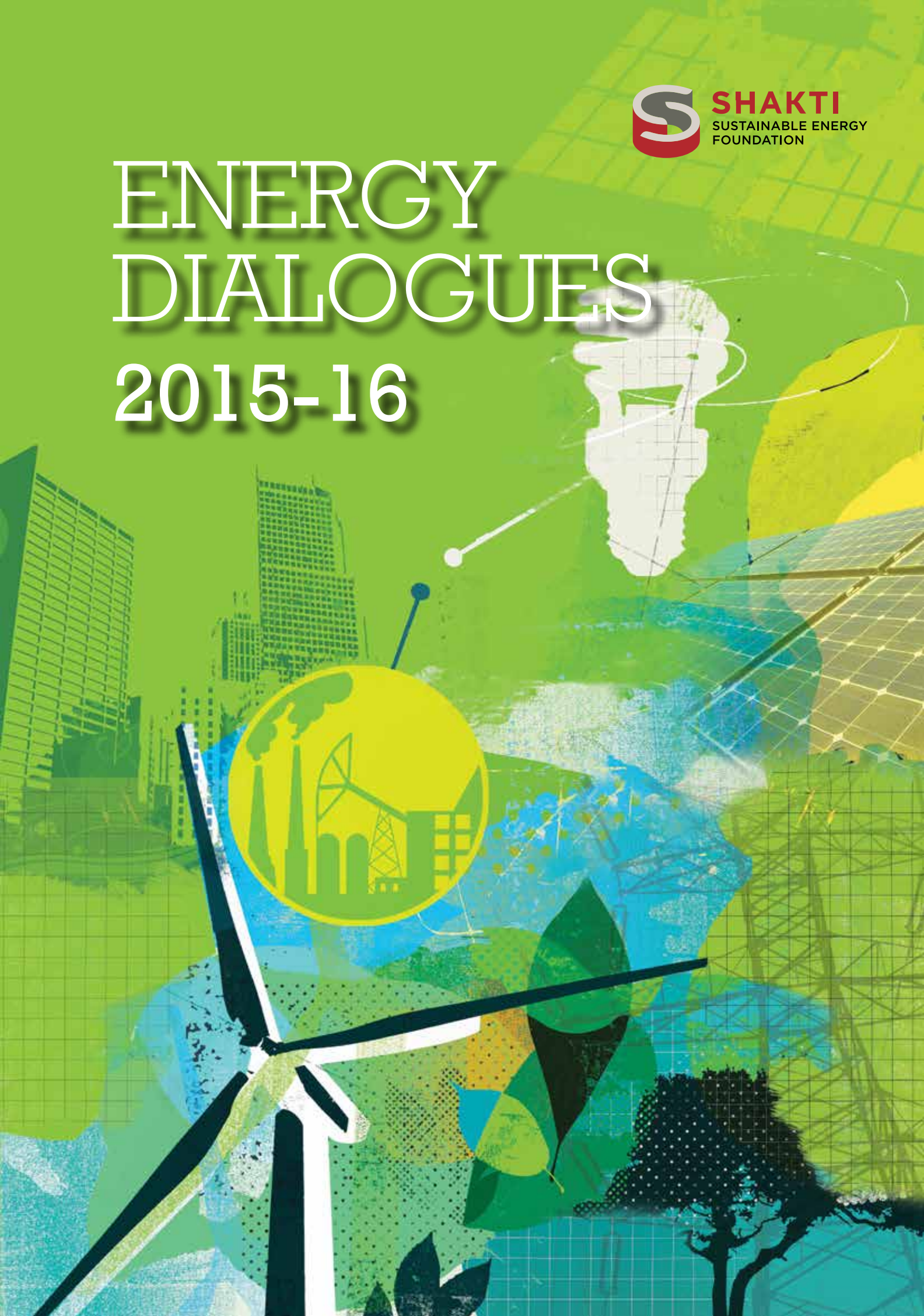


ENERGY DIALOGUES 2015-16



Who We Are

Shakti Sustainable Energy Foundation was established in 2009 to support India's developmental objectives. We facilitate India's transition to a sustainable energy future by promoting policies that encourage energy efficiency, renewable energy and the rapid adoption of sustainable transport solutions.

Advancing smart energy policies will be key to meeting the defining challenge of the next generation—how to provide millions of Indians with reliable, affordable, secure access to energy in a sustainable manner.

We have a reputation for supporting high-quality research and providing policy makers with specific and practical policy recommendations for an energy secure future.

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 keep our environment clean.

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 (national, state and local decision-makers), business, civil society and academia to craft energy policies.
- We facilitate strategic policy interventions
- evaluating all aspects of the policy spectrum.
- 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.

Board of Directors

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Oak Foundation

Message from the Chairman

Around the world, nations are striving to use increasingly scarce resources more productively, meet energy needs and reach development goals, all the while addressing climate change. The decisions taken by India and the rest of the world at COP 21 in Paris will have profound implications for our future. Within India, this will likely lead to a fundamental shift in the development paradigm.

What India needs now is a strong policy framework to realise the goals set out at Paris. A greatly strengthened effort to develop renewable energy sources reduces India's dependence on oil, and at the same time responds to the increasingly dire need to reduce fossil fuel based emissions to help avert massive climate change. The careful management of efficiency interventions can bridge the energy demand-supply gap and power the energy-deprived parts of the country apart from bringing down the emissions intensity of our economy. As India embarks on rapid urbanisation, we stand to benefit from designing sustainable transport infrastructure in cities to realise multiple benefits like reduced emissions, improved air quality, decongestion and better living experience.

Shakti's work is guided by a straightforward goal: the achievement of a clean and secure energy future for India. In its seven years of operation, Shakti has strategically invested to articulate feasible policy solutions in the areas of energy and climate modelling, renewable energy and energy efficiency deployment, sustainable urban development, climate change mitigation, and many others. I am enthused to see Shakti's demonstrated capacity to convene important stakeholders on the key issues of sustainable development. Notably, Shakti strives to add strategic value beyond its financial contributions. This is evident in its role as a conceptualizer and thought leader for several innovations interventions including the Utility CEO Forum on Demand Side Management and the Clean Energy Access Network.

I am pleased to witness Shakti's successful evolution, made possible by a highly motivated and capable team as well as by inspirational leadership. I congratulate Shakti for its achievements in the past year. I also thank all the partners and stakeholders for their support and look forward to working together for a clean, efficient and secure energy future for our country.

Jamshyd Godrej
Board Chair
Shakti Sustainable Energy Foundation

Message from the CEO

I am pleased to share with you our 2015-2016 annual report that outlines the efforts undertaken by Shakti to foster a cleaner, sustainable growth path for India over the past year. In collaboration with our diverse group of partners, we have contributed to the achievement of important milestones in our journey towards a sustainable energy future.

The past 12 months were very significant ones in this journey. India, along with 185 other nations signed the Paris Climate Accord. This articulates clear objectives that the country has set itself to reduce emissions intensity and to increase the share of energy generated from non-fossil fuels. These objectives provide definite markers against which to calibrate our ambitions for clean energy as well as to measure the progress being made. These objectives will help to pull together the diverse initiatives the Government is taking in the areas of solar and wind energy and in efficiency measures across the energy and transport

sectors. The immediate challenge lies in establishing a measurement and verification process that covers all relevant sectors and that will enable us to track progress towards our goals.

The Government has been extremely busy over the past year, putting in place initiatives that are critical to the clean energy and sustainability agenda. These include reforms of the power sector, more stringent fuel quality and vehicle fuel efficiency norms, new and stringent thermal power plant emission norms, a further increase in the cess on coal, and steady increases in the tax on liquid fuels as international prices fell. Good progress has been made on the roll out of the Smart Cities program, on the ambitious 175 GW renewable energy targets, and the national LED lamp program. A draft renewable energy policy and a draft national policy on renewable energy based mini grids were also published.

We are pleased to note that Shakti has been involved in and

contributed to most of these key developments.

As the policy framework fills out at the Centre, Shakti is also working on implementation opportunities, especially at the State level.

In addition to providing inputs to policy makers, Shakti continues to remain active in convening stakeholders with a shared interest in clean energy. In support of our activities, we convened groups to discuss issues such as GHG estimation, wind power deployment, promotion of bus transport, demand side management, roof top solar, green power buying groups and strengthening standards and labelling.

