficient lighting program in India was huge and untouched-over 50 billion kWh in annual savings, delivering financial savings of \$250 billion to consumers. This translated into an avoided capacity addition of 19,000 MW. Energy-efficient lighting offered an extraordinary opportunity to achieve these benefits.

One of the simplest solutions for energy-efficient lighting was replacing incandescent lamps (ICLS) with light emitting diode (LED) lamp. An LED bulb uses only a tenth of the energy of an incandescent bulb and half that of a compact fluorescent lamp (CFL) to produce the same amount of light. Despite the obvious benefits, the biggest impediment to LED conversion remained its price.

In 2012, domestic consumers were the largest category of consumers in Puducherry comprising around 73 per cent of the total consumers, consuming around 25 per cent of the total electricity consumed in the state, with incandescent bulbs being the norm in homes. It was estimated that 88 per cent of the residential consumers still used incandescent bulbs at an average of three bulbs per household.

Shakti facilitated the LED adoption programme which resulted in 735,000 ICLs being replaced in 16 months in Puducherry, leading to an annual demand reduction of 48 million-kwh, financial savings of \$15 million and 383.7 MTCO2 reduction.

Shakti's Intervention

Shakti collaborated with US-based International Institute for Energy Conservation, Puducherry Electricity Department (PED) and Energy Efficiency Services Limited (EESL) to design an innovative pay-as-you-save, demand-aggregation market intervention model to implement LED conversion in Puducherry. EESL procured and distributed 7,35,000 LED lamps at a cost of Rs 310 per lamp to households in Puducherry. PED distributed the LEDs to their customers, recovering the cost through nominal charges in the monthly electricity bill.

The department recovered the entire cost of the distributed LEDs in 7.5 years. PED agreed to procure energy efficiency as a resource at a cost ranging from ₹ 1.23/kWh in the first year to ₹ 0.67/kWh in the 10th year (USD 0.042/kWh to USD 0.01/kWh), 4 to be paid to EESL for every unit of energy saved. By October 2014, Puducherry had achieved the unique feat of lighting almost every home with LEDs.

The success of this initiative lent momentum to similar actions by states such as Andhra Pradesh, Delhi, Rajasthan, Himachal Pradesh and Uttar Pradesh. Shakti's support in the early stage program design helped the initiative evolve into a national flagship program, known as Unnat Jeevan by Affordable LEDs and Appliances for All (UJALA) for large-scale deployment of end-use energy-efficient technologies for mass markets.

Prime Minister Narendra Modi launched UJALA in 2015 to provide LED bulbs to domestic consumers with a nation-wide target to replace 770 million incandescent bulbs.



LED streetlights have now become a common sight on Indian roads

IMPACT

Over the years, EESL has achieved over 85 per cent cost reduction in the overall cost of LED lamps in progressive phases of procurement (₹ 320 per lamp to ₹ 38 per lamp).

The program has emerged as the world's largest energy self-financed and self-sustained market transformation initiative for promoting end-use energy-efficient technologies. It has not only surpassed traditional benefits, such as energy savings and reduced carbon emissions, but also triggered large-scale investment in the manufacturing of end-use efficient technologies and generated employment.

From a small intervention in Puducherry to a nation-wide initiative for the large-scale deployment of end-use energy-efficient technologies, Shakti's initiative helped India take a quantum leap on climate change mitigation goals.

NATIONAL UJALA DASHBOARD

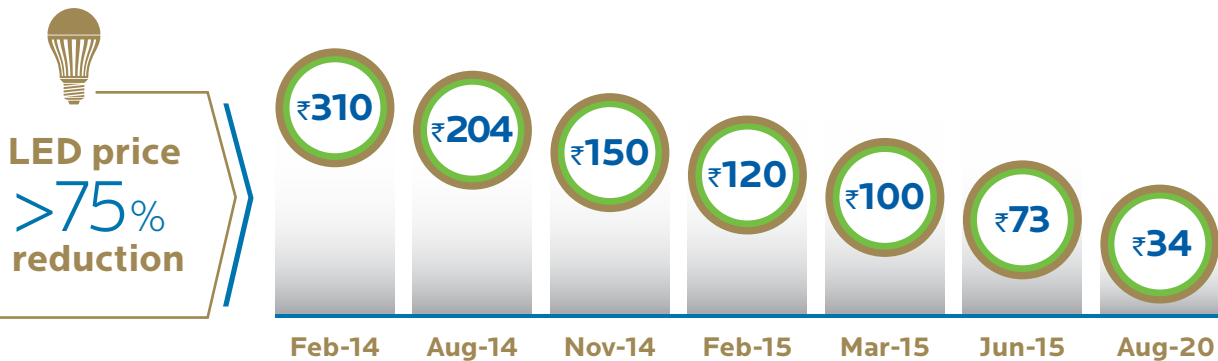
19,068
CR cost saving per year

Energy savings of
47,669 mn kWh per year

Avoided peak demand of
9,544 MW

3,86,12,143 t CO₂ reduction per year

* Figures as on 02 FEB 2021



The Emergence of Energy Efficient Industries



Over the last few years, Shakti has helped to shape the design and implementation of India’s premier energy efficiency scheme for industries, Perform, Achieve and Trade. This is a market-based mechanism to enhance energy efficiency in industries by making efficiency a tradable commodity

Industries consume around 34 per cent of India’s total primary energy consumption. Perform, achieve and trade (PAT), by Bureau of Energy Efficiency (BEE) under the National Mission for Enhanced Energy Efficiency (NMEEE), is a key market-based mechanism aimed at enhancing industrial energy efficiency. The scheme is a unique energy efficiency cap and trade scheme, which currently covers energy-intensive units consuming 55-60 per cent of India’s total industrial energy consumption.

Under the scheme, ministry of power sets energy efficiency targets for large industrial consumers of energy (called Designated Consumers or DCs) under the Energy Conservation Act, 2001. Those who exceed their targets are awarded energy savings certificates (ESCs), which they can sell to those who fail to meet their targets. PAT is a multi-cycle scheme, with each cycle spanning over a period of three years. The first cycle began in 2012. Up to April 2019, four cycles of PAT were in progress, consisting of 956 DCs from 13 energy-intensive sectors.

IMPACT

During PAT cycles 2 and 4, efforts facilitated by Shakti led to the identification of new energy-intensive industrial sectors and notifying these sectors as designated consumers under the PAT scheme.

Shakti's support has led to the inclusion of petroleum refineries under cycle 2 and petrochemicals and hotels under cycle 4.

During cycle 4, Shakti's efforts laid the groundwork for a more informed discussion on the issue and in March 2018, Ministry of Power notified **37 buildings and 8 petrochemical units as designated consumers.**

In 2018-19, BEE engaged agencies to assess the energy intensity of non-PAT sectors and identify new sectors to be included under future cycles.



■ Designated Consumers ■ PAT Cycle ■ GHG Mitigation Target

Shakti’s Intervention

Shakti engaged with key stakeholders to strengthen the design and implementation of the PAT scheme. Shakti actively supported development of baseline methodology and in compiling industry-wise best practices on energy efficiency.

Shakti supported training programs, which helped industrial units and state designated agencies (SDAs) to address the knowledge gap around energy auditing, energy management systems, technological innovations and trading outlook for energy saving certificates. We collaborated with the designated agencies in Maharashtra, West Bengal, Bihar, Jharkhand, Odisha, Assam, Meghalaya, Tripura, Arunachal Pradesh, Nagaland, Mizoram, Manipur and Sikkim to train more than 500 practicing energy auditors, industry professionals, SDAs, public sector enterprises and other energy professionals.

Shakti has enabled capacity building and outreach efforts to make stakeholders aware of the processes and compliance modalities associated with the scheme. Several workshops were targeted at industrial units and SDAs in eastern and north-eastern parts of the country. The workshops addressed the knowledge gap around energy auditing, energy management systems, technological innovations and the trading outlook for ESCerts.

Shakti also supported the development of PAT Pulse, a quarterly update on the PAT scheme and is also continuing its engagement with the Institute for Global Environmental Strategies to successfully identify energy efficient Japanese technologies for adoption in India.

Green Finance: From Ideas to Action



The India Innovation Lab accelerates well-designed financial instruments that can unlock billions for energy efficiency, renewable energy, sustainable transport, while reducing private investors' risks and improving their financial returns

Private investors are already channeling significant amounts of money into the global low-carbon economy, but much more investment is needed. This is particularly true for developing countries, which often face difficulties in attracting private investment at the scale needed to reach their sustainable development and energy access goals

Significant investments are required for the implementation of India's climate actions at the national and state levels. Given the scope and scale of investment required, financing through international and domestic sources, via public and private channels need to be scaled up and effectively utilized.

Shakti supports efforts focusing on capacity building of institutions, strategic allocation of climate finance and designing financial instruments to facilitate access to finance from appropriate funding sources. The India Innovation Lab for Green Finance was established in response to this need, to provide solutions to the financing challenges to investment in green infrastructure. The lab is hosted by Shakti and the secretariat for the lab is Climate Policy Initiative India with additional financial support from the UK government, and the David and Lucile Packard and Oak foundations. It has also been endorsed by MNRE. Members, drawn from the infrastructure, finance and renewable energy sectors, bring valuable expertise to the activities of the lab.

Since its inception, the lab has launched ideas that can be replicated and scaled up quickly, by driving more private finance and also by leveraging public finance. The lab network accelerates well-designed financial instruments that can unlock finance for energy efficiency, renewable energy, sustainable transport, while also reducing private investors' risks and improving their financial returns. A public-private partnership, the lab brings together and catalyzes broader government and private sector efforts to scale up climate finance.

IMPACT

The lab has created significant progress in the Indian clean energy investment space with over \$50 million being mobilized towards such interventions. The lab's work has helped raise the profile of clean energy infrastructure in the Indian finance community and led to significant reduction in financial risk perception for the sector.

Green Finance Initiatives

Battery Subscription Facility



Electric bus battery financing mechanism to provide long-term debt financing to the electric transit sector in India and reduce the ownership cost of electric buses to compete with diesel buses

Financing for Low-Carbon Autorickshaws



Facility to deploy more electric autorickshaws on Indian roads and provide better livelihoods for autorickshaw drivers through a model that provides up to 100 per cent debt financing at competitive rates and opportunities for ownership

Residential Rooftop Solar Accelerator



Aims to accelerate mass adoption of residential rooftop solar to power 200 million households in India through standardized product offering, easy financing and efficient execution

Solar Investment Trusts (SEITs)



Solar-specific Investment Trust aims to mobilize capital for the rooftop solar sector in India

Sustainable Energy Bonds (SEBs)



Aims to drive impact investment to sustainable energy in India by offering debt exposure, sufficient returns and standardized impact measures

The Matchmaker Service



Platform to drive private capital to sustainable urbanization projects in India by connecting investors and municipalities with a pipeline of investment opportunities

P50 Risk Solutions



Insurance to reduce the cost and increase the amount of long-term debt to utility-scale renewable energy (RE) by transferring the risk of revenue uncertainty from banks to insurers, through a blend of commercial and donor capital

Rooftop Solar Private Sector Financing Facility



A facility to drive capital at a lower cost for financing rooftop solar projects in India, by providing long-term financing through securitization

FX Hedging Facility



Hedging facility to facilitate large-scale foreign investment into RE in India by providing a cheaper currency hedging solution

Loans4SME



A peer-to-peer lending platform to help SMEs operating in RE and energy efficiency sectors to raise debt finance

Cleaner Air and a Healthier Nation

Against the backdrop of rapidly increasing contribution of vehicular pollution and the rising share of diesel vehicles in the fleet, India decided to implement stricter emission norms under Bharat Stage VI and minimize the price distortion between petrol and diesel. To inform this decision, Shakti helped facilitate analysis as well as sustained engagement with policy makers and other stakeholder groups

BS VI Norms

Bharat Stage (BS) emission standards are standards instituted to regulate the output of air pollutants from the tailpipe of any motor vehicles to a prescribed upper limit. The standards, which were based on European regulations, were first introduced in 2000 and progressively stringent norms have been rolled out since then. While BS IV emission norms have been in place since April 2010, in 2016, Government of India announced that the country would skip the BS V norms altogether and leapfrog to BS VI norms, especially as the technology was already available.

Shakti's Intervention

Shakti, along with partner organizations submitted detailed analysis to key government stakeholders on the economic and public health benefits of adopting aggressive BS VI emission

standards. A fact sheet was published on the emerging concerns of emissions from next generation diesel technologies and helped make the case for implementation of BS VI emission standards by 2020. Several studies focused on the knowledge and design of measures needed to reduce emissions, while simultaneously identifying the role that stakeholders, particularly the auto industry, must play in the transition to BS VI norms.

Efforts supported by Shakti kept the spotlight on this complex policy debate to enable a steady flow of information to policy makers, public and the media. Through engagement with the Environment Pollution Control Authority set up by Supreme Court of India, the stage was set for the 2020 timeline being committed to by the government. This progressive development brings India on par with the US, European Union and other advanced automotive markets across the globe in terms of vehicle emission standards.

IMPACT

International Council on Clean Transportation (ICCT) estimates that the adoption of BS VI will result in 2.3 million tonnes of avoided PM_{2.5} emissions between 2020 and 2050 and about 1.2 million premature deaths in the same period. This is a conservative estimate and does not consider the health benefits of reduction in pollutants other than tailpipe PM_{2.5}. Relatively, while the actual cost of the makeover will be \$10 billion, health benefit will amount to \$90 billion, an eight-fold benefit.



Diesel Price Rationalisation

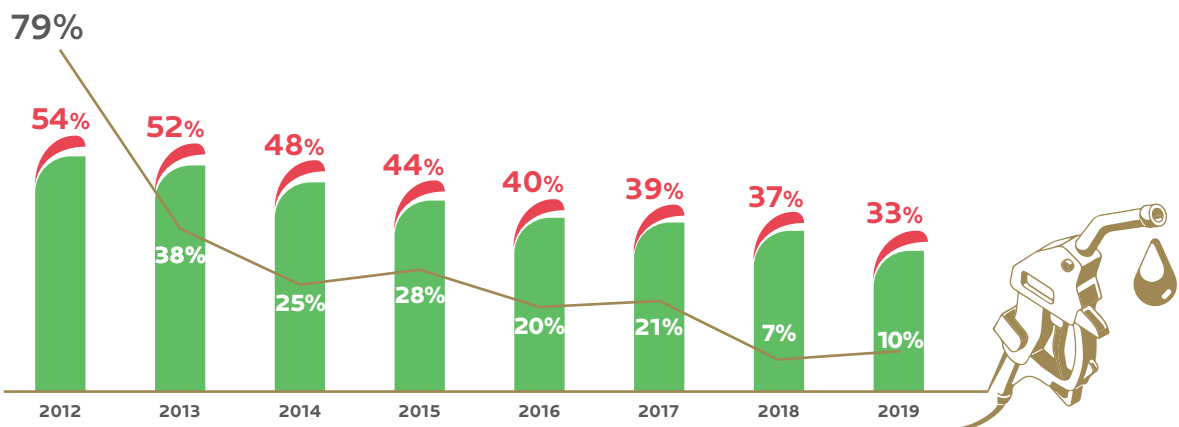
Since diesel is used for agricultural activities and road transport, India has always subsidized diesel by charging lower excise duties than petrol. This resulted in a price distortion between the two fuels, making diesel substantially cheaper. This inclined consumer behaviour towards diesel vehicles, which are much more polluting than petrol vehicles.

Shakti's Intervention

Our rationale in supporting diesel price is - consumer behaviour too will change in favour of petrol and reduce the proportion of diesel vehicles in the fleet. Shakti supported Integrated Research and Action for Development (IRADe) to evaluate the case for reducing the existing price differential through a revenue neutral equalization of central excise duties that are levied on diesel and petrol.

The report assessed the impact of the revision in excise rates on state government finances, truck freight, farmers, car manufacturers and bus operators and passengers, and showed that a move towards parity in excise rates will not pose a major hurdle to any group of stakeholders. This study builds upon an earlier Shakti supported report on the macroeconomic implications of the diesel subsidy.

