Institutional Structures for Making Electricity Sustainable

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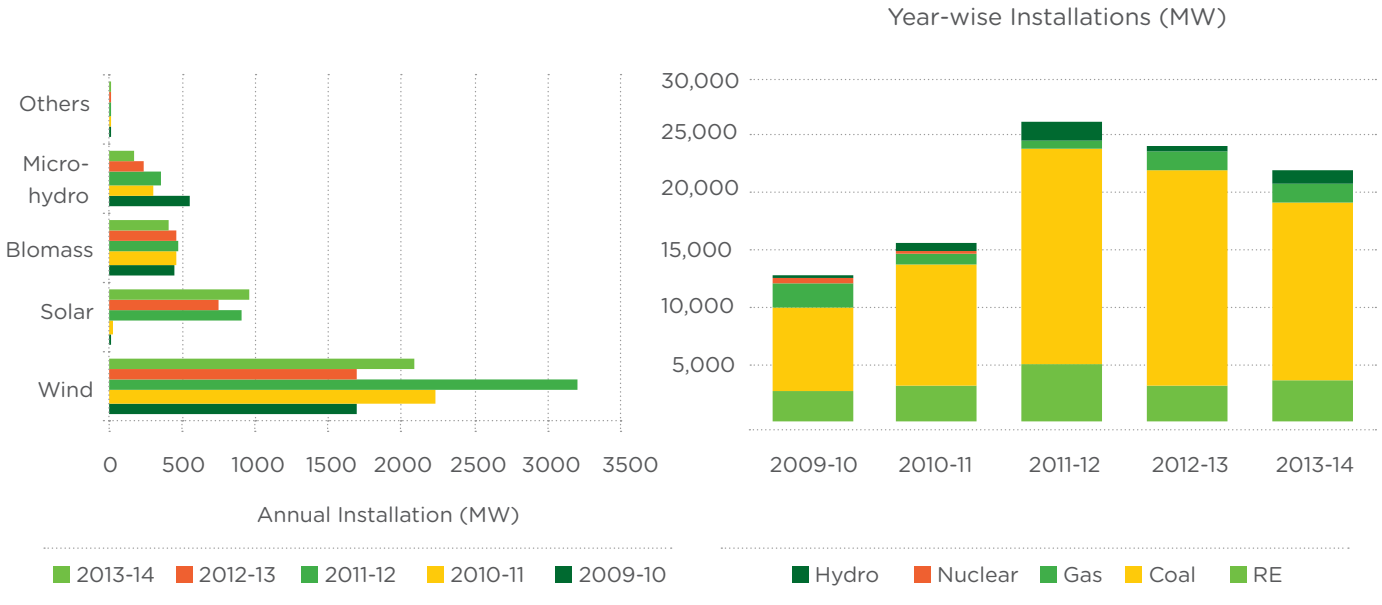
Sustainable energy comes in different forms and has a wide array of applications. For this reason the institutional structures required for effective and promotion of sustainable energy vary widely. Within the overall sustainable energy basket, renewable electricity is the largest contributor, and is progressively becoming an overwhelming policy priority in the face of the development challenges that conventional electricity generation alternatives face. This chapter focuses on renewable electricity generation at scale and the institutional and financing arrangements required for making this happen.

The principal sources of renewable energy at this time are wind and solar. The history of wind energy in India spans two decades, although it is only in the last ten years that the scale of production has started acquiring meaningful dimensions. Solar development at scale is more recent. However, in a short couple of years it has come to stand comparison with the scale of incremental wind installations, as the graph below depicts. Small hydro and Biomass based generation are the only other source of substantial scale. The installed capacities of these resources are significant, but new build has witnessed fall in installation growth due to development issues in the case of small hydro and fuel supply chain issues in biomass that have proved difficult to resolve. Other technologies like geothermal, tidal energy, etc., are still some distance from commercial implementation, even as the technologies per se are proven.

