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Energy Access for the Poor

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"We are energy secure when we can supply lifeline energy to all our citizens irrespective of their ability to pay for it as well as meet their effective demand for safe and convenient energy to satisfy their various needs at competitive prices, at all times and with a prescribed confidence level considering shocks and disruptions that can be reasonably expected."

- Integrated Energy Policy , Government of India

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1. Introduction

Why Energy Matters for Development?

Of the approximately 7 billion people living on the planet, around 3.1 billion, or 55 per cent of the total, live in rural areas. Further, around 1.4 billion of them continue to live in extreme poverty, i.e. on less than US $ 1.25 per day. Almost two-thirds of those living in poverty, i.e. around a billion live in rural areas of developing countries. Therefore addressing global poverty is the biggest challenge confronting the world today.

To address the challenge of reducing global poverty, the United Nations adopted the MDGs (Millennium Development Goals). These goals aim to address key development challenges with the aim of reducing global poverty. However addressing rural poverty requires a huge and concentrated effort along a number of dimensions ranging from interventions in food and nutrition, education, health & sanitation, income generation, etc. Critical to all these dimensions is the availability of and access to clean, efficient and sustainable sources of energy.

Energy is one of the key drivers of development and access to clean; safe, affordable sources of energy can stimulate economic, social and physical development leading to critical improvement in people's lives and livelihoods and the communities as well as a nation's social and economic status and interactions. Energy is a cross cutting input that facilitates effective and efficient delivery of most basic services like safe drinking water, public lighting, health care, education, etc. while also enabling better standards of household living and fuelling economic and income generation activities. It has been seen that a high correlation exists between consumption of electricity (energy) and improvements in the Human Development Index (HDI), especially at low levels of HDI. The correlation values are very high for poor nations who are also energy poor[1], with a steep rise seen in human development index with increasing energy consumption for energy-poor nations. This trend tends to taper as we move to transiting nations and is almost flat for developed nations. It suggests that huge gains in HDI can be made in the energy poor countries by addressing access to energy for the poor. Lack of access to clean and efficient energy sources is thus the most significant barrier to alleviation of poverty.

The fuel-mix in the rural areas of most developing countries is characterized by predominance of bio-energy based fuels like fuel-wood being the main source of energy and India is no exception with biomass fuels—fuel-wood, crop residues, and animal dung providing 85%–90% of the domestic energy and 75% of all rural energy. This heavy dependence on inefficient biomass and traditional devices with low conversion efficiency has led to serious environmental effects, particularly at the loco-regional level.

The most obvious solution would be to shift rural poor to more efficient energy sources like commercial fuels and electricity. However, the low purchasing power of the rural poor (and associated high subsidy burden on governments) and low penetration levels of commercial and clean energy options/ fuels in rural areas has resulted in a generic failure in achieving this objective.

Issues around global access to clean energy resources are no longer limited to rural areas. With burgeoning urban populations and high concentrations of migratory population, this is an issue for urban planners and development experts as well.

On the other hand with rising awareness, economic and social status, rural households and businesses have also shown that they realize the key role energy plays in development and improving the quality of life. These households routinely pay more for their energy than corresponding urban households and still their demand for energy keeps growing. Added to this recent technology advances which are increasingly giving us new options in terms of technologies, bring down the cost of delivered energy, increasing efficiency of delivery, improving product performance, and finding new business based approaches to providing rural households affordable energy access solutions.

Even though much is being done, the hard reality is that critical scale still needs to be built up in this sector. According to the International Energy Agency (IEA), by 2030 and in the absence of significant concerted effort, there shall still remain at least one billion people without access to electricity services. So in effect today under the business as usual the energy gap is not closing.

1 Understanding the role of energy consumption in human development through the use of saturation phenomena; Daniel M. Martıneza & Ben W. Ebenhacka, Energy Policy, December 2007.

UN's International Year of Sustainable Energy 2012

Seeing the criticality of energy in development and the state of the globe in terms of access to energy, the UN General Assembly has declared the year 2012 as the International Year of Sustainable Energy for All. Through this declaration, access to cleaner and more efficient energy has now become a priority of the United Nations. The declaration and the Energy for All initiative aims to bring together all sectors of society– businesses, governments, investors, community groups, and academia – in support of three interlinked objectives for 2030:

1. Ensure universal access to modern energy services
2. Double the global rate of improvement in energy efficiency
3. Double the share of renewable energy in the global energy mix.

2. Energy Access - Global Status

According to the International Energy Agency (IEA), 2011 saw the number of people without access to electricity reduce by 50 million and those without access to clean cooking fuels reduce by 40 million. This reduction took place despite the growth in global population which means that significantly higher number of people got access to clean energy sources in 2011. Most of this decrease took place in the developing countries of India, Indonesia, Brazil, Thailand, South Africa and Ethiopia. However despite this increase in access to energy, the IEA still projects that almost 1.3 billion people lacked access and electricity and 2.6 billion lacked access to clean cooking fuels (still relying on traditional use of biomass for cooking, which causes harmful indoor air pollution) at the beginning of 2012.

A vast majority of the global population without access to clean energy sources lives in the developing world with a huge concentration of this segment in sub Saharan Africa and South Asia. Based on IEA data collected in 2010, almost 95% of people without access to clean energy sources lived in either sub Saharan Africa or the developing countries in Asia, especially South Asia and 84% of these people, an overwhelming majority, lived in the rural areas.

The IEA[2] also projects that in the absence of concerted action by national governments and the international community, this number shall hover at around 1 billion without access to electricity and 2.6 billion without access to clean cooking facilities in 2030. To provide access to these people around the globe by 2030, the global community needs to invest around US$ 1 trillion, which is roughly a five-fold increase in annual investment (over 2009) for facilitating access to energy across the globe.

Defining Energy Access

The International Energy Agency defines modern energy access as: a "household" having reliable and affordable access to clean cooking facilities, a first connection to electricity, and then an increasing level of electricity consumption over time to reach the regional average. The initial, minimum level of electricity for rural households is assumed to be 250 kilowatt-hours (kWh), which, for example, could provide for use of a floor fan, a mobile telephone, and two compact fluorescent lights for five hours per day. (Source: IEA, World Energy Outlook 2011.)

However this definition does not include other categories, such as energy to power businesses and public buildings, including schools and medical centers, and for the agricultural sector, all of which are critical to development.

Global experience – Rural Electrification

Across the world, access to clean, efficient and affordable energy services has seen communities, regions and countries effectively address the scourge of poverty. One of the biggest examples of this has been the Green Revolution in India, where the delivery of water for irrigation through energized pump-sets provided a critical input for enhancing productivity of Indian agriculture. The case of United States is also relevant here. The United States launched its rural electrification programme before the Second World War and as a result almost 98% of farms and rural households had access to electricity services by the beginning of the 1990's. This programme over the years became the bedrock on which much of rural America progressed. Similar examples of development can be seen from countries like Bangladesh, China, Philippines and Brazil to name a few.

2 World Energy Outlook 2011 (WEO2011)

3. Energy Access– Dimensions of the Problem in India

India today is home to a substantial proportion of the world's population, the world's poor and the world's energy deficient. India is one of the fastest growing economies in the world today with a growth rate of around 6 to 8 per cent. However, household electrification and access to sustainable quality electricity services remains a dream for more than half the households in India, despite village electrification being around 90% (MoP, 2011 data). Policy makers in India have realized that any initiative taken to address the demand supply gap and provide localized electrification is likely to have a positive impact not only on rural electrification and poverty reduction but also on the quality of power on the grid.

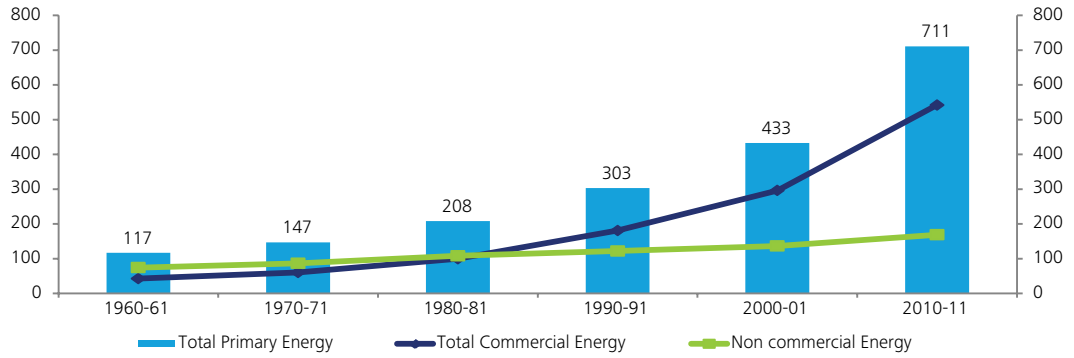
India, despite the unprecedented pace of generation capacity addition over the 11th Five Year Plan period, still has very low levels of energy consumption and per capita energy consumption in the world and well below the world averages . This low level of energy availability and consumption tends to affect the poorest the most. Large populations with access to limited quantum of energy resources have meant that the poor, more often than not, lose out in the race for these resources and feel the impact of any supply shortfall. When they do source critical requirements of energy, in the absence of a backbone infrastructure, they end of paying substantially more than the affluent sections, thus perpetuating the cycle of poverty.

The challenge of energy security (access and delivery) and development together finds no bigger challenge than in the rural landscapes of India. India has by nature been agrarian with a large proportion of the population living in the rural areas and dependent on the land for their livelihood. These large segments of the population have over the years faced the brunt of the poverty challenge due to high population pressures, reducing land holdings, limited increases in land productivity (through intensive agriculture or adoption of newer more remunerative crops) and limited employment opportunities. These areas often do not have access to energy resources for livelihood expansion like power for irrigation, cold storage or processing and for normal day to day activities and are instead dependent on traditional and unclean sources of energy like woody biomass, dung cakes, kerosene, etc. As a result, the opportunities for productivity enhancements and value addition get limited by the lack of modern and efficient energy services.

India has approximately four hundred million people with no access to electricity, a majority of who live in the rural areas. One of the key reasons for this is that such rural population resides in areas where geographical distribution combined with terrain and low purchasing power of consumers creates hurdles in providing uninterrupted electricity supply. As a result, limited investments have gone into maintaining and sustaining infrastructure for energy delivery, even if it gets built under government programmes. Rural areas usually suffer on account of the poor and under developed state of transmission and distribution infrastructure and sometimes even lack adequate distribution capacity to supply electricity.

