PERSPECTIVE PAPER

MARCH 2014

# Policy Imperatives *for* Decentralised Renewable Energy based Micro-Grids in India

## Key Messages

- Decentralised Renewable Energy (DRE) solutions for a country like India are economically and environmentally smart options. DRE based mini-grids offer cheaper options in comparison to diesel generators and kerosene.
- The policy architecture in India around DRE projects however has not been able to trigger confidence amongst service providers, technology suppliers and investors to venture beyond demonstration projects.
- There are a number of roadblocks to the implement-ation of decentralised plants which come in the form of delivery of adequate subsidies and safeguarding the interests of the private entrepreneur / developer.
- There is a need for a multidimensional push: technical, financial, policy and regulatory to ensure successful implementation of DRE systems.

**Authors**

Vrinda Chopra

Shivani Mathur

Sharad Tiwari

Rowena Mathew

**Advisors**

Dr. Arun Kumar
Development Alternatives Group

Ashwin Gambhir, Prayas Energy Group

Sharastant Patara, Technology and Action for Rural Advancement

Upendra Bhatt, cKinetics

Sanjay Kazanchi, Rockefeller Foundation

Suman Sureshbabu, Rockefeller Foundation

**Editors**

Zeenat Niazi, Development Alternatives

Gazala Shaikh, Development Alternatives

# Table of Contents

# List of Abbreviations

| | |
|---|---|
| CEA | Central Electricity Authority |
| CERC | Central Electricity Regulatory Commission |
| CSTEP | Centre for Study of Science, Technology and Policy |
| CUF | Capacity Utilisation Factor |
| DDG | Decentralized and Distributed Generation |
| DF | Distribution Franchisee |
| DG | Diesel Generator |
| DISCOM | Distribution Company |
| DRE | Decentralised Rural Electrification |
| EA | Electricity Act |
| ESCO | Energy Service Company |
| FiTs | Feed in Tariffs |
| FoR | Forum of Regulators |
| GOI | Government of India |
| HT | High Tension |
| IREDA | Indian Renewable Energy Development Agency |
| MNRE | Ministry of New and Renewable Energy |
| MoP | Ministry of Power |
| MoRD | Tariff Policy |
| MSME | Ministry of Small and Medium Enterprises |
| MW | Mega Watt |
| NEA | National Electricity Act |
| NEP | National Electricity Policy |
| NGOs | Non- Governmental Organizations |
| NRDC | National Resources Defense Council |
| NSM | National Solar Mission |
| OGDBDF | Off-Grid Distributed Generation Based Distribution Franchisee |
| PLF | Plant Load Factor |
| PPA | Power Purchase Agreement |
| RBI | Reserve Bank of India |
| RE | Renewable Energy |
| REC | Renewable Energy Certificates |
| REP | Rural Electricity Policy |
| RET | Renewable Energy Technology |
| RGGVY | Rajiv Gandhi GrameenVidyutikaranYojana |
| RPO | Renewable Purchase Obligation |
| RVE | Remote Village Electrification Scheme |
| SERC | State Electricity Regulatory Commission |
| SLDC | State Load Despatch Centre |
| SNAs | State Nodal Agencies |
| SPEED | Smart Power for Environmentally- Sound Economic Development |
| TP | Tariff Policy |
| VESP | Village Energy Security Programme |

# List of Tables



# List of Figures



# List of Boxes

## Introduction

India is one of the fastest growing economies in the world with an annual growth of 7-8% . It has 70% of its population residing in rural areas, yet only 55% of this rural population has access to electricity. In most regions, grid based power is extremely unreliable and demand is highly disaggregated amongst rural and small town population of almost 700 million people. As a result, while 94% of urban households are electrified in rural India only 55% of households are electrified leading to more than 43% still using kerosene to light their houses[1].

The National Rural Electrification Policy (2006) mandates states to develop their own rural electrification implementation plan. Unfortunately, even 7 years after the mandate, only 12 states have formulated draft plans, these being, Chhattisgarh, Gujarat, Maharashtra, Himachal Pradesh, Madhya Pradesh, Mizoram, Nagaland, Orissa, Punjab, Tamil Nadu, Uttar Pradesh and West Bengal.

Environmental concerns, particularly those related to climate change, have led to heightened interest in generation of electricity from renewable resources and its deployment through innovative off-grid service delivery models to meet basic needs of the poor.

Given this backdrop and the fact that reliable energy availability can have a transformative effect on the lives of people, the Government of India (GoI) has prioritized rural energy programmes. It has embarked on a massive programme, the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) to extend the grid and enhance local power generating capacity through its Decentralised Distributed Generation Scheme (DDG) with emphasis on connections to households below the poverty line. The implementation of Rural Electricity Policy (2006) provides a unique opportunity to promote village electrification and meet rural energy needs.

Policies related to rural electrification and the promotion of renewable energy continue to favour large producers of electricity and grid-connected users through a range of incentives for supply of green power to the grid. In the case of off-grid models, there are several bottlenecks or roadblocks in the schemes and polices which act as barriers to their implementation leading to lack of innovative service delivery models. A vicious circle is thus initiated; discouraging interest of both private and public entities in renewable energy based decentralized power projects. This triggers the need to demonstrate and replicate viable models through a considerably more favourable policy and regulatory environment that provide last mile service delivery and supplement the grid.

The paper explores the policy and regulatory environment for Decentralised Renewable Energy (DRE) projects. The focus of the paper lies within the perspective lens of a programme initiated by the Rockefeller Foundation (RF) called Smart Power for Environmentally sound Economic Development (SPEED). The following sections will first explain the background going on to the policy roadblocks for DRE systems. It will then place these blocks in the context of SPEED and other such DRE based micro-grid systems. Finally, the paper will end with recommendations for Policy and Regulatory change to accelerate viable DRE systems. In order to understand these obstacles and make suitable recommendations – an extensive literature review was carried out and augmented with experiences from implementation of services delivery models and consultations with various stakeholders (including but not limited to policy and decision makers).

**Box1: Decentralised Electricity Generation**

Decentralised electricity generation means “an electric power source connected directly to the distribution network or on the customer’s side of the meter”. DRE systems use local renewable resources -biomass, water, sunlight and wind - to generate electricity. Such micro-grids can play an important role in bridging the electricity access deficit by providing access to remote villages which cannot be electrified through central grid extension due to techno-economic considerations, those which are unlikely to be electrified in the near future through the central grid, and by supplementing unreliable grid supply in villages already electrified.

Source: Gambhir et al, 2012

[1]*According to Census of India 2011: Houses, Household Amenities and Assets. http://www.censusindia.gov.in/2011census/hlo/hlo_highlights.html*

## Background

Despite several policy initiatives by the Government of India (GoI) and progress in extending the national grid, the 2011 census shows that 7.5 crore rural households even today do not have electricity compared to 7.8 crore such households in 2001. Regardless, the Census of India 2011 indicates that almost every state saw an increase in household connectivity to the grid (Table 1); and most of these states have been seeing a faster fall in the levels of poverty.

As on 30th November 2012, a total of 34,887 villages of India were yet to be provided with electricity access. Out of a total of 593,732 inhabited villages as per the 2001 census, as on 30th November 2012, a total of 557439 villages were electrified.

Table1 : Comparison of electrified lighting ten years apart

| Rank | State | Percentage of households using electricity as their primary source of lighting (%) (Census 2001 | Percentage of households using electricity as their primary source of lighting (%) (Census 2011)[1] |
|---|---|---|---|
| 1 | Lakshadweep | 99.7 | 99.7 |
| 2 | Delhi | 92.9 | 99.1 |
| 3 | Daman and Diu | 97.8 | 99.1 |
| 4 | Chandigarh | 96.8 | 98.4 |
| 5 | Puducherry | 87.8 | 97.7 |
| 6 | Goa | 93.6 | 96.9 |
| 7 | Himachal Pradesh | 94.8 | 96.8 |
| 8 | Punjab | 91.9 | 96.6 |
| 9 | Dadra and Nagar Haveli | 86 | 95.2 |
| 10 | Kerala | 70.2 | 94.4 |
| 11 | Tamil Nadu | 78.2 | 93.4 |
| 12 | Sikkim | 77.8 | 92.5 |
| 13 | Andhra Pradesh | 67.2 | 92.2 |
| 14 | Karnataka | 78.5 | 90.6 |
| 15 | Haryana | 82.9 | 90.5 |
| 16 | Gujarat | 80.4 | 90.4 |
| 17 | Uttarakhand | 60.3 | 87 |
| 18 | Andaman and Nicobar Islands | 76.8 | 86.1 |
| 19 | Jammu and Kashmir | 80.6 | 85.1 |
| 20 | Mizoram | 69.6 | 84.2 |
| 21 | Maharashtra | 77.5 | 83.9 |
| 22 | Nagaland | 63.6 | 81.6 |
| 23 | Chhattisgarh | 53.1 | 75.3 |
| 24 | Tripura | 41.8 | 68.4 |
| 25 | Manipur | 60 | 68.3 |
| 26 | Madhya Pradesh | 70 | 67.1 |
| 27 | Rajasthan | 54.7 | 67 |
| 28 | Arunachal Pradesh | 54.7 | 65.7 |
| 29 | Meghalaya | 42.7 | 60.9 |
| 30 | West Bengal | 37.5 | 54.5 |
| 31 | Jharkhand | 24.3 | 45.8 |
| 32 | Odisha | 26.9 | 43 |
| 33 | Assam | 24.9 | 37 |
| | **All INDIA AVERAGE** | 55.8 | 67.2 |

Source: Census of India 2001 and Census of India 2011

Of a total of 29 states of India, only 9 states have achieved 100 percent village electrification as on the 30th November 2012. Table 2 gives an overview of the status of village electrification across the 29 states of India.

The target of 100 percent village electrification with 100 percent household electrification was fixed for 2009. However, as on 30th November 2012, 5.87 per-cent of India's villages are yet to be electrified.

While the above information is based on the 2001 village census data, the 2011 census shows a total of 645,856 villages in India[3]. Based on the 30th November 2012 village electrification figure of 557439 villages, the total number of un-electrified villages are in the region of 88,417.

Even when villages do have grid connectivity, many opt not to connect due to a number of reasons. Foremost being high-upfront connection charges, high fixed cost charges along with erratic voltage levels and an unreliable power supply which are a result of inadequate energy supply and ageing transmission systems (Rolland & Patel, 2011).

