LCA for Biofuels

A proposal of a model LCA for bioethanol

The Inmetro LCA Collaboration

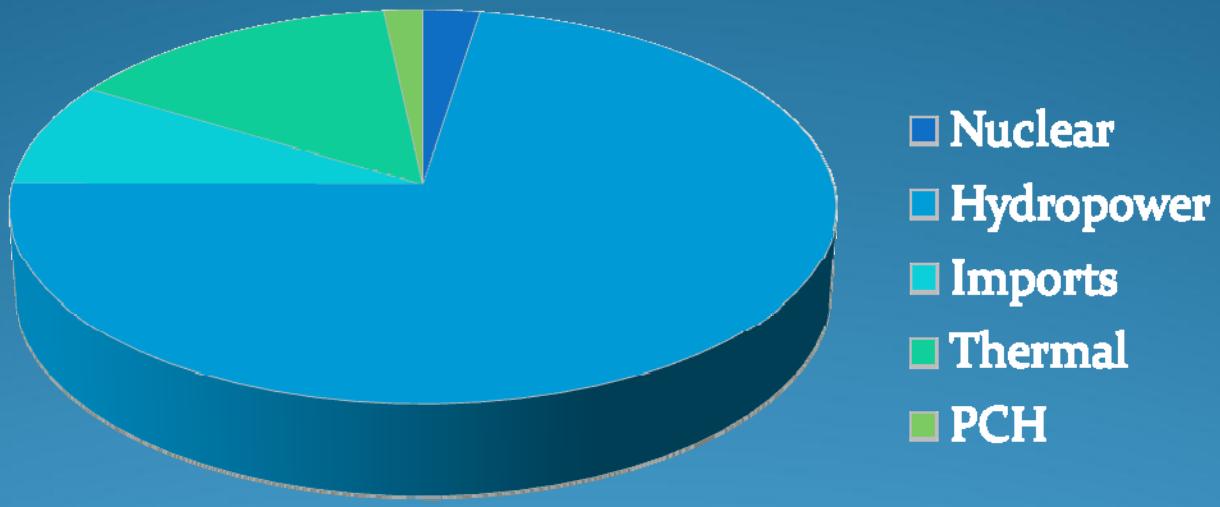
Biofuels and the Environment

- Currently, the default for fuels worldwide is petroleum. Lately, with the tighter regulations and with the increase in environmental awareness, this default has been contested.
- With new technologies and enhanced methods, the scientific community has been finding ways to replace fossil fuels with cleaner fuels, such as ethanol and biodiesel.
- The establishment of a new fuel worldwide needs to be closely monitored in order to ensure that it will have a beneficial effect compared to the previous fuel matrix.

