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ECO-ENTERPRISES, POLICIES AND INSTITUTIONAL SETUP FOR RHEES - NORTH EAST INDIA

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ABSTRACT: The paper presents a possible approach to address India's formidable challenge of ensuring security of access to modern energy carriers to the majority of its rural population. This study presents a case study of the selection methodology, implementation strategies for setting up Energy Eco-enterprise in North-East, India under RHEES. The RHEES (Rural Hybrid Energy Enterprise Systems) approach aims at designing and implementing a *'participatory'* process of capturing the perception of rural end-users on all the aspects of energy and associated benefits as well as seeking their inputs for energy access induced empowerment and long-term sustainability. In addition, the paper provides an insight into the profitability of such eco-enterprises using existing business models which support sustainability in renewable energy generation, distribution, use and develop new entrepreneurial modes which prioritize and enable production and fair marketing of value-added by-products as well as carbon credits to local, national and international markets.
Keywords: bioenergy, policies, business issue, economics, sustainability.

1 INTRODUCTION

The majority of the poor in developing countries, such as in India, lives in villages and is deprived of all those facilities, assets and services that are considered as basic and essential for normal living in developed countries (e.g., energy, water, sanitation, housing, etc.). This majority, in addition to getting exposed to the hardship of day-to-day livelihoods, are also likely to be the most vulnerable to the shocks of natural calamities that are likely to become more frequent in future due to climate change. Thus, there are serious threats for the sustainable development with the continued presence of about 710 million energy deprived people. They account for nearly 60% of the Indian population. To bring transformations in their life styles and to build resilience among them, the need is for implementation of some radical and out of the box solutions. The need is to develop *Packaged Solutions* which are an amalgamation of local renewable resources, modern technologies, enabling policies, efficient local institutions and inclusive business models. The expected outcomes of such solutions are – access, livelihoods, empowerment, equity, resilience, profit and sustainability. Thus, the overall goal of such solutions is to provide access to both energy services and resulting empowerment for the rural poor. The Rural Hybrid Energy Enterprise System (RHEES) approach proposes to demonstrate such a solution.

RHEES projects are typically designed and implemented with twin objectives – (i) to provide access to modern energy carriers for meeting the basic energy end-use services needs of poor and deprived section of the population, especially the rural people, and (ii) to enable creation of productive energy use opportunities through production of surplus modern energy. The overarching goal is empowerment of the poor through cleaner energy access, income generation and enterprise opportunities, better access to education and health leading to overall economic progress and human development. Long term sustainability of such projects can be ensured by adopting a "Use and Pay" mode of transaction, which is made possible because of productive uses of energy. In other words, RHEES projects can aim at achieving financial success, which is impossible in the case of basic energy access projects.

This study presents the selection methodology, implementation strategies for setting up an energy Eco-enterprise in Assam, North-East, India. The paper addresses the typical energy access gap in a rural environment followed '*prescriptive*' mode of implementation without taking any inputs from the beneficiaries (rural population). A generalized approach towards achieving the model needs in designing and implementing a *'participatory'* process of capturing the perception of rural end-users on all these aspects as well as their inputs for energy access induced empowerment and long-term sustainability of such a process by adopting business models.

The RHEES approach is being implemented in an un-electrifird village in the north-east India. The village, Jhawani is located in the sub-district of Tezpur in Sonitpur district of Assam state.

2 ENERGY ACCESS – CURRENT STATUS

As per the 2011 Census in India, about 168.85 million households (146.65 million rural households) depend on solid fuels as primary fuel for cooking and 80.8 million households (75.02 million rural households) are without access to electricity [1]. These translate into 68% of the total and 87.4% of the rural households lacking access to modern fuels, and 32.8% of the total and 44.7% of the rural households lacking access to electricity. The situation in Assam is worse compared to the country as a whole. In Assam, 80.3% of the households depend mainly on solid fuels for cooking and this number increases to 89.8% in the case of rural households. With respect to electricity access, in Assam, about 63% of the households do not use electricity as main carrier for lighting. It increases to whopping 71.6% in the case of rural households and they depend mainly on kerosene for meagre and polluting lighting or live in dark during the nights. This is the main reason for choosing Assam as one of the states for demonstrating RHEES approach.