3 India houses 16% of the global world population while its share of energy consumption is a paltry 4.2%. India consumes around 0.58 tonnes of oil equivalent in terms of commercial energy consumption, which is about a third of the global average. India's per capita electricity consumption of around 734 kWh is very low as compared to the global average of 2,782 and China's 2,471 kWh.

Figure 1: Energy Consumption profile in India



Current Status of Rural Energy Access and Rural Electrification

The consumption pattern shows that India's use of non-commercial energy as proportion of total energy demand has been declining with time. Most of the non-commercial energy usage is biomass which has steadily declined from 63% to 24% in the last fifty years.

This change has primarily been brought about due to a change in the pattern of energy use, mostly by urban households. Both rural and urban households differ vastly in terms of their pattern of energy consumption. Between 1981 and 2011, 65% of the urban population started using LPG, up from 47%. However the change is not so significant in the case of rural households with only 11.4% of the households using LPG. In the case of lighting, 92% of urban households use electricity for lighting while only 55% use electricity in the rural areas. In case of rural electrification, even though electricity access has improved appreciably over the past two decades, from 36% in 1994 to around 56% of rural households in 2011, even now around 74 million rural households are still without access to electricity services. Even in areas with access to the grid and despite significant growth in electricity generation over the years, power shortages continue to plague rural households. The national electricity deficit has hovered around 8 to 10% over the last few years and the population group which has suffered the most due to this deficit has been the rural consumers. In terms of village level electrification almost 90% of all villages stand electrified.

In terms of rural electrification at the state level is concerned, there exists great disparity in household level electrification across states, with states like Bihar, Assam, Uttar Pradesh, Orissa and Jharkhand lagging way behind states like HP, Punjab and AP. The table below highlights the status of household electrification across all states in the country based on the National Census Data 2011.

Table 1: Status of household electrification in India

S. No.	Electrification Levels	States
1	90% and above	Himachal Pradesh (96.6%), Punjab (95.5%), Chandigarh (97.3%), NCT of Delhi (97.8%), Sikkim (90.2%), Daman & Diu (98.3%), Andhra Pradesh (89.7%), Dadra & Nagar Haveli (91.7%), Goa (95.6%), Lakshadweep (99.8%), Tamil Nadu (90.8%), Kerala (92.1%) and Puducherry (95.8%)
2	89%	Jammu & Kashmir (80.7%), Uttarakhand (83.1%), Haryana (87.2%), Gujarat (85%) and Karnataka (86.7%)
3	Between 70-79%	Nagaland (75.2%), Chhattisgarh (70%), Maharashtra (73.8%) and A&N Islands (79.4%)
4	Between 60-69%	Manipur (61.2%), Mizoram (68.8%) and Tripura (59.5%)
5	Between 50-59%	Rajasthan (58.3%), Meghalaya (51.6%), Arunachal Pradesh (55.5%) and Madhya Pradesh (58.3%)
6	Between 40-49%	West Bengal (40.3%)
7	Below 40%	Uttar Pradesh (23.8%), Bihar (10.4%), Jharkhand (32.3%), Assam (28.4%) and Odisha (35.6%)

Source: National Census data 2011

Access to Energy – Cooking and other thermal applications

Unlike developed countries like USA, UK etc, India still derives a large majority of its cooking fuel from solid fuels like firewood and cattle dung. Heavy reliance on biomass leads to a number of problems which range from health issues related to indoor air pollution to depletion of forests and natural resources. Keeping these in view the Government of India via the Ministry of New and Renewable Energy has been implementing a number of programmes related to cooking and related thermal applications. In the early 1980s the MNRE launched a National Project on Biogas Development which took up development of household biogas plants. Over 4.5 million biogas plants were set up under the project.

Biomass still forms a major source of the thermal energy requirements of most households in India, especially in the rural areas. Based on the data collected during the National Census 2011, it was found that 67% of all households in India depended on solid fuels which in most cases were biomass-based. In case of rural households a large majority of the households used fire-wood (62.5%); crop residue (12.3%) and cow dung cake (10.9%) while LPG penetration stood at a paltry 11.4%. Kerosene (0.7%), coal/charcoal (2.9%) and electricity (0.1%) were the other fuels used for cooking. Close to 85% of all rural households continue to use biomass as it is easily accessible (relative to cleaner liquid fuels) and is available free of charge. These two factors also explain a majority of the reasons why even households with access to LPG continue to use a combination of LPG and firewood. Besides these two factors other issues which also constrain clean fuel usage include awareness and to some extent the acceptability of cleaner fuels.

Another trend which is seen is that the use of cleaner fuels in the rural areas rises with income levels, which means that affordability is one of the key driving factors. This can be seen from NSSO Household Survey Trends as well. Patterns of cooking fuel use across states shows that there is quite a variation of fuel usage across states. States with higher infrastructure development and higher per capita income tend to have a higher proportion of households using cleaner fuels like LPG. The National Project on Biogas Development was followed by a programme on Improved Chulhas. The aim of the programme was to provide better, less polluting more efficient Chulhas to rural households. Over 35 million improved Chulhas were disseminated between 1983 and 2003, after which the programme was handed over to the states. The MNRE again launched this programme at a national level in 2009-10 under the guise of National Biomass Cook-stoves Initiative. This had two components, one a pilot scale

project which aimed to deploy around 5,500 community based biomass cook-stoves and the second 15000 household level family sized cook-stoves which aimed to demonstrate applications at the household level. Although these programmes have been deployed in appreciable numbers, their sustainability has suffered due to limited after deployment support and cumbersome use.

While the Chulha programme is being rolled out to reduce the harmful impacts of indigenous cook-stoves, the government has also been promoting a shift to cleaner cooking fuels such as LPG. The Ministry of Petroleum & Natural Gas launched the Rajiv Gandhi Gramin LPG Vitaran Yojana (RGGLVY) scheme in October 2009 with the aim of enhancing LPG coverage in the rural areas. The ministry has also been promoting the deployment of more affordable smaller cylinders through the launch of small sized LPG cylinders (5 kg capacity). However these programmes still suffer from issues related to affordability and lack of access to supplies (on account of an under developed supply chain).

The MoPNG has also started to focus more on the rural areas with the launch of the Vision 2015 which aims to extend the penetration of LPG in the rural market for cooking purposes. The vision aims to provide 55 million new connections by 2015. The vision also aims to assist poorer households in their move from kerosene to LPG through use of corporate social responsibility (CSR) funds available with oil Public Sector Undertakings.

Household Energy Security

Energy security at the household level means ensuring assured and regular supply of clean energy fuels at an affordable price for various household activities. Threat to physical availability of clean energy fuels for cooking and lighting is determined through various indicators such as dependence on traditional fuels and limited access to clean fuels. The rural areas of the country are characterized by dependence on biomass and traditional fuels like kerosene for meeting their energy needs. Traditionally energy security from the perspective of rural households has been limited to the availability of fuel wood, cattle dung, crop residue and kerosene. Hence, there is a wide gap between the perception of rural masses and the policy makers with regard to what constitutes energy security. Primarily, for the rural households energy security is limited to the issue of access and the price. Since the fuels that are locally available are generally, non-monetised energy security at the rural household level is largely determined by the abundance of local resources like fuel wood etc.
On the other hand the micro-level, supply in rural areas is primarily determined by macro level demand-supply gaps the process of looking at energy security has failed to incorporate micro level variations in the policy formulation process. In the present ongoing energy reform process there is a definite inclination towards a de-centralized and locally sustainable solution based approach. In such a scenario, incorporating micro-level concerns in policies and programmes addressing energy security becomes even more pertinent.

Increasingly it is being felt that one of the main interventions required for putting the rural areas on the path of development is to deliver adequate energy services to the rural areas or ensure the energy security of these villages. Till now talk in the area of energy security is limited to the national level. To use the concept effectively at the micro level there is a need to apply the same concept at the micro level. For this one of the first steps is the development of a framework for providing energy security at the village level.

In case of rural India two things are seen: one most energy services are delivered on the infrastructure created by the government/ services being delivered through the public sector and all energy programmes are supply driven not differentiating based on actual needs or in other words on the planning of these programmes which is mostly centralized.. At the village level it is seen that the level of energy access and security of the village depends on a number of micro parameters, which we call micro complexities. This framework needs to be based on two main drivers of energy security i.e. planning and micro complexities. While we have done well on the planning level, we have used the concept of one size fits all which ignores the realities of the actual ground situation. There is an urgent need to address this issue through incorporating small micro-complexities at the state, district and even at the village level. Household energy security therefore needs to be addressed through centralized planning based on decentralized disaggregated inputs from across the country providing specific inputs to energy planners.

4. Energy Access in India – Programmes and Initiatives

Genesis of Rural Electrification in India

With the largest rural population in the world, India faces a huge electrification challenge. Statistics on access to electricity services in India stand at around 90 % of villages and 56% of the rural households. Although the government has been making conscious efforts since the beginning of its planned economic development programmes to make substantial improvements to the electricity infrastructure in terms of availability and accessibility in the rural areas, the household electrification rate and power availability is still far below the desired level as well as the world average.

Till the 1970s, rural electrification was a by-product of connecting the towns and semi-urban areas with the grid. However the green revolution and concomitant increase in demand for agriculture connections also promoted rural electrification. The initial focus on providing electricity services to the rural areas was to ensure national food security through promotion of intensive agriculture. Along the way, a number of villages also got electricity for lighting and domestic uses.

The Green Revolution in agriculture started Rural Electrification in India in a large way. Pump-sets energisation was an important contributor to the success of the Green Revolution in agriculture and in turn became the main driver for rural electrification in the country. The energisation of irrigation pump-sets was the principal aim of rural electrification for a long time. Thus, the level of electrification was not measured as a percentage of electrified households but in the extension of electricity lines to particular villages. As can be seen in the table below, the definition of electrification before 1997 and even after 1997 considered a village to be electrified with electricity reaching only revenue areas of the village and to irrigation pump-sets.

In the late 1980s, the GoI for the first time adopted some initiatives to address household electrification, especially for the rural poor. The Kutir Jyoti Program was initiated in 1989 to provide single point light connection to all Below Poverty Line (BPL) households including SC/ ST and has been the longest amongst all household electrification programs. This program provided 100% grant for one time cost of internal wiring and service connection charges. As per REC, nearly 60 lakh households were covered under the scheme till 2004 at a cost of Rs.450 crores. However the programme suffered from poor quality of supply and subsequent apathy in maintenance. The scheme was merged into the AREC (Accelerated Rural Electrification Program) in 2004.