I am thankful to our Board for their valuable guidance, our donors who generously support our work and the excellent team at Shakti that consistently delivers high quality work. I deeply appreciate your interest in Shakti and hope you will find this Annual Report of interest.

Krishan Dhawan
CEO, Shakti Sustainable Energy Foundation

The image features a teal-tinted background with a repeating pattern of wind turbines. The text "CLEAN POWER" is prominently displayed in the center in a large, bold, white, sans-serif font. The overall aesthetic is clean and modern, emphasizing renewable energy.

CLEAN POWER



India's growing economy and population are leading to an increased demand for power. While the installed capacity has increased, parts of the country still face acute power shortages. Around 237 million Indians in rural areas lack access to electricity. Even in urban areas power shortages occur because of inefficiencies in power generation, distribution and end use.

Recognizing these challenges, the Government of India is taking several steps to bridge the gap between power demand and supply. Some of these include the proposed amendments to the Electricity Act (2003), the launch of the Deendayal Upadhyaya Gram Jyoti Yojana (DDUGJY) and the Ujwal Discom Assurance Yojana (UDAY), 'electricity for all' by 2019, ambitious targets for renewable energy and transmission connectivity plans. Other positive developments are also underway. Renewables like wind and solar are becoming increasingly cost-competitive, both locally and globally, and the clean power market is attracting a higher level of investment.

In line with these aspirations, Shakti is working to support India's clean power scale-up by mainstreaming renewables, reducing power demand through efficiency measures, promoting distribution sector reforms and enabling rural electricity access through clean and affordable means.

Harnessing the power of the wind

In 2015, Shakti was part of an expert committee constituted

by the Ministry of New and Renewable Energy to develop a revised estimate of India's wind potential. Based on the analysis conducted under the aegis of this committee, the ministry released a revised number – 302 GW at a height of 100 metres, which was significantly higher than the previous estimate. This number underscores the fact that potential is no longer a constraint for wind to play a major role in India's electricity future. It also provides a reference point around which evidence-based wind policies can be developed.

Shakti has supported several other initiatives to deploy wind power on a larger scale. Working closely with the government, we have helped to create technical and commercial frameworks to integrate wind energy into the grid. The Wind Discussion Forum, supported by Shakti, has been gaining traction. This year the Forum released the Wind Vision document 2032, which provides a roadmap for India to reach 200 GW of wind capacity by 2032. Highlighting the need to boost investor confidence and strengthen the policy space, the roadmap is a promising starting point for informed deliberation amongst stakeholders.

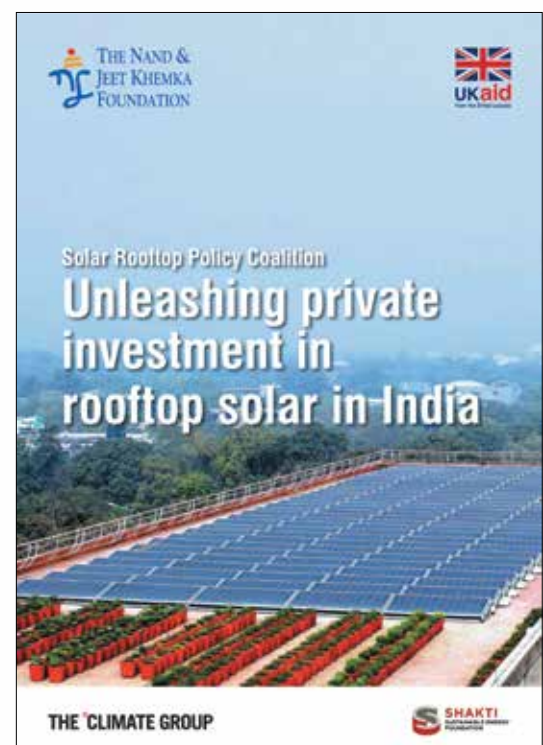
India's Renewable Energy Roadmap 2030

In 2015, efforts by Shakti contributed to the development of the Renewable Energy Roadmap 2030 for the country, which provides actionable recommendations to scale up renewable electricity deployment. The roadmap was officially launched by the NITI Aayog and received substantial attention from decision makers and the media.

Several of its recommendations are already under consideration by the government. To further this process, we have facilitated support for the NITI Aayog to set up an overseeing mechanism consisting of two committees, one of state level energy ministers, and the other of state level energy secretaries. Both committees will guide the implementation of the recommendations.

Scaling up rooftop solar

With a target of 40 GW of rooftop solar PV by 2022, this sector has a vital role to play in meeting India's power needs. As part of the Solar Rooftop Policy Coalition, we help identify practical policy solutions that can support India's ambitions for scaling up the rooftop solar. A recent report released by the coalition titled 'Unleashing Private Investment in Rooftop Solar in India' provides concrete recommendations that





can facilitate progress towards the 2022 target without any additional subsidies. Under another initiative, we are supporting research to identify solutions to support Discoms to increase the adoption of rooftop solar PV.

A renewable energy act for India

In 2015, Shakti was part of the committee set up by the Ministry of New and Renewable Energy to draft a renewable energy act for India. Currently, renewable energy is under the ambit of India's Electricity Act, but a comprehensive legislation such as this will streamline the planning process for all renewable energy applications – electric as well as non-electric. The draft proposes a strong institutional framework resting on the pillars of market development, a robust data regime and a focus on innovation, technology and finance. It has been made available for public comments.

Tools for power sector planning

With increasing ambition for both renewables and energy efficiency measures, an important step ahead is to build them into the current planning framework. But this requires a change throughout the electricity sector such as understanding the costs and benefits of such measures when compared to 'business as usual'. It also means developing new models for providing power in a cost-effective way. In 2015, we supported efforts to develop an integrated resource planning tool for two states, Karnataka and Tamil Nadu, which will help address some of these considerations. A similar tool is also being developed on a nation-wide scale to contribute to the achievement of India's renewable energy target.

In concrete terms, such tools will provide a way to include demand growth implications from all of sectors and more renewable energy and energy efficiency in the power mix, in a transparent and inclusive manner. Decision-makers in Karnataka and Tamil Nadu will soon be presented with the tool to improve power planning and implementation in these states.

We have also contributed to the development of the NITI Aayog-led India Energy Security Scenarios (IESS) 2047, an energy planning tool that explores India's future energy scenarios for several energy demand and supply sectors leading up to 2047.

From ideas to action - The India Innovation Lab for Green Finance

India has pledged that 40% of its electricity supply will come from non-fossil fuel sources by 2030. Increasing private investment will be critical to meet these targets. But the cost and terms of the debt available is a major challenge for financing green infrastructure projects, which are very capital intensive. India thus needs new and better finance instruments to tackle investment barriers and to scale up finance.

The India Innovation Lab for Green Finance was established in response to this need. The Lab aims to develop ideas that can unlock investment in green infrastructure. In 2016, after announcing an open call for ideas, the Lab selected four innovative green finance instruments with the most potential. In selecting these, the Lab focused on ideas that could be replicated and scaled up quickly, by driving more private finance and also by leveraging public finance. Now, the Lab Secretariat has developed prototypes for each

instrument and is readying them for implementation.

The Lab is hosted and funded by Shakti with additional financial support from the UK Government, the David and Lucile Packard Foundation and the Oak Foundation. It has been endorsed by the Ministry of New and Renewable Energy. Its members, drawn from the infrastructure, finance and renewable energy sectors, bring valuable expertise to the activities of the Lab.

