POLICY BRIEF ON BIOMASS BASED DDG PROJECTS

Village Electrification through Sustainable use of Renewable Energy (VE-SuRE)

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Embassy of Switzerland in India

TARA

Contributor

S.C. Rajshekar, Symbiotec Research Associates

Reviewers

Dr. Shirish Sinha, Swiss Agency for Development and Cooperation

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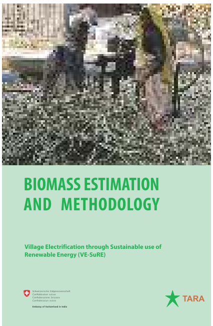
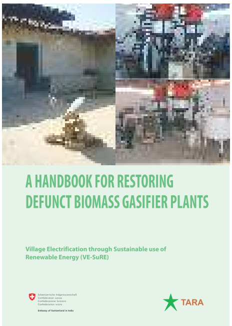
Branding and Designing Guidance

Ranjeeta Ghosh, Jay Vikash, Development Alternatives Group





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- Background to the policy brief paper
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1.1 Background

The Climate Change and Development Division, Embassy of Switzerland in partnership with the National Thermal Power Corporation (NTPC) aims to engage with the Government of India in a positive dialogue by supporting up renewable energy based off grid pilot projects for further up scaling through the through its "Village Electrification through Sustainable Use of Renewable Energy (VE-SuRE)" project. An outcome envisaged of this project is that decentralized, renewable power gains prominence in electricity policies and Rural Electricity Plans at the state and national level through experiences, lessons learnt and knowledge created through the project.

"Technology and Action for Rural Advancement" (TARA) has been identified as the "Project Management Unit" (PMU). The PMU is responsible for the overall project implementation and demonstration of sustainable Decentralised Distributed Generation (DDG) projects. The PMU commi-ssioned Symbiotec Research Associates (SRA) to carry out a study titled **"Policy Brief on Management of biomass based generation projects for their commercial viability, including role of Franchisees as per the existing regulatory framework".** This report is based on the study carried out by Symbiotec Research Associates during February-July, 2012.

1.2 Objective

The Government of India, through the Ministry of Power has been implementing the Rajiv Gandhi Gramin Vidyuthikaran Yojana (RGGVY) to electrify unelectrified villages in the country. The RGGVY has a provision to support Decentralized Distributed Generation (DDG) projects to electrify a village. However, despite making available a capital subsidy of upto 90% of the project cost, there are hardly any entrepreneurs coming forward to take up such projects.

The objective of this paper is

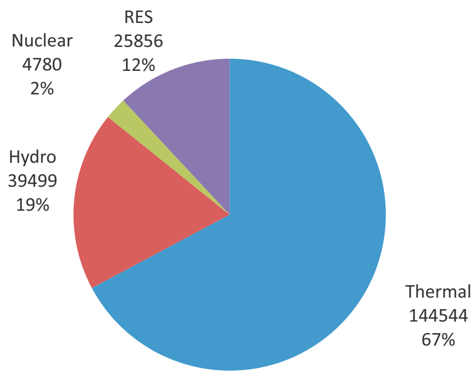
- To understand why response from entrepre-neurs to biomass based DDG projects under RGGVY has been poor and
- To understand what possible solutions to make the venture more attractive to ensure that the vast potential for biomass based DDG projects in rural electrification is realized.

1.3 Status of Electrification in India

India is the 5th largest generator of electricity in the world with a total installed generation capacity of 214,679 MW as of February, 2013[1]. Thermal power generation accounts for 67% of the installed capacity followed by hydro (19%), renewable sources (12%) and nuclear energy (2%). Share of renewable energy sources in the generation mix has increased from a paltry 2% in 2002 to 12% in 2013. What is impressive is that this growth in share has happened even as the installed capacity in the country doubled during the same period growing from 105,046 MW in 2002 to 214,679 MW in 2013.

However, despite such impressive growth in installed capacity, all is not hunky dory on the electrifica-tion front in India. As of November, 2012, 94% of the 593,732 villages in India have been electrified and only 34,887 villages are yet to be connected to the grid[2]. A majority of these villages are in Uttar Pradesh, Bihar and Odisha. However, a whopping 75 million rural and 6.5 million urban households had no access to grid electricity in the country. A further 33% faced under-electrification; just 50 units of power/household/ month were available to them. This transla-tes to just 10 units/capita/ month or an annual supply of 120 units/capita as against the national average of 746 units/ capita/ annum[3].

Figure 1.1:Source-wise Installed Generation Capacity



Source: Central Electricity Authority, 2013

[1] http://www.cea.nic.in/reports/monthly/executive_rep/feb13/8.pdf
[2] http://www.cea.nic.in/reports/monthly/dpd_div_rep/village_electrification.pdf
[3] Even this is very low as compared to

To further compound matters, the country faces a peak demand deficit of 10.3% with many highly electrified states such as Maharashtra facing peak demand deficit of upto 22%. To manage this, most DISCOMs follow a policy of diverting power from rural areas to urban areas, leaving rural areas with even less reliable power. This implies that connection to an electric grid does not guarantee that a rural household would enjoy use of the electricity, simply because in many cases there may not be enough electricity to supply! There is a growing realization that decentralized distributed generation of electricity is the answer to ensure supply of electricity to rural households, especially for those that are at the tail-end of the grid. Renewable energy sources, especially solar PV and biomass-based technologies have been identified as being highly suitable for deployment as DDG. Further given the wide-spread suitability of the country in producing biomass, power generation technologies based on biomass have been assess-ed as having a very high potential in improving access to electricity for rural households in the country.

However, as Table 1.1 shows[4], the promise of biomass has been as yet largely unfulfilled. Only 15% of the total potential has been exploited so far as against 38% for wind and 24% for small hydro power..

Table1.1: Installed Renewable Energy Capacity in India

Resource	Estimated Potential (MW)	Cumulative till February, 2013
Wind power	48,500	18635
Small Hydro Power	15,000	3552
Bio Power (including cogen)	23,700	3660
Solar Power	20-30 per km^2	1447

Source: MNRE, 2013

[4] http://mnre.gov.in/mission-and-vision-2/achievements/

1.4 Framing the Issues for the Study

Given that the problem to be addressed is:

Despite the high potential assessed for biomass based DDGs and the high capital and operating subsidies offered under the RGGVY-DDG scheme, no biomass based DDGs have taken off. What are the reasons?

A priori, for entrepreneurs to make investments, a project must provide **adequate and attractive returns on the investments, managerial efforts and the risks** taken by the entrepreneurs. This is influenced by the **performance of the project**, the enabling or disabling **environment created by policy** and by **institutional capacities** needed to execute and sustain the project.

Accordingly, this paper examines issues that affect biomass based DDG projects at the policy, project and institutional level and presents a way forward. These findings and insights are based on desk review of policies, regulations and programmes of the Ministry of Power (MoP) and Ministry for New and Renewable Energy (MNRE) and extensive project level performance reviews and discussions with owners/ operators/facilitators of selected biomass DDG plants[5].

[5] The plants were selected largely from VESP (Village Energy Security Programme of MNRE). They also covered a UNDP-GEF supported tail-end DDG plant

Section 2

- Definition of DDG
- Policy context for DDG in India
- Implementation of DDG through schemes and programme by Govt. of India

2.1 What is meant by DDG?

Decentralized Distributed Generation has been defined differently by different people and entities. **CIGRE**[6] (Interna-tional Council on Large Electricity Systems) defines distributed genera-tion as all generation units with a **maximum capacity** of 50 MW to 100 MW, that are **usually connected to the distribution network and that are neither centrally planned nor dispatched.**

The IEEE (Institute of Electronic and Electrical Engineers) defines distributed generation as the generation of electricity by facilities that are sufficiently smaller than central generating plants so as to allow interconn-ection at nearly any point in a power system.

Dondi[7] et al define distributed generation as a **small source of electric power generation** or storage (typically ranging from less than **a kW to tens of MW)** that is not a part of a large central power system and is **located close to the load.**

Some common elements emerge from a reading of the above three definitions. DDG systems:

- Have a plant capacity range that is smaller than a central power generating plant
- Are connected to the distribution network
- Closer to the load centre

Figure 2-1 provides a definition that comprehensively includes all these features and serves well as a working definition of DDG[8] and will be used as such in this paper.

Figure 2.1: Definitions of DDG

Ackermannetal. (2001), define distributed generation in terms of connection and location rather than in terms of generation capacity. They define a distributed generation source as an electric power generation source connected directly to the distribution network or on the customer side of the meter.

[6] CIRED, 1999. Dispersed generation, Preliminary report of CIRED working group WG04, June, p. 9+Appendix (p.30).

[7] Dondi et al. (2002) define distributed generation as a small source of electric power generation or storage (typically ranging from less than a kW to tens of MW) that is not a part of a large central power system and is located close to the load.

[8] Ackermann, T., Andersson, G., Soder, L., 2001. Distributed generation: a definition. Electric Power Systems Research 57, 195–204.

