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

### Business characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geography</td>
<td>Regions with large agro-industries</td>
</tr>
<tr>
<td>Scale of production</td>
<td>20-30 tons of chemical product or ethanol per day from agro- or industrial waste</td>
</tr>
<tr>
<td>Type of organization</td>
<td>Agro-industrial factory and/or private technology enterprise</td>
</tr>
<tr>
<td>Investment cost range</td>
<td>Approximately USD 150-400 per ton of chemical product or ethanol</td>
</tr>
<tr>
<td>Key costs</td>
<td>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</td>
</tr>
<tr>
<td>Revenue stream</td>
<td>Sale of ethanol or chemical products, sale of by-products (lignosulfonates, fertilizer), and potential sale of carbon credits</td>
</tr>
</tbody>
</table>

### 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) 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 Model Value Chain Diagram]

**BUSINESS MODEL VALUE CHAIN**

- **Technology and know-how**
- **Agro-industry and farmers**
- **Enterprise producing ethanol**
- **Petroleum companies**
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%