Energy Access in India: A stocktaking and directions for the future

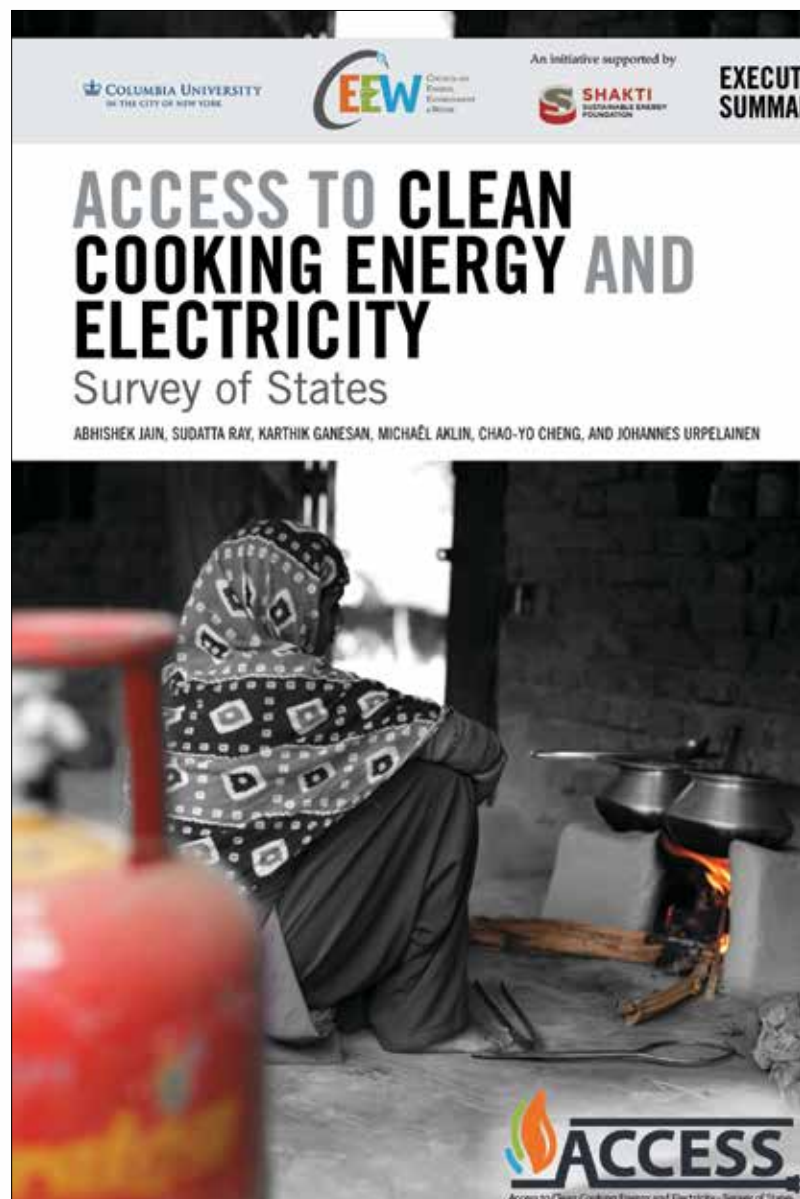
Only a fifth of rural households in India have access to an LPG connection, and 95% of rural households use some form of traditional fuel for cooking. These are just a few of the findings of a Shakti-supported report titled *Access to Clean Cooking Energy and Electricity – Survey of States (ACCESS)*. India's largest energy access survey, it covers over 8,500 households, 714 villages and 51 districts, across Bihar, Jharkhand, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal.

Launched in 2015 by Mr. Piyush Goyal, Minister for Power, Coal and Renewable Energy at a high-profile event in New Delhi, the report has received significant attention. It underscores the need for sustained action to provide affordable, reliable energy access to underserved parts of the country, and provides recommendations towards this. The exhaustive data collected during this exercise will soon be made available in the public domain to ensure the transparency of the analysis.

Minigrids become a priority

We were invited to be part of an expert committee constituted by the Ministry of New and Renewable Energy to draft the first ever national policy on renewable energy based mini grids. With a focus on building a supportive ecosystem for mini grid development, the draft policy has set a target to achieve at least 10,000 renewable-based power projects in rural areas in the next five years.

Another encouraging development is that the state of Uttar Pradesh has announced the first ever state-level mini grid policy. Nearly 20 million households in the state are not connected to the Discom grid, and the policy is expected to bridge this gap. The Uttar Pradesh Electricity Regulatory Commission followed up this announcement with draft regulations to action the policy. Support provided by Shakti led to the inclusion of important recommendations in these regulations that will help achieve the state's mini grid vision. A key



A little solar with your food

Delhi may not have made solar rooftop systems mandatory for homes and commercial buildings just yet, but the city has been adopting solar power at an encouraging rate. A recent convert is Guru Prasad Udupi Restaurant, popularly known as “Udupi”, located right next to the Shakti office. The restaurant, set up in 1985, is now using rooftop solar to meet some of its power needs.

Mr. Akash Rao, proprietor of the restaurant says, “We were looking to reduce the electricity requirements of the restaurant. With a fair amount of solar irradiance and ample roof space, solar became an attractive option.”

The new solar rooftop system consists of 66 solar panels of 310 watts each. It generates enough clean electricity to meet around half of the restaurant’s requirements. Mr Rao adds, “it will pay for itself in approximately six years.” Net metering will enable the restaurant to sell excess power generated, if any, back to the grid.

A small but very important forerunner, the restaurant has set a good example by showing that a rooftop solar power generating system is a viable and economical idea.

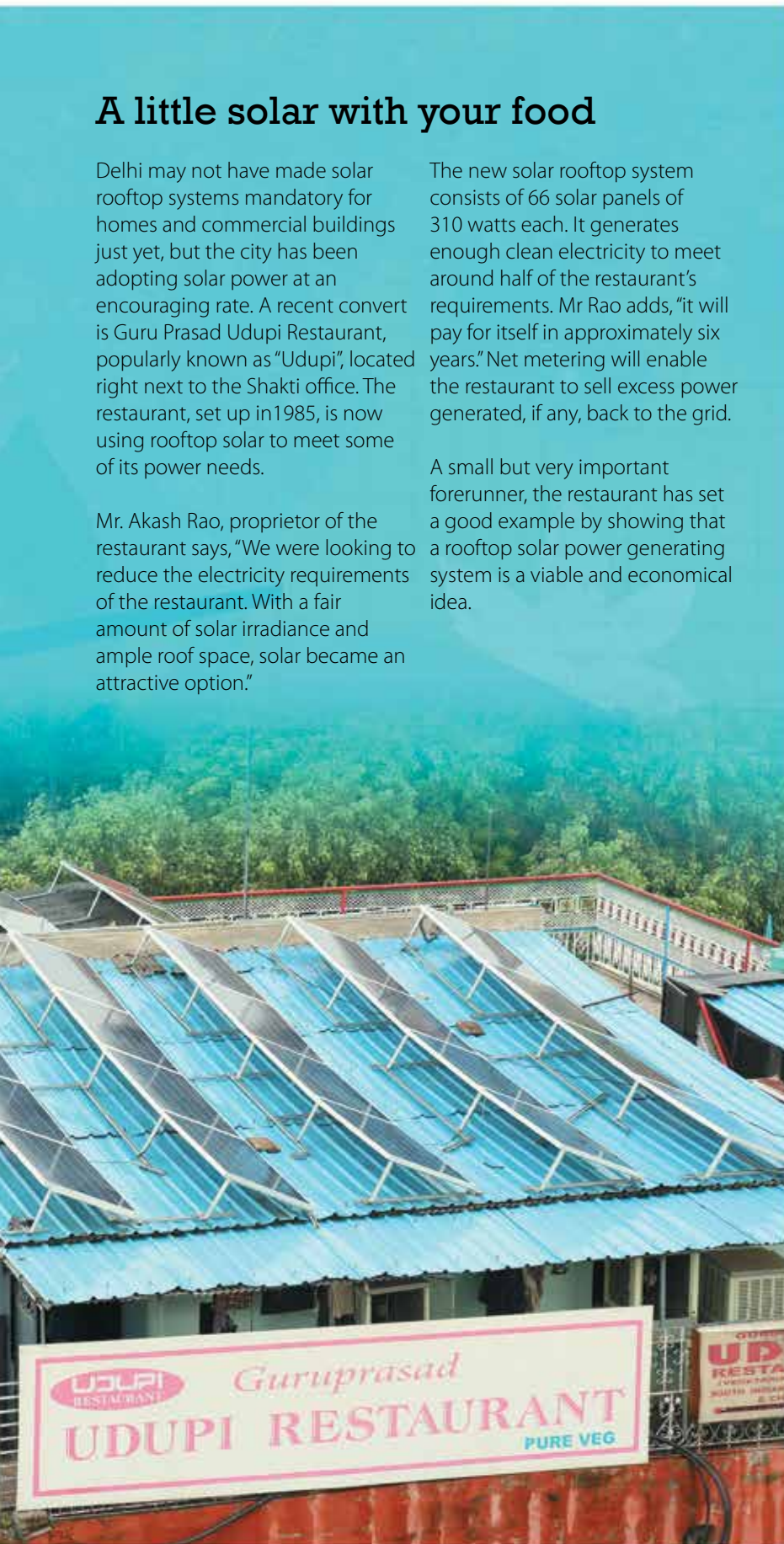
outcome of these regulations is that mini grid operators can work separately when the Discom grid arrives or sell power to the grid. This is an important safeguard for such projects since they are high-investment and face a huge risk on the arrival or improvement of Discom grid supply.