Rural electricity supply in India is thus amongst the poorest in the world when measured in terms of service quality, especially number of hours of supply which impedes uniform economic growth. However, the rural-urban divide continues to be daunting. While almost nine out of 10 households in the urban areas have electricity, the proportion in rural India is only one in two (Mint, 2012).

Based on these facts, there is a tremendous opportunity for electricity supply using renewable resources (Box 2). Renewable Energy (RE) in India is being seen for its tremendous potential in meeting the needs of a growing economy in a carbon smart manner (Garg et al, 2010). Given the constraints faced in resource availability and in delivery mechanisms, traditional means of energy supply are falling short (MNRE, 2011). There is a need for a shift in looking at RE not as an 'alternate energy' option but as a 'key part of the solution to India's energy needs' (MNRE, 2011). In this context, RE solutions may be applied to issues of rural electrification and sustainable development to enhance reliability and quality of service to rural consumers; also placing greater control in their hands over supply and demand side management to meet household, irrigation and enterprise needs (Garg et al, 2010; SPEED, 2011).

Lately, many other development agencies including Ministry of Power, Government of India under the "Power for All" programme are working on various Decentralized Distributed Generation (DDG) models to establish a business case for supply of reliable power to rural communities on sustainable basis.

Table 2: Status of Rural Electrification in India[2]

| SI No | Percentage of Electrified Villages | Total Number of States | Names of the States |
|---|---|---|---|
| 1 | 100% | 9 | Andhra Pradesh, Delhi, Goa, Haryana, Karnataka, Kerala, Punjab, Sikkim and Tamil Nadu |
| 2 | 90-99% | 12 | Assam, Bihar, Gujarat, Himachal Pradesh, Jammu and Kashmir, Madhya Pradesh, Chattisgarh, Maharashtra, Mizoram, Rajasthan, Tripura, Uttaranchal and West Bengal |
| 3 | 81-90% | 3 | Jharkhand, Manipur, Meghalaya, Orissa, Uttar Pradesh |
| 4 | 71-80% | 5 | Arunachal Pradesh , Nagaland |

Source: Central Electricity Authority 2014

[2]http://www.cea.nic.in/reports/monthly/dpd_div_rep/village_electrification.pdf

[3]http://censusindia.gov.in/2011census/Listofvillagesandtowns.aspx

**Box 2: Benefits of Renewable Energy Systems for Rural Electrification**

Renewable Energy (RE) not only expands energy generation and greenhouse gas mitigation, but also contributes to improvements in local environment, drought control, energy conservation, employment generation, health and hygiene, social welfare, security of drinking water, and increased agricultural yield. For instance, implementing wind farms and solar power in villages brings development in the form of infrastructure, efficient agriculture, and an overall better quality of life for the rural people. Thus, the broader developmental goals, such as poverty alleviation, sustainable development and employment generation should be integrated into the RE programs while seeking direct support under bilateral and multilateral cooperation. The GoI, NGOs, the international community, private businesses, and the villagers themselves all have a significant part to play in creating a better life.

Source: Rolland and Patel, 2011

The Indian economy depends heavily on agricultural production, and livelihood of majority population is dependent on farming. Yet the farmers and the rural poor remain the underserved. Installing RE for rural agricultural purposes could significantly add to the productivity of agriculture based services and enterprises (Rolland & Patel, 2011). All of this adds to creating a sustainable market base for DRE based rural electrification projects. Power producers catering to commercial demand that helps overcome dependence on diesel is critical to the success of decentralized power plants; as local entrepreneurs and farmers are willing to pay for electricity and allied services at competitive prices (Planning Commission, 2011). Rural households depending on their socio-economic condition are willing to pay around INR 100-120 per month (Rs 7-10/kWh) (Cust et al, 2007; Gambhir et al, 2012). There have been studies that indicate that rural consumer are willing to pay Rs 30-120/hh/month for domestic lighting and Rs 10-15/kWh for commercial lighting and other productive applications (Shakti Foundation, 2011).

Besides these numbers, evidence shows that DRE based mini-grids in fact offer cheaper options in comparison to diesel generators and kerosene, especially after factoring in the subsidies for diesel and kerosene (Bairiganjan et al, 2010; Gambhir et al, 2012), increasing the case for using such options for rural electrification.

## 3. Policy Imperatives for DRE based Rural Electrification Models

Studies on Decentralized Renewable Energy (DRE) models indicate that such models can be successful in a country as vast as India provided that there is assurance of demand and the model is economically viable (Iyer et al 2010). Evidence shows that Renewable Energy (RE) solutions can be applied to the issues of rural electrification while creating employment opportunities at all stages of the value chain (Garg et al, 2010). Opportunities for employment will open up for local level community members through local enterprise development, sourcing of raw material and local plant management; for project developers and technology suppliers to explore a new market area; and for developing a nascent supply chain for RE projects (to provide spare and replacement parts when required) etc.

### 3.1 Role of Ministries in Promotion of DRE based Rural Electrification Models

The Electricity Act 2003 (EA, 2003) together with the National Electricity Policy (NEP) and the Tariff Policy (TP) provide the necessary regulatory and legal framework for implementation of electrification projects in India – covering generation, transmission, distribution and use of electricity (Deo and Deshpande, 2010). The EA 2003 thus acting as a major binding law mandates the promotion of renewable energy based electrification projects. However, it is the Central Electricity Regulatory Commission (CERC) and the State Electricity Regulatory Commissions (SERCs), by virtue of their regulatory jurisdiction are and will remain the main drivers of India's efforts towards a low-carbon power sector (Deo and Deshpande, 2010).

Within this framework, the Centre defines a broader policy environment, whereas the states according to their renewable energy potential and extent of un-electrified areas work towards setting actual implementation targets of RE based Rural Electrification, which correspond with national targets. In this regard, for identifying Policy Imperatives for DRE based rural electrification models, the roles of the two major central ministries in promoting such models have been discussed in this section.

***Ministry of New and Renewable Energy (MNRE)***

In terms of remote rural electrification, the Ministry of New and Renewable Energy (MNRE) through its

Table 3: Year-wise Targets for Off-Grid RE application for the period 2011-17

| RE Applications/Years | Cumulative (likely by 31.3.11) | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | Total Target for 6 Years Period | Cumulative Total Target |
|---|---|---|---|---|---|---|---|---|---|
| Family Biogas Plants No. in Million | 4,5 | 0,15 | 0,15 | 0.2 | 0.2 | 0.2 | 0.2 | 1.1 | 5.6 |
| Remote Village Electrification – No. of Villages | 7500 | 500 | 0 | 0 | 0 | 0 | 0 | 500 | 8000 |
| Biomass Gasifiers – Rural No. of Villages | 150 | 100 | 120 | 130 | 140 | 160 | 200 | 850 | 1000 |
| Rural Electrification SPV No. of Village Covered | 30 | 30 | 40 | 40 | 50 | 50 | 60 | 270 | 300 |
| Decentralised SPV System-MWp | 132 | 68 | 100 | 150 | 200 | 200 | 250 | 968 | 1100 |
| Rural Solar Lights Nos In Millions | 0,2 | 0,6 | 1,2 | 1,2 | 1,2 | 1,3 | 1,3 | 6,8 | 7 |
| Micro-hydel Water Mills - Nos | 1550 | 200 | 250 | 300 | 350 | 400 | 450 | 1950 | 3500 |
| Solar Thermal-Water Heating etc – Million Sqm | 4,4 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 1,1 | 6,6 | 11 |
| Urban WTE Plants MWeq | 4 | 10 | 10 | 10 | 10 | 10 | 10 | 60 | 64 |
| Industrial WTE/Biopower-Weq | 330 | 50 | 60 | 70 | 80 | 90 | 100 | 450 | 780 |
| Industrial WTE/Biopower-MWeq | 330 | 50 | 60 | 70 | 80 | 90 | 100 | 450 | 780 |
| Improved Cookstoves Million Numbers | Data Not Available | 0,2 | 0,4 | 0,6 | 08, | 0,1 | 0,12 | 0,42 | 0.42 |

**Basis:**

| | |
|---|---|
| Biogas Plants: | Considering trend of yearly achievements so far and the increased levels of CFA from Current FY. |
| Remote Village Elect: | Considering likely availability of villages after exclusion from RGGVY. |
| Biomass Gasifiers Rural: | New initiative. |
| Rural Electrification through SPV: | As envisaged under National Solar Mission. |
| Decentralised SPV systems: | As envisaged under National Solar Mission. |
| Rural Solar Lights: | The MW equivalent power from such lights are already incorporated in the Decentralised SPV system targets. |
| Micro-hydel / Water Mills: | Considering trends of yearly achievement so far. |
| Solar Thermal for Water heating: | Considering total achievements of 2.5 min. during 11th plan till Oct 2010. |
| Urban WTE Plants: | Urban / Municipal Waste projects limitations due various factors. |
| Industrial WTE / Bio power in industry: | Covers biomethanation of liquid effluents; combustion / gasification of biomass and rice-husk (new initiative) |
| Improved Cookstoves: | Additional component not included in 11th plan document |

schemes like the Village Energy Security Programme (VESP) and the Remote Village Electrification (RVE) scheme has attempted to play a significant role. However, while the MNRE has been set up to promote RE based power, its main role has been in distributing up-front capital subsidies, and continues to keep to this position (Shakti Foundation, 2012). Even with subsidies, MNRE policy currently does not consider hybrids such as Solar-Biomass for subsidies. Moreover, the MNRE under its RVE programme states consumer tariff for DRE projects should be in line with the existing tariffs in the neighbouring villages and those electrified through the grid. There is presently no policy or regulatory mechanism to de-link the projects financial viability with the high consumer tariffs being levied on off-grid consumers to ensure adherence to such guidelines (Prayas, 2012a).

On the flipside with the advent of the 12th plan the MNRE has a growing interest in mini-grids with its potential being realized as a scalable option for electrification. Year wise targets for deployment of off-grid applications for 2011-17 have been formulated (Table 3). In its current plans the MNRE is targeting 3200 MW of installed off-grid renewable energy projects in the next five years, which would be a large leap in reference to the existing installed power of 500 MW.

