BUSINESS MODEL 6

Power from agro-waste

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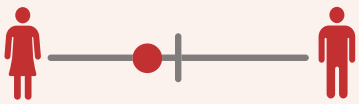
A. Key characteristics

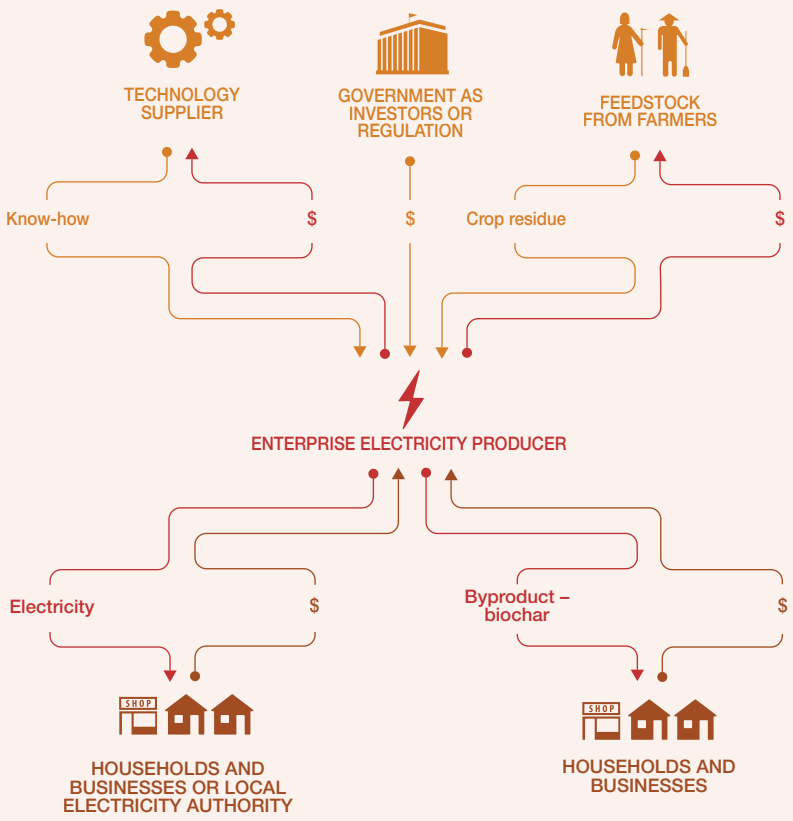
Model name	Power from agro-waste
Waste stream	Agro-waste (from farmers and agro-industries)
Value-added product	Power (through biomass gasification or combustion)
Geography	Rural areas with large acres of crop cultivation for ease of procurement of crop residues
Scale of production	Small to medium scale; 25–100 kW (gasification) and up to 8 MW (combustion)
Supporting cases in this book	Koppal, India; Bihar, India
Objective of entity	Cost-recovery [X]; For profit [X]; Social enterprise [X]
Investment cost range	Approx. USD 1,000 to USD 1,400 per kW
Organization type	Private
Socio-economic impact	Improved energy access resulting in increased local income and productivity, cleaner local environment, reduced greenhouse gas emissions and employment generation
Gender equity	Clean air working environment supports in particular women where it is replacing kerosene lamps 

B. Business value chain

The business model is initiated by a standalone private enterprise, social enterprise or agro-industries such as coffee processing units or rice mills that generate large quantities of crop residues as waste (Figure 78). The business concept is to process crop residues like wheat stalk, rice husk, maize stalk, groundnut shells, coffee husks, sawdust, etc. which has no commercial value and is often burned or dumped in the rivers or on landfills to generate electricity. The electricity can be consumed internally or sold to households, business or local electricity authority or combinations thereof.