2.2 DDG within the Policy Framework

The impetus for DDG comes from the enactment of the Electricity Act (EA), 2003 and the National Electricity Policy (NEP), 2005 and the Rural Electrification Policy (REP), 2006. Specifically, the **EA, 2003** has the following legislative provisions to promote rural electrification:

- **Section 6–**which obligates the state government to supply electricity to all areas, including villages and hamlets.
- **Section 13–**which exempts the need for a distribution, transmission, and trading licence based on recommen-dation of the state government for local authority, Panchayath institution, co-operative society, or franchisees.
- **Section 14–**which exempts licence to a person who intends to generate and distribute electricity in a rural area notified by the state government. Furthermore, a person exempted under the 8th Proviso of Section 14 as above would also be free from purview of appropriate commissions in matters pertaining to determi-nation of tariffs.
- The retail tariffs for such exempted persons would be based on mutual agreements between such persons and the consumers.

A reading of the above sections reveals that the EA, 2003 provides several enabling conditions to promote DDGs for rural electrification. However, while it allows the retail tariff to be mutually fixed between the generator and the consumers, at the ground level, such operators have to often compete with very low priced grid electricity, however unreliable the supply of power from the grid may be.

Grid tariffs for rural areas are set very low because they are cross subsidized by higher tariffs being charged for other customers using the grid, especially industrial and commercial users. Such an arrangement is usually, not available to DDG power plants therefore, their tariffs tend to be higher.

Further, as Figure 2-2 shows the NEP, 2005 (Section 5.1.2 (d)) and the REP, 2006 (Para 3.2) state that DDG plants are the preferred choice for rural electrification where grid extension (GE) is not technically feasible or economically viable. Typically, such villages tend to be in remote and inaccessible locations with low and scattered populations and very low level of economic activities. In short, DDG is the preferred choice where ESCOMs would not like to go because GE may not be techno-economically unattractive.

Such an approach leads to DDG plants that are tiny in scale and located in remote areas with very low demand for electricity other than for lighting. Indeed, “DDG” would draw up in most minds an image of a tiny plant (1-10kW) that is operating in a remote forest village or in an inaccessible mountainous area in a stand-alone mode. A review of the DDG programmes of the MNRE and the MoP show that policy makers have indeed, viewed and restricted DDG to “small-scale off-grid remote applications, run by local entities”.

Figure 2.2: DDG in NEP, 2005 & REP, 2006

“Wherever above is not feasible (it is neither cost effective nor the optimal solution to provide grid connectivity) decentralized distributed generation facilities together with local distribution network would be provided so that every household gets access to electricity.” NEP, 2005 5.1.2(d)

“For villages and habitations where grid connectivity would not be feasible or not cost-effective, off-grid solutions based on standalone systems may be taken up...” REP, 2006 Para 3.2

2.3 Implementation of DDG in India

Policy orientation towards DDG described in the preceding section is amply demonstrated by the DDG programmes that have been / are being implemented by the MoP and the MNRE.

Remote Village Electrification (RVE) programme is being implemented by the MNRE in remote areas that have a population of <100. The programme aims to cover 10,000 villages. While the guidelines state that the most adequate technology would be used, >95% of all RVE installations have been Solar Home Lighting systems (SHLS). The programme is being implemented in each state through the State Nodal Agency (SNA). The RVE provides 90% subsidy on capital costs which also includes the cost of a 5 year Annual Maintenance Contract.

Village Energy Security Programme (VESP) was implemented by MNRE and covered all unelectrified remote villages that had 50-100 Households. The overall goal of the Programme was to provide energy to the villages through locally available biomass resources with full participation and ownership of the community and ensure enhanced livelihoods and improved quality of life. The emphasis of the VESP was on energy security at the village level with a further thrust on micro-enterprise development for enhancing employment opport-unity and economic viability of the Programme projects.

Based on a community-centred approach (see Fig 4-3), the Programme provided a one-time grant (up to 90 percent of the investment cost) to a village community (only in remote villages that are unlikely to be connected with grid electricity) for providing energy systems capable of meeting local energy demands. The villagers were expected to provide an equity contribution either in cash or kind. The Programme included several biomass based energy technologies of which biomass gasifier systems was the dominant application. VESP also mandated raising and managing dedicated planta-tions as feedstock in biomass gasifiers.

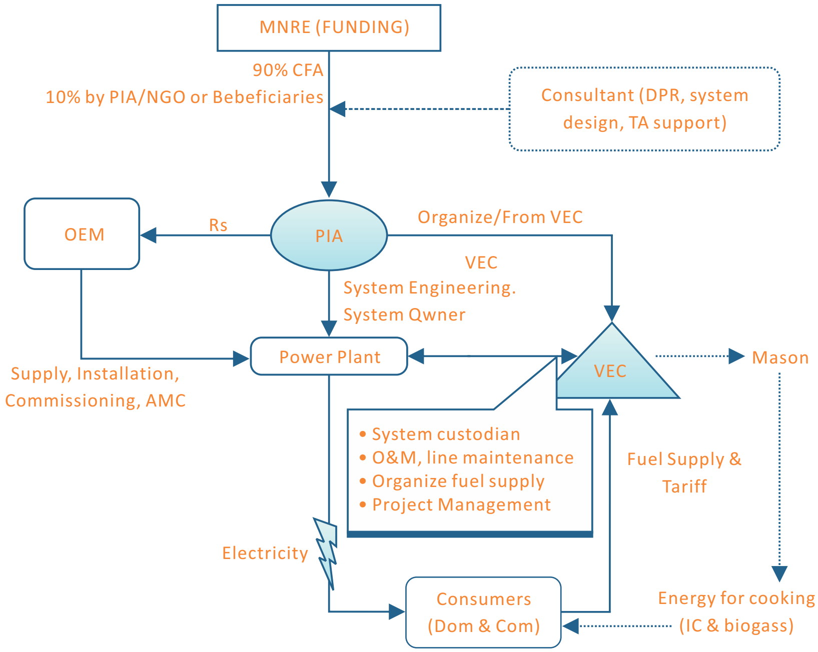


Figure 2.3 : VESP Institutional Model

MNRE=Ministry of New and Renewable Energy; OEM=original equipment manufacturer; DPR=detailed project report; TA=technical assistance; PIA=project implementing agency; VEC=village energy committee; O&M=operation and maintenance; IC=improved cookstoves

A World Bank study[9] of the operations of VESP found that performance of VESP was largely mixed at the project level due to the following key reasons: the failure of the technology suppliers to provide prompt and reliable after sales services; inadequate training of local operators and non-payment of their salaries; lack of organized supply of fuel wood; and the lack of capacities and interest among the village communities to manage the day-to-day affairs of the power plant. The study also made the following recommendations for improving performance of VESP projects:

[9]India: Biomass for Sustainable Development, Lessons for Decentralized Energy Delivery: Village Energy Security Programme, World Bank, 2010

Table 2.1: Lessons from VESP	
Improving technical performance	
Build a robust after sales services network of third party local service providers	• Every state must identify and train local service providers, such as diesel mechanics and electricians before project implementation. • Develop contractual obligations between the project and trained local service providers.
Impart modular and graded training to develop specific skills and knowledge	• Provide innovative and hands-on training to entrepreneurs, operators and selected village community representatives.
Improving financial performance	
Make viability gap funding an incentive for better performance	• Viability gap funding should be used to attract entrepreneurs. • However, this support should be gradually phased out so that entrepreneurs are encouraged to secure other revenue streams for commercial viability.
Secure convergence and revenue streams of VESP at a policy level	• Convergence is necessary to enhance loads and secure additional revenue streams. • A system should be instituted to secure the cooperation of state and district officials from the relevant departments to the VESP.
Sustainable plantations and improving biomass supply	
Monetize biomass supply	• Voluntary contributions of biomass on a non-payment basis have not worked. • Village level systems should be in place to provide a cash incentive to villagers who deliver biomass to the power plant.
Emphasize sustainable biomass plantations	• Every project should secure biomass supply by dedicated plantations on private and public lands, contracting with village forest committees and forest departments. • At a policy level, central and state governments should promote incentives for biomass plantations in individual and community lands with assured buy-back and forge systematic and large-scale convergence with forest department programs.

Decentralized Distributed Generation (DDG) Scheme of the MoP is being implemented under the RGGVY and tries to address several of the shortcomings found in the VESP. It is technology neutral and focuses only on providing electricity in remote villages (where grid would not be extended) with

100 or more households. The Project Implementing Agency could be SNAs/State Deptt./State Utilities/ Identified CPSUs. Ownership unlike other programmes will be vested with the state government. PIAs are expected to invite Project Developers (PD) to set up projects and run them for a period of 5 years and then hand them over to the state govt. PDs could be NGOs, Panchayaths, entrepreneurs, etc. Tariffs would be decided by the PIA and should not be lower than the grid tariff prevailing in adjoining areas. Although, the programme was launched in 2006-07, no significant progress has been recorded.

Jawaharlal Nehru National Solar Mission (JNNSM) is the latest programme of MNRE which has a small component for off-grid generation through SPV technology. It provides capital subsidy of upto 30% and is being implemented through SNAs and Akshay Urja shops. The maximum capacity per site (for individual homes) is 100kWp and 250kWp for microgrid applications.