The MNRE plans to promote concepts of small power plants at tail end of grid for both solar and biomass and developing financial support structures. There is also emphasis within their strategy for development of entrepreneurship for rural electrification through biomass wastes, rice husk, solar etc and enabling banks/ grant funds. This is coupled with the realization of the need for grid interaction of such models (which in the future means a link with the (MoP). An optimistic picture for DRE model developers emerges that can encash on this growing interest in mini-grids to accelerate such models.

***Ministry of Power (MoP)***

One of the flagship schemes of the Ministry of Power (MoP) has been the Decentralised Distributed Generation (DDG) scheme. The scheme in the past has not taken off despite the offering of 90 percent subsidy if the village is rural and notified as un-electrified. The ministry had even set aside Rs 900 crores for this scheme, as per the 12th Plan document. However, certain stringent requirements have acted as a barrier to uptake of this scheme by potential project developers such as the tariff of the Energy Service Company (ESCO) has to match grid tariff and assets to be returned to the government after 5 years.

Keeping these barriers in mind, in 2011 the DDG scheme was modified around the potential to feed in and draw from the grid but the scheme is yet to take off. These barriers need to be closely monitored to ensure that any gaps in the system can be addressed for DRE models.

***Evaluation of these Programmes:***

A detailed analysis of some of these programme indicate that they have not been able to achieve what they set out to and this is also evident from the table 4, which gives an overview of the cumulative achievement of each of these programmes, as on 31st December 2012.

These small mediocre achievements do not reflect the actual number of projects that continue currently since a number of sanctioned projected are no longer functional.

Table 4: Village Electrification achieved through Government of India schemes (as on 31 December 2012)

| Programme Objective (via scheme) | Cumulative Achievement up to 31.12.2012 | Implementing Ministry |
|---|---|---|
| **Village/Hamlets Provided with RE Systems** | 9009 numbers | MNRE |
| **Village Electrified under the RGGVY DDG Scheme** | 86 Projects with a cumulative expenditure of Rs. 12951.90 Lakhs[4] | MoP |
| **Bio-mass Gassifiers (rural)** | 15. 99 MW | MNRE |
| **Solar Photo Voltaic systems (> 1 kW)** | 81.01 MW | MNRE |
| **Water mills/micro hydel** | 2025 Numbers | MNRE |
| **Aero Generators/Hybrid Systems** | 1.45 MW | MNRE |

Source: MNRE/MoP

[4] Question Hour, Rajya Sabha, Reply by Minister for state for Power, India, http://164.100.24.167:8080/members/website/quest.asp?qref=172749

Table 5: Operational projects under VESP

| State | Total projects submitted | Total projects sanctioned by MNRE | Projects commissioned | Projects operational | % operational vs. commissioned | % operational vs. total operational |
|---|---|---|---|---|---|---|
| Chhattisgarh | 15 | 15 | 15 | 12 | 80 | 35 |
| Orissa | 12 | 12 | 9 | 9 | 100 | 26 |
| Maharashtra | 10 | 10 | 5 | 4 | 80 | 12 |
| Madhya Pradesh | 15 | 10 | 8 | 2 | 29 | 6 |
| West Bengal | 10 | 4 | 2 | 2 | 100 | 6 |
| Gujarat | 10 | 2 | 2 | 1 | 50 | 3 |
| Assam | 20 | 14 | 4 | 4 | 0 | 12 |
| Andhra Pradesh | 3 | 0 | 0 | 0 | 0 | 0 |
| Total | 95 | 67 | 45 | 34 | 76 | 100 |

Source: World Bank Report, 2011

For instance, under the VESP, a total of 95 project proposals were submitted for consideration, out of which, 67 projects were sanctioned, and 45 projects commissioned. As on July 2011, only 34 projects were functional with a few projects being temporarily out of commission due to technical issues (Table 5).

Similarly, under the Solar Photovoltaic programme, the Ministry of New and Renewable Energy claims that 81.01 MW of DRE systems were sanctioned, but only 70% of these projects are functional, with close to 30% of these no longer operational.

Further, in the last six years, 96,562 villages were newly electrified with over 1.75 Cr households being granted electricity access. However of the 96,562 villages, only 9009 villages were electrified through DDGs[5].

Back of envelope calculations indicate that of the 1.75 Cr households electrified in the last 6 years, just about 15,00,000 households[6] probably got access to electricity through renewable energy systems.

Hence, an overview of all these programmes clearly indicates the following:

- There has definitely been a lot of effort made to improve energy access in the country and the Government, with a number of programmes mandated to address the issue of "Universal Energy Access"
- However, none of these programmes have achieved what it set out to achieve. While village electrification programme through conventional and grid based system with fossil fuel sources being the key sources of energy seems to have a larger share of success as compared to "DDGs" or "DREs", it must be noted that the DDG and DRE programmes were not the key focus of any of the electrification programmes until 2005. Moreover most of the programmes that were designed, did not achieve what they set out to achieve due to poor and inadequate investments or business interest in them
- Further, DRE projects as designed in these programmes were more "stop-gap systems" until grid extension was made possible.

### 3.2 Policy incentives to increase Private Investment in DRE

The policy architecture in India pertaining to rural electrification and renewable energy has not been able to trigger confidence amongst service providers, technology suppliers and investors to venture beyond demonstration projects that have been supported with grant funding and/or soft lines of venture capital or credit. The Government of India has made efforts to explore the potentiality of these models to no avail. A major factor for this is the overemphasis of the Government on expanding the grid to remote locations (MNRE, 2011), despite evidence, which indicate that DRE options maybe cheaper than extending the grid to remote

[5] Prayas discussion paper on RGGVY, July 2011
[6] Computation based on the number of electrified villages and other programmes of the MNRE

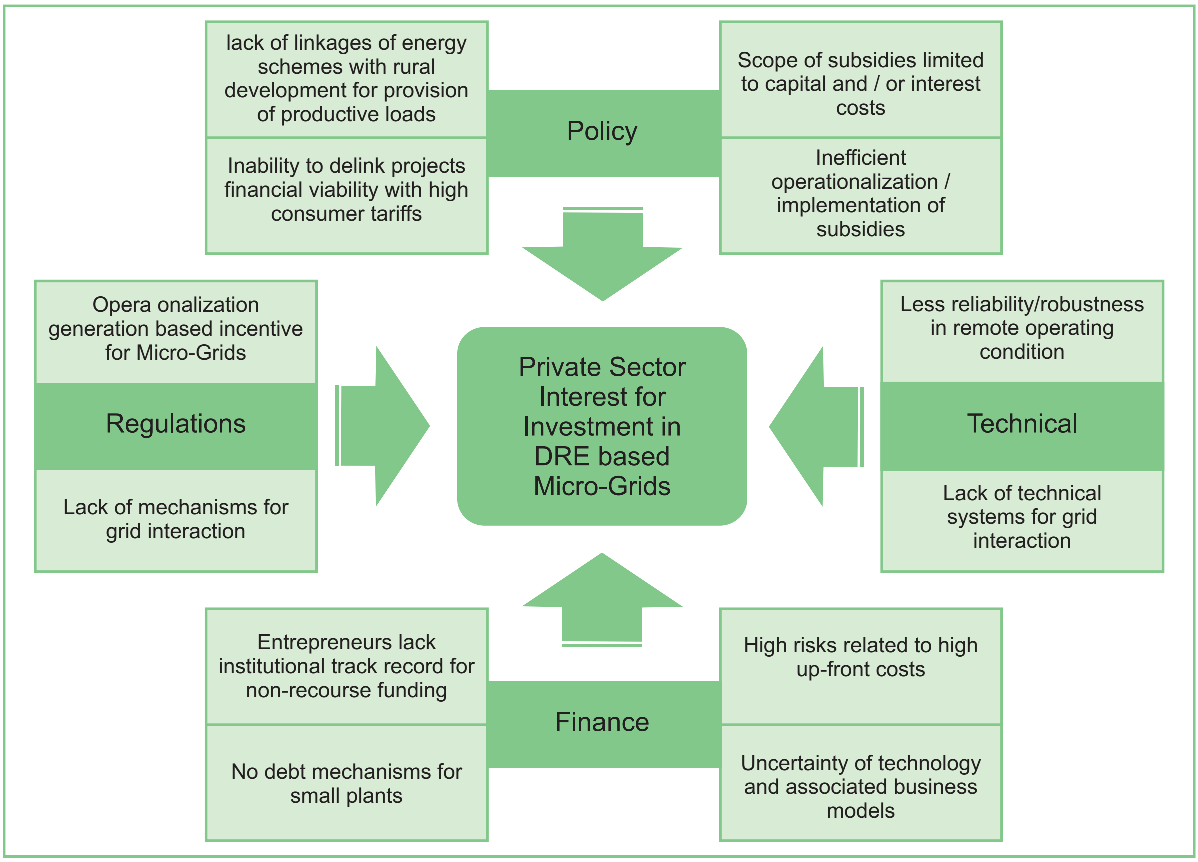
location. A comparison of various DRE options for electrification against the centralized grid electricity based on the distance of un-electrified areas from the nearest grid access indicates micro-hydro and biomass gasification to be the cheapest options for rural electrification in remote areas rather than extending grid. In a conventional grid electricity price increases by Rs1/kWh/km for grid extension. The factors that have been considered while comparison are grid extension cost, generation cost and transmission and distribution losses (Cust et al, 2007; Deshmukh, 2009)

Although India's National Electricity Policy (NEP) 2005, does make provision of standalone systems, these models have not taken off. The policy mandates the Central Government to formulate policy permitting standalone systems, including systems based on renewable and non-conventional energy for rural electrification where grid connectivity is neither feasible nor cost effective so that every household gets access to electricity. However these models have not taken off due certain inherent barriers to their penetration (Shakti Foundation, 2012;Prayas, 2012a,b):

- **High capital investment** and hence higher cost of electricity generation making it unviable in comparison to subsidized grid tariffs: The high specific costs (lakhs/kW) of small scale renewables and the much higher Operations & Maintenance (O&M) costs in remote locations, result in higher costs of generation and hence tariffs are quite high when compared to grid based tariffs, even with the availability of capital subsidies.
- The increasing **risk of off-grid system losing its viability** once the grid is extended to the village it is operating in: There is a perceived risk of developers that their projects may lie defunct once the centralized grid reaches their targeted villages.
- Lack of Availability of low cost financing options
- Low demand and loads in remote areas leading to low Plant Load Factors (PLF) / Capacity Utilisation Factors (CUFs)

Integrating DRE systems to the grid would address some of the issues arising from the aforementioned barriers but there are a number of roadblocks to the implementation of decentralised plants which come in the form of delivery of adequate subsidies and safeguarding the interests of private entrepreneur / developer who will undertake such stand alone projects (Figure 1). The current schemes do

Figure1 : Multidimensional Pressure Leading to Disinterest of Private Entrepreneurs in DRE based Micro-Grids



not create viability and sufficient returns to necessitate private sector interest. Even a programme as large as RGGVY designed to improve the distribution network, has not been able to provide reliable and sustainable electricity to rural population due to structural disincentive the distribution companies (DISCOM) face while supplying power to the rural poor which makes supplying electricity to the rural poor a losing proposition (Prayas, 2012a,b).

