Modern Energy Access to All in Rural India: An Integrated Implementation Strategy

HARVARD Kennedy School
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ABSTRACT

Expanding energy access to the rural population of India presents a critical challenge for its government. The presence of about 364 million people without access to electricity and about 726 million who rely on biomass for cooking indicate both the failure of past policies and programs, and the dire need is for a radical redesign of the current system that will address the need to expand energy access for these people. In this paper, we propose an integrated implementation framework with recommendations for adopting business principles with innovative institutional, regulatory, financing and delivery mechanisms. The framework entails the establishment of rural energy access authorities and energy access funds, both at the national and the regional levels, to be empowered with enabling regulatory policies, adequate capital resources, and the support of multi-stakeholder partnership. These institutions are expected to design, lead, manage and monitor the rural energy interventions. At the other end, the trained entrepreneurs would be expected to establish bioenergy-based micro-enterprises that will produce and distribute energy carriers to rural households at an affordable cost. The energy service companies will function as intermediaries between these enterprises and the international carbon market both in aggregating certified emission reductions and in trading them under clean development mechanism. If implemented, such a program could address the challenges of rural energy empowerment by creating access to modern energy carriers and global climate change mitigation. Additionally, it could provide economic/livelihood benefits to the rural population while simultaneously earning handsome profits for the entrepreneurs.

INTRODUCTION

India faces energy challenges on three fronts: the presence of majority energy poor lacking access to modern energy carriers; the need for expanding the energy system to bridge this access gap as well as to meet the requirements of a fast-growing economy; and the desire to partner with global economies in the effort to mitigate the threat of climate change. The best possible outcome would be to achieve all the three objectives without compromising on any one. In this context the most critical question India needs to answer is just how to expand access to basic energy services for the large number of energy poor while at the same time being able to make contributions to climate change mitigation. The next most critical question India needs to answer is just how climate change mitigation might become a stimulus for expanding rural energy access in India. In this paper, as a response to these questions, an integrated implementation framework to guide the process of providing universal energy access in rural India is proposed.

Lack of access to modern energy carriers has implications for the economic, the social, and the environmental well-being of humanity. The implications could be in the form of income poverty, primitive lifestyles, loss of dignity, physical hardship, health hazards, lack of employment, and a polluted environment. Many stakeholders including national governments, international organizations, and non-governmental organizations (NGOs) have recognized these linkages and have recognized as well the need for expanding energy access. However, experience suggests that the gap between recognition of the need for expanding energy access and action toward accomplishing it is very wide. In part, this is because energy governance is always biased towards "supply-side" and suggested solutions always revolve around "hardware" aspects. The "demand-side" aspects of energy have always been neglected. Energy service for sustainable development has never been the focus of energy planning.

The findings of the National Sample Survey suggests that though 74% of the Indian villages were electrified as of 2005; only 55% of the rural households had access to electricity and the remaining 45% of the households were depending on kerosene lamps for lighting (NSSO, 2007). Also in 2005, only 9% of the rural households had access to liquefied petroleum gas (LPG) and about 84% of the rural households were still depending on biomass for their cooking energy needs with only 1.3% having access to kerosene. This is the equivalent of about 364 million people relying on kerosene for lighting and about 726 million relying on biomass for cooking out of a total rural population of about 809 million in 2005. Thus, a major challenge for India is to bridge this access gap in modern energy services both for cooking and for lighting. The above data indicates the failure of prevailing policies, governance, and institutions. The changing global situation, along with existing untapped capabilities, has provided many new opportunities for India to bridge this energy access gap:

- First, India has an adequate renewable energy resource potential, especially biomass resources, to produce adequate quantum of modern energy carriers to meet the energy needs (Ravindranath and Balachandra, 2009). The current annual usage of woody

biomass is estimated at about 200 MT and the potential for additional production has been estimated at 255 MT. The quantity of cattle dung produced in India is about 1,190 MT/year and the non-fodder dry soft biomass available is estimated to be between 300-600 MT/year.

- Second, advanced biomass energy technologies, which are versatile and robust enough to perform at various scales and in rural regions, have reached near commercialization. India has sufficient experience and expertise in developing and deploying biomass gasifier technologies for power generation and bio-methanation technologies for biogas production. The above resources could produce 50,000 MW of power and 120 billion m^3 of biogas per year (Ravindranath and Balachandra, 2009).
- Third, global climate change mitigation imperatives have resulted in market mechanisms that, in turn, have created a demand for carbon credits, which then can be translated into revenue opportunities for reducing the cost of energy access. The Clean Development Mechanism (CDM) is a particularly important market for developing countries like India. The estimates suggest that the annual GHG mitigation potential could be as high as 213 million tonne by 2030.
- Fourth, medium, small and micro-enterprises (MSMEs) are an established concept in India. These enterprises have been the major source of employment and income generation. About 52% of the MSMEs are located in the rural areas and about 91% of enterprises are of a proprietary type indicating the entrepreneurial qualities of the individuals (MSME, 2010).
- Fifth, the wrongly-targeted energy subsidies, having failed to provide affordable access to modern energy services, can now be re-launched as operational incentives for energy access projects. The current burden of subsidies and under recoveries (losses due to selling petroleum products below market prices) due to the sale of kerosene and LPG is estimated at about Rs. 485 billion in 2008-09 (MOPNG, 2009, PPAC, 2009) and the subsidies on account of electricity sales were approximately Rs. 415 billion in 2005-06 (IEA, 2007).

Effective combination of these opportunities could be used to create workable mechanisms to produce multiple products – for example, modern energy services, carbon credits, livelihood opportunities and rural employment – thus becoming an effective rural energy access program.

NEED FOR AN INNOVATIVE IMPLEMENTATION MECHANISM

It has 40 years since the government of India first made any serious efforts to expand access to modern energy carriers for rural people. The earlier efforts made were by supplying kerosene through the Public Distribution System (PDS) and power through rural electrification programs supported by the Rural Electrification Corporation (REC). Since then many policies have been framed and programs have been initiated to try to create access to modern fuels for cooking and electricity for lighting. However, the current status of rural energy access provides proof enough of the limited success achieved by these initiatives. The past initiatives have completely failed in creating access to modern cooking fuels while they have been partially successful in expanding rural electricity access. The

reasons for failure are many; however, they could be broadly classified into the following categories:

Lack of effective policies. Policies provide guidelines and a plan of action for achieving the desired objectives. Even though the situation related to lack of rural energy access in India was serious, until recently, the government never showed any inclination toward bringing out exclusive policies for expanding access. The situation changed at least for rural electricity access in 2006, with the enactment of rural electrification policy. Even before that the Electricity Act 2003 had clear mandate for rural electrification. However, the government has yet to frame an exclusive policy targeting expansion of rural cooking energy access. Although, the recently approved Integrated Energy Policy (IEP) has specific recommendations for expanding access to modern energy for cooking in rural areas it lacks exclusivity. With most of the focus on mainstream energy policies, the recommendations on rural energy would probably fail to attract the attention of the policy makers.

Lack of effective programs. Even with respect to the launching of targeted programs on expanding rural energy access, the issue of cooking energy has been missed by the government. However, there were many programs targeting rural electrification, which were finally merged into a single program and launched as Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) for expanding rural electricity access in 2005. Such a focused and targeted program was never designed for expanding rural cooking energy access. The programs on subsidizing modern cooking fuels mostly benefited the middle- and high-income households. The technology focused biogas program failed to influence a shift from biomass-based cooking in rural areas and even the limited success is confined to rich rural families. Even the programs on rural electrification focused mainly on providing connectivity to the grid and largely ignored the issue of the reliability and quality of the electricity supply. These poorly executed programs have caused even electrified households to live with very frequent and long-duration electricity supply disruptions, fluctuating voltages, and the continued use of kerosene as their backup lighting option.