FIGURE 1: Annual Capacity Installation Trends by Resource



SOURCE: Yearly Energy Statistics, Ministry of Statistics and Program Implementation, Government of India, for all years except 2013-14 for RE. Data for 2013-14 for RE from MNRE

The need for economies of scale in renewable electricity is markedly lower as compared to conventional alternatives, making resource development substantially easier

The increasing contribution of wind and solar has been accompanied (and perhaps propelled) by a reduction in the gap between these resources and the supply costs of conventional alternatives. Indeed, barring coal, supply from new hydro, nuclear and gas plants are often more expensive than the mainstream renewable electricity resources at the generator bus-bar. Even considering the costs of integration of renewable energy in the main electricity grid, the differences between conventional and renewable energy costs have come down sharply in the past few years. This is clearly good news for renewables. Even better is the prognosis of further fall in renewable energy costs, in contrast to the increasing costs of conventional alternatives. The need for economies of scale in renewable electricity is markedly lower as compared to conventional alternatives, which also makes resource development substantially easier. For all these reasons and more renewable electricity generation projects increasingly find a larger space in the investment plans of developers.

India has clearly got some things right in this area because rarely has any other developing country (barring China which, one can argue, defies that definition any more) achieved this scale of growth. Wind power has largely been a private sector initiative, aided by favorable fiscal policies (mainly Accelerated Depreciation or AD for new build) for much of its run in the country, and a standard Feed in Tariff (FIT) procurement regime. With these two stays as support, investors took a deep dive into manufacturing, logistics, project development and, more recently, technology development. The framework for solar has been more driven by a government sponsored, subsidy driven, large scale procurement program in the form of the National Solar Mission (NSM). The benefits have been fast to come. In any planning scenario India currently looks at renewable energy technologies to substantially deliver its future electricity needs, thereby protecting the economy from the shocks of imported fossil fuel. The global environmental benefits from renewables in terms of CO2 reduction and the reduction of local environmental pollution in coal based power generation hubs is also being progressively recognized in the planning and permitting processes.

CHALLENGES FOR MAINSTREAM RE TECHNOLOGIES

As renewable energy penetration increases, challenges start to show up. The wind industry stands at a cusp where after a decade of strong growth it is struggling for reasons that it attributes to lack of institutional support from the national and state Governments. Governments in turn are finding it increasingly difficult to find the same levels of subsidies to support solar energy, especially in the face of increasing scale of deployment. More recently, for both wind and solar, utilities that offtake the energy are increasingly reluctant to commit to higher purchase levels due to the impact on their already stretched finances.[1] This has put the investments made by the developers in jeopardy and affected their confidence in building new assets.

An added problem is the concentration of resources in a few states in the country. This is particularly true for wind, but also holds to a great extent for grid scale solar. Most of the resource rich states have already reached the Renewable Purchase Obligations (RPO) targets set out by their respective regulatory commissions. At the other end, regulatory commissions in states deficient in

[1] *For example, in the state of Rajasthan where the incremental costs of renewable energy is Rs. 5.31 – 5.93 per kWh for wind (depending on location within the State and the AD benefits availed), the costs of marginal thermal generation is of the order of Rs. 4.50 (NTPC Aravalli). To put the costs in context, the distribution utilities in Rajasthan have accumulated financial losses of about Rs. 75,000 crores (approximately USD 12.5 Billion), which severely reduces their appetite for relatively expensive electricity when there is discretion in the purchase decisions. It is noteworthy that hydropower costs for Rajasthan are higher, generally of the order of Rs. 6.00 per kWh from NTPC projects like SEWA II, Dulhasthi, etc. However, these are concluded contracts with Government of India owned entities, and the DISCOMs are obligated to procure the contracted power from these stations.*

resources have either set low RPO targets and/or have not enforced the targets set out. The CERC instituted the market based Renewable Energy Certificate (REC) trading framework to obviate the resource deficit issues in such states. However the REC mechanism has taken a hard fall on account of significant design issues relating to eligibility criteria for REC issuance, certificate pricing and trading framework, which has resulted in a very large unsold REC stock. These issues can be addressed, and indeed the CERC is taking measures to improve the design of the REC framework that could result in more rational price caps and collars, vintage based certificate pricing (to address the issues of falling/fluctuating costs of installations), a more flexible trading arrangement that would allow for market making by traders, etc. More fundamentally, the states that need to procure REC see the cost of the certificates as an additional and unwanted cost burden. On the other hand the RE rich states where developers obtain their RECs do not see apparent benefits of such generation. Instead, in-spite of getting the electricity from these projects at their relatively low Average Power Purchase Costs (APPC[2]), they see the costs of management of these fickle resources to be much higher than the benefits that accrue to them from the lower costs.