The Rural Electricity Supply Technology Mission launched in 2002 had the aim of electrification of 1 lakh villages by 2007 and 1 Crore households by 2012 using decentralized distribution systems (using renewable or conventional fuels) and grid extension.
The Remote Village Electrification Program (2003), a programme launched by MNRE to electrify the un-electrified remote villages and remote hamlets of electrified villages using renewable energy technologies. The target of this scheme was to electrify all remote villages by 2007, remote hamlets by 2012 and all households by 2012. In 2005 with the launch of the Rajiv Gandhi Grameen Vidyutikaran Yojana, all grid related rural electrification programs were consolidated and a concerted attempt made to provide “electricity for all” in a time-bound manner.

The table below highlights the important events taking place in country towards achieving 100% village and household electrification:

Table 2: Events on Rural Electrification in India

Year	Event	Remark
1969	Incorporation of Rural Electrification Corporation (REC) under GoI (MoP)	With the Assistance of USAID, GoI create REC. Electrification of Rural areas was mandate of this institution which worked under the flagship of Ministry of Power.
Up till 1997	Village Electrification Definition	"A Village should be classified as electrified if electricity is being used within its revenue area for any purpose whatsoever"
Post 1997	Change in Village Electrification Definition	"A village will be deemed to be electrified if the electricity is used in the inhabited locality, within the revenue boundary of the village for any purpose whatsoever" However, according to this definition, if only one light bulb was kept lit for a nightly hour Centre of a village or one irrigation pump was powered, the whole village was considered electrified.
1988-89	Kutir Jyoti Program (KJP)	100% grant from central government was provided under this program to install single point light source/connection to BPL households. This program was later on merged in to RGGVY.
2000-01	Pradhan Mantri Gramodaya Yojana (PMGY)	The program was launched to provide basic minimum services including Rural health, Education, Drinking water and Rural Electrification. Central Govt. provided 90% loan and 10% grant to states and states could allocate the overall fund among different basic minimum services. This program was discontinued in 2005 and merged in to RGGVY.
2001-02	Village Electrification Program of MNRE	Ministry of New and Renewable Energy has started this program to light the remote villages through stand-alone solar PV systems including lantern and home systems. Also the major reason behind initiation of this program was to energize the pump-sets in rural areas to ensure the food security.
2001-02	Minimum Needs Program (MNP)	States having than rural electrification level of less than 65% were identified and provided with 100% loan facility to reach at 100% electrification level.
2002	Accelerated Rural Electrification Program (AREP)	Loan facilitation from REC, PFC and Rural Infrastructure Development Fund (RIDF) with 4% of interest subsidy was provided in this program. This program was later on merged in to RGGVY.
2002	Rural Electrification Supply Technology (REST) Mission	Aim of the program was to electrify the villages with local renewable sources and decentralized technologies along with grid electricity if feasible.
2003	Enactment of Electricity Act 2003	This acts brought in the legislative guideline to provide the improved delivery of rural service or supply through different mediums. However it lacked in not mandating the SERCs to take care of regulatory interventions in rural electrifications and thus in absence of no specified guidelines for tariff and supply rural electrification through DDGs or mini grid couldn't take off.
2005/ 06	Announcement of National Electricity Policy	As per Sec 3 of EA 2003, this policy was announced which had set targets such as • Complete Electrification by 2009 • Power to All by 2012
2005/ 06	Launch of Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)	National Common Minimum program ignited the launch of this program which goes hand in hand with Bharat Nirman program as well and aims to achieve the targets set under NEP and REP. RGGVY has three components including • REDB • VEI • DDGs
2005/ 06	Announcement of Rural Electrification Policy (REP)	This lays the guidelines for rural electrification through RGGVY and RVE (erstwhile VEP) programs. Post announcement of NEP, REP and launching of RGGVY, it was declared that those villages which are not covered under RGGVY shall be electrified through RVE program of MNRE.

Source: Deloitte Research

Definition of Rural Electrification & Key Programmes

One of the key issues in the roll out of rural electrification over the years has been the multiplicity of programs and lack of funding, especially during the initial years of rural electrification. Over the years number of programs attempted to enhance electricity access either as part of overall rural development or specially targeting rural electrification. However, program implementation was not properly coordinated or managed and the financial burden (and high levels of cross-subsidy) that the program imposed on electricity utilities meant that they were unwilling partners in promoting these schemes. The launch of RGGVY in 2005 was expected to be a watershed with clear provisions for capital subsidy from the central Government, program implementation through independent designated entities and the provision of lifeline consumption and cross-subsidy under the National Electricity Policy. MNRE in parallel continues to focus on flagship RVE program in addition to certain other programs for off-grid electrification in remote villages.

Definition of Rural Electrification

Earlier, a village was defined as being electrified if at least one connection existed. In 2003-04, the definition of an electrified village was amended to require linking at least 10 percent of the households in the village, to require that electricity is provided to public places like schools, Panchayat office, health centers, dispensaries and community centers, and to require that distribution transformers and distribution lines are provided in the inhabited locality as well as a Dalit Basti/hamlet if it exists. Using this new definition, out of the total number of villages as of the 1991 census of 587,556, there were 1,12,401 villages were un-electrified. The National Common Minimum programme (NCMP) in 2005 envisaged electrifying all these villages over a five year period (Box 1). The following section briefly discusses some key government policies, primarily aimed at improving rural electrification in the country, which have been developed and implemented in the past.

National Common Minimum Programme

Strategy to achieved electrification of all the villages under the NCMP consists of the following elements:

(i) Creation of Rural Electricity Distribution Backbone (REDB) of 33/11 KV substations, with one such substation in each block appropriately networked and linked to the State transmission system.

(ii) Creation of Village Electricity Infrastructure (VEI) by providing Distribution Transformer(s) with at least one such transformer in every village.

(iii) Rural Households Electrification of electrified households from village distribution transformer(s).

(iv) Decentralized distributed generation system for such villages where grid connectivity is either not feasible or not cost effective.

Source: Economic Survey 2004-05

Kutir Jyoti Programme

The Kutir Jyoti programme was launched in 1988-89 and covered the extension of a single point connection to "Below Poverty Line" households in rural India and included a onetime 100% grant especially for the Harijan and Adivasi families. The main objective of the programme was to improve the quality of life of the poorest of the poor. The funding was provided to the SEB's through the REC and covered the cost of a service line from the pole, the fuse unit, switch, the meter and the board besides the cost internal wiring and the cost of the bulb. The grant amount which was initially Rs 200 per connection in 1988-89, which was later increased to Rs 220 per connection.

The grant amount has since been increased to Rs 1800 per connection in respect of special category states and Rs 1500 per connection in other states from March 2002. The programme suffered on account of factors like faulty targeting, poor quality of supply and high leakages. The programme was merged into the AREP in 2004.

Pradhan Mantri Gramodaya Yojana (PMGY)

The PMGY (Pradhan Mantri Gramodaya Yojana) covered areas such as Primary health, Education, Drinking water, Rural Shelter, Nutrition and Rural Electrification and was launched between 2001/02. This assistance was extended to the state government in the form of a 30% (up to 90% grant in case of special category states). This scheme allowed states the flexibility for sector-wise allocations to allocate funds as per their own plan priorities and discretion. PMGY's main aim was to facilitate delivery of selected basic minimum services, in order to focus on certain priority areas of the Government.

Rural Electricity Supply Technology Mission (REST)

The Rural Electricity Supply Technology Mission was established on 15 August 2002 to accelerate electrification of all villages and households through local renewable energy sources / decentralized technologies and the conventional grid. The REST mission has been designed in such a manner that it provides a holistic and integrated approach using a market approach through the use of cost effective technology options, innovative financing methods and new institutional arrangements at the grassroots level for the provision of electricity services to the rural poor.

The mission will concentrate its resources and expertise at identifying and developing low cost indigenous / appropriate technology sets that can provide affordable and reliable power supply to rural areas identify and implement innovative financing mechanisms for standalone distributed systems and identify institutions working at the grassroots level who could take up the delivery of these services.

Electricity Act 2003

The Electricity Bill, 2001 was introduced in Lok Sabha on 30 August 2001 and passed on 26 May 2003 and was notified in the Gazette of India on 2 June 2003. The Electricity Act, 2003 seeks to bring about a qualitative transformation of the electricity sector through the creation of a liberal framework for development for the power sector and dissociate the government and the regulator. The objectives of the Act are "to consolidate the laws relating to generation, transmission, distribution, trading and use of electricity and generally for taking measures conducive to development of the electricity industry, promoting competition therein, protecting the interests of consumers and the supply of electricity to all areas, rationalization of electricity tariff, ensuring transparent policies regarding subsidies, promotion of efficient and environmentally benign policies, constitution of CEA, Regulatory Commissions and establishment of an Appellate Tribunal, and for matters connected there with or incidental thereto."

The main features of the act that will facilitate the extension of rural electricity services across the country are:-

- The act allowed the participation of the private sector in distribution and generation to create a competitive environment as well as tap private investment and increase the efficiency of power delivery.
- The Act obligates the supply of electricity to rural areas by the government which can either supply the rural areas itself or facilitate its supply through other players
- The Act advocates the formulation of a national rural electricity policy, which shall be undertaken in consultation with the state governments / commissions, and cover issues such as rural electrification, bulk purchase of electricity, management of local distribution in rural areas through PRI's, users associations, co-operatives societies, non-governmental organizations or franchisees.
- The act has de-licensed generation and distribution in the rural areas except for hydro.

At the same time the act has also provided policy initiatives for increasing the pace of rural electrification and its penetration. Some of these are –

- For the rural areas stand-alone generation and distribution have been de-licensed allowing public as well as private participation in the generation and delivery of power.
- The act has also advocated the gradual phasing out of cross subsidies which will have the effect of reducing the cost of electricity for two productive users i.e. commercial enterprises and industry and at the same time improve the financial health of most electric utilities.

The RGGVY (Rajiv Gandhi Grameen Vidyutikaran Yojana) Programme

The RGGVY Programme was launched in April 2005. At that time almost 1.25 lakh villages (almost a quarter of the total) and 7.8 Crore rural households did not have access to electricity services. RGGVY aimed to address this gap and electrify all the un-electrified villages while also providing electricity connections to the 2.34 Crore un-electrified Below Poverty Line (BPL) households. The aim of the programme was to achieve this by 2009 at a cost of Rs. 16,000 crores and also ensure electricity for all by 2012.