Lack of institutional framework. Institutions are essential to implement, manage, coordinate, and monitor the policies and programs created by the government. Rural energy access or rural energy development does not have any exclusive institutional support. The past and current energy access programs are managed by the energy-supply focused government institutions. For example, ministry of power at the national level, power ministries at the state government levels, national and state electricity utilities and public sector organizations engaged in electricity supply are managing the expansion of rural electricity access in India. Similarly, a technology dissemination focused ministry of new and renewable energy is attempting to provide technological solutions to expand rural cooking energy access. The main activities, objectives and priorities of these institutions are not on expanding access but rather are on the supply of energy or technology, the maximization of sale of energy or the dissemination of technologies, adding new capacities, etc. Their dominant focus is on supply-side and not on demand-side issues of energy. Energy access is a demand-side problem and the need is to have an institution with exclusive focus on resolving demand-side issues and with targets fixed based on these.

Inefficient and ineffective governance. Almost all the past and ongoing major efforts in expanding rural energy access are government-centric and have all had to endure the

governance-related ineffectiveness. Bureaucratic inefficiencies typically result in delayed approvals and delayed release of funds, ineffective monitoring, favoritisms, low quality output, etc. The lack of tangible incentives to perform well leads to low motivation among the people involved in implementation. Short tenures associated with specific ministries and organizations tend to compromise on the long-term sustainability of the process, especially, post-implementation. Political motivations typically overshadow the social and economic objectives of the programs. Combination of these factors make a program or policy which appears to be very effective as a theory be a massive failure on implementation.

Misdirected focus and targets. Programs on expanding cooking energy access have lacked focus. The national biogas and cookstoves programs were technology focused with dissemination being the objective and numbers deployed the target for measuring success. The subsidies on LPG and kerosene targeted at the urban middle and high income groups as well as urban poor. The ongoing rural electrification programs, as well as those of the past have predominantly focused on expanding the grid connectivity with little attention on programs for expanding electricity supply. Also, the predominant targets of these electrifications programs are below poverty line (BPL) households with a limited focus of providing single lighting point connection for each household. Non-BPL rural households are largely ignored as a result.

Ineffective delivery mechanisms. The quality and reliability of energy access as well as its sustainability, depends largely on the effectiveness and robustness of the mechanisms established in the villages. Any energy access expansion program involves the creation of local infrastructure and institutions to support energy production and distribution, repair and maintenance, new connections, billing and collection, monitoring and reporting, etc. These linkages are critical and they need to be performed effectively for the sustenance of these programs. Most of the earlier programs have completely ignored these aspects. The current program to expand rural electricity access, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), has made provisions for these local mechanisms. The village-level franchisees are expected to manage the local operations and to enable long-term sustainability of the process. However, recent experience suggests that the franchisee implementation process has encountered many bottlenecks. Even though the RGGVY scheme prioritized on a model which was expected to promote “entrepreneurship” among the franchisees, the implemented model was a simplistic “revenue collection” franchisee. The majority of the franchisees act merely as agents of the distribution utilities by engaging only in billing and collection activities. They are neither empowered nor trained to perform many of the above activities to make the program sustainable in the long-term.

Lack of private benefits. Energy access programs tend to be successful as long as the individual households accrue perceived and real benefits. Poor rural households do not perceive it to be beneficial to be shifting from free biomass to priced cooking fuels like kerosene or LPG even if they are subsidized. With low opportunity cost of labor and starved of cash, the saved efforts in biomass collection do not translate into benefits. The health benefit of clean cooking fuels is not perceived as such because of the lack of knowledge. Biogas technologies have resulted in the additional burden of collecting and processing of dung to produce the required biogas. There are no forces within the village which influence shift to clean cooking fuels. On the other hand, market forces have a played a major role in

pushing the fast moving consumer goods, typically classified as luxury items in the rural context, and in influencing rural people to adopt them. The need is to adopt business principles in expanding rural energy access by including opportunities to earn profits.

The current status of energy access suggests that the above factors have been largely responsible for ineffective implementation. The proposed implementation framework is expected to address many of these limitations. We have come out with specific recommendations for regulatory policies, programs, institutions, adopting business principles, and establishing delivery mechanisms. The main goal of the whole implementation process is to facilitate easy and affordable access to energy services for all rural households. Like their counterparts in urban India, the rural households would remain the buyers of modern carriers or services to perform their preferred end-uses. Like the urban households, the rural households too are expected to be delinked from the complexities of programs, technologies, and processes. It is not the aim of this paper to propose a radically new approach for implementation, but rather to adopt existing mechanisms with certain incremental modifications and innovations. The current program on rural electrification, the RGGVY, is following a multi-stakeholder-based implementation process with an appropriate mix of business principles and government regulations. It is proposed to adopt this model with a few critical modifications essential for the success and sustainability. These modifications will strengthen the implementation process.

PROPOSED IMPLEMENTATION FRAMEWORK

The proposed approach is a public-private-partnership-driven *business model* with innovative institutional, regulatory, financing, and delivery mechanisms. Some of the innovations recommended for adoption are:

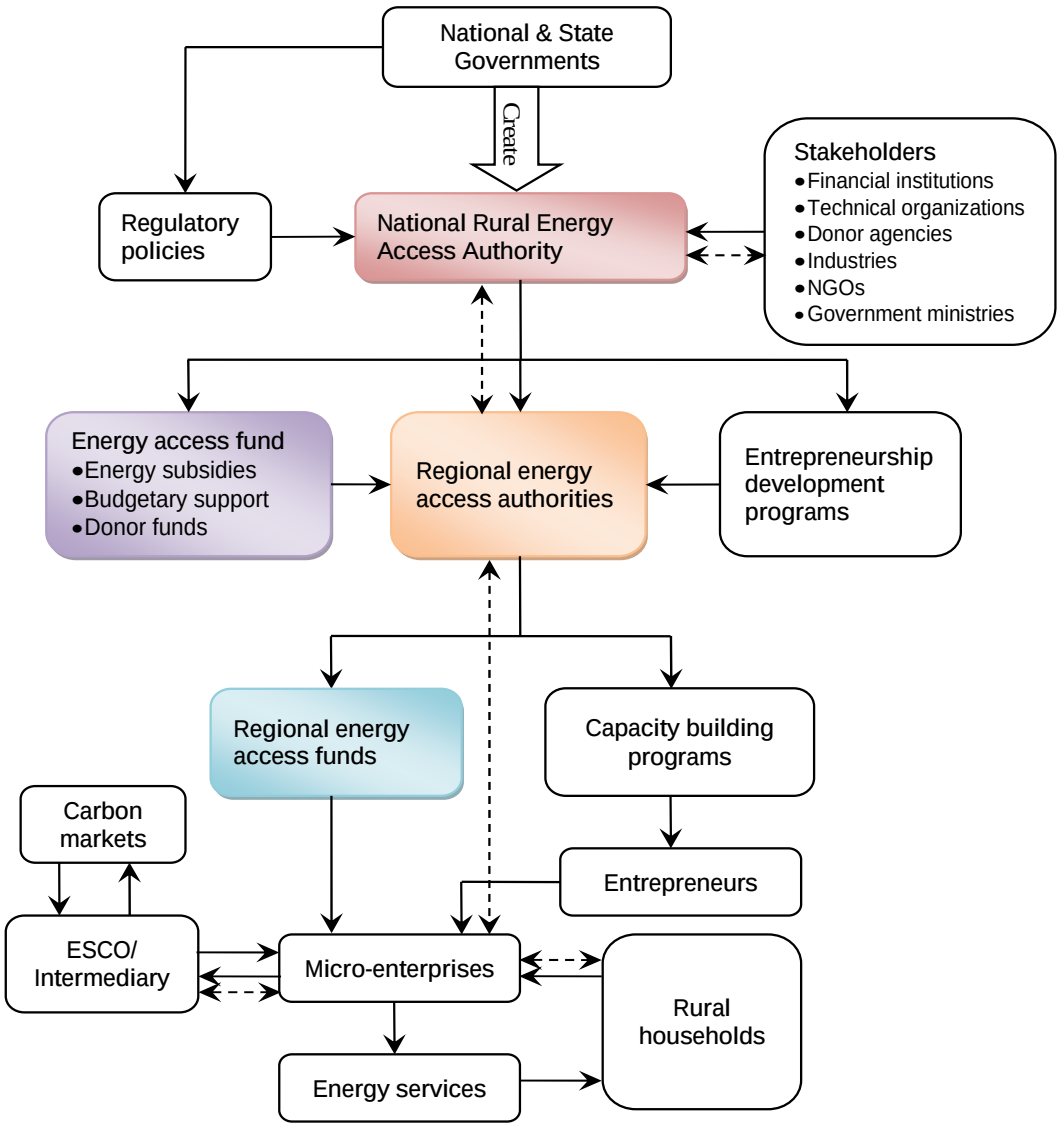
- Creation of exclusive **rural energy access authorities** within the government system as leadership institutions;
- Establishment of **energy access funds** to enable transitions from the regime of *investment/fuel subsidies* to *incentive-linked* delivery of energy services;
- **Integration of business principles** to facilitate affordable and equitable energy sales to households and carbon trade; and
- Treatment of **entrepreneurs as implementation targets** and not millions of rural households.