The status of access to modern fuels and electricity is not much different in the study district (Sonitpur) and

study sub-district (Tezpur). The project village is located in Tezpur. Figure 1 shows the comparative status of access to modern fuels and electricity in these chosen locations, Assam and India. In terms of rural cooking energy access, Tezpur performs the best with 29% having access to modern cooking fuels with both Sonitpur (12%) and Assam (10.2%) showing lesser access levels compared to India (12.6%). Same situation prevails even with respect to urban cooking energy access with Tezpur (80.5%), Sonitpur (76.2%), India (73.1%) and Assam (71.4%) performing in that order.

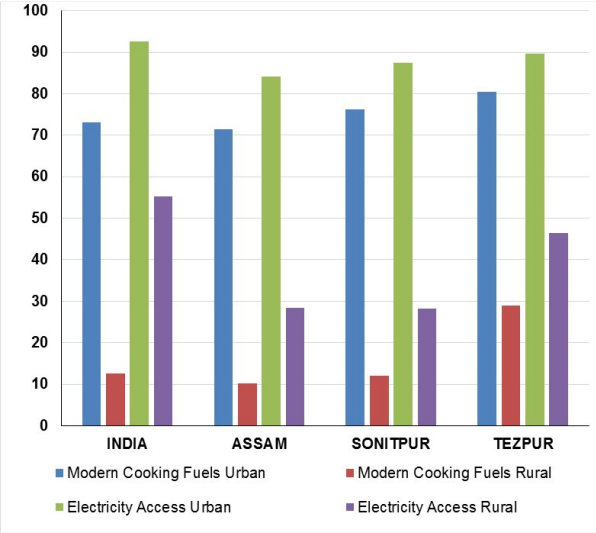

Figure 1: Comparative status of modern energy access

The situation is completely different with respect to electricity access levels. Both the state and the study locations perform worse than overall Indian access levels. The descending order is India (92.7%), Tezpur (89.6%), Sonitpur (87.4%) and Assam (84.1%) for urban electricity access levels. The rural energy access levels too have similar order with India (55.3%) and Tezpur (46.4%) taking the top two positions and both Sonitpur (28.3%) and Assam (28.4%) showing same levels.

The village chosen for RHEES project implementation is Jhawani, and it is 100% un-electrified and all the households depend on fuelwood as main cooking fuel. The village has 31 households with a population of 133 (Table 1). About half of the households has installed solar home systems, which enable them to have 2-4 hours of lighting daily. However, given their high priority for entertainment (TV and audio), these households compromise on lighting and use the meagre power available for operating small TV sets. All the households have mobile phones and charging them is the important end-use service provided by the solar home systems. Kerosene meets most of the lighting needs. Relatively rich households (six) use LPG as secondary cooking fuel. Nearly 94% of the energy needs of the village is derived from fuel wood, which is consumed in low-efficient and highly polluting conventional cook stoves. It may be observed from Table 1 that the villagers rank entertainment and mobile charging as the top two electricity end-uses. This may be partially due to lack of availability of adequate quantity of electricity. A micro-grid based distributed generation of electricity could be the most appropriate solution given its remote location.

Table I: Energy consumption pattern in Jhawani village

Activities	Energy Sources	No. of House-holds	Popula-tion	Village Total, MJ/day	Share (%)
Cooking fuel	Fuel wood	31	133	5970	93.89
	LPG	6	28	65.46	1.03
Transport	Petrol	4	21	51.97	0.82
Lighting	Kerosene	31	133	165.67	2.61
	Solar	16	73	0.18	0.00
Audio	Solar	4	20	10.37	0.16
TV	Solar	10	45	67.39	1.06
Mobile	Solar	31	133	27.48	0.43