Till March 2011, the programe had been successful in electrifying around 96,000 villages, which raised the village electrification levels to 91% from 74%. The programme was also able to provide electricity access to around 1.75 Crore rural households, mostly Below Poverty Line (BPL) have been given connections, raising the level of rural household electrification from 44% to 56%.

The "Rajiv Gandhi Grameen Vidyutikaran Yojana" – Scheme for Rural Electricity Infrastructure and Household Electrification"

The programme was launched by the Prime Minister Dr. Manmohan Singh in April 2005. The scheme has been launched to fulfill the commitment of the National Common Minimum Programme (NCMP) of completing the household electrification in next 5 years and modernizing the rural electricity infrastructure. Since independence so far only about 44% rural households could be given access to electricity and more than one lakh villages are still to be electrified. The new programme involves providing access for electricity to 7.8 Crore rural households in five years. The scheme, to be implemented through Rural Electrification Corporation, will provide Ninety per cent of the capital cost of the programme by the Central Government as grant for creating:-

- Rural Electricity Distribution Backbone (REDB) with at least one 33/11 KV (or 66/11 KV) substation in each block.
- Village Electrification Infrastructure (VEI) with at least one distribution transformer in each village/habitation.
- Decentralized Distributed Generation (DDG) Systems where grid supply is not feasible or cost-effective.

The scheme provides for free of cost connection to all rural households living below poverty line. Further, there will no discrimination in the hours of supply between rural and urban areas. It aims at a qualitative transformation of the rural electricity infrastructure. It envisages that there will be no discrimination between urban and rural areas in respect of hours of supply. 24 hours supply of good quality power would also enable dispersal of small industries, khadi and village industries in the rural areas. It will also facilitate delivery of modern health care, education and application of information technologies. This is aimed at accelerated rural development, employment generation and poverty alleviation.

The scheme also lays special emphasis on sustainability of rural supply through collection of the cost of electricity from the beneficiaries. To achieve this objective, it is proposed that franchisees like NGOs, consumer associations etc. will be deployed with appropriate involvement of Panchayati Raj institutions. The State Governments will be free to provide appropriate targeted subsidy to poor households. The Central Government has also offered the project implementation and management expertise of its Central Power Sector Undertakings like NTPC, NHPC, PGCIL and DVC to the States who are willing to make use of these services for ensuring timely completion of the project in this scheme. The scheme has a target of electrifying 1, 25,000 un-electrified villages and giving access to 7.8 Crore uncovered rural households in next 5 years (by 2012). The Central Government has already approved Rs.5000 Crore for providing capital subsidy for this scheme in the remaining period of 10th Five Year Plan. Total estimated cost of the scheme

The following table highlights the key programmes being implemented by the Ministry of Power and the Ministry of New and Renewable Energy for delivery of energy services to the rural areas.

Table 3: Programmes for Rural Energy Delivery (Source: MNRE)

Ministry	Program	Description	Resource/Application
Ministry of Power	RGGVY	Electrification and Intensive electrification of un electrified villages. DDGs is also an option	Renewable based DDGs- Hydro, PV, Biomass based
	JNNSM	Electrification of villages using solar PV applications	Focus on Solar PV
	RVE	Electrification of Remote Villages	All renewable however solar PV is mostly prevalent
	Solar Lantern	Distribution of solar lantern in remote villages	Solar lantern
	Solar PV Program	Demonstration of PV equipment in rural, urban and commercial	Solar home systems for rural segment
	VESP	Total energy security for villages meeting continuous power and energy requirement	Biomass preferred then mini hydro and solar
	Small Wind Energy and Hybrid Program	For electricity and energy through windmills, aero-generators and hybrids	Small wind mills and aero-generators
Ministry of New and Renewable Energy	Small Hydro Program	Water mills for mechanical work and power production	Micro hydro water mills
	Biomass Gasifier	Gasifier for power production	Biomass gasifier- conventional and 100% producer gas
	Bio Gas Power	Biogas plant for power generation	Biogas plant for power generation
	Family type Biogas plants	Biogas plants for cooking	Biogas plants for cooking
	Solar Thermal Energy Demonstration	Solar water heating, cooking and drying	Solar water heaters, solar cookers etc

Source: Deloitte research on MoP and MNRE programs

Key Issues impacting Rural Energy & Rural Electrification

Various programmes over the years have had only limited impact on providing access to rural households. Some of the main issues that have been hindering the provision of clean and efficient energy services to the rural areas have been indicated below.

Emphasis on top-down planning

Most programmes in India like IREP, RVE, RGGVY, KJP etc have been designed and planned at the central government level, largely by the MoP, MNRE and their agencies like the REC. Not only funding (in the case of RGGVY a grant of 90% capital cost) comes from the central government, but the blue print as well along with targets, guidelines, involvement of key agencies and programme implementation, managing and monitoring system design. This leads to issues such as ambitious targets, no acknowledgement of ground realities and lack of connect on capacity of implementation agencies. For example under the RGGVY, uniform estimates for village or household electrification and similar approach to franchisees across the country may not lead to the desired results.

Lack of a policy framework for a customized decentralized approach

It is desirable to develop a comprehensive decentralized approach for delivery of energy services for the rural areas. The issue of rural energy has been basically dependent on national programmes that have either been technology-centric or end use based without any inter-linkages with the rural eco-system and hence has faced the challenge of sustainability.

High grid push: Rural energy has been synonymous with rural electrification

Over the years, planners have regarded rural energy as synonymous with rural electrification. This has led to a scenario wherein the energy needs related to cooking, water extraction, and space heating have not been looked at as an integral and integrated component of energisation, but rather as disjointed and specific programmes catering to a particular end use.

Most rural energy programmes have been electrification programmes. For example RGGVY has resulted in a high push for grid electricity as the only solution for electrification at the cost of stand-alone and grid interactive systems. Another example is that RGGVY guidelines focus more on low capacity stand-alone systems and have no provisions for guaranteed grid evacuation.

Lack of research and development (including customization)

In spite of the need, sufficient emphasis has not been laid on technology development in the national level energy programme, and in several cases, the budget allocation for research and development has been inadequate. In the entire planning mechanism there is no emphasis on the necessity of designing devices as per the needs of the community, and this is reflected in the absence of a mechanism that can take and incorporate feedback for assessing R&D requirements from the community in the planning process. For instance, the kerosene devices used in rural areas for lighting purposes are technically archaic in nature. This results not only in higher kerosene consumption, but also higher emissions of smoke and poor luminosity.

Limited inter and intra-agency co-ordination

Currently, rural energy programmes are largely being implemented by government agencies, and on a much smaller scale, by non-government organizations. In case of government agencies, there is neither intra nor an inter-agency coordination. An example of lack of intra-agency coordination is the fact that there was no synergy between the improved Chulha programme and the biogas programme. The same has been true to the cook-stove and the LPG programmes. In some cases, biogas subsidy is extended to the households that are using improved Chulha and vice versa. This leads to duplication of efforts and of resources that could have been applied productively elsewhere.

Poor access to credit

Owing to the cumbersome procedures involved in accessing formal credit and reluctance of formal banking institutions to provide credit to the poor for meeting their household energy needs, the latter have remained outside the mainstream; more so, because they are unable to provide the required guarantees. Hence, financial packages for rural energy programmes also have to be taken up as part of the comprehensive planning approach if they are to make the desired impact.

Ineffective Subsidy Administration

The subsidies that were intended for the rural poor have largely been ineffective and subsumed within the delivery systems without benefitting the poor adequately. Design of more direct cash transfers are currently being seen as the way forward in making subsidies more effective but several systemic challenges, including financial delivery mechanisms have to be laid out for these to be effective.

For DDG projects, subsidy is linked to benchmark capital cost which means that the subsidy in India promotes capacity addition rather than generation in DDG projects. There is need for evolution in subsidy mechanism which encourages installation of sustainable project across all the regions/areas. Part capital subsidy as up-front and operational incentives linked to performance, distributed over project life must be designed to provide a bias for sustainability of operations instead of mere capacity addition.

5. Key Challenges for Energy Access

Providing electricity access to the vast rural population poses many technical, financial and institutional challenges. However among these larger set of villages, in over 18,000 villages, the challenge is higher manifolds. These 18000 villages have been identified as remote villages where grid extension is not feasible due to physical and economic constraints and where locally available resources, mostly falling in the renewable energy category have to be effectively utilized. Even where grid extensions are feasible, cost of supply vis-à-vis affordability has been a concern.

Key Options for addressing the challenges for Energy Access

The two basic routes for the provision of sustainable energy services across the globe are

- Grid Extension (GE)
- Decentralized Distributed Generation (DDG)

Grid extension involves developing dedicated transmission and distribution infrastructure to reach each and every village while on the other hand, DDG comprises of small, modular, decentralized off-grid energy systems (or in some cases grid connected systems which are then called dispersed generation units) located in or near the place where the energy is to be consumed.

Grid extension while preferred suffers from some great constraints

Grid extension has been the preferred source of energisation across the globe due to better quality of services, higher technical reliability, continuous supply, cheaper costs and simpler as well as centralized planning, execution and management. However where grid extension has had problems is in the huge upfront investments and costs of planning and constructing the grid. These investments are all the more higher in case of remote locations due to one, low penetration of consumers and load and two the tough terrain across which the grid has to be extended. Therefore grid extension turns out to be a costly solution if connecting remote locations or highly dispersed consumers (population sets or loads) spread over a large area. The other issues with grid extension are the high costs of maintenance of a large distribution networks, high transmission and distribution (T&D) losses and the inefficiencies brought in by large utilities in the delivery of these services. In India for example most utilities are in dire fiscal states and cannot afford the financial burden of grid extension as well as sustainable power provision at current tariff levels over the medium to long term.

DDG, while expensive has a number of advantages

Besides grid based electrification, DDG is the other option for rural electrification. DDG projects have been successfully implemented across the world in the United States of America, Cambodia, Nepal, China, India, and Philippines to name a few. DDG projects can be conventional or renewable based. Over time DDG projects based on renewable resources are becoming the preferred option for a variety of reasons like local access to energy sources (be it water, radiation or biomass), savings on transport (of fuel) and reduction in costs of developing fuel supply chains, cleaner generation, boost to the local economy etc. DDG projects, although more expensive to commission, tougher to operate and maintain and still unable to provide continuous energy, however are increasingly being seen as viable options for long term energisation and energy security due to the availability of sustainable local energy resources. Advancements in technology is making these systems easier to install and more reliable to operate, while at the same time bringing their costs to manageable levels.