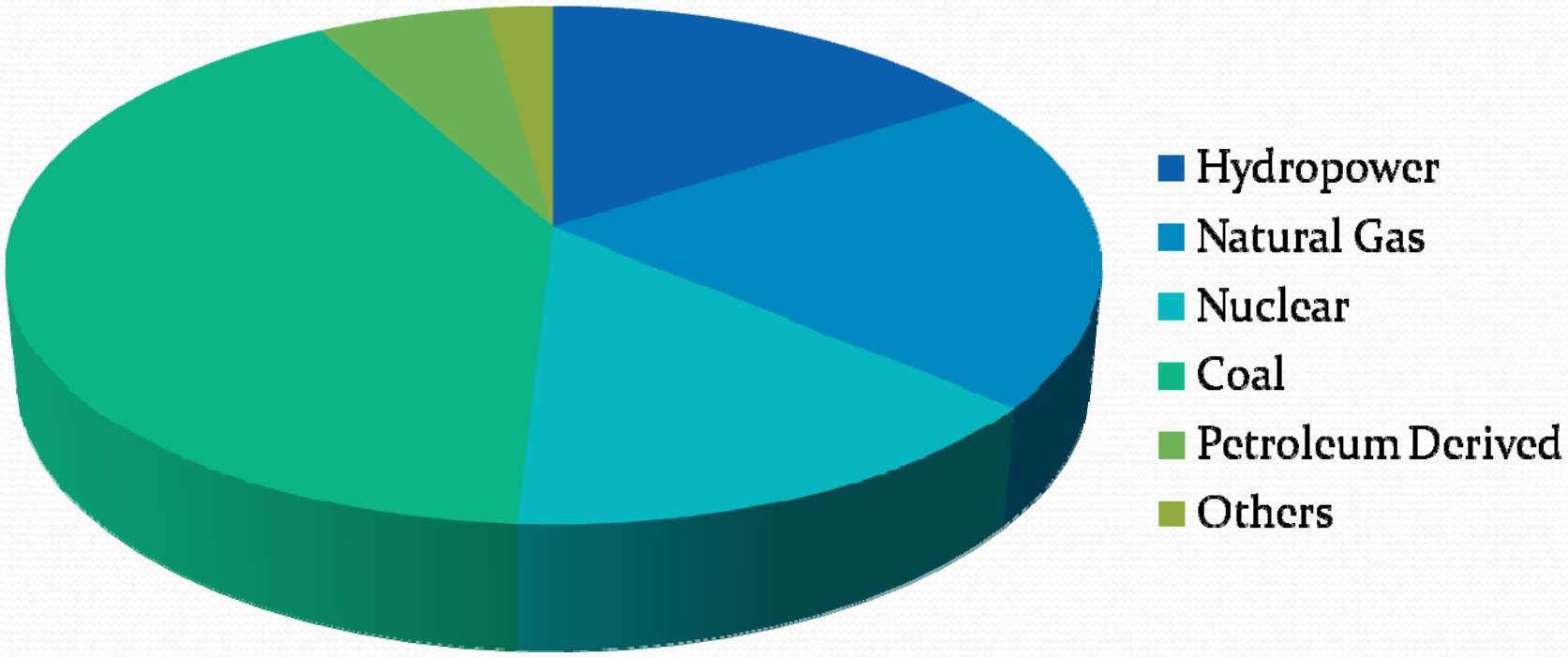
Biofuels vs. Fossil Fuels

The main difference is the biological photosynthesis, which uses sunlight and draws CO_2 from the atmosphere to produce biomass. The CO_2 emited from biofuels will eventually be reabsorbed by new crops. Fossil fuels, on the other hand, use limited supplies of petroleum to generate fuels, and aside from being finite, the process draws carbon from oilwells and deposits that carbon in the atmosphere, tilting the carbon cycle.

Brazilian Energy Matrix



World Energy Matrix



What is LCA?

A **life cycle assessment** (**LCA**, also known as **life cycle analysis**, **ecobalance**, and **cradle-to-grave analysis**) is the investigation and valuation of the environmental and energy impacts of a given product or service.

LCA vs GHG Inventory

The purpose of an LCA is to identify environmental and energy impacts in general. In our methodology, we chose a GHG inventory as our goal, since we want to establish the mitigation power of biofuels in comparison with petroleum for the Brazilian light vehicle fleet.

We are thus excluding any other environmental impacts, aside from the emission of GHGs.

Brazilian Sugarcane

- Leading edge technology
  - (Pro-Álcool - 1980s)
- Leading sugarcane production
  - (8,2 MHa of canefields)
- Leading ethanol efficiency
  - (Superior to corn, beet, etc.)
- One of the most efficient photosynthesizers in nature

Brazilian Sugarcane

- Deforrestation
  - Lately, the correlation with canefields is negligible
- Sugarcane Burning
  - Cheaper, but highly polutant
- Land Use Change
  - Pastures
  - Corn & Soyfields

    These changes may actually be benefitial to the environment, since they raise the level of carbon sequestration through its fixation in the soil

Sugarcane Harvesting

Mechanized (40%):

Automated machinery

Social implications

(a single harvester does up to 80 men´s work)

Sugarcane Harvesting

Traditional (60%):

Manual labor, Canefield Burning

Trabalhador carrega cana em Alagoas.
Foto: Sérgio Vignes / Observatório Social

Energy Balance

- Gasoline produces 0,9 units of energy for every unit spent in production
- Brazilian ethanol produces 9,1 units of energy for every unit spent in production

GHG Aspects: Growing Crops

- Land use change from pastures and other plantations
- Carbon sequestration when replacing plantations / pastures
- Carbon fixation in soil
- Seed production
- Fertilizers / Herbicides
- Machinery

GHG Aspects: Growing Crops

- Water usage
- Typical Cycle (6 years)
  - Harvesting

    (18 months)
  - Ratooning

    (four 12-months cycles)
  - Resting

    (6 months)

