POLICY BRIEF ON
BIOMASS BASED DDG PROJECTS

Village Electrification through Sustainable use of Renewable Energy (VE-SuRE)
Contributor
S.C. Rajshekar, Symbiotec Research Associates

Reviewers
Dr. Shirish Sinha, Swiss Agency for Development and Cooperation

Acknowledgment
We place on record our gratitude to the Swiss Agency for Development and Cooperation for providing the financial and institutional support, National Thermal Power Corporation (NTPC) and TARA field team for providing field support, local communities of the project villages, local NGOs for their untiring work and enabling us to broaden our understanding of field realities.

Branding and Designing Guidance
Ranjeeta Ghosh, Jay Vikash, Development Alternatives Group

Disclaimer
The views, analysis, interpretations and conclusions expressed herein are those of the contributors and do not necessarily reflect the view of the Swiss Agency for Development and Cooperation (SDC) or NTPC. The information contained herein has been obtained from sources and consultations, which the Contributors believe to be reliable and accurate. The Contributors, editor and the supporting agency associated with the policy brief are not liable for any unintended errors or omissions, opinions expressed herein. The contents of this report may be used by anyone providing proper acknowledgement.
POLICY BRIEF ON BIOMASS BASED DDG PROJECTS

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

SECTION 1
1.1 Background 3
1.2 Objective 3
1.3 Status of Electrification in India 4
1.4 Framing the Issues for the Study 6

SECTION 2
2.1 What is meant by DDG? 9
2.2 DDG within the Policy Framework 10
2.3 Implementation of DDG in India 12

SECTION 3
3.1 Performance of Biomass DDG Projects in India 19
3.2 Location of the Projects Analyzed 20
3.3 Technical Performance of Biomass DDG Projects 21
3.4 Financial Performance of Biomass DDG Projects 27
3.5 Managerial Performance of the Biomass DDG Projects 32
3.6 Institutional Arrangements in the Biomass DDG Projects 34

SECTION 4
4.1 Key Learnings 41
4.2 Proposal for Making DDG Viable for Village Electrification 43
4.3 Advantages of a Distribution Level Grid Connected DDG Plant 44
4.4 Issues Facing the Proposal 45
4.5 Building a Local and Sustainable Biomass Supply Solution 47
4.6 Next Steps 48

ANNEX 1: SUMMARY OF KEY DDG PROGRAMMES IN INDIA 53
ANNEX 2: PROFITABILITY OF VESP PROJECTS (BASE CASE) 54
ANNEX 3: PROFITABILITY OF VESP PROJECTS (BREAK-EVEN CASE) 54
ANNEX 4: PROFITABILITY OF HUSK POWER PROJECTS (BASE CASE) 55
LIST OF TABLES

Table 1.1: Installed Renewable Energy Capacity in India 3
Table 2.1: Lessons from VESP 12
Table 3.1: Classification of Biomass DDGS 17
Table 3.2: Sample of Biomass DDG Projects Studied 17
Table 3.3: Technical Performance of Biomass DDG Plants 20
Table 3.4: Vesp- Increased Uptimes 21
Table 3.5: Typical Operating Conditions of VESP Plant 26
Table 3.6: Investments, Operating Costs & Tariffs - VESP 26
Table 3.7: Break-even Analysis for VESP DDG Plants 27
Table 3.8: Profits/month Husk Power Vs. VESP 28
Table 3.9: Attractiveness of Profits VESP Vs. Husk Power 29
Table 4.1: Comparison of VESP, Husk Power & Beri Model of DDG 40

LIST OF FIGURES

Figure 1.1: Source-wise Installed Generation Capacity 2
Figure 2.1: Definitions of DDG 7
Figure 2.2: Ddg in Nep, 2005 & Rep, 2006 9
Figure 2.3: VESP Institutional Model 11
Figure 3.1: Dicholi - Remoteness, Inaccessibility & Commitment Defined 18
Figure 3.2: Motor Costs More Than Flour Mill - Chopan Vesp Project 21
Figure 3.3: Cost of Doing Simple Things in Remote Locations 22
Figure 3.4: Dedicated After Sales Service - Secret of Better Uptimes 23
Figure 3.5: Tree Based Farming - An Innovative Approach to Biomass Supply 24
Figure 3.6: Dicholi: Could You Not Have Just Given Us Solar Lights? 30
Figure 3.7: Feedback from Mr. Satheesh, Md, Enzen on DDGS 35
Figure 4.1: Schematic of Remote Area Electrification Thru Distribution Grid Connected DDG 42
Figure 4.2: Public-private-panchayat Partnership for Biomass Supply 45
Section 1

- Background to the policy brief paper
- Objectives of the study
- Status of electrification in India
- Framing the issues for the study
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 renewable energy based off grid pilot projects for further up scaling 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 commissioned 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 entrepreneurs 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.

