BUSINESS MODEL 9

Bio-ethanol and chemical products from agro and agro-industrial waste

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A. Key characteristics

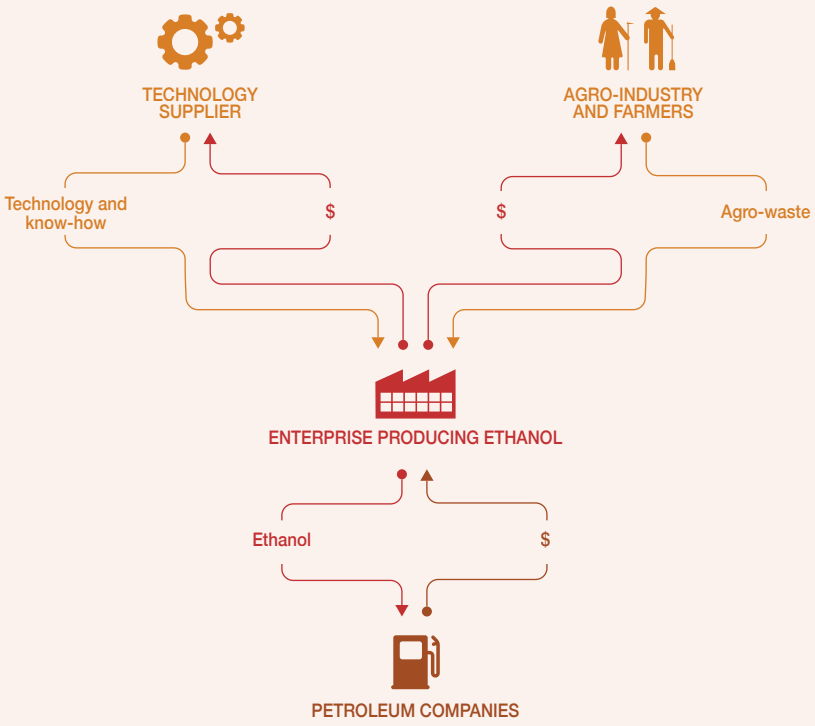
Model name	Bio-ethanol and chemical products from agro and agro-industrial waste
Waste stream	Organic waste – Agro-waste from farms and agro-processing factories and vinasse waste generated during ethanol production
Value-added waste product	Bio-ethanol (as additive to petrol/gasoline as transportation fuel) and chemical products (like lignosulfonate substitutes for various industries)
Geography	Regions with large agro-industries
Scale of production	Small to medium scale 20–30 tons of chemical product or ethanol per day from agro or agro-industrial waste
Supporting cases in this book	Carabobo, Venezuela; Veracruz state, Mexico
Objective of entity	Cost-recovery [ ]; For profit [X]; Social enterprise [ ]
Investment cost range	Approx. 150–400 USD/ton of chemical product or ethanol
Organization type	Private
Socio-economic impact	Employment generation (12–50 jobs), improved income of farmers, reduced water, land and air pollution from vinasse and agro-waste, reducing GHG emissions by substituting petrol used for transportation or non-eco-friendly product (like lignosulfonates)
Gender equity	No advantage to a specific gender 

B. Business value chain

This business model is owned and operated by either a standalone private entity or agro-industries such as rice mills, coffee, cassava and palm-oil-processing units. The business processes solid or liquid agro-waste or crop residues such as wheat stalk, rice husk, maize stalk, groundnut shells, coffee husks and cassava waste to produce ethanol or chemical products (Figure 114). Specific technology tailored to the quality of available waste needs to be developed for each case, depending on the type of waste. If ethanol is produced, this can be blended with gasoline and used in motor vehicles. This is becoming an increasingly cost-effective renewable solution to transport, as gasoline stations around the world start to provide blended fuel and motor vehicles no longer need any modifications to use this fuel.

The key stakeholders in the business value chain are the suppliers of agro-waste (farmers and agro-industries), technology suppliers and petroleum companies and consumers of ethanol. The process of

FIGURE 114. VALUE CHAIN FOR BIO-ETHANOL AND CHEMICAL PRODUCTS FROM AGRO AND AGRO-INDUSTRIAL WASTE



generating ethanol uses enzymes to break down cellulose in the agro-waste into fermentable sugars. For the business to be successful, it is important to develop enzymes that break down complex cellulose efficiently and economically. In addition, the business could require developing special strains of yeast or bacteria for improved fermentation processes for better yields of ethanol. These micro-organisms can be engineered to work more efficiently in specific temperatures and acidities, or can be engineered to have new scopes of enzymatic activities or combinations thereof. R&D of such technology is costly and can only be initiated with availability of sufficient R&D capacity, either in-house (for a large company) or with a R&D partner, and with the availability of sufficient funds throughout the technology development stages. The newly-developed materials and/or processes should also be patented to protect the technology to ensure return on investment. However, this represents another substantial cost over the course of life of the patent(s).