Challenges emanate from the lack of availability of usable resource data, regulatory approvals and high cost of finance

What thus becomes necessary is to resolve the challenges that the developers and utilities face. The developers face some challenges on viability of investments at the present FIT or bid determined tariff levels. However, the bigger challenges come from the uncertainties that they face in project development and power offtake. On development, these challenges emanate from the lack of availability of usable resource data, regulatory approvals and high cost of finance that cause significant delay in project development, often undermining their viability. More importantly, even plants that are constructed now face loss of generation due to curtailment by utilities. Utilities curtail generators for technical and commercial factors that range from transmission inadequacies to the high costs of variability management. Wind and solar show significant variability in generation profile. Solar displays diurnal and seasonal variations, while wind at a location often has a very strong seasonal bias and uncertain daily generation profiles. These problems can be resolved through suitable investments in networks, developing forecasting capabilities, providing alternate balancing supplies to manage renewable electricity generation variability and in general through conscious planning and management. However, these responses have their own financial and managerial demands on the utilities which, in the short term, often see renewables as troublesome, high cost, and low contribution energy sources. While they remain positive about the prospects of renewable energy, they would like their next generation of managers to avail the benefits and manage the costs.

RESPONSES TO ADDRESS THE CHALLENGES

Robust responses that help address the developers and utilities to manage their issues would be fundamental for accelerating renewable energy deployment in the next decade.

Over the last few years all stakeholders – policy makers, regulators, civil society, utilities and developers – have become more aware of the issues. The key now is to find the right mix of solutions, and administering them through a framework that is reliable and durable.

[2] The definition of APPC has been a very contentious matter. CERC's proposed definition has been widely altered by State Regulators, thus creating anomalies. The changes made by the State regulators alter the concepts that determine REC pricing. The REC market mechanism has thus become exposed to multiple and non-standard regulation, which inevitably brings its efficacy and viability into question.

In terms of solutions, the following assume importance:

• Curtailment of available generation is very poor advertisement for renewable energy and deters investments. Adequate network capacity needs to be created to prevent curtailment. Curtailment for commercial reasons needs to be avoided;

• With very little operating costs, wind and solar viability are very sensitive to the cost of capital. Cost of financing needs to be brought down significantly if India has to deploy renewable energy at scale. While these costs are linked to broader macroeconomic issues, till those are addressed, means to limit the impact on RE deployment costs need to be found;

• In terms of management of variability the parallels between RE and the broader climate changes responses are noticeable. Just as climate change requires a combination of mitigation and adaptation, variable renewable energy requires better forecasting and scheduling (much like mitigation) and also the capability to manage the inevitable deviations from the forecasts (i.e., adaptation). While regulators led by the Central Electricity Regulatory Commission (CERC) have attempted the former, they have ignored the latter;

• Adaptation to generation variability can be achieved through resources that compensate or balance the variability (to the extent necessary), which need to be made available to the entity responsible for managing the variability. Under the present framework, utilities are charged with the variability management responsibilities. The utilities need to have access to balancing resources at costs that they are willing to bear;

• The management costs need to be evaluated on a system-wide basis rather than the specific cost involved in managing a specific RE resource. This has been traditionally the responsibility of the Government of India through its Central Electricity Authority (CEA). However, a debilitated CEA has not accorded the centrality to renewables in its planning processes that is otherwise required. In any event, since the Electricity Act 2003 and its market based construct have taken roots, CEA's plans are no longer of the same significance as before;

• Design of financing mechanisms like the REC need to be improved and supported by rational RPO levels across the country and strong compliance of the RPO levels by the designated entities responsible for such compliance. The specific philosophy guiding the level of RPO across states would need to be evolved, and must rely on robust analysis on the overall cost of delivered energy for the resource rich states as well as those deficient in renewable energy resources.[3]

State Governments are very important actors and most of the implementation actions would finally be in the States

The institutional set-up for the managing the above changes would be varied and complex, involving system planners, regulators, transmission developers and operators, system operators, financial institutions and above all utilities. It would also involve a number of parts of the Government of India namely the Ministry of Power, Ministry of New and Renewable Energy, Ministry of Finance, Ministry of Science and Technology, and potentially the Planning Commission. Most importantly, the State Governments are critical actors and most of the implementation actions would finally be in the States.