Section 1
Policy Brief on Biomass Based DDG Projects
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 commissioned 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 Vidhyyothikaran 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 entrepreneurs 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 electrification 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 translates 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](http://www.cea.nic.in/reports/monthly/executive_rep/feb13/8.pdf)

<table>
<thead>
<tr>
<th>Source</th>
<th>Estimated Potential (MW)</th>
<th>Cumulative till February, 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>4780</td>
<td>25856</td>
</tr>
<tr>
<td>Hydro</td>
<td>39499</td>
<td>3552</td>
</tr>
<tr>
<td>Thermal</td>
<td>144544</td>
<td>1447</td>
</tr>
<tr>
<td>RES</td>
<td>23,700</td>
<td>20-30 per km</td>
</tr>
<tr>
<td>Bio Power</td>
<td>15,000</td>
<td>23,700</td>
</tr>
</tbody>
</table>

Table 1.1: Installed Renewable Energy Capacity in India

\(^1\)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 up to 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 assessed as having a very high potential in improving access to electricity for rural households in the country.

However, as Table 1.1 shows, 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.

<table>
<thead>
<tr>
<th>Resource</th>
<th>Estimated Potential (MW)</th>
<th>Cumulative till February, 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wind power</td>
<td>48,500</td>
<td>18635</td>
</tr>
<tr>
<td>Small Hydro Power</td>
<td>15,000</td>
<td>3552</td>
</tr>
<tr>
<td>Bio Power (including cogen)</td>
<td>23,700</td>
<td>3660</td>
</tr>
<tr>
<td>Solar Power</td>
<td>20-30 per km²</td>
<td>1447</td>
</tr>
</tbody>
</table>

Source: MNRE, 2013

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.

---

5The 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
Section 2

2.1 What is meant by DDG?

Decentralized Distributed Generation has been defined differently by different people and entities. CIGRE (International Council on Large Electricity Systems) defines distributed generation 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 interconnection at nearly any point in a power system.

Dondi 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 and will be used as such in this paper.

---


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.

2.1 What is meant by DDG?

Decentralized Distributed Generation has been defined differently by different people and entities. **CIGRE** (International Council on Large Electricity Systems) defines distributed generation 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 interconnection at nearly any point in a power system.

Dondi 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: Definitions of DDG](image)

Ackermann et al. (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.

---

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.
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 recommendation of the state government for local authority, Panchayath institution, cooperative 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 determination 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.
Section 2

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.
2.3 Implementation of DDG in India

Policy orientation towards DDG described in the preceding section isamply 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 opportunity 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 plantations as feedstock in biomass gasifiers.

A World Bank study 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:

---


---

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
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 its 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 applications” 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. 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.

---

Section 3
• Commercial performance of biomass-based DDGs

Description of sample biomass-based DDGs selected for study

Performance analysis of sample projects
• Technical performance
• Financial performance
• Managerial performance
• Institutional performance
Section 3

- Commercial performance of biomass-based DDGs
  - Description of sample biomass-based DDGs selected for study
  - Performance analysis of sample projects
    - Technical performance
    - Financial performance
    - Managerial performance
    - 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

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>
<thead>
<tr>
<th>Grid Area</th>
<th>Off-Grid Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built for future grid connectivity?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Project Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects covered</td>
</tr>
<tr>
<td>Source of information</td>
</tr>
<tr>
<td>Plant Size</td>
</tr>
<tr>
<td>Households</td>
</tr>
<tr>
<td>Implemented by</td>
</tr>
<tr>
<td>Dicholi, Satara dist, Maharahstra</td>
</tr>
<tr>
<td>NGO, under VESP</td>
</tr>
<tr>
<td>Bhingara &amp; Chalistapari, Buldana dist, Chopan &amp; Bharitakheda, Amravati dist, Maharashtra</td>
</tr>
<tr>
<td>NGO, under VESP</td>
</tr>
<tr>
<td>Biomass Energy for Rural India (BERI), Tumkur dist, Karnataka</td>
</tr>
<tr>
<td>NGO, under VESP</td>
</tr>
<tr>
<td>BERI Society with support from Dept. of Rural Development &amp; Panchyati Raj, Govt. of Karnataka, UNDP-GEF, ICEF &amp; MNRE</td>
</tr>
</tbody>
</table>