The other key factor promoting the use of DDG for rural electrification, especially in countries like India, Nepal and Bangladesh is the lack of adequate centralized energy generation available for meeting continuously growing energy demand, especially rural demand.

Relevance of Off Grid (DDG) in India

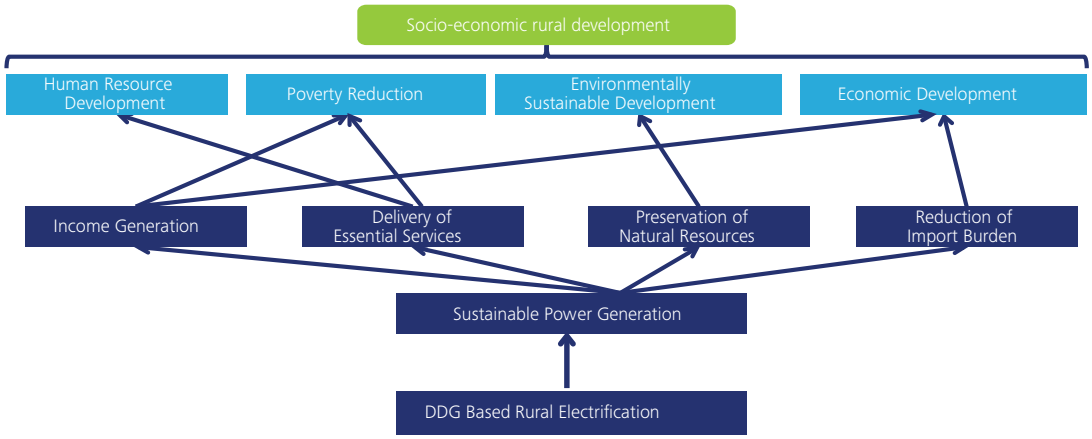
The biggest challenges facing South Asian Nations like India with regard to energy access is the lack of access to grid based electricity in the rural and remote areas. In case of India, rural electrification is marred with both demand and supply side constraints. On one hand utilities are not able to provide quality supply to rural areas, on the other hand a large majority of consumers in rural areas are not able to pay the real cost of services in the given circumstances. With remoteness coupled with tough topography in some of the regions, high loss levels and low connected loads, high cost of services act as deterrents for suppliers like utilities, lack of integration of economic development programmes with electrification act as major deterrent for consumers. Further, the cost of setting up the grid and associated infrastructure is high and time taking which results in a number of areas especially remote areas remaining neglected for long periods.

Furthermore India has a number of areas where even though the grid has is in place, electricity services are not available due to a variety of reasons like lack of generation, frequent breakdown of key equipment, lack of spares, limited transmission and distribution capacity at key nodes, or low returns and high commercial losses for delivery of these services. Examples of these types of cases include a large number of villages in India in states like Bihar, Uttar Pradesh, Madhya Pradesh, Chhattisgarh, Jharkhand etc. Even in fairly developed states such as Haryana and Rajasthan, daily power cuts are normal (especially in the peak seasons).

The state of affairs in rural electrification is making it increasingly clear that while grid extension is required, simultaneous development of large scale DDG projects based on local renewable resources is also critical keeping in view the large spikes in energy demand forecast in the coming few years. DDGs operating in an isolated mode may only be a transitory step to a future scenario where integration of these DDG projects takes place into the larger grid as dispersed generation becomes the norm (in light of higher costs of fossil fuels and increasing energy demand).

DDG systems have a definite positive impact on the rural economy due to the introduction of a new revenue generating entity (the DDG unit) into the system and the jobs that are created due to its establishment. The usual benefits that come with electrification are higher productivity and better access to resources and improved awareness and communication. The figure below depicts clearly, the kind of impact that DDG has on poverty alleviation and rural development.

Figure 2: Rationale for Distributed Decentralized Generation



Source: Deloitte Analysis

Some of the advantages of RE based DDG projects have been listed below in the table:

Table 4: Advantages of Off Grid Based Electrification

Area	Advantages
Environmental	• Does not involve typical environmental issues associated with large plants • Provides alternate energy options for rural areas • Enhances environmental awareness among communities
Social	• Attractive option for Rural Electrification for both grid-connected/ off-grid systems depending on size • Catalyst for economic and social well-being in small, scattered rural areas • Rural employment opportunities in construction/ operation • Local community involvement in management/ operation
Economical and Financial	• Cheaper option to costly grid extension in low-demand remote areas. • Reduces peaking stress on grid through meeting incremental demand/ rural demand and avoidance of losses
Sustainable	• It promotes use of indigenous resources which will make provisioning of energy not only cost-effective and reliable but sustainable as welln

Source: Deloitte Analysis

Off-Grid based Rural Electrification - Key Programmes and Projects

The attractiveness of renewable energy technologies (RETs) such as wind, solar, and biomass lies in their abundance. Since most rural communities consume small quantities of electricity, extending grids may not be viable. Therefore, the other decentralized forms of energy using local renewable resources with technological improvements can be considered. Decentralized energy production and distribution may also provide opportunities for rural development and encourage local institutions to manage their energy needs.

Interventions in this field have the potential to bring about drastic changes not only as far as access to basic services is concerned but also to the economic prosperity of the rural landscape. Provision of energy could translate into provision of water, healthcare, ICT's for information and market access, education, lead to reduction in deforestation, enable people to take up a host of occupations related to delivery of basic services and reduce time/resources spent procuring wood etc.

RET's (renewable energy technologies) such as wind, solar, and biomass have the ability to solve the above problems, encourage a host of economic activities related to this industry and provide a complete solutions approach to other basic service providers as far as delivery of energy services is concerned. These provide just the attributes required for delivering rural energy services like modularity, decentralized operation, low repair and maintenance and flexibility in use especially when it is seen that a large number of rural communities consume very low quantities of electricity, extending electricity grids may be less economically viable. The biggest obstacle in this regard seems to be the relative high economic cost of RE technologies, which could go down drastically with scaling up of the use of these services.

To understand RE based DDG projects as well as the issues around these projects, it is important to understand the various government and non-government pull programs or schemes which have been instrumental in their development.

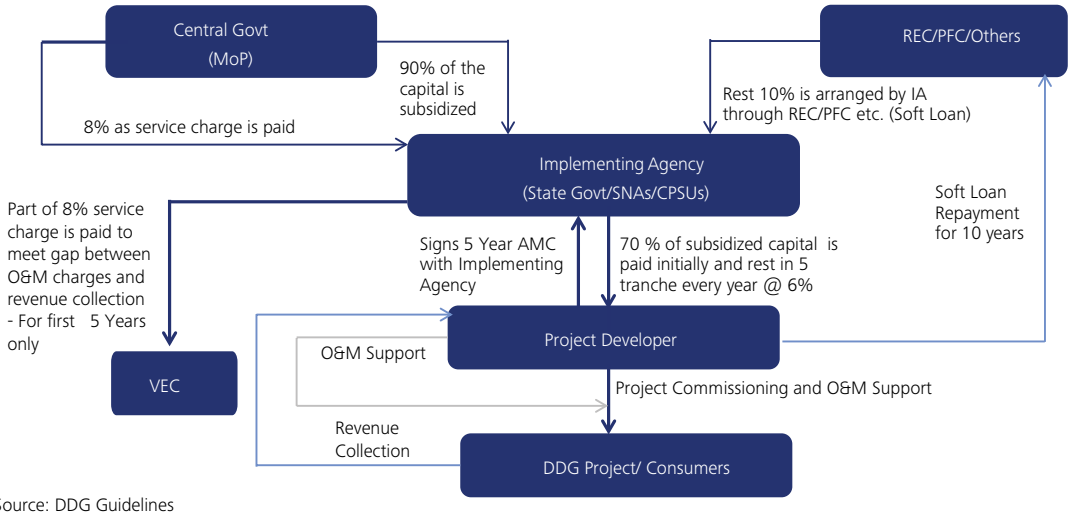
RGGVY (Rajiv Gandhi Grameen Vidyutikaran Yojana)
This is the most recent, largest and the flagship program of the Government of India, Ministry of Power (MoP), India for rural electrification. The RGGVY programme was launched in April 2005 with the aim of electrifying all the un-electrified villages and providing electricity connections to 2.34 Crore un-electrified Below Poverty Line (BPL) households by 2009 at a cost of Rs. 16,000 crores. As per MoP figures, by March 2011, RGGVY, has been able to, in the course of the last six years, electrify 96,000 villages, raising the level of village electrification from 74% to 91% and provide electricity access to around 1.75 Crore rural households, largely BPL, raising India's household electrification from 44% to 56%. However the programme still suffers from a number of challenges, the chief among them being around the quality of power supply, sustainability of infrastructure and the contribution of this initiative to rural development.

The initial RGGVY document also targeted decentralized generation for rural electrification in year 2005. However it was only in January 2009 that the MoP came up with the "Guidelines for village electrification through Decentralized Distributed Generation (DDG)". According to these guidelines, RGGVY shall also undertake development of DDG projects in remote villages where grid shall not reach for the next 5-7 years, barring the ones being electrified by MNRE for electrification.

The DDG component of the programme has a capital budget outlay of around Rs 540 Crore for the Planning Commissions XIth Five Year Plan period. The DDG component scheme involves a capital subsidy of 90% which is provided by the central government and rest 10% is arranged by Implementing agency at the state level. These implementing agencies can either be state government departments like the state renewable energy departments or any central public sector undertaking like NTPC. 10% of soft loan can be provided by either the Rural Electrification Corporation (REC) or the Power Finance Corporation (PFC).

The model used under this scheme is BOMT (Build Operate Maintain and Transfer) wherein private project developers initially bid for development of the project/s. The bid is for both capital cost of the project as well as the cost of supplying power. The scheme under the programme provides for 90% capital subsidy (of total project cost/Indicative Price under DDG guidelines). This subsidy is provided to the project developer in tranches starting from project commissioning to 5 years after project commissioning. The first tranche of 70% of the total capital subsidy is provided just after project is commissioned and rest 30% is provided to the developer in annual tranches over 5 years period (6% per annum) which is also the duration of Annual Maintenance Contract (AMC) under the agreement that is being signed between the implementing agency and project developer. The broach schematic of the project under this scheme is provided below.