Share of diesel cars in total car sales



¹https://economictimes.indiatimes.com/industry/auto/auto-news/diesel-car-share-in-total-q1-sales-falls-to-14/articleshow/70684964.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

²<https://www.autopundit3.com/autopedia/diesel-cars-sales-trend-india/>

Time for the Bus



A developed country is not a place where the poor have cars. It's where the rich use public transportation
 – Gustavo Petro, Mayor of Bogotá

Providing quality city bus systems is a crucial requirement for developing low-carbon transport systems in cities. Shakti has worked across the spectrum of bus-based mobility to create broad-based guidelines for making this form of public transport viable

While on the one hand promoting the use of public transport as a critical strategy for reducing emissions from passenger transport, decreasing motorization and improving the quality of urban life is imperative, on the other hand, most Indian cities lack the essentials of a sound bus system. Most do not have a formalized bus service and the few cities that do have buses, have fewer than the norm of 50 buses / lakh population. Expanding services has also been a challenge due to the non-availability of critical infrastructure like terminals and depots, which in turn has reduced the passenger capacity offered by the existing bus systems. Passengers have gradually shifted to private vehicles, which cause more pollution and congestion.

Shakti’s Intervention

Shakti has facilitated the improvement of bus transport through five critical interventions – improved technology adoption, operational processes, transport infrastructure, contracting frameworks and planning and funding. These were carried out through focused technical assistance to state transport undertakings (STUs), dialogue and training through the Bus Karo Forum. Bus Karo platform is a comprehensive program that engages STUs and other stakeholders in the bus transport sector by providing technical expertise, capacity-building support, facilitating discussion and knowledge sharing between cities.

Technology Adoption: Shakti supported World Resource Institute (WRI) India to work with STUs in Delhi (DTC) and Bangalore (BMTC) to analyze transit data and develop route rationalization methodologies and tools to improve the efficiency of bus operations to meet the growing demand for public transport.

Operational Processes: Shakti piloted a tool in Himachal Pradesh to review the existing fleet inspection and maintenance practices, and to propose recommendations for further improvement. The resultant fleet maintenance guidelines offer practical ways to enhance the fuel efficiency of buses.

Transport Infrastructure: Shakti facilitated the development of planning and design guidelines for bus terminals and depots to accommodate different functions and bridge shortcomings in existing designs, which are being piloted in Himachal Pradesh and Andhra Pradesh. Recently, these guidelines have been adapted to inform the design on e-bus depots and is being piloted in Delhi.

Contracting Frameworks: Shakti commissioned a study to explore the various ways in which STUs could make use of private participation in developing infrastructure for bus operations. Shakti has provided training sessions to STUs and developed tendering guidelines for e-bus contracting under the FAME II scheme.

Planning and Funding: As an inherently loss-making operation, access to robust multi-year funding and resource planning is essential for city transport undertakings to supply uninterrupted high-quality services to the public. Based on our experience in Himachal Pradesh, Jammu & Kashmir and Maharashtra, helping develop long-range business plans, Shakti developed the FLEET tool to help STUs to build and test various scenarios, including a full e-bus transition. BMTC supported the development of the tool, with the initial plans being developed for BMTC and the Odisha STU.

IMPACT

Shakti’s Bus Terminal Design Guidelines have been used by various STUs to guide their design consultants. It was used for the design of eight terminals in Delhi in 2019, most of which have been tendered for implementation. It has also been used for the development of 23 bus terminals across Uttar Pradesh and by APSRTC to develop terminals in Vijaywada, Guntur, Vishakhapatnam and Tirupati.

The guidelines were used by the Delhi government to develop three electric bus depots in 2018-19.

The guidelines were used as part of an international benchmarking exercise for bus depot business model development for Cape Town, South Africa. It is also a part of the curriculum developed by IIT-D to train delegates from other countries.

A 2016 WRI India study formed the basis for BMTC receiving an exemption from motor vehicle tax amounting to ₹ 1200 million in 2017-18. Various states are considering an obligatory viability gap funding support to STUs and the removal of taxes on STUs.

WRI India’s support to Delhi to plan and optimize 17 new bus routes led to a 17 per cent increase in ridership (11,000 more passenger trips completed per day), 19 per cent increase in overall earnings per kilometer and improved schedule adherence, besides improving public transport connectivity to the area. There are plans to scale the rationalization process to the entire bus network in Delhi.

Biking: Not Just Fitness

Non-motorized transport or human powered transport such as walking and cycling are arguably the cleanest modes of transport available. It can drastically reduce pollution, congestion, noise, accidents and injuries, improve the health of users due to the positive effects of physical activity and non-users from improved air quality. Recognizing their importance in the emerging urban agenda, Shakti pioneered an early effort to promote NMT supportive infrastructure through better street design and cycling facilities, in areas like Dwarka in Delhi and by informing various smart city efforts to redesign streets and introduce public bicycling schemes

Over the past 25 years, India has seen an exponential increase in the use of private vehicles and consequently, higher emissions from the transport sector. To limit these emissions, the mode share of non-motorized transport (NMT) and public transport must be restored. A majority of trips in India are less than 5 kms, especially in small cities, which can easily be undertaken on NMT modes such as walk or cycle if proper, safe infrastructure were in place. This is also true for short distance trips within the neighbourhood, while longer trips can be undertaken on public transport with NMT serving as first and last mile modes.

The foremost way of promoting NMT use, is to ensure that street infrastructure is conducive to providing a safe environment for NMT users. This requires a means for assessing existing streets infrastructure, identifying conflict points and addressing them through street design strategies such as provision of adequate widths for footpaths, level pavements, traffic calming measures, bicycle lanes and markings among others.

An additional action to promote bicycling, especially for those who may be users of public transport, or do not own a bicycle is a public bicycle share (PBS) system. They are often located at proximity to public transit points and over several locations in surrounding neighbourhoods, allowing users to travel from one point to another within the neighbourhood itself, but also addressing first and last mile connectivity needs.

Shakti supported various cities to provide NMT-friendly infrastructure, through support in envisioning street improvement plans, pedestrianization, street design and developing public bicycling schemes



Shakti’s Intervention

Shakti worked with Clean Air Asia to assess walkability in Bhubaneshwar, Chennai, Pune, Indore, Surat and Rajkot, and to understand the various barriers to developing NMT safe streets in these cities. Using the learning, Shakti supported various cities to provide NMT-friendly infrastructure, through support in envisioning street improvement plans, pedestrianization, street design and developing public bicycling schemes in Udaipur, Visakhapatnam, Ludhiana, Gwalior, Pune, Ramgarh, Chennai and Jaipur. With support to IIT Delhi, Shakti has also developed planning and design guidelines for cycle infrastructure.

One of our most focused efforts have been at Delhi, with two different initiatives. First, was the Aapki Sadak program that worked with residents in Malviya Nagar, Khirki Extension and Sheikh Sarai to develop a consensus plan for the improvement of their streets and environment-friendly connections to public transport. In the second, Shakti supported the Centre for Green Mobility (CGM) to develop a detailed project report on PBS for South Delhi Municipal Corporation (SDMC) for Dwarka Sub-city between 2013-15. In Phase 2 (since 2019), Shakti is supporting CGM to provide technical assistance for the implementation of PBS system and bicycle infrastructure for Dwarka Sub-city.

The program is being implemented in Dwarka by Delhi Development Authority (DDA), with technical and advisory efforts supported by Shakti in the design of this program. Several recommendations regarding technical specifications, designs for stations, streets and intersections, safety requirements and financial models have been approved for implementation. Underpinning the robustness of these recommendations, the DDA has already committed to the necessary capital investment required for the project.

IMPACT

Shakti’s support has led to the adoption of a bicycle sharing policy for Delhi and the design and implementation of safe streets, and junctions in various cities such as Udaipur and Chennai. In Dwarka, DDA has committed to the necessary capital investment required for the street improvement and PBS system. It is expected to result in a mode shift from private modes of transport to bicycles for neighbourhood trips and from private modes to public transport in and out of Dwarka due to greater access to the buses and metro through bicycles. The installed PBS system will have the potential to shift 4 million trips annually from private vehicles. It could lead to CO₂ emissions savings of approximately 1,586 tonnes / year.

The interventions will improve local air quality, reduce accidents and injuries, have a positive impact on local businesses and the neighbourhoods, creating more effective economies.

¹Bike sharing allows a user to collect a bicycle on loan from one location and return it at another destination. Under the PBS system, cycles are stored in a closely spaced network of stations and are available to users who do not own their bicycles. Users can rent a cycle from a station and return it to any other station.

A Sunny Solution for Agriculture

Solar agricultural pumps offer a compelling application of solar technology for many reasons - improving energy access in remote areas, providing cleaner and more reliable power, replacing costly grid and diesel pumps, ensuring availability of water during daytime and reducing agricultural power subsidies

A study supported by Shakti strengthened the case for solar agriculture pumps as a promising solution to meet the energy needs of India's agriculture sector. Recommendations from this study were included in the state level guidelines for the implementation of "Solar Pumping Program for Irrigation and Drinking Water" under India's off-grid and decentralized solar applications program.

To deliver both electricity and financial savings, Shakti is actively pursuing partnerships with several states to identify the progress made in the adoption of solar pumps and to help in the implementation of large-scale solar irrigation pump programs.

Government of India has identified solar water pumps as a policy priority with ambitious targets and substantial capital subsidy support. The importance of solar photovoltaic (PV) powered water pumps is echoed in the government's target to install nearly a million solar-powered water pumps for irrigation by 2022 and also in the announcement of expanding this scheme to support 1.5 million farmers set up grid-connected solar pumps.

IMPACT

Shakti's techno-economic feasibility study which resulted in the first-ever government supported program for solar pump installation, paved the way for ecosystem growth in solar-based irrigation in the country. Over the years, we have further catalyzed this growth by supporting central and state governments in developing policy guidelines for implementation of solar irrigation pump schemes.

Our work highlighted the need for much stronger targeting of program implementation along with increased awareness, specifically among low-income farmers. Based on these inputs, MNRE has strengthened its program design and state-level programs continue to evolve towards meeting socio-economic outcomes. Going forward, Shakti will work towards strengthening the state-level implementation of the KUSUM Scheme.

Based on recommendations from research supported by us, Chhattisgarh government has rolled out a tender for one and sub-one horse-power pumps, shaping conversations on optimal pump design to conserve ground water resources in the state.

Shakti's Intervention

Shakti began investigating the feasibility of solar agricultural pumps way back in 2013. On the request of Ministry of New and Renewable Energy (MNRE), we supported a techno-economic feasibility analysis of solar pumps and submitted a draft implementation roadmap. MNRE announced the installation of 10,000 solar-agri pumps in that year.

Shakti supported a survey-based impact assessment in four states—Rajasthan, Uttar Pradesh, Bihar, and Tamil Nadu—to assess the status and socio-economic impact of solar-powered pump sets installed in the early phases of the program. The results showed significant gaps stemming from non-targeted program implementation at the state-level, lack of awareness among low-income farmers and the absence of financial innovation.

One of our state specific interventions conducted by Council on Energy, Environment and Water (CEEW) in Chhattisgarh aims to assist the state government in the design of the next phase of solar irrigation pumps scheme and the policy framework for scaling up solar-based irrigation in the state in a sustainable manner.

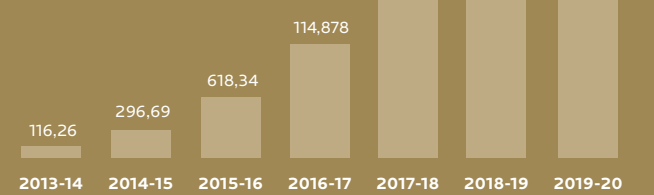
Shakti has also contributed to the development of three other research studies, conducted by CEEW, which highlighted the need for specific deployment strategies, customer-centric approaches, better technologies and key risks and challenges affecting financing for scaling up solar agri pumps.

KUSUM scheme aims to achieve an enhanced solar capacity of 30.8 GW by 2020 with ₹3,40,000 million central government financial support



(Source: https://mnre.gov.in/img/documents/uploads/file_f-1585710569965.pdf)

Cumulative solar pumps installed YoY for last 7 Years



(Source: https://mnre.gov.in/img/documents/uploads/file_f-1585710569965.pdf)

Results of a Shakti-sponsored survey showed significant gaps stemming from non-targeted program implementation at the state-level, lack of awareness among low-income farmers and the absence of financial innovation.

Stakeholders need to continue to work in close coordination to facilitate a cost-effective transition to clean energy systems with net-zero emissions while enhancing energy security and energy access

A key development of the last few years has been the enormous reduction in the cost of vehicle battery packs, down 80 per cent over the last eight years

Clean Energy Technologies can Deliver a Net-zero Development Pathway

ANAND R GOPAL, Ph.D.

Program Officer, Environment | Hewlett Foundation

Energy-related emissions account for more than two-thirds of the world's greenhouse gas emissions. As emerging economies, like India, rightfully prioritize the needs of their citizens for greater incomes and superior standards of living, these emissions could increase further. Fortunately, clean energy technologies can deliver a development pathway that is decoupled from increasing emissions, but that requires bold decisions from governments, businesses, philanthropy and civil society. A clean energy pathway is the only pathway that can simultaneously support long-term flourishing of Indian society, while also rebuilding the economy from the COVID-induced recession.

All stakeholders must work in close coordination to meet the challenges of a cost-effective transition to a clean energy system with net-zero emissions, while enhancing energy security and energy access. It is the creation of such a conducive ecosystem that, in the last few years, has led to the maturation of nascent green technologies into commercially viable technologies-solar photovoltaics, wind turbines, energy storage and electric vehicles, to name a few.

Globally, the use of renewables, specifically wind and solar, has reached the point where it is cheaper than conventional thermal power and is emerging as the energy source of choice. Recent developments in energy storage have made renewables a dependable source of power for electricity grids. India benefited from the cost declines triggered by early solar and wind generation incentives in Germany, the US and Japan. In recent years, India has been an international pioneer in structuring reverse auctions for grid scale renewable power that has resulted in the lowest long-term renewable power purchase contract prices in the world.

As cost declines, stationary batteries are becoming attractive as another storage option, whether in the form of behind-the-meter storage in combination with rooftop solar PV, utility scale battery

storage plants or grid storage to reduce bottlenecks. Utility-scale storage capacity worldwide is estimated to grow at a CAGR of 31 per cent from 173 GW in 2019 to 741 GW by 2030¹ with front-of-the-meter accounting for 70 per cent of the capacity additions.

Another key development of the last few years has been the enormous reduction in the cost of vehicle battery packs - down 80 per cent over the last eight years². Combined with rapid improvements in the energy density and life of the battery pack, the transportation sector has also come within reach of the decarbonization by making electric vehicles a superior alternative to conventional internal combustion engine vehicles.

While challenges remain in converting the long haul, heavy vehicle segment to electric, current battery technology is superior to engines for all other road vehicle types. If batteries and other components of the electric vehicle supply chain are made in India, this sector could play a critical role in rebuilding India's economy post COVID-19. The Indian government has recently recognized the immense potential here by announcing battery cell production incentives up to ₹ 18,100 crore as part of the National Mission on Transformative Mobility and Battery Storage. The Rocky Mountain Institute, a collaborator of both Shakti and Hewlett Foundation, was instrumental in working in partnership with NITI Aayog in providing analysis in support of this plan.