Policy Brief on Biomass Based DDG Projects pg. 17

Section 3
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>
<thead>
<tr>
<th>DDG System</th>
<th>Grid Area</th>
<th>Off-Grid Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid Connected</td>
<td>BERI</td>
<td>Built for future grid connectivity?</td>
</tr>
<tr>
<td>Stand Alone</td>
<td>Husk Power, Desi Power</td>
<td>VESP Projects</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Projects covered</th>
<th>Source of information</th>
<th>Plant Size</th>
<th>Households</th>
<th>Implemented by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicholi, Satara dist, Maharashtra</td>
<td>Field visit</td>
<td>10 kW</td>
<td>85</td>
<td>NGO, under VESP</td>
</tr>
<tr>
<td>Bhirangara &amp; Chalistapari, Buldana dist, Chopan &amp; Bharitakheda, Amravati dist, Maharashtra</td>
<td>Field visit</td>
<td>20 kW &amp; 10 kW</td>
<td>80-181</td>
<td>NGO, under VESP</td>
</tr>
<tr>
<td>Biomass Energy for Rural India (BERI), Tumkur dist, Karnataka</td>
<td>Field visit</td>
<td>3 x 100kW + 1 x 200kW (500kW)</td>
<td>Grid connected</td>
<td>BERI Society with support from Dept. of Rural Development &amp; Panchyati Raj, Govt. of Karnataka, UNDP-GEF, ICEF &amp; MNRE</td>
</tr>
</tbody>
</table>
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 remoteness due to huge geographical hurdles that has left these villages bereft of even simple infrastructural services that can vastly improve the quality of their lives, if not, their economic status. The projects represented 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 backwaters 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.

---

**Table 3.1:** Biomass Based DDG Projects

<table>
<thead>
<tr>
<th>Project Location</th>
<th>Technology</th>
<th>Capacity (kW)</th>
<th>Capacity Range (kW)</th>
<th>Company Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Husk Power, Bihar</td>
<td>Secondary sources</td>
<td>~32kW</td>
<td>400-1000</td>
<td>Husk Power Systems, a private company</td>
</tr>
<tr>
<td>Bhalupani, Mayurbhanj dist, Orissa</td>
<td>Field visit</td>
<td>10kW</td>
<td>50</td>
<td>NGO, under VESP</td>
</tr>
<tr>
<td>Bhaliaguda, Mayurbhanj dist, Orissa</td>
<td></td>
<td>10kW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
“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.”

In contrast, both Husk Power Projects and the BERI are located in more easily accessible 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:

\[
\text{Uptime} = \left( \frac{\text{No. of units of power actually supplied in a period}}{\text{No. of units of power that the plant designed to supply during that period}} \right) \times 100
\]

\[^{11}\text{Ibid 6}\]
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\textsuperscript{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.\textsuperscript{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.\textsuperscript{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>
<thead>
<tr>
<th>Projects covered</th>
<th>Plant size</th>
<th>Load kW</th>
<th>Uptime</th>
<th>Hours of operation</th>
<th>CUF</th>
<th>Biomass kg/day</th>
<th>SFC kg/kWh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicholi</td>
<td>10 kW</td>
<td>7.8</td>
<td>84%</td>
<td>4</td>
<td>11%</td>
<td>55</td>
<td>1.76</td>
</tr>
<tr>
<td>Chopan &amp; Bharitakheda</td>
<td>20 kW</td>
<td>12</td>
<td>73%</td>
<td>5</td>
<td>9%</td>
<td>100</td>
<td>1.67</td>
</tr>
<tr>
<td>BERI,</td>
<td>500kW</td>
<td>340</td>
<td>44%</td>
<td>5.3</td>
<td>8%</td>
<td>2451</td>
<td>1.36</td>
</tr>
<tr>
<td>Husk Power</td>
<td>~32kW</td>
<td>19</td>
<td>90%</td>
<td>6</td>
<td>21%</td>
<td>300</td>
<td>2.63</td>
</tr>
<tr>
<td>Bhalupani</td>
<td>10kW</td>
<td>6</td>
<td>59%</td>
<td>6</td>
<td>9%</td>
<td>50</td>
<td>1.67</td>
</tr>
<tr>
<td>Bhaliaguda,</td>
<td>2 x 10kW</td>
<td>15</td>
<td>Yet to be commissioned</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\textsuperscript{12}Data accessed from BERI website http://bioenergyindia.in/
\textsuperscript{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 processing 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>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dicholi</td>
<td>50%</td>
<td>84%</td>
</tr>
<tr>
<td>Bhalupani</td>
<td>24%</td>
<td>39%</td>
</tr>
</tbody>
</table>