3 RHEES APPROACH

3.1 Energy Access Redefined

Energy access is a term mostly used in the context of describing the energy consumption pattern of poor people in the world [2, 3, 4, 5]. It basically means extent of access these poor people have to the energy end-use services delivered by the modern energy carriers like electricity, petroleum products and modern biofuel. The typical energy end-uses considered for determining access levels are household cooking and lighting, which are treated as basic energy needs. On the other hand, the RHEES energy access looks beyond basic energy needs, and targets at addressing the modern energy services needs of lifestyle end-uses (for enhancing the quality of living standards through convenience, entertainment, information and communication), society (street lighting, clinics, schools, etc), productive end-uses (which results in establishment of enterprises, creation of income generating and employment opportunities) and productive livelihoods (drudgery reduction, income generation, extended working hours, etc.). Thus, any RHEES project expected to have the capacity to meet energy needs of following five classes of end-use services.

Basic energy services: Lighting, Cooking/heating

Lifestyle energy services: Cooling/heating, TV, mobile charging

Social energy services: Education, health, public services

Productive energy services: Mechanical energy (motors), Agro-processing (dryers, mills), Irrigation

Livelihood services: By-products based livelihoods like organic fertilizer, mushroom cultivation, tailoring, etc.

3.2 RHEES Access – Empowerment and Resilience

As explained above expanding basic plus productive energy access provides direct and indirect as well as tangible and intangible benefits to the population, especially, to the poor population in the developing countries. The linkages establishing connection between energy access and human resilience to adverse events or shocks (e.g., climate change related) are straight forward and very strong. Access to modern energy carriers brings in development – enhanced income, opportunities for economic activities, establishment of enterprises, access

to better education and health facilities, connectivity to external world through TV, internet and other media, gender empowerment, clean environment, access to information facilitating knowledge gains, enhanced social status with ability to participate and interact, ability to take informed decisions, etc. All these could significantly enhance the adaptive capabilities of individuals as well as society as a whole. Further, with the adoption of low-carbon pathway to expand energy access has significant environmental and ecological benefits. All these contribute to empowering the poor and build resilience to adversities. Resilience could be built through economic, knowledge, human and social empowerments. The achievement of two end goals of climate change mitigation and climate change adaptation are possible through RHEES access delivered from distributed energy technologies using bioenergy sources. The path is straight forward and could be win-win solution for all the stakeholders, and has potential to traverse the sustainability path – renewable energy → distributed/off-grid energy technologies → modern energy carriers and savings in GHG emissions → climate change mitigation and basic & productive access to energy services → livelihoods, enterprises, profits, employment, education, health, technologies → empowerment and equity (income, knowledge, gender) → sustainable development → resilience → better adaptation capacities for shocks → climate change adaptation.

3.3 Participatory approach and survey

The paper addresses the typical energy access gap in a rural environment followed '*prescriptive*' mode of implementation without taking any inputs from the beneficiaries (rural population). A generalized approach towards achieving the model needs in designing and implementing a *'participatory'* process of capturing the perception of rural end-users on all these aspects as well as their inputs for energy access induced empowerment and long-term sustainability of such a process. The key aspects of the approaches are following.

Interactive workshops were held in the Jhawani Village in Assam to assess the perceptions and requirement of the villagers on energy service needs and priorities; size, scope and location of the energy production and distribution facilities; willingness to supply the input energy resources (at fixed price), form an all-inclusive (productive) uses of the energy services; pricing of inputs and energy services; sharing of costs and benefits and legal approvals for the project land. The structured discussions were carried out with 100% participation from the villagers both male and female at the village level, forming an institution (registered society); potential enterprise opportunities, willingness to pay for services such as irrigation, electricity end-use services to improve the livelihood of the village.

Three types of structured questionnaires for – (i) Village survey, (ii) Household survey, and (iii) Women's role, participation and needs have been developed and analyses are being finalized. These questionnaires gathered very detailed information/data on demographic, social & economic status, potential energy resources, energy use status and service needs, potential livelihoods improvements and enterprises, agriculture status and potential production improvement scopes and irrigation needs and several other details.

