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King Abdullah Petroleum Studies and Research Center

Renewable Energy Policy in India: Creation, Implementation and Efficacy

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About KAPSARC

The King Abdullah Petroleum Studies and Research Center (KAPSARC) is a non-profit global institution dedicated to independent research into energy economics, policy, technology, and the environment across all types of energy. KAPSARC's mandate is to advance the understanding of energy challenges and opportunities facing the world today and tomorrow, through unbiased, independent, and high-caliber research for the benefit of society. KAPSARC is located in Riyadh, Saudi Arabia.

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Key Points

India aims to transition from a fossil fuel burning economy to a comparatively low-carbon economy through the increased use of renewables. To achieve this, India aims to build 175 GW of renewable energy capacity by 2022, establishing one of the largest renewable programs in the world. Such a step change has enormous implications for policy and sustainability. Success in this transformation will require progress on many fronts, the key points of which were discussed at the KAPSARC workshop. These include:

- Developers and investors in power generation perceive the solvency of their customers – the electricity distribution companies – as a barrier. Curtailing political alignment and interference is an important step in improving the operational and financial performance of these utilities.

- India's underdeveloped capital market will constrain deployment of renewables unless policy creates a financeable business proposition, free of political temptations to provide unsustainably subsidized electricity.

- Renewable energy and new coal-fired power are competitive in terms of cost of energy supplied. However, renewables require balancing and integration services that are effectively subsidized by legacy fossil fuel fired power plants, even more so as penetration increases. Proper assessment of grid integration and management costs, and their likely impact in financial terms, is needed.

- Electricity access in remote and rural areas may be facilitated by off-grid renewables, as extending the grid to them would not be an immediate cost-effective option. Off-grid renewables can support development of microgrids, which aggregate demand to underwrite the costs of future grid connection.

Summary for Policymakers

India needs energy to meet its economic growth objectives, yet almost a quarter of its population has limited or no access to electricity. Providing every citizen with access to affordable energy has always been high on the Indian government's agenda. With the rapidly changing economics of solar power, the government has realized that solar and other renewables can potentially transform the energy landscape, increase access and help India meet its climate change objectives. Grid transmission capacity has been a barrier; however, distributed and off-grid solar solutions provide a viable solution in increasing energy access.

Although the government of India has promoted renewable energy (RE) since 2003, the states hold primary responsibility for developing the electricity industry (generation, transmission and distribution). The states have been proceeding with caution on RE, largely because of their political interest in keeping tariffs low. Being dependent primarily on cheap coal-based power generation, the states hold the view that any increase in RE's share of electricity generation will further exacerbate their local distribution companies' current poor financial situation.

Over the years, India has established fairly comprehensive policy and regulatory frameworks to encourage RE development. However, meanwhile the institutional mechanisms responsible for policy implementation are insufficient or even absent.

To achieve the quantum leap in national-level RE targets by 2022, states will need to realign their goals and strengthen their existing policy and regulatory frameworks. However, the energy generation issues of individual states cannot be ignored. Having additional latitude for states to meet national targets in a coordinated manner could reduce societal costs.

Feed-in-tariffs have provided a high level of certainty to investors. However, regulators risk imposing unnecessary costs on society if they fail to adapt to market signals, learning curves and technology innovations. Such adjustments will reduce the policy cost that must be borne by either taxpayers or consumers. Furthermore, balancing requirements brought on by large-scale integration of intermittent renewables will eventually exceed the ability of existing dispatchable power generation to provide this service. The system will then require additional investment in peaking power, increasing overall costs.

Financing will be crucial to achieving the 175 GW target, which comprises 100 GW of solar, 60 GW of wind, 10 GW of small hydro and 5 GW from biomass. Transforming the operational and financial performance of the electricity industry can be achieved by eliminating subsidies from the supply side and applying them to those customers in need. Investors see less risk in the "financial covenant" provided by the aggregated balance sheets of customers paying prices that cover production costs than in the government's promise to pay.

The financial and operational challenges of bringing power to communities that are currently off-grid may be better achieved by implementing RE projects. Newly served customers are likely less driven by reliability of service than by cost per unit of delivered electricity. Such installations can support the development of microgrids that serve to aggregate demand and therefore underwrite the costs of future grid connection. Policymakers will have to be cognizant of the fact that an integrated approach to energy policy will be needed to meet future energy requirements. Renewables are just a part of the solution, not the complete solution in itself.