An Integrated National Sustainable Electricity Mission

India's success in implementing the National Solar Mission (NSM) has brought to bear the benefits of a mis-

[3] *Evolving a fair and rational framework for RPO is a challenging task. It may be possible and appropriate to evolve a framework based on the avoided generation costs of each state in the long run, and thereafter ensure that the incremental difference in delivered cost of renewable energy is of the same order. For example, if the avoided cost for State A is of the order of Rs. 4 while it is Rs. 5 for State B, then they should be willing to bear the delivered costs of RE of Rs. 5 and Rs. 6 respectively, assuming that there is a willingness to pay a premium of Rs. 1 (delivered basis) for renewable energy. In such a framework the RPO can be the same for all states. The key in such case would be to evolve a transparent and adequately simple transfer mechanism for subsidies to bring about such equalization, and in all likelihood would require a Government of India controlled entity to manage the financial transactions and the subsidy flow.*

sion mode approach in complex and high impact tasks that involve multiple agencies across the span of the country. There is merit in continuation of the mission approach and widen its ambit if the contribution of renewables to the electricity supply basket is to be stepped up in the coming decade.

The efforts on solar have not been backed by similar efforts to propagate wind and other renewable energy technologies. In fact while incentives like Accelerated Depreciation (AD) were being extended to solar, they were simultaneously withdrawn from wind. Ostensibly this was because wind as a more mature technology, had already benefited from incentives in the past, and that such incentives were distorting the market and encouraging inefficient capacity. The latter point of inefficient capacity, while perhaps true in the 1990's, is no longer the case. What the withdrawal of the incentives did was to eliminate an entire class of investors for whom the tax benefits from AD mattered. More fundamentally, it signaled that the Government was no longer seeking to encourage wind.

This needs to change. Arguably, wind and solar need to be looked at through the same lens. Beyond the technological nuances and relatively minor differences in the scale of costs, there are few fundamental differences between grid scale wind and solar generation. On the contrary, there are obvious benefits in considering them on a similar footing since this would reduce artificial policy distinctions between them. The development and integration issues also tend to be similar, although the details vary. Further, technological integration of wind and solar in the form of hybrids is a real prospect. That said, there are still reasons to maintain distinction between wind and solar. In particular, the possibilities of distributed solar on a large scale (along with the associated issues of integration at the tail end of the grid) makes solar and wind candidates for common but differentiated attention. More importantly, the National Solar Mission has worked in its current form, and the fear is that the dilution of focus could in turn compromise the benefits.

Beyond the development issues which arguably could be addressed separately for wind and solar, there is however an unquestionable need to address the grid integration and variability management issues together. Variability management is clearly the biggest showstopper, and must be addressed through very rigorous and sophisticated planning, technological and operational measures. This is a multi-stakeholder activity that demands attention as a separate action area in itself.

National Sustainable Electricity Mission (NSEM) would integrate conventional resources like hydro and also newer concepts of energy storage and Demand Response

Integrating the above, it is perhaps time to launch the National Sustainable Electricity Mission (NSEM). The prime drivers of NSEM would be wind and solar, but it would integrate even conventional resources like hydro (including pumped hydro), gas and spinning coal, and also newer concepts of energy storage and Demand Response.

The NSEM should have multiple component missions and programs. Firstly, the National Solar Mission should continue with the same ambitions and zeal as at present. A parallel National Wind Mission (NWM) should build a parallel track for wind power, with incentive frameworks that are aligned with solar. The entities made responsible for detailed implementation actions of the component missions can differ. Much like the Solar Energy Corporation of India (SECI) that manages the implementation of the NSM, an agency can be established for implementing the NWM.