3.4 Business model for energy service delivery

Effective delivery of energy services in village needs to adopt a business model with social-entrepreneurship at the core with innovative institutional, regulatory, financing and delivery mechanisms to ensure tangible benefits for every household of the village. The paper provides an insight into the profitability of such enterprises using existing business models which support sustainability in renewable energy generation, distribution, use and develop new entrepreneurial modes and tools which prioritize and enable the production and fair marketing of value-added by-products as well as carbon credits to local, national and international markets. In this paper, we have discussed an innovative approach for mainstreaming sustainable energy access in rural India. The need for innovations given the implications of lack of energy access on human well being, sustainable and replicable business models for renewable energy base systems focused to improvement in livelihood.

4 RHEES IMPLEMENTATION: AN INNOVATIVE GOVERNANCE AND INSTITUTIONAL MECHANISM

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 [6] – (i) *Multi-stakeholder and multi-level* implementation programme, (ii) Enacting an exclusive *integrated rural energy policy*, (iii) Creation of exclusive *rural energy access authorities (REAAs)* within the government system as leadership institutions, (iv) Establishment of *energy access funds (EAFs)* to enable transitions from the regime of *investment/fuel subsidies* to *incentive-linked* delivery of energy services, (v) *Integration of business principles* to facilitate affordable and equitable energy sales to households and carbon trade, and (vi) Treatment of *entrepreneurs as implementation targets* and not millions of rural households.

An earlier paper by the first author describes the proposed implementation framework in detail [6]. The framework represents a top-down approach with the government/s represented by the appropriate ministries at the top and the rural households, at the other end reaping the benefits. The framework entails establishment of the rural energy access authorities (REAAs) both at the national and regional levels to be empowered with enabling regulatory policies and supported by the multi-stakeholder partnership. The national REAA is expected to establish the national energy access fund (EAF), support the creation of and coordinate with the regional REAAs, and develop a comprehensive entrepreneurship development programme with inputs from stakeholders. The regional REAAs are expected to manage the regional EAFs and facilitate the conduct of intensive capacity building programmes for the prospective entrepreneurs. At the other end, the trained entrepreneurs are envisaged to establish village-level energy micro-enterprises to produce and distribute energy carriers to rural households at affordable cost. The energy service companies (ESCOs) will function as intermediaries between these enterprises and the international carbon market in aggregating certified emission reductions (CERs) and

trading them under clean development mechanism (CDM) or similar mechanisms. As per the proposal, the ESCOs would share carbon trade proceeds with energy enterprises at pre-determined rates. The financial institutions are expected to lend to these energy enterprises as well as ESCOs at soft interest rates under priority lending schemes. RHEES too adopts a similar approach.

5 BUSINESS MODEL FOR ENERGY SERVICE DELIVERY

The final delivery of energy services to the rural households is to be performed by the micro-enterprises. The overall structure of the micro-enterprise would be as shown in Figure 2 [6]. The enterprise would own an energy facility consisting of biogas plants, either based on biomass or cattle dung or both types, for producing biogas and biomass gasifier plants for generating electricity. The energy infrastructure would also include biogas distribution system connecting every household in the village/s. This would ensure piped biogas supply to the households. For electricity access, either new or existing electricity distribution infrastructure would be created or used under lease from the government utilities at pre-determined leasing rates.

The financial institutions are expected to support the enterprise with loans at favorable terms and government entities to support 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 the households, revenue share from the ESCO due to CER sales and operational incentives from the government. The enterprise could enhance its revenue 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 (lighting and cooking). 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.