Overall, the model contributes to the reduction of environmental and health hazards associated with disposing of waste from agro-processing units, and thus creating a green image for the agro-processing units. The business is eligible for sale of carbon as ethanol is a biofuel and is generated from sustainable biomass source. Furthermore, the production of ethanol results in vinasse, a by-product of waste distillation which can be treated to recover clean water. Finally, there is also the potential to produce value-added animal feed, biogas and bio-fertilizers by further processing of remaining sludge.

C. Business model

The primary value proposition of the business model is production of environment-friendly ethanol from cellulose in agro-waste for blending with petrol/gasoline as transportation fuel. Figure 115 depicts the business model canvas for emerging technologies.

As an additional business line and in consideration of pursuing an emerging technology route, the business should consider developing a product from the vinasse waste generated during ethanol production. One of the business cases described (Eco Biosis) in the energy section of the catalog elaborates on the company's successful efforts to research and produce a low-cost substitute for lignosulfonates from the vinasse. These chemical additives are used extensively in several industries such as construction, agriculture, mining and cosmetics. Benefits in this manner double, as effluent is minimized and cleaned, while another revenue stream is added. Both the Eco Biosis material and the process are protected with patents.

It requires considerable investment in developing the technology and process. The business spends a substantial amount of money on product R&D and subsequent patenting. In order to develop the new product that meets customers' needs at a competitive price and to ensure sales, the business requires collaboration and consultation with different agencies for technical assistance, product development including partnership with an R&D institute, business development and legal assistance including patent protection measures. The business model may require technology validation for which the "launching customer" concept is an ideal strategy. For example, the business starts as a pilot plant in partnership with agro-processing units and gradually increases its scale of operation while at the same time securing off-take contracts with specific buyers. These projects require high-risk money with flexibility of adopting strategies to the business needs for technology and process development.

Once the technology and the process are streamlined for commercial production, it is important for the business to form partnerships with agro-processing units to secure reliable supply of inputs. Hence, this business is either located near or is incorporated into the agro-processing factories as production of ethanol depends, among other things, on the availability of the feedstock. The business receives the feedstock free of charge or pays a nominal value because it offsets the cost of disposal for the agro-processing factory. Incorporating the business into the agro-processing factory is a strategic decision for the agro-processing factory.

An alternative strategy is for the business to buy-in newly-developed technology from a specialized R&D organization that it partners with. This might take longer and have less security but it dramatically reduces the risks associated with the R&D stages. The business may enter a contract R&D arrangement or may invest in participating in a technology development consortium. Still alternatively, the business may adopt an R&D networking strategy in which it vigilantly monitors technology developments within the R&D arena and buys in at a time of interest. It should expect to invest considerable time liaising within the R&D network and the technology transfer channels, with smaller chances of a good match.

A further alternative is for the business to license in strategically-important technology developed and patented by another party. Benchmarks for upfront payments and royalties on sales vary widely and depend on the type of technology, technology maturity and market dynamics. In both two alternatives mentioned, it is important to avail the required critical understanding and capacity in intellectual property rights and legal affairs.

FIGURE 115. BUSINESS MODEL CANVAS – BIO-ETHANOL AND CHEMICAL PRODUCTS FROM AGRO AND AGRO-INDUSTRIAL WASTE

KEY PARTNERS

- Farmers and agro-processing units
- Research institutes
- Funders/ investors

KEY ACTIVITIES

- R&D of products
- Production of ethanol/chemical product
- Marketing of product

KEY RESOURCES

- Land
- Capital
- Agreement with agro-processing units and farmers
- Agro-waste
- Technical and operational competencies
- Patent protected IP
- Patent expertise
- Green brand image

VALUE PROPOSITIONS

- Environment friendly ethanol from agro-waste for blending with petroleum
- Producing environment-friendly lignosulfonate substitute from alcohol distillation by-product waste and reduce environment pollution

CUSTOMER RELATIONSHIPS

- Direct interaction with user
- Industries/ petroleum companies

CHANNELS

- Direct supply to petroleum companies under contract

CUSTOMER SEGMENTS

- Petroleum companies
- User industries

COST STRUCTURE

- Investment cost (land, building, machines)
- Operational cost (raw material cost, labor, utilities, maintenance)
- Marketing cost
- Depreciation
- R&D
- Patent filing, maintenance and patent attorney costs
- Equity and/or interest on loans

REVENUE STREAMS

- Sale of ethanol
- Sale of chemical products

SOCIAL & ENVIRONMENTAL COSTS

- Possible risk of pollution of water from vinasse

SOCIAL & ENVIRONMENTAL BENEFITS

- Creation of jobs
- Reduced water, land and air pollution through processing of agro-waste and vinasse
- Reduced GHG emissions by using ethanol from renewable source blended into petrol
- Clean water savings
- Environmental benefit from consuming substitutes of lignosulfonates made from wood pulp
- Carbon footprint reduction from the local purchase of lignosulfonates instead of importing them

D. Potential risks and mitigation

Market risks: This business model is offering a new product, which can substitute existing products with an established market. The business faces uncertainty in successfully deploying the new product from R&D and pilot stage to commercialization. Ethanol from agro-waste can be used as a substitute for ethanol from other sources such as sugarcane and corn. This business faces the challenges of developing a viable business and requires extensive marketing and awareness creation among its end users to secure off-take contracts.

