

Converting Waste to Energy

HIGHLIGHTS

- Waste-to-energy enterprises reduce CO₂ emissions, save trees, save time spent on collecting firewood, provide smoke-free energy, and deliver cash savings from replacement of expensive fuel.
- On-site waste-to-energy enterprises empower households to recycle the waste they generate into energy (mainly biogas) for their own consumption or sale to their community.
- Off-site waste-to-energy enterprises are highly scalable and provide products (briquettes, liquid fuel) that are more cost-effective than traditional energy products (wood charcoal, diesel).



Development Challenge

Low-income communities are often unable to afford structured waste management processes to dispose their trash. Most of the waste ends up in open dumpsites near residential areas, causing diseases, polluting the environment, and occupying extensive space. While recycling and reusing are disposal options, they are not always feasible for all types of waste. Recyclable waste can also become so contaminated that they cannot be economically or practically recovered. Moreover, since waste is not segregated at source, it is difficult and unviable to recycle mixed waste. Hence, the waste is typically dumped into landfills without being treated, posing higher risks of environmental damage. Incineration is another commonly employed means of managing waste. Estimates of global black carbon emissions suggest that 40 percent comes from open burning of biomass. Lack of effective methods in disposal of non-biodegradable plastics leads to soil degradation and impacts groundwater tables.

Business Model

In recent years, social enterprises have commercialized waste-to-energy technologies to convert the unrecyclable waste to affordable fuel products, either at the source of waste generation (on-site) or at a centralized facility (off-site).

Many social enterprises provide innovative solutions that enable households or businesses to convert the waste they generate into useful energy. These enterprises treat waste at source to bring down transportation inefficiencies and consume low-cost energy for domestic/industrial purposes. For example, The Waste Transformer, an enterprise that operates in Sub-Saharan Africa, offers gasifier waste-to-electricity installations that can handle a wide variety of waste streams as its input, including wood, food, plastics and agricultural waste. These wastes are then turned into heat and gas. The resultant gas can then be used to generate electricity.

Some enterprises deploy large-scale solutions where waste is procured, transported to processing facilities and centrally processed into liquid fuel or briquettes. These enterprises employ waste collectors to aggregate waste and transport it to their plants thereby providing livelihood opportunities to local people and reducing the flow of waste to landfill dumps.

Features of Waste-to-Energy Business Model

On-site conversion of waste to energy



- Many enterprises manufacture and sell equipment for conversion of waste to energy at the household level
- The technology is generally sold to household waste generators as a do-it-yourself kit; enterprises impart training about the systems to enable individuals to produce energy for domestic consumption
- Some enterprises also provide innovative financing/marketing options to enable ease of access to these technologies

Off-site conversion of waste to energy



- Some enterprises aggregate plastic and organic waste into a central facility and, using their proprietary technology, convert the waste into fuel such as diesel, briquette and pellets
- The fuel is sold to industries – as a replacement for coal and diesel – for purposes such as heating, steam generation, operating machinery etc.
- Some enterprises have designed technology that can treat and convert mixed waste to energy

Implementation: Delivering Value to the Poor

Awareness

Most waste-to-energy enterprises use non-traditional marketing channels to create awareness about their products and services. For example, SimGas promotes its products through local churches and NGOs that are well connected with the local community. Habona promotes its product through social media (Facebook), while Biotech organizes roadshows around southern India, demonstrating the benefits of biogas plants to a wide audience.

Acceptance

Waste-to-energy enterprises create win-win situations for their customers (access to clean energy) and entrepreneurs/franchise partners (additional income). (B)energy, a waste management enterprise based in Ethiopia, provides households in rural Africa, Asia, and Latin America with access to cooking biogas by converting organic solid and liquid waste to biogas and fertilizer. Some enterprises use local champions as employees to drive acceptance of their waste-to-energy solutions within the community. Bright Energy Africa employs farmers to run briquette fabricators in central locations. It also employs unemployed women and youth as commission-based sales agents, who advise families in their network to replace traditional wood charcoal with smokeless briquette for cooking.

Accessibility

Waste-to-Energy enterprises tap into the existing rural network to ensure last-mile delivery of their systems. For example, (B)energy has a decentralized hub-and-spoke distribution model wherein it appoints social franchisees at a local level and imparts training to them for filling in the biogas in the backpacks. Often households are reluctant to invest in a biogas plant because they consider the running and maintenance of the plant highly technical. Some of the standard products may also have parts that are not readily available locally or may not be suitable for installation. To address this issue, some enterprises provide modular or customizable solutions. For example, India-based Samuchit Enviro Tech provides a do-it-yourself kit consisting of all critical components along with an instructional video.

Affordability

Some enterprises make their on-site plants affordable by partnering with local governments that offer subsidies to consumers for the use of the systems. The cost of implementation of biogas technology is significantly lower than for other renewable energy technologies (wind, solar, and hydro), thus making it a cost-effective source of energy for domestic consumption. Some enterprises also provide consumer finance. For example, Takamoto Biogas (Schutter Energy) provides pay-as-you-go biogas systems in Kenya where their customers (mainly smallholder farmers) pay a small fee to install the biogas system and make mobile payments for the biogas they use.

On-site waste-to-energy enterprises incur high costs on developing and manufacturing the waste treatment systems, while off-site waste-to-energy enterprises incur high costs for setting up the waste treatment plants. Off-site enterprises incur higher capital expenditure overall. On-site waste-to-energy systems treat waste locally, and hence, do not incur costs associated with waste collection. For example, consumers of SimGas and (B)energy collect their own organic waste (e.g., animal dung, kitchen waste, human feces) and feed them into the mobile biogas systems provided by the enterprises. Some enterprises provide community-level solutions, which treat waste and generate biogas for a few households.

The major revenue streams for waste-to-energy enterprises include sale of waste treatment systems and energy products such as biogas and briquette. Briquettes are sold by off-site waste-to-energy enterprises at prices that are generally comparable to wood charcoal of the same calorific value.

Many off-site waste-to-energy enterprises piggyback on government waste management programs to install centralized small-scale waste-to-energy systems. For example, Clean India Ventures has joined the Clean India Mission to install community-based waste re-processor machines. Waste-to-energy enterprises also partner with local manufacturers and NGOs throughout the development and implementation of their products. and other local partners.

Results and Effectiveness

Off-site enterprises offer a more scalable and cost-effective solution for waste to energy conversion due to economies of scale. However, they are limited by the high capital investment required to start the business. The most commonly seen offsite waste-to-energy enterprises are briquette manufacturers. On-site enterprises are more effective in waste management as they divert waste from landfills. However, many households hesitate to install the plant in their homes due to the stench and space constraints. The most commonly seen onsite waste-to-energy enterprises are biogas plants. In general, the waste-to-energy business model is highly scalable and has the potential to reach thousands of households within a few years of operations.

Waste-to-energy enterprises create significant impact across many parameters such as carbon dioxide emission reduction, trees saved, time saved from not collecting firewood, health benefits of smokeless energy, and money saved by replacing expensive fuel with lower priced or more efficient fuel. Enterprises providing biogas solutions shared outcome data that highlights the multi-level impacts of this model, in addition to savings or additional income to farmer households. For example, SimGas Saves on average USD 250 per household per year on energy expenditure, and each woman saves 2-4 hours a day by not collecting firewood.