As can be seen from the preceding paragraphs, of the 4 programme that have DDG as a key strategy for rural electrification, only one has biomass based DDGs as it dominant technology option, namely, VESP. Of the remaining, RGGVY-DDG is yet to progress while the other two are focused mainly on SPV lighting.

Further, all programmes have identified DDG for electrifying only remote, inaccessible villages with small populations and as will be seen in the next section, tiny loads. The net result is that DDG has become restricted to “small-scale off-grid remote applicati-ons” as articulated in policy.

In contrast, many villages that have been electrified through grid extension under RGGVY are yet to receive electricity supply because there is simply no power to supply! It is estimated that nearly 20,000MW of additional capacity needs to be created to meet demand generated through RGGVY[10]. DDG can be a potential solution!

Realignment of DDG policy to focus on tail-end generation will help to make good use of the REDB (Rural Electricity Distribution Backbone) and the VEI (Village Electricity Infrastructure) that has been setup in RGGVY. In turn, this would unleash the potential for DDG and at the same time unpack the economic development of rural India which was the driving force for rolling out RGGVY.

[10]Vidyasagar, K. (2007, July 15). Presentation: Universal Service Obligation in Rural Electrification - RGGVY. 14th Steering Committee Meeting, South Asia Forum for Infrastructure Regulation. New Delhi.

Section 3

- Commercial performance of biomass-based DDGs

  3 Description of sample biomass-based DDGs selected for study

  3 Performance analysis of sample projects

  - n Technical performance
  - n Financial performance
  - n Managerial performance
  - n Institutional performance

3.1 Performance of Biomass DDG Projects in India

In the preceding sections we have seen how policy has restricted the scope for DDG. In this section we will look at biomass DDG projects in India and analyse their performance from an entrepreneurs/ commercial entities point of view. An entrepreneur takes risks in anticipation of adequate and attractive returns. Therefore, for entrepreneurs to invest their time and money in biomass DDG, the project must be attractive.

Biomass DDG projects may be classified based on their location and connectivity to grid as shown in Table 3.1

Table 3.1: Classification of Biomass DDGs

DDG System	Grid Area	Off-Grid Area
Grid Connected	BERI	Built for future grid connectivity?
Stand Alone	Husk Power, Desi Power	VESP Projects

As a part of this study, the following projects were covered either through a field visit or through a review of secondary sources. Table 3.2 gives brief details of the sample chosen for study.

Table 3.2: Sample of Biomass DDG Project Studied

Projects covered	Source of information	Plant Size	Households	Implemented by
Dicholi, Satara dist, Maharahstra	Field visit	10 kW	85	NGO, under VESP
Bhingara & Chalistapari, Buldana dist, Chopan & Bharitakheda, Amravati dist, Maharashtra	Field visit	20 kW & 10 kW	80-181	NGO, under VESP
Biomass Energy for Rural India (BERI), Tumkur dist, Karnataka	Field visit	3 x 100kW + 1 x 200kW (500kW)	Grid connected	BERI Society with support from Dept. of Rural Development & Panchyati Raj, Govt. of Karnataka, UNDP-GEF, ICEF & MNRE

Husk Power, Bihar	Secondary sources	~32kW	400-1000	Husk Power Systems, a private company
Bhalupani, Mayurbhanj dist, Orissa	Field visit	10kW	50	NGO, under VESP
Bhaliaguda, Mayurbhanj dist, Orissa		10kW		

The sample covers all categories of DDG projects mentioned in Table 4.1 except projects built for future grid connectivity in currently off-grid areas and thus is fairly representative of the current biomass DDG scenario in India.

3.2 Location of the Projects Analyzed

Remoteness and inaccessibility are key site characteristics of a typical VESP project. Often, more than the distance from the nearest grid-connected village, it is the sheer physical remoten-ess due to huge geographical hurdles that has left these villages bereft of even simple infra structural services that can vastly improve the quality of their lives, if not, their economic status. The projects represen-ted a wide range of terrain: from deep dense forests (as in Bhalupani, Chopan & Bharita-kheda), to an island (as in Dicholi) and to inaccessible hill tops (as in Bhingara & Chalistapari). Thus, these projects are fairly representative of what a typical VESP project is all about. This is what the World Bank report on VESP had to say about the difficulties of a VESP project:

Figure 3.1: Dicholi-Remot-eness, Inaccessibility & Commitment Defined

Dicholi is located in the backwa-ters of the Koyna dam. Ironically, while the dam produces electricity in thousands of mega watts, Dicholi does not receive any since it is an island and it is expensive to draw the grid across 10–15 km of water. Added to this, the village is situated on a hill, the way to which is through a dense forest and up a steep slope. Thus, the only way to reach the villages is by an hour-and-a-half motorboat ride followed by a steep climb of about 45–60 minutes. In Dicholi, when the gasifier engine arrived at Koyna town, the local community had to help the supplier to disassemble the engine and take it by boat to the boat jetty at Dicholi, from where each part was carried as a head load up the hill or slung from bamboo poles and carried on the shoulders of teams of 10–20 persons.

"All these villages become completely inaccessible during the monsoons when roads turn into slushy stretches and the only way to reach a village is on foot, that too when the weather permits. The degree of difficulty in installing, operating and servicing a biomass-based power plant in such locations can easily be visualized. Therefore, it needs fierce commitment, great ingenuity and persistence to implement a VESP project."[11]

In contrast, both Husk Power Projects and the BERI are located in more easily accessi-ble location with none of the difficulties associated with VESP projects that are imposed due to terrain. BERI is located in Kabbiere village of Tumkur district about 120km from Bengaluru and is a connected to the 11kv grid line that comes from a substation that is about 5 km away. Thus, as long as the grid line is functional, the BERI project can pump power into it and is in turn purchased by the local ESCOM through a Power Purchase Agreement.

Husk Power Systems works mainly in Bihar and parts of Uttar Pradesh. It installs a 32kW gasifier based power system that works on rice husk. It is a standalone system that lays its own distribution lines and does not interact with the grid. It sells power to domestic and commercial (shops, petty businesses) customers.

3.3 Technical Performance of Biomass DDG Projects

3.3.1 Uptime

Remoteness and inaccessibility are key site characteristics of a typical VESP project.

A key question to measure technical performance is, "Did the project supply the electricity that it was designed to supply? If yes, to what extent? " This is measured by "Uptime" which is defined as:

Uptime for the electricity generating system: This is the number of units of power actually supplied during a period of operation compared to the number of units estimated to be supplied in the village energy plan. This ratio is expressed as a percentage and is called 'uptime.

$$\text{Uptime} = \frac{\text{No. of units of power actually supplied in a period}}{\text{No. of units of power that the plant designed to supply during that period}} \times 100$$

[11]Ibid 6

In addition, other factors such as load, Capacity Utilization Factor (CUF), etc. have also been assessed to analyze the performance.

Of the 7 VESP plants visited during field visit, Dicholi & Bhalupani have been in operation for the last 4-5 years while Chopan & Bharitakheda and Bhingara and Chalistapari were 1-2 years old. The VESP plant in Bhaliaguda was yet to be commissioned at the time of our visit. BERI[12] plants were commissioned and connected to the grid in 2006-07 and have been in operations since then. However, data for analysis was for the period May 2010-2011. For Husk Power data was based on secondary sources.[13]

Table 3.3 gives details of the technical performance of biomass DDG Plants. Uptime ranges from a high of 90% for Husk Power systems to a low of just 44% for BERI. Uptime for VESP projects range from 60% to 84%. In contrast, the World Bank study shows that uptimes for VESP projects ranged from 23% to 50% (Dicholi) 1-2 years after they were commissioned.[14] Thus, clearly, uptimes have not only improved for older VESP projects, but also newer projects are now operating at higher uptimes within 1-2 years of commissioning.

Table 3.3: Technical Performance of Biomass DDG Plants

Projects covered	Plant size	Load kW	Uptime	Hours of operation	CUF	Biomass kg/day	SFC kg/kWh
Dicholi	10 kW	7.8	84%	4	11%	55	1.76
Chopan & Bharitakheda	20 kW	12	73%	5	9%	100	1.67
BERI,	500kW	340	44%	5.3	8%	2451	1.36
Husk Power	~32kW	19	90%	6	21%	300	2.63
Bhalupani	10kW	6	59%	6	9%	50	1.67
Bhaliaguda,	2 x 10 kW	15	Yet to be commissioned				

[12]Data accessed from BERI website http://bioenergyindia.in/
[13]http://www.forumofregulators.gov.in/Data/Reports/CWF%20Off-grid%20final%20report%20nov%202011_Latest_feb2012.pdf
[14]Ibid 6

However, load, hours of operations and therefore the Capacity Utilization Factor have more or less remained the same for these VESP projects, thereby having an impact on the financial returns to a potential entrepreneur. For example, in Dicholi and Bhalupani where the DDG plants have been working for more than 4 years, the load has remained unchanged despite vastly improved uptimes. Similarly, hours of operation have remained unchanged from 4-6 hours. These two data sets reveal that despite improved regularity of supply of power from the DDG plant, **demand for electricity has not increased,** either from existing customers or from newer ones. Further, no commercial loads have come up in any of the 6 villages where VESP has been implemented, excepting in Bhalupani where a honey proce-ssing unit was in existence before VESP was implemented. In Chopan and Bharitakheda a flour mill has been set up as a part of the VESP and is facing stiff competition from diesel engine based flour mills, despite lower cost to customers. In Dicholi, no one has come forward to operate a flour mill based on power from the DDG plant. Thus, in addition to poor load growth, no commercial loads have come up in the last 4-5 years in these VESP projects. And this has a significant impact on financial viability of such operations.