The proposed implementation framework is presented in Figure 1. It represents a top-down approach with government/s represented by the appropriate ministries at the top and the beneficiaries, the rural households, at the other end reaping benefits of the program. Considering the scale of problem of expanding access, the bottom-up approaches resulting in independent small-scale initiatives would not be able to achieve the desired success levels. The past experiences too suggest failure of a large number of NGO and private sector initiated projects. The framework entails establishment of the rural energy access authorities (REAAs) both at the national and the regional levels to be empowered with enabling regulatory policies and to be supported by the multi-stakeholder partnership (Figure 1). The stakeholders are expected to be from both the public and the private sector organizations. The national REAA is expected to establish the national energy access fund

(EAF), to support the creation of and then coordinate with the regional REAAs, and to develop a comprehensive entrepreneurship development program with inputs from stakeholders. The regional REAAs are expected to manage the regional EAFs and to facilitate the conduct of intensive capacity building programs for the prospective entrepreneurs. The national REAA would support the regional REAAs in these endeavors. At the other end, the trained entrepreneurs would be expected to establish energy micro-enterprises to produce and to distribute energy carriers to rural households at an affordable cost. The energy service companies (ESCOs) will function as intermediaries between these enterprises and the international carbon market in aggregating the certified emission reductions (CERs) and then trading them under a clean development mechanism (CDM) or a similar carbon trading mechanisms. As per the proposal, the ESCOs would share the carbon trade proceeds with the energy enterprises. The financial institutions are expected to lend to these enterprises as well as ESCOs at soft interest rates.

In Figure 1, the dark lines with arrows represent various types of flows and they are unidirectional. They represent flow of authority, inputs (financial, advisory, etc.), services, payments, etc. The dotted lines with arrows represent flow of communication and they are bi-directional. These represent flow of information, guidance, feedback, etc. These flows have been designed to reduce complexities, to eliminate overlapping of authorities and interference, and to keep the communication and monitoring hierarchical and simple. This we believe can make the whole process very effective. Though the implementation framework appears to be a top-down approach, there is every chance that the actual process would be a bottom-up one. If the whole program needs to be successful, then the energy-enterprises need to perform very well. For this to happen, the inputs from the top should be timely and effective. Here, the presumption is that the successful energy-enterprises will demand contributions from the entities above them. In other words, it is the “pull” factor from the bottom will make the whole program successful rather than the “push” factor from the top. Thus, the main responsibility of the energy access authorities would be to ensure smooth flows of required inputs to the enterprises. Some of the important aspects of this framework are discussed in detail in the following sections.

Figure 1. Implementation framework



STAKEHOLDER PARTNERSHIPS

These kinds of innovative processes aiming at universalization of energy access through bioenergy, in addition to centralized access through grid and LPG, have to pass through a number of hurdles. These barriers are created by various stakeholders of energy systems and their involvement is absolutely necessary to overcome them. Government/policy makers, energy organizations, technical and R&D organizations, industries, entrepreneurs, financial institutions, donor agencies, NGOs and rural households are some of the stakeholders.

Governments. The government system consisting of national and state ministries set the rules for transactions through policies, regulation, incentives, and frameworks. When the government realizes that a large section of the population is deprived of the benefits of economic and technological development due to skewed market forces, financial/economic inadequacies, and infrastructural bottlenecks it intervenes through appropriate measures. In the context of expanding rural energy access, the role of government is primarily to provide a mechanism to link all the stakeholders and act as a facilitator and an enabler. The primary task is to frame regulatory policies to govern and to provide guidelines for implementation of the energy access program. The second task is to establish REAAs and to empower them with sufficient authority to lead, manage, and monitor the rural energy interventions. The third task is to create EAFs through diverting energy subsidies, through exclusive budgetary allocations, and through donor funding.

Energy Organizations/Utilities. The electricity distribution utilities and LPG distribution arms of the oil corporations are the relevant stakeholders. The responsibility of providing centralized access to modern energy carriers lie with these agencies. These agencies would function in coordination with regional REAAs. The role of electricity utilities could include the development of an electricity distribution infrastructure and the provision of connections to all the rural households. The RGGVY program is in the midst of implementing such a program and our proposal is that henceforth these activities would be coordinated by the national and regional REAAs. Similarly, the oil corporations' role is to establish rural LPG distribution agencies to provide LPG connections to the households.

Technical Institutions and R&D Organizations. The proposed bioenergy technologies have to compete with large-scale technologies, to use local energy resources, to perform under adverse local environments, to be robust enough to encounter minimum operational problems, and to be amenable to being repaired by less skilled people, and to be able to deliver cost effective and reliable energy services for the rural population. These demands could be met only through continuous and involved R&D efforts. These efforts should result in either incremental or radical innovations with respect to existing energy technologies as the situation demands. Thus, there is a need for continuous involvement of R&D organizations in the proposed partnership. Further, the energy access is being created through a large number of micro-energy enterprises producing and distributing modern energy carriers. To manage and to operate these enterprises, the entrepreneurs require comprehensive technical training. The involvement of relevant technical institutions is essential for training these entrepreneurs.

Financial Institutions. Access to cheap financing is one of the major factors that influence the success of energy access programs. Financial institutions could be commercial banks, international financial institutions, non-banking financial institutions, co-operative sector banks, micro-credit organizations, and individual or institutional investors. It is important to note that though the proposal envisions the adoption of business principles in establishing rural energy systems, the actors involved have very low financial capabilities. The entrepreneurs producing energy carriers are expected to be mainly from the same or neighboring locations and with relatively low financial capabilities. Similarly, the customers buying these energy carriers are mainly from rural poor households. The governments as

well as the financial institutions need to keep this in mind while offering finances for the distributed energy projects. The most appropriate scheme appears to be the priority lending schemes of the commercial banks. Even the interest rates charged under these schemes might be high for these entrepreneurs. It may be essential to reduce the interest rates further with contributions from EAFs.

Industries. The equipment manufacturers too have roles to play in expanding access to modern energy services. They can build efficient supply-chains with better economies of scale in supplying assembly parts for energy production systems and end-use equipment. Some key products such as biogas plants and biomass gasifiers are made in relatively small numbers, which can be mass manufactured. They can benefit from economies of scale by standardizing entire product lines, thus reducing a wide range of manufacturing and related costs. These cost savings are easily realized, since most product models are essentially identical from one market to another. They can also help entrepreneurs in sales and service operations in rural regions.