Competition risks: The success of ethanol from agro-waste depends on how fast the technology is commercialized and how much it costs compared to established alternative products. The business can avoid competition from existing companies in the market by targeting those buyers which are not served by existing companies or enter a market through strategic positioning by offering the product that is environmentally-friendly and is lower-priced than established alternative products in the market. Ethanol from agro-waste is expected to be less expensive than the alternatives as inputs can be sourced at a low cost, and thus giving this business a competitive advantage over other ethanol producers.

Technology performance risks: Technology is new and was not tested at the assessment time on an industrial scale. Technology development and market introduction are a multi-year, multi-step process, often requiring financial injections at various stages. Capital costs are uncertain when constructing a pilot plant and a commercially-viable demonstration, as the technology is not proven. Hence, there is considerable risk from inability to reach investment coverage at each individual stage. Partnership with an R&D institute is required to move the technology from pilot to commercial scale, and in the process mitigate any risk associated with technology performance.

Political and regulatory risks: There is limited awareness on the technology or process among policy makers. Since the technology is new and not tested on an industrial scale, the business may face challenges from unfavourable 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. Few governments in developing countries have implemented the policy of mandatory blending of petrol/gasoline with ethanol and such policies will significantly help this business model.

Social-equity-related risks: The model is considered to have no advantage to any specific gender. The benefits of the model are to agro-industries to help manage their waste and the employment opportunities created are for highly-skilled labor. The model could suffer from social-equity risks which can be mitigated from corporate social responsibility initiatives that provide benefits to the community around the plant.

Safety, environmental and health risks: There is 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. Untreated vinasse waste discharged into the open is an environmental hazard and can harm the local ecosystem. However, there are technologies and good practices to prevent this (Table 33).

TABLE 33. POTENTIAL HEALTH AND ENVIRONMENTAL RISKS AND SUGGESTED MITIGATION MEASURES FOR BUSINESS MODEL 9

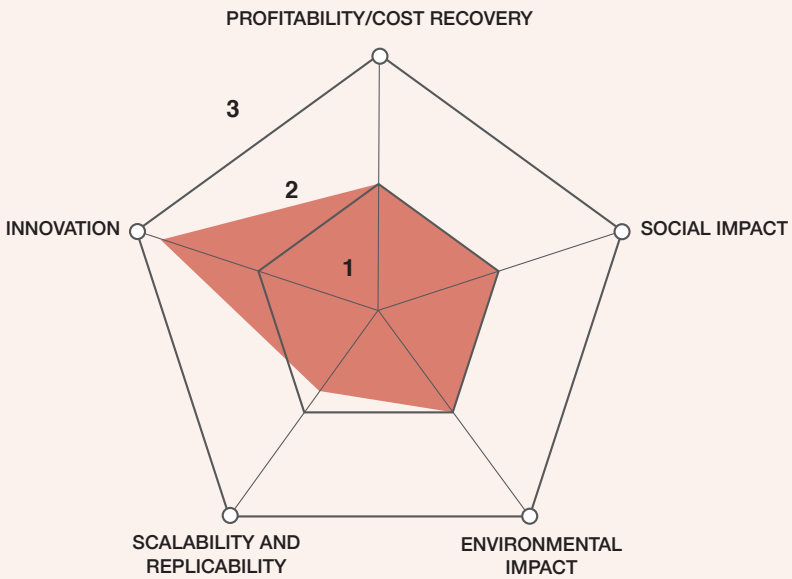
RISK GROUP	EXPOSURE					REMARKS
	DIRECT CONTACT	AIR	INSECTS	WATER/ SOIL	FOOD	
Worker						Risks to workers from direct contact with the waste can be mitigated using protective gear/equipment.
Farmer/User						
Community						
Consumer						
Mitigation measures						

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

E. Business performance

This business model is rated as high in innovation but medium on profitability, social and environmental impact and low on scalability and replicability potential (Figure 116). The business is highly innovative in

FIGURE 116. RANKING RESULTS BIO-ETHANOL AND CHEMICAL PRODUCTS FROM AGRO AND AGRO-INDUSTRIAL WASTE BUSINESS MODEL



terms of its developing new and patented materials and/or processes. The business is also innovative in creating strategic partnerships with different players in the market, such as input suppliers, technology developers, business development and legal advisors. This business model can result in high returns from its innovative process and strategic partnership. However, the deployment of the new technology into the commercial market requires significant amount of capital, and thus affecting the profitability and future cash flows.