



Eco-Efficiency Analysis: Case study of palm biodiesel in Brazil

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- Biodiesel advantages in Brazil
 - Excellent climate and soil conditions and vast territorial extension
 - Ethanol utilization
 - Possibility of an economic independence
- Biodiesel sustainability assessment (GP2 project)
- Assessment and comparison of palm biodiesel, via ethylic alcohol and petrodiesel considering economic and environmental performance using Eco-Efficiency Analysis by BASF

What is Eco-Efficiency Analysis?

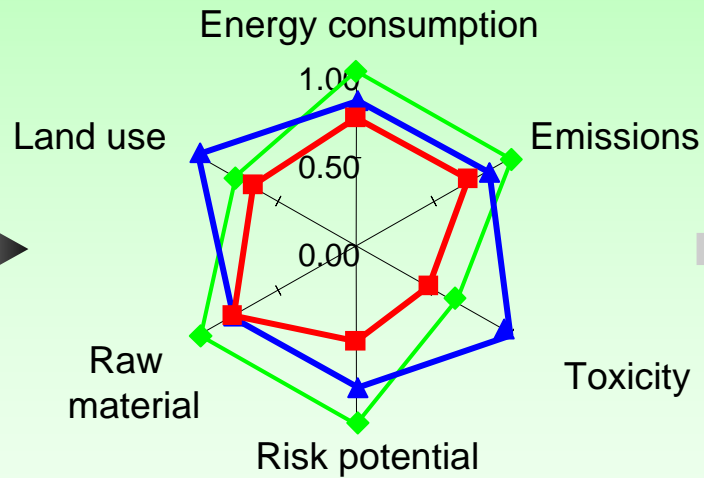
- BASF strategic tool to help drive towards and measure sustainability
- Method for the **comprehensive assessment** of products and processes.
- **Ecological and economic aspects** are given equal weight in assessments.
- The products are analyzed from the **angle of the end customer**.
- **(Future) scenarios** and effects of various action options are presented.
- Eco-efficiency analysis is a **standard** tool at **BASF Group**; over 200 analyses have been carried out.

Development of Ecological Value

Parameters considered

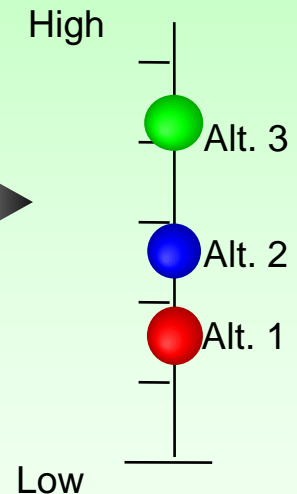
- Raw material
- Energy consumption
- Emissions {
 - air
 - water
 - soil
- Land use
- Toxicity potential
- Risk potential

Ecological fingerprint



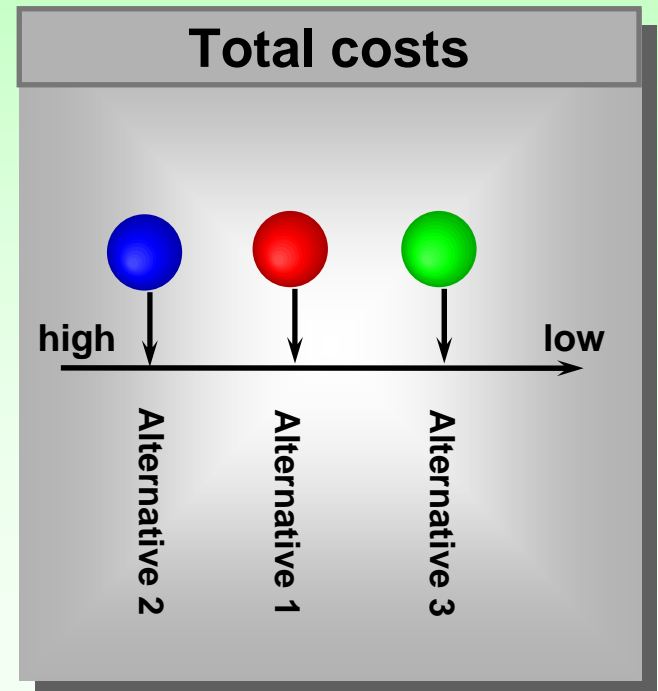
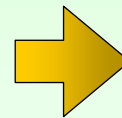
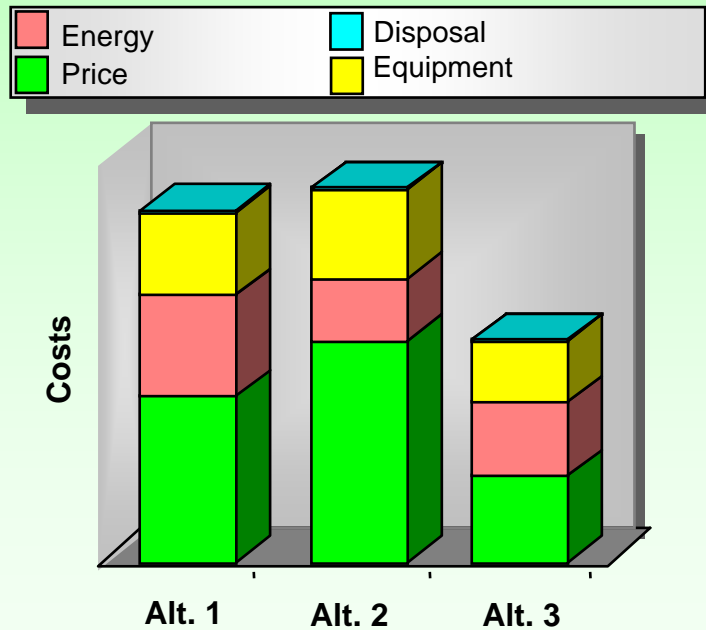
Ecological advantage