Background to the Workshop

KAPSARC's Energy Workshop Series on India's Energy Policies will create a collaborative space for discussion of some of the most pressing issues facing India's economic development and its energy economy. The first in this series was hosted in Jaipur, Rajasthan, in March 2016. The workshop initiated dialogue among key stakeholders including policymakers, regulators, academics, financiers and industry executives. RE has gained tremendous attention at both the central and state level since the government of Prime Minister Narendra Modi was elected in May 2014 and this formed the focus of the inaugural workshop.

The Indian people want improved electricity services in terms of availability, accessibility and quality. However, almost a quarter of the country's 1.3 billion people have limited or no access to electricity, as the current infrastructure is incapable of providing sufficient and reliable power to every household. India faces major challenges in providing electricity for economic growth and in enabling access to modern and affordable electricity in unserved and underserved regions.

Although India has significant RE potential, historically the country has focused largely on increasing its supply of fossil fuel-based electricity, but seldom reaches the targets it sets. Alternatives to fossil fuels were originally very costly but this premium has diminished in recent years. RE has gradually become an integral part of India's electricity development strategy due to persistent electricity shortages, growing environmental concerns and a desire to achieve sustainable development goals.

> **"There is no separate political economy for the renewable energy sector that is different from the political economy of the energy sector."**

The National Action Plan on Climate Change in 2010 outlined a number of measures, including the National Solar Mission, to accelerate the deployment of RE. As a result, installed capacity increased from about 17 GW in 2010 to around 39 GW in 2016. As India works toward its goals of providing universal access and sufficient electricity to power economic growth, reform in the current electricity system is essential.

Growth of Renewables and the Political Economy of Energy

Electricity policy and provision in India is the joint responsibility of the states and the central government. The Indian electricity industry was largely a vertically-integrated, state-owned monopoly. The government owned, operated and regulated the industry. The largely monopolistic State Electricity Boards (SEBs) were responsible for generating and supplying power in their respective states. They were caught in a vicious circle of unviable, but politically popular, low tariffs that did not cover costs. Political interference in the electricity industry was and remains significant. As a result, the industry accumulated and continues to incur huge losses, preventing it from being able to invest to keep up with growing population and electricity demand.

Electricity subsidies in India particularly focus on agricultural and residential consumers. During the Green Revolution of the 1970s, political parties offered farmers very low subsidized electricity tariffs to ensure that agriculture could be sustained year-round with pumped ground water. Since then, politicians from agriculturally rich states have rejected attempts to rationalize electricity pricing, resulting in subsidies that prevent the development of a financially sound electricity sector.

Following the 1990s reforms, electricity regulatory commissions were created to keep the state governments at arm's length from state utilities to lessen political interference. However, in reality, complete autonomy for these state electricity regulatory commissions has remained elusive as regulators are not immune to political constraints/ pressures in their decision making.

The Electricity Act of 2003 further reformed the sector by separating generation, transmission and distribution to introduce better accountability and improve the financial performance of the electricity sector. Over the years, while electricity tariffs have increased, progress in tariff reform has been slow. Distribution companies (DISCOMs) selling directly to consumers suffered aggregate losses (after tax, on accrual basis) of INR 691.1 billion ($10.3 billion) during 2012-13. These losses were a result of distribution losses, electricity theft, the gap between average cost of supply and average revenue realization, inadequate metering and billing and collection inefficiencies.

As electricity pricing in India is a politically sensitive subject, state governments are strongly vested in maintaining the status quo of low power tariffs. A transition to a low-carbon economy through increased use of renewables would require:

- Proactively involving utilities, consumers, government and other stakeholders and balancing their interests, and understanding the political and economic challenges of renewable energy deployment in a system where electricity is the joint responsibility of the states and central government.
- Reconfiguring policy and regulatory instruments to maximize the socio-economic benefits of RE. This would sustain its growth over the long term, incorporating and developing off-grid RE solutions.
- Identifying and addressing implementation issues associated with RE policies, incorporating lessons learned from other countries.
- Transforming the operational and financial performance of the electricity industry to provide financially viable utilities that can secure infrastructure investment capital.
- A rational approach to integrating RE within the overall energy mix with due assessment of financial costs and impact on grid behaviour.

