The sustainable expansion of sugarcane ethanol in Brazil and the trends for others countries - The experience of ETH Bioenergia
Build a leading Company in bioenergy (ethanol and co-generation of electricity), focused on value creation to the stakeholders.

ETH Bioenergy

A new paradigm in the sector

Competitiveness

Sustainability

Culture & People
ETH Bioenergy

Consistent business plan implementation

CA-ETH approval for 3 greenfield projects (17.5 MM ton)

2nd Acquisition (Eldorado)

Merger with Brenco (bringing new shareholders)

Alto Taquari startup

1st Acquisition (Alcidia)

Partnership with Sojitz

3 greenfield startups

Morro Vermelho startup

2 greenfield will startups

2011

BUILT IN 13 MONTHS
ETH - Growth plan

Leader in ethanol and energy from biomass

- Alcídia Acquisition
- Alcídia Expansion
- Rio Claro (Aug/09)
- Morro Vermelho (Aug/10)
- Sta. Luzia (Oct/09)
- Alto Taquari (Nov/10)
- Costa Rica (Oct/11)
- Água Emendada (Nov/11)
- UCP (Oct/09)
- Eldorado Acquisition
- Eldorado Expansion
- Alcídia Acquisition
- Alcídia Expansion
- Morro Vermelho (Aug/10)
- Costa Rica (Oct/11)
- Água Emendada (Nov/11)

Industrial capacity (MM ton)
- 2.9 (07/08)
- 3.3 (08/09)
- 3.9 (09/10)
- 9.0 (10/11)
- 20 E (11/12)
- 30 E (12/13)
- 40 E (13/14)

Crushing (MM ton)
- 3 bi liters - Ethanol
- 2,700 GWh - Cogen

Clusters
- SP
- MT
- GO
- MS

Ethanol Pipeline

New Projects

Market Consolidation

MARGIN LEADER
ETH - Acquired mills

Alcídia
- Teodoro Sampaio, SP
- Startup: 1978
- Acquisition (93%): Jul 2007
- Capacity: 2,1 MM ton

Eldorado
- Rio Brilhante, MS
- Startup: 2006
- Acquisition (100%): Mar 2008
- Capacity: 3,0 MM ton
- Planned expansion to 6,0 MM ton
ETH - Greenfield projects

Conquista do Pontal
Mirante do Paranapanema, SP
Startup: Oct/2009
Capacity
- Startup: 3,0 MM ton
- Projected: 5,5 MM ton

Santa Luzia
Nova Alvorada do Sul, MS
Startup: Oct/2009
Capacity
- Startup: 3,0 MM ton
- Projected: 6,0 MM ton

Rio Claro
Caçu, GO
Startup: Aug/2009
Capacity
- Startup: 3,0 MM ton
- Projected: 6,0 MM ton
ETH - New mills (Brenco)

**Morro Vermelho**
*Mineiros, GO*
Startup: Aug/2010
Capacity: 3,8 MM ton

**Alto Taquari**
*Alto Taquari, MT*
Startup: Oct/2010
Capacity: 3,8 MM ton

**Costa Rica**
*Costa Rica, MS*
Startup: Oct/2011
Capacity: 3,8 MM ton

**Perolândia**
*Água Emendada, GO*
Startup: Nov/2011
Capacity: 3,8 MM ton
ETH Bioenergy

Investments

Investments Accomplished until oct/10

- R$ 5,3 bi

Investments Commitment between 2011/12

- R$ 1,9 bi

Total Investments R$ 7,2 bi

Market Leader (2012)

- Ethanol Sales: 3.0 bi liters
- Energy: 2,700 GWh
- Revenues: US$ 2.5 bi
- Potential EBITDA: 50%

1 US$ ~ R$ 1.62
Brazilian Trends

Macro trends 2010-2020 open great opportunities for energy from biomass

- Increasing international concerns on energy security and CO₂ emission reduction
- Ethanol is part of the Brazilian strategic agenda
- Strong domestic ethanol market growth coupled with international expansion
- Increasing potential for electricity from biomass in Brazil

Sector in evolution
- Consolidation
- New Players
- Pipeline and terminals

Competitiveness:
- Oil production cost ↑
- Ethanol production cost ↓

Potential for innovation and break-through technology

- Increasing international concerns on energy security and CO₂ emission reduction

Brazilian Trends
ETH – International Expansion

ETH is aiming to be the key driver in the international expansion of sugar and ethanol.