**Box 3: RGGVY**

The Rajiv Gandhi GrameenVidyutikaranYojana (RGGVY) is the major programme for rural electrification, which aims to electrify all villages through extension of the centralized grid by laying the distribution infrastructure and provide free connections to below poverty line (BPL) households.

There is a need for a multidimensional push: technical, financial, policy and regulatory to ensure successful grid integration of DRE systems to complement the conventional grid based electricity supply (Prayas, 2012a). There is growing realization that off-grid projects cannot be seen only as stand-alone entities, as with the grid arriving everywhere (as per the RGGVY). Businesses cannot put a stake on the fact that the grid may not arrive in their chosen area. Even if the grid provides only a small amount of productive use electricity in an area, the businesses need to work in conjunction with the grid to augment energy sources. Moreover, how well the grid does or does not work in a chosen area in the future is a largely unpredictable fact (Prayas, 2012a).

## 4. The SPEED Model

Building upon the concept of providing for commercial and household rural energy needs, the Rockefeller Foundation conceptualized Smart Power for Environmentally Sound Economic Development (SPEED). It contributes towards a positive impact on the lives of poor and vulnerable populations by providing clean energy to rural communities, thereby improving the quality of life and enhancing livelihood security. Given this goal, the attempt is to ***"establish the SPEED model as a widely replicable mechanism for local economic development through delivery of reliable, affordable and clean electricity and influence policy to create a more conducive environment for investment in sustainable rural electrification."***

Virtually every renewable energy based electrification programme initiated by either the Government or development agencies has been geared towards household electrification. There has been very little emphasis on supply to productive loads or the adoption of innovative models such as selling power based services (irrigation, battery charging etc.) to communities. Such projects are promoted within subsidy regimes or grant mechanisms and have a poor commitment to cost recovery or sustainability.

SPEED conceptualized DRE projects supply to productive loads as well as households through the initiation of private entrepreneurs – allowing the private entrepreneurs to provide reliable energy to rural population while being self-sustainable thereby promoting local socio-economic development. This contributes towards its long term goal of improving the quality of life and enhancing livelihood security by providing them access and control over clean energy solutions.

The SPEED Model envisages being a key driver behind local economic development, and views making an impact in the following ways:

- Access to reliable and affordable electricity will enhance income-generation, particularly amongst women's groups, from local micro-enterprises and increase agricultural output, particularly of "cash-crops" and horticultural produce.
- Village communities will benefit from high quality, clean household lighting resulting in extended study hours for children, enhanced access to information

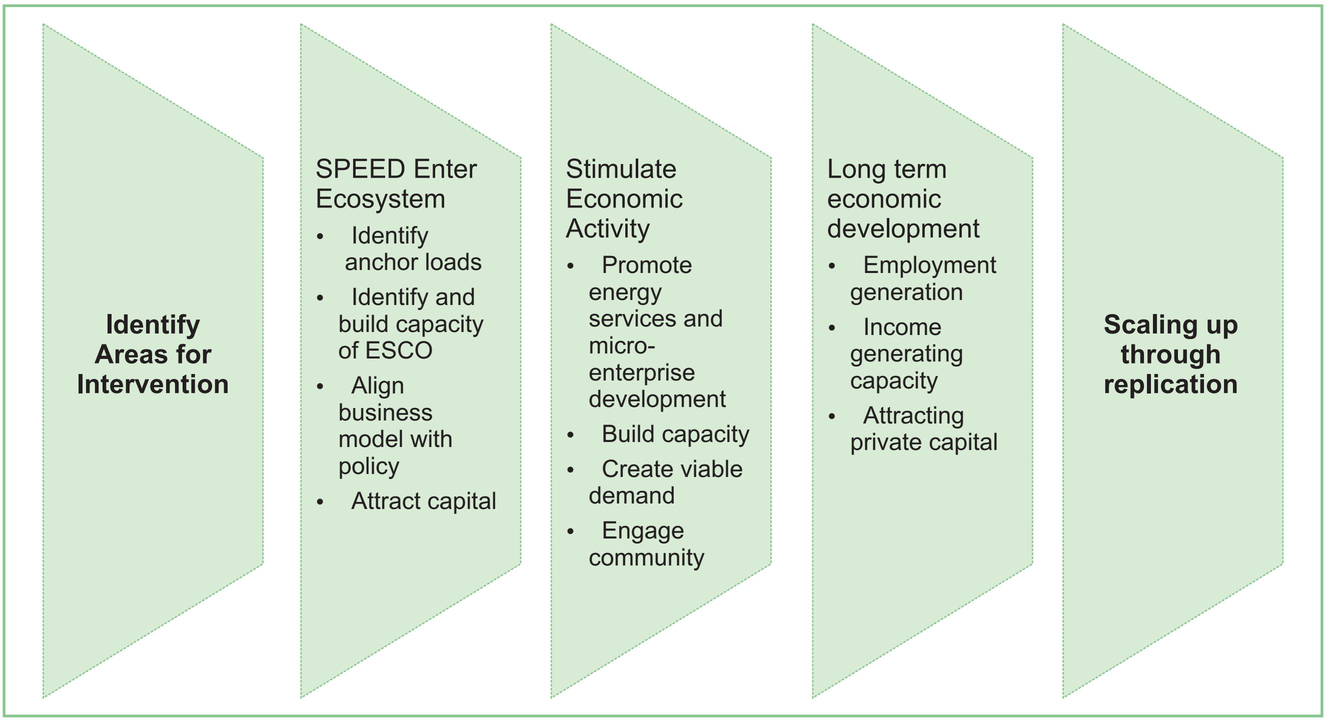
**Box 4: Types of contexts and scenarios for SPEED**

a. The **Private entrepreneur** entering a completely off-grid location where no electricity solutions have reached.

b. **Decentralized Distributed Generation (DDG) enhancement** refers to projects that will aim to augment the projects set up under the DDG scheme of the ministry of power (MoP)

c. **Distribution Franchisee (DF) enhancement** refers to projects under the Distribution Franchisee (DF) provision of the RGGVY, and will include tail-end generation projects. These projects will aim to augment current grid based supply to provide reliable and quality service to those villages / hamlets coming under the grid but are at the tail-end of the grid.

Figure 2: Visualization of SPEED driving local economic growth




and entertainment through electronic media and smoke reduction with consequent health benefits

- Adoption of drudgery reduction appliances such as flourmills, oil presses and farm equipment will reduce the workload on women, supporting greater gender equality.

Three SPEED prototypes have been envisaged which will be established in locations where projects will build upon the community mobilization and institution. The contexts are:

A. **Assured anchor load** (eg. poultry farm, Tussar production) existing along with decentralized enterprises owned by individual families working on diesel or other sources of energy that have the potential to be shifted to electricity based enterprises through diesel replacement measures.

B. **Existence of potential Anchor Load** that is small village with local enterprises and a market node or Peri/Semi- urban energy consumption enterprises (Eg. dhabas, grill factories) in the vicinity that are using DG set and would like to reduce their cost by shifting to electricity based systems. These are locations that also have telecom towers that can serve as an anchor load.

C. **Completely Off-Grid Remote locations** where some development initiatives have been undertaken (land and water work, irrigation etc) leading to the use of non-electricity based pump sets and other equipment. In these areas SPEED will initiate activities, which will lead to creation of new income generation activities possibly through the set-up of small enterprises. SPEED projects would also need to support a shift from existing diesel based equipment to electricity based. An anchor load will have to be figured out in these cases and could include mobile towers. Such locations have great potential to showcase socio-economic development through the demonstration of a SPEED model.

In a nutshell, SPEED models are geared around promotion of economic development, and thus catering to productive loads is an essential component of the same. While considerations to maintain equity (for instance with regard to pricing) are essential, SPEED models are primarily concerned with being economically viable to promote local development.

**Box 5: Targeted States and Areas for the SPEED Model**

The relatively backward Indian states of Bihar, Jharkhand, Orissa, West Bengal, Chattisgarh, Madhya Pradesh and Uttar Pradesh are the targeted geographies from the SPEED perspective. Other than very remote hill or coastal locations, it is these states that still have the largest number of un-electrified villages (approximately 10,500) and suffer from extremely poor last-mile supply to villages where the grid has been extended.

## 5. Contextualizing Policy and Regulatory Blocks

This section contextualizes policy and regulatory blocks pertaining to functioning of DRE based rural electrification projects. These identified gaps / blocks / processes have been organized under the following heads: *Streamlining Processes, Policy Enhancement and Regulatory Change*.

### 5.1 Streamlining Processes

Issues and gaps have been discussed which can ease the implementation of DRE / off-grid projects through engagement with Ministries and Agencies.

#### 5.1.1 For Establishing linkages and Engagement with relevant agencies Ministries for extension of SPEED Archetypes

The emerging interest in micro/ mini-grids and the evolving policy architecture with regard to renewable energy systems, possibilities can also emerge for DRE based rural electrification models as those promoted under SPEED. In order to tap into and to explore these opportunities, the formation of linkages and increasing awareness regarding these models and their advantages need to be made visible through engagement with various states and central level officials. The need for establishing linkages and engaging with Ministries, State Nodal Agencies (SNAs) and financing institutions arises from certain inherent issues within the policy architecture:

***Administration of Subsidies***

Subsidies exist but their implementation and operationalisation remain an issue due to inherent problems with the subsidy (See Box 6) or due to access to them through the implementing agencies[7]. This has been seen under the DDG scheme, which provides for a 90 percent subsidisation of the capital cost, and yet unable to attract developers. The low-level of importance given to decentralised / off-grid projects under the subsidy regime acts as another barrier for creating private entrepreneur interest.[8] At a structured dialogue organised by Prayas Energy Group in April 2012, it was discussed that a common concern for all developers was getting subsidies and incentives released in a time bound and procedurally simple manner. The situation is further complicated by the fact, that while most policies claim a focus on access to energy, the situation in reality with regard to administration of subsidies is quite different.