As this chapter has emphasized, variability management is among the biggest issues that the renewable electricity sector faces. This is where the conventional genera-

tion resources are not alternatives but complements to wind and solar. It is impossible to ensure renewable energy growth without the support of the (conventional and emerging) sources. These actions can be effectively managed through a National Clean Energy Integration Program (NCEIP) that can be supported by the coal cess earnings that accrue to the National Clean Energy Fund (NCEF). As this paper has commented earlier, some conventional alternatives are more expensive than wind and solar. This has led to demands in certain quarters that new build of conventional resources be replaced by renewables. These demands and contentions are fallacious and ill-informed.

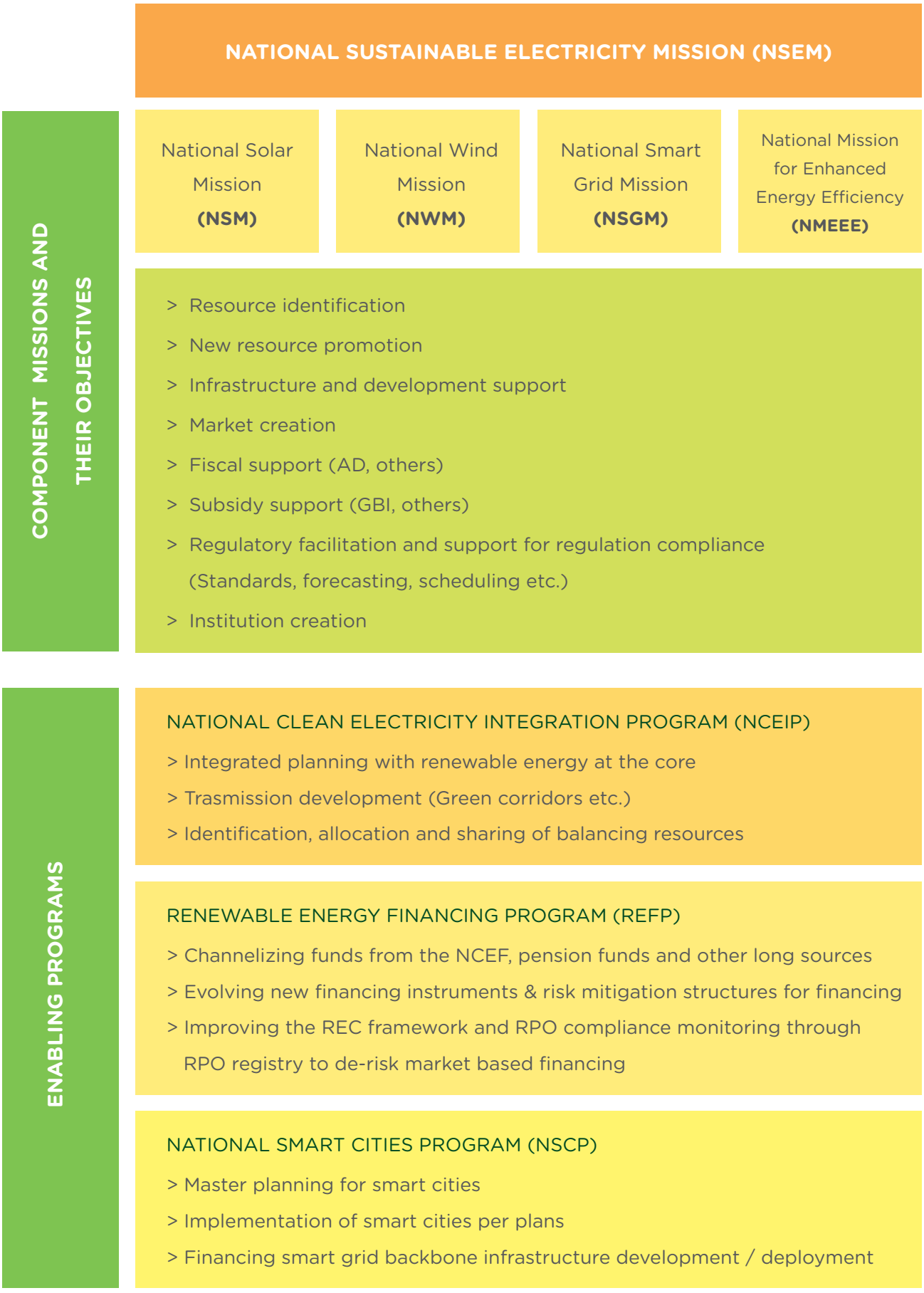
It is over-simplistic and incorrect to evaluate system costs based only on the individual resource costs, since each of these resources have very different operating characteristics