Table 3.4: VESP- Increased Uptimes

Projects	Uptime (World Bank Study, 2009)	Uptime (Current Study, 2012)
Dicholi	50%	84%
Bhalupani	24%	59%

Figure 3.2: Motor costs more than flour mill - Chopan VESP Project

In Chopan the operator is interested in running the power plant because he wants to run the flour mill, off which he is making Rs.2000-3000/month. The flour mill itself was a part of the VESP package and it is a moot point if he would have made the investment in a flour mill himself if the VESP package had not included it.

The flour mill that came with the package has a motor-drive which runs on electricity that is generated by the DDG plant. Thus, mechanical energy produced by the gasifier engine is converted into electricity to run the motor which converts this energy into mechanical energy again to run the flour mill! Undoubtedly, this wastes energy. The motor itself costs nearly 2-3 times the cost of the flour mill, which could have been run on the gasifier engine through a pulley and belt, as other diesel engine flour mills in the area do.

3.3.2 Main reasons for down time & its Management

Several factors contribute to downtime in VESP projects. Chief among them are:

- **Lack of water** Chalistapari and Bhalupani were both not operational at the time of our visit, because the well /bore well on which they were dependent for water had gone dry. In Bhalupani, operators stated that every year between March and June they shut down the plant for lack of water. In Chalistapari, although there is water source nearby, the Forest department has objected to it being used to run the gasifier plant.

- **No biomass supply** or wet biomass is a frequently mentioned cause for the plant being shut down. This is mainly because of the ad hoc manner in which biomass is being procured in all these projects and lack of a biomass plantation to ensure supply. This will be discussed in greater detail in the sections that follow.

- **Breakdown of parts,** especially broken cutter blades and drained batteries. The latter is more frequent when the plant has been newly commissioned and operators are greenhorns. Usually, batteries get drained because operators crank the engine well before the gasifier has started generating producer gas of requisite quality and quantity. In Dicholi, the cost of getting a drained out battery charged was nearly Rs.500-750 since it had to be taken by boat to the nearest town and brought back after a day or two. Now, they have changed the original battery and also keep a battery on standby, so that a battery can be used to start the engine, when the other fails. Since the plant is operating and generating electricity, the drained out battery is now charged on site instead of going to the nearest town.

- **Poor After-Sales Service,** especially from equipment manufacturers who were bound by an AMC to provide prompt after sales service. The World Bank study on VESP identified this as a major cause for poor technical performance of VESP which in turn also had a severe impact on financial and institutional performa-nce of VESP.

Figure 3.3: Cost of doing simple things in remote locations

In Bhingara, the plant is not operational since the cutter blades are broken. Another cutter machine is available to do the job but it is lying about 4 km from the plant at the base of the hill and it costs about Rs.1000 to hire a tractor to bring it up the hill to the plant.

As analysis in the next section reveals, this amount is almost equal to the gross monthly profit for this scale of operation. The terrain magnifies the cost of doing simple things in such remote villages.

A key reason for improved uptimes in older VESP projects and high uptimes in even newer VESP projects is localization of after sales service and close handholding of operators.

Key reasons for downtime in BERI was related to lack of biomass, breakdown of engine, cleaning of gas filtration systems and not being able to evacuate power due to grid being down. Repairs and maintenance in **BERI** are being managed with help from the Combustion Gasification & Propulsion Lab (CGPL), Indian Institute of Science (IISc.) which is the technology developer and by hiring appropriate vendors on a case to case basis.

Husk Power provides all technical backup to its own plants as well as to its franchisees for fee of Rs.15000 per month/plant. Uptimes in Husk Power plants are high because not only do they provide dedica-ted technical assistance to plant operators but they also ensure biomass supply and thus take away a key cause that has been often the cause for downtime in other plants.

Figure 3.4: Dedicated After Sales Service - Secret of Better Uptimes

VESP projects in Chopan, Bharitakheda, Chalisatapari and Bhingara are being serviced by Bluegum Diesel System which is based in Nagpur which is nearly 250km from these villages. The firm has deployed two well trained technicians and opened a local office to provide prompt after sales service.

These technicians are responsi-ble for repair and maintenance of the plants as well as for training the operators. They provide support through mobile telepho-nes as well as by making site visits.

The monthly costs are nearly Rs.22000 covering salary and travel costs of these technicians.

3.3.3 Management of Biomass Supply in Projects

In VESP projects biomass supply was unorganized. Usually, the operator hired a labourer or two to cut wood from surrounding forest areas and supply to the plant. Typically, a labourer was paid Rs.100 and he brought in about 40-50kg of wood in a single trip in a day. Usually, such labourers did only one trip in a day[15]. Often finding such labourers is difficult task because very few people want to do this on a regular basis as this invariably brings them into conflict with Forest department officials. Although, biomass plantations were funded and set up under VESP package, none of them are in existence. In Bhalupani and Dicholi each household contributes a fixed quantity of biomass, however, the source is again the nearby forests.

In BERI, nearly 30-50% of the biomass comes from project plantations which included plantation on common land, forest land (through VFC) and on private land. The rest comes from forest department and other commercial sources. The average landed cost of biomass in BERI is ~Rs.2/kg. Another Re.0.3 to Re.0.5/kg is incurred for cutting it to the requisite size. Thus, the cost of biomass ready for use in the power plant is ~Rs.2.5/kg.

Figure 3.5: Tree Based Farming - An Innovative Approach to Biomass Supply

BERI adopted the Tree Based Farming System on private farming lands to grown biomass for the power plant. TBFS, the farmer digs trenches along farm bunds and across contours. Soil from the trenches is piled on to the bunds thus, strengthening them. Timber species such as teak, acacia, silver oak, sisum, casurina etc. are planted at the rate of 2-3/trench. Fuel, fodder and other species such as subabul, Cassia siamea, drum stick are planted on the farm bunds such that an acre has about 200-300 plants. Someti-mes even plants such as papaya are planted on the bunds.

The main crop land is planted with fruit trees such as mango, sapota, guava, etc., depending on the choice of the farmer. In between these trees, the normal agricultural crop of the farmer is taken.

Along the border of the plot, live fence in the form of Euphorbia, Glyricidia, etc. are planted to provide protection to the plantations from grazing. In addition, these also provide a ready source of green leaf for manure and fodder purposes.

Thus an acre of land is planted with 400-500 trees without significantly reducing the area under the main agricultural crop.

[15]This means that cost of biomass at the plant is Rs.2-2.5/kg as against the common assumption that biomass in such areas would cost less than a rupee.

Husk Power plants use rice husk as their only fuel and Husk Power Systems ensures its supply to its plants by tying up with rice millers in the area.

3.3.4 Takeaways from Analysis of Technical Performance

VESP projects have significan-tly improved their uptimes, which indicate that the techno-logy has turned the corner in terms of local operators running these plants. However, loads have remained unchanged.

Very low CUF means that investments made in plant capacity is being wasted. Plants are unable to increase CUF for want of local loads and since they are not grid connected, they cannot sell it outside the village. For example, if Rs.1.2 lacs are invested in building a 10kW DDG plant and only 10% of the plant capacity is being utilized annually, it represents an investment of 90% being wasted.

Biomass supply continues to remain an issue for concern as also after sales service which is still either too costly for commercial plant operations to sustain or is too project specific to be easily scaled up.[16]

In contrast, Husk Power installations seem to have overcome these issues as reflected in their high uptimes (upto 90%). However, the terrain in which these plants operate are easily accessible with high concentration of loads as compared to the VESP plants.

3.4: Financial Performance of Biomass DDG Projects

This section examines the financial viability of VESP projects (the kind of projects that the RGGVY-DDG programme wants to promote) by carrying out a breakeven analysis at current levels of operations and also contrasts this with financial performance of Husk Power plants.

3.4.1 Key Operating Conditions of a VESP Power Plant

Table 3.5 provides details of typical operating conditions of a VESP plant. Each household is provided with 40W of load. Street lighting is also underta-ken as part of VESP. Including all these loads, the CUF is about 12% only.

[16]The after sales support being provided by Bluegum Diesels is not commercially sustainable and is also not likely to be replicated easily. It represents an approach that is driven purely by Mr.Abhay Bhure's passion for making VESP projects work.

3.4.2 Typical Investments, Operating Costs and Tariffs of a VESP Power Plant

Table 3.6 shows investments, operating costs and tariffs in a typical VESP project. It enjoys a capital subsidy of 90% from MNRE. The rest comes in the form of investments from the PIA, the VEC or the SNA. For making a commercial assessment, we have assumed that the rest of the investment comes in the form of equity and debt in the ratio of 30:70.

Maintenance costs include AMC and consumables. Tariff collected from households is Rs.50-75/month/household. No payments are received for street lighting from the Pancha-yath which is responsible for the payment.