National/International Donors. Expanding rural energy access to a large extent is not a market-based intervention rather a societal intervention. The goal is to realize social benefits instead of profits. There are agencies, national as well as international, which are philanthropically oriented and have dedicated funds for supporting such interventions. Even corporate sector entities support such activities under their corporate social responsibility schemes. In addition, there are bilateral and multilateral mechanisms, which typically support interventions focusing on human development. All these contributions could be used to strengthen the EAFs. At present, most of this funding is being used for supporting smaller initiatives in energy at various locations and they are independent of each other. A number of interventions have been made in installing biogas plants, providing solar home lighting systems, modern cookstoves, etc. However, experience suggests that these interventions have failed to create any significant impact in expanding access. Most have failed to take-off beyond the demonstration phase. The solution might be to pool all such resources into a common fund and use that fund for supporting a large-scale program.

NGOs. In a centralized planning and policymaking establishment, very little attention is given to the actual needs of the target beneficiaries. There is a need to build capacity among rural communities to recognize their needs, and to educate them on the options available. Only those needs that are collectively recognized in such communities, if honored, would result in successful implementation of developmental projects. Non-governmental organizations (NGO) play a major role in bringing such communities together and in empowering them. Many NGOs are local and hence their knowledge is critical to the implementation of such programs. NGOs can also assist in awareness campaigns on the importance of energy empowerment; help involve other grass-root organizations and step-up demand for basic energy requirements; and lobby with government to get financing for specific interventions.

Market Intermediaries. Though there are many possible types of market intermediaries for example, consultants, media, consumer groups, and trade associations our focus here is on energy service companies (ESCOs). The intermediaries can help to raise awareness

among target groups and other stakeholders, to assist technology producers in marketing, to help in preparing business plans, to bring potential partners together, to secure intellectual property rights and licenses, to educate financers about technologies, and to channel investment proposals. In the present study, the role of ESCOs has been proposed mainly as an aggregator of carbon credits and an explorer of the international carbon market to trade them.

Entrepreneurs. They are at the core of the whole program implementation. The proposed approach envisions the creation of a large pool of small-scale entrepreneurs who are closer to the local community. These entrepreneurs, supported by financial institutions are expected to set up micro-enterprises to produce energy carriers, to market energy-efficient devices and to sell these energy carriers to rural households. In addition, these enterprises also can act as franchisees of the electricity utilities and oil companies to distribute electricity as well as LPG to the households.

Rural Households. They are the targeted beneficiaries of the proposed energy access program. Most of them have become used to the hardships of sub-standard lighting and cooking conditions. They are used to paying very little for kerosene-based lighting or accessing free biomass for cooking. The cash-starved rural poor are unfamiliar with the intangible benefits associated with drudgery reduction and improved health. It is very important, therefore, to educate them about the benefits of using modern energy carriers for cooking and lighting even at additional cost. They need to be influenced to change the established practices of cooking by adopting newer technologies and fuels. Further, they need to be empowered to perceive the large future benefits of energy access for meager investments they make now.

ENABLING POLICY FRAMEWORK

The development of any system requires a regulatory framework that serves to create a level playing field for all the relevant actors. Clear political commitment for its promotion should be translated into supportive policies and regulations that work to create incentives and greater certainty for all participants. In markets, including rural markets, where consumer preferences have been shaped by the long-term use of existing technologies, regulatory policies play a decisive role in the creation and gradual expansion of niche markets (Menanteau and Lefebvre, 2000). According to Almeida (1998), market forces are constrained by a variety of transaction types and by the decision-making practices of the agents, in an environment characterized by lack of information and split incentives for adopting sustainable technologies. He argues that public intervention is necessary for organizing the market and promoting sustainable technologies. Government initiatives to promote such technologies must include both supply-push and demand-pull policies during pre-commercialization, first commercial use, and leading to adoption (CTI, 2002).

In India, policy making with respect to energy systems are fragmented. The policy frameworks predominantly focus on the type of energy sources. For example, there are policies exclusively focusing on electricity, coal, oil & natural gas, renewable energy, etc. There was no all encompassing energy policy until the government's acceptance of Integrated Energy Policy (IEP) in 2008. Realization of the serious inadequacies with respect to rural electrification and the lack of rural electricity access influenced the government of

India to adopt rural electrification policy in 2006. However, rural energy problems are not limited to lack of electricity access alone, the more critical issue is with respect to lack of cooking energy access which has forced large majority of rural population to use biomass fuels in primitive cookstoves. Though IEP has recommendations for expanding rural cooking energy access, it is very likely that these aspects would get ignored among the many so-called "critical recommendations" for the energy sector as a whole. As observed in the past, the government's focus will be mostly on large-scale energy expansion projects needing huge investments. Therefore the need is to have an exclusive policy focusing only on rural energy in an integrated manner. Thus, this proposal addresses the need for an integrated rural energy policy (IREP). The advantage is that most of the components of this proposed policy framework already exist in various policy documents related to energy. Therefore the recommendation is to extract relevant policies from these and include them into the proposed IREP. However, some of the existing policy recommendations would need some minor adjustments to address the rural energy access issues in totality. In addition, IREP also needs to include some new policy guidelines to facilitate establishment of new institutions and to expand the scope of currently pursued initiatives.

Inputs from Existing Policies for Designing an Integrated Rural Energy Policy

The relevant components of the existing policy documents have been adopted for designing an expanded integrated rural energy policy. The following are some of the important policy recommendations from Integrated Energy Policy (IEP), National Electricity Policy (NEP) and Rural Electrification Policy (REP), which are critical for the proposed IREP (Planning Commission, 2006; Electricity Policy, 2005; Rural Electrification Policy, 2006).

- To provide clean cooking energy such as LPG, natural gas, biogas, or kerosene to all within 10 years and to provide subsidy for electricity and cleaner fuels to the targeted households through entitlement of 30 kWh of electricity per month and LPG, kerosene or biogas equivalent to 6 kg of LPG per month.
- The financial sustainability is to be ensured by recovering at least the cost of electricity and related O&M expenses from consumers, except for lifeline support to households below the poverty line who would need to be adequately subsidized. Also, it is important to opt for least cost options after taking into account full life cycle costs and explicit as well as implicit subsidies in different delivery options and mechanisms. The government is to provide necessary capital subsidy and soft long-term debt finances for investment in rural electrification. Energy efficiency should be promoted as a mass campaign in the rural areas.
- Establish appropriate institutional framework to ensure creation of rural electrification infrastructure, and to operate and maintain supply system for securing reliable power supply to consumers. Empowerment of local level institutions to undertake the business of electricity distribution. Enable stakeholder partnerships and capacity development.
- Policy provisions for bulk power purchase and management of local distribution in rural areas. Deployment of franchisees for management of local distribution in rural areas is considered necessary in order to ensure revenue sustainability and to improve services to the consumers. Franchisees for the management of rural distribution could be NGOs, users' associations, cooperatives, or individual entrepreneurs.

- Feasible potential of non-conventional energy resources, mainly small hydro, wind, and biomass would also need to be exploited fully to create additional power generation capacity. Automatic approval for standalone systems of up to 1 MW which are based on cost effective proven technology and use locally available resource such as biomass.
- Flexibilities with respect to licensing obligations and in matters pertaining to determination of tariffs. The retail tariffs for electricity supply by these persons would be set, based on mutual agreement between such person and the consumers. But the benefit of financial assistance/subsidies by the government or other agencies, if any, must be fully passed on to the consumers. The distribution licensees should be allowed, non-discriminatory open access to the transmission systems without the requirement of payment of any surcharge.

Specific Recommendations for Designing an Integrated Rural Energy Policy

The list of policies given above would not be adequate to create an effective program for expanding rural energy access as proposed in the study. Few of the above polices need some critical modifications and few more need to be introduced afresh to facilitate such a program. These are essential for the creation of necessary institutions and expanding the scope of the currently pursued initiatives on expanding energy access.