Inducing Renewable Energy Generation Through Policy

The government of India has been very aggressive in promoting solar energy since it introduced the National Solar Mission in 2010. With nearly 39 GW of installed RE capacity, India has emerged as one of the world's leaders. This impressive growth has benefited from supportive policies at the state and central government levels, the rising cost of fossil fuel generation and reductions in RE technology costs. Despite these successes, challenges remain that must be addressed to achieve India's RE goals.

If we want to make progress on renewable energy, we really need to understand how the political economy works."

Adding up the policy targets

For India to achieve its 100 GW solar energy target by 2022, state-level actions will need to match national-level aspirations. Capacity targets under state-level policies do not add up to the national target: 41.5 GW of solar capacity by 2022 in the key states, compared to the 64.4 GW that the Ministry of New and Renewable Energy (MNRE) believes will be required from these states to achieve the overall 100 GW target. Going by recent developments in the industry, which has surpassed original expectations, the targets set by the MNRE may be ambitious but not difficult to reach. The scale of the shortfall varies, as shown in Figure 1.

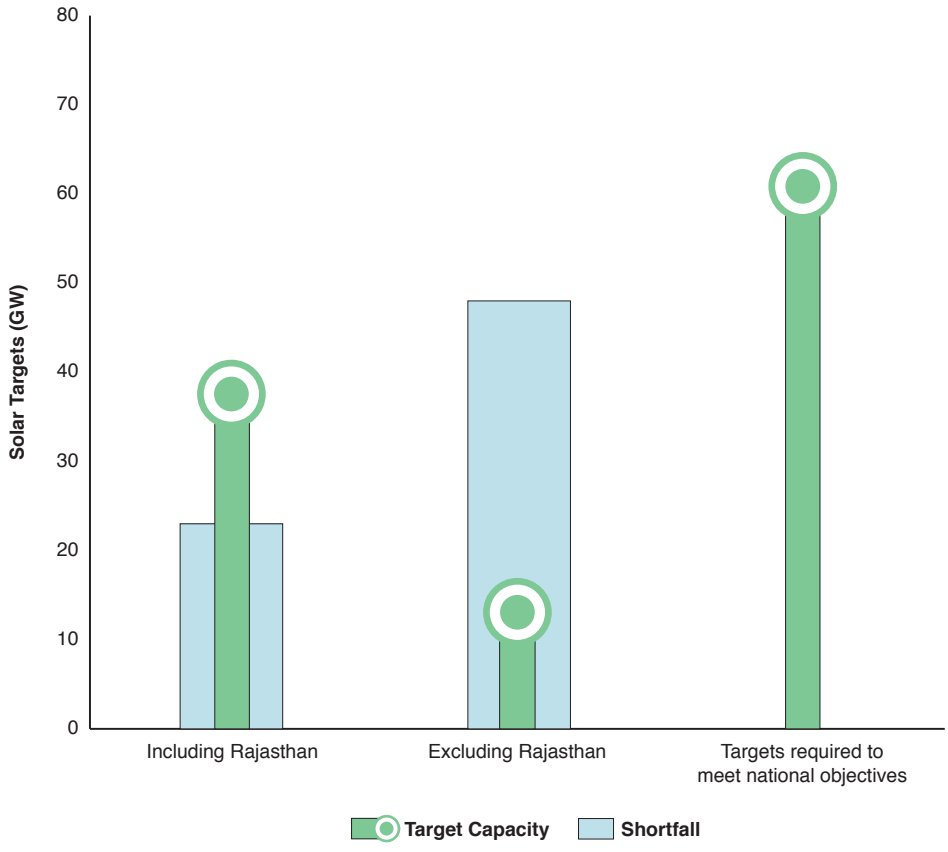

Figure 1. Mismatch between state's and MNRE targets.

Source: KAPSARC analysis.

The states of Andhra Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu and Uttarakhand need to increase their solar energy targets by two to five times.

While states like Gujarat, Uttar Pradesh and Haryana need to increase their targets by 16, 21 and 41 times, respectively.

Rajasthan, which has already set a very high target of 25 GW by 2019, is the only exception.

"There is a perception that states are working against national policy, but the specifics of individual states matter."

The mismatch in priorities illustrates the problem. The central government is focused on capacity growth while the states' bankrupt DISCOMs are in no position to buy the power generated. They are currently losing money on every unit of electricity they sell. More expensive RE generation only exacerbates the problem. Adjustment of state level targets may be necessary to take care of local contextual factors without compromising the national level aspirations.