**Box 6: Issues in the Subsidy Regime - Case of the National Solar Mission**

The mission targets 200 MW of off-grid solar PV installed capacity by 2013 and 2,000 MW by 2022. Given the lack of electrification and access to clean energy sources in Indian villages coupled with T&D losses, decentralized distributed systems make very good sense. Therefore, the targets set for off-grid capacity could be bolder. A capital subsidy of 150 per Wp is available for rural micro-grids as against 90 per Wp for other applications. The problem associated with the current capital subsidy is that the projects might not be self-sustainable and there is no incentive to continue operation of the micro-grid plant once it is set up. Even if all the 200 MW was allocated to rural micro-grids, the total subsidy would amount to only Rs. 30 billion (this outlay is expected from tax revenues). Even if the capacity is increased substantially (set aside for utility-scale PV), the total subsidy would work out to be still considerably less than the incentive offered for the utility scale.

Source: CStep

Lastly, the purview of the subsidies is another limiting factor as they cover the capital costs but not the costs of generation and distribution. This is complicated by the fact that State government budgets are already supporting loss-making utilities (CSTEP, 2011).

***Definition of electrified and un-electrified villages***

Under the Rural Electricity Policy (REP) 2006, a village will be deemed electrified if basic infrastructure is established, electricity is provided to public spaces and at least 10 percent of the total number of households are electrified. This is regardless of the fact whether the electricity is available to that village and the village electrification infrastructure is operational throughout the year (Iyer et al, 2010). This acts as a barrier to setting up projects as it limits the scope of setting up DRE plants and the access to relevant subsidies / government support for such plants. In recognition of this problem, MNRE under its revised draft of the RVE programme (August 2012) has indicated that subsidies can be provided for the electrification of villages that get less

[7] As discussed earlier – the DDG scheme has not taken off. These issues have been looked at under the section on DDG scheme

[8] To ease the operationalization and disbursement of subsidies, the draft NSM-2 Guidelines talk of online disbursement of subisidies MNRE (in the past) and MOP subsidies for de-centralized renewable projects only apply to rural notified (as un-electrified) areas.

than 6 hours of electricity a day. The problem with this is that it contradicts the provisions under the Electricity Act 2003 (EA 2003), which states that off-grid solutions based on stand-alone systems may be developed where grid connectivity is neither feasible nor cost effective, so that every household gets access to electricity. This leads to the next point in case regarding competing and contradicting roles of different ministries, acts and schemes.

***Competing roles of different Ministries and Agencies***

Building upon the contradiction between the new provisions under the MNRE's Rural Village Electrification (RVE) programme and the National Electricity Policy (NEP) 2005, there are issues with lack of inter and intra agency coordination in case of government agencies and ministries (Iyer et al, 2010) which directly affects the administration of subsidies while causing a duplication of efforts and resources (Iyer et al, 2010). A framework or action plan that includes both long term and short term strategies is critical for all round development of RE (Garg et al, 2010).

***Lack of Data and Information***

To understand the feasibility and viability for a DRE site, projects developers need the State government to publish up-to-date plans, which include comparative cost of line extensions for a particular area. The fact is that a number of government agencies collect data at the rural level that focus on different aspects of energy, including resource availability, supply potential and to a limited extent demand assessment, but this data is neither shared not collated into a single database for an informed decision making system either by the government or by the private sector (Iyer et al, 2010), leading to lack of information and data, for rural energy entrepreneurs looking to enter the DRE market. Even the un-electrified areas are not clearly communicated even though the government mandates that every state has to prepare a Rural Electrification Plan (REP) to achieve the goal of providing access to all households, mapping the electrification delivery mechanisms (grid or standalone) considering available technologies, environmental norms, availability of fuel, number of un-electrified households and distance of village from existing grid. The policy indicates that every state and district should have a plan ready which showcases where grid supply is going to reach. Information availability to potential investors, financing institutions as well as local agencies on technology, prices, and their effectiveness is low. This severely affects the implementation of such projects at the community level (Garg et al, 2010).

**Box 7: Anchor / Productive Load**

An anchor / productive load is an economically efficient system which has a demand for power to which the local power plant can address along with providing electricity to the local households. This makes the local system economically viable as providing electricity only to households would make the system a loss making entity, as the loads would be insufficient.

Examples: Telecom towers, cold storage chains, irrigation, micro enterprises etc.

### 5.1.2 Linkages with other Ministries for promotion of Anchor/Productive Loads

DRE based rural electrification models, as mentioned, offer opportunities for economic development through provision of power. The idea is then not to simply provide electricity on a grant / philanthropic basis but to create self-sustainable systems which are economically viable and promote the advent or the thriving of local economic

**Box 8: Technical Issues in competing in locations that could be Grid connected**

Looking at potential areas for decentralized renewable energy supply, certain studies have indicated that the estimated values of the Levelized Unit Cost of Electricity (LUCE) from the decentralized electricity generation options under Indian conditions is found to vary in the range of Rs. 4.56/KWh to Rs. 47.14 / KWh depending on the technology, the resource availability and other operating factors. The values of LUCE are found to be more or less independent of the distance by which the distribution network has to be extended from the existing point of electricity distribution network in the case of decentralized electricity supply options. On the other hand, in the case of grid extension options, the values of LUCE have direct dependence on the distance by which electricity distribution network is to be extended. Therefore, the decentralized option cannot compete in villages that require grid extension (in terms of delivered cost of electricity).

Source: Nouni et al, 2009

activities. In order to do this as well as for the power system in itself to be a sustainable model, there is need for anchor / productive loads in the locations being targeted (See Box 7). While some of these locations may have active loads, which have power requirements, there are locations, which do not have such loads or sufficient loads for the viability of a DRE model such as the ones proposed under SPEED to be set up.

The NEP 2005 indicates need for development of infrastructure which would also cater to requirement of agriculture and other economic activities including irrigation pump sets, small and medium industries, khadi and village industries, cold chain and social services like health and education. Thus the addressal of dual needs of local economic development and provision of sufficient loads for the power plant necessitates establishment of linkages with Ministry of Small and Medium Enterprises (MSME) and MoRD and their schemes to set up systems which need power and then which in turn promote local socio-economic development.

**5.1.3 Need for Modern Infrastructure and Mechanisms for Grid Connectivity**

Improvements in grid technology are in the first instance necessitated through initiatives for energy efficiency. Even at present there is approximately 40 percent loss of power in transmission and distribution (Deo&Despande, 2010). The total losses of Distribution Companies (DISCOMs) comprise both technical losses and commercial losses. The technical losses are associated with thermal energy loss and commercial losses include all other components of financial losses broadly comprising electricity thefts and metering errors (Deo and Deshpande, 2010). There is in fact lack of a strong commitment from utilities to reduce Transmission & Distribution (T&D) losses and implement energy efficiency which is a necessity in conjunction with RE. This has bearings on the application of Renewable Energy Certificate (REC) mechanisms for off-grid plants.

Modern Infrastructure would address the need for energy efficiency, and allow for grid interaction, which is dictated through prevailing sentiments that the grid will sooner or later arrive in majority of locations. Any plants set up to augment the grid supply such as tail-end systems, would need updated infrastructure for grid connectivity (See Box 8). At present no business system would take the risk of setting up a stand-alone system due to the immense threat of it becoming unviable (See Box 9). The Electricity Act 2003 recognizes this fact and indicates need for grid connectivity protocol for evacuation and purchase of electricity generated from renewable decentralized sources to prevent them from becoming redundant and idle once the grid reaches a village (EA 2003, Section 61

**Box 9: The Risk of Grid Expansion: Case of Sagar**

Eight years ago, Sagar Island, part of the Sundarbans ecosystem in the Bay of Bengal was a shining example of India's efforts to power remote, impoverished areas with solar energy. Between 2000 and 2004, a range of solar power systems - including household photovoltaic panels, home and street lighting, and mini grids - were installed on Sagar with large state subsidies. The government also helped cover generation and distribution expenses, at a cost of around $2.5 million. A year ago, solar and wind-diesel hybrid generation facilities were generating close to 1 megawatt (mW) of electricity, distributed through mini grids to some 2,000 households. Yet, despite the early success of renewable energy on the island, the government decided in 2009 to connect the island with the main power grid.

Sagar has been hooked up with the grid under the Rajiv Gandhi GraminVidyutikaranYojna (RGGVY). Initially, Sagar had been excluded from the national RGGVY scheme due to technical unfeasibility – a decision that has been reversed for business and political reasons.

With grid connectivity, the isalnders get cheaper electricity and many have stooped using solar energy. The state as well is no longer paying to maintain the solar facilities. As a result, solar capacity is gradually declining and the state of the generation equipment is deteriorating.

These decisions were taken despite the prevailing opinion that the capital cost, transmission loss and generation expenses (incurred) in extending the main grid will be far greater, which the government will eventually need to pay as subsidies. Instead, far less subsidy would have been required to spread solar connectivity and generation, an option, which is far more environmentally friendly

Source: Ghosh, A (2012) India's grid expansion erodes island's solar scheme. AlertNet.Available at: http://www.trust.org/alertnet/news/indias-grid-expansion-erodes-island-solar-scheme/

(h)). However, although the states are required to provide for evacuation of power from RE projects, in practice it is the RE developer who has to provide for such infrastructure thus affecting the project costs (Garg et al, 2010).

Modern infrastructure is also required to aid in updation of anti-islanding regulations. At present, the anti islanding mechanisms do not allow for creating power islands when also evacuating to the grid in the event of grid failure. Modern infrastructure can allow for this without violation of any safety norms (Lasseter, 2011; Fang et al, 2011). The absorption of renewable energy based in-firm generation in the grid can be also increased by inducting Smart Grid technology, which is a platform for integrating renewable energy generation (such as solar and wind), smart meters, demand response and many more technologies into the DISCOMs system (Deo&Deshpande, 2010).

### 5.2 Policy Enhancement

This section addresses aspects of current policies that need to be changed or modified for the successful implementation of DRE projects from the SPEED perspective.