Figure 3: DDG scheme under RGGVY Programme



Source: DDG Guidelines

It is worth mentioning that several of DDG projects in India have been installed with capital subsidy but only a very few have been able to manage and sustain operations[4].

The RGGVY programme and the DDG scheme under the programme is a move in the right direction for developing DDG projects as this scheme provisions subsidy disbursal over a 5 year period and also allows for provision of service charges (8% to 9% of the project cost/indicative price) for meeting any viability gap which may arise between the operational costs of the project and the revenue collected through tariff for the first 5 years (this would also include recovery of the 10% which the developer may have arranged as a loan) when the private player is maintaining the plant in close association with the Village Electricity Committee (VEC). Thus this scheme provides a payment security to the private players.

A VEC is established to ensure community involvement in the project. The VEC is supposed to maintain the plant after 5 years of plant operation. During the first 5 years tenure, members of the VEC are trained by the project developer in plant maintenance and management.

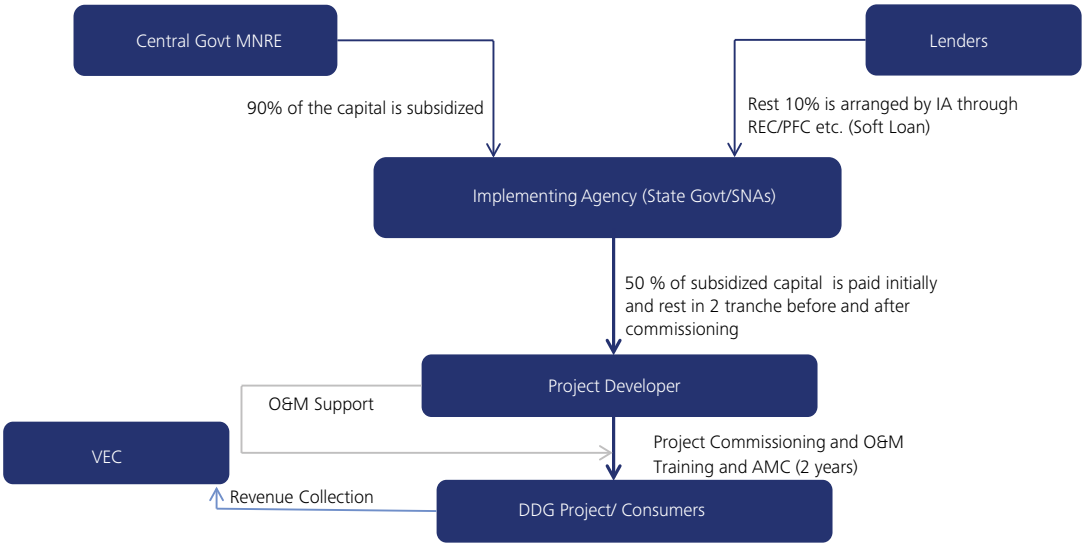
The DDG scheme under the RGGVY programme has borrowed a number of features from previous programmes and added a few innovations of its own. Some of the key features of this scheme are:

- Allotment of the projects based on bids with project which have come in from the learnings from the National Solar Mission
- Subsidy provision to these projects is based on the benchmark costs of of each technology which are determined by the Ministry from time to time
- 90% capital subsidy which is an old benchmark from RVE
- Provision of subsidy in tranches over 5 years to ensure that developers stay connected with the project and ensure its operation over the first five years at least
- Provision of service charge which allows the developers to meet higher O&M costs rather than depend upon the community

As the first sets of projects under this scheme are in the process of being allotted, it is too early to comment on the key impact as well as the success/ failure of the scheme design.

4 RREC installed some 80 SPV projects in Rajasthan under PMGY scheme but after few years almost all the projects were found non-operational due to lack of operational expense covering funding.

Figure 4: RVE Programme



Source: RVE Guidelines

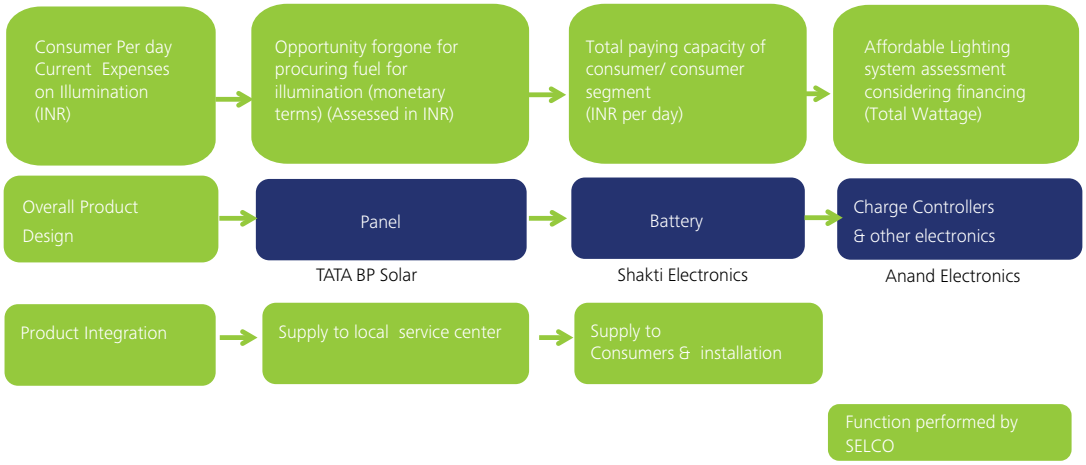
Remote Village Electrification Model (now Remote Village Lighting Program)

This was the flagship scheme or program of Ministry of New and Renewable Energy (MNRE) and was started almost a decade ago (2002-03). The objective of RVE is to electrify all the remote census villages and remote hamlets of electrified census villages through non-conventional energy sources such as solar energy (Solar PV), small hydro power, biomass, wind energy, hybrid systems, etc. This programme covers all villages which were not covered under RGGVY grid connected program and have been designated as remote.

Under the scheme under the RVE programme, the Ministry of New & Renewable Energy (MNRE) solicits proposals from state level implementing agencies for remote villages (areas where grid extension has been found to be economically or technically unfeasible). Till December 2011, MNRE had received and sanctioned applications from villages and hamlets in 26 states, with the most applications approved from the states of Assam (2,157), Orissa (1,447), West Bengal (1,210) and Tripura (1,006). However the RVE program has till now covered more than 95% of its villages through decentralized systems like solar lanterns or solar home systems (SHS). Very few village have been electrified with renewable energy based DDG plants/ mini grids. The RVE promotes a BOMT (Build Operate Maintain and Transfer) model like the DDG scheme under the RGGVY program, however a number of differences exist between the two programs. As shown in the figure above, the modalities of this program almost converge with that of the RGGVY DDG programme. Under this programme, the central government (MNRE) enters into an MoU with state governments and hence state governments or state nodal agencies are designated as the implementing agencies for these projects. Private players build the projects, maintain them for 5 years under AMC and then transfer the projects to the state government or SNAs.

90% capital subsidy is provided under the program and rest 10% is either made available from the state government fund or from consumer contributions. The 90% subsidy is made available based on cost benchmarks set by the ministry for each technology. It is pertinent to mention here that under this programme the maximum limit of Central Finance Assistance (CFA) or capital subsidy has also been fixed.

Figure 5: SELCO's Business Model



Source: Stakeholder consultations

This scheme doesn't have any provision for meeting the viability gap between operational expenses and revenue earned and thus it is found that more than 95% of villages/hamlets being electrified under this scheme are through SPV decentralised home light systems (these projects have very low O&M costs and no requirements for fuel costs). The ownership of DDG power plants after 5 year AMC period is transferred to the Village Energy Committee (VEC) whereas in case of the decentralised systems the ownership is transferred to the consumers.

The RVE programme has been facing a number of issues in its implementation, the biggest being the commissioning of projects due to the limited capacity of implementing agencies and lack of coordination between state agencies for project implementation.

Purely Private Model

Projects under this model generally include providing lighting through decentralized applications like solar lantern or solar home light systems. Players like Dlight in northern parts of India and SELCO in southern parts of the India are among few players in this segment. Former one use the carbon benefits under Kyoto Protocol whereas the latter facilitates cheap financing of its systems to end consumers through local small and cooperative banks. However there are two players - Husk Power who has provided DDG based rural electrification service through biomass gasifiers in Bihar and SELCO which has used priority sector lending with customized product design to set up an alternate market for solar PV based applications.

The SELCO model

The SELCO model for the sale of solar decentralized applications is based on quality and relationships. The quality of products is never compromised and relationship built with suppliers, banks and customers are maintained. The business model followed by SELCO is highlighted below

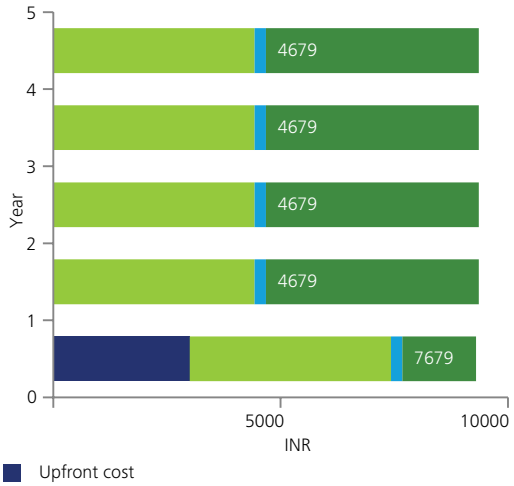
- SELCO uses the most reputed Indian module suppliers to ensure the quality of modules/panels.
- SELCO starts the product design after identification of an energy destitute group and understanding of their per day paying capacity. This is generally the amount spent by this group on kerosene for illumination in addition to opportunity forgone for procuring the fuel for illumination.
- Once the total paying capacity or potential cash flow is estimated, the product is designed.
- Modules are procured from TATA BP in bulk to enjoy cost of economies.
- Limited suppliers for battery and other electronics having experience in blending the TATA BP products made for European markets into Indian conditions are used.
- Except TATA BP, other suppliers are very small units in scale and hence no excise duty is paid by them. This keeps the cost low.