Table 3.5: Typical Operating Conditions of VESP Plant		
Plant Size	kW	10
Plant life	Years	10
Auxiliary load	kW	10%
No. of connections	No.	80
Load/connection	W	40
Operating load domestic	kW	3.2
Operating load street lighting	kW	2
Operations/day	hr	6
Operations/year	days	300
Capacity Utilization Factor	%	11.90%

Table 3.6: Investments, operating costs & tariffs - VESP		
Capital cost	Rs.	1200000
Subsidy	90%	1080000
Debt	70%	84000
Equity	30%	36000
Interest	14%	11760
Maintenance	Rs. /annum	36000
Fuel	Rs./kg	2
SFC	kg/kWh	1.8
Operators (2) salary	Rs. /month	6000
Tariff domestic	Rs. /month	72
Tariff domestic	Rs./kWh	12
Tariff street lighting	Rs./month	0
Tariff street lighting	Rs./kWh	0
Escalation	%	5%

3.4.3 Break-even Analysis at Current Levels of Operations

Table 3.7 shows how the VESP project fares financially at current level of operations. It also presents a breakeven scenario[17].

At current level of operations the project is unable to generate enough contribution margin to cover fixed costs. It needs to increase the no. of units sold by a factor of 6.8 times, i.e., from 9360 units to 64,372 units[18]. In turn this means that at current tariffs, the CUF has to increase from 11.9% to 82%, a tall order considering that even domestic loads have not increased significantly in the last 4 years in Dicholi and Bhalupani.

Table 3.7: Break-even Analysis for VESP DDG Plants

	Base case	Break-even case
Units Sold/Annum	9360	1.76
1. NET SALES PROCEEDS	69120	Break-even case
Net Sales Proceeds/Unit	7.4	16.2
2. VARIABLE EXPENSES		
i) O & M Expenses	51696	51696
ii) Interest on working capital	3500	3500
Total Variable Expenses	55196	55196
Variable Expenses/Unit	5.9	5.9
3. CONTRIBUTION (1-2)	13924	96004
Unit Contribution Margin	1.49	10.26
4. FIXED EXPENSES		
i) Interest on term Loan	11760	11760
ii) Depreciation	12000	12000
iii) Administrative Expenses	72000	72000
ii) Depreciation	12000	12000
Total Fixed Expenses	95760	95760
Profit Before Taxes	-81836	244
5. BREAK EVEN POINT (value)	475361.333	150815.716
Breakeven Point Units	64371.85	9336.21
6. CASH BREAK EVEN POINT (value)	415792.24	131916.5
Cash Breakeven Point (Units)	56305.20	8166.26

[17] For the base case a tariff of Rs.72/household/month is assumed with no revenue coming in from street lighting services. For the breakeven case a tariff of Rs.120/household/month and Rs.3000/month from street lighting is assumed. In both cases it is assumed that 100% collection would be made.

[18] Breakeven no. of units (64372) divided by units being sold currently (9360)

Alternatively, the tariff can be for domestic consumers from Rs.12/unit to Rs.20/unit (Rs.72/ month/households to Rs.120/ month/household) and payment collected from the Panchayath for street lighting @ Rs.10/unit (Rs.3000/month). At this level, the plant would just breakeven even at 11.9% CUF and at current levels of no. of units being sold. However, given the situation in most VESP villages, where people are paying even the Rs.50-75/month/house-hold, it seems unlikely that they would agree to pay Rs.120/ month/household. Further, at this level the plant would only breakeven. That means to make profits, the tariff will have to be higher or the CUF has to be increased significantly.

3.4.4 Comparison of VESP with Husk Power Plants in Terms of Operational Profits

Analysis similar to the one presented for VESP in the preceding section was carried out for Husk Power and the profits before interest and taxes (PBIT) calculated for Husk Power and VESP in two scenarios viz., Base case and Breakeven Case. Table 3.8 shows that Husk Power gives the entrepreneur a profit before interest and taxes of Rs.27433 every month in the base case and even at breakeven point Rs.10,603/month. In contrast, VESP gives a loss of Rs.4548/ month at a profit of Rs.2292/ month at breakeven point, which we saw was difficult to reach at current CUF levels.

Table 3.8: Profits/month Husk Power vs. VESP

All figures in Rs./month	Husk (Base case)	Husk (Break-even)	VESP (Base case)	VESP (Break-even)
Sale	66660	49830	5760	12600
O&M	15000	15000	1500	1500
Fuel	12226	12226	2808	2808
Salary	12000	12000	6000	6000
PBIT	27433	10603	**-4548**	2292

To understand this better let us compare scale of operations, investments and returns at base case and breakeven case for both projects. Table 3.9 shows that not only does the Husk Power plant give a higher Return on Investment (ROI) in the base case but is the quantum of profit is also large enough to sustain interest. In contrast, even at breakeven point (which we have seen is not easy to achieve), the VESP project gives a return that is not large enough. To put it in perspective, at breakeven point, Husk Power projects give the entrepreneur Rs.10,603/ month as against a paltry Rs.2292/month for VESP. At the base case this is even better for Husk Power, Rs.27,433/month.

In short, not only is VESP not breaking even at current levels of operations, but even if it were to reach breakeven the absolute volume of profits would not be attractive for an entrepreneur to spend 8-10 hours every day to manage the plant in a remote location. On the other hand, although the Husk Power entrepreneur makes a larger investment, for the same 8-10hours of work in managing the plant, even at base case, he manages to earn Rs.27,433/ month.

Table 3.9: Attractiveness of Profits VESP vs. Husk Power

Parameters	VESP	Husk Power
Plant size kW	10	32
Investments after subsidy (Rs.)[19]	120000	1120000
Returns (Base Case)	-54576	329196
Returns (Breakeven Case)	27504	127236
Hours of operation/day	6	6
ROI Base Case	-45.5%	29.4%
ROI Breakeven Case	22.9%	11.4%

[19]VESP has a 90% capital subsidy while Husk Power gets 30% only.

3.4.5 Takeaways from Financial Analysis

Thus, the scale of VESP operations and therefore profitability is unattractive to entrepreneurs. Given this situation, it is not surprising that entrepreneurs/commercial entities do not find VESP type of "small-scale, off grid, remote area" applications of DDG very attractive. Further, given the higher complexity of tasks in managing a biomass based DDG as compared to other renewable energy technologies, entrepreneurs would perceive a higher degree of effort and risk and therefore would expect a higher degree of return. Finally, the risk of grid coming in and rendering the investments infructuous is real and a big deterrent for potential investors.

3.5 Managerial Performance of the Biomass DDG Projects

VESP projects were funded by the MNRE but owned by the community. Village Energy Committee (representatives drawn from the community with at least 50% of the committee having women members) was expected to manage the power plant by appointing local opera-tors, setting tariffs, organizing biomass supply, ensuring collection of user fees, making payments to operators, etc. In turn they were supported by NGOs that helped them in these tasks.

In reality, VECs were not only ineffective in managing the power plant operations but in many cases were not working any more as a committee. They lacked interest, incentive and motivation to involve themsel-ves in making the DDG plant work. Often, they even lacked the authority and

Figure 3.6: Dicholi: Could you not have just given us solar lights?

The VEC members who manage the DDG plant at Dicholi asked us since the plant was being used to only for domestic and street lighting, would it not have been better to provide a Solar Photovoltaic Micro Grid? It would have saved them a lot of effort in running this plant.

Even as this was being said, the plant operator was chopping the woody fuel manually with a machete since the cutter wheels had broken down a month back and replaced was still on its way. I was left wondering if.....?

stature to discharge their duties, since they were not the natural leaders in the community. Many VEC members even asked, why they needed to spend their time and effort for ensuring that the plant ran or for ensuring biomass supply, when they got no returns (especially financial). In a few villages, though, 1 or 2 motivated members of the VEC were actually found running the power plant[20]. In Chopan, since the plant was also connected to a flour mill, the operator had an incentive to run the plant regularly.

However, in all the projects collection of user fees was very poor. Most of the operators (also VEC members) lamented that people did not pay for the power used, when they went to ask for user fees. They felt that only an outsider (in this case the supporting NGO) could actually do it. Currently, operators are being paid from the O&M fund that was given for managing operations for 2 years in the VESP package. In Dicholi, collection of user fees is being linked to payments that are made through the local milk cooperative. Since the whole village has households that belong to just two large related families and they have a high degree of community cohesion (mainly due to their extreme isolation), they are able to collect enough from the house-holds to pay the operators to keep them doing the job. However, for repairs, they take money from the Gram Panchayath[21].

Overall, **management of VESP** power plants by the VEC as an institution is ineffective and in many cases non-existent. In places where the plants are running it is because of highly motivated individuals and also the fact that the O&M fund is being used to pay these individuals to operate the plants. Thus, the operations of the plants are not linked in any way to any form of financial sustainability. Therefore, it is a moot point as to how long these plants would continue to be operated.

Husk Power plants are either run by Husk Power Systems or by their franchisees. Since they are run by entrepreneurs they are guided by commercial performance and the high uptime and higher level of returns

[20] In Chopan, Bharitakheda and Bhingara, either the President or the Vice-president of the VEC was also working as the operator and managing the plant operations including hiring labour to procure biomass.