Environmental impact

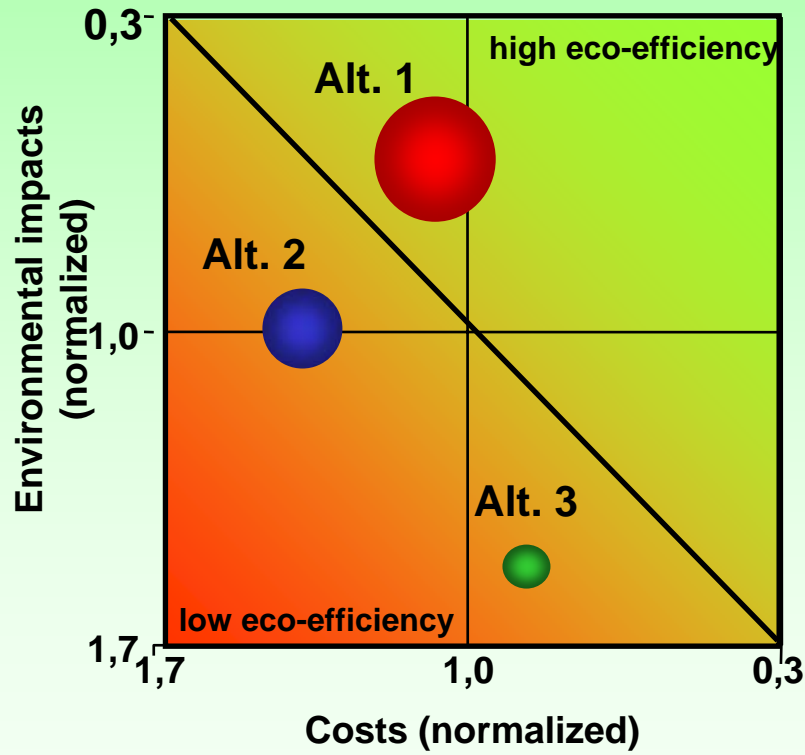


Total costs

- Assign costs for economic parameters, such as:
 - Investment, Labor, Material, Energy, Maintenance etc.