- The proposed implementation program requires setting-up exclusive rural energy access authorities (REAAs) both at the national and regional (states) level as nodal agencies. These authorities need to be given exclusive powers to initiate, establish, manage, support, and supervise specific programs for expanding rural energy access. The specific roles of the national REAA would be to establish stakeholder partnerships for implementation, to establish and manage energy access fund, and to facilitate development of the entrepreneurship development programs. The regional access authorities would manage the state-level program implementation, operate the regional access funds, and facilitate the conduct of capacity development programs for the prospective entrepreneurs with the help of relevant stakeholders.
- To establish energy access funds (EAFs) both at the national and regional level to support implementation and sustainable operation of the program. The fund should be established with contributions from the diverted fossil fuel subsidies, budgetary allocations, plan grants, and donor funding. The EAFs are to be used for providing incentives to the energy enterprises to ensure sustainable operations of the distributed energy systems. These funds are to be used for covering the losses, if any, to ensure some profitability for the enterprises, and to be linked to the energy carriers supplied to the rural households.
- At present, the RGGVY franchisees function as representatives of the electricity distribution utilities. Their main functions are limited to distributing electricity to households within their jurisdiction, to metering and billing the consumption, to revenue collection, to O&M and to providing new connections. This needs to be changed. The franchisees need to be transformed into independently functioning rural energy enterprises. The proposed IREP should have policy guidelines to enable establishment of a large number of such rural energy enterprises. They should be enabled to carry out the business of all-inclusive energy service providers including production of energy carriers. The scope of these enterprises should be enlarged to include electricity

generation from distributed power generation systems, performing existing transactions between the distributing utilities and the rural households, LPG distribution, usage of the infrastructure created by the government, and establishment of biogas supply systems for supplying cooking gas. In other words, these enterprises would be responsible for providing access to modern energy carriers for lighting and other electricity end-uses, and for cooking either by producing the required energy carriers or by buying them from the government, public or private sector entities. Rather than functioning as agents of these entities, the energy enterprises would be having pure business relationships with them. Appropriate lease rates could be arrived at for using the infrastructure created by the government. With multiple revenue earning options and competing sources of energy supply, the enterprises can be expected to sustain their operations in the long-run. These could ensure sustained profits for these enterprises and energy access for rural households at affordable prices.

- All the policies and rules related to licensing, pricing, taxation, depreciation, exemptions, etc., that have been addressed for rural electrification should also be extended to any program related to the expansion of rural cooking energy access.
- The education and awareness building programs planned for the rural electrification program need to be appropriately modified and then extended to the rural cooking energy access program as well.

Rural Energy Access Authorities

Providing the exact structure of these authorities, their roles, and their function are all beyond the scope of this study. The attempt here is to provide only the broad prescriptions for establishing such authorities. The national REAA could be established on the lines of Central Electricity Authority (CEA) including the bureaucratic structure. An empowered group of ministers (EGoM) under the chairmanship of the Prime Minister could perform the leadership roles and could make crucial policy level decisions. Ministers of Finance, Power, New and Renewable Energy, Petroleum and Natural Gas, Rural Development and Panchayati Raj, Coal could be part of the EGoM. In addition, there could be an advisory group with representatives from the relevant stakeholders providing technical as well as expert inputs. As explained above, the role of REAA is to design implementable programs, to support its actual implementation along with regional REAAs and many other stakeholders, and to monitor its progress. In order to accomplish this, the national REAA is expected to establish the partnership of stakeholders and to use its services for performing different activities: to supervise and monitor the activities of the regional REAAs; to design and implement the entrepreneurship development programs; and to transfer funds to the regional energy access funds for subsequent distribution to entrepreneurs as incentives. The regional REAAs also could be structured on similar lines keeping the state-level administrative system in mind. The regional REAAs would actually be responsible for implementing the programs, for conducting the entrepreneurship development programs with the help of identified stakeholders, for interacting with the entrepreneurs, and for providing incentives.

Energy Access Funds

The second most important proposal is to establish EAFs at the national as well as at the state levels. The past efforts in expanding energy access or even in dissemination of

sustainable energy technologies have shown that providing very high capital subsidies do not ensure success of the initiatives. The energy benefits alone may not motivate the households or individuals to use these assets continuously. Surplus revenue streams, or cash incentives, are likely to be better motivators for sustained performance of energy systems. The urgent need is to convert the *capital subsidies* into *operational incentives* for achieving the desired success levels. Further, the entrepreneur would be more responsible toward the asset provided if he or she has an investment in the asset either through a loan from a financial institution or through an equity contribution or both. Thus, *burden of investment* and *operational incentives* can be expected to contribute to the success of the program. It is proposed that the EAFs will contribute to the payment of operational incentives to the entrepreneurs. The regional REAAs would be authorized to distribute these incentives to entrepreneurs. These incentives should be linked to the performance levels of the enterprises in terms of quantity of energy carriers sold to rural consumers. The national EAF, managed by the national REAA, would make contributions to the regional EAFs. The EAF would be made up of plan grants, budgetary allocations, diverted energy subsidies, and donor grants.