Once a product is designed and manufactured, SELCO uses its relationship and tie-ups with several commercial banks, Regional rural banks, Rural Farmer cooperatives and MFIs to facilitate the loans to consumers. The tentative cost economics for SELCO products is based on the consumers ability to pay Rs.13 per day (and 15% upfront cost paying capacity or grant availability) and be provided with a 4 light SELCO home-system costing around Rs. 20,000. This is with the following assumptions:

- Loan up to 85%
- Soft loan @ maximum of 10% per annum
- 5 year tenure for loan
- SELCO AMC for 5 years with nominal charges

The cost to SELCO is around Rs 17000 and selling price is Rs 20000. A consumer ends up paying around Rs. 2600 over a period of 5 years. The most important aspect is payment of upfront cost of Rs 3000. This is generally granted by various agencies like E+CO, Lamelson foundation, Good Energies etc. SELCO utilizes the grant in a better way by not covering the cost of entire system and distribute the grant over many others by paying the upfront cost. This was a consumer only spends an amount equivalent to his/her prevalent expenditure on kerosene and still get a better and clean illumination.

Figure 6: SELCO's financing mechanism



Source: Stakeholder consultations

Husk Power Model

The Husk Power Model is again based on first calculating the paying capability of the consumers and hence providing them with most optimized energy. Two major types of models with per month recovery from each household are used, i.e. either Rs 275-278 or Rs 100. The connection points and luminaries are dependent upon the models shown in table below (based on backward calculation and secondary literature review).

Table 5: Husk Power Model 1

Equipment Per Household/ Connection	Numbers	Wattage	Hours of Operation	Total Watt-hours
CFL	3	17	6	306
Fan	1	40	6	240
Mobile Charger	1	10	2	20
CFL Cowshed	1	17	2	34
Total Watt Hours per day				600
Per Unit Charge Calculations				
Kilo watt hours per month				18
Total Recovery Per Household per Month				278 Rs
Per unit charge out rate				15.28

Source: Deloitte research on MoP and MNRE programs

Table 6: Husk Power Model 2

	Numbers	Wattage	Hours of Operation	Total Watt-hours
CFL	2	15	6	180
Fan	0	0	0	0
Mobile Charger	1	10	2	20
CFL Cowshed	0	0	0	0
Total Watt Hours per day				200
Per Unit Charge Calculations				
Kilo watt hours per month				6
Total Recovery Per Household per Month				100 Rs
Per unit charge out rate				16.67

Source: Stakeholder consultations

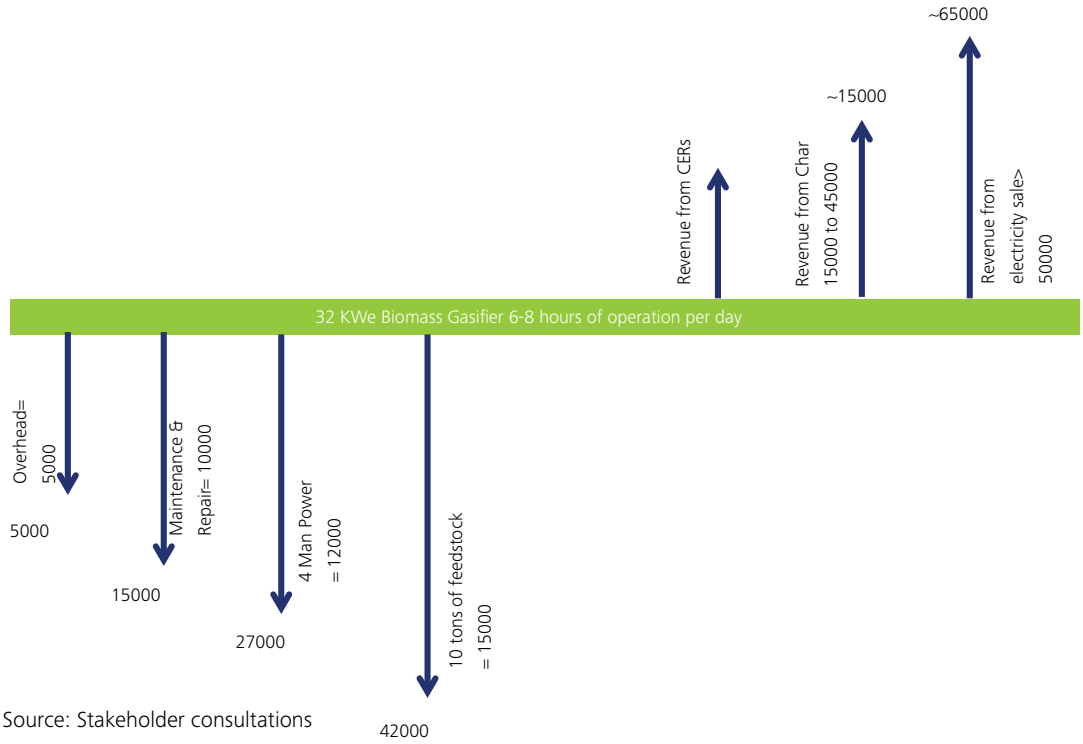
Based on the energy requirements in an area the gasifier is designed by Husk power itself. The luminaries and distribution system is also managed by Husk power. The company also charges margins from its partners Havells on the luminaries sold to consumers. Cost economies for a 32 KWe biomass gasifier of Husk power as used in 2011 has been shown below:

- Overhead includes the financing cost
- Tenure is for 20 years
- Repair and maintenance of biomass gasifier per month is around Rs 10,000
- Trained man-power cost is around Rs 3000/man with 4 person at a plant
- Rice husk cost from captive area is Rs1/ kg; blending the same with fuel from other sources an average of Rs. 1.5/kg is generally paid.

Overall revenue from consumers and others (CERs, Char monetizing) must provide overall cost recovery and returns.

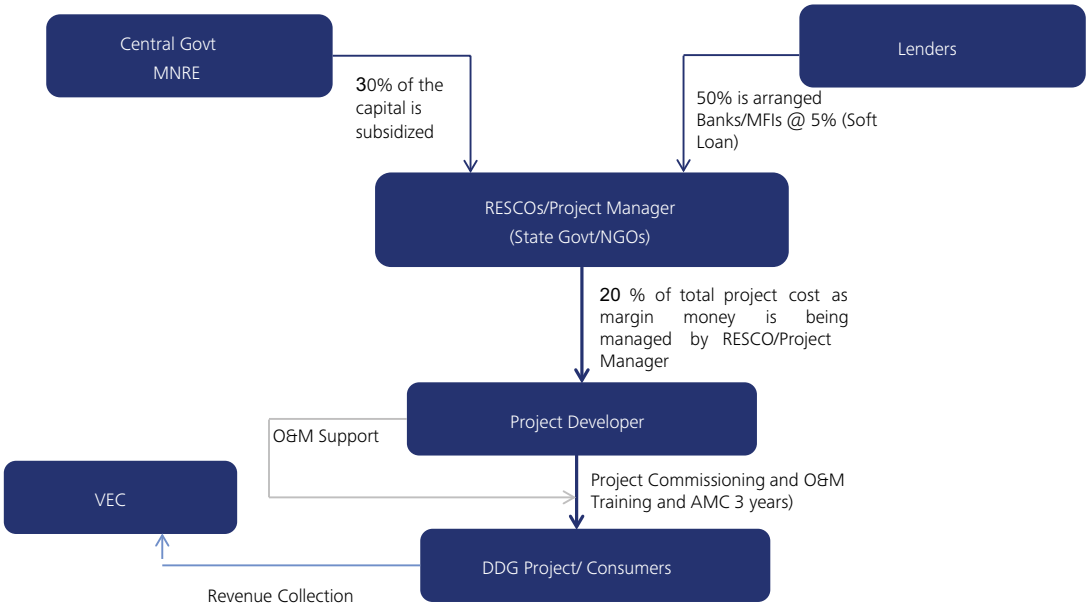
The most important aspect of this business model is capital subsidy from MNRE which can go up to 90% of capital cost of Biomass gasifier. The rest 10% can be taken on soft loan or can be funded by grants from various agencies like Shell foundation, Acumen Fund, Bamboo Finance, International Finance Corp, Draper Fisher Jurvetson, LGT Philanthropy etc.

Figure 7: Cost economies for 32 kWe biomass gasifier



Source: Stakeholder consultations

Figure 8: JNNSM Rural Electrification Scheme



Jawaharlal Nehru National Solar Mission (JNNSM)

One of the key components of the recently launched JNNSM is small and off-grid Solar PV applications which include the DDG based power plants. Over the last year JNNSM has added around 40 MW of capacity which includes some decentralized applications. The states of Chhattisgarh, Jharkhand and Punjab have had some villages electrified recently through Solar PV DDG systems in year 2010-11.

The business model proposed under the JNNSM programme includes a 30% capital subsidy and 50% of project capital cost coming in the form of soft loans from MFIs/Banks (which would be refinanced from REDA/NABARD at a 2% interest rate). The rest 20% of the margin money has to be arranged by the project manager or the RESCOs themselves. This is a build and transfer model in which the project developers transfer the ownership to the RESCOs after building the plant but maintenance services are provided for a contracted period.

As margin money has to be borne by the RESCOs, this model is generally more apt for commercial segments like telecom towers, hospitals, industries, schools, colleges etc where the savings in energy cost is shared between the RESCO and consumer of energy and thus RESCOs earn returns on their investments. For electrification of villages under this program, the state governments would have to fund the margin money or provide revenue returns to the RESCOs. This model is relatively new and thus not much can be said about its impact at the ground level.

Key Challenges for DDG Projects in India

It has been seen that RE based DDG projects across the world have been successful in areas where demand exists and DDG has been found to be economically viable. However, successes at the local level or the micro level have rarely been scaled up. This is due to a number of institutional, financial and technical reasons. In this section we look at the basic barriers that have constrained the development of RE based DDG projects especially in a market like India which dominates the South Asian landscape.

Geographical Distribution

Even with efforts of reducing the gap in demand and supply of energy for already connected populace, Government of India has been attempting to make electricity available for all villages and electrify them as soon as possible so to adhere to the mandates under the National Electricity Policy (NEP). However India has a vast number of villages distributed across far flung areas where geography and topography don't justify the extension of grid to meet low load levels.

Multiple activities/ agencies in implementation process
Installation of DDGs has to go through various stages and different agencies are involved in the process. The Activities which are carried to develop DDG and stand-alone rural electrification projects are shown in the figure alongside. Also shown is the responsible agency for each of the activities. It can be seen that for most of the activities Rural Electrification Corporation (REC) or State Nodal Agencies (SNAs) are responsible and concerned ministry has the responsibility of approving the detailed project reports. For identification of states and preparation of DPRs both REC and respective SNA can engage the external consultants or agencies but the responsibility stays with them.