[21] Dicholi is the only village in the Dicholi Gram Panchayath, hence decisions on spending money to get the DDG plant repaired is relatively easier as compared to other GPs where a no. of villages would be competing for funds.

indicate their effective-ness. Since Husk Power Systems takes responsibility for ensuring fuel supply and plant uptime, the entrepreneur has to only ensure that he runs the plant regularly and collects payment promptly from users, unlike VESP projects, where the operators (or VEC) has to ensure biomass supply, interact with various service providers to ensure that the plant is repaired in time, ensure that users receive power regularly and they pay for it as well. All this has to be managed against the backdrop of difficult terrain, remoteness (both physical and telephonic) and unattractive returns.

Further, the skill set of these local operators (even if they were considered and treated as entrepreneurs) is limited and inadequate when confronted with the range and complexity of the tasks. However, for entrepreneurs with requisite skills to take up these operati-ons, the financials are not attractive as compared to the time and effort needed.

3.6 Institutional Arrangements in the Biomass DDG Projects

This section examines how these projects are rolled out and what support is provided to them, who could be entrepreneurs, etc.

VESP (and also RGGVY-DDG) was conceived, funded and rolled out by the central govt ministries through several state level govt departments such as SNAs, Forest Deptt., etc. Often, in these arrangements, ESCOMs which actually grid electrify and distribute power in the local area are not consulted other than for taking a declara-tion that they would not extend the grid to these village within the next 5 years. These, declaration, as many PIAs found were flouted with impunity and grid was extended to the village within 1-2 years, rendering the DDG plant irrelevant.

The onus of project preparation, seeking permissions from Forest department, ESCOMs, etc. was left to the PIA (mostly NGOs in the case of VESP) with hardly any help coming in from the SNAs. Even technical support was not forthcoming from any of the govt. institutions and often the PIA and the VEC had to work directly with the equipment supplier or find local service providers.

Even during operations, when the water source dried out or the Forest guards created hurdles, the VEC and the NGO had to fight their own battles. No financial help was forthcoming other than the initial capital grant and an O&M grant which was supposed to cover costs of operations and normal maintenance. For larger costs, the VEC was expected to find its own means. For example, the VEC at Dicholi incurred a total expense of Rs.80,000 in 4 years of operati-ons in repair and maintenance. This included replacement of batteries, pumps, repairs to engines and the gasifier itself. They had no O&M funds because the VESP package had no such provision when the Dicholi project was sanctioned. As seen from the financial analysis, such profits are not generated from these plants. They managed to fund the repairs by seeking grants from the Panchayat as well as contri-butions from every user family.

Thus, institutionally, the project does not receive any significant support once it has been installed and commissioned. Even during the project preparation, installation and commissioning the support from other govt. institutions is limited. Finally, if the grid is extended, no government agency including MNRE can help. In such a scenario, it is no wonder that entrepreneurs are reluctant to come in.

Finally, who can be entrepre-neurs in such projects? The World Bank study[22] on VESP makes the following observa-tion in this regard:

"The entrepreneur could be an individual or groups of individuals, NGOs, or self-help groups, that were chosen based on an appropriate process of selection. Given the very tiny scale of operations in a typical VESP project, it is very unlikely that entrepreneurs from far off places would be attracted on purely commercial terms. Therefore, it is very likely that the entrepreneur would be from the project village itself or from neighbouring villages. An entrepreneur who is already running a flourmill or an oil expeller in the village using diesel engines, for example, could be the first choice because the person would have the necessary technical and business skills to manage the power plant."

Thus, it is clear that no commer-cial entity is likely to invest in these plants for purely commer-cial reasons. At the same time even local entrepreneurs do not find the project attractive given the poor monthly earnings. As against the monthly earning of about Rs.2000-4000 (Rs.65-130/day) expected from these plants, even a daily labourer would earn at least Rs.100/day without having to manage so many issues and tasks.

[22] Ibid 8

3.6.1 RGGVY Distribution Franchisees' Perception of the DDG Opportunity

Following reforms in the electricity sector, many ESCOMs have hived off some of their distribution responsibi-lities such as meter reading, billing, and user fee collection to franchisees, who are paid a commission to undertake these tasks. In more advanced levels of engagement, ESCOMS hand over the distribution infrastruc-ture to a franchisee and bill them only for the bulk power that they receive from the ESCOM. The franchisee is responsible for distributing the power in its area, repairing and maintaining the distribution infrastructure, augmenting it when needed, collecting dues from the users, etc. Such franchisees are called Input Based Franchisees (IBF).

In several RGGVY areas, ESCOMs have engaged with franchisees to just do billing and bill collection or as IBF. Given that the task of DDG plant operation (as seen in the preceding sections) involved not only generation but distribution management as well, it was felt that they could be potential candidates for being entrepreneurs to take up biomass based DDGs. Accor-dingly, this study spoke with several of them from UP and Bihar as well as with a large distribution franchisee com-pany, Enzen Ltd., Bengaluru.

The RGGVY franchisees that we spoke to were apprehensive about the shift to IBF for their current areas of operations. They were not aware of RGGVY-DDG scheme details but felt that operations in remote areas would be difficult and costly and people would not pay for power.

Figure 3.7: Feedback from Mr.Satheesh, MD, Enzen on DDGs

Off grid DDGs usually are done in remote, backward regions of the country and the scales do not offer a business case for commercial entities to manage the power plant

However, such locations do need power. **Entrepreneur** who would go there would be **social entrepreneurs** who should be **liberally supported** to not only put up the power plant and supply power, but also develop **livelihoods** that would increase use of power.

He felt that the current focus of MoP on attracting entrepreneurs to do this on commercial terms and bidding basis is **too premature** and **not likely to work**

Section 4

- Key learnings
- Way forward

4.1 Key Learnings

We find from the preceding sections that policy has limited the scope of DDG applications to small-scale, off grid remote areas.

Analysis of projects **(VESP)** based on these policies have shown that while the technical performance of these projects have improved vastly as compared to the time when the VESP was launched, serious issues related to sustainability of biomass supply, after sales service and its costs and lack of increase in loads and utter lack of commercial loads continue. Financially, these projects are unattractive compared to the effort and risks that an entrepreneur would be exposed to. It is unlikely that commercial entities would take up such projects on commercial terms given the small-scale and unattractive returns. Even local entrepreneurs may not be interested given the limited earning currently and poor scope for enhancing it in the short to medium term. Finally, given the uncertainty about grid extension, commercial investors would shy away from such projects.

Husk Power projects fared better on all these issues. The combination of entrepreneurs closely backed by Husk Power for technical issue and ensuring biomass supply is working well in ensuring attractive returns to the investor. Since these projects are in dense population areas, load is not an issue. Further, these projects have not only domestic loads but also light commercial loads. Customers in these areas are willing to pay a higher tariff than those in the remote, off grid location and thus, these projects are financially viable. However, these projects face the threat of improvements in grid supply leading to dwindling demand. Also, if their tariffs come under the purview of regulators, as is being discussed in the Forum of Regulators, then it is likely that their margins will be under severe pressure. Finally, while the Husk Power model has worked in areas of high load densities, in easily accessible areas, it is unlikely that it would work in locations where VESP kind of DDGs are being deployed.

The BERI project as a concept addresses several of these issues that plague the VESP and the Husk Power Model. The plant is a 500kW generating station that is connected at 11kV to a substation that is 4-5km away. Thus, it has no dearth of load as long as the 11kV line is live. Potentially, it can also meet some of the loads of the surrounding villages that are downstream of the BERI plant[23] thereby improving its CUF as well as the quality of life in the surrounding areas. At this scale it would be attractive to entrepreneurs since the volume and rate of profit both would be larger[24]. It would also mean that technically well qualified and trained personnel could be hired to operate the plant. It could also invest in procuring biomass in a systematic manner and even work with local farmers to encourage them to grow it for the plant.

Table 4.1 summarizes the comparison of the three models of DDG analyzed in this study.

Table 4.1 : Cmparision of VESP, Husk Power & Beri Model of DDG

	Model		
	VESP	Husk Power	BERI
Plant size	10-20kW and mostly biomass gasifiers	Can be upto 100kW mostly biomass gasifiers	Can be in MW range and need not be limited to biomass gasifiers
Description	Stand-alone, off grid in remote areas with low loads	Stand-alone, off grid in grid areas with dense loads	Grid connected at distribution level. Load is not an issue
Technical	Wasted capacity, difficult to operate and service. Grid connectivity is difficult	Better utilization of capacity, but still wasted. Feasibility in non rice husk areas is not known Grid connectivity is difficult	Capacity can be utilized well. Already grid connected
Financial	Not attractive and not profitable. Does not attract investors since volume of profits is very small	Attractive at current tariffs. Entrepreneurs interested, but usually only local players and not commercial ones	Not attractive at current grid tariffs, but can be profitable if tariff is determined differentially and also if 3rd party sale is undertaken

[23]BERI Society which operates the plant is currently negotiating with BESCOM to allow it to cater to local village loads when the grid is down and resume supply to the grid when it is restored. This would help BERI maximize its CUF.