Portfolio links costs and environmental



Alternatives investigated

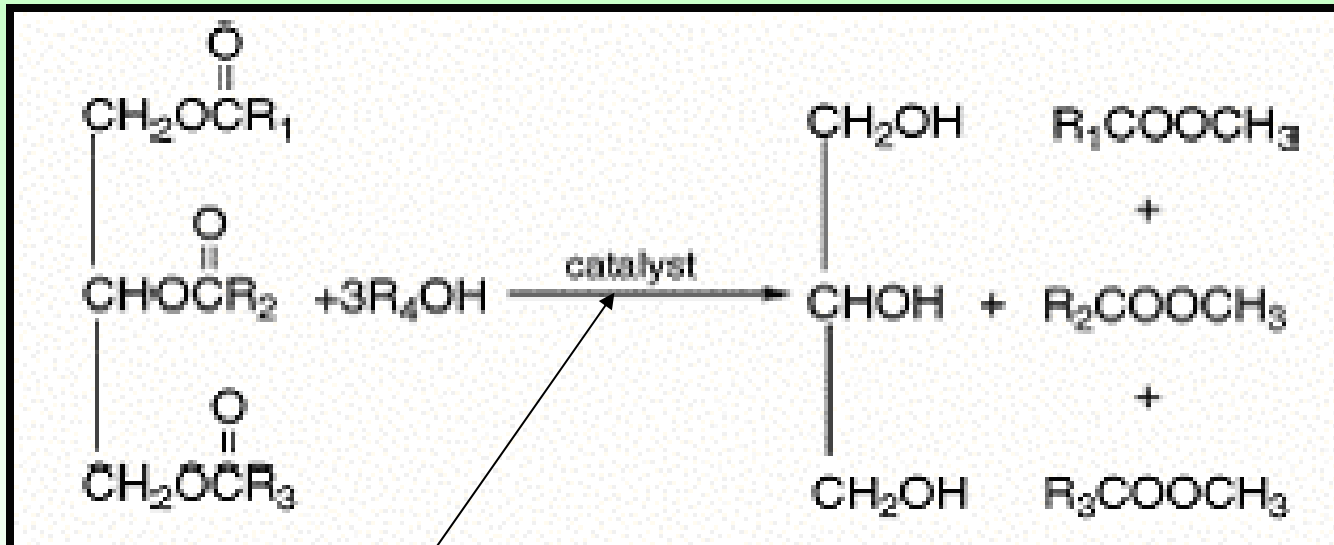
Relative Market Positions

● Alternative 1	35 %
● Alternative 2	20 %
● Alternative 3	5 %

- Obtained in the fractional distillation of crude oil
- Brazilian Production: 38,252,266 m³
 - REPLAN 26%
 - REPAR 12%
 - RPBC 12%
 - RLAM 12%
 - Others 38%
- Imported Amount: 2,694,702 m³
 - India 25.7%
 - Saudi Arabia 17.63%
 - Others 56.6%

Biodiesel

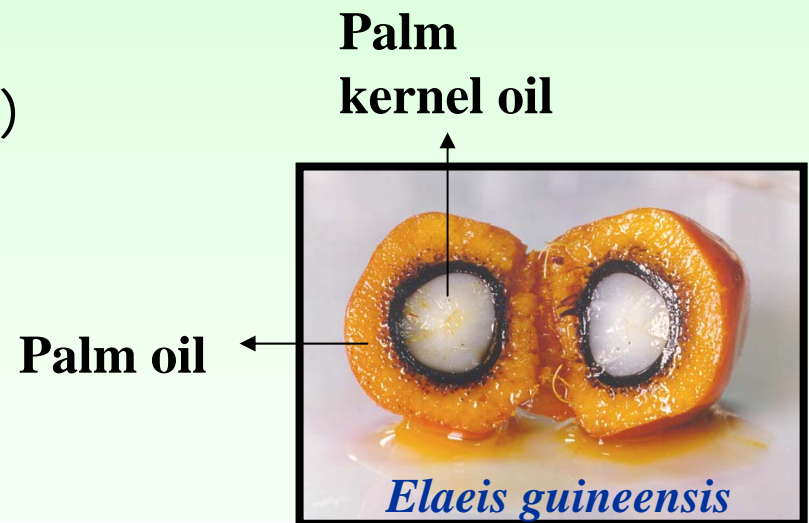
- Obtained from a transesterification reaction between any triglycerides and an alcohol, with short chain, methanol or ethanol



**acid, basic or
enzymatic**

- Current Brazilian situation
 - National Biodiesel Production and Use Program (PNPB)
 - 240,000 m³ acquired in auction
 - Three production plants working
 - Soyminas
 - Agropalma
 - Biolix
 - Brazilian biodiesel distributors
 - ALE Combustíveis (108 stations)
 - BR – Petrobras (2,300 stations)

- Brazilian Production: 115,000 t
 - 70,000,000 ha (potential cultivation)
 - 54,463 ha (already cultivated)
- Imported Amount: 9,269 t
 - Malaysia (43.25%)
 - Republic of Mauritius (30.42%)
 - Indonesia (26.33%)