While electric power and transportation are important, buildings, appliances and space cooling are also critical to decarbonize. Here, rapid advances in Internet of Things (IOT) technologies are enabling smart energy and grid management that will substantially lower the costs of decarbonization. Appliance standards enacted by the Bureau of Energy Efficiency are foundational to succeeding in these sectors. The rapid worldwide shift to LED lighting, pioneered in India through a Hewlett grant, is a successful example of how behind-the-meter strategies and technologies are leading the

Buildings, appliances and space cooling are also critical to decarbonize. Rapid advances in IoT technologies are enabling smart energy and grid management that will substantially lower the costs of decarbonization in these sectors

movement towards efficiency. EESL (Energy Efficiency Services Limited)³, a government owned energy services company, successfully aggregated demand across; India leading to over 85 Per cent fall in LED prices in progressive phases of procurement (₹ 320 per lamp to ₹ 38 per lamp). To get to net-zero across the economy, we need to deploy carbon removal technologies at scale. Investments in research, development and demonstration are necessary now if there is any hope for them to meaningfully contribute before 2050. Green hydrogen can also play a crucial role in both industrial decarbonization and seasonal grid scale storage. An International Renewable Energy Agency study from 2019⁴ projects that green hydrogen is poised to grow rapidly in the coming years as a key component of the clean energy mix. The study found that hydrogen can boost the renewable electricity market growth and broaden the reach of renewable solutions, although an energy transition based on hydrogen is unlikely to happen very quickly with supply infrastructure emerging as a key challenge to adoption. The capture, transport and utilisation or storage of CO₂ emissions as a successful decarbonization strategy pivots on the commercial availability of technologies at each stage of the process as well as on the development of CO₂ transport and storage networks on scale.

India benefited from the cost declines triggered by early solar and wind generation incentives in Germany, the US and Japan. In recent years, India has been an international pioneer in structuring reverse auctions for grid scale renewable power

Commercial maturation of CCUS (Carbon Capture Use and Storage)⁵ technologies will be hastened by potential new applications, which can range from power generation and fuels transformation to cement and iron and steel production. Other emerging uses of CO₂, include building materials (which would provide long-term, but not permanent CO₂ storage) and feedstock for synthetic fuels (which would prevent the CO₂ from being released into the atmosphere only temporarily)⁶. Policy can play an important role in developing a market for such applications.

Businesses and financiers are increasingly realizing that being climate positive is also being balance-sheet positive. Their role in

financing green technologies will help steer the world away from a high-carbon future. The demand is already being created by corporates that are championing green technologies and the move away from BAU by pledging to use electric vehicles and power their businesses through renewables and by platforms such as EV100 and RE100. Philanthropy also funds the We Mean Business Coalition which works with the most influential businesses around the world to take meaningful actions to mitigate climate change.

After signing the Copenhagen Accord in 2009 at UNFCCC's 15th Conference of Parties, India embarked on new development

paradigm-one that put emphasis on a clean energy path to development. Since then, the country has come a long way and leads the world in several aspects of mitigation such as cooling and energy efficient lighting. Hewlett is glad to have been a part of this journey through its support to Shakti.

Over the past decade, Shakti has helped grow the ecosystem for clean energy and climate change mitigation in India by putting these critical concepts on the country's developmental agenda. Shakti worked, and continues to work, at the confluence of government, civil society, businesses and academia, and crafting transformative low-carbon solutions for the country's energy needs.

In the past 10 years, Shakti has tackled big, relevant and obvious problems such as energy access, air quality and sustainable transport, identified and enabled emerging trends to mature into national-level policies such as

cooling and industrial energy efficiency, as well as identifying unaddressed challenges that have potential to hold up the transition to a cleaner energy future. The Hewlett Foundation has been proud to support many of these indigenously developed solutions.

Over the short to mid-term, the COVID-19 crisis can delay the development of advanced technologies, as innovation funding is scaled back to concentrate on day-to-day cash management issues. But the pandemic has presented us with an opportunity to direct scarce development resources toward cleaner technologies, which will have greater future value.

³<https://www.greentechmedia.com/articles/read/woodmac-global-storage-to-reach-741-gigawatt-hours-by-2030>, ²Source: <https://hewlett.org/getting-to-zero-a-strategy-for-delivering-on-clean-freight/>, ³ Energy Efficiency Services Limited.

⁴<https://www.irena.org/publications/2019/Sep/Hydrogen-A-renewable-energy-perspective>, ⁵ Carbon capture, use and storage (CCUS), ⁶ IEA Energy Technology Perspectives 2020



Guzzlers like this picturesque truck are a reminder that the heavy vehicle segment remains a challenge for conversion to cleaner technologies

FOCUS

Shakti's work can be sliced into three major focus areas, facilitating a climate resilient future, capacity building of stakeholders and enabling urban transformations



Capacity Building



Unlocking Finance for DRE in Rural India

Limited understanding of decentralized renewable energy solutions among financial institutions has restricted the flow of investments required to scale up such interventions. Shakti supported training programs for bankers


The decentralized renewable energy (DRE) sector in India is still evolving with investors coming to grips with the business models and commercial viability, risks and opportunities presented by the sector. Shakti felt an urgent need to address the prevailing knowledge gap among including rural banks and non-banking financial institutions (NBFCs) to unlock further investments for the sector.

Shakti supported SELCO Foundation to develop a cadre of qualified resource persons through a “train the trainer” (ToT) program involving key bank staff in rural areas. A one-of-its-kind structure was developed to institutionalize the TOT program for rural banking staff, primarily to give them an understanding of the sector and develop financing mechanisms for it.



Phase I of TOT (2016-17) developed a training scheme targeted across the chain of command to facilitate continued interest in financing DRE solutions. In all, 131 trainers were trained through the program and 464 bank managers were trained by the TOT trainers in turn.

Phase-II (2018-19) of the program deepened the efforts to enhance the availability of finance for the rural poor by increasing capacity among local financial service providers and building other parts of the financial ecosystem. The goal is to advise banks on creating saving schemes for villagers and convert those savings into comprehensive, integrated loans for not only include electrification and lighting, but also livelihood, housing and agricultural production. This allows banks to do group lending and reduce the transaction cost of supporting rural electrification-led development initiatives.

	No. of loans disbursed post training programs: 260	Finance unlocked through different FIs post workshops: ₹5.5 million	No. of different types of livelihood application financed- sewing machine, pottery, poultry, milking machine, rope making machine, blacksmith blower and roti rolling machine
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IMPACT

SELCO Foundation conducted 30 financial inclusion workshops and nine banking correspondent/entrepreneur preparation workshops to create financial awareness in six states.

As a result of the training programs:

- Odisha Gramya Bank supported financing of basic solar home solutions for 54 un-electrified tribal households in Kaptipada and Bada-Koladi blocks.

- Canara Bank financed solar solutions for nine tribal households in Churachandpur district, Manipur.
- Bihar Gramin Bank financed 100 households in Jamui, Banka and Samastipur for solar home solutions.
- Mahila Shakti Kendra (identified through the FI workshop in Assam) has initiated the process of creating a revolving fund for end-users for solar implementation.

Connecting India with a Clean Network

Clean Energy Access Network’s mission is to bring together a wide range of decentralized renewable energy practitioners and stakeholders to strengthen the sector and expand access to energy. Shakti is one of the founding members and resource partners of the network

Though there were enterprises that worked towards addressing the energy-access gap in India, solutions they offered had limitations in terms of replicability and scalability. This often was a barrier to their growth. Effective functioning and scaling up of these energy access practitioners was also impacted by the absence of a supportive eco-system. Lack of clarity on policy regulations and limited engagement with policy makers, limited availability of skilled human resources, high cost of capital and lack of interest from financiers, and also put paid to these enterprises' survival.

For a sector which has a growing number of stakeholders across regions, an alliance such as the Clean Energy Access Network (CLEAN) was essential to align efforts across the sector and ensure a stronger representation. In 2014, Shakti

decided to bring together multiple stakeholders to create the CLEAN platform to help institutionalize decentralized renewable energy (DRE) in rural areas and smaller cities. CLEAN provides common services that benefit members as well as a stronger representation of its members' interests with external stakeholders such as government agencies and financial institutions.

CLEAN has a mandate to support, unify and grow DRE sector across the country. With a membership of 200+ enterprises and organizations, it aims to bring together diverse stakeholders. Its main focus is to improve energy access for the rural and urban poor and works to enhance access to finance, capacity building, testing and certification of technologies, policy dialogue and advocacy.

In 2015, CLEAN held the first ever India Off-grid Summit, featuring practitioners, policy makers, experts and investors to share lessons learnt from their experiences and discuss off-grid opportunities to address the prevailing power gap in the country. CLEAN brings together these stakeholders in the DRE State of the Sector report annual launch to discuss the most pressing policy, operational and financial issues of the sector. The annual report on state of the DRE sector remains the flagship knowledge product from CLEAN that holistically covers the performance, challenges, case studies of the sector from a technology, policy, finance and market-linkage perspective. The yearly edition captures the challenges, prospects, growth and milestones achieved in the sector. The report captures important status indicators such as technology, geographical reach and finance.



CLEAN works to enhance access to finance, capacity building, testing and certification of technologies, policy dialogue and advocacy

IMPACT

CLEAN has actively contributed to the development and influencing policies for DRE sector, bridged access to finance for its enterprises, facilitated technology innovations, assisted its members in accessing markets and built capacity of enterprises through trainings. CLEAN has successfully spearheaded conversations with MNRE and NITI Ayog to

accelerate the deployment and adoption of renewable energy based livelihood applications for rural development. They have extensively organized state level workshops with state nodal agencies to sensitize them about the potential of DRE for enhancing livelihoods and introducing them to the current developments in the sector.

Leading a Shift in the Clean Energy Access Narrative

Shakti undertook assessment of the existing narratives around electricity access and found that in order to establish a holistic electricity access narrative amongst influential decision makers, a sustained and aligned program of multiple interventions is required

India has made huge strides in improving electricity connections to households in the last decade; however, the use of energy services remains limited in rural areas. The average electricity demand for rural households in some parts of the country is well below the national average and is primarily due to low appliance penetration, gaps in reliability and adequacy of supply and affordability. DRE solutions can bridge these gaps, improve quality and efficiency of delivery, and boost rural electricity demand, whilst enhancing opportunities for diversifying income sources.

Shakti undertook an assessment of existing narratives on electricity access in India to understand and advance the prevailing narrative towards one that ensures affordable, reliable and sustainable access for all, highlighting the role of decentralized renewable energy (DRE).

To evolve the narratives of influential decision makers, a sustained and aligned program of six interventions was instituted in 2019. These include articulating a new narrative with stakeholders, equipping the media to provide sophisticated coverage aligning with this new narrative, providing platforms for those influencers who align with the new narrative, supporting aligned legislators to raise questions using the new narrative in parliament and state legislatures, challenging myths and broadening exposure to energy access solutions through popular TV, radio and other media, and supporting storied institutions that train bureaucrats, politicians and professionals to help their students champion the new energy access narrative.

Shakti brought together key stakeholders and helped co-build a new shared narrative. Shakti supported the placement of the narrative into mainstream conversations and build the capacity of communication professionals.



✿ IMPACT

From quantity to quality

Discussions at various forums, conferences and dialogues along with reports and articles by actors in the electricity access community (think tanks, non-profits, ESCOs, philanthropies and incubators) have moved from achieving household access (indicated primarily through number of households with electricity connections) to quality, availability and reliability of supply.

From household access to development and outcomes indicators

We have seen a significant shift in the enablers of the ecosystem as think tanks, non-profits, ESCOs, incubators are actively linking and speaking about quality electricity access through better livelihood opportunities, health services, agriculture productivity and education services.

Realized key opportunities to feed ideal narratives to key influencers:

We curated messages and recommendations for various events and opportunities such as recommendations for Government of India's 1000 day plan, resources for India Energy Access Summit 2019, resources for Indian Energy for All Summit 2020, resources for Power for All's energy access month in Economic Times, hosted a webinar with Power for All on gathering and sharing success stories on electricity access, inputs to SELCO's Sustainable Energy and Livelihoods Nexus conference, various dialogues by WRI's on electricity access and its outcomes and discussions held by CLEAN.

Catalyzing Solutions for Sustainable Urban Transport

To create a more strategic vision for sustainable urban transportation, Shakti has supported the Sustainable Urban Mobility Network (SUM Net), a network of grassroot-level civil society organizations working on urban transport issues

Shakti supported SUM Net - a membership-based coalition of individuals, voluntary organizations and civil society networks, to ensure rich and sustained public engagement on sustainable transport in various cities. SUM Net seeks to improve the overall quality of life for all by ensuring that urban transportation systems are universally accessible, socially just, safe and secure, economically viable and environmentally sound. Network members see urban mobility as a part of the larger sustainability agenda, bringing with them a uniquely local perspective - a truly local, grassroots character where action and policy travel bottom up. SUMNet's presence has grown from around five cities in 2010, to 20 over the past decade.

The network undertakes the following activities in support of sustainable transport:

- Critical analysis of policies and project implementation experiences
- Campaigns to enhance public participation in urban transportation planning and project implementation
- Experience sharing by local communities in shaping their urban transportation policies
- Networking and partnership with groups engaged in democratizing urban transport governance
- Public awareness and outreach



✿ IMPACT


SUM Net played a crucial role in the National Urban Transport Policy revision exercise. SUM Net's efforts led to an important amendment to Motor Vehicles Act 1988, which seeks to protect pedestrians and cyclists, the most vulnerable segment on the road. Section 138, clause 1A has now been inserted to the act, that allows the state to make rules in the interest of road safety.

SUM Net published an analysis of five states' transport policies looking at the state of urban transport in Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra and Punjab. A key insight that emerged was that the needs of each state are sufficiently diverse to warrant a individual urban transport policy. As a follow-up SUM Net has begun the process for such a policy in Maharashtra.

In support of better streets, successful stakeholder consultations were held in Bodh Gaya, Patna, Guwahati, Imphal, Ranchi and Ramgarh. In all the consultations, an alternative design for a walkable street was presented to different stakeholders - nagarparishads, city planners, smart city officials, local activists, journalists, women and the elderly.

On September 7, 2020 in Ramgarh, the cantonment board passed a resolution to make Nehru Road a smart road as per the alternative design submitted by SUM Net.

In September 2020, the Bodh Gaya Nagar Parishad tabled a proposal to make Domuhan Road pedestrian and tourist-friendly as per the alternative design submitted by SUM Net.



The very nature of philanthropy is multi-generational and therefore, patient. It is this kind of capital that is needed to catalyse climate change mitigation in India

Role of Indian Philanthropy in Climate Mitigation

MEHER PUDUMJEE

Chairperson, Thermax Limited

Director, Shakti Sustainable Energy Foundation

Climate-related giving has increased by more than 30 per cent from 2015 to 2017. However, less than one per cent of total foundation giving in the European Union and the United States is devoted to mitigating climate change worldwide.

In India, only seven per cent (on a much smaller base as compared to the US and Europe) of philanthropic funding goes towards climate change – predominantly around agriculture, followed by energy and environment and finally, energy efficiency.

While the entire globe is reeling under the adversities of climate crisis, India tops the list as one of the most vulnerable countries, given its huge dependence on agriculture, a long coastline and relatively higher dependence on fossil fuels than most countries. Some startling facts reiterate the urgency to act now to avoid more profound risks, more devastating effects in future. India ranked highest in climate-triggered deaths in 2018 and is the fifth most vulnerable of 181 countries in the world to the impacts of climate change. In 2017 alone, India saw 1.2 million deaths due to air pollution. In 2018-19, about 2,400 Indians lost their lives to extreme weather events such as floods and cyclones, according to the Ministry of Environment, Forests and Climate Change.

Recently, we have seen a lot of disparity in rainfall across the country. While some parts reel under water scarcity, rains have played havoc in other parts of the country, causing floods, displacing thousands of people from their homes. Both extremes are destroying crops, which create livelihood for a majority of our rural population. India suffered an economic loss of \$37 billion due to climate change in 2018, of which losses due to floods amounted to \$2.8 billion.

Having said that, attracting philanthropists to climate change related contribution has been difficult. India has so many challenges hitting you in the face - be it poverty, lack of health, sanitation and homelessness - that the effects of climate change lie much farther into the future. It is very hard to raise money for climate change because it competes against helping somebody get shelter or food, or curing children with cancer, which are closer to people's everyday lives.