Main parameters to identify target countries for the international expansion:

- **Climate** zones and adequate **soil** for sugarcane cultivation;
- The potential existence of **internal demand** for sugar, ethanol, and/or competitive tax and logistical cost benefits for **exportation to the US, Europe, and Asia**;
- Presence of **Odebrecht** in the country.
World

Sugar Cane Around the World – Climate and Soils
World

Ethanol is becoming a reality in the international markets

Countries with projects underway in Africa and Latin America

Mexico
- Ethanol Production: 500 MN liters
- Co-generation: 50 MWs

Dominican Republic*
- Potential Ethanol production: 300 MN liters
- Co-generation: 100 MWs

Colombia*
- Ethanol Production: 2010: 400 MN liters
  2020: 1,2 Bn liters
- Co-generation: 300 MWs
- E-10 in 2010 – E-20 until 2014

Angola
- Biocom
  Ethanol production: 60 MN liters
  Co-generation: 60 MWs
  Start up: Aug/2011

Peru*
- Ethanol production:
  2010: 55 MN liters
  2020: 660 MN liters
- Co-generation: 150 MWs
- E-7.8 - whole country until 2011

Ghana
- Ethanol production: 150 MN liters
- Co-generation: 35 MWs

Tanzania
- Ethanol production: 1.5 Bn liters
- Co-generation: 150 MWs

Mozambique
- Ethanol production: 750 MN liters
- Co-generation: 100 MWs

Important Notes:
- All plants should produce Ethanol, Sugar and Power;
- Beyond the countries under Odebrecht assessment, others like Zambia, Kenya and Uganda have been interested in local ethanol production.

* Preliminary due diligence underway
**ETH – International Expansion**

*Actions underway in Africa*

**Mozambique**
- Technical and financial viability analysis for the project EcoEnergy (Swedish company), at a hub for ethanol, sugar, and electric energy in Cabo Delgado, with crushed cane capacity of 4MM tons per year.
- Identification of new potential development areas.

**Tanzania**
- Technical and financial viability analysis for the project EcoEnergy, at a hub for the production of ethanol, sugar, and electric energy in Rufiji, with crushed cane capacity of 4 MM tons per year.

**Libya** *(Project suspended until the situation there normalizes)*

Analysis done in partnership with LIA (Libyan Investment Authority) for:
- ETH/LIA investment greater sugarcane production capacity in Brazil.
- Provision of sugar from ETH to Libya.
- Investment in a sugar refinery by Odebrecht in Libya.

Besides the aforementioned countries, Zambia, Kenya, and Uganda are interested in developing ethanol production capabilities, and will be evaluated from a joint perspective with Odebrecht.
ETH – International Expansion

*Actions underway in Africa - Angola Investments*

- **Biocom acquisition study** (investment in early stage)
  - 40% Odebrecht, 40% Damer, and 20% Sonangol;
  - Cacuso – Malanje: production of ethanol, sugar, and electric energy;
  - Capacity of 2MM tons of crushed cane per year;
  - Identification of other areas for new project development

**Biocom**
- Sugar and Ethanol

**Block 16 Oil**

**Women Mechanical Training Angola**
ETHANOL OPPORTUNITIES

USES

Transportation (fuel)

Energy

Consumer goods

PRODUCTION
**PRODUCTION ISSUES**

- Brazilian Biomes

**PRODUCTION**

- Destruction of sensitive biomes
  - Amazon Rainforest
  - Cerrado (savanna)
  - Pantanal (wetlands)
- Risks to biodiversity
  - High Value Conservation Areas
  - Sugarcane expansion pushes agricultural activities into the rainforest
The Evolution of Legislation

- **Agro-ecological zoning for sugarcane**: Prohibition of any future sugarcane farming or processing in the Amazon, Pantanal, or in any area of native vegetation.
- **Defined Areas** for Permanent Preservation and Areas of Legal Reserve.
- Today in Brazil, **65% of recent sugarcane expansion** took place on degraded pastures in the South-Central region.
**PRODUCTION ISSUES**

- Brazilian Biomes
- Land Use

- Sugarcane vs. other crops
- Expansion of sugarcane production
**PRODUCTION FACTS**