**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.
Section 3

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 performance of VESP.
Section 3

3.3.2 Main reasons for downtime & 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/borewell 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 a 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 performance of VESP.

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 dedicated 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.

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 dedicated 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.
Section 3

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.

\(^{15}\)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 significantly improved their uptimes, which indicate that the technology 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.\textsuperscript{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 undertaken as part of VESP. Including all these loads, the CUF is about 12% only.

\textsuperscript{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 street lighting | 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\(^\text{17}\).

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\(^\text{18}\). 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.

\(^{17}\)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/household, 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>
<thead>
<tr>
<th>Table 3.8: Profits/month Husk Power vs. VESP</th>
</tr>
</thead>
<tbody>
<tr>
<td>All figures in Rs./month</td>
</tr>
<tr>
<td>Sale</td>
</tr>
<tr>
<td>O&amp;M</td>
</tr>
<tr>
<td>Fuel</td>
</tr>
<tr>
<td>Salary</td>
</tr>
<tr>
<td>PBIT</td>
</tr>
</tbody>
</table>

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 8-10 hours of work in managing the plant, even at base case, he manages to earn Rs.27,433/month.
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 8-10 hours of work in managing the plant, even at base case, he manages to earn Rs.27,433/month.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>VESP</th>
<th>Husk Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant size kW</td>
<td>10</td>
<td>32</td>
</tr>
<tr>
<td>Investments after subsidy (Rs.)</td>
<td>120000</td>
<td>1120000</td>
</tr>
<tr>
<td>Returns (Base Case)</td>
<td>-54576</td>
<td>329196</td>
</tr>
<tr>
<td>Returns (Breakeven Case)</td>
<td>27504</td>
<td>127236</td>
</tr>
<tr>
<td>Hours of operation/day</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>ROI Base Case</td>
<td>-45.5%</td>
<td>29.4%</td>
</tr>
<tr>
<td>ROI Breakeven Case</td>
<td>22.9%</td>
<td>11.4%</td>
</tr>
</tbody>
</table>

Table 3.9: Attractiveness of Profits VESP vs. Husk Power

19VESP 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 operators, 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 themselves in making the DDG plant work. Often, they even lacked the authority and 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. 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 households to pay the operators to keep them doing the job. However, for repairs, they take money from the Gram Panchayath.

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.

[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\textsuperscript{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\textsuperscript{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

\textsuperscript{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.

\textsuperscript{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 effectiveness. 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 operations, 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 declaration 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 operations 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 contributions 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 entrepreneurs in such projects? The World Bank study on VESP makes the following observation in this regard:

“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 commercial entity is likely to invest in these plants for purely commercial 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.