Solarizing India’s agripumps

In 2015, a study supported by Shakti strengthened the case for solar irrigation pumps as a promising solution to meet India’s energy needs. Recommendations from this study were included in the state level guidelines for the implementation of the “Solar Pumping Programme for Irrigation and Drinking Water” under India’s Off Grid and Decentralised Solar applications scheme. Now, these guidelines need to be implemented at the state level to deliver both electricity and financial savings. We are therefore actively pursuing partnerships with a few states to identify the progress made in the adoption of solar pumps over the last year, and to help in the design and implementation of large-scale solar irrigation pump programs.

Unleashing entrepreneurship

With the right kind of support, energy enterprises can provide solutions to some of the energy access challenges affecting their communities. This is the premise behind various Shakti-supported projects to provide off-grid enterprises with targeted technical and capacity building assistance. We have been supporting select enterprises across various states in the areas of business development, market and last mile distribution strategies, financial models and technology innovation – all key requirements that can prepare



entrepreneurs to turn business ideas into successful new ventures. In collaboration with other incubators on the field, we now plan to expand this effort on a larger scale to cover a wider geographic area.

Clean Energy Access Network

Shakti is one of the founding member and resource partner of the Clean Energy Access Network (CLEAN), a pan India network working to expand decentralized renewable energy (DRE) access. CLEAN's mission is to bring together a wide range of DRE practitioners and stakeholders to strengthen the sector.

Shakti is playing a pivotal role in the network by supporting a portfolio of activities that will inform policy making in the DRE sector. In 2015, we co-supported the first ever India Off Grid Summit in association with CLEAN and other partners. The summit featured 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. We are also supporting the development of a report on the 'Annual Status of DRE in India', which is expected to capture important status indicators about the sector such as technology, geographical reach, finance and institutional arrangements.

A boost for Demand Side Management

Demand Side Management (DSM) is fast gaining momentum. Most state electricity regulators have announced DSM regulations for their respective states. These efforts must be bolstered by well-designed and actionable DSM programmes. In 2015, we initiated efforts to strengthen



DSM efforts at the state level by building stakeholder capacities and strengthening the overall DSM ecosystem. We are currently assisting key state actors in Jharkhand, Karnataka and Uttar Pradesh in the areas of programme design, implementation frameworks, regulatory approval and other DSM-related priorities. We are also working with state actors in Haryana and Maharashtra on alternative program designs for DSM implementation. These efforts can inform the design of DSM programmes in other states as well.

We have been regularly convening the Utility CEO Forum on DSM, which continues to be well received by stakeholders as an exclusive platform for dialogue and learning. In 2015, the Forum helped launch the handbook on the Standard Offer Programme, an innovative DSM implementation opportunity. Developed in consultation with Discoms and State Electricity Regulatory Commissions (SERCs), and sector experts, the handbook has provided a practical contribution towards promoting DSM measures in India.

Our support to the Indian Institute of Technology, Bombay (IIT-B) towards becoming a resource centre on DSM has led to the creation of a vast knowledge repository on DSM. These resources are being shared with discoms, regulatory commissions and project implementers to address knowledge gaps in the DSM space.



Strengthening the distribution sector

The distribution sector is an important segment of the power sector value chain. In the last decade, India has taken several steps improve to the sector's commercial performance and financial viability. However, progress has been slower than envisaged. The sector is not very efficient owing to significant energy and revenue losses. The aggregate technical and commercial (AT&C) losses are around 27%, which is much higher than the global average of approximately 10%. The financial health of the sector is fragile, limiting its ability to invest in delivering better services and clean energy.

In light of these dynamics, Shakti has initiated several efforts to strengthen the distribution sector. This is particularly important in light of the sector's critical role in meeting India's ambitious targets on renewables, energy efficiency and universal access. An important focus is the development of a robust stakeholder-driven roadmap that will provide recommendations to strengthen the sector. In parallel, we are working to improve regulatory processes across the sector, developing an index to evaluate the quality of supply and services provided by Discoms, and strengthening their institutional structure.

Catalysing stakeholder actions under the PAT scheme:

The effective implementation of the Perform, Achieve and Trade (PAT) scheme remains a high priority. Following in-depth sector assessments, we identified a few new energy-intensive industrial sectors and a number of different industrial units within these to broaden the scope of the scheme. This has contributed to their formal inclusion under the second phase. Recognizing the need for strengthened capacity to implement the scheme in an efficient manner, we collaborated with the State Designated Agencies of Maharashtra, Chhattisgarh, Punjab, Orissa, Kerala, Madhya Pradesh, and Rajasthan to train more than 500 practicing energy auditors, industry professionals, SDAs, public sector enterprises and other energy professionals.

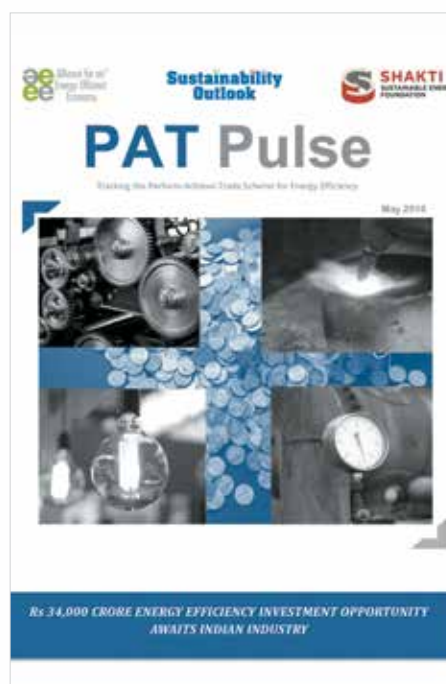
Support for the deployment of high potential-low investment energy efficient technologies across the cement, iron and steel, and pulp and paper subsectors

last year has yielded good results - 26 energy saving projects were implemented across the country and will lead to a reduction of about 1.54 million tons of GHG emissions every year. We are also continuing our engagement with the Institute for Global Environmental Strategies to successfully identify Japanese technologies for adoption in India.

The quarterly briefing series on the PAT scheme provides real time updates and presents important stakeholder perspectives. The initial issues have generated a positive response from the Industry.

Boosting Energy Service Companies (ESCOs) efforts and financing for energy efficiency projects

ESCO-based projects can help launch large-scale energy projects by mitigating perceived risks and providing assured savings. Shakti has supported several efforts to identify some of the barriers that are hindering the growth of ESCO-based projects in India along with important recommendations to



address the barriers. Based on this analysis, we helped to develop a model Energy Performance Contract (EPC) template, which could resolve techno-legal and third party financing issues in ESCO contracting. Following this, we worked with ESCOs, energy consumers and Financial Institutions across six prominent industrial hubs to promote the use of the contract. Our efforts have received a major boost from a collaboration with the Small Industries Development Bank of

India (SIDBI), who have adopted the model contract under their Partial Risk Sharing Facility scheme.

Promoting energy efficiency in Small and Medium Enterprise (SMEs) sector

In 2015, we began to design a new strategic plan to initiate work in India's Small and Medium enterprises (SME) sector. Nearly three million SMEs form the

bulwark of total industrial enterprises in India. Their economic significance is immense - they contribute nearly 35 percent in direct export and 45 percent in the overall export from the country and are a big employment generator. According to estimates, their energy saving potential is around 3.5 MTOE. Research supported by us will provide a practical analysis of pathways to achieve energy efficiency in the sector, and document the environmental, social and financial benefits.