#### 5.2.1 Fiscal measures to encourage investment in Small off-grid RE plants

Access to credit facilities is crucial for facilitating access to clean energy technologies, especially for relatively capital-intensive DRE systems. The high upfront cost of DRE technology options make them beyond reach of common rural consumers unless backed by some support and access to financing (Iyer et al, 2010). The high up-front costs classifies the sector as a high-risk one causing lack of availability of viable financing options for off-grid DRE projects, despite them being promoted under the government schemes (Prayas, 2012b). The existing fiscal measures as well as financing mechanisms do not encourage small-scale entrepreneurs to set up such plants. In fact, no robust financing mechanism exists for supporting off-grid Renewable Energy projects (NRDC 2012), which take care of start-up capital as well as aid in overcoming the costs in the initial years of functioning (CSTEP, 2011). For instance, currently IREDA has very limited provisions for support of Biomass and in cases where such support is provided the same is limited to either capital subsidy or interest subsidy.

**Box 10: Current Financial Sector Involvement**

There are no debt mechanisms for a 32 KW to a 50 KW plant (the typical size of a SPEED archetype project)

Majority of Equity investors seek a profitable track record of Rs. 300,000 + revenue

Lack of interest in small investments due to:

- Uncertainty of technology and associated business models
- Lack of exit options
- Due diligence costs

Owing to the consumptive nature of energy, cumbersome procedures involved in accessing formal credit and the reluctance of formal banking system to provide credit act as barriers to setting up the system to meet rural energy needs (Iyer et al, 2010). Technology obsolescence acts as a huge barrier for financier interest, along with the enormous paper work and costs associated with identifying and obtaining access to finance for small and medium scale RE projects relative to their financing needs (See Box 11); limited understanding of RE in financial institutions; lack of familiarity and awareness of technologies, particularly for those that have recently achieved commercialization. Further, especially in the context of DRE mini-grids projects, the RE project developers would be small, independent and newly established, lacking institutional track record and financial strength to secure non-recourse project funding (Garg et al, 2010).

#### 5.2.2 Priority Sector Status to Small DRE projects to encourage financial assistance

The previous point establishes the need for formal fiscal measures to encourage investment for DRE systems. Linked to this is recognizing the importance / role the sector can play in modifying the rural electrification scene and meeting rural energy needs.

At present, off-grid projects in the eyes of the government as well as financing institutions lack in significance. The need for establishing its significance stems from the very nature of Renewable Energy systems (renewable sources are varied and depend on geography) and their capacity (plants are smaller in size) is distributed. For financing such projects, a major step would be towards having dedicated credit facilities especially for DRE projects, by including RE sector under priority sectors for lending. Currently, priority sectors include agriculture, small-scale industries and other activities/borrowers. This step would aid in increasing availability of credit to this sector and lead to larger participation by commercial banks (Garg et al, 2010), encouraging investments from small and medium scale entrepreneurs. A beginning in this direction has been made in the recent RBI notification wherein off-grid renewable energy projects for households being promoted by individuals have been considered.

**5.2.3 Coexistence of islanding and anti-islanding mechanisms**

All western standards encourage islanding but in India currently standards don't even exist for connecting back to the grid, making the discussion around coexistence of islanding and anti-islanding redundant. Engagement with the Central Electricity Authority (CEA) maybe essential to push these standards through but in this regard there are a lot of sub-factors, which are more essential to address before these standards can be put in place (Prayas, 2012b).

**5.3 Regulatory Change**

The regulatory regime doesn't include for smooth functioning of off-grid plants. While certain changes are being attempted through the Forum of Regulators (FoR), there are modifications in other areas and processes that would allow for off-grid plants and SPEED projects to run smoothly.

**5.3.1 Improvement of the Current REC mechanism**

The Government of India to encourage use of renewable sources of energy considers it desirable that the purchase of energy from non-conventional sources takes place more or less in the same proportion in different states. To achieve this objective in the current scenario of large availability of such resources only in certain parts of the country, appropriate mechanisms

such as Renewable Energy Certificates (REC) are being evolved.[9] In this regard, the amendment to the tariff policy in 2011 (section 6.4) states that the purchase of energy from non-conventional energy sources to be in the same proportion across the states, which can be achieved through REC mechanisms.

The current Renewal Purchase Obligation (RPO) regime, however, covers only grid-based plants. There is a need for these regulations to be evolved and amended to accommodate off-grid renewable energy generation into the existing REC mechanism to support such projects. This is keeping in mind the number of off-grid RE plants that already exists across the country (ABPS, 2012). The need for REC mechanisms for off-grid projects is embodied in the need to increase viability and attractiveness of investment in the sector. It is believed that new project developers will chose the less certain and more risky REC route only if higher returns are ensured. It is increasingly believed that performance based revenue incentives would be more effective than capital subsidies to improve investment in the sector. Additionally the incentives should not be based on fiscal

**Box 11: Investment Needs of Energy Service Companies**

- There exists a funding gap in the project cost of approximately 45 to 60 percent after accounting for available subsidies and ESCOs contribution
- Need for almost a 15 percent (of the project cost) bridge financing through government subsidies. This varies according to the technology as per the MNRE guidelines
- Equity funds at about 30 percent of project cost as contribution from the ESCO. This helps to maintain the ESCOs business interest.
- In terms of Debt about 55 percent of the project cost would need to be met through loans (after accounting for subsidy and equity). Currently for the SPEED archetypes, the ESCOs can absorb a 9 to 10 percent interest rate, however the commercial rates are at about 15 to 16 percent.

[9] Under the REC mechanism, the renewable energy based generation companies can sell the electricity to local distribution licenses at the rates for conventional power and can recover the balance cost by selling certificates to other distribution companies and obligated entities enabling the latter to meet their renewable power purchase obligations (RPOs).

disbursements but rather it is better to leverage the DISCOMs ARR and internalize DRE costs (Prayas, 2012). Revenue incentives provide the developer a long-term interest in sustaining the project.

There is however a counter-argument against applying REC mechanisms for off-grid plants comes in the form of excessive and time consuming monitoring which will be required due to current grid infrastructure (CSTEP, 2011; Kaundinya, 2009). Under the prevailing mechanism it is the responsibility of the State Load Despatch Centre (SLDC) to provide energy injection report to the Central Agency (nodal agency for issuance of REC's). REC's are issued on the basis of this report. It is felt that the off-grid generating facility maybe located at a remote place and the distribution licensee would face major costs to certify the energy generation on regular intervals. In order to overcome this, standard procedures and protocols need to be put in place as part of the REC mechanism. Information about metered data should be easily accessible through modern technology regarding the use of remote metering and suitable communication links (Iyer et al, 2010). Moreover, in the current RPO system, there is a lack of rational and transparent approach to set RPO's based on consumer tariff impact (Singh, 2010), which further necessitates the use of modern systems in defining the RPO and REC regime.

#### 5.3.2 Removal of dual-tariffs

A techno-economic analysis conducted by ABPS (2012) in conjunction with the Shakti Foundation brought out the high cost of generation and indicated the need for covering incremental costs if consumer tariffs are to be kept equitable as demanded by the policies. A major risk with the set up of the DRE plants is the risk to their functioning and viability if and when the grid reaches the locations targeted by these projects. Grid supply tariffs are lower and subsidized when compared to tariffs charged by the DRE plants. The lower tariffs are the results of cross-subsidizing effect that the higher tariff paid by high-tension (HT) consumers have on the overall revenue of the distribution companies. The remote areas electrified by DRE plants typically do not have any subsidizing consumers, thus resulting in higher tariffs for domestic consumers (Iyer et al, 2010; ABPS, 2012).

The EA 2003 has provisions, which provide for mutually agreed tariffs. However, tariffs of grid-connected consumers are decided by the respective regulatory authority and are lower than the average cost of supply for the area in case of domestic and agricultural consumers. The rural populace will not pay more than what they are paying to the government by way of grid-connected tariffs. The complication lies within the fact that the state utilities are actually loss making but cannot charge more, and independent DRE plants cannot be viable at the grid-based supply costs (CSTEP, 2011; Iyer et al, 2010) leading to a paradoxical situation.

In order to alleviate or work towards addressing this paradox, the Forum of Regulators (FoR) has proposed no dual tariffs. They propose building in the costs of distribution and production into the tariff billing system, that is, if the electricity is produced at INR 7 and is sold at INR 5, then INR 2 should be borne by the utility (FoR, 2012).

#### 5.3.3 Feed in Tariffs (FiTs)

A Renewable Energy Policy like the Feed-in Tariff (FIT) is the best political mechanism to provide investment security and spread decentralized production of renewable energy (World Future Council, 2009). Feed-in Tariffs are intended to increase the adoption of renewable energy technologies, encourage development of RE industry, and provide significant economic development benefits.

Historically promotion of renewable energy technologies (RET) in isolated areas has involved international donors

**Box 12: Feed-in Tariffs**

Feed-in-tariffs (FITs) are policy instruments that attract investments in renewable energy by setting a long-term guaranteed purchase agreement for green power producers to sell their electricity into the grid (Klein 2008; Mendonca et al. 2009) They are designed to accelerate investment in renewable energy technologies. FIT policies aim at driving down the cost of renewable energies by fostering learning and accelerating the diffusion of green technologies. Under FIT mechanisms, governments purchase green energy at tariffs that are set above market price. The success or failure of FIT policies, in turn, critically depends on how these tariffs are determined and adjusted over time (Alazamir, 2012).

Experience from Europe suggests that a well-designed feed-in tariff can generate rapid growth for targeted RE technologies by creating conditions that attract capital to those particular sectors. By using a variety of design variables to incentivize production in different areas as well as projects of different sizes, FIT policies can help encourage a variety of RE technology types and different-sized RE projects (Cory et al, 2009).

or government subsidising the initial capacity investment. Financing schemes centered around FiT can provide a cost-effective scheme and achieve different purposes of provides sustainable and affordable electricity to local users from remote areas in developing countries and to make renewable energy projects attractive to policy-makers. Although capital costs of renewable energy projects are much higher than a conventional genset, FiTs help to offset the large capital costs associated with RET.

India at present has attempted to provide for FiT rates for grid-connected projects but no mechanism exists for off-grid projects. Moreover, due to the information asymmetry in the Indian situation (as mentioned earlier) makes it difficult to determine the most justifiable rate, which would be further alleviated in the context of off-grid models.