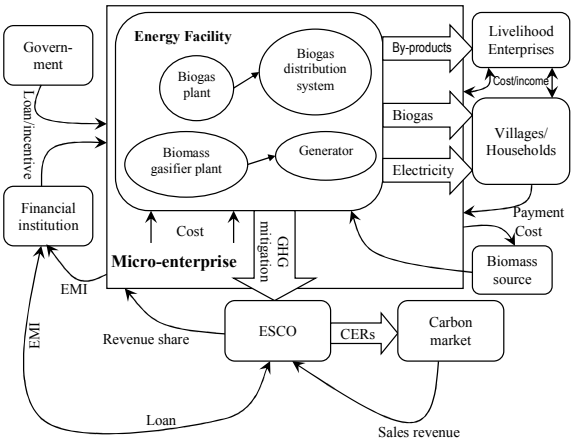

Figure 2: Hybrid-enterprise for rural energy services [6]

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

6 HYBRID-ENERGY SERVICE ENTERPRISE: A FINANCIAL FEASIBILITY ANALYSIS

The success of any business is dependent on the level of profits it could earn. Thus, a financial feasibility analysis of a business proposition is very much critical to assess its profitability potential. The estimates of net present value (NPV) and internal rate of return (IRR) are excellent indicators of profitability of a business. The financial feasibility assessment of two possible rural energy enterprises is performed [8, 9]. The first one is adopting biomethanation technology for producing biogas for cooking by using cattle dung and biomass gasifier technology for generating electricity for lighting and other end-uses. The second enterprise uses soft biomass for producing biogas and biomass gasifier for generating electricity. For ease of understanding, the first enterprise is named as Biomass-Dung-Energy-Enterprise (BDEE) and the second one as Biomass-Biomass-Energy-Enterprise (BBEE). In both the enterprises, energy efficiency is integrated with the inclusion of compact fluorescent lamps (CFL) for household lighting. While performing the financial feasibility study of energy enterprises, the following assumptions have been used – (i) The number of households per enterprise is assumed to be equal to 1000, (ii) an equity contribution of 20% of the investment will be contributed by the entrepreneur. Remaining 80% will be obtained as a loan at a subsidized interest rate of 6% with a repayment period of 5 years, (iii) a discount rate of 10% is used for estimating the present values of cash flows happening in different years, (iv) a price for Certified Emissions Reduction (CER) of US \$20/tCO_2 and a conversion rate of Rs. 50/US$, and (v) the benefits for households are on account of cost and efforts saved due to non-use of biomass, and the cost is the monthly payment to be made to the entrepreneur. All the costs related to distribution infrastructure, operations and maintenance (O&M) and end-use devices are to be borne by the entrepreneur.

The results show that the Net Present Value (NPV) for the entrepreneur from BDEE model is about Rs. 21.1 million and that for BBEE model is about Rs. 13.4 million and this could be compared with the original equity contribution of Rs. 2.5 million (Table II). The internal rate of returns (IRRs) of 66% and 39% respectively for the two types of enterprises show the benefits are significantly higher than the costs. The profitability analysis shows that the financial performance of both enterprises is extremely high and can be attractive even without government incentives. The avoided methane emissions are mainly responsible for higher returns in the case of BDEE.

Table II: Profitability from Entrepreneur's Perspective

Characteristic	BDEE	BBEE
Contribution by entrepreneur @ 20% equity (Rs. million)	2.50	2.50
Loan amount (Rs. million)	10.0	10.0
Equated monthly installment, EMI (Rs.)	197,977	197,977
O&M cost (Rs./month)	221,577	221,577
Annual CO_2 emissions reduction (tonne)	2,688	1,682
CDM revenue from intermediary (Rs./month)	199,685	121,868
Household repayment (Rs./month)	340,944	340,944
Profit per month for the first 5 years (Rs.)	121,075	43,258
Profit per month for the remaining 20 years (Rs.)	319,052	241,235
Internal rate of return (IRR) - %	66%	39%
Net present value (Rs.)	21,131,724	13,426,090

For a bundling intermediary (an ESCO), a bundle of either 20 BDEEs or 30 BBEEs would be feasible from the point of view of cost implications and the need for retaining the status of small-scale CDM project. The results suggest that the financial returns with NPVs of about Rs. 12.9 million and Rs. 15.4 million respectively for the two project cases seem to be very attractive (Table III). Again the IRRs of 68% and 47% further prove the profitability nature of these CDM projects for the ESCOs.