SPOTLIGHT

Innovation in Action: The promise of LEDs

Investing early in policy design and market mechanisms can build the evidence required to shape a policy in its final form. It can also identify best practices that lead to better, long-term results. This was the premise behind an early stage LED-based project in Puducherry that was seeded by Shakti and its partners. The project aimed to realize the immense energy savings potential offered by the LED bulb. In 2012, each LED bulb was priced around Rs. 1,200, which was very expensive when compared to the cost of a Compact Fluorescent Lamp (CFL) or an Incandescent Light Bulb (ICL). As a result, the market for LED lighting was quite limited, despite it being the most energy efficient lighting technology available.

This was the challenge that the Puducherry project sought to address. It was important to bring down the cost of LED bulbs in order to encourage their use. We attempted to do this through a demand aggregation model called the Standard Offer Programme (SOP). An innovative approach to promote energy efficiency, the SOP looks at energy efficiency as a commodity quite similarly to renewable energy or conventional resources.

At the time, energy efficiency interventions in the lighting sector were still in their nascent stage. But with the lighting sector contributing significantly to India's electricity demand, such a project was extremely important. Not only was it timely, but it was strengthened by the collaborative efforts of several partners. Shakti partnered with the International Institute for Energy Conservation (IIEC) to develop the SOP. Once ready, the model was presented to the Puducherry Electricity Department, which agreed to pilot the model in Puducherry for the large-scale

replacement of incandescent bulbs. Energy Efficiency Services Ltd (EESL), a national energy services company (ESCO) agreed to invest in and implement the project. At this point, Shakti partnered with IIEC once assess once again to the replacement opportunity in Puducherry, which was estimated to be between 700,000- 750,000 bulbs.

The stage was now set for action. Based on the SOP model, EESL procured the LEDs in bulk and replaced around 735,000 ICLs with LEDs across Puducherry. As a result of this replacement, the PED is expected to benefit from a reduction in power procurement of around 48 million units each year. The PED will repay EESL over a fixed period of time from the savings that accrue from the reduced energy consumption. With the model being a success in Puducherry, EESL decided to promote it in other states. It was replicated under various frameworks in Andhra Pradesh, Delhi, Rajasthan, Himachal Pradesh, Uttar Pradesh and many other states. An important milestone was reached when the Government of India launched the national LED-based home and street lighting programme in January 2015. These developments led to the increase in the domestic manufacturing of LEDs. Now, with more LEDs in the market, the wholesale LED price has dropped to less than Rs. 100 – making it much for affordable for consumers.

Now under the national LED programme, over 140 million LED bulbs have already been distributed to India's citizens. And coming back to where it all began, today, Puducherry can boast of a significant accomplishment – almost all its homes are illuminated by energy efficient LED lamps.



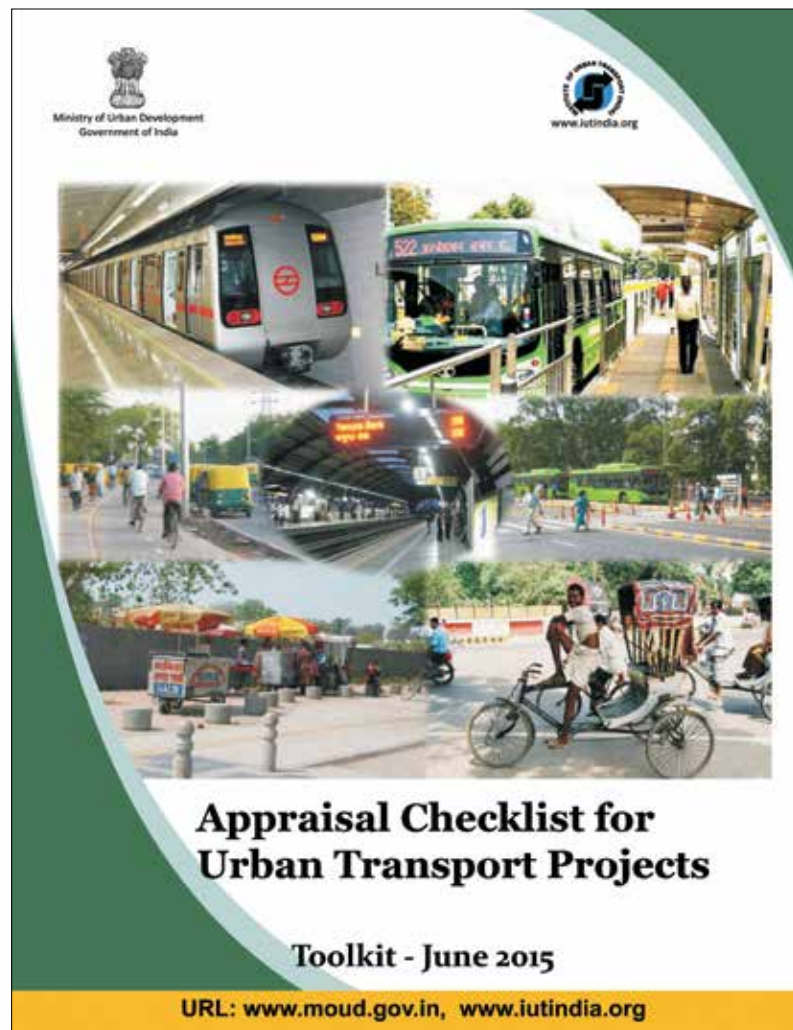
SUSTAINABLE CITIES

2015 marked a turning point for India. Two ambitious urban renewal initiatives were launched – the Smart Cities Mission and the Atal Mission for Rejuvenation and Urban Transformation. India’s ambitions are cognizant of its new urban reality: by 2030, India’s cities are expected to grow from 377 million people in 2011 to 600 million. During the same time, a number of new cities will be built from ground up. These trends will increase the demand for urban infrastructure such as transport and housing, and public amenities such as power and water supply. Energy use will rise, too, as a result of a surge in demand for household appliances, vehicles and other consumer goods.

How India manages this change has huge implications for its citizens, economy and environment. At Shakti, we build on the principles of sustainable development to help cities be better planned and more energy efficient. Our work focuses on sustainable urban planning, sustainable urban transport and energy efficiency in the built environment, particularly new buildings and appliances.

Toolkit to evaluate urban transport projects

With the new urban agenda in focus, it is important to incorporate the principles of sustainability in transport projects. A Shakti-supported project aims to meet this need by ensuring that the evaluation criteria used to fund a city’s transport projects are based on the principles of sustainable development. In 2015, we supported the Institute of Urban Transport (IUT), India to develop a revised evaluation criteria for five categories of urban transport projects: transport planning, public transport, non-motorised transport, transport infrastructure and urban freight.



The Ministry of Urban Development has officially adopted this toolkit to screen sustainable transport projects. This will help prioritize projects for funding that will improve the overall mobility and quality of life in a city, while also helping to use public funding in a more judicious manner. The official report developed under this project was launched at the Urban Mobility India Conference 2015 in New Delhi and received significant media attention.

Progressive new vehicle standards and labelling

Shakti is pursuing the step-by-step establishment of stringent fuel efficiency norms for various vehicle types including passenger cars and Heavy Duty Vehicles (HDVs).

Early 2016 saw an important win on the passenger car front. India released a draft notification for a labelling program for passenger cars based on their fuel efficiency. The programme is slated to begin in the second half of 2016. The design of this programme is based on technical assistance and research supported by Shakti. The labels will provide buyers with valuable information on a car’s fuel economy, energy use, fuel costs and environmental impact, which will help make more informed purchase decisions. Our contribution to the labelling programme follows through on our previous work to support the notification of fuel efficiency standards for passenger cars in 2015. India will implement these standards by 2017.



We have catalyzed important efforts to develop fuel efficiency standards for HDVs. Given that HDVs account for around 40 % of India's diesel consumption, such standards have immense potential to reduce both fuel use and emissions. Last year, we helped advance recommendations to inform the development of the standards as well as stakeholder readiness to implement them. The final recommendations have already been shared with the official committee that is deliberating the HDV standards for India.