Moreover, the rates need to be high enough to encourage investments and low enough to avoid over subsidizing.

However, the success of financing through FiTs to encourage investment in off-grid projects has been seen especially in the European context, and thus is has the potential of being a viable option for increasing investment opportunities in India as well.

## 6. Recommendations for Promotion of DRE Micro-grids in India

Considering the needs for the promotion of DRE based micro-grids in India, a number of options and recommendations emerge. The Forum of Regulators (FoR) in this respect approved the off-grid distributed generation based distribution franchisee (ODGBDF) model (Box 13). While these models will need to be

### Box 13: Off-Grid Distributed Generation Based Distribution Franchisee (ODGBDF)

The ODGBDF model approved by the FoR is significant due to its structuring – which deals with the viability gap of off-grid projects while taking into consideration grid interaction.

Distributed renewable energy is more expensive (INR 15-20/unit) than the grid, but the policy technically requires developers to sell at grid tariff rates of INR 3-4/unit. While the policy is not enforced there is a risk for developers /businesses that the government can enforce it at anytime and/or the grid arrives at the project locations. The ODGBDF model provides a solution to this problem.

The model is based on two agreements:

a. Franchisee Agreement: wherein the ESCO agrees to be a franchisee of the DISCOM (or the utility)
b. Power Purchase Agreement (PPA): wherein the DISCOM/utility agrees to 'buy' electricity from the ESCO at full price to generate (say INR 20/unit). The DISCOM is not actually taking the electricity but is paying the ESCO the amount for as many units as it generates. The ESCO then distributes this to the community members and charges INR 5/unit. This results in a win-win situation for both parties as:
    - The ESCO generates INR 20/unit enough for a good IRR, promoting scale
    - The DISCOM/ utility provides electricity at INR 5/unit to the community fulfilling its legal mandate to serve the communities
    - The DISCOM and ESCO read the community meters together to agree that the ESCO gets paid for the amount it sells (set up as generation based incentive)

The model is mainly dependent upon the FIT provided by DISCOM and the CFA provided by GoI to DISCOM. The project developer shall form a franchisee agreement with DISCOM. The project developer shall provide electricity to consumer and receive tariff. DISCOM will provide FiT to project developer and receive CFA from GoI. The guidelines for the model are much more detailed than any in the past and they stipulate that the state regulators will set particular FiT for each state based on state conditions and technology. In case the grid arrives, the model proposes two scenarios that create last mile strengthening, the significance of which will grow with increasing rural demand. These are:

a. The DISCOM/utility can cancel the franchisee arrangement and buy the micro-grid from the ESCO. The ESCO is not part of the utility but the entrepreneur still generates and now instead of distributing – just sells everything he generates directly to the DISCOM/utility, which is fed into the grid.
b. The ESCO continues to manage the mini-grid and the DISCOM provides the ESCO with a service fee – the ESCO then distributes and can feed into the grid

closely watched, there are a number of other factors that need to be taken into consideration in attempting to promote the sector.

Besides looking at these new business models, there is also a need for action with respect to the dimensions of – regulation, policy, finance and technical systems (Table 6)

While the table below sets the tone for what needs to be done in different areas, it is imperative to study and galvanise action around particular Policy ASKS to promote the sector. These are described below:

1. **Risk Capital:** There is a need to look into the possibility of complete funding for risk capital to protect the interests of the ESCO's.

2. **Continuity of operations:** Current DRE micro-grids face a threat to their operations once the grid arrives in their area. Under the current subsidy regime, ESCOs should have exclusivity in a geography, which can be set up as an incentive on first cum first serve basis. If the ESCO gets exclusivity for 8 - 9 years it aids in alleviating some risks from the minds of the developers.

3. **Project Insurance:** There is a need to give the developer insurance for project development to protect his interests. The MNRE / other ministries can creat an insurance scheme around operational disruption to safeguard interests for the ESCO as well as the financers.

4. **Partial risk guarantee fund:** Having a partial risk guarantee fund would aid in initiating greater financial sector participation, by acting as a risk mitigation option. The fund would act as a buffer in case one of the stakeholders defaults on payments

5. **Sustainable development Mandate under the 12th five year plan:** This mandate has 14 sub-items, in which one is on RE but the policy does not cover off-grid at the moment. There is opportunity here to promote off-grid models

6. **Licensing:** Currently, developers are uncomfortable with licensing regulations especially in the face of

Table 6: Multidimensional Push to Promote DRE based Micro-Grids in India

| | |
|---|---|
| Regulation | Improvement of REC mechanism (inclusion of DRE projects) |
| | Removal of dual tariffs |
| | Coexistence of islanding and anti-islanding mechanisms |
| Policy Enhancement | Better Implementation of Schemes (Single Window Clearance) |
| | Linkages with Ministry of Small and Medium Industries (MSME) and Agri Schemes for Promotion of Anchor Loads |
| Financial Aid / Instruments for DRE systems | Access to Credit Facilities |
| | Priority Sector Status |
| | Bridge Financing through Subsidies (15 percent) |
| | Equity Funds at 30 percent of Project costs |
| | Reduction of interest rate on loans |
| | Promotion of Generation based Incentives |
| Tech nical Systems | Technical systems for grid interaction |
| | Promotion of Energy efficiency |
| | SMART Grid |

lack of data on state rural electrification plans. There is a need for greater clarity on licensing regime to build developer confidence.

Table 7 collates the factors and aforementioned Policy ASKs and prioritises action on the basis of ease of implementation. It forms an indicative base for initiating work, which will lead to promotion of DRE based Micro-grids in India. The aim is to increase the participation of Energy Service Companies (ESCOs) in the area and to protect ESCO interests.

There is a conclusive need to accelerate private sector participation in the sector, which is mostly through better financing mechanisms and allowing for technical systems for grid interaction to alleviate the risk of the plant becoming dysfunctional once the grid arrives at a location. The steps taken for acceleration need to be coupled with steps to de-stress the current policy and regulatory environment. Currently, Energy Service Companies (ESCOs) are vary of making investments for DRE based Micro-Grids, as the policies while on paper wants to encourage such systems, but their operationalization and provisions make it a high risk and a cumbersome initiative. New business models must be set up, and the policy and regulatory scenario around them should be made conducive for the replication and scale-up of DRE based micro-grids. The potential of

these models is slowly being realised, but the changing policy environment must be tracked relentlessly to steer it in the favour of such models.

Table 7: Policy and Regulatory ASKS for Enhancing ESCOs Participation and Protecting ESCO Interests

| | Ease of Implementation | | |
|---|---|---|---|
| | **Moderately Challenging** | **Challenging** | **Very Challenging** |
| Accelerate | • Bridge Financing | • Linkages with MSME, Agri Schemes and other Rural Development<br>• Tapping into the Sustainable Development Mandate of GoI<br>• Implementation of Technical Systems for Grid Interaction<br>• Coexistence of islanding and anti islanding mechanisms<br>• Promotion of GBIs for off-grid / Micro grids | • REC Mechanism for Off-Grid / Micro Grids<br>• Feed in Tariffs |
| De-Stress | • Removal of Dual Tariff<br>• Efficiency in State Rural Electrificatio n Plans | • Better Implementation of schemes and subsidies<br>• Exclusivity in a Geography<br>• Partial Risk Guarantee Funds for Banks | • Reduction of Interest Rate on Loans<br>• Project Insurance<br>• Priority Sector States for Lending |

## 7. Conclusion

While there has been substantial efforts made by Governments to ensure energy access, very clearly the current energy policy and direction have not resulted in ensuring energy access for all. One might argue that the very definition of an electrified village is flawed, leading to ineffectual implementation, it is very clear, that it is not just the definition of an electrified village which is flawed but the main problem is the "trickle down effect" prescription of policy framework which leads to flawed definition.

In other words, setting up massive electricity generation capacities with grid and conventional system has so far led to only trickle down effect, with surplus electricity generated if any making its way to rural communities and when there is an increase in demand for electricity in urban centres, promptly rural energy supply gets affected.

Unless, there is a dedicated energy supply stream for rural communities, which can co-exist with conventional grid systems, will the situation of energy access situation be addressed holistically. This will also ensure that there is equity in energy supply, with the quality and quantity of energy supply to rural areas compete with those currently available to urban consumers.

Therefore, there is a urgent need for the government to undertake an urgent paradigm shift in emphasis from only "Centralised Grid Based Conventional Energy Systems" to one where "Decentralise Systems and particularly Mini-grid" have not only a role to play, but a major role to play as and where most appropriate and required.

There are also inherent benefits of mini-grid systems, which goes beyond the important factor of 24 x 7 energy access, but these systems also help in electricity loss reduction, ensures increased efficiencies in generation and distribution, reduce infrastructure costs and importantly ensures holistic development of communities and have the propensity to contribute immensely to livelihood creation, enhancement and market access to agricultural produce.

There are a few good examples of successful decentralised energy projects, though, they currently seem to exist more as demonstration projects. Very clearly, we need to make a fast shift from having mere demonstration projects to having actual projects on the ground.

There is an urgent need to have business models which can encourage private sector investments, promote community entrepreneurship and importantly, encourage and involve community participation in infrastructure projects, thereby creating a sense of ownership and thereby assuring long term sustainability of these projects.

It is also absolutely necessary to break the myth that DRE is an expensive option as compared to conventional electricity. It is clearly not the case, and is perceived so only because of faulty pricing and tariff mechanism, cross-subsidisation, and utilities bearing the losses incurred due to this anomaly. The rising prices of coal and increase in dependence on imported coal has also resulted in a increase in price of generation of electricity from coal, while the falling prices of solar, has actually resulted in grid parity of costs being achieved earlier than what was perceived. For example, the current cost of electricity generation from coal is estimated to be Rs. 5.50 per kWh, while the most recent bid for electricity generation from solar was at Rs. 6.50 per kWh.

The other clear advantages for DRE include, low gestation period, smaller land holdings and importantly opportunities for community involvement. These projects also do not cause large scale displacement of communities and destruction of flora and fauns as is the case with many of the current large electricity generation projects.

However, as has been pointed out in the preceding sections of this report, there needs to be substantial changes in policy framework to ensure penetration of DRE, but these are definitely feasible both technically and economically and can be done in a very short period of time, given political will.