[24]Currently, BERI has a PPA with BESCOM which buys power at a paltry Rs.2.83/unit. Efforts are on to get the Karnataka Electricity Regulatory Commission (KERC) to determine the tariff for such plants on a basis that is different from that being used for biomass power plants that are connected to the grid at transmission levels (66/132kV).

Managerial	Not manageable locally and not attractive to outsiders	Can be managed locally but not very attractive to outsiders	Cannot be managed locally, but may be attractive to commercial entities
Biomass Supply	Usually local and not organized. Currently works only on woody biomass	Organized by Husk Power. In non rice husk areas, not known	Can be from a wider area and other commercial suppliers

4.2 Proposal for Making DDG Viable for Village Electrification

Small-scale DDG (10kW) in remote location is not justified financially, especially if grid extension is expected in the next 5-6 years. Even economi-cally, the benefits to the community from purely lighting loads do not justify investments in DDG for just 5 years. With no commercial loads coming up there is a need to rethink this policy.

Medium scale plants (20-100kW) in stand-alone minigrids are feasible in dense load areas and not in low load remote areas. Further, they would become unviable if grid improves and also are not very feasible to connect to the grid.

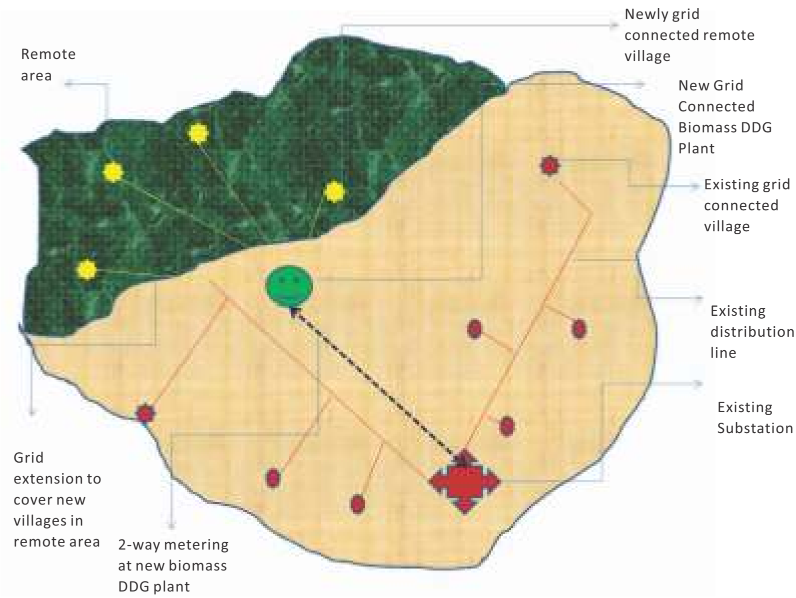
Larger scale plants (500kW to 2 MW) in grid connected mode at distribution level are feasible and viable, but cannot serve un-electrified villages since these villages are not connected to the distribution network of the grid.

Therefore, extend the grid by incurring a one-time capital cost and set up the DDG at such a scale and location that it is able to cater to the existing load of the un-electrified villages and is able to pump surplus power in to the grid.

In short, instead of taking the power plant to a village, take only power. In VESP projects in Maharashtra, the grid was only 7km away and the substation 20km. In Orissa, grid was less than 500m away!

Figure 4-1 presents a schematic representation of a grid connected biomass DDG plant that helps extend the grid to remote areas while also feeding surplus power to the grid through an existing substation.

Figure 4.1 :Schematic of Remote Area Electrification thru Distribution Grid Connected DDG



4.3 Advantages of a Distribution Level Grid Connected DDG Plant

A DDG plant that is connected to the grid at the distribution level meets the definition of DDG that we discussed in section 2.1 (Ackermann et al). Since the grid provides a large load, the DDG plant can operate at higher CUFs. Pumping power at the tail-end of the distribution network improves quality of power delivered to consumers and since now more power is available, the grid can be extended to cover more areas.

At larger scales (especially 1-3MW) scale other biomass technologies especially biomass combustion also becomes feasible. Further, these technologies can use a variety of biomass fuel unlike current models of gasifiers which need only woody fuel or biomass briquettes. This would increase the sources from which biomass could be procured for operating these plants.

Users in remote areas can now be brought under grid tariffs and on par with existing rural grid customers, thus address-ing issues of equity.

However, tariff for DDG generation[25] would have to be determined separately from existing basis for biomass power projects since the operating conditions (especially PLF is likely to be significantly lower) would be vastly different and the scale of operations would also be very different[26].

At this scale commercial entities would be attracted especially since **grid extension is part of the solution and not the problem!** The same model may be used even in existing distribution networks (as BERI is doing) to strengthen tail-end supply. Finally, unlike in existing DDG projects, generation and distribution need not be vested with the DDG plant operator alone. However, if both operations are combined the operator gets an incentive to minimize distribution losses and increase his profits.

4.4 Issues Facing the Proposal

Among the various stakeholders, buy-in from ESCOMs and Forest department (especially for remote forest villages) would be crucial for making this idea work.

From an ESCOM's point of view working with this model entails capital expenditure[27] for extending the grid to remote locations, purchase of power at higher tariffs than even existing tariffs for non-conventional energy sources from the DDG plant, having to supply power to more villages and for longer hours. With cost of supply already exceeding the revenue from even existing villages, the ESCOM would be averse to increasing supply to them leave alone actually adding more such villages to its distribution network. Therefore, a financial mechanism for compensating the ESCOM should be put in place, if the goal for providing electricity for all has to be achieved in substantive terms and not as a token by providing lighting for a few hours.

The Forest department is likely to have concerns with allowing distribution lines being drawn through forest areas in the proposed

[25] Such plants may need to be compensated for providing reactive power as well for having to operate at lower PLFs.
[26] A good bench-mark for setting a tariff for an operator who generates and distributes power is the existing cost of supply to the village by the ESCOM less the gains from reduction in T&D losses + adequate Return on Equity
[27] This can be mitigated by funding through RGGVY

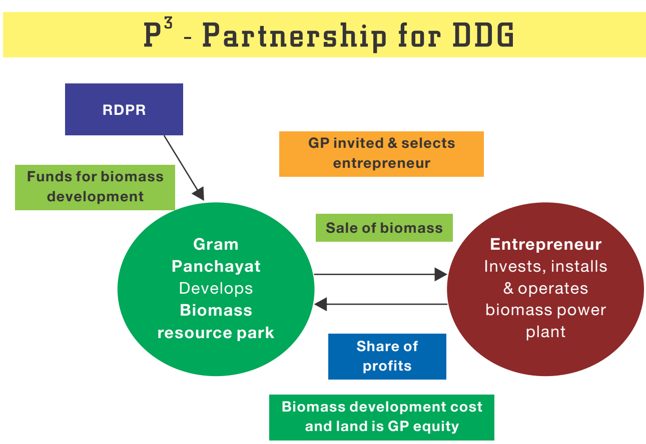
model. This is a genuine concern. However, in our opinion, the option of putting up biomass DDG plants in remote villages is worse than putting a larger plant in a more accessible location and only drawing distribution lines to such villages. DDG plants in remote villages are managed by local operators who source biomass from nearby forests, often illegally. It is unlikely that, they will invest in organized biomass production and supply, especially given their skills, scale of operations and its profitability. On the other hand a larger grid connected biomass DDG can source biomass from a variety of sources and a larger area. Given their scale of operations, they can invest in contract farming and more organized biomass procure-ment and supply. Further, the Forest department will not have to monitor numerous biomass DDG plant at many remote villages.

From a DDG project promoter point of view reliable and adequate financial returns,[28] sustainable and cost effective biomass supply and simple and clear technical standards and norms for connecting to the grid are required to reduce project risks.

4.5 Building a Local and Sustainable Biomass Supply Solution

Figure 4-2 shows a way for building a local and sustainable biomass supply solution.

Figure 4.2 :Public-Private-Panchayat Partnership for Biomass Supply



[28]Financial returns may be through Feed In Tariff and other means including competitively determined viability gap funding.

Often power plants set in rural areas aim to procure biomass by targeting existing sources which are often already being used for other purposes. Sometimes, existing sources, especially agri-residues are dependent on the crop pattern and the performance of the crop itself leading to huge changes in supply. Therefore, it would be prudent for biomass power plants to invest in creating backward linkages for creating a biomass source and supply chain.

From a rural community point of view, the only assets they have for making an earning is labour, land and the knowledge to grow plants, trees, etc. The Gram Panchayat has funds for taking up plantations under various schemes and also has funds for providing wage employment to rural folks under MNREGA.

Thus, if all these three (Public-Private-Panchyat, P3) decide to collaborate, biomass can be grown on public and private lands with funding for these plantations coming from the Panchayat, while the power plant can offer a buy-back guarantee as paper and match-stick making companies do. This would not only ensure a sustainable source of biomass to the power plant but also ensure better quality power to the villages since the power plant is a DDG connected to the distribution line.

A more intense form of P3 partnership could be when the Gram Panchayat creates "Biomass Parks" by using funds at its disposal to carryout plantations (on public and private lands) and invites biomass power project develo-pers to set up the plant with a guaranteed supply of biomass in return for a share of the profits to compensate for the investments in biomass development. The villagers who are the biomass growers would also get paid for the quantity of biomass that they supply. Thus, such an arrangement would help the biomass power plant operator in a quick start up and also lower project risks significantly. In addition, if the Gram Panchayat is also able to ensure that the "Biomass Park" has land identified for setting up the power plant the turnaround time for the biomass DDG plant is reduced further.