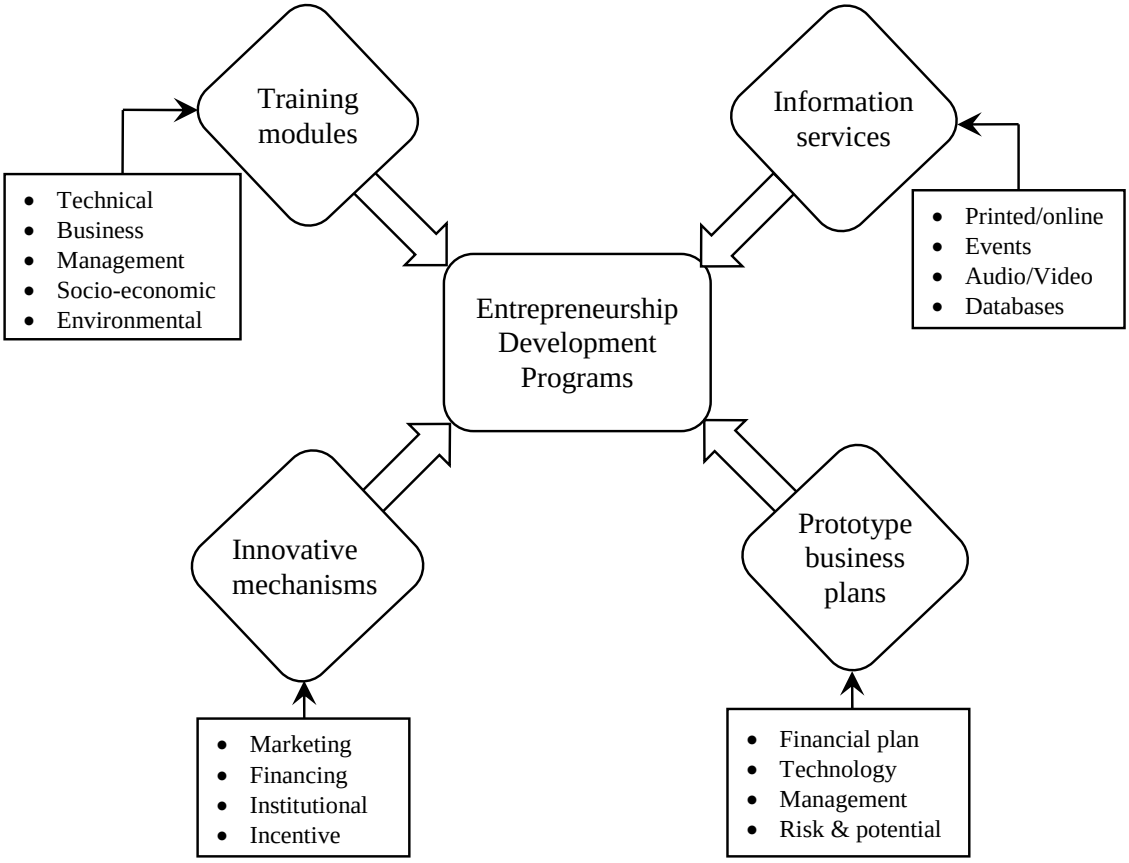
Entrepreneurship Development Program

In order to establish large number of distributed energy systems based on bioenergy technologies (BETs) there is a need for the emergence of a large pool of new age entrepreneurs who are concerned about social needs in addition to making profits in their business ventures. These entrepreneurs will not emerge automatically because the majority of the people do not view providing rural energy access to the poor as commercially attractive alternative or business. Therefore it is important to create an enabling environment where such entrepreneurs can emerge and start businesses in rural energy. Small-scale and emerging entrepreneurs will be seriously handicapped without the knowledge of: availability of products/processes; sustainable energy technologies; technical information; techno-economic and commercial viability of enterprises; and technology management, production, employees, markets, finance, and government policies. The lack of entrepreneurial and technical skills necessary to absorb advanced technologies and business processes will be a major hindrance to setting up energy enterprises. There should be a mechanism to provide expert help to the entrepreneurs in technical and financial feasibility analysis, demand analysis, environment impact analysis, product design, etc. The success of such programs in rural regions will greatly depend on the strengthening of local entrepreneurial capacity for sustained commercial operation of energy enterprises.

The RGGVY program for rural electrification too has designed and implemented a comprehensive franchisee training program for capacity development. The initial experience with franchisee operations showed that, in the absence of any formal training, existing franchisees were facing technical and managerial deficiencies during actual operation. The objective of the scheme is to enhance capacities at all levels of franchisers and franchisees to strengthen the implementation of RGGVY scheme (REC, 2009). The training modules for the course have been designed to help the participants understand the conceptual framework for various models of rural franchise agreements, to impart knowledge on the basics of distribution business covering management, technical, commercial and legal aspects, and to help them understand and apply mechanisms for quick efficiency gains and improved customer service.

Thus, the institutional structure for the capacity development program for franchisees has already been created by the government. However, the need is to enlarge the scope of this program and transform the whole initiative as an entrepreneurship development program for the existing and prospective entrepreneurs to enable them to establish and successfully run the rural energy enterprises. Therefore the proposal is for a comprehensive entrepreneurship development program with the following contents (Figure 2).

Figure 2. Contents of the entrepreneurship development program



Training Modules

The training modules must be very comprehensive in order to provide a complete perspective for running a complex energy enterprise in the rural context. The business is expected to be complex because of the multitude of activities that will need to be performed by the enterprises. Some of these are electricity and biogas production from biomass energy systems, purchase of electricity and LPG from government entities, leasing of local electricity infrastructure belonging to the distributing utilities, energy carrier sales and revenue collection from the rural customers, transacting with ESCOs for carbon trading, performing annual O&M, regulatory compliances, transacting with financial institutions, post-installation services and reporting. Keeping these aspects in mind, we propose the following modules:

- Technical inputs related to energy production, distribution and utilization technologies; energy efficiency, skills required to perform O&M, and repair services, etc.
- Inputs related to business principles focusing on commercial and legal aspects, regulatory policies, acts and rules, licensing, capacity expansion, etc.
- Management related inputs focusing on finance and accounting, marketing, human resources, production and operations and supply chain.
- Socio-economic inputs focusing on community participation, information dissemination, contributions to local economy development, etc.
- Environmental modules focusing on issues related to local and global pollution, carbon market, compliance with environmental standards, etc.

Information Services

Providing information and making people aware of large interventions is critical for their success. The proposed rural energy access program envisions radical changes in the energy-use behavior of the rural population. The benefits of shifting to modern energy carriers for cooking and lighting need to be discussed with them in an effective manner. The rural households need to be educated about the benefits to them in shifting from using freely accessible biomass to using priced biogas or LPG for cooking. They should be helped to understand that having electricity connection will improve their livelihood opportunities and living standards. Such awareness will be needed to build support among the rural population about the energy enterprises that function within the village boundaries and the advantages of utilizing their services. All these steps will require a very structured information dissemination program. Entrepreneurs will need to perform all these steps effectively in order to be successful.

In addition to the prospective entrepreneurs there are other stakeholders who will be part of this intervention. Therefore, the scope of the information services should cover all of them as well. As proposed in the study, multiple stakeholders at different levels are involved in implementation of this rural energy access program. The awareness and knowledge levels, educational qualifications, professional experiences, and commitment levels are varied across the strata of individuals associated with these entities. Successful implementation of the program depends to a large extent upon the empowerment of these individuals through effective capacity development programs. The capacity development programs could be in the form of information dissemination, awareness campaigns, sensitization programs, training programs, and course programs depending on the type of individuals.

Innovative Mechanisms

Considering the likely lack of support from the conventional market forces for this kind of business of BET-based rural energy access programs, there is a need for creating innovative mechanisms to ensure success. The innovations need to happen with respect to mechanisms related to financing, marketing, incentives and institutions. The innovations mentioned here do not necessarily mean adoption of entirely new methods or practices. Essentially, they represent marginal modifications in established practices of supporting energy access programs. For example, if conventional financial instruments are inadequate to lend to a

rural energy access project, then there is a need to change the modalities of governing those instruments.

Innovative Financial Mechanism. Financial support will be a critical factor in the success of the program and there is a need is to devise an innovative financial mechanism. Even though many BETs have reached the stage of commercial viability, financing for these will still faces numerous challenges. In general, financiers do not show interest in these until there is sufficient volume with attractive returns. However, one cannot expect to provide large-scale business readily. Under such situations, the mechanism of financing needs to be different and the financiers need to accept incentives other than just profits. Some of the possible innovative initiatives are provided here (IPCC, 2000):

Leasing. Leasing is a highly flexible form of finance. It is often packaged as a form of sales financing to help customers of a company buy that company's equipment. It can be a major source of finance for the diffusion of BETs.

Venture capital. Venture capitalists are prepared to back risky investments in return for high returns and will invest in small companies, such as those who have developed new technology, and/or have difficulties raising capital from most other investors.

Micro-credit. Micro-credit is the provision of small amounts of finance to individuals and micro-financiers are prepared to lend to those often ignored by conventional financial institutions. It may be suitable to finance the adoption of energy efficient devices at household level.

Innovative Marketing Mechanism. Ensuring profitability by selling energy carriers to the rural households cannot be guaranteed. Therefore it is essential to design innovative marketing mechanisms to create more demand for energy from BETs. The distributed energy systems should be capable of generating surplus energy so as to meet demands of other possible customers or activities like water pumping for agriculture, rural industries, shops, etc. In addition to enhancing energy sales opportunities, the enterprise should also explore other avenues to enhance profitability. One such mechanism could be transformation of these entrepreneurs from pure energy suppliers to energy service providers. These entrepreneurs have to develop the capacity to provide all the energy related services (lighting, heating, cooling, motive power, etc.) to the consumers. Further, all these services put together has to be marketed as an “Energy Service Package.” The pricing should be per package and not per unit of energy. With appropriate pricing and marketing strategies this scheme can become successful. Though it is easy to sell energy carriers rather than energy services, the profit levels could be higher with second option.