Another challenge has been the lack of a unified response to this existential threat by the Indian social sector and can be attributed to factors such as insufficient awareness about climate change's downstream impact on people's livelihood and education, health and nutrition, a dearth of technical expertise necessary to craft holistic policies, and the lack of a common classification that would help philanthropies, NGOs, and government align on actions – an area Shakti has been working on.

Climate change will have a disproportionate impact on the poor, who are more exposed and do not have the resources to address it. It is a long-term phenomenon which will have an impact on generations. It is risky since we do not quite know the end result, and therefore, needs innovative thinking, not all of which may yield results. Climate change is not restricted to just India, but the entire planet and will require plenty of global funds working towards research and policy changes to mitigate it. This is exactly where philanthropic funds as against CSR or money from the government can play a key role - they are always directed towards the most marginalized; the very nature of philanthropy is patient and

multi-generational; philanthropists are willing to take risks and are meant to be catalytic.

While the ongoing COVID-19 crisis has damaged human lives and economies around the world, it has also brought to fore the positive effects on the environment - the absence of cars on the roads, fewer people flying across continents, most of us working from home, with hopefully a new order emerging. Many have breathed cleaner air for the first time, felt a lot healthier, which may direct funds towards policy changes. While our initiatives should definitely address immediate societal challenges,

we also need to focus on more significant issues that threaten the survival of the planet, to ensure that the needs of the future are not detached from the actions of the present. Let us remember the old American Indian proverb, "We do not inherit the earth from our ancestors; we borrow it from our children".

My best wishes to Shakti Sustainable Energy Foundation as you complete 10 years - wish you continued success.

Sources: Private Philanthropy for Development- OECD 2018; India Climate Collaborative; Press release India Climate Collaborative



The changing climate has a disproportionately large impact on the poor and the marginalized

Creating an Enabling Environment



Putting Progressive Norms in Place

The transport sector accounts for approximately 15 per cent of carbon dioxide emitted by all sectors. This share is increasing rapidly due to the increase in vehicular fleet. Shakti is pursuing the step-by-step establishment of stringent fuel efficiency norms for passenger cars and heavy-duty vehicles

CAFÉ Norms

Passenger cars are the only class of vehicles in India with established fuel efficiency standards notified by Bureau of Energy Efficiency (BEE) in 2014. The standards mandate that Corporate Average Fuel Economy (CAFÉ), i.e., the average fuel efficiency of all cars sold by a manufacturer in a year, should be less than the fuel efficiency corresponding to the vehicle closest to the average weight. CAFÉ standards came into effect in FY 2017-18 under the supervision of Ministry of Road Transport and Highways.

Shakti facilitated the research and analysis required to support the government in this endeavour and developed a procedural guideline document for implementation and compliance. These include protocols for data collection from manufacturers, data verification from implementing agencies and penalties for default.

❁ IMPACT

The procedural guideline document on implementation framework for CAFÉ norms was prepared and these norms have been in effect since April 2017. It is expected that these standards will reduce the 23 million tonnes of fuel consumption by 2025.

Heavy Duty Vehicles Fuel Economy Norms

Heavy duty vehicles (HDVs) comprise only 8 per cent of vehicle fleet in India but consume nearly 38 per cent of the country's total diesel consumption. Therefore, it is imperative to improve the fuel efficiency of these vehicles in order to curb the growth in CO₂ emissions. Recognizing this need, Ministry of Petroleum and Natural Gas constituted a steering committee to formulate a time-bound action plan to develop fuel economy norms for HDVs in 2014.

The proposed project recommended a roadmap for adoption of HDV fuel efficiency standards in India through review of the HDV standards adopted in other countries and their applicability in Indian conditions. It was also supported by data collection and analysis of the vehicle technologies that existed or were under development in India, the duty cycles of India's HDV fleet, codified testing procedures for fuel efficiency and a cost-benefit analysis of the technological options practical for Indian conditions. The analysis was done separately for trucks and buses as they vary significantly in terms of vehicle configuration and loading patterns.

❁ IMPACT

The fuel economy standards for HDVs (>12 tonnes) have been in effect since Aug 2017. Fuel economy norms for 3.5-12-tonne HDVs were notified in 2019.



Though fewer in number, heavy duty vehicles account for nearly 38 per cent of the diesel consumed in India

Comparing Models to Cut Emissions

Recognizing that different stakeholders using different baseline data was leading to a multiplicity of scenarios and recommendations that often did not reconcile with each other, Shakti supported India’s first ever inter-model comparison for emission mitigation strategies within the transport sector

India’s Nationally Determined Contributions (NDCs) articulates targets for cutting the emissions intensity of GDP by 33-35 per cent by 2030 from 2005 levels. NDC targets are economy-wide and not sector-specific. To evolve policy recommendations, quantifying the energy and emission intensity targets for all end-use sectors, including the transport sector, is necessary together with specific contributions from various emission mitigation strategies.

Various Indian think tanks have carried out independent energy modelling studies to provide inputs to policymakers. However, since they used varying baseline data, different reference scenarios and underlying assumptions, there existed a lack of consensus among policymakers on their recommendations. An inter-model comparison was required to develop recommendations agreeable to all stakeholders, reconciling differences in data, while adopting common assumption and scenario parameters. Recognizing the need for such enhanced modelling capabilities in the energy sector, the American and Indian Governments formed a Sustainable Growth Working Group (SGWG) as part of the bilateral energy dialogue. The group comprises various government representatives and energy modelling teams from both countries including Pacific Northwest National Laboratory (PNNL) from the US and Council on Energy, Environment and Water (CEEW), Center for Study of Science, Technology and Policy (CSTEP), Integrated Research and Action for Development (IRADe) and The Energy and Resources Institute (TERI) from India.

Shakti extended support to a consortium comprising CEEW, CSTEP, TERI and IRADe to undertake the inter-model comparison for the transport sector. This first-of-its-kind study aimed to identify a set of technology and policy options to improve access, address mobility issues, reduce energy usage and GHG emissions and assess how the transport sector can contribute to achieving the NDCs. Scenarios were developed, in coordination with an advisory board led by NITI Aayog and representatives of various central government ministries related to transport, energy and environment.

IMPACT

The results of the scenarios modelled across various modelling teams indicate that fuel efficiency and modal shifts (shift from private vehicles to public modes) yield the highest energy and emission savings, whereas electrification of transportation contributes substantially only when accompanied by decarbonization of the power sector. Prior to this effort, India did not have a systemic process of energy modelling, which could bring various experts and decision-makers together on a neutral platform to discuss issues of energy and environment. This pilot effort and its success led to the launch of India Energy Modelling Forum in June 2020, for the first time formalizing a systemic process for an energy modelling forum in India.

Shakti extended support to a consortium comprising CEEW, CSTEP, TERI and IRADe to undertake the inter-model comparison for the transport sector



An Ecosystem for Rooftop Solar


Rooftop solar is expected to make a significant contribution towards meeting India's renewable energy goals. The rooftop solar capacity in India is likely to reach 15-16 GW by 2022¹ about a third of the 40 GW target set by the government. Shakti decided to support the State Rooftop Solar Attractiveness Index to boost investments in the sector by creating healthy competition among the states

With the renewable energy market becoming increasingly relevant to the Indian power sector, the sector as a whole, specifically the rooftop solar segment, is witnessing substantial interest from entrepreneurs, developers, potential investors, end-users and government stakeholders. Government of India is striving to support the rapid scale-up of the sector through multiple initiatives. Though most states have also put in place state-level guidelines to create a conducive ecosystem for rooftop solar installations, proliferation has been patchy across states.

Shakti supported Solar Attractiveness Index (SARAL) Index with the idea of introducing a platform for knowledge-sharing and inducing healthy competition in rooftop solar segment among Indian states. The index ranks states based on a range of parameters gauging their attractiveness for solar rooftop deployment and investment opportunities. It also highlights the best practices followed, positive developments and key improvement areas in policy development and implementation, consumer involvement and the overall investment ecosystem. Developed by Associated Chambers of Commerce of India (ASSOCHAM) with technical assistance from Ernst & Young, SARAL identifies areas of improvement for individual states and acts as an investment tool for the rooftop solar sector.

The index encourages states to assess initiatives undertaken to promote solar rooftop installations till date, as well as inform future improvements by evaluating and ranking all states according to their performance, growth, level of maturity, policy framework and implementation environment in the rooftop solar sector.

SARAL also enables states to channelize future investments and create a more conducive ecosystem for solar rooftop installations. With SARAL being endorsed by MNRE, Shakti is now in the process of developing the second phase, SARAL 2.0. The updated index will include all electricity distribution companies (both public and private) and have separate rankings for residential and industrial/commercial sectors. A self-sustaining and private sector driven rooftop solar sector holds the key to a renewable energy revolution in India. SARAL is envisioned as a stepping-stone on this journey.

 **IMPACT**

For stakeholders and industry watchers, SARAL serves as a starting point in evaluating state-level policies and ease of doing business in each state. The index helps Discoms effectively design and implement suitable market interventions in various consumer categories to increase adoption of solar rooftops among residential consumers.

SARAL RANKING OF TOP FIVE STATES

Ranking	State	SARAL Score	Grades
1	Karnataka	78.8	A++
2	Telangana	72.2	A++
3	Gujarat	67.9	A++
4	Andhra Pradesh	66.1	A++
5	Rajasthan	62.2	A+



¹ <https://jmkresearch.com/one-third-of-40-gw-rooftop-solar-target-expected-to-be-achieved-by-2022/>

Bringing together Indian Power Distribution Utilities


Systemic challenges in electricity distribution have long been the bottleneck in India's electricity sector. Shakti facilitated a platform to bring together Discoms to discuss issues and challenges faced by the Discoms and potential solutions to enable distribution sector reforms

India has made giant strides in the past decade in making electricity accessible to its citizens. Electricity generation has reached an all-time high while the grid has expanded to reach people in remote and far-flung areas. Despite this, large swathes of the country live without access to reliable and affordable electricity.

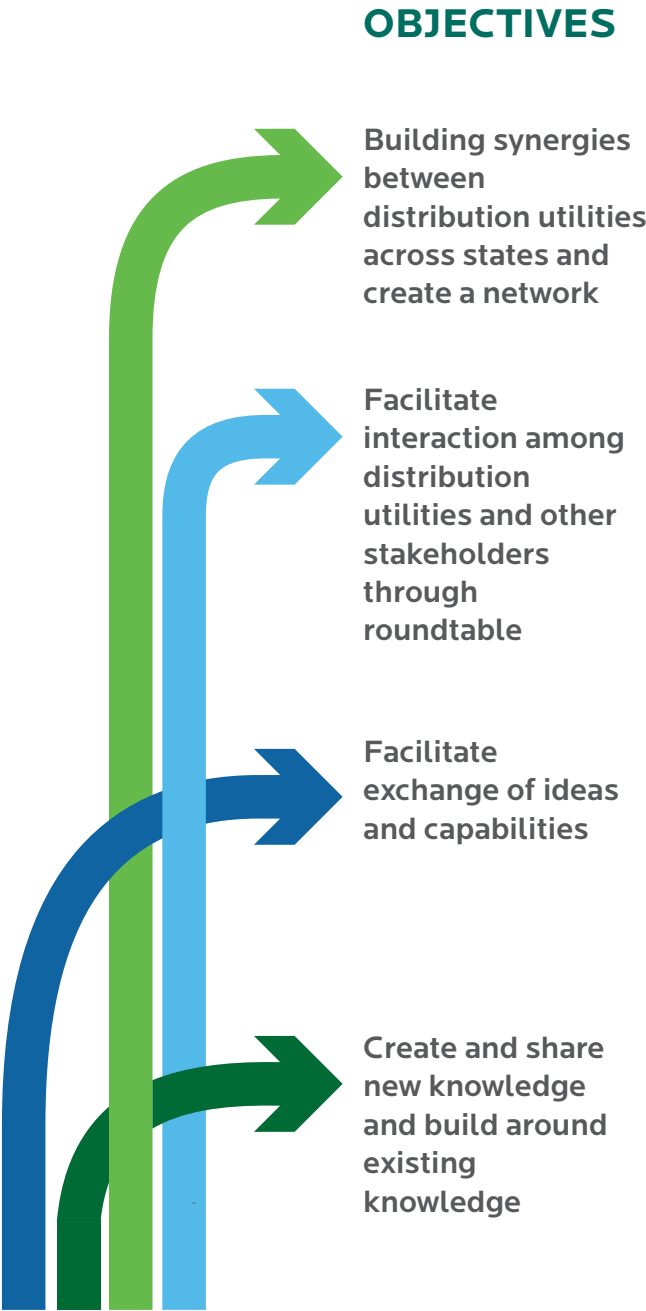
Much of this can be ascribed to system inefficiencies and institutional barriers. The 'last mile' distribution sector continues to suffer the most from these systemic challenges. Although almost all the distribution utilities (Discoms) in the country have been making concerted efforts to modernize, attempts have varied in degree and nature depending state-wise socio-economic imperatives as well as the financial and systemic constraints, resulting in varying degrees of achievement.

Launched in 2018, Distribution Utilities Forum (DUF) provides a platform for Discoms to meet with their peers in an independent and open environment to share views, learnings and challenges and to advocate change. The forum provides a platform where utilities can look collectively at the big picture changes that they must face-up to in the context of evolving technology and growing consumer expectations and seeks to build synergies between distribution utilities across states and facilitate interaction among them to enable an exchange of ideas, sharing of knowledge and best practices that can benefit the sector as a whole.

In the last two years, DUF held six meetings on different thematic areas and released reports addressing issues both current and critical to the distribution sector. These included rural electrification and the impact of the Saubhagya scheme on Discom finances, strategies to expand the implementation of rooftop solar schemes, issues and challenges faced by Discoms in implementing open access, determining the actual cost of supply of electricity and creating an enabling environment for electric vehicle offtake.

 **IMPACT**

In six meetings held over two years, DUF has seen participation from nearly all the Discoms in the country either at the meetings or in the studies sponsored by the forum. Close to 50 stakeholders including Discoms, policy makers, civil society, technology suppliers, consumer groups, have participated in DUF meetings. Key recommendations made at the DUF meetings have found place in guidelines issued by the central and state governments.





It is in the interest of corporations and governments to accelerate the progress of renewable energy and energy efficiency because every rupee invested in these projects positively impacts the triple bottom line - giving handsome economic returns, enabling accelerated achievement of climate goals and creating green jobs

Enhancing renewable energy use is a big part of building back better

Creating Private Sector Leadership on Climate Change

ANIRBAN GHOSH
Chief Sustainability Officer, Mahindra Group

Congratulations to Shakti Foundation on their remarkable journey over the last decade. India is progressing rapidly towards a future powered by green energy and a lot of credit goes to Shakti for their pioneering work in the space of renewable energy.

As I write this, we continue to deal with the random uncontrolled disruption caused by the SARS-CoV-2 virus (COVID-19); people are yet to recover from the effects of a lockdown of unforeseen proportions; though vaccines have given us a ray of hope, we cannot afford to let our guard down. We are witnessing the wheels of the economy restart, slowly but surely.

Milton Friedman once said, “Only a crisis - actual or perceived - produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around.” The COVID-19 disruption is a crisis; if ever there was one. And one idea that is lying around is about building back better. An idea that can ensure that we don’t succumb to the slow poison of climate change even as we dodge the COVID-19 bullet.

Enhancing renewable energy use is a big part of building back better. We know that the Stone Age did not end when we ran out of stones. It ended because man found better alternatives to stone. The same will be the case for the transition from fossil fuel powered energy to renewable energy.

A ground-breaking development during the lockdown was the announcement that ReNew Power had won the auction for a 400 MW solar power project at a levelized tariff of ₹ 3.52/unit for 15 years including the cost of storage. This was lower than the thermal power tariff of ₹ 4.5/unit as the price of solar power plus storage

plunged lower than thermal power for the first time. A barrier has been breached and this is, without doubt, a harbinger of things to come.