---

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 responsibilities 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 infrastructure 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. Accordingly, this study spoke with several of them from UP and Bihar as well as with a large distribution franchisee company, 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.
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 responsibilities 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 infrastructure 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. Accordingly, this study spoke with several of them from UP and Bihar as well as with a large distribution franchisee company, 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.
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
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>
<thead>
<tr>
<th></th>
<th>VESP</th>
<th>Husk Power</th>
<th>BERI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plant size</strong></td>
<td>10-20kW and mostly biomass gasifiers</td>
<td>Can be upto 100kW mostly biomass gasifiers</td>
<td>Can be in MW range and need not be limited to biomass gasifiers</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>Stand-alone, off grid in remote areas with low loads</td>
<td>Stand-alone, off grid in grid areas with dense loads</td>
<td>Grid connected at distribution level. Load is not an issue</td>
</tr>
<tr>
<td><strong>Technical</strong></td>
<td>Wasted capacity, difficult to operate and service. Grid connectivity is difficult</td>
<td>Better utilization of capacity, but still wasted. Feasibility in non rice husk areas is not known. Grid connectivity is difficult</td>
<td>Capacity can be utilized well. Already grid connected</td>
</tr>
<tr>
<td><strong>Financial</strong></td>
<td>Not attractive and not profitable. Does not attract investors since volume of profits is very small</td>
<td>Attractive at current tariffs. Entrepreneurs interested, but usually only local players and not commercial ones</td>
<td>Not attractive at current grid tariffs, but can be profitable if tariff is determined differentially and also if 3rd party sale is undertaken</td>
</tr>
</tbody>
</table>

\(^{23}\)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).
Potentially, it can also meet some of the loads of the surrounding villages that are downstream of the BERI plant 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. 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: Comparison of VESP, Husk Power & Beri Model of DDG

<table>
<thead>
<tr>
<th>Model</th>
<th>VESP</th>
<th>Husk Power</th>
<th>BERI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant size</td>
<td>10-20kW and mostly biomass gasifiers</td>
<td>Can be upto 100kW mostly biomass gasifiers</td>
<td>Can be in MW range and need not be limited to biomass gasifiers</td>
</tr>
<tr>
<td>Description</td>
<td>Stand-alone, off grid in remote areas with low loads</td>
<td>Stand-alone, off grid in grid areas with dense loads</td>
<td>Grid connected at distribution level. Load is not an issue</td>
</tr>
<tr>
<td>Technical</td>
<td>Wasted capacity, difficult to operate and service. Grid connectivity is difficult</td>
<td>Better utilization of capacity, but still wasted. Feasibility in non rice husk areas is not known</td>
<td>Grid connectivity is difficult</td>
</tr>
<tr>
<td>Financial</td>
<td>Not attractive and not profitable. Does not attract investors since volume of profits is very small</td>
<td>Attractive at current tariffs. Entrepreneurs interested, but usually only local players and not commercial ones</td>
<td>Not attractive at current grid tariffs, but can be profitable if tariff is determined differentially and also if 3rd party sale is undertaken</td>
</tr>
<tr>
<td>Managerial</td>
<td>Not manageable locally and not attractive to outsiders</td>
<td>Can be managed locally but not very attractive to outsiders</td>
<td>Cannot be managed locally, but may be attractive to commercial entities</td>
</tr>
<tr>
<td>Biomass Supply</td>
<td>Usually local and not organized. Currently works only on woody biomass</td>
<td>Organized by Husk Power. In non rice husk areas, not known</td>
<td>Can be from a wider area and other commercial suppliers</td>
</tr>
</tbody>
</table>

### 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 economically, 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.
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 addressing issues of equity.
However, tariff for DDG generation\(^\text{25}\) 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\(^\text{26}\).

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\(^\text{27}\) 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 procurement and supply. Further, the Forest department will not have to monitor numerous biomass DDG plants at many remote villages.

From a DDG project promoter point of view, reliable and adequate financial returns, 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

---

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-Panchayat, 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 carry out plantations (on public and private lands) and invites biomass power project developers 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. Appropriate 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.
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. Appropriate 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
### Annex 1: Summary of Key DDG Programmes in India

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RVEP, 2003</td>
<td>Villages with a population of 100 inhabitants</td>
<td>6446 remote villages and 1587 remote hamlets</td>
<td>Remote 1587 villages and 95% electrification</td>
<td>MNRE</td>
<td>Most appropriate energy technology (no clear guideline).</td>
<td>95% electrified through solar photovoltaic systems</td>
<td>MNRE</td>
<td>Remote and inaccessible</td>
<td>90% capital subsidy from MNRE</td>
</tr>
<tr>
<td>VESP</td>
<td>Village should be a minimum of 50 and maximum of 400 HHs</td>
<td>700 kW of capacity has been created</td>
<td>Remote and inaccessible 1000 villages and meet the total energy needs of villages</td>
<td>MNRE</td>
<td>Biomass gasification and Bioenergy is prioritized</td>
<td>Total energy requirements of cooking, electricity and motive power</td>
<td>MNRE VESP VESC</td>
<td>Community</td>
<td>One time grant up to 90% of the project cost subject to Rs 20,000 per beneficiary. Rest as equity contribution in terms of cash or kind (User charges)</td>
</tr>
</tbody>
</table>

