BUSINESS MODEL 7

Power from municipal solid waste

Krishna C. Rao and Solomie Gebrezgabher

A. Key characteristics

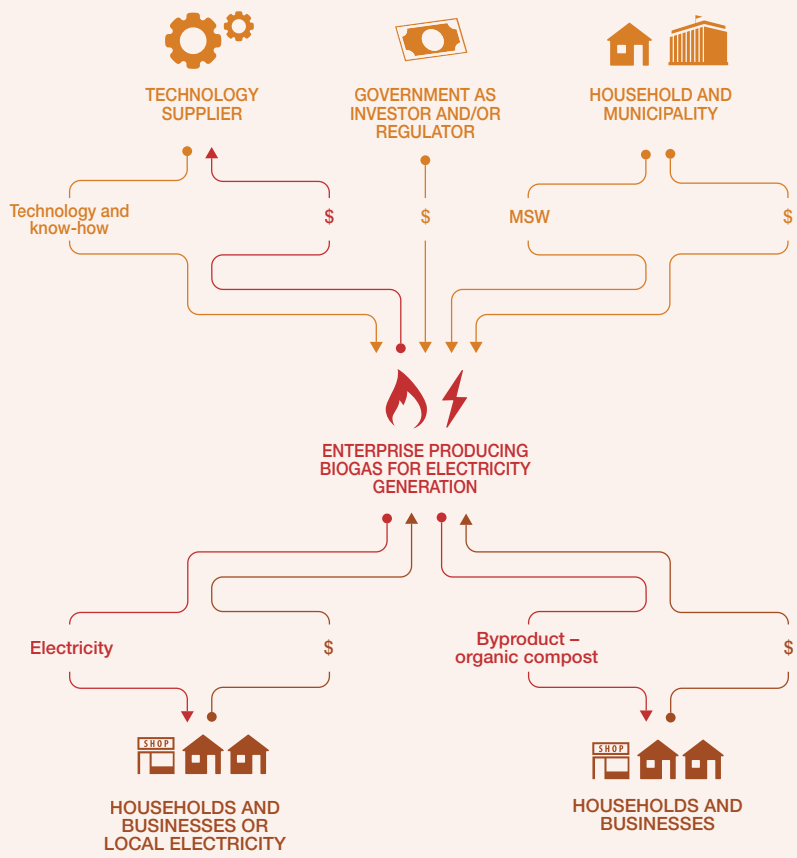
Model name	Power from municipal solid waste (MSW)
Waste stream	Organic waste – Organic component of MSW
Value-added waste product	Anaerobic digestion of organic waste to produce biogas to generate electricity and produce organic compost
Geography	Applicable to cities and towns that generate large quantities of organic solid waste
Scale of production	Medium to large scale; About 145 MWh/year to 9 GWh/year of electricity and 180 tons/year to 12,000 tons/year of organic compost
Supporting cases in this book	Pune, India
Objective of entity	Cost-recovery [X]; For profit [X]; Social enterprise [X]
Investment cost range	About USD 180,000 for lower size plant to USD 11 million of large size plant
Organization type	Private and public-private partnership (PPP)
Socio-economic impact	Improved and reliable electricity resulting in increased income and productivity, reduced greenhouse gas emissions, improved MSW management and processing and employment generation
Gender equity	Clean air working environment for women where kerosene lamps are replaced; and waste collection jobs for women 

B. Business value chain

The business model is initiated by a standalone private enterprise or a public-private partnership (PPP) where a private entity partners with the municipality to manage the solid waste generated by the city. The business concept is to collect, segregate and process organic component of MSW to generate electricity and compost. The electricity and compost can be sold to households, business or local electricity authority (Figure 85).

The key stakeholders in the business value chain are the waste suppliers, either household or the municipality; regulators-government; investors – municipality or private enterprise; technology supplier and plant operator – private enterprise and end users of the product–household and businesses or municipality. The process of generating electricity from MSW can be done through either incineration to produce heat and steam, gasification or anaerobic digestion. In this business model, the technology process used is anaerobic digestion where the organic component of MSW is segregated and sent to a digester to produce biogas, which is used to generate electricity. The business is eligible for sale of carbon as the electricity is generated from sustainable organic source with improved MSW management as MSW left in the open releases methane to the atmosphere.

FIGURE 85. VALUE CHAIN OF POWER FROM MSW



The contractual agreement of the PPP and role of private and public entities can take many forms. There are multiple options for the ownership of the plant. The plant can be owned by the municipality or the private enterprise with the concession from municipality to provide land and MSW. If it is owned by private enterprise, it may be on Build, Own, Operate (BOO) basis which is also called energy service company (ESCO) or on Build, Own, Operate, Transfer (BOOT) basis. Under BOOT, the private entity designs, constructs and maintains the energy production unit until BOOT period is expired after which it assists the municipality to own and operate the unit.