1. **Brazilian Biomes**
2. **Land Use**

**ETH'S CASE:**
Use of already cultivated land

---

**AREA (in million hectares)**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>% total</th>
<th>% arable land</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAZIL</td>
<td>851</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total arable land</td>
<td>354.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Area cultivated – total</td>
<td>76.7</td>
<td>9%</td>
<td>21.6%</td>
</tr>
<tr>
<td>Soy</td>
<td>20.6</td>
<td>2.4%</td>
<td>5.8%</td>
</tr>
<tr>
<td>Corn</td>
<td>14.0</td>
<td>1.6%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>7.8</td>
<td>0.9%</td>
<td>2.2%</td>
</tr>
<tr>
<td>Sugarcane for ethanol</td>
<td>4.0</td>
<td>0.5%</td>
<td>1.1%</td>
</tr>
<tr>
<td>2. Pasture</td>
<td>172.3</td>
<td>20.2%</td>
<td>48.6%</td>
</tr>
<tr>
<td>3. Available area</td>
<td>105.8</td>
<td>12.4%</td>
<td>29.8%</td>
</tr>
</tbody>
</table>

**Source:** IBGE and Conab 2009

- Arable land used for sugarcane: 1.1%
- In 2017, ethanol double production will be: 1.5%
- **Diversified agriculture makes Brazil the world’s leading exporter of beef, coffee, orange juice, soybeans, and sugar**
- Degraded pasture land is being used for sugarcane production

In 2017, ethanol double production will be: 1.5%
World water supply and scarcity

Water use by sector (1995)

- Agriculture: 63%
- Industry: 21%
- Domestic: 10%

- Water Supply
- Industry
- Agriculture

PRODUCTION ISSUES
- Brazilian Biomes
- Land Use
- Water Usage
PRODUCTION FACTS
- Brazilian Biomes
- Land Use
- Water Usage

ETH'S CASE: Consume 0.86 m³ water / ton of sugarcane while the sector consumes 1.81 m³

Minimum water consumption for sugarcane

PRODUCTION FACTS

Water supply

Industry
Future: Innovation
- Sugarcane water
- Self-sufficiency
- Commercialization

Agriculture
Fertirrigation with vinasse
Mechanization

Trend Curve: Water Capture Rate, Sugarcane Industry

Capture Rate (m³/ton sugarcane)

PRODUCTION
ISSUES
- Brazilian Biomes
- Land Use
- Water Usage
- Agrochemicals

- Intensive use of agrochemicals and loss of soil fertility
- Climate change impacting pest control
- Noxious effects on workers’ health
Less agrochemicals in sugarcane cultivation

- Use of pesticides is low
- Biological control and advanced genetic enhancement programs
- Innovative use of recycled residues as organic fertilizers: filter cake, vinasse.

**ETH’S CASE:** intensive use of biological control and residue reuse
Monoculture risk: biodiversity impacts and difficulty in pest and disease control

Exclusion of small-scale producers from the market
Competitiveness requires quantity / quality / cost
Leased areas
Small suppliers
Establishment of green corridors connecting Permanently Protected Areas and Regularized Legal Reserves

ETH'S CASE: study of local fauna chain to evaluate how species adapt to new crop introduction
Ethanol production process: disposal and environmental impact of by-products and residues

PRODUCTION ISSUES
- Brazilian Biomes
- Land Use
- Water Usage
- Agrochemicals
- Monoculture
- Wastes
100% of sugarcane processing wastes are reused internally to minimize environmental impacts:

- **Vinasse, liquid effluent, filter cake ➔ fertirrigation**
  **Advantage:** replaces use of fertilizers and irrigation

- **Bagasse and sugarcane straw ➔ energy cogeneration**
  **Advantage:** self sufficiency in energy and contribution to the country's energy supply
Inadequate work conditions on the field
Mechanization will eliminate thousands of jobs in the sector
Seasonal employment
Social impacts on neighboring communities
Mechanized harvest

- Increases productivity of the harvest by around 20%
- Makes the process safer
- Improves work life quality

Signed in June 2009
Result of three-party negotiations:
- Companies
- Workers
- Federal Government

A huge program of training and requalification of cane cutters done by the sugarcane sector