Mandates and incentives to support renewables

The mechanism of renewable purchase obligations (RPOs) was established to promote RE generation and sustain capacity growth. However, most state electricity regulators have implemented RPO targets of 2 percent or less by 2016 (see Figure 2) for their distribution companies. Such low RPO targets act as a ceiling on deployment rather than a stimulus, since there is no incentive for the DISCOMs to buy renewable power beyond these targets.

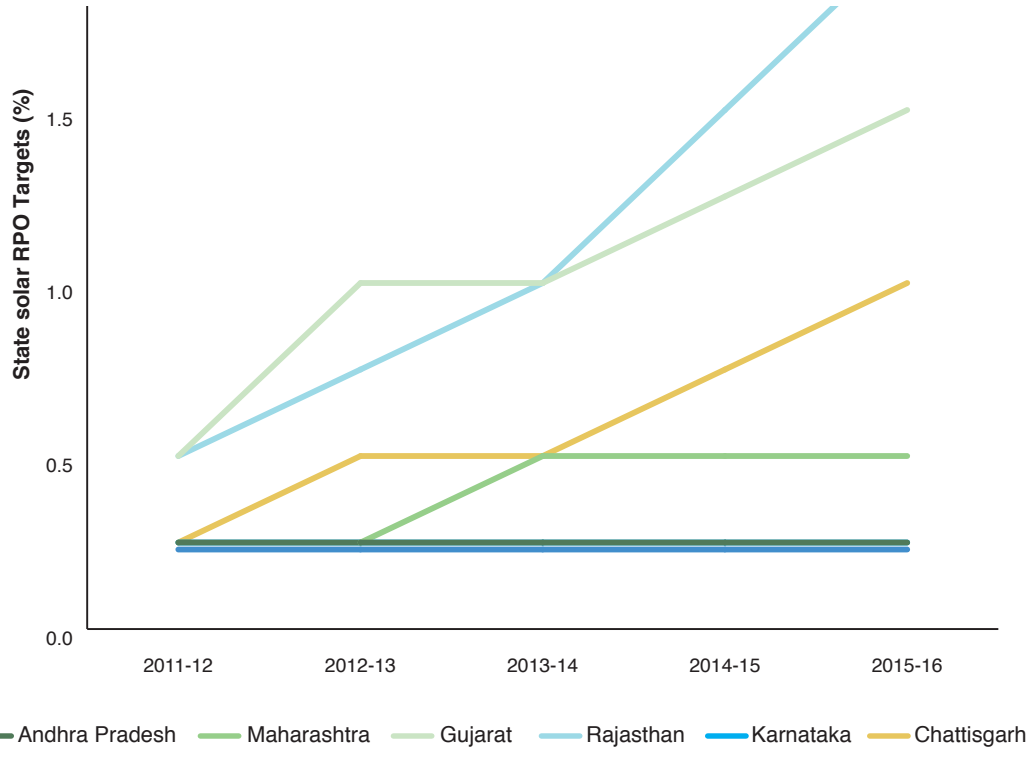

Figure 2. Low RPO targets in resource rich states.

Source: KAPSARC analysis.

KAPSARC analysis shows that achieving 100 GW of solar energy capacity would require solar RPO targets of approximately 10.5 percent by 2022, a fourfold increase from existing targets. The 2016 National Tariff Policy, which proposes a minimum 8 percent RPO for solar energy by 2022, could be a significant step in the right direction. RE capacity growth would require electricity regulators to outline the long-term trajectory of RPOs, ideally aligned with national objectives, and incorporate transparent compliance mechanisms.

The disparities among states in terms of RE potential and development cost could make developing differing national and state-level targets contentious. Germany faced a similar situation in the 1990s (Langniß 2001). Utilities were obliged to purchase renewable electricity from installations located in their service area. This led to consumers in northern Germany, where the majority of wind installations are located, paying higher electricity tariffs (and a higher share of overall renewable electricity costs) than consumers in the south. The German government tried to address this problem by capping the RPO at 10 percent of the northern utilities total sales. However, this solution threatened deployment of wind energy in resource-rich areas and insufficiently addressed the unbalanced burden, as utilities in resource-poor areas were not obliged to meet the 10 percent RPO. The Renewable Energy Act of 2000 resolved this problem by requiring all electricity suppliers to purchase equal amounts of RE-based electricity regardless of where it was generated.