The combination of energy efficiency and renewable energy will make a serious dent on emissions from the energy sector which accounts for 68.7 per cent of GHG emissions. Around the time ReNew Power was making its landmark bid, Mahindra Heavy Engines Private Limited (MHEPL) announced that it had doubled energy productivity in an unbelievably short time of four years. MHEPL had joined The Climate Group’s EP100 program and had committed to double energy productivity in 25 years. But given its commitment to

the cause and access to cutting edge technologies, it completed the task in only four years. The achievements of ReNew Power and MHEPL clearly show that it is possible to accelerate the adoption of renewable energy and achieve high levels of energy efficiency.

It is in the interest of corporations and government to accelerate the progress of renewable energy and energy efficiency because every rupee invested in these projects positively impacts the triple bottom line - giving handsome economic returns, enabling accelerated achievement of climate goals and creating green jobs. Today, technological solutions to build back better are available and the private sector can deliver; all we need are visionary policies to hasten the adoption of green solutions and slay the horcrux of the Indian Discom situation.

This is what makes Shakti Foundation’s next decade likely to be even brighter than its first. May the Force be with the team at Shakti to enable path-breaking progress towards a more sustainable future.

Today, technological solutions to build back better are available and the private sector can deliver

Enabling Cities



Bridging the Knowledge Gap on Air Quality

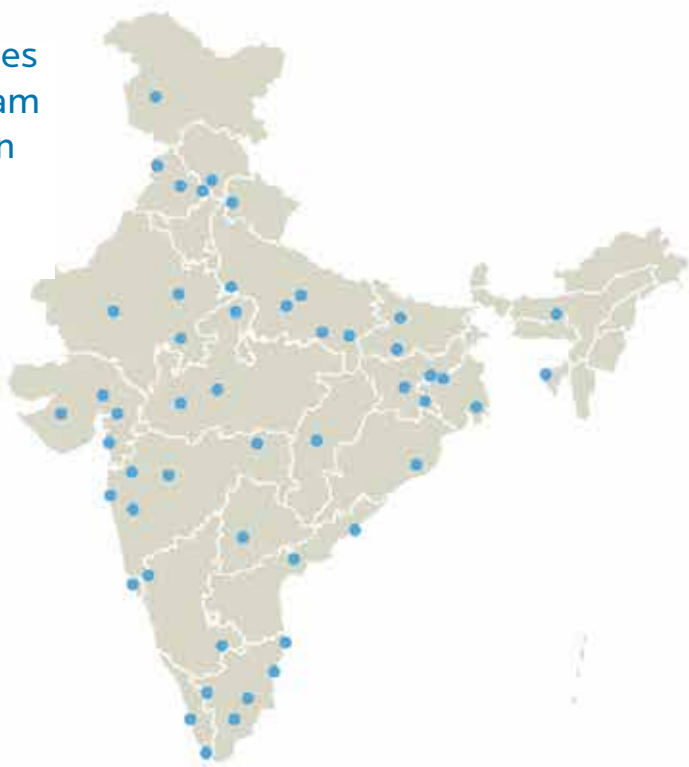
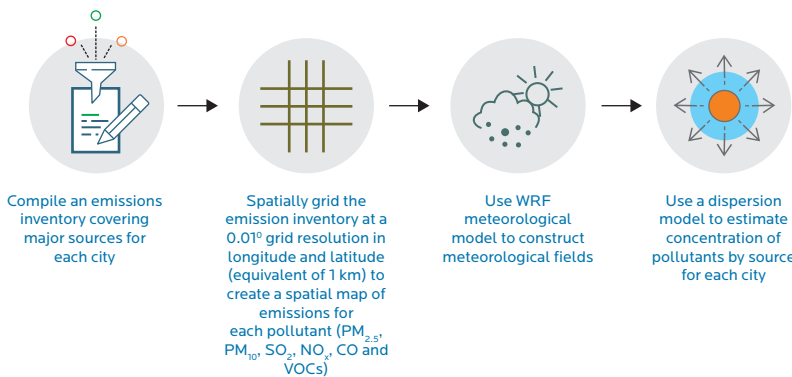
There is a limited understanding of the extent of air pollution in most Indian cities. Shakti supported air pollution assessments in 50 cities

Hazardous levels of air pollution in Indian cities pose a severe threat to public health. A majority of cities, both metro and smaller ones, are emerging as pollution hotspots. Air pollution was the fourth leading risk factor for premature deaths globally, accounting for nearly 12 per cent of all deaths, with more than 6.67 million in 2019 alone¹.

We have only a limited idea of the scale of pollution in Indian cities, except for a few major cities where continuous monitoring data is available from more than one station. With the lack of systems, impacted cities generally resort to ad-hoc methods to deal with increased pressure on existing infrastructure. Indian cities need to start planning by anticipating the challenges they would face; as they grow and be proactive about solutions to reduce air pollution. To address urban air pollution, cities need to draft and implement well-designed air quality management plans (AQM). Information and data are prerequisites for effective AQM. This involves creating a detailed information database that includes pulling together data from disparate sources, surveys, mapping and atmospheric modeling.

Many of these 50 cities covered in the program saw their air pollution profiles for the first time

Shakti facilitated Air Pollution Knowledge Assessment (APnA) city program. A one-of-its-kind program, APnA generated air pollution baselines, sources and projected trends for 50 cities using a scientific air quality modeling approach—an important starting point for city governments and stakeholders to chart out strategies for better air quality. The APnA program with a database of emissions and source contribution assessments by each sector is unique and aims to contribute towards the understanding of urban air pollution



IMPACT

Patna was the first city to immediately sanction five additional monitoring stations for the city, based on the recommendations of the APnA report. The city even went ahead to develop and adopt a robust and scientific action plan based on the APnA assessment. Other cities like Gaya and Muzaffarpur are currently undertaking detailed source apportionment studies. These city-wise reports generated by the APnA program also informed the development of the National Clean Air Program (NCAP).

¹<https://www.stateofglobalair.org/sites/default/files/documents/2020-10/soga-global-profile-factsheet.pdf>

Clean Air for All

Mitigating air pollution will have a beneficial impact not only on human, but also on India’s economic health. Shakti facilitated the CEO Forum on Air Quality to deliberate on the role that industry can play in supporting air quality improvements, technology advancements, financing and innovation

In India, more than 100,000 infants died within the first month of birth due to health issues resulting from exposure to household and ambient air pollution. More than a million die in India every year as a result of outdoor air pollution, stroke, heart disease, lung cancer and chronic respiratory diseases. In addition to the human health impacts, poor air quality has been shown to be responsible for nationally aggregated (for wheat and corn) crop loss, enough to feed about 94 million people every year. Particulate matter is also known to impact the regional monsoon and rainfall circulation in India. Hence, acting on ambient air quality will have multiple benefits on human health, crop yields and climate change related phenomena.

Solutions to improve air quality and consistently manage it will take a combination of long-term planning, conformance to policies and voluntary leadership to achieve India’s National Ambient Air Quality Standards (NAAQS). Recognizing that industries are significant contributors to air pollution, as well as an important part of the solution, key Indian corporates assembled thrice between May 2017 and March 2018 to identify high leverage actions.

The forum outlined the key principles that would facilitate decision making and shaping initiatives towards the objective of achieving “Clean Air for All”. These principles were built across a series of CEO round tables co-facilitated by World Resources Institute India and Shakti. The final communiqué also underlined key policy actions and voluntary business commitments towards subscribing to Government of India’s vision of 35 per cent emission cuts in 100 large cities in the country.

IMPACT

To facilitate decision making, CEO Forum released a communiqué outlining specific recommendations, policy asks and voluntary commitments that businesses can make to achieve the vision of “Clean Air for All”. The communiqué highlights the importance of concrete actions aimed at building capacity within existing set-ups, driving voluntary business action and collaborating across segments to build clean air action plans as well as mainstream control measures. These efforts are an important step ahead by businesses to respond to the air pollution challenge.

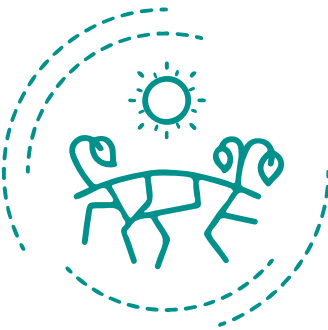
¹ State of Global Air 2020, <https://www.stateofglobalair.org/health/newborns>

² Brown to Green Report, 2019, <https://www.climate-transparency.org/wp-content/uploads/2019/11/Brown-to-Green-Report-2019.pdf>

³ <https://www.wri.org/blog/2019/06/5-under-recognized-impacts-air-pollution>

⁴ <https://shaktifoundation.in/wp-content/uploads/2018/07/AQ-CEO-Communique.pdf>

More than 100,000 infants died within the first month after birth due to health effects related to exposure to household and ambient air pollution



Poor air quality has been shown to be responsible for a nationally aggregated (wheat and corn) crop loss, enough to feed about 94 million people every year

Reducing Air Pollution in Patna

Patna Clean Air Action Plan, launched in November 2019, made Patna the first city in Bihar to have a comprehensive plan to tackle air pollution, backed by a rigorous scientific methodology. The plan is both timely and relevant for Patna, one of the five most polluted cities in the world and a non-attainment city under the National Clean Air Program (NCAP). Shakti supported the development of the plan

In recent years, Patna has emerged as one of the most polluted cities in India and was ranked the 5th most polluted city in terms of particulate matter, globally, in 2016 (WHO, 2016). The city has experienced (annually) PM2.5 levels of 117.48 µg/m3 in 2018 (CPCB, 2018), compared to acceptable levels of 40 µg/m3. Rapid urbanization and industrialization have greatly contributed to the ever-rising levels of air pollution in the city. Transportation sector, industries, brick kilns and biomass burning are the major contributors to Patna's deteriorating air quality.

Shakti supported a consortium of research institutions—Centre for Environment, Energy and Climate Change at the Asian Development Research Institute (ADRI), Center for Study of Science, Technology and Policy (CSTEP) and Urban Emissions—under the aegis of Bihar State Pollution Control Board (BSPCB).

Based on extensive research on major polluting sectors, the plan proposes control measures as well as their techno-economic feasibility. According to estimates arrived at by the study, by 2030, under the business-as-usual (BAU) scenario, total PM2.5 emission load will increase to 28,000 tonnes per year as against 20,000 tonnes per year, taking 2018 as the base year.

Patna Clean Air Action Plan identifies several measures to reduce pollution from different sources. Increasing the share of public transport to 40 per cent and introducing EVs and CNG vehicles could reduce transport sector emissions by about 10 per cent. Installing solid waste management facilities and enforcing stricter laws on garbage burning can reduce emissions from the waste sector drastically. Thirty-four per cent of the emissions from brick kiln related air pollution can be targeted by converting brick kilns from their current fixed chimney kiln model to the less polluting zig-zag model. Under the best-case scenario, the Patna Clean Air Action Plan can result in reducing emissions in the city by 69 per cent by 2030 on the 2018 baseline.

IMPACT

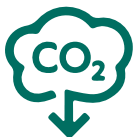
BSPCB conducted source apportionment studies and released clean air action plans for Gaya and Muzaffarpur. At the national level, Patna's plan can be used as a template for other cities to develop their own clean air action plans.



NCAP will help reduce transport sector emissions by about 10 per cent and increase the share of public transport to **40 per cent** by introducing EVs and CNG vehicles



34 per cent of the emissions from brick kiln pollution can be targeted by converting brick kilns to zig-zag chimney model



Under the best-case scenario, the Patna Clean Air Action Plan has the capacity to cut down emissions in the city by **69 per cent** by 2030



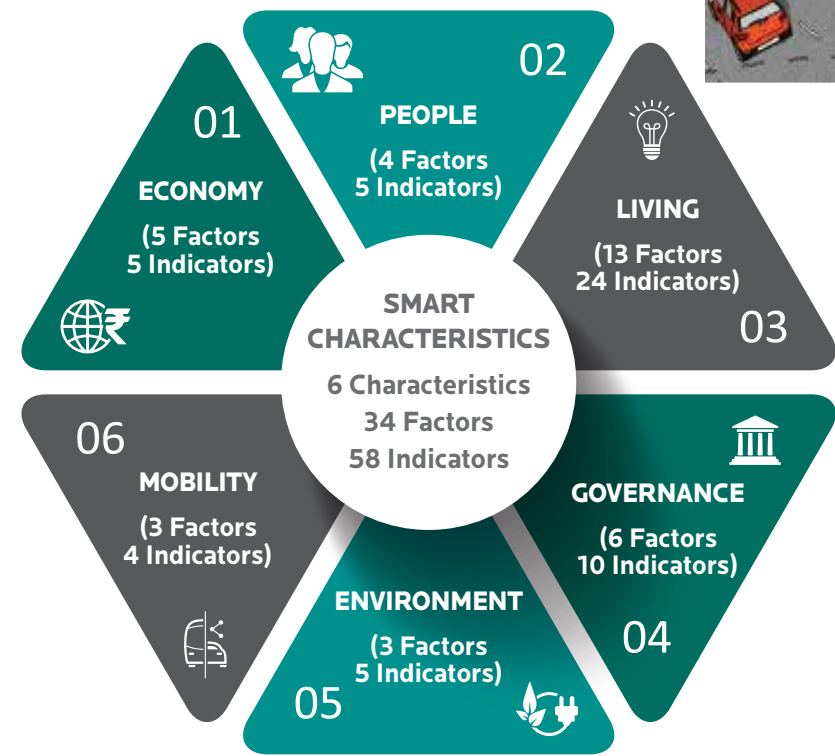
70 per cent waste segregation would result in reducing **90 per cent** of emissions from waste burning



Shifting from traditional chulhas to smokeless chulhas/induction and LPG stoves will help reduce emissions by **35 per cent**

Shaping Future Cities

India's urban population will double to more than 600 million by 2030. Urban centres will house 40 per cent of the country's population and contribute 75 per cent of the GDP. How we manage this change has huge implications for our citizens, economy and environment



IMPACT

Shakti's efforts were rewarded when all the four cities supported in developing smart cities proposal made it to the list of first 20 Smart Cities identified for the first round of funding through the Smart Cities Mission. Visakhapatnam, Kakinada, Jaipur and Udaipur, along with the other cities, were sanctioned up to ₹ 1000 million funding annually from the central government for five years. Our subsequent support to Udaipur, Gwalior, Visakhapatnam, Ludhiana, Jaipur and Chennai in implementation of the projects has led to street redesigns in support of non-motorized transport, development of draft parking policies and parking management strategies, pilot projects for electrification of autorickshaws and e-busses.



The Smart Cities Mission is an ambitious multi-year effort to make Indian cities much more livable and prosperous. It aims to promote sustainable and inclusive growth by creating a replicable model for aspiring cities, driving economic growth through technology enabled solutions.

To support the Smart Cities Mission, Shakti facilitated the adoption of sustainable energy-efficient solutions for urban transportation using a network of organizations in urban planning, finance, policy and similar areas. Shakti helped design and catalyze solutions that make the fast-growing urban environment more resilient to future challenges.

Working closely with strategic partners - ICLEI and C40 - Shakti supported the development of Smart City proposals of four cities – Visakhapatnam and Kakinada (Andhra Pradesh), and Jaipur and Udaipur(Rajasthan), and supported project implementation in the second phase in Udaipur, Gwalior, Visakhapatnam, Ludhiana, Jaipur and Chennai. The support covered a wide range from public transport, walking and cycling solutions, vehicle restraint measures, parking management, regulations for paratransit, adoption of intelligent transportation systems, digital ticketing and electrification of buses and paratransit. In Chennai, we also supported the development of Chennai's Global Protocol for Community complaint Greenhouse Gas Emissions inventory.

The Smart City Index, supported by Shakti, ranks cities on important criteria such as economy, governance, environment and mobility so as to provide an indication of their 'smartness'. This index allows comparisons between cities and ranks them based on how they perform. It also assesses improvements over time and serves as a tool to measure a city's livability and smartness.