The key stakeholders in the business value chain are the suppliers of crop residue: farmers and agro-industries, government as a regulator and/or investor, technology supplier and end users of the product – household and businesses directly or through the local electricity authority. Generating electricity from agro-waste or crop residue can be from one of the following processes: anaerobic digestion through biogas, gasification through producer gas and combustion/incineration through steam. Biomass combustion is generally suitable for large capacity and grid-connected applications, whereas biomass gasifier and bio-methanation-based power plants are more suitable for sub-megawatt level and decentralized applications. The business is eligible for sale of carbon as the electricity is generated from sustainable biomass source. In this business model description, the process used is gasification where crop residue is used as a feedstock for making syngas or producer gas, which contains carbon

FIGURE 78. VALUE CHAIN OF POWER FROM AGRO-WASTE



monoxide and hydrogen and can be used to generate electricity using modified diesel or gasoline engine generators.

The ownership and operation of the enterprise generating electricity can take different forms. The plant can be designed, constructed, owned and operated by a standalone private enterprise such as agro-industrial processing factory, community-based organization, social enterprise and individual entrepreneur, either on a Build, Own and Operate basis or on a Build, Own, Operate, Transfer (BOOT) basis. In the latter scenario, the private entity brings investment to set up the energy production technology, while the concessionaries i.e. the agro-industrial factories or community provides land and inputs. The private entity designs, constructs and maintains the energy production unit until BOOT period is expired after which it assists the host company to operate the unit. The business model can use BOOT approach and franchise its model to scale up its business operations.

C. Business model

The primary value proposition of the business model (Figure 79) is to be a reliable provider of electricity from sustainable biomass source (agro-waste/crop residue). Depending on the ownership structure, the primary motive of the enterprise varies. This would in turn result in significant differences in the operations and management of the business.

FIGURE 79. BUSINESS MODEL CANVAS – POWER FROM AGRO-WASTE

KEY PARTNERS

- Government
- Equipment suppliers
- Farmers and agro-industries
- Carbon trading partners
- Investors/Donors

KEY ACTIVITIES

- Collection of crop residue
- Contractual agreements
- Electricity generation and distribution
- Community mobilization
- Meter, billing and collection
- Managing Clean Development Mechanism (CDM) process

KEY RESOURCES

- Crop residue
- Technical know-how
- Land and skilled local labor

VALUE PROPOSITIONS

- Reliable provision of environment-friendly electricity at a fair price from a sustainable biomass source
- Environment-friendly, low-cost biochar
- Carbon emission reductions

CUSTOMER RELATIONSHIPS

- Direct interaction with the community and electricity authority
- Direct interaction
- Direct interaction with carbon market agents

CHANNELS

- Emission trading platform
- Direct electricity connection to community
- Direct sales or network of distributors

CUSTOMER SEGMENTS

- Households and businesses
- Electricity authority
- Industries household
- Carbon market

COST STRUCTURE

- Land costs
- Investment costs – building and equipment, transmission and distribution lines
- O&M costs – training, input cost (crop residue), utilities, labor (can be intensive and skilled labor)
- Debt and equity payments
- Costs incurred for CDM/Voluntary Emission Reductions registration and carbon sale

REVENUE STREAMS

- Sale of electricity
- Sale of activated carbon or charcoal (by-product)
- Sales of carbon credit

SOCIAL & ENVIRONMENTAL COSTS

- Potential leakage of gas
- Laborers' health and safety risk if no proper safety measures are present in the electricity generation unit
- Potential safety issues on handling of biochar

SOCIAL & ENVIRONMENTAL BENEFITS

- Improved social and economic sustainability through improved access to electricity
- Reduced GHG emission
- Create job opportunities

Social enterprise or community business model

A community-based organization or a social enterprise would run such an enterprise with the primary motive of providing reliable electricity to remote and underserved households and small businesses as a service while trying to achieve operational sustainability. This type of business model requires the enterprise to mobilize the community, procure agro-waste from local sources, develop appropriate and agreed pricing and establish transmission and distribution lines to reach out to every customer. The key activities for this business model are labor intensive, as it requires regular maintenance of transmission and distribution lines along with monthly meter, billing and collection activity for each customer. The business on a per capita basis is higher on capital and operation cost. From a cost recovery perspective, the business model is dependent on subsidies from government and donors to cover at the least its capital cost, but it has high potential to be financially viable and recover its operational cost including making marginal profits. Typical electricity generated under this model are in the range of 25–100 kW. The electricity generated is too small in size to be viable to apply for CDM projects unless the business does franchising of its model and bundles these transactions. However, it can access carbon offset on VERs market.