Fuel quality

As we entered 2016, India announced its decision to leapfrog to Bharat Stage (BS)-VI emission norms by 2020, skipping the BS-V level. This is a big step towards lower emissions and better public health. Several initiatives supported by Shakti during the last few years contributed to this decision. We worked with multiple partners and policy makers to help craft a compelling vision for better fuel quality norms in India. Findings from the research on the techno-economic viability automotive fuel quality options were submitted

to the official Auto Fuel Policy Committee. These findings have helped to inform the fuel standard road map for the entire country. Targeted engagement of key stakeholders including the Ministry of Petroleum and Natural Gas (MoPNG) and Society of Indian Automobile Manufacturers (SIAM) has contributed to the discourse on more stringent norms.

Demonstrating best practices

Bus terminal guidelines

Bus terminals play a critical role in providing good quality bus services. The capacity of a bus terminal to handle buses determines the total fleet it can operate. A well-designed terminal can help passengers to move between different modes of transport and also provide them easier travel access. This helps wean people away from car use and towards bus services.

Bus terminals have received attention with the Ministry of Road Transport and Highways encouraging their proper planning and development on a public private partnership (PPP) basis. In this context, the comprehensive



planning and design guidelines for bus terminal development, supported by Shakti, are a first of their kind. These guidelines recommend ways to improve the fleet and passenger handling capacities of bus terminals and support smoother transit exchanges between various modes of transport. They have been well received by stakeholders particularly after their presentation at a 'National Best Practice Workshop on Infrastructural Development in State Road Transport Undertakings' in Ahmedabad, conducted under the aegis of the Ministry of Road Transport and Highways. These efforts have made the design of bus terminals an important topic on the urban planning agenda.

Bicycle sharing

The advantages of bicycle sharing systems are well known: better air quality, less congestion and improved health. Such systems are gradually being piloted across the country. Recognizing their importance to the urban agenda, we supported an early effort public

bicycle sharing project designed to serve parts of New Delhi. The programme is being implemented in Dwarka by the Delhi Development Authority (DDA) and in South Delhi by the South Delhi Municipal Corporation.

Technical and advisory efforts supported by Shakti have contributed to the design of this programme in a critical way. 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.

Integrating transport and land use planning

The relationship between transport and land use patterns is important to a city's developmental trajectory. A spread out land use pattern or 'sprawl' can significantly impact the pattern of mobility in a city. A sprawl creates greater travel distances, which increases the demand for transportation. This in turn leads to more vehicles on the road and therefore more emissions. Such a development pattern can hinder people from accessing opportunities, goods, services, and other resources to improve the quality of their lives.

As our cities grow, this challenge has been increasingly coming to the forefront. Some cities have already revised their development plans to restrict spread out land use patterns. To support these efforts, we commissioned research to analyse the long-term impact of these revisions on the mobility patterns of cities. Five innovative land use and development control policies were identified from across the country. Their impact was

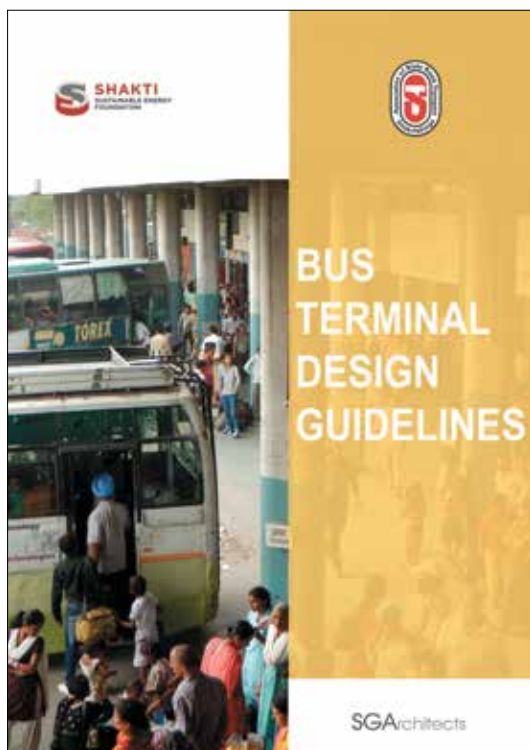
assessed on travel demand and related emissions in their respective cities. Based on this analysis, a Land-Use Transport Interaction (LUTI) model has been developed that can help cities plan their land use patterns.


Implementation of the Standards and labelling programme

India has introduced important policy measures in order to promote energy efficiency in appliances. One of these is the Standards and Labeling programme (S&L), which has significant potential for energy demand reduction and consumer cost savings. States are making efforts to implement the programme, within their own jurisdictions, to increase the adoption of efficient appliances in the market. We are building the capacity of the State Designated Agencies to implement the programme in a more effective manner. An ongoing study supported by Shakti is developing guidelines that SDAs can use to check compliance with labelling norms. These checks have been mandated under the Energy Conservation Act. The guidelines will be piloted in two SDAs to allow a practical understanding of how compliance issues can be better addressed at the state level.

Mainstreaming building efficiency in academic curricula

Enhancing energy efficiency in the building sector is a key urban focus today. In order to respond to newly emerging urban and environmental needs, stakeholders must upgrade their knowledge and technological expertise. A new initiative supported by Shakti is focusing on bringing another stakeholder group – students of architecture and engineering –





within this ambit. This is important because for the most part curricula in professional institutions has not adequately covered building energy codes and related efficiency components. Recognizing this critical gap, we are currently partnering with select architecture and engineering colleges in six Indian cities to integrate building energy efficiency considerations into their academic curricula. Our support will help bridge this knowledge gap and also equip professionals entering the market to design energy efficient and sustainable buildings.

Advancing the adoption of India's Building Energy Code

Buildings consume around 30% of India's electricity. With rapid development, building efficiency is at the core of a smart urbanization strategy and can lead to tangible economic gains: more efficient use of existing resources will lead to lesser power generation capacity, and thus capital can be directed toward more pressing needs.

India's Energy Conservation Building Code (ECBC), when implemented properly, can lead to significant energy savings. Over the last two years, we have worked to facilitate its enforcement in four states – Gujarat, Tamil Nadu, Maharashtra and Madhya Pradesh. As part of these efforts, we supported the development of a roadmap and recommendations for each state to enforce the Code in an effective manner. A number of experts and government stakeholders contributed to development of the roadmaps. These four states are pioneering code adoption placing special emphasis on strong compliance and enforcement. Now, as a first, all four states have set up their ECBC cells. This will help to implement the Code in a more streamlined manner.

Robust data: A driver for better building energy performance

Robust data on the energy performance of buildings can help tailor energy efficiency measures. But this data is often not easily available making it difficult to design and implement energy efficiency programmes. In response to this challenge, we are facilitating several initiatives that focus on addressing data gaps in the buildings sector.

The commercial buildings sector accounts for around 10% of the overall energy consumption in India. Energy performance data for commercial buildings is often scattered across sources and in different formats, making it difficult to analyse. To fill this information gap, we have helped develop a national framework for the collection and analysis of this data. This will lead to a more systematic and periodic data collection exercise, which in turn will help create better policies for the buildings sector. Complementing this effort, we are supporting the development of a feasibility framework to notify commercial buildings as Designated Consumers as provided for in the Energy Conservation Act. It will help in collecting and recording energy performance data in a more organized manner and can pave the way for large-scale energy efficiency actions.

Another focus area for improved data collection and analysis is the end use applications in the residential sector, which accounts for 24% of India's total electricity consumption. Individual consumers have great influence on the amount of energy consumed in homes partly by virtue of consumer behaviour, and partly as a result of the devices they choose to use. But most consumers have very little awareness about

how the electricity consumption in their homes, compares to other homes, and how it can be reduced. Building on the lessons learned from a pilot framework for consumer awareness of energy consumption patterns, we supported a follow on activity in Kerala to establish the programme at scale. Under this initiative, more

than 25,000 houses in Kerala's Aluva district will be provided with personalized data regarding their energy consumption. This information will increase awareness amongst consumers and help them to take concrete action to reduce their energy consumption through behavior change and adoption of efficient appliances.

We also supported the development of a robust data-driven framework that can quantify the benefits of ECBC implementation in the city of Ahmedabad in Gujarat. It can be easily replicated in most Indian cities to plan for more energy efficient development as new floor space is added over the next few years.