Lack of on ground institutional support
The DDG based on renewable energy mainly caters to the remote areas. Remote areas face issues related to lack of the local technical & management capacity for operation & maintenance. This hinders the successful operation of the DDG based system and can further increase the cost of running such systems, thereby impacting the financial viability also. Owing to the remote location of the renewable energy based DDG system, usually the distance between the local manufacturer/service providers is large. Visits of the local manufacturer/service provider to provide support are therefore expensive and not executed regularly. Lack of planning to keep sufficient feedstock for the biomass based DDG systems and mismatch between the needed electricity for use of specific applications and the supplied energy can further impact the performance of the DDG systems.

DDGs have high financial cost for low income generation populace
DDGs have the ability to provide electricity to areas where grid can't reach but the local distribution and maintenance cost associated with these projects makes the cost of generation higher than the grid electricity. Population having very low level of income finds affording this electricity difficult unless suitable financing mechanisms are not put in place.

Focus on a target based approach rather than sustainable energy supply
In the past in India a large number of off-grid electrification projects have failed as the focus of the projects as well as project initiators has been on technical installation of the equipment and its initial operation rather than focus on long-term sustainability. This is due to the nature of the design of the programmes. Most programmes in India are designed and implemented on a top down target based approach in which each programme has a budget attached with it which in turn is converted into a capacity or a number of systems which have to be installed. This approach provides limited or no support in the form of back up funds and support for O&M, technical support for sustainable operation, development of spares and sustaining the supply chains, etc. Although recent programmes like the RGGVY (DDG component) & the RVE have started putting in place measures to try and ensure that the systems work for at least a certain period of time, until sustainable institutional arrangements at the local level are created, these problems will continue to afflict the Indian rural energy sector. For most stakeholders, government DDG programmes are seen as another target to be achieved with little or no focus on the results, product development and customization to local needs, sustenance, after sales service.

Limited market development and poor performance of energy programmes
Structural failures, poor quality control, lack of repair and maintenance infrastructure, and limited local capabilities have added to the poor performance of almost all RE based DDG programs in India. Added to this the high subsidies on commercial fuels like kerosene, electricity, inadequate budgetary allocations for these programmes and limited investments in R&D for rural RE technologies have also contributed to the slow dissemination of technologies. The way forward today is being shown by the market, which in the last decade has clearly pointed to a need for promoting and facilitating commercialization of energy-efficient and renewable energy technologies. This would entail setting up of energy service units in rural areas, undertaking market assessments, setting up marketing and supply channels, mechanisms for decentralized credit and finance, product customization, and training of different stakeholders.

Lack of local institutional support
DDGs based on renewable energy mainly cater to the remote areas which in turn face issues like lack of local technical & management capacity for operation & maintenance. This hinders the successful operation of the DDG based systems and further increases the cost of running such systems, thereby impacting the financial

viability of these projects. The remote location of these projects usually means that they are located at quite a distance from the manufacturer/service provider, which makes visits from the manufacturer/ service providers more expensive and irregular.

Program effectiveness

Some key issues impacting the program effectiveness are detailed below:

- Lack of participation by local governance institutions: Lack of any direct linkages and support from local governance institutions like Panchayati Raj Institutions, Forest Committees, local community organizations and NGOs has been limited for the design, deployment and operation of RE DDG programmes. Experience from parallel sectors, such as rural water supply, and natural resource management, demonstrates significant potential benefits from greater participation of local institutions. There is a need for these institutions to be formally involved in the design, implementation and operation of these programmes.
- Lack of performance monitoring of the DDG projects and systems and adequate staggering of disbursement of grant/subsidy by the government

Figure 9: DDG project Implementation Cycle under the RGGVY

Source: RGGVY DDG Guidelines

Willingness to pay

Successful deployment of DDG based renewable energy interventions are contingent on widespread willingness to pay amongst rural households and energy users. It has been seen that electricity consumption has high value for rural households where electricity access exists. At these places the willingness to pay for efficient energy services is high (as has been highlighted by models such as Husk Power and Sunderbans), even amongst poorer households. The average tariff paid by poor households in the Sunderbans ranges between Rs.5 to 7 per kWh, which is higher than that paid by most urban consumers in large cities.

The key challenge is first getting the population in remote villages to experience and get used to the advantages of DDG installations. However the present programme structure as well as the high entry costs results in very few villages/ families adopting these systems. In cases like Gosaba and Sagar in the Sunderbans, consumers have been known to pay a very high premium for DDG based power as they have experienced it and have integrated it into their economic and social milieu. Here it has been seen that rural communities are able and willing to pay for reliable electricity services, especially where good quality electricity connections exist as the positive impact on rural incomes offsets the higher cost of electricity supply. If electricity generation and supply is directly tied to income-generation activity, the community's ability to pay for electricity services are further enhanced.

Poor Access to Credit

Low access to credit also means that these poor consumers usually also lack the capital to even pay for basic connection charges. This is due to the consumptive nature of energy and cumbersome procedures involved in accessing formal credit and the reluctance of formal banking institutions to provide credit to the poor for meeting their household energy needs, especially in the remote areas. The poor are unable to provide the required guarantees and hence, financial institutions do not develop packages for decentralized rural energy programmes.

Lack of Adequate Information/data for Market Development

Limited data and information exists for most project developers trying to provide rural energy solutions and enter the clean energy DDG market. In the case of

India, 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, this data is neither shared nor collated into a single database for an informed decision making system either by the government or private sector.

Limited site specific site options

The DDG based renewable energy projects are site specific and may face issues related to limited option for technology selection owing to its dependence on the availability of the locally available renewable energy resource, dispersed population/low level of population density may offer low level of demand resulting in short hours of operation of the system thereby impacting the viability.

Financial viability

Financing is a major issue related to the DDG systems based on renewable energy. The major components related to cost are capital cost and operation & maintenance cost. The relatively high capital cost and operation & maintenance cost results in the overall high cost of generation related to these systems. The rural households, owing to the lower income levels, are generally able to meet the operational costs and some part of the capital cost related to the DDG systems. The relatively high capital expenditure requires the government to provide support in the form of capital subsidy/grant in order to meet the financial viability of the DDG systems. The involvement of the local community stake in a way enhances the viability of the project.

Alternative Energy Promotion Centre (AEPC) in Nepal has been implementing various mini-grid and off-grid renewable Rural Electrification projects, where the contribution of the community is as high as 50% of the project cost. This has increased the sustainability of the project as the communities themselves set the tariff, manage the project, ensure O&M, and also undertake other development work in the village from the fund created under the project.

Risks associated with developing a marketing enterprise in RE technologies

Entrepreneurs face issues like competition from highly subsidized RE products being marketed by the state REDA's under the MNRE programmes. These government programmes are often seen as another target to be achieved, and as a result, the product development and customization to local needs, sustenance, after sales service is poor. Added to this problems associated with awareness and the quality of RET products, entrepreneurs usually end up developing a marketing structure that is doomed to fail from the beginning. Additionally, the marketing skills and knowledge of entrepreneurs regarding RETs are often not very developed. Added to this, entrepreneurs face large pre-investment risks associated with the costs of marketing, contracting and information collection.

Another area where entrepreneurs have to face huge risks as well as make investments up front is the supply chains. In rural areas, strengthening the "supply-chain" for service delivery is essential. For example, in case of SELCO, the start-up required access to huge amounts of funding initially to set up its marketing and supply chain operations. A reliable supply chain of goods and services is essential to the sustainability of infrastructure investments. In rural areas, for example, having spare parts available on the local market and trained mechanics to make repairs and installations is important if the benefits of access to sustainable energy services are to be realized.

Small scale local entrepreneurs may also need to be made aware of the market growth potential in the sector and be provided with initial assistance in market research and development. In order to encourage such innovation and ownership, micro credit schemes have supported the development of local capacities to plan, execute, maintain and finance rural infrastructure.

Need to focus on the use of DDG based power for income generating activities

Access to electricity is often a constraint for rural non-farm production. Availability of off-grid power can enhance the ability of local producers to improve their earning potential by rising outputs and being able to take on tasks that were earlier not possible. In some sectors, availability of power may also result in the possibility of longer working hours thereby increasing productivity.

6. Discussion Points

- Can the focus of providing energy for all be facilitated by the development of a comprehensive integrated rural energy policy?
- Can the integration of various programmes across ministries into a single integrated energy access programme flowing from the comprehensive integrated rural energy policy?
- Has the Electricity Act 2003, the National Power Policy and the Rural Electrification Policy been successful in encouraging the development of DDG based projects in the rural areas? If no, then what are the changes required for providing the much needed fillip to the DDG sector?
- Is there a need (at the institutional level) for the creation of a partnership framework for agencies working across sectors to deliver integrated energy services or the creation of a single agency like the REC (USA) with joint ownership from various ministries to take on the task of rural energisation?
- How can we be more effective in combining centralized target setting using bottom up planning and decentralized implementation?
- Is there a need to shift focus of rural energy delivery from providing access to energy services (through build up a massive rural electricity infrastructure) to a more service oriented indicator like availability of electricity at the rural household level?
  - Is there a need for a Key Performance Indicator for measuring adequate and quality power for a certain minimum number of hours to the rural network?
- Is there a target (for rural household energy consumption) for the future and the development of a roadmap to transit to that target – focus on starting small and building on it?
- Is there also a need to shifting focus of rural electrification programmes from lighting to addressing productive loads?
- Is there a need for developing a hybrid subsidy delivery mechanism which is part capital subsidy part generation based incentive?
- What is the way forward for encouraging the development of Public Private Partnership Projects for rural energy delivery?
- What are the main structural barriers which are limiting the investment by the private sector into India's rural energy sector?
- What are the key steps which need to be taken to promote household based energy security in rural India?

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India Energy Congress (IEC), an apex congregation of energy professionals from across the sector, is the annual flagship event of WEC India. The Congress is growing in stature with every passing year. At each edition of the congress professionals across the sector from with in the country and across the globe come together to deliberate on issues highly relevant to the sector. Delegates gain immensely from the comprehensive discussions. The background papers are a definite take away. **Deloitte** has supported WEC India in preparing background papers for India Energy Congress 2013.

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