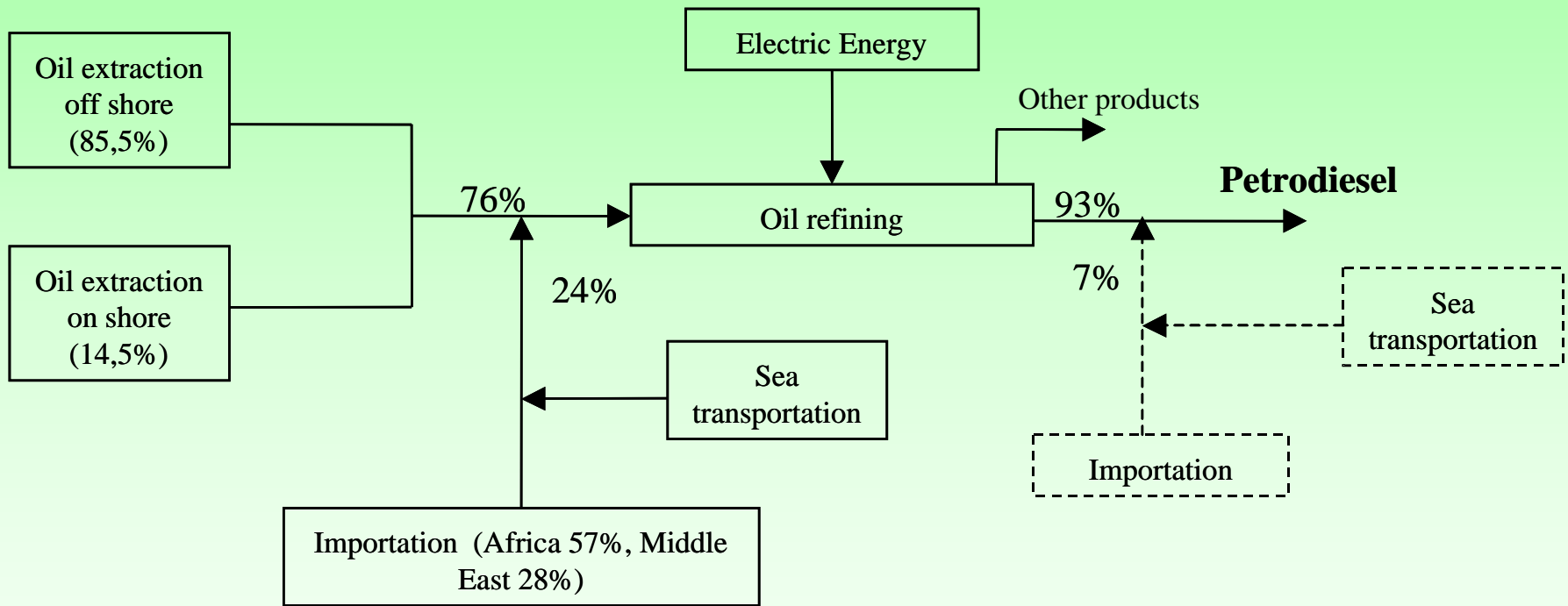


Life Cycle Analysis

- Goal:
 - To give subsidies and information about the two fuels by means of Eco-Efficiency Analysis

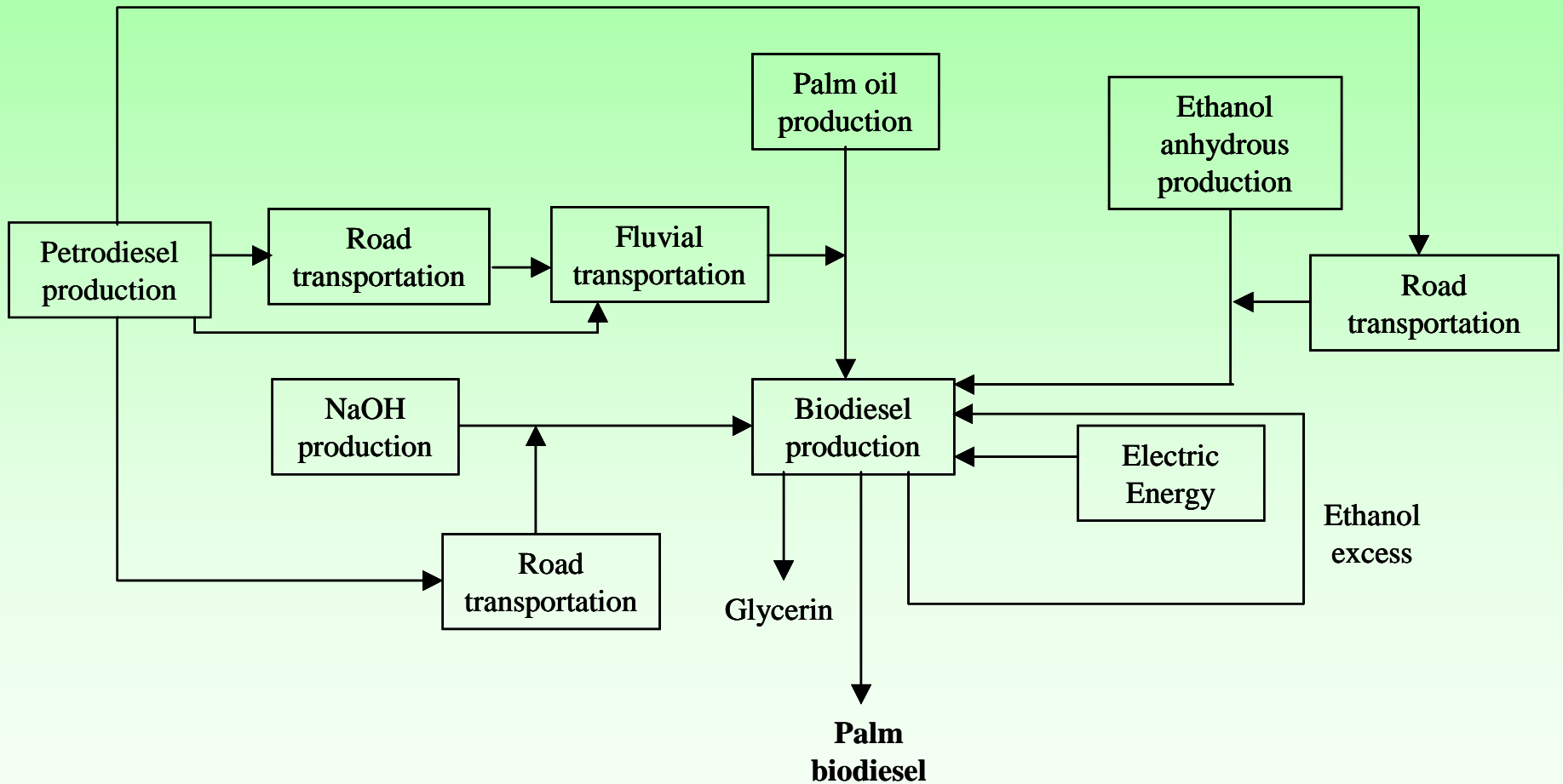
- Scope:
 - Function: to generate energy for internal combustion engines
 - Functional unit: 1,000 MJ
 - Performance: 38.3 MJ/L petrodiesel
33.3 MJ/L biodiesel
 - Reference flow: 26.11 liters petrodiesel
30.03 liters biodiesel