Table III: Profitability from Intermediary's Perspective

Characteristic	BDEE	BBEE
No. of enterprises	20	30
Annual CERs available for sale	53,759	50,460
Revenue from CERs (Rs. million)	53.76	50.46
Transaction cost (Rs. million) - One time	3.5	4.0
Transaction cost (Rs. million) - Annual	3.	3
Intermediary's contribution @ 20% equity (Rs. million)	0.7	0.8
Loan amount (Rs.)	2.8	3.2
Equated monthly installment, EMI (Rs.)	55,392	63,306
O&M cost (Rs./month)	120,000	180,000
Net profit from CER sales (Rs. million)	48.65	44.54
Share of profits @1.5% for the first 5 years (Rs. Million)	0.7	0.7
Share of profits for the remaining 20 years (Rs. Million)	1.4	1.4
Share of profit for entrepreneurs (Rs. million)	47.92	43.87
Internal rate of return (IRR) - %	107%	88%
Net present value (Rs)	8,580,346	8,436,599

7 SCALING-UP RHEES PROJECTS: AN IMPLEMENTATION FRAMEWORK

Large scale scaling-up needs a robust implementation mechanism to achieve the time-bound targets. Specific recommendations for designing of regulatory policies, programmes, institutional structures, financing (including micro finance), multi-stakeholder partnerships, local delivery mechanisms, market development, entrepreneurship development, incentive schemes, capacity building and prioritized set of productive and livelihood energy use opportunities needs to be elaborated, which may function as useful inputs for developing country-specific programmes for large scaling-up.

Any energy access project needs a robust implementation mechanism to achieve the time-bound targets. We have made some specific recommendations for designing of regulatory policies, programmes, institutions, financing and local delivery mechanisms, which may function as useful inputs for developing RHEES based programmes. Some of these recommendations are based on literature [6, 7].

7.1 Enabling policy framework

Policies provide guidelines and plan of action for achieving the desired objectives. Clear political commitments for its promotion are typically translated into supportive policies and regulations that work to create incentives and greater certainty for all participants. RHEES access policies need to be targeted at the poor who are vulnerable and have serious issues with affordability. The affordability issues would be largely addressed through enabling energy-based livelihood, income generation and enterprise opportunities (clubbed together as productive end-use opportunities). Thus, the proposed policy should encompass following:

- Account for universal service obligation
- Allow for lifeline energy consumption and affordable tariff design
- Flexible and affordable connection, disconnection and reconnection policies
- Enable the establishment of institutions for programme implementation and delivery of energy services.
- Enable the creation of dedicated energy access funds to support the programme implementation.
- Provision for establishing distributed energy generation systems and flexible access to the grid for the local institutions
- Provision for tax incentives for establishing off-grid and micro-grid power generation systems.
- Support capacity development through education, training and awareness programmes.

7.2 Institutions for programme support

Institutions, both at the national and local levels are needed to facilitate, support and guide the process of up-scaling. These will be essentially government organizations, which enable translation of government policies into implementable programmes targeting at both the energy access and productive use value chains.

Establishment of dedicated national and regional institutions for implementing programmes related to basic plus productive access is critical for the success. The role of national level institution is to design implementable programmes, support its actual implementation along with regional/state level institutions and many other stakeholders, and monitor its progress. For doing this, the national level institution is expected to establish the partnership of stakeholders and

use its services for performing different activities, supervise and monitor the activities of the regional institutions, design and implement the capacity development programmes, transfer funds to the regional energy access funds. The regional institutions are the ones who would be implementing the programmes, conducting capacity development programmes, interacting with the entrepreneurs and NGOs, and providing incentives.

7.3 Multi-stakeholder partnerships

These kinds of innovative processes aiming at scaling up of RHEES projects 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/utilities, technical institutions and R&D organizations, industries, entrepreneurs, financial institutions, donor agencies, NGOs and poor households need to join together to achieve the objective of universal rural energy access. The role of the individual stakeholders in the partnership would be based on their competencies and it could be related to financing, advising, expressing needs, information dissemination, technology provision, training and capacity building, management and monitoring, etc.