## Bibliography


- ABPS Infrastructure Advisory Private Limited (2011) Report on Policy and Regulatory Interventions for Community Off-Grid Projects. Shakti: Sustainable Energy Foundation
- Alazimir, S., Vericourt, F.D., Sun, P. (2012) Efficient Feed-In-Tariff Policies for Renewable Energy Technologies. Duke
- Bihar Policy for Promotion of New and Renewable Energy Sources 2011
- CSTEP (2011) Universal Energy Access by 2030: Technology, Economics, Policy. Note for GSP, Version 2.0. Prepared for Miniter of Environment and Forests, India. Centre for Study of Science, Technology and Policy
- Central Statistics Office (2012) Energy Statistics. Ministrry of Statistics and Programme Implementation (Nineteenth Issue), Government of India
- CEEW & NRDC (2012) Laying the Foundation for a Bright Future: Assessing Progress under phase 1 of India's National Solar Mission. Council of Energy, Environment and Water (CEEW); National Resources Defense Council (NRDC) and Shakti Foundation
- CERC Terms and Conditions for Tariff Determination from Renewable Energy Sources 2012
- Clean Tech (2008) Pursuing Clean Energy Business in India. CleanTechAustralAsia
- Cory, K, Couture, T. and Kreycik, C. (2009) Feed-in Tariff Policy: Design, Implementation and RPS Policy Interactions. National Renewable Energy Laboratory
- Cust, J., Singh, A., &Neuhoff, K. (2007a). Rural Electrification in India: Economic and Institutional aspects of Renewables. In (pp. 7): Faculty of Economics, University of Cambridge.
- Decentralized Distributed Generation Scheme: Guidelines (2009) Government of India
- Decentralized Distributed Generation Scheme: Amendments 5th January 2011 (2011) Government of India
- Decentralized Distributed Generation Scheme: Amendments 17th March 2011 (2011) Government of India
- Deshmukh, A. (2009) The role of decentralized Renewable energy for rural electrification. Maharashtra Case Study. Lund University, Sweden. iiiee
- Deshmukh, R, Gambhir, A. and Sant, G. (2010) Need to Realign India's National Solar Mission. Special Article. Economic and Political Weekly, Vol XLV No. 12
- Dixit, S., Dubash, N.K., Maurer, C. and Nakhooda, S.(2007) electricity Governance Initiative (EGI): Benchmarking Best Practice and Promoting Accountability in the Electricity Sector. Assessment Toolkit. World Resources Institute
- EAI (N.D) India MSW to Energy: Status, Opportunities and Bottlenecks. White Paper by Energy Alternatives India.
- Electricity Act 2003
- Electricity Act (Amendment) 2007
- Fang, X, Yang, D and Xue, G. (2011) Online Strategizing Distributed Renewable Energy Resource Access in Islanded Microgrids. Arizona State University available at: http://www.public.asu.edu/~xfang5/publications/papers/gc_2011_sg.pdf
- FoR (2012) Assessment of Achievable Potential of New and Renewable Energy Resources in Different States during 12th Plan Period and Determination of RPO trajectory and its Impact on Tariff. Final Report. Prepared by CRISIL Risk and Infrastructure Solution Limited. Forum of Regulators
- Gambhir, A (2012) Presentation on Advantages and Key Issues in the Proposed Model. Prayas Energy Group
- Gambhir, A, Toro, V. and Ganapathy, M. (2012) Decentralised Renewable Energy (DRE) Microgrids in India: A review of recent literature.Prayas Energy Group
- Indian Renewable Energy Status Report (2010) NREL
- International Energy Agency, World Energy Outlook 2010.
- Jawaharlal Nehru Solar Mission (JNSM): Mission Document. Government of India
- JNSM: Resolution 11th January 2011 (2011) Government of India
- JNSM: Addendum – Guidelines for Decentralized Solar Applications and Minimal Technical Requirements/ Standards 19th August 2010 (2010) Government of India
- Joshi, B. (2012) Presentation on Policy and Regulatory Interventions for Community Off-Grid Projects. ABPS Infrastructure Advisory Private Limited

- Joshi, B. (2012) Presentation on Regulatory and Policy Changes for Distributed Renewable Energy. ABPS Infrastructure Advisory Private Limited
- Kaundinya, D.P., Balachandra, P. &Ravindranath, N.H. (2009) Grid-Connected Stand Alone Energy Systems for Decentralised Power – A review of literature. Renewable and Sustainable Energy Reviews 13 (2009), pp 2041-2050
- Khan, Z.A. (2012) MP Policy will bring shine back to India's Solar Market. Pioneer
- Klein, A. (2008). Feed-in Tariff Designs: Options to Support Electricity Generation from Renewable Energy Sources. VDM VerlagDr. Mueller e.K.
- Lasseter, R.H. (2011) Smart Distribution: Coupled Microgrids, IEEE, available at www.pserc.wisc.edu/documents/publications/papers/2010_general_publications/LasseterIEEEJan2011.pdf
- Madhya Pradesh electricity Regulatory commission (cogeneration and generation of electricity from renewable sources) regulations 2010
- Mendonca, M., D. Jacobs, and B. Sovacool (2009). Powering the Green Economy, The feed-in tariff handbook. Earthscan, London.
- Mint (2012) Trading up: Powering India. LiveMint
- Minutes of Meeting of the Thirtieth meeting of the Forum of Regulators (FoR) 6th June 2012
- Moner-Girona, M (2008) A New Scheme for the Promotion of Renewable Energies in Developing Countries. The Renewable Energy Regulated Purchase Tariff. Joint Research Centre, European Commission
- MNRE Scheme: Rural Village Electrification. Revised Draft 21st August 2012 (2012). Government of India
- MNRE (2010) Modified Scheme on the Programme on Small Wind Energy and Hybrid Systems (SWES) during 2010-11 and 2011-12- reg. Government of India
- Nouni, M.R., Mullick, S.C. and Kandpal, T.C. (2009) Providing Electricity Access to Remote Areas in India: Niche Areas for Decentralised Electricity Supply. Renewable Energy 34, pp 430-434
- Pandit, A. (2012) Presentation on Emerging Regulatory and Policy Issues in Grid Integration of DRE. ABPS Infrastructure Advisory Private Limited
- Prayas Energy Group (2010) Comments on MNRE Draft Off-Grid Guidelines. Prayas
- Prayas Energy Group (2012a) Summary Report on Workshop on grid integration of small scale decentralized renewable energy (DRE) systems. Workshop organized byPrayas Energy Group, NCPRE and IIT-Bombay
- Prayas Energy Group (2012b) Summary Report on Structured Dialogue on Policy and Regulatory Interventions required for supporting DRE Projects. Organized byPrayas Energy Group, NCPRE and IIT-Bombay
- Rajiv Gandhi GrameenVidyutikaranYojana (RGGVY)
- Reddy, T. and Dixit, S. (2010) Clean Energy Regulation and Civil Society in India: Need and Challenges to Effective Participation. Prayas Energy Group
- Rolland, S. and Patel, A. (2011) Rural Electrification in India: Challenges and Successes. India Carbon Outlook
- Rural Electrification Policy 2006
- Sreedharan, P., Ghanadhan, R., Alagappan,L., Price, S., Olson, A., &Bharvirkar, R. (2011) Electricity Grid Evolution in India: A scoping study on technical and planning needs to support the National Action Plan. Prepared for Regulatory Assistance Project by Energy and Environment Economics Inc
- Teri (N.D) Policy and Regulatory Approaches for Promoting RE power. The Energy and Resources Institute
- World Bank (2010) Empowering Rural India: expanding Electricity Access by Mobilizing Local Resources. Analysis of Models for Improving Rural Electricity Services in India through Distributed Generation and Supply of Renewable Energy. South Asia Energy Unit. Sustainable Development Department. World Bank
- World Future Council (2009) Unleashing Renewable Energy Power in Developing Countries. World Future Council
- Zerriffi, H. (2007) Making Small Work: Business Models for Electrifying the World. Program on Energy and Sustainable Development, Freeman Spogli Institute for International Studies. Stanford University

## Smart Power for Environmentally Sound Economic Development

The Rockefeller Foundation (RF) has conceptualized the Smart Power for Environmentally Sound Economic Development (SPEED) initiative to facilitate enhanced access to affordable energy services, particularly electricity, from clean energy sources, in underserved regions of the country and to contribute towards a positive impact on the lives of poor and vulnerable populations, thereby improving the quality of life and enhancing livelihood security. The attempt is to "establish the SPEED model as a widely replicable mechanism for local economic development through delivery of reliable, affordable and clean electricity and influence policy to create a more conducive environment for investment in sustainable rural electrification."

RF is exploring whether the power needs of the massive and rapidly-growing infrastructure of cell phone towers - many of which are far from the electricity grid and powered by very expensive diesel fuel - can be harnessed as an anchor demand and source of revenue to help provide clean energy services and universal electrification in poor communities. The Foundation is working with the mobile phone industry, governments, financiers (private and donors), researchers and civil society groups to identify business models and pilot projects that could be replicated around the world.

The project is now seeking to operationalize the concept of anchor loads on a larger scale through a sustainable business development approach in which on-ground pilots will be run by Energy Service Companies (ESCOs) to deliver on SPEED goals. Three SPEED prototypes have been envisaged which will be established in locations where projects will build upon the community mobilization and institution, namely assured anchor load, potential anchor load and completely offgrid remote locations.

SPEED models are geared around promotion of economic development, and thus catering to productive loads is an essential component of the same. While considerations to maintain equity (for instance with regard to pricing) are essential, SPEED models are primarily concerned with being economically viable to promote local development.

## SPEED Partners

## About Development Alternatives Group www.devalt.org

Development Alternatives (DA) is a premier social enterprise with a global presence in the fields of green economic development, social equity and environmental management. It is credited with numerous technology and delivery system innovations that help create sustainable livelihoods in the developing world. DA focuses on empowering communities through strengthening people's institutions and facilitating their access to basic needs; enabling economic opportunities through skill development for green jobs and enterprise creation; and promoting low carbon pathways for development through natural resource management models and clean technology solutions.



Development Alternatives

**World Headquarters**
B-32 TARA Crescent, Qutub Institutional Area
New Delhi 110016, India
Tel: 011-26544100, 26544200, Fax: 011-26851158
Email: mail@devalt.org, Website: www.devalt.org