For-profit private business model

A private enterprise with profit maximization motives would get into a power purchase agreement with a local electricity distribution company. The electricity generated is directly fed to a local grid, and the local electricity distribution company pays an agreed price per unit to the enterprise as per the long-term power purchase agreement (PPA). The burden of transmission and distribution of electricity is transferred to the local electricity distribution company. The enterprise is not as labor-intensive as the social enterprise business model on per capita of electricity generated. In addition, this business model installs larger electricity generation plants of up to 8 MW. This is large enough and viable to apply for CDM.

In both the business models described above, it is important for the enterprise to have a strong partnership with farmers and agro-industries to ensure reliable supply of crop residues at an agreed price. The common key activities are procurement and processing of crop residue, electricity generation and sales. To improve the production efficiency, training of farmers can be a useful activity so that farmers provide high-quality crop residue and store-crop residue in appropriate manner to reduce moisture content. Sales of electricity is the primary revenue source with some additional revenue if the enterprise is able to tap into the carbon market.

Gasification process results in a by-product called biochar, which is rich in carbon. Biochar has multiple applications, as it can be sold to household or businesses as fuel to industries to produce activated carbon, and it is also an excellent fertilizer. The business model could potentially increase its revenue through sales of this by-product. The combustion process has fly ash as its waste product, which is used in brick manufacturing.

D. Potential risks and mitigation

Market risks: The electricity generated from processing crop residue is mainly sold to local electricity grid on a long-term power purchase agreement or to household and businesses through a social enterprise or community-based model. In the latter, community mobilization and product pricing are key activities before the enterprise is established, and hence this risk is addressed significantly. In the business model where electricity is sold to local electricity grid, since the demand for electricity is continuing to grow in developing countries and local electricity distribution companies are trying to manage to bridge the gap between demand and supply, the risks are lower. However, in environments where the electricity sector is regulated and the state utility is the sole buyer, the bargaining power

of the business producing and selling electricity will be low. If the business has high dependence on sale of carbon credit for its viability, the volatility of carbon credit market puts the sustainability of the business under risk. In such scenarios, the business has to diversify its revenue streams so as not to entirely depend on the sales of carbon credits.

Competition risks: The business risk for the output (electricity) is relatively low. The social enterprise business model has risks from competitive products like solar home lighting system while the for-profit business model selling electricity to local grids has to compete with businesses generating electricity from cheaper fuel source such as coal and hydropower. The business has higher risk in procuring inputs (crop residue) at a price suitable for the business' financial viability. With time, as they realize the revenue potential from crop residue, the farmers are likely to demand higher price. To mitigate this risk the enterprise should target different types of farmers cultivating different crops or have longer-term agreements with farmers. The enterprise can also create its own plantation or agro-processing unit (rice mills) to secure its supply of agro-waste.

Technology performance risks: The technology used is gasification, which is well-established and mature for decentralized applications. The technology has been widely used commercially and is proven. However, the technology requires skilled labor.

Political and regulatory risks: In most developing countries the demand for electricity is projected to grow and governments are encouraging green initiatives by providing incentives such as concessional loans, feed-in tariff mechanisms and through long-term power purchase agreements. However, in regions where electricity is dominated by public sector and regulations do not allow sale of electricity, the business model cannot be established.