ETH’S CASE: 70% of planting and 100% of harvesting is mechanized
Job Creation

- The sugarcane industry is the largest employer in Brazilian agriculture – 1.2 million workers (2010);
- Strict labor laws in Brazil, helping to improve occupational health conditions

Widespread production of ethanol vs. Concentrated production of petroleum

In units - 2007

<table>
<thead>
<tr>
<th>Sector</th>
<th>States</th>
<th>Cities</th>
<th>Jobs</th>
<th>Establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol(*)</td>
<td>25</td>
<td>1042</td>
<td>465236</td>
<td>16829</td>
</tr>
<tr>
<td>Petroleum (**)</td>
<td>24</td>
<td>176</td>
<td>73075</td>
<td>1239</td>
</tr>
</tbody>
</table>

Note: (*) includes sugarcane farming and ethanol production. (**): includes petroleum extraction and derivatives production.


ETH’S CASE: Job creation
- Harvest of 2009/10: 3,500 workers
- Harvest of 2010/11: 11,000 workers
- Harvest of 2012/13: 15,000 workers
Social impacts on neighboring communities

- Seasonality of labor balanced with mechanization alleviates local labor migration
- Training and use of local labor

ETH’S CASE: The Social Energy for Local Sustainability Program involves the government and community in investments in the region.
Results of 2010's Program

- Socio-environmental diagnostic of the 9 towns where ETH operates;
- Diagnostic of the relationship between ETH and the local communities before implementing the program;
- Hosting of 242 forums in 5 towns, involvement of 4,623 people in the actions of the program;
- Setting up of 27 training centers with the participation of 508 people;
- 52 sessions of Social Energy Cinema were held with the participation of 1940 people;
- 20 projects defined with the community.
International credibility
International restrictions on Brazilian ethanol
The Brazilian sugarcane sector is seeking a process for certification

The sugarcane sector has been seeking continual development of sustainable management of its chain:

- Participating in the creation of solid legislation;
- Encouraging producers to invest in the subject;
- Showing itself to be transparent in verifying its sustainable actions.

The Agro Environmental Protocol defines directives for promoting environmental sustainability, including:

- Burning reduction;
- Protecting of streamside woodlands and headwaters;
- Minimizing water usage;
- Minimizing pollution, among other things;
- Auditing annually with a three-party executive group.
BSI defines criteria, indicators, and standards for producing sugarcane, taking into consideration local conditions and circumstances, involving the whole sugarcane chain;

It promotes measurable improvements in social, environmental, and economic impacts of growing and processing sugarcane;

System for certification/ external recognition.

Considering the vast quantity of initiatives, the Brazilian industry is actively involved in a specific scheme: the Better Sugarcane Initiative – BSI/BONSUCRO and RFS2.

INTERNATIONAL CREDIBILITY

- BSI defines criteria, indicators, and standards for producing sugarcane, taking into consideration local conditions and circumstances, involving the whole sugarcane chain;
- It promotes measurable improvements in social, environmental, and economic impacts of growing and processing sugarcane;
- System for certification/ external recognition.

PRODUCTION FACTS
- Brazilian Biomes
- Land Use
- Water Usage
- Agrochemicals
- Monoculture
- Wastes
- Social Responsibility
- Certification
- Credibility
ETHANOL OPPORTUNITIES

USES

Transportation (fuel)

Energy

Consumer goods
Flex-fueled cars

- **Projected fleet** in millions of vehicles
  - Motorcycles
  - Flex-fueled vehicles
  - Gasoline vehicles
  - Alcohol vehicles
  - 25.8 million vehicles
  - 605 thousand motorcycles
  - 43.1 thousand vehicles
  - 14.5 thousand vehicles

Potential ethanol demand in Brazil

- **Ahydrous**
- **Hydrated**
- CAGR 16%

(Billions of liters)

- 2009: 23.5
- 2010: 28.8
- 2011: 35.3
- 2012: 40.2
- 2013: 45.5
- 2014: 50.8
- 2015: 56.1
- 2016: 61.2

Source: LCA
USES
Transportation

Ethanol cycle (Kg CO₂/1000 l)

1. GROWING AND HARVESTING
   Tractors, harvesters and inputs in the field*
   Emissions: 2,961

2. GROWTH
   Sugarcane is a natural sponge for carbon gases as it grows
   Absorption: 7,650

3. PROCESSING
   Fermentation and bagasse burning for energy generation
   Emissions: 3,604

4. BIO-ELECTRICITY
   Use of bagasse to generate electricity and energy surplus
   Emissions Avoided: 225

5. TRANSPORTATION
   Ethanol is transported to gas stations in diesel lorries
   Emissions: 50

6. ON THE STREETS
   Car motors burning ethanol
   Emissions: 1,520

89% of carbon emission reduction vs. gasoline production

*Assuming 50% mechanized and 50% manual harvest.

