BUSINESS MODEL PROFILES: ENERGY
SUMMARIZED FROM THE FORTHCOMING PUBLICATION
RESOURCE RECOVERY FROM WASTE

CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems
LED BY: IWMI International Water Management Institute

Generating Bio-ethanol and Chemical Products from Agro-waste and Agro-industrial Waste

Business characteristics

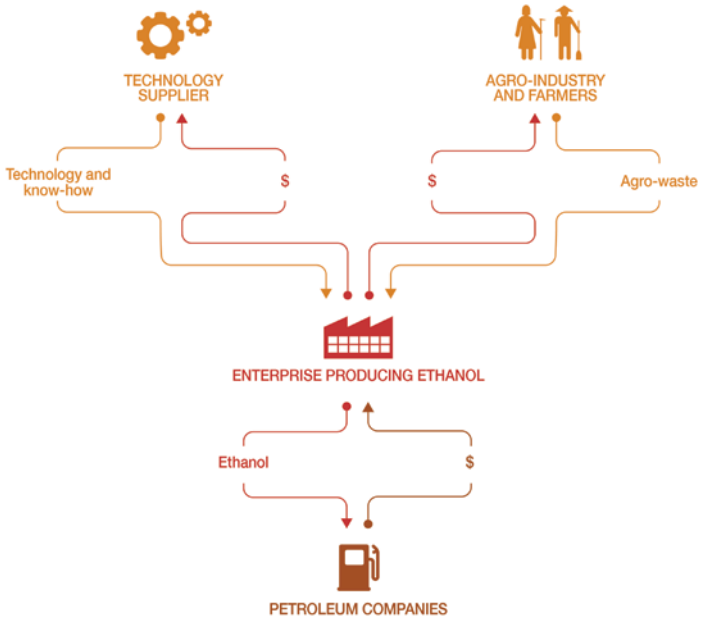
Geography	Regions with large agro-industries
Scale of production	20-30 tons of chemical product or ethanol per day from agro- or industrial waste
Type of organization	Agro-industrial factory and/or private technology enterprise
Investment cost range	Approximately USD 150-400 per ton of chemical product or ethanol
Key costs	Investment costs (land, building and machines), operational costs (raw materials, labor, utilities, maintenance), marketing costs, depreciation, research and development, patent filing and maintenance costs, and equity and/or interest on loans
Revenue stream	Sale of ethanol or chemical products, sale of by-products (lignosulfonates, fertilizer), and potential sale of carbon credits

Business model

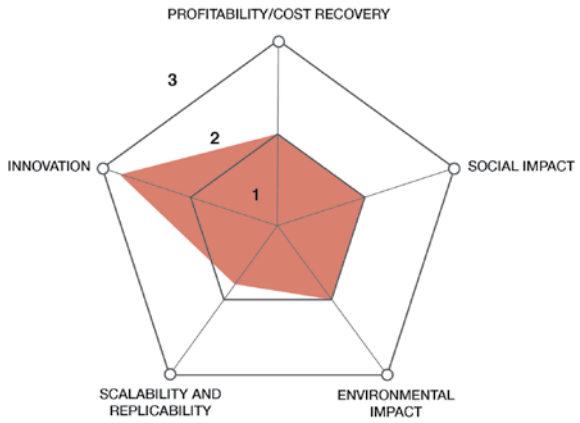
The business model processes solid or liquid agro-waste or crop residues such as wheat stalks and rice husks to produce ethanol or chemical products. The model uses enzymes to break down cellulose in the agro-waste into fermentable sugars to produce ethanol, which is sold to petroleum companies. This ethanol can then be blended with gasoline and used as an environmentally friendly fuel for transport.