Petrodiesel product system

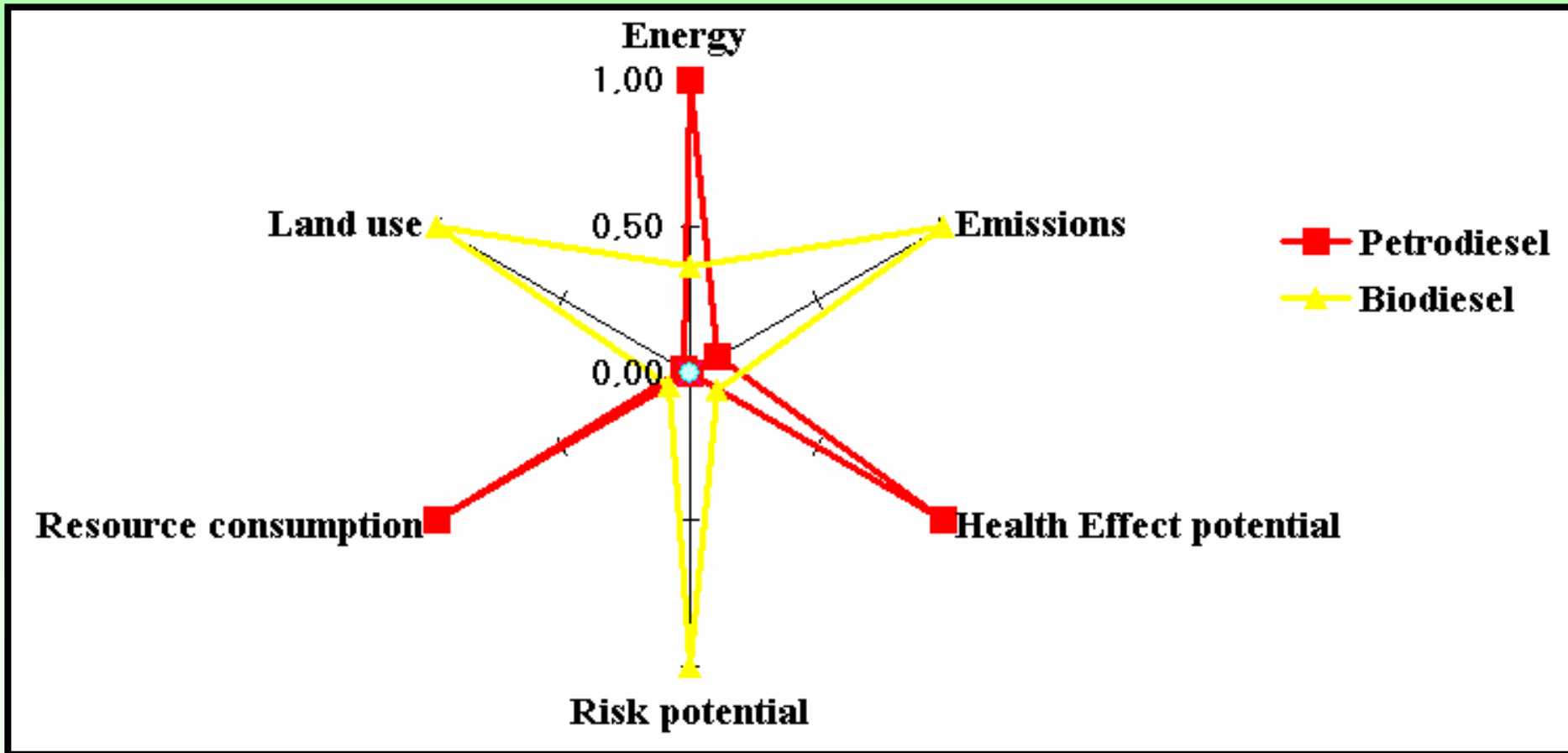


—— Considered stages
- - - Not considered stages

Biodiesel product system

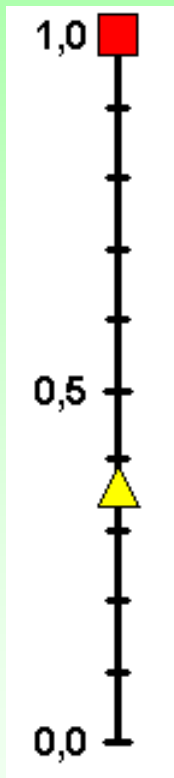


Ecological fingerprint



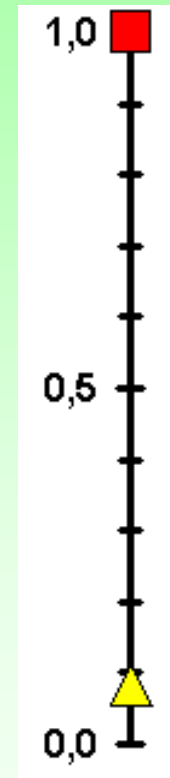
Results

Energy



Palm oil and ethanol are energetically self-sufficient

Resource consumption

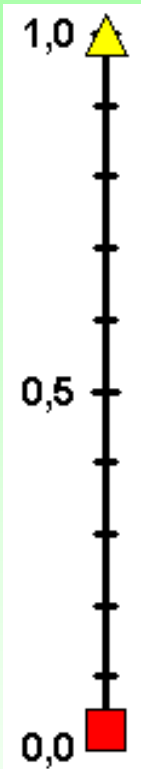


Palm oil and ethanol are renewable sources

- ▲ Biodiesel
- Petrodiesel

Results

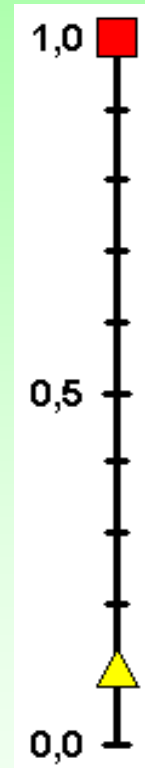