Facilitating Investment in Sustainable Transport

Lack of adequate financing for sustainable transport presents a significant challenge to promoting low-carbon transport in cities. Shakti supported Janagraaha's work on municipal finance reforms, which plays a crucial role in transforming urban mobility

It was estimated that between 2012 and 2032, Indian cities will require about ₹ 800 billion¹ to meet the demand for urban transport services, primarily, to address the current backlog in urban transport infrastructure and meet future requirements.

Urban local bodies (ULBs) are dependent on central and state grants, generating only a third of their expenditure, which constrains their ability to invest adequately to create sustainable transport infrastructure. Cities will have to seek recourse through other means, including the issuance of municipal bonds. While the potential of India's municipal bond market is high, it remains untapped and few ULBs have experience of raising funds through the bond market. Besides, to evoke investor interest,

ULBs must significantly improve financial management practices, including developing and releasing audited financial statements to raise their credibility, showcase their financial performance and map their assets. However, less than 10 per cent of the cities in India currently prepare audited financial statements.

Shakti supported the development of a model annual report for Udaipur Municipal Corporation and Balotra Municipal Council, Rajasthan, with an overview of the ULBs' key accomplishments. Shakti also supported efforts to strengthen the fiscal management system of these ULBs to promote better utilization of resources, identify new revenue streams and develop a roadmap to raise resources from the bond market to fund sustainable development projects.

IMPACT

The model annual reports prepared for Udaipur and Balotra now serve as templates for other ULBs. 108 ULBs in Rajasthan have prepared their audited financial statements using this framework. For its role in helping ULBs become more financially sustainable, the Directorate of Local Bodies in Rajasthan received the HUDCO Award 2017-18 for 'Best Practices to Improve the Living Environment'.

Recommendations from the effort were shared with the XVth Finance Commission and found a place in the commission's report, leading to the development of a portal for MoHUA (www.cityfinance.in), which provides a national framework for standardized financial information on cities.

A toolkit for property tax reforms was also developed, supporting reforms to property tax mandated by the XVth Finance Commission and the conditions laid down by Ministry of Finance for additional borrowings by states under the Atma Nirbhar Bharat Abhiyan (property tax reforms are tied to nearly ₹ 500 billion of borrowings).

¹ Ahluwalia, "High Powered Expert Committee Report on Estimating the Investment Requirements for Urban Infrastructure Services."



In order to evoke investor interest, urban local bodies must improve financial management practices

Strengthening Urban Design

Innovative urban planning approaches, such as transit oriented development, can make the city accessible through walk, cycle or public transport, greatly reducing the demand for motorized transport and energy use. Shakti has supported efforts to adopt transit oriented development in Indian cities, through technical assistance and capacity building measures with Indian cities.

India is slated to double its urban population in the next 20 years, urbanizing at faster rates than ever before. With most of our cities of the future yet to be built, we have an opportunity to ensure that they are built in a manner that supports the use of sustainable transport while providing access to all and combats deteriorating air quality, congestion, increasing GHG emissions and rising road fatalities. This requires that our cities are planned in a manner that the city is accessible through the use of non-motorised modes such as walking, cycling and public transport. Adopting the principles of transit oriented development (TOD) can make this possible. TOD is a globally recognized approach which offers cities a unique solution to encourage transit use by providing high-density, mixed-use and pedestrian-friendly neighbourhoods within walking distance of high-quality public transport systems.

The national TOD policy, released in 2017 by Ministry of Housing and Urban Affairs (MoHUA), acknowledges the importance of cities adopting TOD within their master plans. Many states have adopted and released their own TOD policies. Some cities in India also have made a start on using TOD in their master plans – the Delhi master plan has an entire section dealing with TOD provisions, while Ahmedabad has delineated transit oriented zones (TOZ) as part of its development plan and is in the process of preparing detailed local area plans. Bengaluru is in the process of preparing station area plans.

However, despite these policy actions, two critical barriers to implement TOD remained unaddressed. The first was the lack of adequate urban planning tools that enabled area level planning and design interventions necessary for TOD; the second was the challenge of sustainable funding for high-quality transit and urban infrastructure required for TOD.

Recognizing this, Shakti supported National Institute of Urban Affairs (NIUA) to provide technical assistance to National Capital Region Transport Corporation

(NCRTC) on overcoming these barriers while implementing TOD along the proposed Delhi-Meerut Regional Rapid Transit System (RRTS). Over a period of two years, NIUA provided targeted inputs to NCRTC on implementing this project, incorporating the means to sustainably finance TOD through value capture finance (VCF) mechanisms.

In an effort ensure the redevelopment of railway stations areas by the Indian Railway Station Development Corporation (IRSDC) could occur as per the principles of TOD, Shakti supported the development of the first-of-its-kind form-based codes to guide station area redevelopment. Form-based codes was preferred over the commonly used land-use based development regulations to ensure greater control over the built form using a combination of layout plans and property development cards for regulating buildings, streets, layouts, green-building guidelines, building volumes and open space around railway stations. Form-based codes ensure that the development of a high-quality public realm around our railway stations that are compact, mixed-use, pedestrian-friendly and market-responsive, while discouraging private motor-vehicle use.

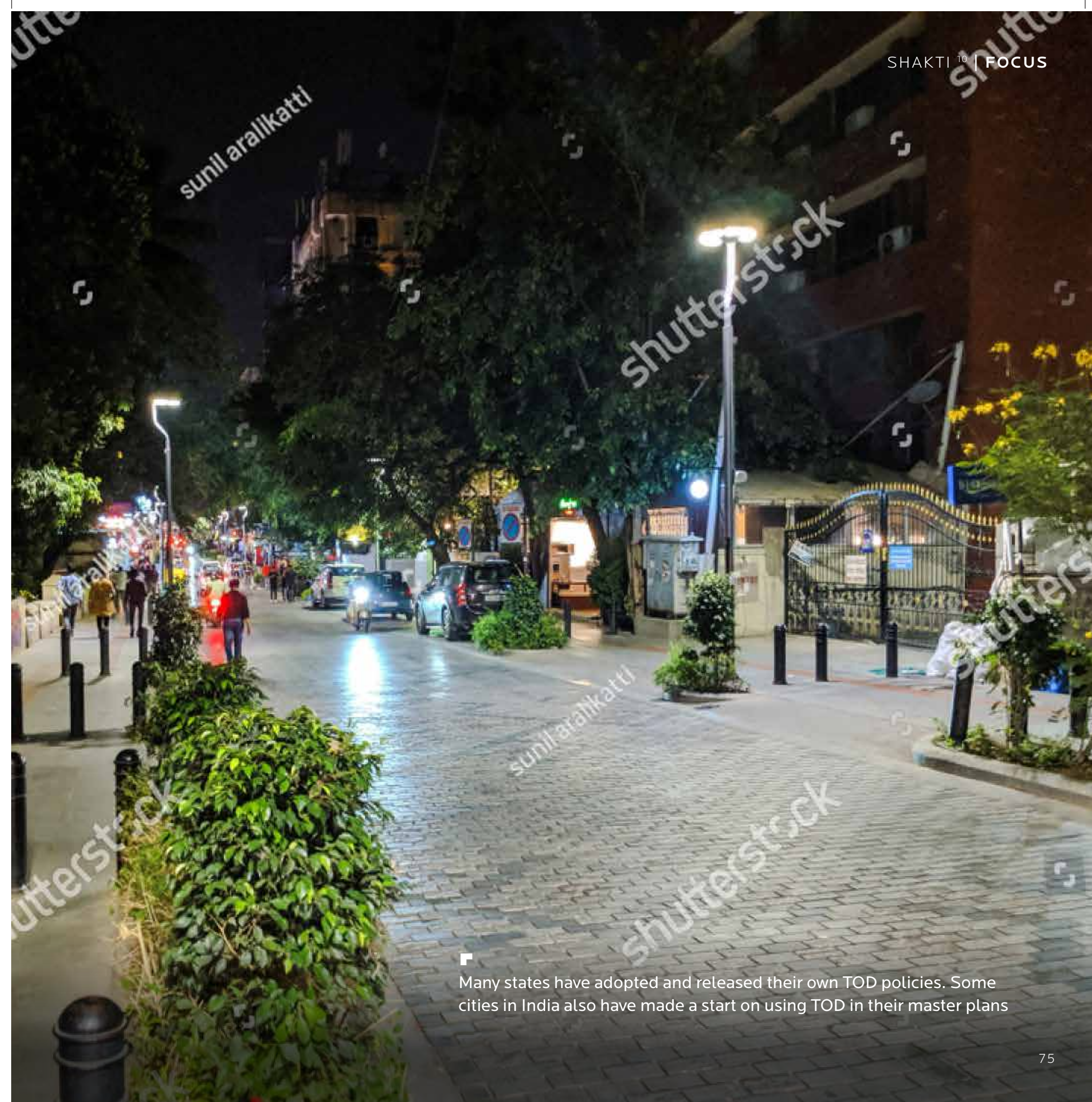
Shakti supported CEPT University, Ahmedabad, to review the effectiveness of the existing TOD plans in Indian cities in meeting their objective of increased transit ridership. The project developed guidelines on housing mix (high, medium and low-income housing), optimal parking provisions that limit car and two-wheeler usage and street design guidelines to be adopted within TOD zones. The governance and institutional mechanisms to incorporate TOD provisions in the urban planning and development processes through local area planning were also established through an illustrated guidebook.

❁ IMPACT

A detailed report on value capture financing for Delhi-Ghaziabad-Meerut RRTS corridor and a comprehensive report detailing non-fare box revenue for the entire corridor was submitted to Uttar Pradesh government. Subsequent to the effort, the technical team that worked on the project was absorbed by NCRTC for further projects.

Form-based codes developed for IRSDC are currently being piloted for station redevelopment in Chandigarh, Anand Vihar (New Delhi), Bijwasan, Nagpur and Gwalior. On successful completion of testing, these codes would guide the development of close to 60 stations in the first phase and subsequently inform the redevelopment of all railway stations. Its use has the potential to influence cities all over the country to adopt TOD and form-based codes as to tool for TOD implementation.

The handbook on local area planning for implementing TOD was used to train 360 town planners belonging to 25 cities from across the country. Through these training, cities under the AMRUT program, would pilot local area planning in their cities. It is hoped that through this effort and the familiarity gained, there would be greater adoption of local area planning and implementation of TOD across cities in India.



Many states have adopted and released their own TOD policies. Some cities in India also have made a start on using TOD in their master plans

Shakti is exploring new opportunities, many of which have come from its past work. Amongst them are opportunities for creating an eco-system for financing a green and sustainable public transport infrastructure, sustainable thermal cooling across the spectrum of Indian society and greening corporate India's footprints



Exploring New Opportunities and Learning from the Past

DR HARISH HANDE

Founder, SELCO India

Director, Shakti Sustainable Energy Foundation

The decades between 2020 and 2040 are critical for India to make sure it creates a sustainable growth path for itself while trying to ensure it is on track for UN Sustainable Development Goals. The issues in India range from mass transportation to large scale livelihood opportunities in the agricultural space. The sectors needing interventions in clean energy span health, education, livelihoods and urban planning. Thus, it is critical for India to have a coherent strategy with a set of policies that can lay equal importance on all the sectors. Unfortunately, there are very few organizations in India that can play the role of providing an overall analysis of the problems and suggest potential solutions.

Shakti has become a much-valued neutral agency that is a one-stop knowledge bank in the country for issues related to sustainable energy policies and as an organization, it is well positioned to represent all the stakeholders in the sector. It works with well-known grassroots implementing entities, state level government entities, national and international think tanks and Government of India.

Shakti has been able to provide an overall view of multiple sectors related to sustainable energy. It can map out the gaps and is able to work with experts and related organizations to evaluate the best possible replicable solution. The findings are then converted into appropriate policy papers which are then taken to appropriate government entities for large scale policy change.

Over the last ten years Shakti has grown to a big influencer in the Indian policy landscape. It has been instrumental in bringing to fore policies that are India centric and can be replicated in other developing countries without compromising sustainable development while pursuing prosperity for all citizens.

As we stand at the cusp of a new decade, Shakti is exploring new opportunities, many of which have come out of Shakti's past work. This includes opportunities for creating an eco-system for financing green and sustainable public transport infrastructure, roadmaps for ensuring sustainable cooling and thermal comfort across the spectrum of Indian society, greening corporate India's footprints and many others. Shakti has also responded with alacrity to the opportunities thrown up by the COVID-19 pandemic, expanding its cold chain work to encompass vaccine delivery and to bring primary health centres under the Decentralized Renewable Energy (DRE) umbrella.

These initiatives will put India firmly on the path to sustainable low-carbon development in the years to come and act as precursors for more initiatives by others in field.

The issues in India range from mass transportation to large scale livelihood opportunities in the agricultural sector. It is critical to evolve a coherent strategy with an equal emphasis on all such sectors.



EMERGING OPPORTUNITIES

In the new decade, Shakti will continue to explore more ways to deepen India's decarbonization efforts and stay on the path to climate mitigation and resilience



Leading the Transition to Zero Emission Vehicles

The urgency to counter rising emissions from the transport sector while combating deteriorating air quality presents a strong rationale for India to transition to zero emission vehicles. From supply-side policies to creating mechanisms that incentivize the adoption of zero emission vehicles to the creation of accessible charging infrastructure, Shakti remains at the forefront of this transition

India's electric mobility journey started with the launch of the National Electric Mobility Mission Plan 2020 (NEMMP) in 2013 and its flagship program Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) in 2015. In 2019, Government of India renewed the FAME scheme, launched the National Mission on Transformative Mobility & Battery Storage and provided income tax rebate and reduction in GST for zero emission vehicles (ZEVs). Several states have also brought out ZEV policies to promote the manufacturing and adoption of ZEVs.

There are four key challenges in scaling up the adoption of ZEVs in the country - limited availability of ZEV models, high cost of vehicle acquisition, lack of charging infrastructure and low awareness among stakeholders. India's infrastructural challenges being unique, best practices identified in advanced international markets may not be feasible or effective in Indian conditions, requiring the development of tailor-made solutions. Shakti will continue to deploy its efforts in informing indigenous policy solutions to overcome the barriers affecting the uptake of ZEVs in India.

Current Portfolio

Shakti has worked with 14 different civil society organizations on different aspects of electric mobility in five strategic areas - creating policies supportive of a EV manufacturing ecosystem, creating mechanisms to incentivize the adoption of ZEVs, supporting the creation of accessible charging infrastructure, pilots in key cities and increasing awareness among stakeholders to drive faster adoption.

In order to build the ZEV manufacturing ecosystem in the country, Shakti supported a project to assess the impact of ZEV transition on growth in vehicle sales and on jobs under various scenarios. Shakti also supported a study to suggest deployment strategies and the mix of policy instruments required for bringing down the cost of EV batteries in India.

Through inputs to FAME's e-bus guidelines, efforts supported by Shakti informed the design of India's primary demand incentive program and we continue to support its implementation. To ensure ambitious state-level incentives, efforts supported by us helped Delhi, Kerala and Telangana to design and implement their ZEV policies. Shakti is also working in these states along with Uttar Pradesh and Karnataka to ensure adequate support for the deployment of charging infrastructure. Besides, as a system integrator assisting state agencies and catalyzing pilot initiatives, Shakti is also supporting e-bus deployment in Uttarakhand, Karnataka, Gujarat, Delhi and Tamil Nadu.

Shakti supported the development of a handbook that provides guidance and helps city governments interested in deploying and improving e-rickshaw operations as well as supporting the development of a roadmap for urban freight electrification, in order to support the identification of operational use cases that can help electrify freight delivery at scale.