- **DDG, 2009**: More than 100 HHs
- **MOP**: No information available
## Annex 1: Summary of Key DDG Programmes in India

<table>
<thead>
<tr>
<th>Programme</th>
<th>Eligibility Condition(s)</th>
<th>Physical Target</th>
<th>Achievements</th>
<th>Responsibility</th>
<th>Technology Preference</th>
<th>Energy Applications</th>
<th>Decisions on Tariff</th>
<th>Implementation Agency</th>
<th>Ownership Structure</th>
<th>Financial Arrangement &amp; M</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVEP, 2003</td>
<td>Villages with a population of 100 inhabitants</td>
<td>To electrify about 10000 remote villages</td>
<td>6446 remote villages and 1587 remote hamlets have been electrified so far.</td>
<td>MNRE</td>
<td>Most appropriate energy technology (no clear guideline). However 95% of the villages electrified are through solar photovoltaic systems</td>
<td>Lighting</td>
<td>PIA</td>
<td>State Nodal Agencies</td>
<td>Community</td>
<td>State Implementing Agencies. Financial grant includes a five year Annual Maintenance Contract with the supplier</td>
</tr>
<tr>
<td>VESP</td>
<td>Village should be a minimum of 50 and maximum of 400 HHs</td>
<td>To electrify remote and inaccessible 1000 villages and meet the total energy needs of villages</td>
<td>700 kW of capacity has been created.</td>
<td>MNRE</td>
<td>Biomass gasification &amp; Bioenergy is prioritized</td>
<td>Total energy requirements of cooking, electricity and motive power</td>
<td>VEC and implementing agencies will decide tariff</td>
<td>Government Dept (e.g. Forest Deptt.), NGOs</td>
<td>Village Energy Committee/community ownership</td>
<td>One time grant (up to 90% of the project cost subject to Rs 20,000 per beneficiary. Rest as equity contribution in terms of cash or kind (User charges)) Support fund to cover 2 years of operation and management. It shall be 10% of the total project cost</td>
</tr>
<tr>
<td>DDG, 2009</td>
<td>More than 100 HHs</td>
<td>No clear guideline</td>
<td>No information available</td>
<td>MOP</td>
<td>Technology neutral but a hierarchy is suggested</td>
<td>Lighting</td>
<td>Tariffs will be decided by the implementing agency</td>
<td>SREDAs/State Deptt./State Utilities/Identified CPSUs</td>
<td>State Government</td>
<td>90% of the project cost as subsidy and rest 10% will be arranged by the implementing agency</td>
</tr>
</tbody>
</table>
6 Annex 2: Profitability of VESP Projects (Base Case)