Land use



Petrodiesel production in high amount

High number of co-products in petrodiesel production

Toxicity potential

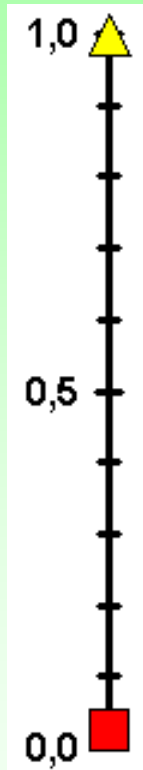


Volatile hydrocarbons are emitted during the petrodiesel production

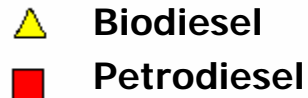
- ▲ Biodiesel
- Petrodiesel

Results

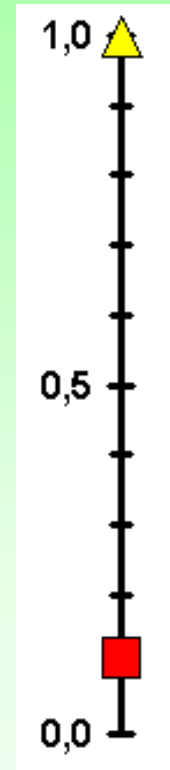
Risk potential



Palm agriculture is not mechanized



Emissions

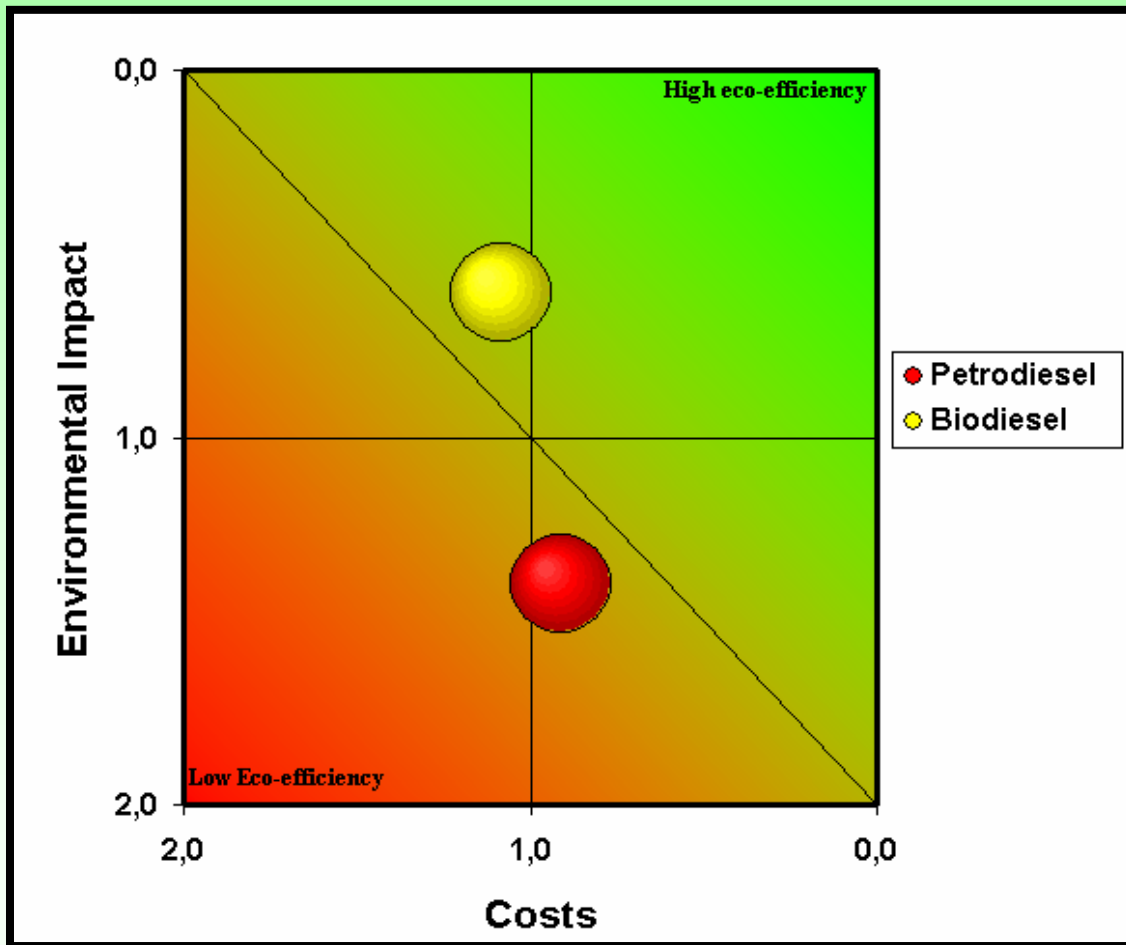


Better petrodiesel performance in wastes, air emissions and water emissions