Going Forward

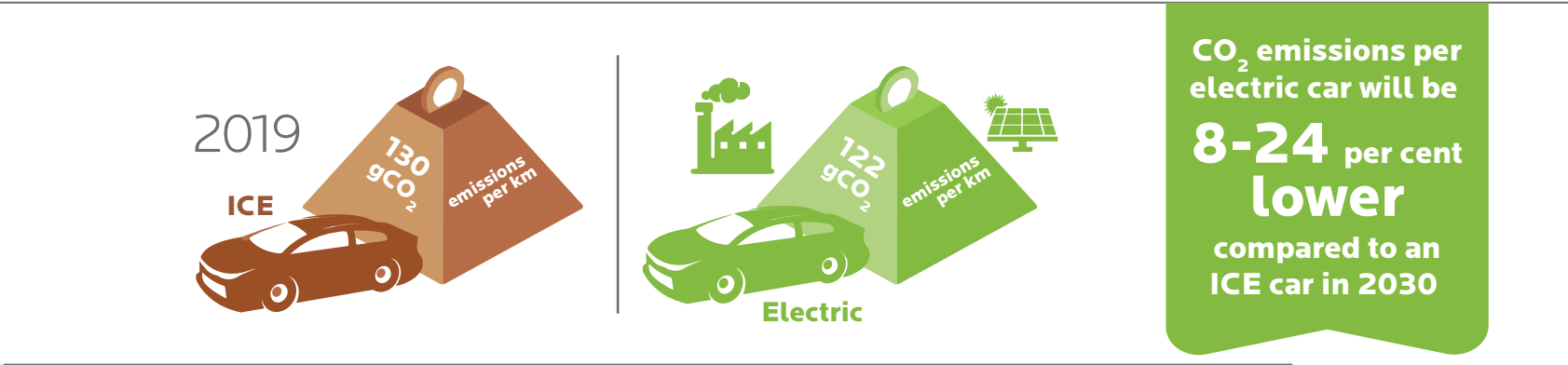
Shakti will continue working towards identifying gaps in the existing policy landscape and create enabling market conditions and industry linkages and develop policy insights that foster ZEV manufacturing, enable competition, improve product availability and ultimately, drive faster adoption of ZEVs at scale.

Shakti will support government initiatives by deploying efforts in effective designing fiscal and non-fiscal incentives, support the electrification of shared, public and private vehicles and create a well-distributed public charging infrastructure.

Shakti plans to undertake a geography-specific collaborative approach to demonstrate success in key areas such as Delhi, Telangana, Karnataka, Rajasthan and West Bengal.

These will be the "lighthouse" states that lead the electric mobility transition and showcase best practices for others to follow. Shakti will engage with urban local bodies to identify gaps, barriers and opportunities at the city level for ZEV acceleration, and continue to support the creation of charging infrastructure by identifying regulatory reforms to facilitate charging infrastructure and leverage EVs as a grid resource.

Shakti also plans to work on exploring viable business models for Discoms and charging infrastructure providers, enabling renewable energy integration, and effective public-private partnerships to ensure large-scale deployment.



¹ <https://www.ceew.in/publications/india%E2%80%99s-electric-vehicle-transition>

² <https://www.ceew.in/publications/india%E2%80%99s-electric-vehicle-transition>

Our Right to Breathe

Under the National Clean Air Program, Shakti is supporting 15 Indian cities to develop Clean Air Action Plans to enable these city administrations to implement source-specific pollution control measures

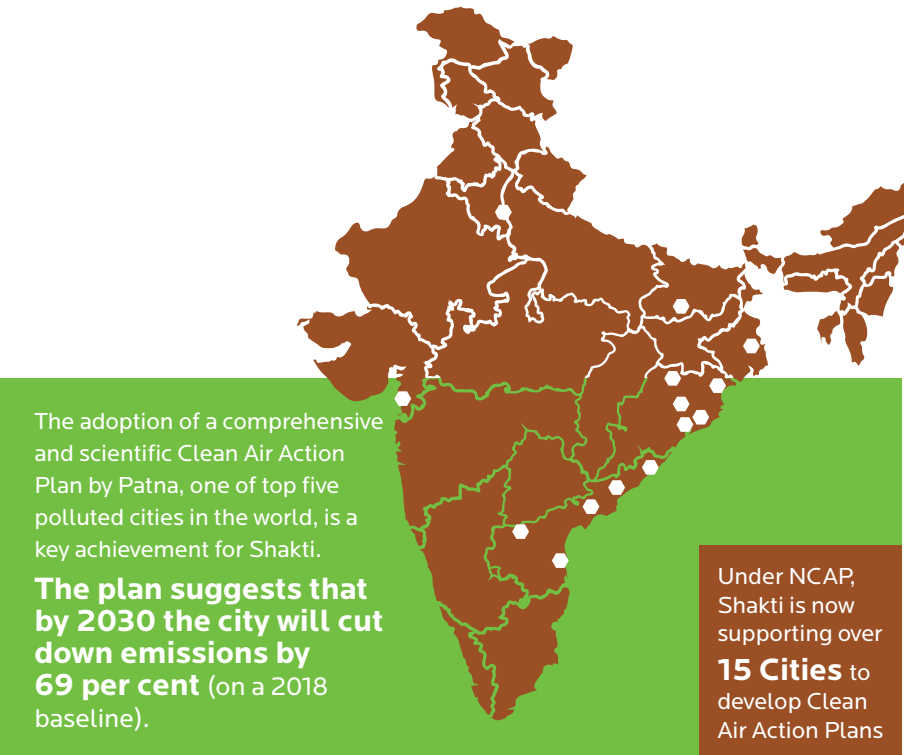
Indian cities regularly make headlines on account of poor air quality. Recognizing the urgency and complexity of this challenge, the MoEFCC initiated the National Clean Air Program (NCAP) in January 2019. NCAP aims to reduce PM2.5 and PM10 concentrations by 20-30 per cent against a 2017 baseline by 2024 and identifies 122 non-attainment cities, that are required to submit clean air action plans. It also aims to expand the national air-quality monitoring network, build capacity for air pollution management and strengthen public awareness. NCAP will be integrated with existing policies and programs, including the National Action Plan on Climate Change (NAPCC) and other Government of India initiatives on climate change.

Shakti facilitated the development of the Comprehensive Action Plan and Graded Response Action Plan (GRAP) for Delhi-NCR, which led to the formation of the NCAP. Under NCAP, Shakti is now supporting over 15 cities to develop clean air action plans. These cities are Surat, Patna, Delhi-NCR, Bhubaneswar, Cuttack, Angul-Talcher, Rourkela, Balasore, Kolkata-Howrah, Vijayawada, Vishakhapatnam, Guntur, Kurnool and Nellore.

The adoption of a comprehensive and scientific Clean Air Action Plan by Patna, one of top five polluted cities in the world, is a key achievement for Shakti. The plan suggests that by 2030 the city will cut down emissions by 69 per cent (on a 2018 baseline).

Shakti is also supporting the establishment of a pollution control program management unit (PMU), under the aegis of Bihar State Pollution Control Board. The PMU will provide technical assistance to line departments for implementing control measures across sectors and to create awareness and engage citizens in improving air quality management in future.

Currently, air quality monitoring is being used to issue health advisories, keep agriculture fire count information, profiling pollution sources in cities and tracking the impact of transportation on pollution, among others.



Going Forward

Shakti plans to support NCAP rollout further by working on broad themes such as building capacity for environment regulators and policy makers at the state level and strengthening the technical knowledge base of cities.

Shakti will support and build capacity of environment regulators and policymakers at state-level towards tackling air pollution and expediting implementation of NCAP. In cities where plans have already been developed, Shakti proposes to enable the city administrations to implement the identified source-specific pollution control measures.

Shakti is also strengthening the technical knowledge base of cities that can help identify most feasible control measures for a city. Converting knowledge on the impacts of air pollution into action can help in assessing exposure to pollution of people working in open areas, especially vulnerable workers in informal and formal sectors and communicating the health impacts of ambient air pollution through hospitals and health professionals.

Shakti plans to work on strategies to improve air quality by advancing advocacy and capacity building to reduce emissions from the transport sector or accelerating adoption of cleaner and more efficient practices in the brick kiln sector as well as on strengthening the data regime for effective air quality management in India.

Climate Friendly Cooling Solutions

Combined with heat waves spurred by climate change, a growing population and rapid urbanization, the need for clean and sustainable cooling solutions is more urgent than ever. Shakti will continue to support efforts to advance policy and address technology, regulatory, cost and market-related challenges in mainstreaming sustainable cooling solutions

India is one of the first countries in the world to develop a comprehensive cooling action plan, with a long-term vision of making cooling sustainable and accessible to all, address its cooling requirements and list out actions that will help reduce cooling demand. In adopting the Kigali amendment with nearly 200 other countries, India sent a clear message to the world on the need to transition to ozone-friendly, climate-friendly alternatives. In the aftermath of Kigali, Shakti continued to support forward-looking efforts, such as a first-of-its-kind study on community cooling hubs and improving servicing and installation practices in the AC sector to make systems more safe, reliable and climate-friendly.

In March 2018, ministry of environment, forest and climate change (MOEFCC), prioritized the drafting of a national cooling action plan, creating six thematic working groups—space cooling and cold chain, air conditioning and refrigeration technology, R&D and production, servicing, transport air conditioning, and cross-cutting policy regulation.

MOEFCC engaged Shakti’s grantees, Alliance for an Energy Efficient Economy (AEEE), Centre for Energy Environment and Water (CEEW)and The Energy and Resources Institute (TERI), many of whom, by virtue of being a part of the Sustainable Smart Space Cooling Coalition¹, had the expertise required to contribute to the plan. AEEE, CEEW and TERI led four of the thematic working groups working on the ICAP. Another grantee, Centre for Science and Environment (CSE) was a member of the thematic group on R&D and production. They submitted a number of critical recommendations to address cooling requirements across sectors. Since much of the groundwork had already been laid, these think tanks were able to develop their recommendations within a few months.

ICAP was unveiled in March 2019, and in line with India’s commitment to the Kigali Amendment to the Montreal Protocol, it provides an integrated roadmap for space cooling, transport, insulation and cold chain sectors for reducing their cooling demand, refrigerant transition, enhancing energy efficiency and better technology options over a 20-year time horizon.

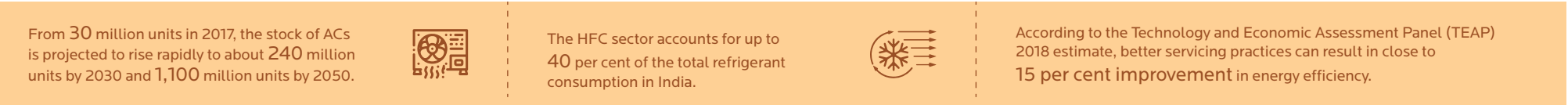
Going Forward

Among Shakti’s future focus areas under ICAP are HFC alternates. An economy wide impact assessment on introducing non-HFC based refrigerants and the creation of an information database for cognizant stakeholder action to help us create a roadmap for replacing HFC-based refrigerants. The development of safety and other standards for products based on HFC alternates, combined with skill development of technicians for installation and maintenance of these products, will support corporate action and spur market development for these products.

Another priority under ICAP is the development of roadmap for clean cold chain infrastructure. Shakti will assess various thermal requirements within the supply chain and the local community to design cooling as a service infrastructure, which could be funded by entrepreneurs and farmer producer companies. This infrastructure could then be utilized for various purposes—storing vaccines and medicines, to support food processing activities and fishery products. This will increase the commercial viability of the cold chain infrastructure and widen its social impacts.

Affordable housing is Shakti’s third area of focus under ICAP. For India to achieve its NDC goals, it is important that the building envelope of upcoming housing stock is complaint with Eco-Niwas Samhita (ENS) 2018 and ICAP to ensure thermal comfort for the occupants. Shakti is preparing a database of thermal and physical properties of commonly used walling materials so that the end users can make an informed choice.

We are also monitoring thermal performance and thermal comfort surveys of occupied affordable housing dwelling units of known Residential Envelope Transmission Value (RET²)².



¹Sustainable Smart Space Cooling Coalition was coalition of Civil Society Organizations for facilitating concerted stakeholder actions on energy efficient sustainable smart space cooling.
² RETV is the average net heat gain rate through the building envelope of dwelling units divided by the area of the building envelope of dwelling units. RETV is proportional to the sensible cooling demand (in case of air-conditioned buildings) and degree discomfort hours (in case of non-air-conditioned buildings). Lower the RETV, lower the number of degree discomfort hours/ sensible cooling demand. To comply with ENS, the RETV value should be ≤ 15 W/m2.

An Ecosystem for Energy Storage

With the continued growth of renewables, the global energy mix is inextricably linked to grid-level energy storage, which will provide the grid with abilities like rapid response, optimal cost operation, higher flexibility and lifetime. Shakti has been at the forefront of supporting the development of an enabling battery storage value chain in India

As India focusses on shifting its energy base to predominantly renewable sources, it is necessary to strengthen the electricity grid to continue supplying reliable and quality power. Shakti aims to support the development of a battery storage value chain, which is crucial for grid strengthening.

As India closes in on its 175 GW RE target, the cost of major renewables technologies such as solar and wind has fallen significantly, leading to greater deployment of these sources. However, the reliability of supply from these sources remains a concern because of their intermittent nature, which poses challenges to grid stability and security.

To achieve targets under the Paris Agreement, India must develop a low-carbon electricity grid predominantly based on renewable sources. In such a case, energy storage will play a crucial role in enabling grid stability for quality and reliable power supply. As technology matures, energy storage systems will find many more applications in the industrial sector, leading to enhanced production and job creation.

As energy storage systems emerge as essential parts of the evolving clean energy transition, fast tracking the creation of a favourable battery manufacturing ecosystem will augment the opportunity for radical economic and industrial transformation. Ambitious goals supported by concerted strategies and a collaborative approach will help India avoid import dependency on battery packs and cells as demand surges in the coming years.

According to NITI Aayog estimates, electric mobility and the use of batteries and other forms of storage in power systems will create a substantial demand for energy storage and large parts of this value chain can be localized in India. Considering the crucial role that storage can play in India's energy transition, Government of India has announced the National Mission on Transformative Mobility and Battery Storage along with the National Energy Storage Mission and a phased manufacturing program to stimulate energy storage.

NITI Aayog estimates that electric-mobility and the use of batteries and other forms of storage in power systems will create a substantial demand for energy storage and large parts of this value chain can be localised in India

Going Forward

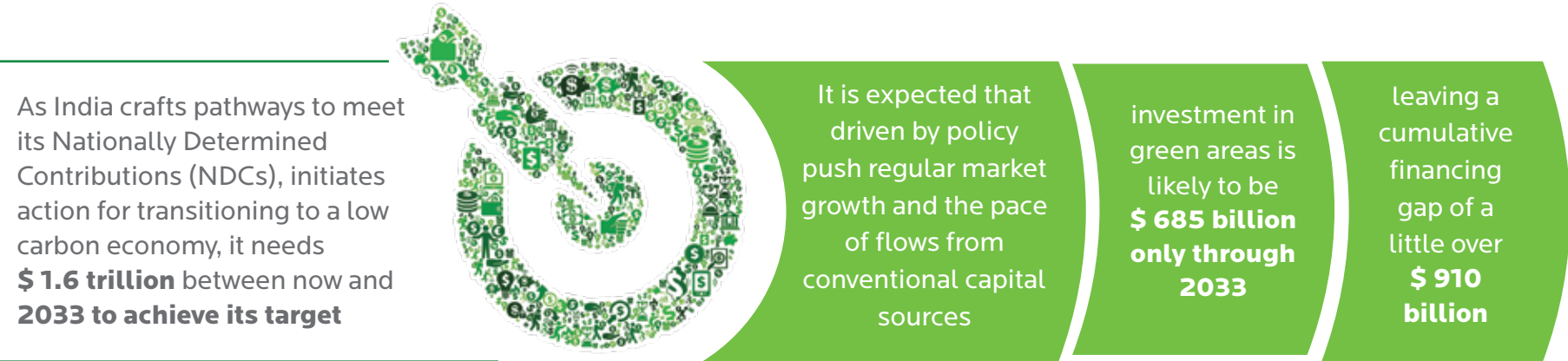
For a system integrator like Shakti, the opportunities lie in exploring prospects for increasing the deployment of energy storage systems, carrying out a detailed review of existing policy and regulatory landscape, identifying and bringing together key actors in the value chain to create an enabling ecosystem for large scale off-take, bringing together the policy makers and industry players to ensure the battery manufacturing industry booms in India.