Innovative Incentive Mechanism. The grants and subsidies from the government or international agencies in the present form may not effectively contribute to the establishment and successful operations of rural energy enterprises. Projects created through such support, which has heavily reduced the investment burden, have influences limited to program boundaries. The scope is likely to be limited to demonstration rather than making any sustaining long-term beneficial contributions. On the other hand, if incentives are linked to efficient operation rather than to initial investment, there is a high chance of the survival

of the system for its lifetime. If the operation related incentives could make the profit margins high, any entrepreneur would be willing to invest in such enterprises. Therefore there is a need for a shift from providing incentives to reduce the investment burden to one that makes the operation highly profitable. The incentives can be paid to the entrepreneur on the basis of quantity of energy produced. This will encourage him or her to produce more and to perform better.

Innovative Institutional Mechanism – Energy Service Companies. Energy service companies (ESCOs) are a specific form of business intermediary that has gained widespread acceptance globally. Two ESCO approaches that are observed are guaranteed savings and shared savings. In the guaranteed savings structure, the end-user finances the project's initial investment costs from a financier and, in turn, the ESCO guarantees that the earnings due to energy efficiency or carbon mitigations will at least cover the debt services for which it receives a share in the net savings. In the second approach, the ESCO finances the project's initial investment costs, usually by borrowing from a third party financier. In return, ESCO is compensated by a higher share of savings from the project (IPCC, 2000). The ESCO concept is very much appropriate for rural energy projects and associated carbon trading. Here the proposal is for ESCOs to perform the role of aggregator of carbon credits from the individual enterprises and to present the bundled projects as small scale CDM project for the international carbon market. The ESCO will earn its profits from the carbon trade revenue which is to be shared with the entrepreneurs.

Prototype Business Plans

Integrating all of the above issues along with other enterprise related aspects in a business plan should be the precursor for starting business in rural energy. The generalized prototype business plans emphasizing the profitability nature of the projects will go a long way in making such enterprises attractive. This may act as a ready reference document for a prospective entrepreneur. The prototype business plan is expected to cover all the issues included in a real business plan:

- Description of market environment, segmentation of market, customer preferences in terms of prices, quality, payment structure, analysis of market size and growth potential.
- Strategies to gain access to market, pricing strategies, after sales service, performance guarantees, production capacity, customer response strategies, discounts, public relations, and distribution strategies.
- Inputs on comparative advantages, cost cutting strategies, efficient supply chain, availability of skilled labor, linkage with research institutes.
- Description of technology, innovations, current development, licensing and patents, advantages and reliability of technology, future development and operational plans.
- Explanation of the company structure, management team, and employee structure.
- Analysis of perceivable risks like fluctuations in price, sales, cost overrun, etc.
- Creation of a financial plan giving details of equity capital, borrowings from financial institutions and support from government, profitability analyses, etc.

RURAL ENERGY MICRO-ENTERPRISES

The final delivery of energy services to the rural households under the proposed program is to be performed by the micro-enterprises. As suggested earlier this could be done either through producing energy carriers by establishing bioenergy-based distributed energy systems or by purchasing these carriers from the centralized energy systems or both. Financial cost and benefits should be the influencing factors for selecting the best among these options. As proposed in the study, these enterprises would be established with the support from different stakeholders.

Support Mechanisms for Micro-enterprises

A micro-enterprise establishes the energy facility to provide access to modern carriers to the households of a village or a number of villages depending on the availability of biomass resources, financial feasibility, size of the villages, geographical clustering, etc (Figure 3). As stated earlier, the government provides regulatory, incentive, and infrastructural support to the entrepreneurs to establish and run the energy enterprises. As regulated by the government, the financial institutions provide soft loans to the entrepreneurs under priority lending schemes. The responsibility of the R&D/technical organizations/manufacturer is to provide the necessary support under agreed terms for installation and operation of the energy facilities. They also could be involved in providing the required training to the entrepreneurs in operating, maintaining, and repairing the systems. Village committees or local governments should function as local enabler and ensure that the enterprise meets the social demands of rational distribution of benefits of energy access. The ESCO would facilitate the access to carbon market and would provide other support if desired on a payment basis.

Micro-enterprise for Rural Energy Services

The overall structure of the micro-enterprise would be as shown in Figure 4. As shown, the enterprise owns an energy facility consisting of biogas plants and biomass gasifier plants for generating electricity. The number of such plants in an energy facility depends on current energy demand patterns as well as possible growth potential. The energy facility would also include the biogas distribution system connecting every household in the village/s to the production system. Further, the electricity distribution infrastructure would be accessed under lease from the government utilities at pre-determined leasing rates. This is one possible way of acquiring the required quantity of energy carriers, i.e., through own production. Other possibilities are directly purchasing electricity from the grid and distributing it to households and to other customers. Similarly, LPG also can be procured from government agencies and then distributed it to households. The best option for entrepreneurs would be to opt for a range of strategies depending on resource, financial and technological considerations. A mixed strategy with purchased quantity complementing own production, especially for electricity, could be the preferred choice. Many factors influence such a decision. Own production with renewable energy sources can earn CER revenue which is not available in the case of purchased energy carriers. Further, if the centralized energy supply is unreliable and of low quality then again own production is a better option. If the prohibitively high investments and the difficulty in accessing loans are preventing new distributed capacity additions then it may be advisable to opt for purchased energy carriers. Also, investment risks are minimal with respect to purchased energy carriers.