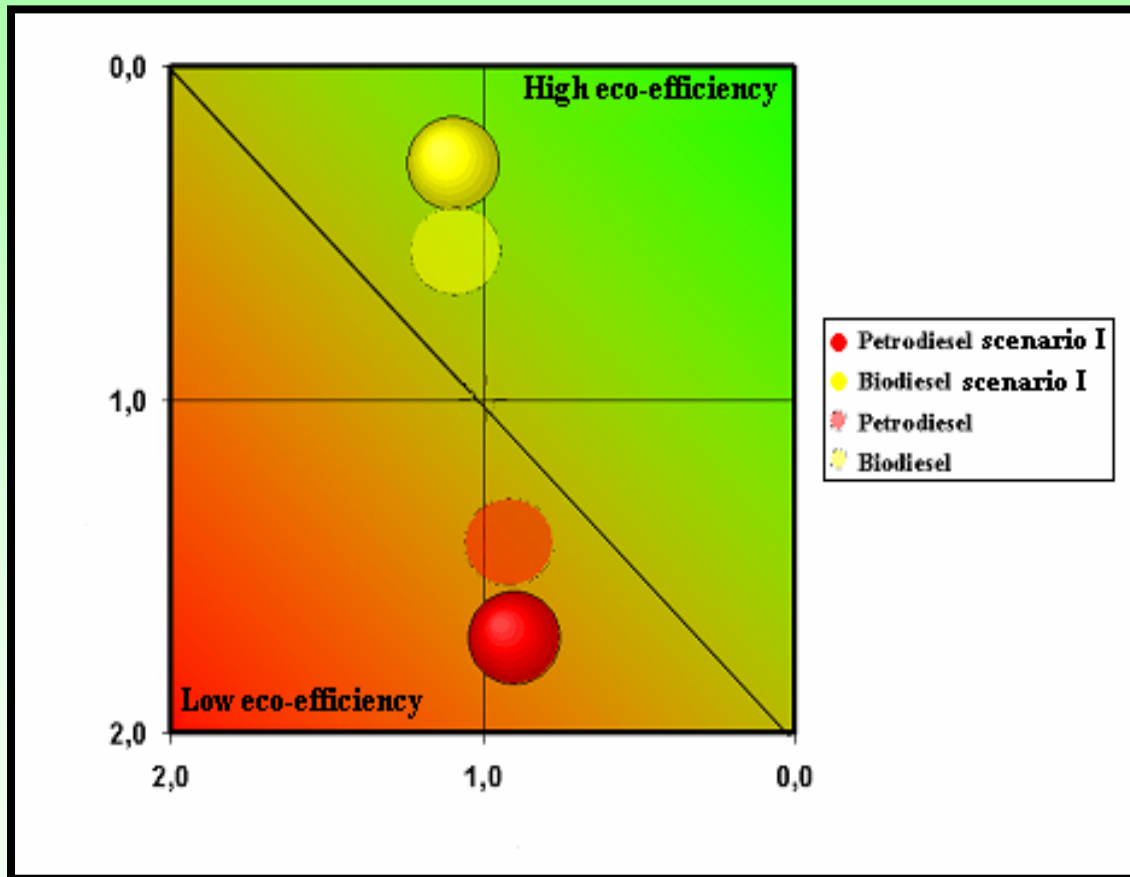
- **Life cycle costs**

Costs associated to energy consumption, resource consumption, besides expenses with workers and maintenance

Eco-Efficiency Portfolio

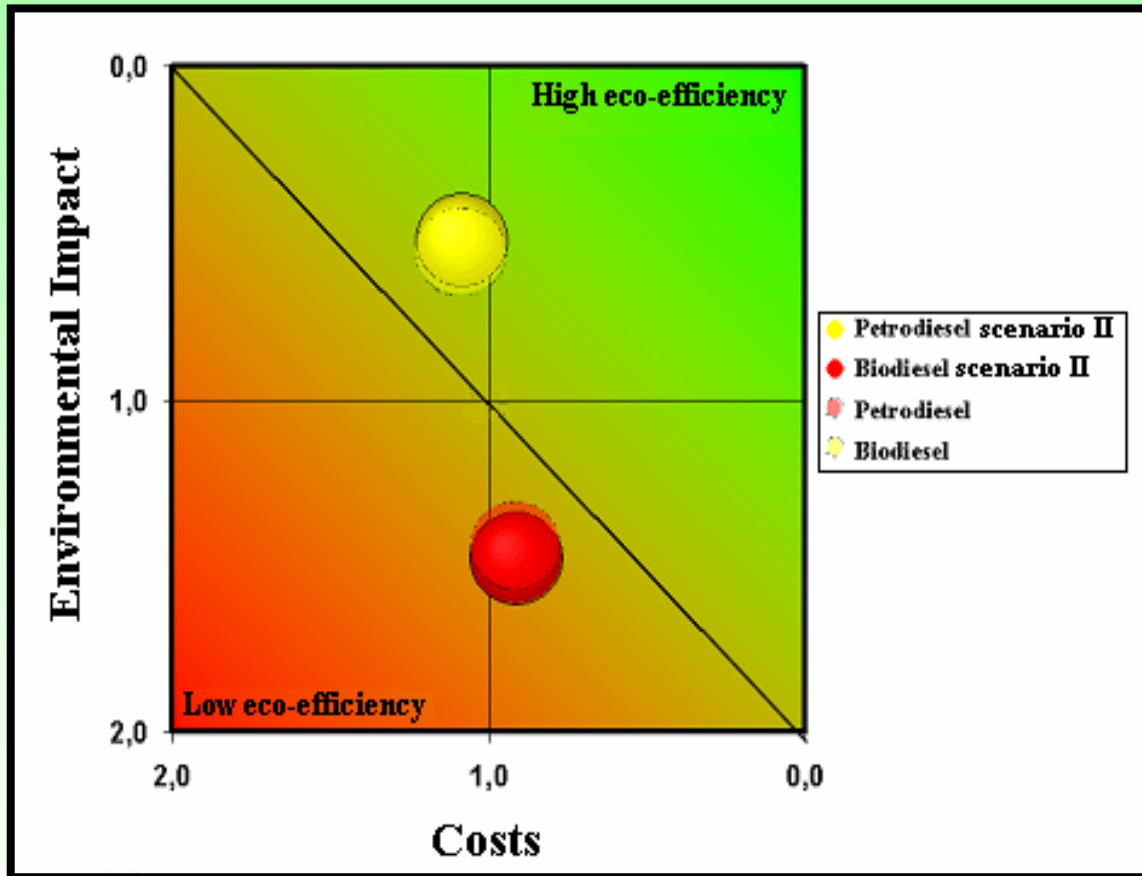


The difference of performances in the economic assessment is smaller than the one noticed in the environmental assessment



Scenario I

Water emissions from palm oil industry were disregarded



Scenario II

Grease material from transesterification reaction was considered as co-product

Conclusion

- The accentuated difference between the environmental performances was the determinant factor to the analysis final result.
- The performances in the categories health effect potential and resources consumption were the most relevant to determinate biodiesel as the most advantageous option considering environment impact.
- It is recommended to extend the study considering distribution and use stages.

Thank you!!!

Contacts

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