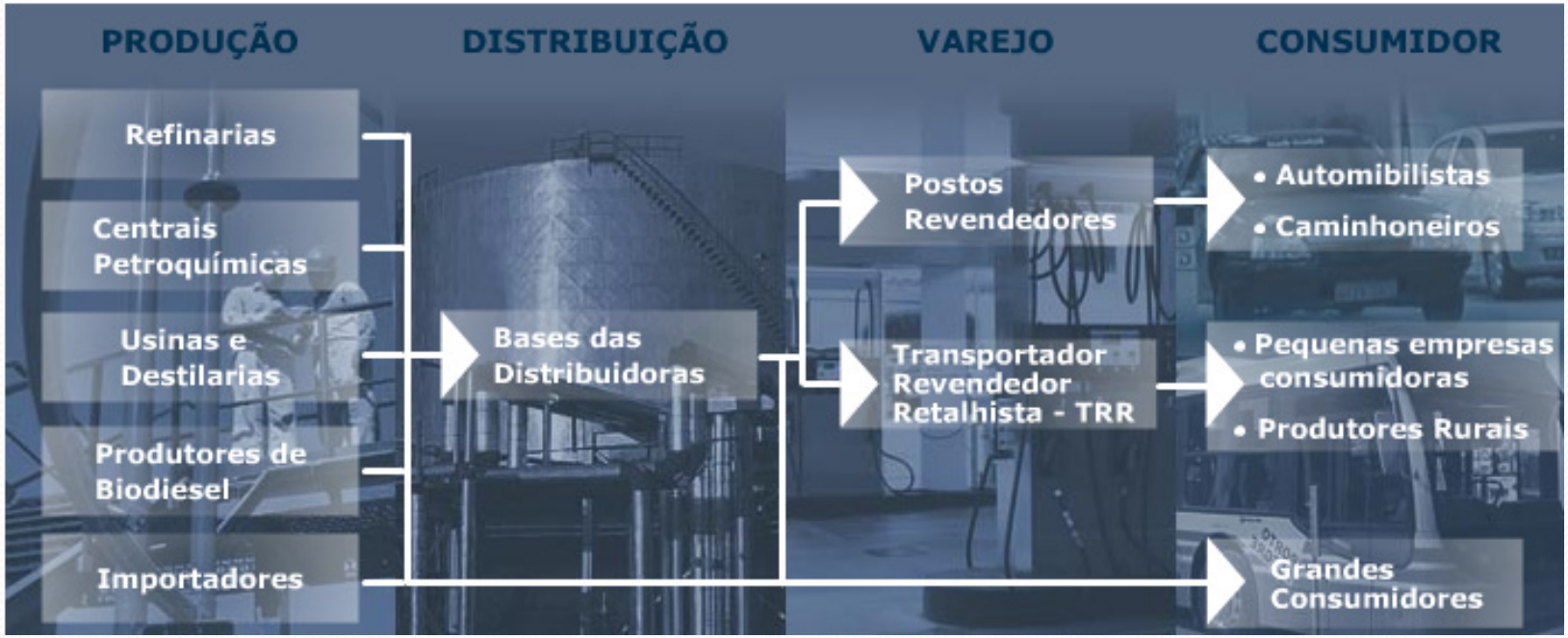
GHG Aspects: Industrial Mills

- Co-generated energy
  - The mills burn the excess bagasse to generate all the energy they require
    - The burning of bagasse is a neutral GHG emission, since the sugarcane reabsorbs those emissions when growing
    - The burning of bagasse is actually an environmental service (energy from the grid: 15% fossil; the unburnt bagasse would emit methane, since the residue ends up fermenting)
- Construction (steel, cement, chemicals, energy)
- Vinasse
  - (pollutant with an unknown emission factor)

GHG Aspects: Transportation

- Fossil fuel carriers (lack of railroad networks for ethanol production)
- Precarious conditions of Brazilian highways (impairs the full distribution potential)
- Diesel powered truck fleet emissions (eventually will use biodiesel)
- Most exports shipped out

Logistics


PRODUÇÃO
DISTRIBUIÇÃO
VAREJO
CONSUMIDOR
Refinarias
Centrais Petroquímicas
Usinas e Destilarias
Produtores de Biodiesel
Importadores
Bases das Distribuidoras
Postos Revendedores
Transportador Revendedor Retalhista - TRR
• Automibilistas
• Caminhoneiros
• Pequenas empresas consumidoras
• Produtores Rurais
Grandes Consumidores

GHG Aspects: Distributors & Refineries

- Refineries
  - (steel, cement, chemicals, energy)
  - Mix anhydrous ethanol with the gasoline
    - No chemical process involved

- Gas stations & Fuel deposits
  - (steel, cement, chemicals, energy)

Mission

Inmetro has been working to elaborate a questionnaire / worksheet model (as inspired by Michael Wang´s GREET 1.8b) for Brazilian producers, in order to construct a database for its different regions.

The goal here is to gather information and studies from reliable sources (such as ANP, CTC, Embrapa, agricultural schools, etc.), and publish a series of results, in order come up with a standard LCA for ethanol production, not only for Brazil, but also for other potential producers.

The ultimate achievement would be to have the producers themselves using our model LCA, in order to rate and improve their processes.

Vision

- The model LCA should be:
  - Open
  - User friendly
  - Based on measurements
  - Verifiable
  - Periodically Updated

The final outcome of our methodology would be a Biofuel LCA Quality Seal.

Thank you for the attention!

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