Figure 3. Support mechanisms for micro-enterprises

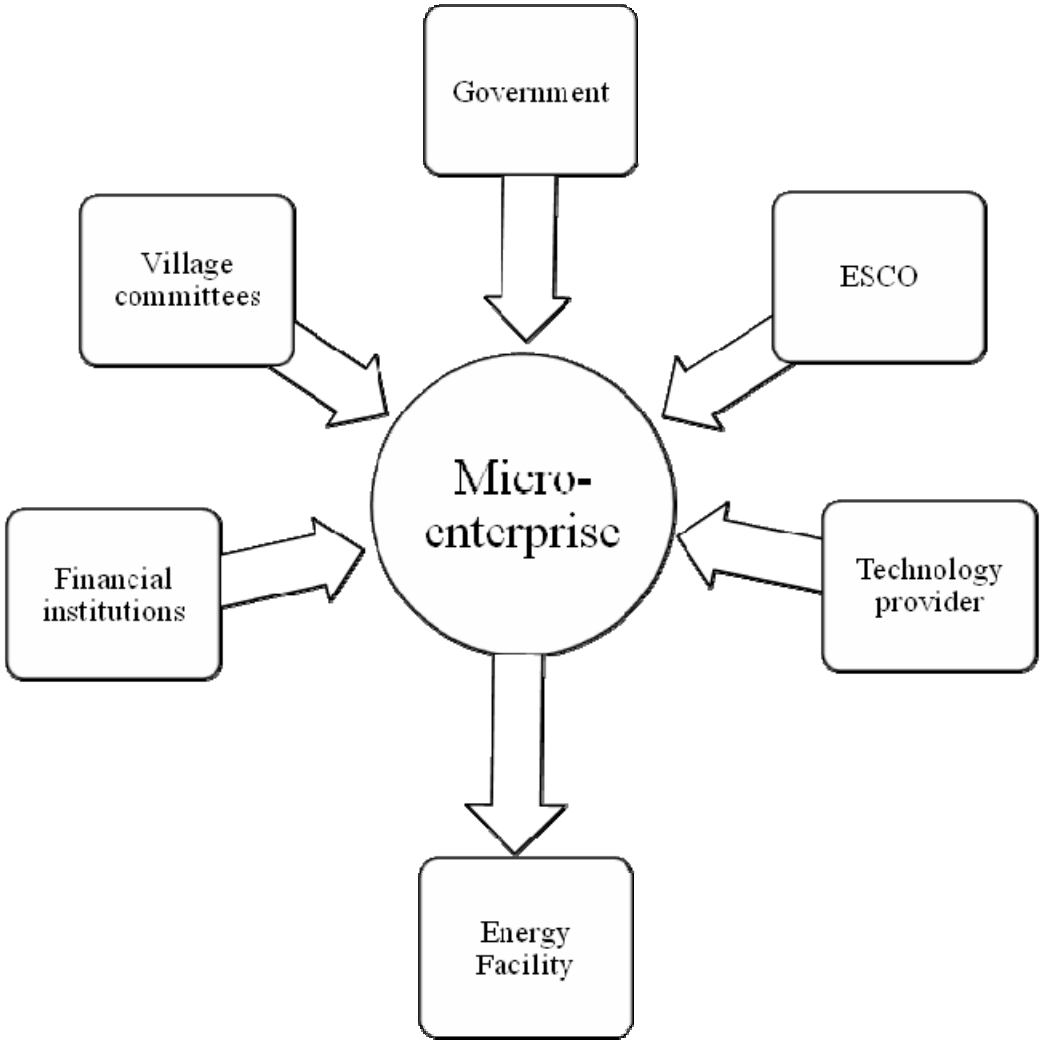
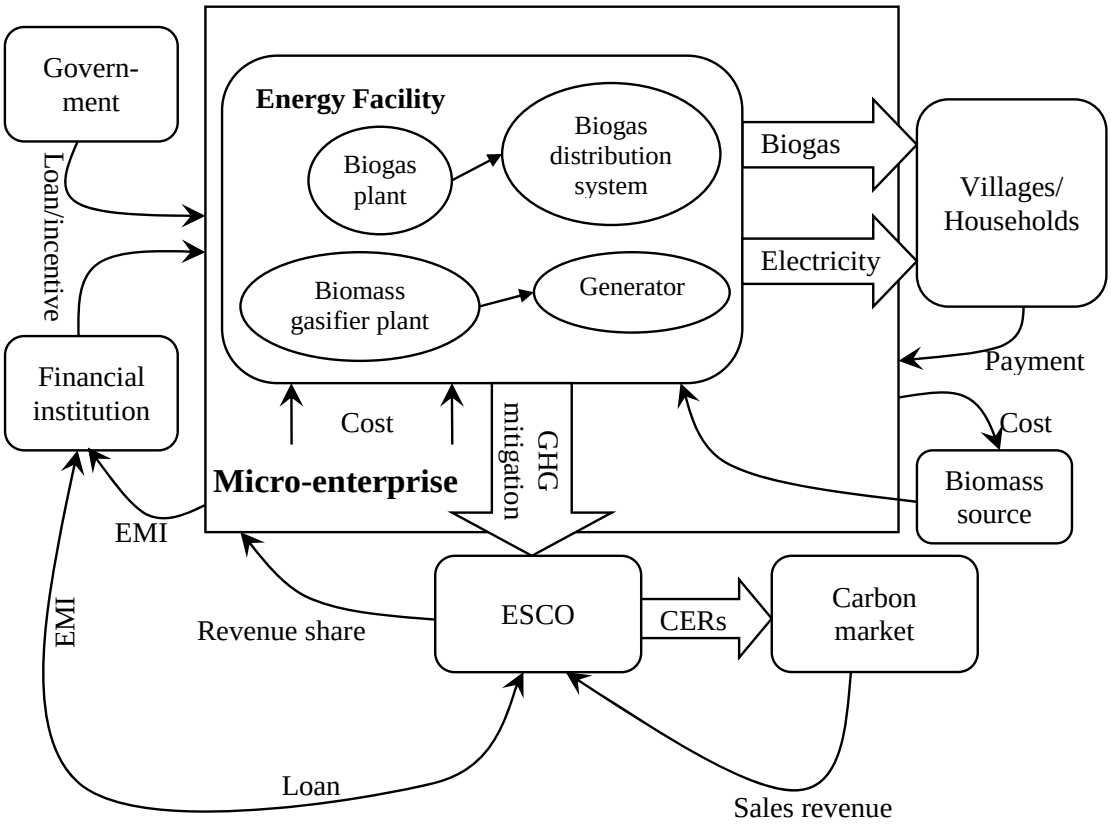


Figure 4. Micro-enterprise for rural energy services



The financial institutions are expected to support the enterprise with loans at favorable terms and government entities are expected to support the enterprise with incentives to enhance profitability. In addition, the entrepreneur is expected to invest in the enterprise as his or her equity contribution. For the entrepreneur, the financial inflow is in the form of payments received from households for the energy carriers consumed, revenue share from the ESCO due to CER sales, and operational incentives from the government. The enterprise could enhance inflows by selling the surplus energy carriers at higher prices to other sectors of the rural economy and to households for other than basic end-uses. The financial outflow for the entrepreneur would be for equated monthly installments (EMI) for loan repayment, and expenses related to O&M and purchase of biomass.

An ESCO would bundle many such enterprises and present a single potential small-scale CDM project to the international carbon market. The ESCO will transform the GHG emissions mitigated into CERs and trade them in the carbon market. In this process, the ESCO will need to bear both the fixed and the variable transaction costs and again it would seek loans on soft-terms from the financial institutions. The revenue from CER sales would be shared with the participating entrepreneurs. Thus, financial inflow for the ESCO would be revenue from CER sales and the outflow would be the EMI for loan repayment, operational expenses and the revenue shared with the entrepreneurs.

The enterprise could be providing energy access to a single village or to multiple villages. This depends on the size of the village, geographical clustering of villages, availability of biomass and financial resources, installed capacity, financial and operational feasibility, potential growth opportunities, demand from other sectors of the rural economy, etc. It is even possible for a single enterprise to have multiple energy facilities at different villages. This would depend on the ability of the entrepreneur to expand his or her enterprises. Further, the households are not expected to pay for the connection costs for the basic energy services. Thus, it is proposed that each household would be getting the basic electricity connection for lighting and biogas connection for cooking including the end-use devices for free of cost. It has been proposed that these costs be built into cost of the enterprise and may be recovered through monthly payments made by households. It is important that these monthly payments cannot be high considering that these households are shifting from free or low cost conventional energy carriers to relatively expensive modern energy carriers.

SUMMARY AND CONCLUSION

The proposed public-private partnership-based implementation framework contained recommendations for the adoption of an integrated rural energy policy developed by extracting the relevant inputs from the existing energy policy documents as well as by including some new policy guidelines to facilitate establishment of new institutions, and mechanisms and to enable implementation of the program on universal rural energy access. It suggested establishment of the REAAs and EAFs both at the national and regional levels to support the implementation of the program. At the other end, the trained entrepreneurs were envisioned as establishing energy micro-enterprises to produce and to distribute energy carriers to rural households at an affordable cost. The ESCOs were to function as intermediaries between these enterprises and the international carbon market in aggregating the CERs and the trading them under CDM. The proposal, if implemented, would result in a win-win situation for all the participating stakeholders. The households could enjoy the benefits of modern energy carriers at affordable cost; the rural entrepreneurs could run the profitable energy enterprises; carbon markets could have access to large quantity of carbon credits; the government could have the satisfaction of securing energy access to a large section of the rural population; and globally, there would be a benefit of climate change mitigation.

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ABOUT THE ENERGY TECHNOLOGY INNOVATION POLICY (ETIP)

The overarching objective of the Energy Technology Innovation Policy (ETIP) research group is to determine and then seek to promote adoption of effective strategies for developing and deploying cleaner and more efficient energy technologies, primarily in three of the biggest energy-consuming nations in the world: the United States, China**,** and India**.** These three countries have enormous influence on local, regional, and global environmental conditions through their energy production and consumption.

ETIP researchers seek to identify and promote strategies that these countries can pursue, separately and collaboratively, for accelerating the development and deployment of advanced energy options that can reduce conventional air pollution, minimize future greenhouse-gas emissions, reduce dependence on oil, facilitate poverty alleviation, and promote economic development. ETIP's focus on three crucial countries rather than only one not only multiplies directly our leverage on the world scale and facilitates the pursuit of cooperative efforts, but also allows for the development of new insights from comparisons and contrasts among conditions and strategies in the three cases.