SPOTLIGHT

Looking ahead to Smart Cities in India



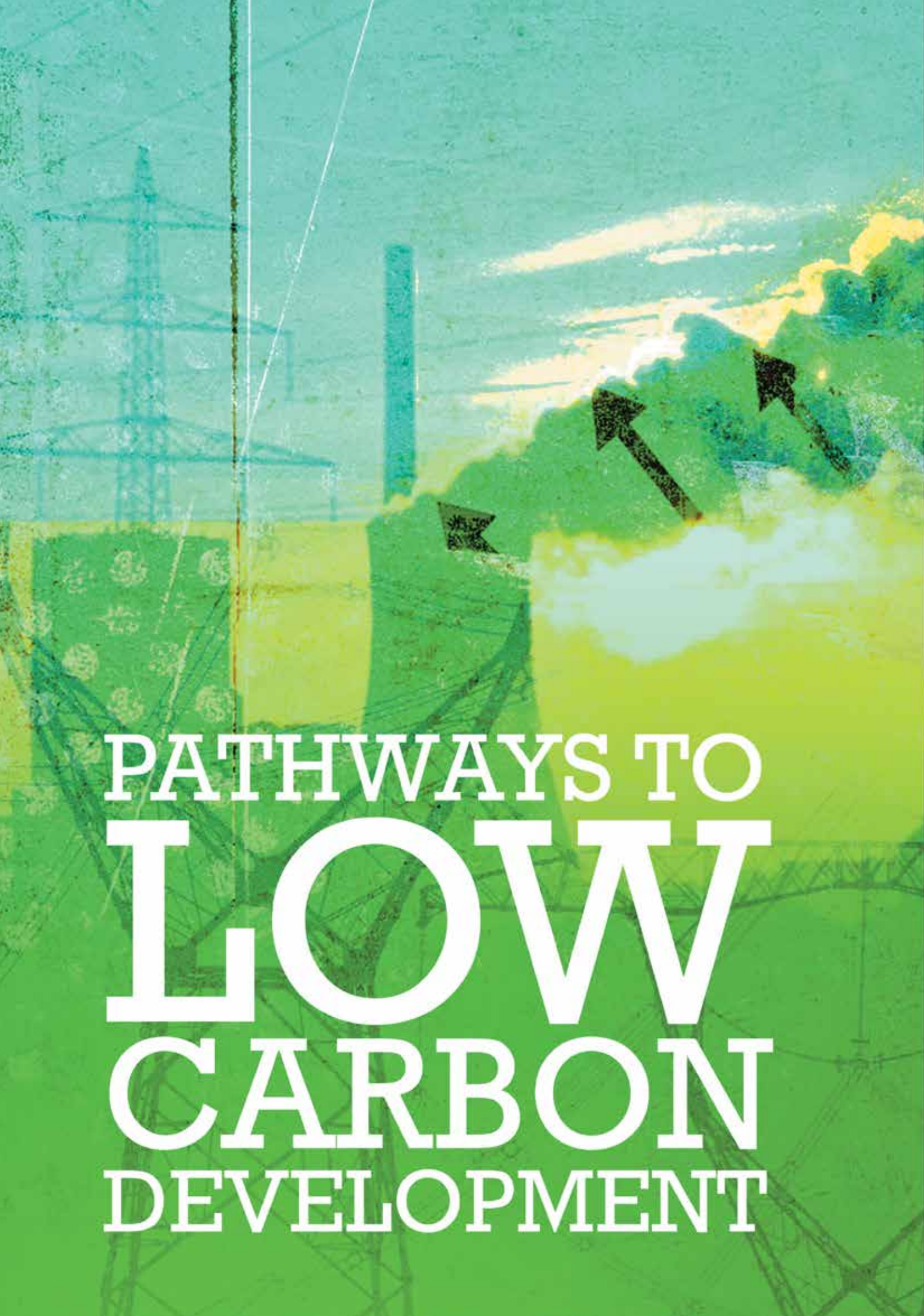
Shakti has been investing considerable effort in the success of the Smart Cities Mission, a bold, new initiative launched last year by the Government of India. The key focus of the Mission is to provide a decent quality of life to citizens through smart solutions enabled by technology applications. These smart solutions will in turn drive economic growth. The Mission focuses on the sustainable and inclusive development of cities with the idea of creating a replicable model for other aspiring cities.

Working closely with strategic partners, we supported the development of the Smart City Proposals of four cities – Visakhapatnam and Kakinada (in Andhra Pradesh), and Jaipur and Udaipur (in Rajasthan). In practical terms, this led to the inclusion of sustainable mobility and building energy efficiency needs into each proposal. The recommendations cover public transport, walking and cycling solutions, car restraint measures, regulations for para-transit and green building improvements - all core ingredients to help build the Smart Cities of tomorrow.

Our efforts were rewarded when all four cities made it to the list of 20 Smart Cities out of the 98 shortlisted for the first round of funding through the Smart Cities Mission.

The Smart City Proposals submitted were the basis of this selection and will now shape efforts to implement a “smart” vision for each city. Visakhapatnam, Kakinada, Jaipur and Udaipur, along with the other cities, will get INR 100 crores in funding each year over the next five years. We are now providing the four cities with the technical assistance required to implement their vision plans.

To maximize impact, we assisted the selected Smart Cities to pilot key interventions required to meet their developmental priorities. An important area of work was bolstering public-private partnerships for sustainable transport initiatives such as street infrastructure, city bus operations, public bicycle sharing (PBS), bus terminal development, and Intelligent Transport Systems (ITS). Various business models and policy enablers required to promote such projects have been developed and shared with cities. We have also helped pilot an innovative public transport information system where a mobile-application based crowd-sourcing technique has been used to collect bus route and bus stop information for the city of Hyderabad. This information will go a long way in making the bus system more reliable and also encouraging passengers to use public transport.



PATHWAYS TO
LOW
CARBON
DEVELOPMENT



In 2015, India signed the Paris Agreement on climate change earlier this year signalling its strong support for concerted climate action. As one of the fastest growing economies and the third largest emitter of GHG gases, India's participation is critical to the global response to climate change.

India's Nationally Determined Contributions (NDCs) are both ambitious and noteworthy, recognising its global responsibility and domestic priorities of development. India is now gearing up to take action towards meeting its voluntary targets.

Action will be required on several fronts. First, data will be needed to estimate emissions intensity as well as progress made over time as the economy grows and the energy fuel mix changes. Equally important, new policy and implementation frameworks will need to be introduced to facilitate the changes that will be necessary.

Shakti will seek to build on the work that has already been underway in these areas to help meet national targets on emissions intensity reduction and non-fossil fuel use within the targeted timelines.

Companies put a number on GHG emissions

The India Greenhouse Gas (GHG) Program, co-supported by Shakti, has received formal policy recognition in the NDCs released in October 2015, and the Biennial Update Report (BUR) that was submitted to the UNFCCC early this year. The programme has been acknowledged as an important voluntary industry-led initiative that is helping Indian businesses act against the threat of climate change.

The Program aims to provide Indian businesses with the technical knowhow to measure their emissions based on the internationally accepted GHG Protocol. In essence, the Program recognizes that businesses cannot manage what they cannot measure. Key data regarding emissions will help businesses meet two critical goals: reduce emissions and improve their business performance.

This is one reason why the Program has received strong endorsement and support from industry leaders. With the voluntary participation of over 45 responsible Indian businesses, the Program already covers over 20% of India's carbon emissions. Companies that have signed up include the National Thermal Power Corporation Limited (NTPC), Indian Railways, Ambuja Cements Limited, Ford India Private Limited, Mahindra & Mahindra, Infosys, ITC Limited, Jet Airways, ACC Limited and Godrej & Boyce Manufacturing Company Limited. The rapid adoption of the Program shows how valuable its tools and processes are in ensuring that India moves towards a more sustainable growth path.

Looking ahead to a cleaner brick sector

India's brick sector, although unorganized, is the second largest producer globally. It is continuously expanding on account of the increased demand for bricks in infrastructure and housing. But it is also one of the most polluting and energy inefficient sectors largely due to the use of traditional technologies. This is why we have invested efforts in helping the industry transition to improved brick kiln technologies.

2016 saw significant progress on this front when the Bihar State Pollution Control Board passed an order requiring brick kilns in Patna and the surrounding areas to upgrade to cleaner technologies. This is an important development – a first for any State Pollution Control Board to ask brick-makers to move away from traditionally used technologies. Several initiatives supported by Shakti have contributed to the technical evidence that shaped this order. The next step is to work with various actors in the State to support its implementation. We are already supporting an early intervention effort that provides technical assistance to brick-makers on available technologies and operational best practices. This information is crucial to help them make sound decisions and to increase compliance to the order.

