# Key elements to assess sustainability of bioenergy projects

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# HOW DOES BIOENERGY CONTRIBUTE TO SUSTAINABILITY?

## Economic development

- mobilizes investment in rural areas
- generates new infrastructure and business opportunities
- generates income

## Social benefits

- new livelihood opportunities
- increases access to modern energy services
- improving quality of life

## Environmental advantages

- promotes resource conservation and ecosystem rehabilitation
- climate change mitigation through use of cleaner fuels
- opens opportunities for marginal/degraded land rehabilitation

# Issues for reflexion/action

- **Is the production, use and trade of bioenergy based on sustainability?**
- **What is the demand/supply balance?**
- **Institutional capacities and coordination?**
- **Who will benefit? Are farmers benefited?**
- **Agriculture and energy sector considerations?**

In order to assess sustainability, we need a closer look at the

(physical, biological and human)

Environmental

impacts related to

bioenergy

| ENVIRONMENTAL ELEMENTS (Physical) | | IMPACT-CAUSING ACTIVITIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Production and supply of agricultural inputs (fertilizer, fuel, machinery) | Production of biomass for energy (forestry or agriculture) | Collection of biomass by-products of existing processes | Production of liquid biofuel (ethanol, methanol, biodiesel) | Transportation of biomass waste and/or energy crops | Transportation of liquid biofuel | Use of liquid biofuels (combustion) | International trade of biomass and liquid biofuels | Research and development in the area of liquid biofuels |
| Climate (GHG emissions balance) | | 1• | • | | • | • | • | • | | |
| Soil | Structure and stability (erosion) | | 3• | • | | | | | | |
| | Quality (bio-chemical) | 2• | • | • | | | | | | |
| Water | Water quality (bio-chemical) | • | • | | 4• | | | | | |
| | Water extraction potential (quantitative) | • | • | | • | | | | | |
| Air quality (points of production and use of biofuels, and materials transport routes) | | • | • | | • | 5• | • | 11• | | |

| ENVIRONMENTAL ELEMENTS (Biological) | IMPACT-CAUSING ACTIVITIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Production and supply of agricultural inputs (fertilizer, fuel, machinery) | Production of biomass for energy (forestry or agriculture) | Collection of biomass by-products of existing processes | Production of liquid biofuel (ethanol, methanol, biodiesel) | Transportation of biomass waste and/or energy crops | Transportation of liquid biofuel | Use of liquid biofuels (combustion) | International trade of biomass and liquid biofuels | Research and development in the area of liquid biofuels |
| Terrestrial ecosystems and biodiversity | | • | | | | | | | |
| Marine ecosystems and biodiversity | | 6• | • | | | | | | |
| Agricultural biodiversity | | 7• | | | | | | • | • |

| ENVIRONMENTAL ELEMENTS (Human) | IMPACT-CAUSING ACTIVITIES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
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| Land-use pattern | | 8• | • | • | | | | | |
| Rural/agricultural employment and income (level and stability) | | 9• | • | • | • | | | | |
| Food security (effective access to food for the most vulnerable) | | 10• | • | • | • | | | | |
| Public health | | | | | | | 12• | | |
| Global scientific and technical knowledge base | | 13• | | • | | | | | • |
| Global economy and terms of trade | | 14• | | • | | | • | • | • |

# Key parameters conditioning the impact of bioenergy projects

- Environmental and social change from baseline
- Incremental demand on biodiversity, air, land and water resources
- Priority to rural development and agrobiodiversity
- Offset of greenhouse gas emissions

# Environmental and social change from baseline depends on:

**Intensity of pressures on natural ecosystems and communal lands by anthropogenic land requirements**

**Agricultural surplus (or deficit) of the region or country affected**

**Vulnerability of the poorest segments of society in the affected area:**

- **security of land tenure for subsistence farmers**
- **existence of “social safety nets”**

# Incremental demand on biodiversity, air, land and water resources

**Requirement for new land resources:**

- whether a dedicated energy crop (requires new land) or
- the exploitation of existing by-products (does not require new land)

**Adequacy of agricultural production techniques to local environmental conditions (soil and water conservation):**

- erosive processes
- conservation agriculture – no tillage – “plantao directo”
- irrigation requirement
- soil nutrient depletion
- protection of water resources