One possible policy option to help state-level RPOs reflect India's national commitment would be to incentivize resource-rich states to set higher-than-national-level targets to make up for the inability of other states to meet the national RPO target. Another policy prescription has been Renewable Energy Certificates (RECs). These provide a mechanism for promoting RE and facilitating RPO compliance, by allowing states to purchase certificates representing RE generation elsewhere. However, RECs have been ineffective to date, not least due to weak regulatory enforcement of RPO compliance.

Feed-in Tariffs (FiTs) can offer RE developers and investors long-term certainty, ensuring a reasonable rate of return for a guaranteed period of time that often matches the project life span. However, state electricity regulators generally do not adjust FiTs as technology develops and prices decrease, rewarding RE developers with windfall profits and increasing the cost of policy support. Regulators must adjust FiTs periodically to keep pace with declining costs.

Increasingly, more and more states are moving toward competitive selection of renewable energy projects. This will certainly lower the cost of policy support to the government and/or impact on retail tariffs, but may also increase the chances of underachieving the set goals as a result of thin profit margins to the developers.

Grid infrastructure requirements

Inadequate interstate transmission capacity and difficulties in obtaining open access are two major bottlenecks in harnessing the geographic diversity of RE resources. By some estimates INR 1trillion ($15 billion) is needed to develop the necessary grid infrastructure (both intrastate and interstate) to integrate planned renewable capacity by 2022. However, the main priorities for utilities are less forward looking. They are seeking to develop the required transmission and distribution infrastructure, and addressing operational issues in the existing interconnected grid system. Furthermore, in addition to upgrading the network, utilities will need to develop balancing options and storage solutions to absorb the variability that large amounts of intermittent renewables on the grid would bring.

Promises of Parity and Challenges of Integration

Technological innovations are driving renewable energy (particularly solar) toward grid parity in terms of the cost of the energy component of supply. The industry estimates that grid-scale solar power will become more economical than conventional pit-head coal in India by 2020. However, grid integration costs will increase as the proportion of RE on the grid rises. There have been no domestic studies of the grid integration and management costs in India and their impact on future grids in terms of the total cost of service. Indeed the actual levels of curtailment in the grid, keeping in mind the diversity of load pattern across the country, have not been properly ascertained.

For planning and operational purposes, the Indian power system is divided into five regional grids. Each regional grid comprises several state-level grids. The respective State Load Dispatch Centre schedules and dispatches electricity within the state, accounts for electricity transmitted through the state grid and monitors grid operations. Due to the smaller control area, balancing requirements for accommodating RE could be higher within a state than for a regional grid. Larger control areas would reduce the balancing requirement for large quantities of intermittent power.

A suitable regulatory framework is needed to promote regional balancing.

The large-scale deployment of intermittent solar and wind energy in India will require development of better grid management and load balancing mechanisms. RE generation forecasting is critical to scheduling, balancing and grid control. Improvement in techniques for forecasting RE availability at a spatial scale could provide the grid operator with a better perspective. Automated monitoring and state-of-the-art forecasting tools are required to help incorporate RE into the grid.

Goal of 175 GW and Financing Hurdles

India needs to mobilize significant capital to achieve its RE goals — approximately $100 billion over the duration of the target, according to industry estimates. In the past, the renewable energy industry largely relied on domestic financial institutions and banks for financing. Given government budgetary constraints, investment will probably come from a portfolio of options, including banks, non-banking finance companies, development financial institutions (public sector and multilateral organizations), overseas investors and the debt capital market. However, India's capital markets may not be sufficiently developed to support the proposed energy transition. It will require intensifying capital market development, and innovative financial support mechanisms and products.

The National Clean Energy Fund (2010), created with payments from the clean energy tax imposed on locally mined and imported coal, was initially designed to fund innovative clean energy technology and provide viability gap funding for renewable energy projects. Although the fund collected a significant amount of money, in 2016 it was renamed the National Clean Environment Fund and is now used to fund clean rivers and afforestation projects and to protect tiger and elephant habitats, reducing the government's RE funding. To address this shortfall, the government has recently proposed a National Renewable Energy Fund. This would provide for research and development, assessment of solar resources and financing options for off-grid renewable energy projects.