While the two mission documents on storage are well developed to suit the need of intended audiences, issues related to their effective implementation remain unaddressed. Two major strategies identified by Shakti are extensive stakeholder consultations with policy makers, CSOs & research fraternity to inform policy discourse and provide technical assistance to Discoms.

Shakti will continue to analyze the implications and opportunities in this emerging scenario to best deploy resources in the areas that are necessary and critical in the energy storage domain.

Finance for a Low-Carbon Future

India’s transition towards low-carbon economic development requires capital inflow at scale. There is a need for the structural transformation of financial policy and regulations to help direct capital towards “green economic activities”. Addressing this need-gap, Shakti has supported the development of a framework for defining green finance in the Indian context



Thus, it is critical to tap additional public and private capital sources to ensure accelerated funding flows for supporting India’s low-carbon transition.

One of the ways to raise this additional capital would be to incentivize financial decisions in favour of low-carbon choices. On the other hand, we have seen other countries such as China, Indonesia and Bangladesh, anticipate this hurdle and draw up policies which facilitated the greening of their financial systems.

Several initiatives are necessary for a well-developed green finance ecosystem to emerge in India–these include building a consensus among public and private financiers on what green finance is and what economic activities it encompasses; a clearly articulated strategy that guides financial policies that are consistent with the principles of sustainability across government ministries and sector regulators; a robust green finance monitoring and tracking system and a precise understanding of the capacity of green finance to enable not just climate goals, but broader development and industrial goals amongst public and private financiers.

Shakti realized that there is an urgent need for all financial sector stakeholders to have a consensus on the meaning of “Green Economic Activity” while discussing greening of the financial system. Shakti supported

an initiative to develop a framework for defining “Green Finance” in the Indian context by creating a taxonomy for green economic activities as well as demystify other similar terms such as Socially Responsible Investing (SRI) and investing on Environmental, Social and Governance (ESG) criterion.

Shakti also realized that simply stating the case for investing in green economic activities would not be adequate. Financiers also need to understand the risks that climate change poses to their assets and portfolios and how continuing to investing in ‘non-green activities’ will only increase these risks. To this end, Shakti has supported Intellectap Advisory Service to baseline the understanding of climate risk and its pricing for Indian financial institutions.

The current policy scenario is India is not designed to promote green investments. While some policies promote investment in clean energy technologies, while some act as deterrents. Supporting the Council for Energy Environment and Water (CEEW), Shakti has initiated efforts to understand the effects of such misaligned policies on investments in favour of green activities.

Going Forward

Future efforts will focus on promoting the adoption of the green finance taxonomy and making it a term universally understood in the Indian financial world. Our efforts will also include capacity building of financiers to better understand and price climate risk involved in their decision making to ensure that more low-carbon choices are made. Other efforts will centre on creating an enabling policy ecosystem for the financiers to operate in.

Aligning Corporate Action and Climate Mitigation

Focused initiatives to reduce the GHG emissions from industrial activity is a definite ask for India to achieve its climate aspirations. Shakti has been involved in multiple initiatives aimed at aligning corporate actions to meet India’s climate goals

Many of Shakti’s initiatives have been focused on reducing corporate emissions as their primary objective. The work of the industrial energy efficiency program helps decrease Scope 1¹ and Scope 2¹ emissions¹, while initiatives such as the Green Power Market Developers Group (GPMDC) enable the shift of corporate energy sources to renewable or cleaner sources. There has also been some focus on developing carbon markets in line with Article 6 of the Paris Agreement², by bringing carbon pricing into the economic system through market mechanisms and carbon taxation.

Like their global counterparts, Indian corporates, too, fear that climate action will reduce profitability and competitiveness. Besides, there is little understanding on how climate change policy and actions will impact businesses. Even the few who do recognize the opportunities arising out of the global economy’s transition to a low-carbon pathway and the risks associated with climate change, do not understand how to proceed towards making the most of the opportunities available to them given the dearth of appropriate data.

Companies need more ambitious emission reduction targets, which ensure that the transformational action they take is aligned with current climate science. Despite setting environmental targets, their pace and scale may not be enough to make the required contribution towards achieving the Paris Agreement goals. The Science Based Targets initiative (SBTi) is the only benchmark framework available to measure against this uncertainty.

Towards addressing the issues of increasing corporate climate action, Shakti has been working on initiatives to enable the companies reduce emissions from their Scope 3¹ emissions and better align corporate climate action to a company’s strategic choices.

Going Forward

Projects with Confederation of Indian Industry (CII) look to upgrade corporate procurement practices by working with their supply-chains and ensuring that procurement criteria are expanded from technical specification and price considerations to include emissions considerations as well.

Concurrently, Shakti is looking to support an incubator for corporates to sign up to the SBTi, prepare the roadmap for emission reduction and then get these targets and road maps verified. Companies targets to reduce GHG emissions are considered “science-based” if they are in line with the goals of the Paris Agreement - that is to limit global warming to well below 2°C above pre-industrial levels and pursue efforts to limit warming to 1.5°C.

Additionally, Shakti is looking to enhance corporate reporting on climate risks and opportunities through promotion of standards such as the Taskforce on Climate related Financial Disclosures (TCFD).

As this area of intervention develops, Shakti sees greater promotion of corporate climate action leadership through supporting measures that improve disclosures of climate risks and reduction of Scope 3 emissions through target setting and carbon pricing.

¹ Scope 1 – All Direct Emissions from the activities of an organisation or under their control. Including fuel combustion on site such as gas boilers, fleet vehicles and air-conditioning leaks.
Scope 2 – Indirect Emissions from electricity purchased and used by the organisation. Emissions are created during the production of the energy and eventually used by the organisation.
Scope 3 – All Other Indirect Emissions from activities of the organisation, occurring from sources that they do not own or control. These are usually the greatest share of the carbon footprint, covering emissions associated with business travel, procurement, waste and water.

² Article 6 of the Paris Agreement is generally referred to as the “markets article.” While Article 6 garnered a strong constituency of support, it also attracted strong opposition during and since the negotiations of the Paris Agreement. It provides a framework for general cooperation in the implementation of the Paris Agreement and the nationally determined contributions (NDCs). More precise provisions in Article 6 create a framework that will enable the creation of an international carbon market. Source: <https://www.adb.org/sites/default/files/publication/418831/article6-paris-agreement.pdf>

Powering up Electricity Markets

Power market reforms are critical for transitioning to a clean, sustainable and efficient power system. Towards driving this key reform, Shakti is leveraging its strength of bringing together policymakers, regulators, businesses, consumers and system operators to develop and promote a market reform roadmap for India

India has witnessed a strong growth in renewable energy generation capacity supported by a conducive policy and regulatory environment. Both national and state governments have made significant efforts to strengthen the national and state-level grids to enable the power system to accommodate upcoming renewable energy-based technologies and services. Concurrently, distribution sector reforms have paved the way towards enhanced reliability and quality of supply through schemes such as 24x7 Power for All and Saubhagya to provide electricity to all households in the country.

These efforts need to be underpinned by an efficient wholesale and retail power market that can provide a level playing field to more efficient and economically desirable technologies including RE, storage and EVs, services such as flexibility, peaking power and demand response, and applications such as rooftop solar, micro-grids and combined heat & power.

Despite market-based operations being actively promoted by Electricity Act, 2003 through provisions such as the introduction of distribution open access, cost reflective tariffs, wholesale and retail markets, India's journey towards a progressive power market structure has been limited by legacy structures. Long-term PPAs through which distribution companies continue to procure power, the transmission monopoly and the issues in electricity dispatch are some of the challenges that the sector must resolve in order to achieve optimum efficiency.

With the launch of real-time markets, it is expected that Discoms will be able to gain higher efficiencies in power procurement planning, scheduling and dispatch as well as manage their system imbalances. Real-time markets would push Indian energy markets forward and help compete with global best practices.

However, considering that the scope for power exchanges to offer enhanced products and services has been limited so far, Shakti has been working stakeholders to undertake a rigorous consultative study to determine and

quantify the impact of market inefficiencies, present a range of possible solutions and help stakeholders discuss the intermediate steps to be taken to reach the ideal state.

Shakti is also supporting India Smart Grid Forum (ISGF) to design a robust time of use (ToU) tariff framework for Gujarat. While some prior studies have quantified the potential value of ToU tariffs to both the power system and the consumers, there is little research that systematically combines these considerations into a comprehensive implementation strategy. This study will recommend a ToU implementation framework by outlining the necessary procedure and infrastructure. ISGF will also assess the use and the impact of the ToU arrangement on peaking power plants and reduction in the use of diesel generator sets that are used to meet peak loads.

Power sector reforms must be underpinned by a well-functioning power market



Going Forward

Market reforms present huge opportunities for deep decarbonization of the power sector. As of now, civil society organizations (CSO) have limited technical capacity to inform this process. Going forward, Shakti endeavours to create avenues for open and constructive discussions amongst various stakeholders, appropriate CSO collaborations and nurturing new talent to expand the pool of power market experts in the country.

Diving Deeper into Climate Action

To meet national targets for climate change mitigation, sub-national actors such as state governments, district administrations and urban local bodies will need to play a crucial role in implementation. Developing capacity for sub-national level stakeholders will be a key intervention for Shakti in the coming years

For India to meet its NDC targets, it is imperative for the states to come on board to implement climate mitigation actions. The states must complement national level climate mitigation efforts by developing, implementing and monitoring interventions that will reduce GHG emissions from each state. State governments must begin to assess the impacts of climate change, identify the sources and levels of emission and implement strategies that can reduce their footprint for a 1.5-degree scenario.

Given India's federal structure, decisions taken at the national-level must be endorsed and implemented at the state level, which makes them key stakeholders in creating an enabling environment for policy implementation.

Having created the national-level frameworks required to cut down emissions, the time has now come for India to deepen the process of embedding climate change impact assessment into the developmental planning and program implementation processes at the state, city and district levels. In fact, climate change impact on communities and businesses must lead the development narratives at the sub-national levels going forward, as that is where most ongoing initiatives and priorities converge.

Considering the significant potential at the sub-national level to scale up the response to climate change, there is ample opportunity to expand their role to meet, and possibly raise, the ambition of national climate goals.

In order to manage country-wide emissions, it is important to measure emissions both by sectors and states, viz., industry, agriculture, waste, energy, and aggregate them to arrive at nation-wide figures.

Two Shakti-supported projects, GHG Platform India and the Sikkim Climate and Inventory Monitoring System (SCIMS) do exactly this. GHG Platform India estimates and analyses GHG emissions nation-wide, while SCIMS developed a dashboard to inventorize Sikkim's GHG emissions annually.

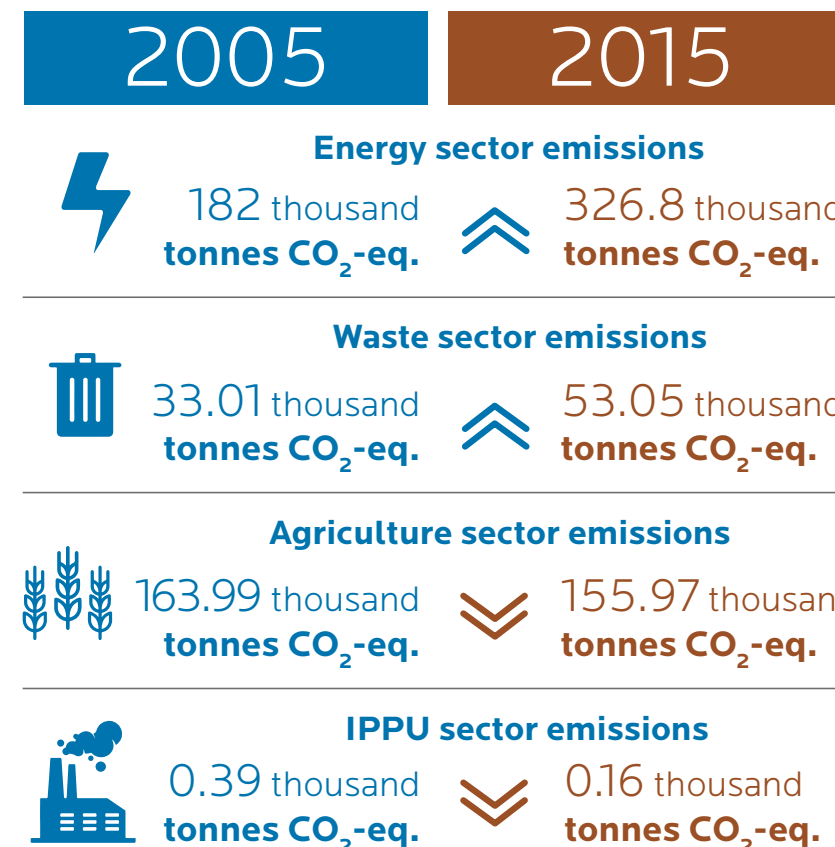
Sikkim was chosen for the pilot as it is a front runner on climate action in India and has a proactive state leadership. The success of SCIMS and its uptake by the Government of Sikkim has proven the importance and feasibility of projects to monitor, report and verify emissions in other Indian states.



Going Forward

In the coming years, Shakti intends to venture further into sub-national work to build capacity among state-level stakeholders to take well-informed decisions on climate change mitigation.

Shakti's efforts would continue to build an emissions data ecosystem in India, which can further help the country show greater transparency in its climate actions. The opportunities going forward would be in the estimation and analysis of state-wise GHG emissions, climate impact evaluation of various state level policies, supporting the development of State Action Plans on Climate Change (SAPCC) and District Action Plans on Climate Change (DAPCC), building the capacity of state governments on climate budgeting and developing sub-national climate governance framework.



Our Partners



Reaching for the Sun
CEEW

Towards Low-Carbon Energy Systems
TERI

Raised Ambitions
Track II Dialogues: Ananta Aspen Centre
Kigali: AEEE, CEEW, TERI

Enabling a DRE Eco-system
WISE

Baking Better Bricks
Society for Development Alternatives

The Emergence of Energy Efficient Industries
CII

Cleaner Air and a Healthier Nation
BS VI Norms: CSE
Diesel Price Intervention: IRADe

Time for the Bus
WRI, SUMNet, IIT-D

Biking: Not Just Fitness
Centre for Green Mobility, SUMNet

Unlocking Finance for DRE in Rural India
SELCO Foundation

Connecting India with a Clean Network
Clean

Leading a Shift in the Clean Energy Narrative
CEEW

Catalyzing Solutions for Sustainable Urban Transport
Parisar, Ceantre for Education and Environment

Putting Progressive Norms in Place
CAFE Norms: IIT-D
Heavy Duty Vehicle Fuel Economy Norms: TERI

Comparing Models to Cut Emissions
CEEW, CSTEP, TERI, IRADe

Bringing Together Indian Power Distribution Utilities
TERI

Clean Air for All
CII

Reducing Air Pollution in Patna
CSTEP, ADRI

Shaping Future Cities
ICLEI, C-40

Facilitating Investment in Sustainable Transport
Janaagraha

Strengthening Urban Design
NIUA, CEPT University

Leading the Transition to Zero Emission Vehicles
AEEE, CEEW, TERI, ASCI, CSTEP, ICRIER, ICLEI, CUTS, ERF, WRI, IRADe, CSE

Our Right to Breathe
ADRI, CSE, CSTEP, WRI, IIT-Kanpur, Chhattisgarh State Health Resource Centre

Climate Friendly Cooling Solutions
AEEE, TERI, CSE, CEE, CEPT University

Aligning Corporate action and Climate Mitigation
WWF, CII

Powering up Electricity Markets
ISGF

Diving Deeper into Climate Action
CSTEP, Vasudha Foundation, CEEW, WRI India, LCLEI, WISE, GERMI