**Pollution prevention standards of fertilizer and pesticides:**

- wastewater
- solid waste
- air pollutants

**Emission of air pollutants for transport:**

- biomass from field to biofuels plant
- biofuels from plant to consumers

# Project priority to rural development and agrobiodiversity

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- erosive processes
- conservation agriculture
- irrigation requirement
- soil nutrient depletion
- protection of water resources

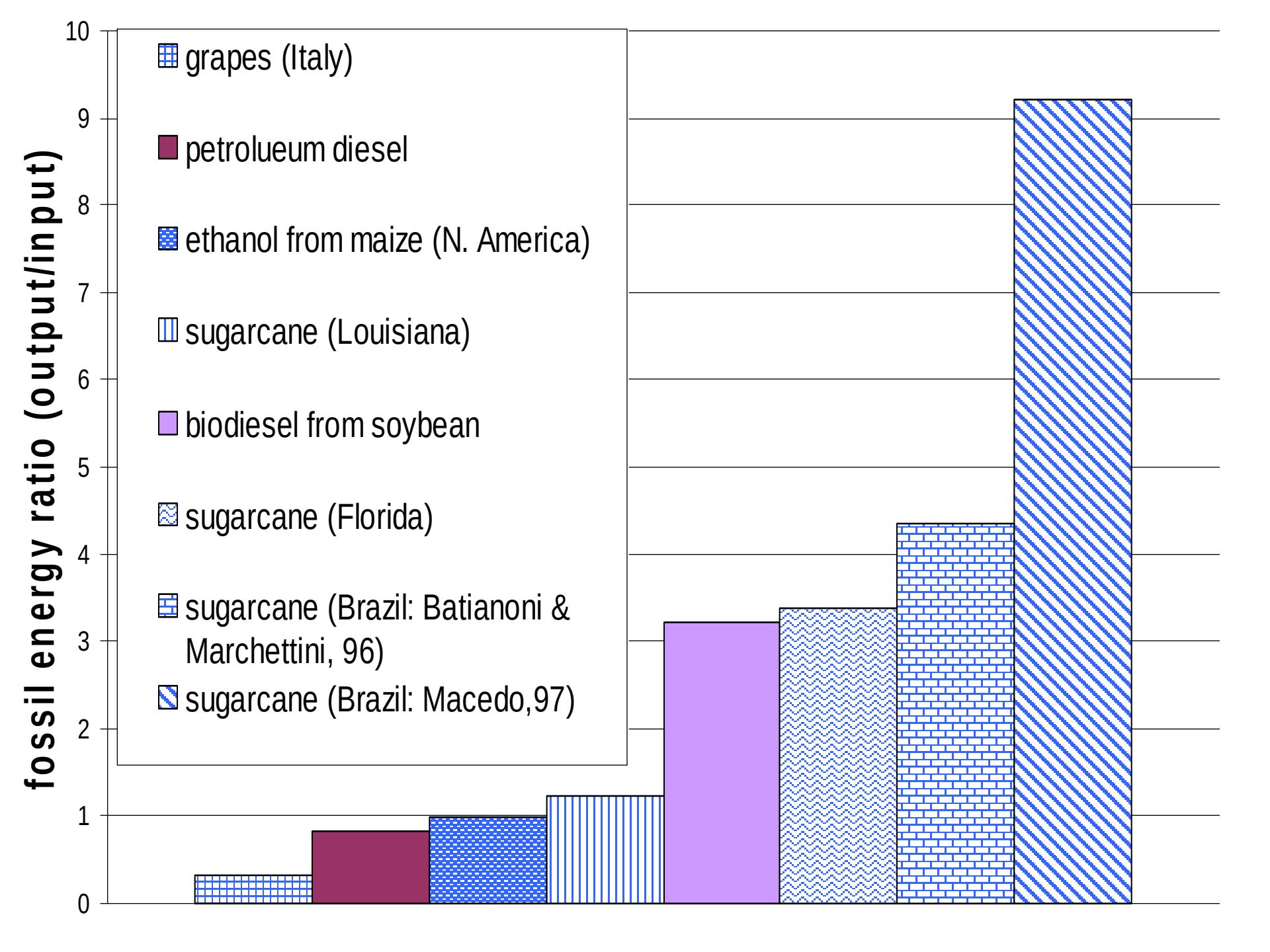
**Integration of the project with existing agricultural traditions:**

- using exogenous or indigenous agricultural products
- produced on small scale
- promoting the culture of multi-use crops (providing food and energy)

Key to sustainability is:

*energy balance*

some examples


fossil energy ratio (output/input)
0
1
2
3
4
5
6
7
8
9
10
grapes (Italy)
petrolueum diesel
ethanol from maize (N. America)
sugarcane (Louisiana)
biodiesel from soybean
sugarcane (Florida)
sugarcane (Brazil: Batianoni & Marchettini, 96)
sugarcane (Brazil: Macedo,97)

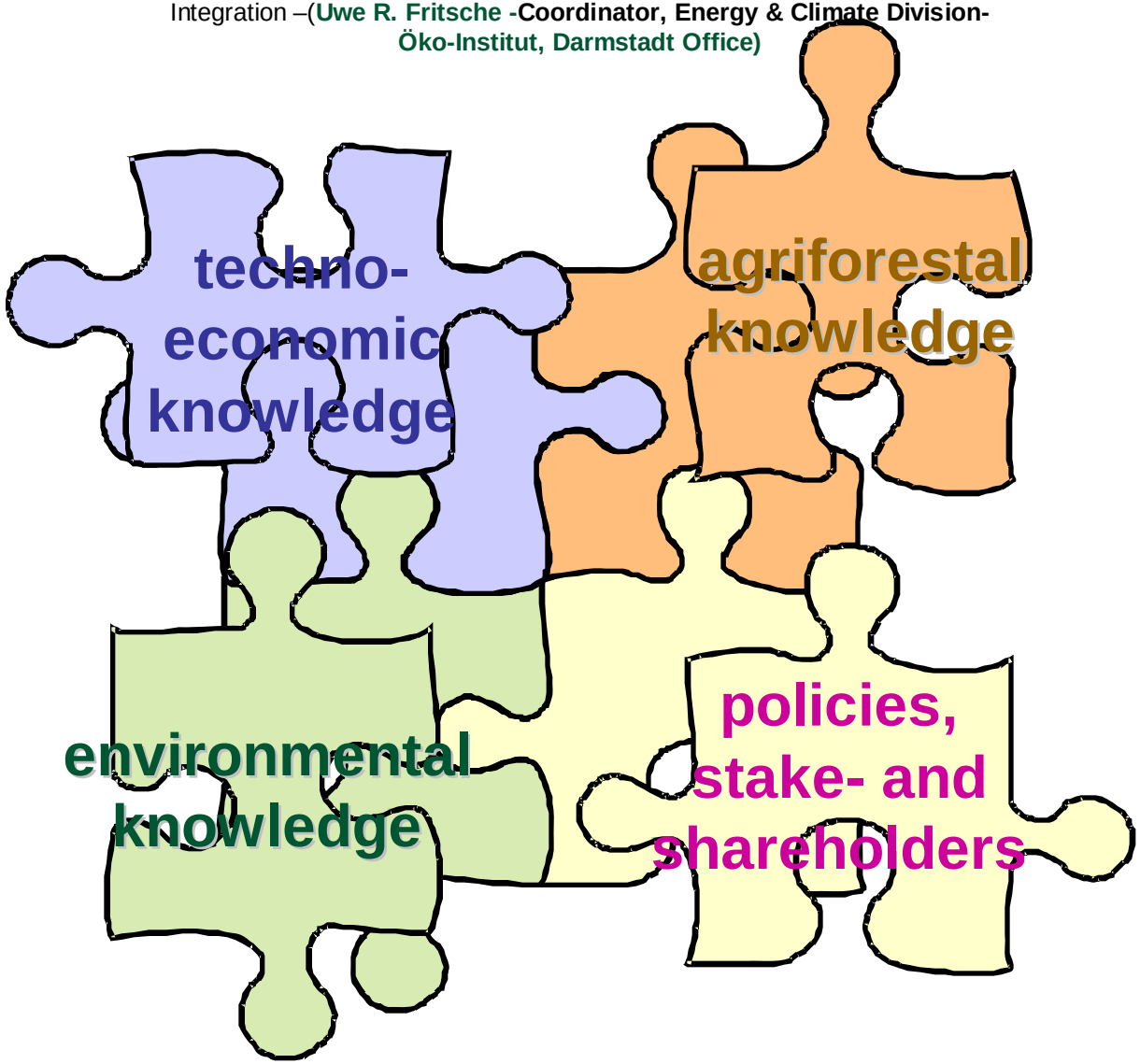
Another key element for achieving sustainability is:

*integration of knowledge*

(but also policies and actors)