4.6 Next Steps

This idea may be piloted in a cluster of RGGY villages that have been connected to the grid but are receiving little or no power. A biomass based

DDG plant of appropriate size (taking into account local loads and scale needed for attracting investments) may be set up in a grid connected mode at distribution voltage.

The local ESCOM needs to be on board at the very outset of the project for its success. Therefore, it would be essential to ensure that irrespective of the project funding source, the ESCOM is made a party to the project.

To ensure that the plant is run on a commercial basis, entrepreneurs may be selected on a competitive basis to partner with the ESCOM/ Government department on a cost and risk sharing basis to build and operate the plant. At the end of predetermined period, the operator may be given the option of buying out the government stake or having it converted into a debt. This would ensure that the entrepreneur would have a longer term interest in operating the plant than just the project period.

At the policy level, the scope for DDGs should be expanded to include tail-end generation, especially to deliver power to rural areas by making use of the infrastructure that has been created under RGGVY. At a regulatory level, appropriate basis for setting the FIT for such DDG plants is required. Appro-priate technical standards and norms, including metering and billing methodology for operations of grid connected DDGs should be developed so that ESCOMs and DDG project promoters are clear on how to implement such projects.

Annex

- Annex 1
- Annex 2
- Annex 3
- Annex 4

5 Annex 1: Summary of Key DDG Programmes in India

Programme	Eligibility Condition (s)	Physical target	Achievements	Responsibility	Technology Preference	Energy Applications	Decisions on Tariff	Implementation Agency	Ownership Structure	Financial Arrangement	& M
RVEP, 2003	Villages with a population of 100 inhabitants	To electrify about 10000 remote villages	6446 remote villages and 1587 remote hamlets have been electrified so far.	MNRE	Most appropriate energy technology (no clear guideline). However 95 % of the villages electrified are through solar phot-ovoltaic systems	Lighting	PIA	State Nodal Agencies	Community	90 % of the capital subsidy from MNRE	State Implementing Agencies. Financial grant includes a five year Annual Maintenance Contract with the supplier
VESP	Village should be a minimum of 50 and maximum of 400 HHs	To electrify\ remote and inacc-essible 1000 villages and meet the total energy needs of villages	700 kW of capacity has been created.	MNRE	Biomass gasification & Bioenergy is prioritized	Total energy require-ments of cooking, electricity and motive power	VEC and project implem-enting agencies will decide tariff	Govt. Deptt (e.g. Forest Deptt.) NGOs	Village Energy Committee/ community ownership	One time grant upto 90 % of the project cost subject to Rs 20,000 per bene-ficiary. Rest as equity contribu-tion in terms of cash or kind (User charges)	O & M Support fund to cover 2 years of operation and management. It shall be 10 % of the total project cost
DDG, 2009	More than 100 HHs	No clear guideline	No information available	MOP	Technology neutral but a hierarchy is suggested	Lighting	Tariffs will be decided by the implem-enting agency	SREDAs/ State Deptt./ State Utilities/ dentified CPSUs	State Governm-ent	90 % of the project cost as subsidy and rest 10 % will be arranged by the impleme-nting agency	Cost of spares for five years after commissioning (excluding the cost of consumables and labour) is included as the project cost

JNNSM, 2009-10	Various off-grid solar photovol-taic systems/ applicati-ons up to maximum capacity of 100 kWp per site. For mini-grid, amaximum capacity of 250 kW will be supported	The progr-amme will be a part of the RVEP and targets to electrify 10000 remote villages	33 MW has been sanctioned by Jan 2011. 300 villages have been electrified and 7000 HHs have been provided home lighting systems.	MNRE	Solar	Lighting/ electricity/ power, heating/ cooling	No clear guideline	State Nodal Agencies/ Akshay Urja Shops	Community	MNRE will provide 30 % of the benchmark costs as capital subsidy and 50 % of the benchmark costs (Rs. 150/Wp) will be eligible for a loan at 5 % per annum. The user must pay a down payment to the tune of 20 % of the benchmark cost.	O & M Support fund to cover 2 years of operation and management. It shall be 10 % of the total project cost

6 Annex 2: Profitability of VESP Projects (Base Case)

		Years										
	Units	0	1	2	3	4	5	6	7	8	9	10
Sales domestic	kWh		5760	5760	5760	5760	5760	5760	5760	5760	5760	5760
Sales street lighting	kWh		3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
Sales	Rs.		69120	72576	76205	80015	84016	88217	92627	97259	102122	107228
Expenses												
Fuel	Rs.		33696	35381	37150	39007	40958	43006	45156	47414	49784	52274
O&M	Rs.		18000	18900	19845	20837	21879	22973	24122	25328	26594	27924
Operator salary	Rs.		72000	75600	79380	83349	87516	91892	96487	101311	106377	111696
Interest on capital loan	Rs.		11760	8820	5880	2940	0	0	0	0	0	0
Interest on working capital	Rs.		3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
Depreciation	Rs.		12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Total expenses	Rs.		150956	154201	157755	161634	165853	173371	181264	189553	198255	207393
PBIT	Rs.		-66576	-69305	-72170	-75179	-78337	-81654	-85137	-88794	-92634	-96665
ROI	%		-6%									
Profit before Tax	Rs.		-81836	-81625	-81550	-81619	-81837	-85154	-88637	-92294	-96134	-100165
PBT/month	Rs.		-6820	-6802	-6796	-6802	-6820	-7096	-7386	-7691	-8011	-8347

Source: Field visit to VESP sites, 2012

7 Annex 3: Profitability of VESP Projects (Break-even Case)

		Years										
	Units	0	1	2	3	4	5	6	7	8	9	10
Sales domestic	kWh		5760	5760	5760	5760	5760	5760	5760	5760	5760	5760
Sales street lighting	kWh		3600	3600	3600	3600	3600	3600	3600	3600	3600	3600
Sales	Rs.		151200	158760	166698	175033	183785	192974	202622	212754	223391	234561
Expenses												
Fuel	Rs.		33696	35381	37150	39007	40958	43006	45156	47414	49784	52274
O&M	Rs.		18000	18900	19845	20837	21879	22973	24122	25328	26594	27924
Operator salary	Rs.		72000	75600	79380	83349	87516	91892	96487	101311	106377	111696
Interest on capital loan	Rs.		11760	8820	5880	2940	0	0	0	0	0	0
Interest on working capital	Rs.		3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
Depreciation	Rs.		12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Total expenses	Rs.		150956	154201	157755	161634	165853	173371	181264	189553	198255	207393
PBIT	Rs.		15504	16879	18323	19839	21431	23103	24858	26701	28636	30668
ROI	%		1%									
Profit before Tax	Rs.		244	4559	8943	13399	17931	19603	21358	23201	25136	27168
PBT/month	Rs.		20	380	745	1117	1494	1634	1780	1933	2095	2264
Source: Field visit to VESP sites, 2012												

8 Annex 4: Profitability of Husk Power Projects (Base Case)

		Years										
	Units	0	1	2	3	4	5	6	7	8	9	10
Sales domestic	kWh		23760	23760	23760	23760	23760	23760	23760	23760	23760	23760
Sales street lighting	kWh		13860	13860	13860	13860	13860	13860	13860	13860	13860	13860
Sales	Rs.		799920	839916	881912	926007	972308	1020923	1071969	1125568	1181846	1240938
Expenses												
Fuel	Rs.		146718	154054	161757	169844	178337	187253	196616	206447	216769	227608
O&M	Rs.		180000	189000	198450	208373	218791	229731	241217	253278	265942	279239
Interest on capital loan	Rs.		109760	82320	54880	27440	0	0	0	0	0	0
Interest on working capital	Rs.		3500	3500	3500	3500	3500	3500	3500	3500	3500	3500
Depreciation	Rs.		12000	12000	12000	12000	12000	12000	12000	12000	12000	12000
Total expenses	Rs.		595978	592074	589347	587855	587661	616269	646307	677847	710965	745738
PBIT	Rs.		317202	333662	350945	369092	388147	408154	429162	451220	474381	498700
ROI	%		19.8%									
Profit before Tax	Rs.		203942	247842	292565	338152	384647	404654	425662	447720	470881	495200
PBT/month	Rs.		16995	20654	24380	28179	32054	33721	35472	37310	39240	41267
Source: Based on published case study in “POLICY AND REGULATORY INTERVENTIONS TO SUPPORT COMMUNITY LEVELOFF-GRID PROJECTS, 2011												

Notes

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Embassy of Switzerland in India

Climate Change and Development
Chandragupta Marg, Chankayapuri
New Delhi - 110021
Phone: +91 11 4995 9570
Email: delhi@sdc.net
Website: www.swiss-cooperation.admin.ch/india

TARA

B-32, Tara Crescent
Qutub Institutional Area
New Delhi - 110016 (India)
Tel.: +91-11-26544100
E-mail: tara@devalt.org
Website: www.devalt.org