Multilateral lending agencies, including the World Bank, KfW and the Asian Development Bank are being enrolled in the transition. In addition, the government has formed a consortium of financial institutions including public and private sector banks and non-banking finance companies to fund renewable energy projects.

Both on- and off-grid electricity solutions face challenges of scale and financing. Rural households lack upfront debt financing options and have limited access to financial institutions and products, posing challenges to increasing the penetration of off-grid solutions. On-grid solutions face the challenge of a viable power purchaser, as the bankrupt DISCOMs cannot take on the counter party risk.

The DISCOMs' long-term profitability is critical to the success of India's electricity industry and thus to India's energy transition.

To ensure continued RE development, the government has focused on minimizing the cost to consumers by bundling on-grid RE with fossil fuel power and by allowing the central power producer (NTPC Ltd), which has a strong balance sheet, to take on the counter party risk. While this approach is suitable for the short term, it will not be feasible over the medium to long term and the DISCOMs must become profitable enough to take on the counter party risk themselves. The DISCOMs profitability is a political decision that requires rationalization of the current low residential electricity tariffs and thus reducing the cross subsidy created by charging higher rates to industrial and commercial consumers.

Transitions in Energy and Institutions

The ready availability of off-grid solar and the development of microgrids provides Indian policymakers with an opportunity to promote energy access in areas with limited or no electricity supply. Incorporation of solar-powered agricultural pumps and microgrids in rural and agricultural areas provide viable options for these consumers to be isolated from the political economy and still benefit from access to electricity.

Such energy solutions in the past often failed as a result of either lack of demand or inability to pay. Faced with poor quality and often intermittent electricity supply, the well-off either opted for their own diesel fuel generators or invested in power inverters. This was the status quo. The economic growth of the past several years has seen the emergence of a nascent consumer class, which is willing to pay for electricity even if it is intermittent. The key to providing these off-grid solar solutions lies in creating the financial mechanisms to promote their greater adoption. One of the benefits of these schemes is that they can lead to organic development of microgrids. This aggregated demand can better underwrite the costs of eventual linkage to the interconnected grid.

In a federal system comprising of several states/provinces, alignment of state-level objectives with national-level policy goals and cooperation between the federal and state governments on renewable energy implementation is essential. Appropriate mechanisms need to be devised for encouraging active participation of states in the development of the renewables. The last decade has seen significant policy and institutional reform that has supported the growth of renewables. However, going forward to a level that is characterized by a significant share of renewables in the overall energy mix would require changes in the existing market designs to support continued growth of the industry.

India is trying to change several things at the same time. It is trying to reduce losses and improve the functioning of the electricity sector. In an era of low prices for fossil fuels, it is trying to grow its renewables portfolio. Living with a grid that has suffered from years of neglect and underinvestment, its plans will inject massive intermittency from renewables and add to the scale of the challenge. But by using renewables to drive change across the electricity market, India can push for greater energy access to its citizens and radically transform the sector. RE, especially solar power, has provided an opportunity for India to bridge the rhetoric-implementation gap.

About the Workshop

KAPSARC convened the workshop in March 2016 with some 30 experts in the areas of renewable energy, energy financing, venture capital, academia and policy to facilitate a discussion on India's renewables policy. The workshop was held under modified Chatham House rules.

List of Participants:

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About the Team

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Brian is a senior research fellow and Human Geography of Energy program director at KAPSARC, leading teams on China, India, local content, policy and bargaining models.

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Shahid is a research fellow at KAPSARC working on renewable energy in India and other countries. He is an energy specialist who has worked in energy policy, regulation, market design and energy infrastructure, particularly in the electricity industry.

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Dennis is a research associate at KAPSARC working on energy modeling and data sciences in India projects. He previously worked in technical energy research and has consulted on renewable energy and development projects.

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Jitendra is a research fellow at KAPSARC working in the India energy research program. He previously worked in consulting, advising organizations on commodity flows and markets.

About the Project

KAPSARC is engaged in analyzing the dynamics of India's energy economy and decision-making process. This will help provide deeper and more comprehensive understanding of the domestic Indian energy challenges and policies designed to address these challenges. The research project aims to investigate the global consequences of changes to energy markets within India, thus allowing assessment and analysis to obtain policy relevant insights.

In line with KAPSARC's overall objectives, the aim is to assist stakeholders outside India to understand the consequences of decisions taken by Indian policymakers.

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