Source: Isaias Macedo and Joaquim Seabra Unicamp, 2008
**USES**

**Transportation**

**Fuel Quality**

---

**Better Energy Efficiency**

<table>
<thead>
<tr>
<th>Crop</th>
<th>Energy (x fossil fuel used to produce)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugarcane</td>
<td>9.3</td>
</tr>
<tr>
<td>Wheat</td>
<td>2.8</td>
</tr>
<tr>
<td>Sugar beet</td>
<td>2.0</td>
</tr>
<tr>
<td>Corn</td>
<td>1.4</td>
</tr>
</tbody>
</table>


---

**Low CO₂ Emission**

<table>
<thead>
<tr>
<th>Region</th>
<th>Advanced biofuel</th>
<th>U.S. EPA</th>
<th>Based on corn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>-50%</td>
<td>-90%</td>
<td>-61%</td>
</tr>
<tr>
<td>U.S. EPA</td>
<td></td>
<td>-61%</td>
<td></td>
</tr>
<tr>
<td>Based on corn</td>
<td></td>
<td></td>
<td>-21%</td>
</tr>
</tbody>
</table>

Source: Renewable Fuel Standards (I and II)
ETHANOL OPPORTUNITIES

USES

Transportation (fuel)

Energy

Consumer goods
USES
Energy
Renewable + Clean

Self-sufficient industry
→ Produces excess energy
→ contributes to a

CLEANER NATIONAL ENERGY GRID

Brazil's green energy matrix

<table>
<thead>
<tr>
<th>Year</th>
<th>Sugarcane</th>
<th>Other renewable sources</th>
<th>Hydroelectricity</th>
<th>Other non renewable sources</th>
<th>Natural Gas</th>
<th>Petroleum and derivatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>10.9%</td>
<td>14.4%</td>
<td>15.7%</td>
<td>8.0%</td>
<td>5.4%</td>
<td>45.5%</td>
</tr>
<tr>
<td>2008</td>
<td>16.4%</td>
<td>15.1%</td>
<td>13.8%</td>
<td>7.7%</td>
<td>10.3%</td>
<td>36.7%</td>
</tr>
</tbody>
</table>

Source: BEN (2009). Elaboration: UNICA

ETH'S CASE
Project to earn carbon credits on energy cogeneration with a reduction of 3 million tons of CO₂ in the next 7 years (4 mills)
ETHANOL OPPORTUNITIES

USES

Transportation (fuel)

Energy

Consumer goods
USES
Consumer goods

Industry

Green Plastics
Improving quality of life with renewable raw materials

Capture & Sequestration 2,5 t CO$_2$/ t green PE

Ethanol - Industrial Uses

Sugarcane → Ethanol → Green PE

Consumer goods with renewable origins
Brazilian ethanol: successful business without government subsidies

- Reduction of GHG from the use of ethanol: transportation + energy
  - 2006 - 22% GHG
  - 2020 - 43% GHG

- Business
  - 2010 - US$ 28 billion
  - 2020 - US$ ????
  - US$ 10 billion collected in taxes

Source: BEN (2010). Elaboration: UNICA
REDUCTION OF GHG FROM THE USE OF ALCOHOL TRANSPORTATION + ENERGY

2020 - ????? GHG

BUSINESS

2020 - US$ ????? + jobs ????
Final Considerations
Ethanol as a sustainable alternative to the transport energy

Ethanol Contributions in Brazilian Experience

- **Environment:**
  - Clean and Renewable Fuel
  - Climate Changes Mitigation
  - Biodiversity

- **Social Impacts:**
  - Largest employer in agriculture
  - Rural Development

- **Food Security:**
  - Not affected

- **Limitations:**
  - Climate and Soil conditions
  - International credibility
Thank you very much for your attention!

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