The business model can be set up by an agro-industrial factory or by an external private enterprise in partnership with agro-industries. In both cases, the model requires a specific technology tailored to the type of waste produced and the end-product desired. The company must, therefore, either invest considerably in research and development (R&D), buy-into/partner with a R&D organization or monitor recent developments in technologies and invest when suitable. If the business develops its own technology, it should also patent it to ensure return on investment. In addition to ethanol, chemical additives (lignosulfonates) can be developed from vinasse, a by-product of ethanol production, for use in industries such as construction, cement, pesticides, mining, etc. Biogas and bio-fertilizers can also be generated from the remaining bio-sludge and the business can sell carbon credits for additional revenue.

BUSINESS MODEL VALUE CHAIN



Business performance



The business model scores very highly on innovation due to the development of new and patented materials and/or processes, as well as the creation of strategic partnerships with different players in the market, such as input suppliers, technology developers, business development and legal advisors. However, due to the need for tailored technology for each business, the model has a low potential for replicability.

Main risks

Market risks: The business faces uncertainty in successfully deploying the new product from R&D to commercialization, and requires extensive marketing among its end users to secure offtake contracts.

Technological risks: There is high uncertainty as to whether the technology will perform well at an industrial scale. Also, technology development and market introduction are a multi-step process, often requiring risky financial injections at various stages.

Political and regulatory risks: Since the technology is new and not tested on an industrial scale, the business may face challenges from unfavorable business environment, encounter resistance from the government to obtain permits prior to initiating production and go through a lengthy process for obtaining approval for patent.

Safety, environmental and health risks: There is a possible risk of water pollution and environmental hazard, if the production of ethanol from agro-waste does not remove pathogens and pollutants completely, and is discharged into the open.

Case study: Venezuela

ETAVEN C.A., (ETAVEN), is a private Venezuelan company, established in 2007, that has patented a process for producing ethanol (named "YARETANOL") through the fermentation of yare - a by-product of cassava processing. The company sells this Yaretanol to petrochemical companies which blend it with petroleum to produce a renewable fuel for transport.

Situated in the cassava flour processing region of the country, ETAVEN has access to cost-effective, suboptimal cassava that cannot be used for other commercial purposes, as well as residual plant waste (yare) associated with cassava flour production. The company processes this waste and obtains a 50% yield of ethanol at 50% of the market price, which it sells for a profit to petrochemical companies. It currently produces approximately 30 tons of ethanol per day, roughly 1% of Venezuela's national consumption of ethanol.

By purchasing and using this waste, ETAVEN has had a significant positive impact on both the local community and the environment. It has reduced the pollution associated with high cyanide runoff from the improper disposal of cassava into local rivers and lakes, reduced greenhouse gas (GHG) emissions, and increased the incomes of local cassava farmers by up to 50%.

Key performance indicators (as of 2012)

Capital investment:	USD 2.5 million
Labor:	50 plant employees and 12 university volunteers to analyze and improve the process
Operation and maintenance cost:	About USD 375,000/year (forecast 2013)
Output:	30 tons/day of Yaretanol
Social and environmental impact:	Reduced water pollution previously caused by improper yare waste disposal into local rivers, reduced GHG emissions by substituting petrol used for transportation, creation of jobs, and improved incomes for about 300 local cassava farmers
Financial viability:	Payback period: Over 2 years Rate of return: Less than 50% Gross margin: 99%

For more information on the business model and related cases, see Chapter 6 of **Otoo, M.; Drechsel, P. (Eds.). 2017.** ***Resource recovery from waste: Business models for energy, nutrient and water reuse in low- and middle-income countries.*** **London: Earthscan/Routledge. In press.** The book has been produced by the Resource Recovery and Reuse subprogram of the International Water Management Institute (IWMI), under the CGIAR Research Program on Water, Land and Ecosystems (WLE) and its Rural-Urban Linkages Research Theme. The support of the Swiss Agency for Development and Cooperation (SDC), the International Fund for Agricultural Development (IFAD), and CGIAR Fund Donors (www.cgiar.org/about-us/our-funders/) is gratefully acknowledged.