C. Business model

The primary value proposition of the business model is to reliably provide electricity from MSW. However, it would vary for a PPP as the primary mandate would be to provide waste collection and waste management service (Figure 86). The model also offers value proposition of providing organic compost which is a by-product of the process.

The business will have to collect MSW from the municipal landfill site or have the municipality garbage trucks deliver MSW to the plant. The business can also organize collection of MSW directly from households, and this would require a larger labor force. The enterprise would sell the electricity either

FIGURE 86. BUSINESS MODEL CANVAS – POWER FROM MSW

KEY PARTNERS

- Government
- Municipality
- Technology and equipment suppliers
- Carbon trading partners

KEY ACTIVITIES

- MSW collection and segregation
- Contractual agreements
- Electricity generation and distribution
- Managing CDM process
- Compost production

KEY RESOURCES

- MSW
- Equipment
- Partnership, technical know-how and operational competencies
- Land and skilled local labor
- Agreement with electricity authority

VALUE PROPOSITIONS

- Reliable provision of environment-friendly electricity from a sustainable biomass source
- Waste collection and management service
- Organic compost from the by-product of anaerobic digestion

CUSTOMER RELATIONSHIPS

- Direct interaction with the community and electricity authority
- Direct interaction with household and municipality
- Direct interaction

CHANNELS

- Direct
- Direct collection from household or municipality
- Direct sales or via distributors
- Via carbon market agents

CUSTOMER SEGMENTS

- Households and businesses
- Electricity authority
- Households and municipality
- Recycling industries
- Farmers and landscapers
- Carbon market

COST STRUCTURE

- Investment costs – Building and equipment, transmission and distribution lines
- O&M costs – Training, utilities, labor (can be intensive and skilled labor)
- Costs incurred for CDM/VER registration and carbon sale

REVENUE STREAMS

- Sale of electricity
- Sales of carbon credit
- Waste collection and management fees
- Sale of recyclables
- Sale of compost

SOCIAL & ENVIRONMENTAL COSTS

- Potential leakage of gas
- Potential health risks for workers at production facility
- Potential environmental risk if the waste is not treated and disposed properly

SOCIAL & ENVIRONMENTAL BENEFITS

- Improved social and economic sustainability through improved electricity access
- Reduced GHG emission and pollution of water bodies and natural habitats
- Contributes to improved MSW management with reduced human exposure to untreated waste
- Create job opportunities

to household or businesses or to a local electricity distribution company. Other key activities for this business model are regular maintenance of transmission and distribution lines along with monthly meter, billing and collection. However, it is preferred by the enterprise to get into a power purchase agreement with the local electricity distribution company and feed the electricity to local grid at an agreed price per unit. The burden of transmission and distribution of electricity is as such transferred to the local electricity distribution company.

Sale of electricity and waste collection and management are the key revenue source. The enterprise is also eligible for carbon offset and since the electricity generated is substantial, it will be viable to apply for Clean Development Mechanism (CDM). MSW consists of inorganic waste such as plastics, paper and glass that have high resale value and sale of recyclables is another revenue source for the business model. In addition to above mentioned revenues, key outputs from the biogas plant are bio-slurry and sludge, which are rich in nutrients and can be processed to make organic compost. The enterprise can sell the compost to farmers and landscapers. Compost can be delivered to the customers either through direct sales, network of distributors or micro-franchising. The direct sales would involve managing a large human resource base for sales and marketing staff.

D. Potential risks and mitigation

Market risks: The electricity generated from processing MSW is primarily sold to local electricity grid on a long-term power purchase agreement. Since the demand for electricity is continuing to grow in developing countries and local electricity distribution companies are trying to bridge the gap between demand and supply, the market risks associated are lower. However, in environments where the electricity sector is regulated, with the tariff decided by the regulatory commission 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 this reuse 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. The business model also sells compost to farmers and landscapers. The market demand for compost can be low in urban areas, but in rural areas there is always high demand from farmers. However, sales in rural areas might significantly increase its transportation cost. The business needs to find the right balance between its urban and rural market.

Competition risks: The business risk for the output (electricity) is relatively low. The business model has to compete with other businesses generating electricity from cheaper fuel source such as coal. The business has higher risk in procuring MSW if it is not able to obtain a contract with municipality. To mitigate this risk the enterprise will have to undertake door-to-door collection of household waste. In the case of compost, competing products are chemical fertilizers, which are subsidized in developing countries; hence, the challenge for compost to be price competitive. The business should diversify its customers across different types of farmers including plantations and agro-forestry that will likely have higher demand for compost. The business could also produce varieties of compost products suitable for different types of crops. However, this in an unlikely scenario if the revenue stream is minor.