7.4 Public-Private-People Partnership (PPPP) model

The proposed business model will follow the PPP framework. The purpose is to integrate the efficiency of private sector, the social obligation and institutional strength of the government organizations and the concerns and participation of community organizations. A practically feasible PPPP model will need to be elaborated and developed. This model will be most appropriate for energy production and distribution enterprises. It is also envisaged that this model will integrate support mechanisms for enabling creation of livelihood opportunities and productive energy use enterprises.

7.5 Dedicated energy access funds

Obtaining the required financial support for programme implementation is crucial. There is a need to establish dedicated energy access funds (EAFs) at the national as well as regional or state levels. The energy access funds would be made up of contributions from national budgets, government grants, redeployed energy subsidies, contributions from multilateral agencies and international donors. All the financial support dedicated to universal energy access need to be routed through these energy access funds. In addition, low cost bank finance from multilateral, bilateral and local financial institutions to support investment requirements needs to be tapped.

7.6 Large scale Financing

Obtaining the required financial support for programme implementation is crucial. The financial support could from contributions from national budgets, government grants, redeployed energy subsidies, contributions from multilateral agencies and international donors. All the financial support dedicated to energy access need to be properly channeled. In addition, low cost bank finance from multilateral, bilateral and local financial institutions to support investment requirements needs to be tapped.

7.7 Micro Financing

Micro financing schemes could play a crucial role in providing financial support to household-based enterprises, livelihood opportunities and very small scale energy based enterprises. Considering that the target population of such programmes would be largely poor, micro finance will play a critical role in the success of RHEES projects.

7.8 RHEES enterprises

The success of the programmes related to providing access to the poor depends mainly on the existence, effectiveness and efficiency of the local institutions/businesses responsible for using surplus energy carriers for productive purposes. This institution could be a private small scale enterprise, an NGO, a government agency or a community organization. The local institution needs to be empowered with capacity to create and maintain the local energy infrastructure and make provisions for energy production and distribution, repair and maintenance, new connections, billing and collection, monitoring and reporting, and other related activities. These institutions are expected to generate revenue surpluses, create business opportunities, enable employment generation, expand health care, and education facilities. Even household scale enterprises are possible that aim mainly at productive livelihood opportunities and income generation. This would enable households to improve their livelihood by being able to earn additional income or reduce current expenditure levels so that they have access to additional disposable income. This will enhance their affordability levels and motivate them to pay for energy services thereby ensuring the sustainability of projects.

7.9 Capacity development

As discussed above, multiple stakeholders at different levels are involved in implementation of RHEES access programme. There are stakeholders at the national, regional/state and local government levels, belonging to public sector organizations, financial institutions, Energy service companies (ESCOs), private sector, small-scale industries, NGOs and the households. 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 programme to a large extent depends on empowerment of these individuals through effective capacity development programmes. The capacity development programmes could be in the form of information dissemination, awareness campaigns, sensitization programmes, training programmes, etc., depending on the type of individuals.

7.10 Entrepreneurship Development

For a large-scale replication of RHEES projects 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 majority does not view providing energy access to the poor or establishing businesses in villages as commercially attractive alternatives or business. Therefore it is important to create the enabling

environment where such entrepreneurs can emerge and start businesses in rural regions. There would be potential for enterprises at household-scale (livelihood and income generation activities), micro- and mini scale (surplus energy and by-product based enterprise).

8 CONCLUSION

The study discusses an innovative approach for effective delivery of energy services in an un-electrified village by adopting a business model with social-entrepreneurship at the core with innovative institutional, regulatory, financing and delivery mechanisms to ensure tangible benefits for every household of the village. The paper provides an insight into the profitability of such enterprises using existing business models which support sustainability in renewable energy generation, distribution, use and develop new entrepreneurial modes and tools which prioritize and enable the production and fair marketing of value-added by-products as well as carbon credits to local, national and international markets. In this paper, we have also discussed an innovative approach for large-scale scale-up for mainstreaming sustainable energy access in rural India.

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11 LOGO SPACE

RHEES
Rural Hybrid Energy Enterprise Systems