<table>
<thead>
<tr>
<th>Units</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales domestic kWh</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td>5760</td>
<td></td>
</tr>
<tr>
<td>Sales street lighting kWh</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td>3600</td>
<td></td>
</tr>
<tr>
<td>Sales Rs.</td>
<td>69120</td>
<td>72576</td>
<td>76205</td>
<td>80015</td>
<td>84016</td>
<td>88217</td>
<td>92627</td>
<td>97259</td>
<td>102122</td>
<td>107228</td>
<td></td>
</tr>
<tr>
<td>Expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Rs.</td>
<td>33696</td>
<td>35381</td>
<td>37150</td>
<td>39007</td>
<td>40968</td>
<td>43006</td>
<td>45156</td>
<td>47414</td>
<td>49784</td>
<td>52274</td>
<td></td>
</tr>
<tr>
<td>O&amp;M Rs.</td>
<td>18000</td>
<td>18900</td>
<td>19845</td>
<td>20837</td>
<td>21879</td>
<td>22973</td>
<td>24122</td>
<td>25328</td>
<td>26594</td>
<td>27924</td>
<td></td>
</tr>
<tr>
<td>Operator salary Rs.</td>
<td>72000</td>
<td>75600</td>
<td>79380</td>
<td>83349</td>
<td>87516</td>
<td>91892</td>
<td>96487</td>
<td>101311</td>
<td>106377</td>
<td>111696</td>
<td></td>
</tr>
<tr>
<td>Interest on capital loan Rs.</td>
<td>11760</td>
<td>8820</td>
<td>5880</td>
<td>2940</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Interest on working capital Rs.</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>Depreciation Rs.</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td></td>
</tr>
<tr>
<td>Total expenses Rs.</td>
<td>150956</td>
<td>154201</td>
<td>157755</td>
<td>161634</td>
<td>165853</td>
<td>173371</td>
<td>181264</td>
<td>189553</td>
<td>198255</td>
<td>207393</td>
<td></td>
</tr>
<tr>
<td>PBIT Rs.</td>
<td>-66576</td>
<td>-69305</td>
<td>-72170</td>
<td>-75179</td>
<td>-78337</td>
<td>-81654</td>
<td>-85137</td>
<td>-88794</td>
<td>-92634</td>
<td>-96665</td>
<td></td>
</tr>
<tr>
<td>ROI %</td>
<td>-6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit before Tax Rs.</td>
<td>-81836</td>
<td>-81625</td>
<td>-81550</td>
<td>-81619</td>
<td>-81837</td>
<td>-85154</td>
<td>-88637</td>
<td>-92294</td>
<td>-96134</td>
<td>-101015</td>
<td></td>
</tr>
<tr>
<td>PBT/month Rs.</td>
<td>-6820</td>
<td>-6802</td>
<td>-6796</td>
<td>-6802</td>
<td>-6820</td>
<td>-7096</td>
<td>-7386</td>
<td>-7691</td>
<td>-8011</td>
<td>-8347</td>
<td></td>
</tr>
</tbody>
</table>

Source: Field visit to VESP sites, 2012
### 7 Annex 3: Profitability of VESP Projects (Break-even Case)

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

Source: Field visit to VESP sites, 2012

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

<table>
<thead>
<tr>
<th>Years</th>
<th>Units</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales domestic kWh</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td>23760</td>
<td></td>
</tr>
<tr>
<td>Sales street lighting kWh</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td>13860</td>
<td></td>
</tr>
<tr>
<td>Sales Rs.</td>
<td>799920</td>
<td>839916</td>
<td>881912</td>
<td>926007</td>
<td>972308</td>
<td>1020923</td>
<td>1071969</td>
<td>1125668</td>
<td>1181846</td>
<td>1240938</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel Rs.</td>
<td>146718</td>
<td>150545</td>
<td>161757</td>
<td>169844</td>
<td>178337</td>
<td>187253</td>
<td>196616</td>
<td>206447</td>
<td>216769</td>
<td>227608</td>
<td></td>
<td></td>
</tr>
<tr>
<td>O&amp;M Rs.</td>
<td>180000</td>
<td>189000</td>
<td>198450</td>
<td>208373</td>
<td>218791</td>
<td>229731</td>
<td>241217</td>
<td>253278</td>
<td>265942</td>
<td>279239</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest on capital loan Rs.</td>
<td>109760</td>
<td>82320</td>
<td>54880</td>
<td>27440</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest on working capital Rs.</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td>3500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depreciation Rs.</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td>12000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total expenses Rs.</td>
<td>595978</td>
<td>592074</td>
<td>589347</td>
<td>587855</td>
<td>587661</td>
<td>616269</td>
<td>646307</td>
<td>677847</td>
<td>710965</td>
<td>745738</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBIT Rs.</td>
<td>317202</td>
<td>333662</td>
<td>350945</td>
<td>369092</td>
<td>388147</td>
<td>408154</td>
<td>429162</td>
<td>451220</td>
<td>474381</td>
<td>498700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROI %</td>
<td>19.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profit before Tax Rs.</td>
<td>203942</td>
<td>247842</td>
<td>292565</td>
<td>338152</td>
<td>384647</td>
<td>404654</td>
<td>425662</td>
<td>447720</td>
<td>470881</td>
<td>495200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PBT/month Rs.</td>
<td>16995</td>
<td>20654</td>
<td>24380</td>
<td>28179</td>
<td>32054</td>
<td>33721</td>
<td>35472</td>
<td>37310</td>
<td>39240</td>
<td>41267</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Based on published case study in ‘POLICY AND REGULATORY INTERVENTIONS TO SUPPORT COMMUNITY LEVELOFF-GRID PROJECTS, 2011’