We are also working with our partners to inform the development of the new emissions standards for brick kilns. Based on the significant amount of technical work completed till now, we have provided recommendations to the Environment Ministry in response to their proposed standards.

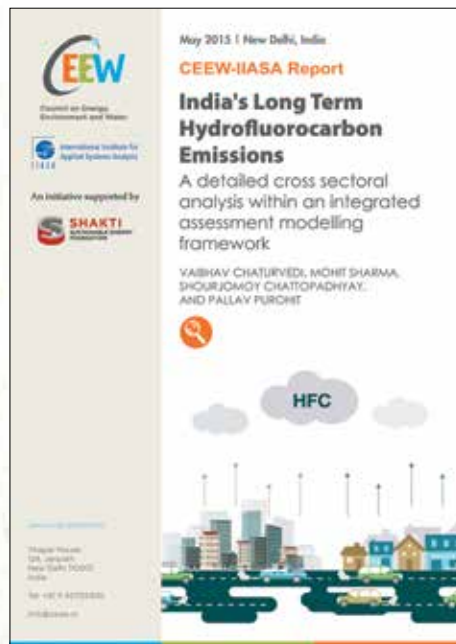
The implications of an HFC phase down

India has submitted an amendment proposal to the Montreal Protocol to phase down the production and consumption of Hydrofluorocarbons (HFCs). These are coolant gases used in refrigerators and air-conditioners with high global warming potential. Phasing them out will lead to significant climate benefits.

But a number of important questions will have to be answered before this transition takes place. For example, what alternatives exist to HFCs? What is the technical and commercial viability of these alternatives? What are the challenges associated with Intellectual Property Rights, transition costs

and safety? With these questions in mind, we supported the first modelling exercise of India's HFC emissions focusing on a sector-wise climate impact.

The findings of this report are quite compelling. If HFCs are not phased down, the cumulative HFC emissions from India will amount to 6.55 Gigatonnes CO₂ equivalent (GtCO₂-eq) between 2010 and 2050. But if the Indian amendment proposal were to be accepted, then 4.2 GtCO₂ equivalent emissions would be avoided between 2010 and 2050 or 64% of the total HFCs that are expected to be emitted between 2010 and 2050. These numbers allow for a more informed discourse, particularly to address the critical issues associated with the phase down.



Building consensus: The US-India Track II Dialogue on Climate Change and Energy

For more than six years now, the US-India Track II Dialogue on Climate Change and Energy has played an important role in fostering greater bilateral cooperation in these areas. This year's meeting, set against the backdrop of the Paris Agreement, was particularly significant. Recognising the need for an effective implementation framework for the NDCs, it laid out concrete ideas for collaboration on issues like advancing the Paris Climate Agreement, minimizing air pollution, and limiting the lock-in of high-carbon futures. With the national energy and climate position of both countries rapidly evolving, joint action for both countries is very relevant to the global effort to tackle climate change.

The Dialogue is co-chaired by Carol M. Browner from the Center for American Progress, and Jamshyd Godrej, Chairman and Managing Director of Godrej & Boyce Manufacturing Company Limited. Its participants include distinguished representatives from academia, research institutions, civil society and industry. In the past, the dialogue has focussed on important areas such as innovations in renewable energy, low-carbon pathways for growth, climate resilience and HFCs.



Bridging the information gap around climate change

Shakti has been working to fill the vital, rapidly growing information needs around climate change action in India. In 2015, we launched a briefing paper series that provide a comprehensive account of India's efforts to address climate change, particularly in the content of India's commitments

at COP 21. Also, the India Climate Dialogue website continues to present commentaries by subject experts and journalists on important thematic areas: Science, impacts, mitigation, adaptation, negotiations and policy making. The information provided on both these platforms can be used to analyze a wide range of climate-related issues, support future policy decisions and inform emerging stakeholder dialogue.



Towards better air quality management

India's air pollution levels have been increasing over the last decade and reached their highest levels in 2015. According to the World Health Organization (WHO) ambient air quality database, 13 of the world's 20 most polluted cities are in India including several state capitals. Given this, we are investing in several efforts to improve air quality management processes.

In 2015, we supported a comprehensive assessment of the process of establishing industry-specific emission standards in India. This is an important exercise because a robust emissions standards process can help reduce air pollution caused by rapidly increasing industrial activity and also protect public health. Based

on this assessment, concrete actions were identified to improve this process such as increasing capacity to monitor emissions, creating a robust evidence base and fostering stakeholder engagement on the issue. Industry-specific assessments in support of better informed standards have also been initiated.

We are also working to increase the availability of air quality monitoring data in various Indian cities. This information can increase public awareness of the rising levels of air pollution as well as inform the next wave of policies. To this end, we are supporting the operation of low-cost air quality monitors in ten major Indian cities. These monitors will become operational during the course of this year providing real time information on air pollution and its hot spots.

An Energy Security Index for India

Meeting India's energy needs in a secure manner is an important priority for the government. Over the years, India's energy needs have grown considerably, which has also increased India's dependence on imported energy. However, it is also recognized that for us to be truly secure in energy, people need to have reliable access to affordable and clean energy. Therefore, we invested in developing a holistic Energy Security Index that is customized to India's context and that tracks energy security on a multi-dimensional basis. This will help monitor progress over time and aid in crafting effective policy choices.



SPOTLIGHT

India's first civil society platform provides data on GHG emissions for various sectors

As India continues to experience the impact of climate change, there is a growing recognition for policy action. Robust, reliable GHG emissions data can help inform such action and complement our developmental goals. But this data is scattered across various sources or not easily available. Also, the methods used to estimate emissions may vary significantly.

Recognizing these challenges, Shakti and a few other eminent civil society organizations partnered to form the GHG Platform India with the goal of providing a comprehensive database on GHG emissions for the country. This is a first of its kind initiative that draws on the significant expertise of partners and sector experts to develop national GHG emission estimates.

So far, the platform has prepared national emission estimates for the Energy, Industry Waste, and Agriculture, Forestry and Other Land Use (AFOLU) sectors from 2007 to 2012 for carbon dioxide, methane and nitrous oxide. The complete data set is available on an interactive

website (<http://ghgplatform-india.org/>) to promote easy access. Methodology and assumptions used for analysis are also documented on the website.

The launch of the platform is a significant step towards increasing transparency and increasing access to GHG emissions data for India. In concrete terms, data is now available to understand both the sources and magnitude of GHG emissions on a sector by sector basis. This is an important step for driving strategic decisions around GHG reduction and climate-friendly policies.

The GHG Platform India is a partnership between the Council on Energy, Environment and Water (CEEW), the Center for Study of Science, Technology and Policy (CSTEP), ICLEI – Local Governments for Sustainability, Shakti Sustainable Energy Foundation, Vasudha Foundation and the World Resources Institute and a few other sectoral experts, in collaboration with SEEG, Brazil (System for Estimation of Emissions of Green House Gases).

The Shakti Dialogues 2016



In early 2016, Shakti Sustainable Energy Foundation hosted the Shakti Dialogues, our annual roundtable discussions with our partners. The 2-day discussions featured sessions on:

- **Renewable Energy and Energy Access**
- **Electric Utility Reforms**
- **Demand Side Management**
- **Appliance Efficiency**
- **Energy Efficiency - Buildings**
- **Energy Efficiency - Industry**
- **Air quality and Vehicular Emissions**
- **Climate Policy**
- **Sustainable Transport**

The purpose of the Dialogues is to share our strategic plans with our partners as well as to discuss areas of opportunity for Shakti and our partners in the current operating environment, and to use the inputs to inform our ongoing work. It is also an opportunity for our partners to get to know each other and explore areas of collaboration. These



are small format conversations comprising a select group of informed participants from our partners in the civil society, think tank, research, academic and consulting communities. Shakti Board members and funders also attended some of the sessions. A number of actionable and practical ideas emerged from the discussion, and we look forward to following up on them.

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At Shakti, we form strategic partnerships with organisations that share our vision of a future powered by clean, reliable, and secure sources of energy. We take this opportunity to acknowledge some of our partners over the last few years.

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