Social-equity-related risks: The model is considered to have relatively more advantages to women especially in underserved communities having clean working environment from clean indoor air by replacing kerosene used for lighting with modern energy. The social enterprise business model is geared to ensure no social equity risk arises in the community. However, the same cannot be said about for profit-private business model. The power generated is fed to the grid and this additional power might be used to improve energy reliability in existing regions rather than providing energy to underserved areas. Both social enterprise and for-profit models provide employment opportunities and additional revenue for farmers from sale of crop residues.

Safety, environmental and health risks: The waste-processing technologies are not without problems and pose a number of environmental and health risks if appropriate measures are not taken. The environmental risks associated with the gasification units include possible leakage of gas, and with the combustion unit's emission of flue gas and fly ash. These emissions should be controlled within acceptable limits by putting in place suitable equipment. Organic waste when left in open begins to decay and releases methane, which is more damaging to the environment than carbon dioxide. The safety and health risks to workers are present, and thus standard protection measures should be put in place (Table 23).

TABLE 23. POTENTIAL HEALTH AND ENVIRONMENTAL RISK AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 6

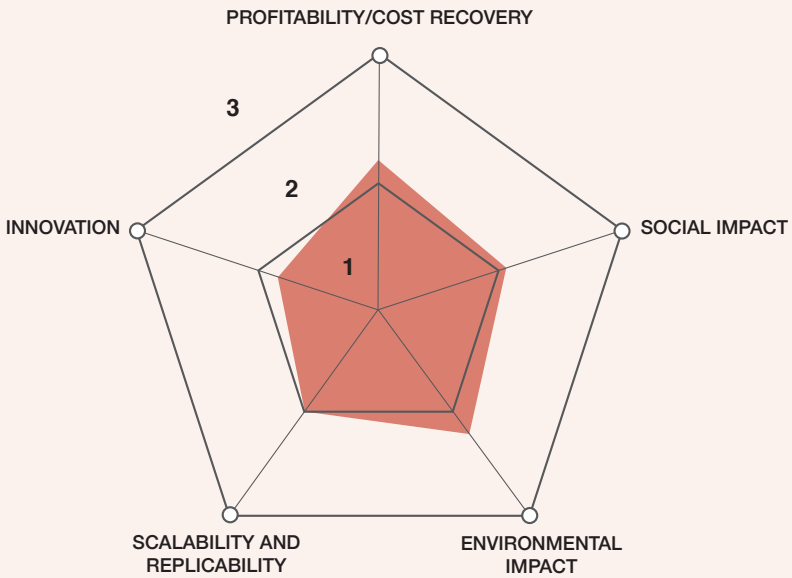
RISK GROUP	EXPOSURE ROUTE					REMARKS
	DIRECT CONTACT	AIR	INSECTS	WATER/ SOIL	FOOD	
Worker						Risk from crop residues can be more physical (sharp edges) than of other nature.
Farmer/user						
Community						
Consumer						
Mitigation measures						

Key: NOT APPLICABLE; LOW RISK; MEDIUM RISK; HIGH RISK

E. Business performance

This business model is rated high on environmental impact followed by profitability (Figure 80). The environmental impact scores high from the large-scale impact potential that the business model offers along with reduced greenhouse gas emission. The business model has a strong revenue source and

FIGURE 80. RANKING RESULTS FOR POWER FROM AGRO-WASTE BUSINESS MODEL



offers potential for additional revenue source from sale of carbon (VERs) and biochar. The social impact of the business model is dependent upon the customer segment served for provision of electricity. If the electricity is provided to underserved communities, the impact will be higher.

The business model has a high potential for replication in developing countries with availability of waste, technology and institutional capabilities. It can be scaled horizontally and has a potential for vertical scaling by expanding into the business of adding value to biochar for domestic and industrial use. It has a strong potential to be implemented in agriculture intensive regions. The business model scores relatively low on innovation as it is fairly straightforward with no sophisticated technology requirements. However, it may require innovative partnership and financing arrangements.