For a secure and economical operation of the power system, the costs of these resources (including transmission) need to be considered and optimized in conjunction. The operating costs of individual resources are not of particular relevance so long as the overall system costs are optimized. The NCEIP would bring together all these technologies through rigorous planning and coordinated implementation and operations of these resources.

Off-grid and distributed generation also need mention in this context. The NSM has been placing increasing emphasis on distributed solar. This needs to be continued and enhanced through strong institutional arrangements and infrastructure support. The impact can be significant since agriculture consumes close to 20 percent of electricity supplies in the country, and the transmission and distribution losses in agriculture (or attributed to agricultural supplies) tend to be high. Conversion of diesel agricultural pump sets and electrical pumps in remote or high loss areas already makes economic sense. Proliferation of these applications will only bring down costs further, and hence must be institutionally promoted. The same applies for household and commercial applications at the tail end of the grid where solar can have a very short payback. Solar rooftop supplies in these categories can indeed get a strong boost with incorporation of Smart Grid technologies that allow for bi-directional flows. Government of India already has an ambitious Smart Grids program, which can work in hand with the renewable energy program to better manage renewable energy integration in all parts of the grid and thereby provide a fillip to sustainable energy supply in the future.

Finally, financing costs have a huge impact on the delivered costs of renewable energy. In the past, regulatory instruments like the Renewable Energy Certificate (REC) mechanisms have been introduced to make renewable electricity more viable. These measures do not fundamentally reduce the costs of energy. If at all, as has been commented on earlier in the chapter, the project risk profile increases with mechanisms like the REC due to the enhanced market risks and transaction costs that the REC trading framework carries, thus increasing the costs of finance. At the first instance the RPO monitoring framework needs to be tightened through creation of RPO registries in every state and implement the penal mechanisms for non-compliance. The REC framework needs to be modified to address a host of issues that have been identified through expert studies. Beyond these measures, to reduce the costs of financing and hence the delivered costs of energy measures like takeout financing, long tenor and lower cost funds from pension funds and the like need to be considered. Specific funds that extend financing to RE projects can also be established and the NCEF marshalled effectively. The entire effort needs to be accorded greater profile through a Renewable Energy Financing Program (REFP).

FIGURE 2: Developing Institutional Arrangements for Sustainable Electricity Provision



Institutions and programs covered in the above framework would integrate parallel but related missions/ programs of the Government of India like the National Mission for Enhanced Energy Efficiency (NMEEE) and the National Smart Grid Mission (NSGM) that are large programs in their own right, but have significant amount of shared space with the clean energy initiatives identified above.

Finally, the actions need to be integrated at the administrative and political level. The myriad ministries that handle the energy issues create turf challenges. The federal structures make implementation the prerogative of the states. Within these constraints and realities, the emphasis must be on the maximum amount of rationalization and creation of structures that transcend inter-ministerial and centre-state issues wherever feasible. The new government in Delhi has already taken an important step of bringing the power, renewable energy and coal ministries under the same minister. Bringing them under the same line ministry – at least the Power and the New and Renewable Energy ministries - to the extent where electricity provision is concerned, would be a logical and indeed welcome step. Under this new and combined ministry, a strong mission directorate that integrates the various policy implementation actions needs to be created.

Bringing the states on board would be more difficult, but is absolutely essential. This would call for strong political leadership from Government of India to ensure that the states follow the same construct and implement the provisions of the laws, policies and the missions in the right spirit. Else, as experience in the past few years has shown, much of the forward thinking measures at the central level can be undone at the state level. However, if done right, the measures would help the country take the leap towards clean, sustainable and universal electricity provision that that for several decades now has been an overwhelming but elusive policy goal.

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