Technology performance risks: The technology process used is anaerobic digestion, which is well-established and mature. However, the type of digester required could potentially be sophisticated and might not be available in developing countries, and in addition, the technology requires skilled labor. It is ideal for the business to transfer the technology from a market where it is widely implemented and have their staff trained in operation, repair and maintenance of the technology.

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. The risks to compost from political and regulatory aspects are similar to electricity. If the regulation does not allow compost from MSW for crop production, it can hamper business viability and restrict the application of such compost to a very specific market and customer segment such as forestry or landscaping.

Social-equity-related risks: The model does not have any social equity risks. The model is considered to have more advantages for women due to clean working environment from clean indoor air by replacing kerosene used for lighting and offering women jobs in waste collection. The employment opportunities are limited for non-skilled workers. The model could potentially improve the working environment of informal workers especially women engaged in waste collection.

Safety, environmental and health risks: Safety and health risks to human arise when processing any type of waste. The risks are even higher when processing MSW. Laborers in enterprises handling such waste should be provided with appropriate gloves, masks and other appropriate tools to handle the waste to ensure their safety. The risk of environment pollution is high if leachate from MSW is untreated and seeps into groundwater or other natural water bodies. 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 anaerobic digestion units include possible leakage of gas (methane) and these emissions should be controlled. Organic waste when left in open begins to decay and releases methane which is more damaging to the environment than carbon dioxide (Table 25).

TABLE 25. POTENTIAL HEALTH AND ENVIRONMENTAL RISKS AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 7

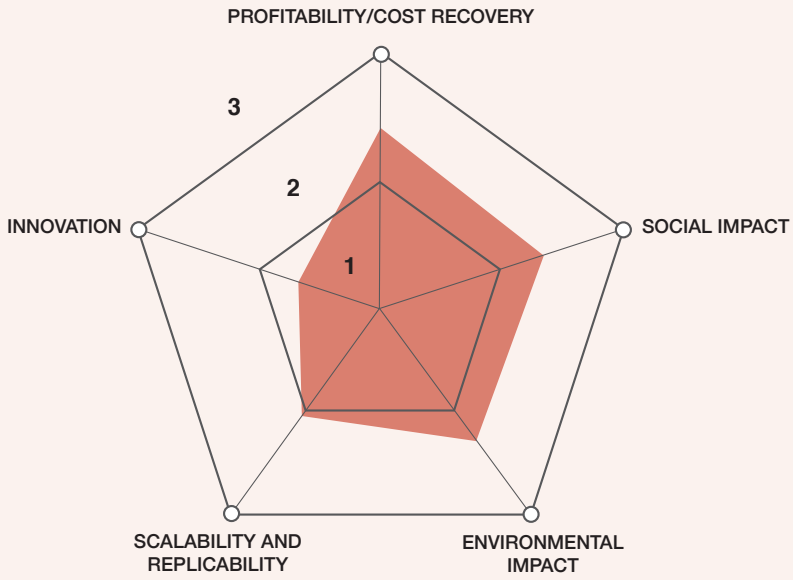
RISK GROUP	EXPOSURE					REMARKS
	DIRECT CONTACT	AIR	INSECTS	WATER/ SOIL	FOOD	
Worker						Air exposure if RDF is burnt (incl. organic and non-organic waste) Food based risks if slurry is chemically contaminated, which requires compost monitoring for chemical contaminants
Farmer/User						
Community						
Consumer						
Mitigation measures						

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

E. Business performance

This business model is scores high on profitability, followed by social impact and environmental impact indicators (Figure 87). The business model has multiple revenue sources: sale of electricity, waste collection and management fees, sales of recyclables and potential for sale of carbon and compost, and the model serves a diverse customer base. Since the business model is involved in MSW management and offers multiple value propositions, it provides direct jobs to about 20 people, and the number is higher if the business is also involved in the collection of waste from households. The environmental impact scores high from the large-scale impact potential that the business model offers from safe MSW management along with reduced greenhouse gas emissions.

FIGURE 87. RANKING RESULTS FOR POWER FROM MSW BUSINESS MODEL



The business model has high potential for replication in developing countries. It can be scaled horizontally and has potential for vertical scaling by expanding into the compost business. It has a strong potential to be implemented in agriculture intensive regions. The business model scores low on innovation. However, one needs to acknowledge that despite the process is well-known, there is need for a sophisticated technology tailored to specific characteristics of MSW in developing countries and the model requires innovative financing arrangements.