Uwe Fritsch shows it very well:

Integration –(**Uwe R. Fritsche -Coordinator, Energy & Climate Division-Öko-Institut, Darmstadt Office)**



Another is

*eco-matching of crop and land*

# Some commercially important plant for wastelands of arid climates

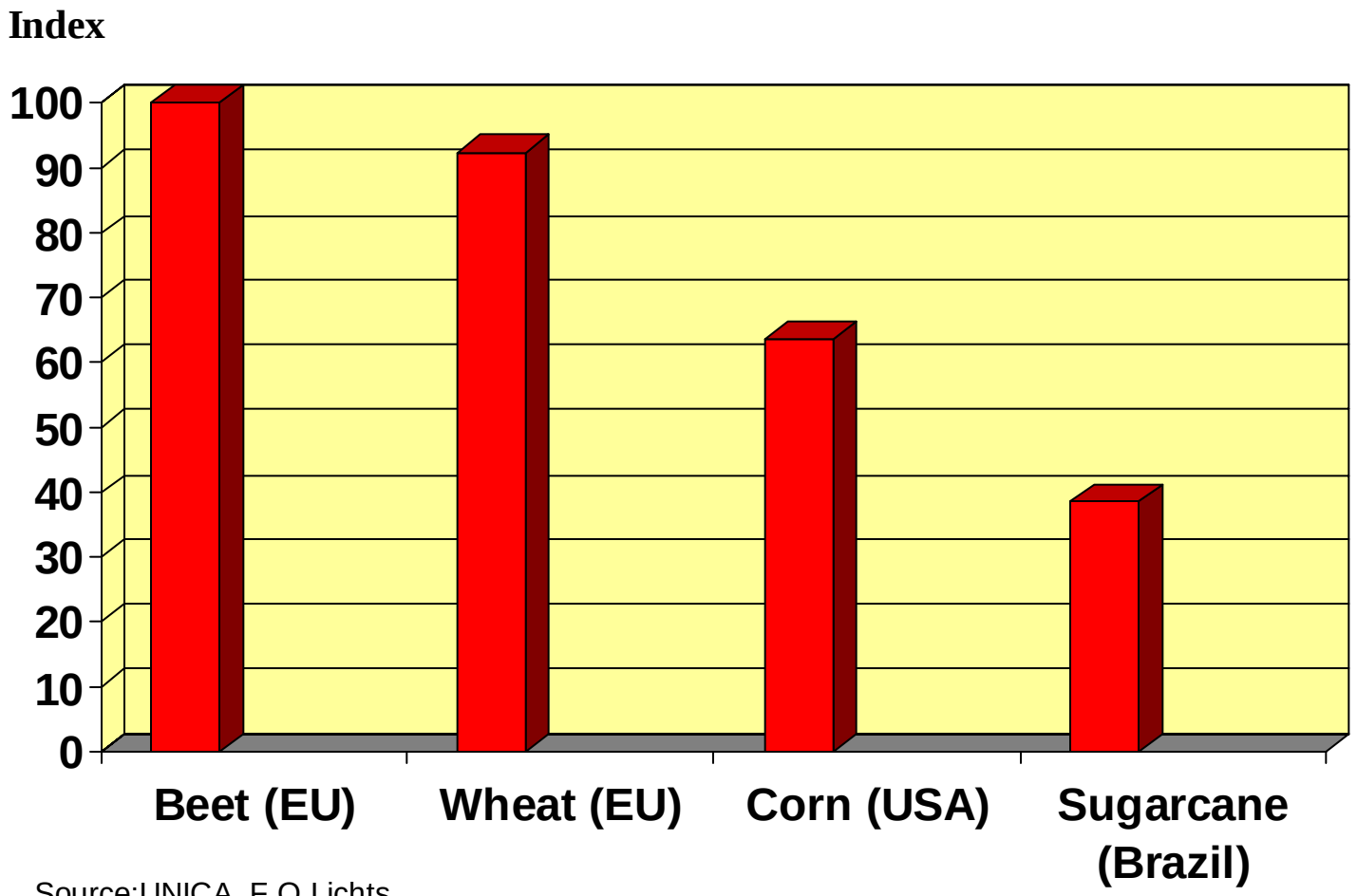





# Economics

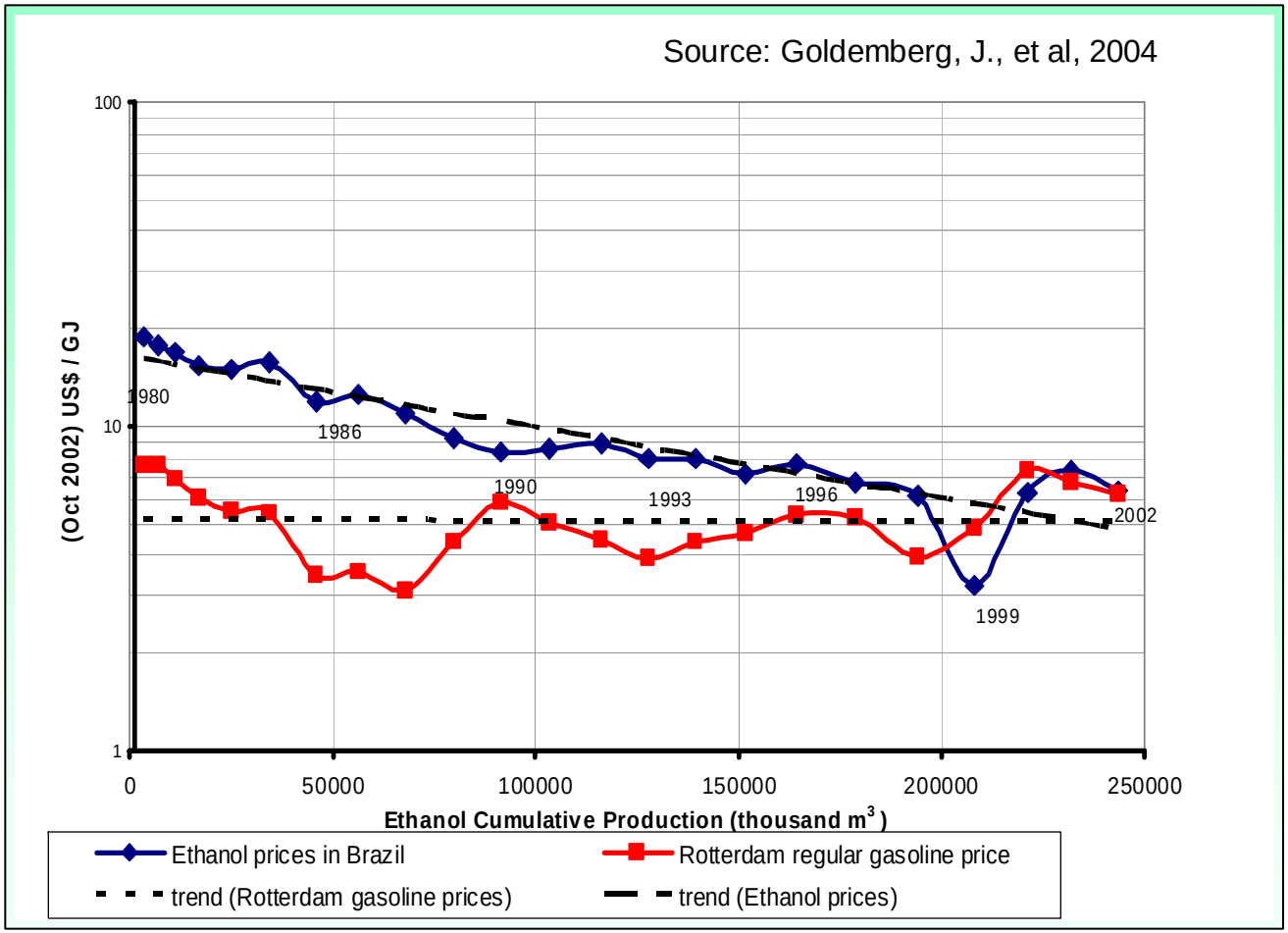
# Critical

# Cost of ethanol in Brazil 40 % of EU beet-ethanol




Source:UNICA, F.O.Lichts

# Learning curve in Brazil



# Examples of
# social indicators of sustainability

(from Farioli, 2004)

## Improved access to services

• Availability of services (water, energy, facilities, health, education). Assessment against local policies and plans

## Capacity development

• Know-how/knowledge of project participants and beneficiaries.

## Access to affordable energy services

• % of energy expenditure in the overall household budget.

## Energy self-reliance

• Independence; use of local energy resources.

## Employment (quality)

• Quality and long term of new jobs created.

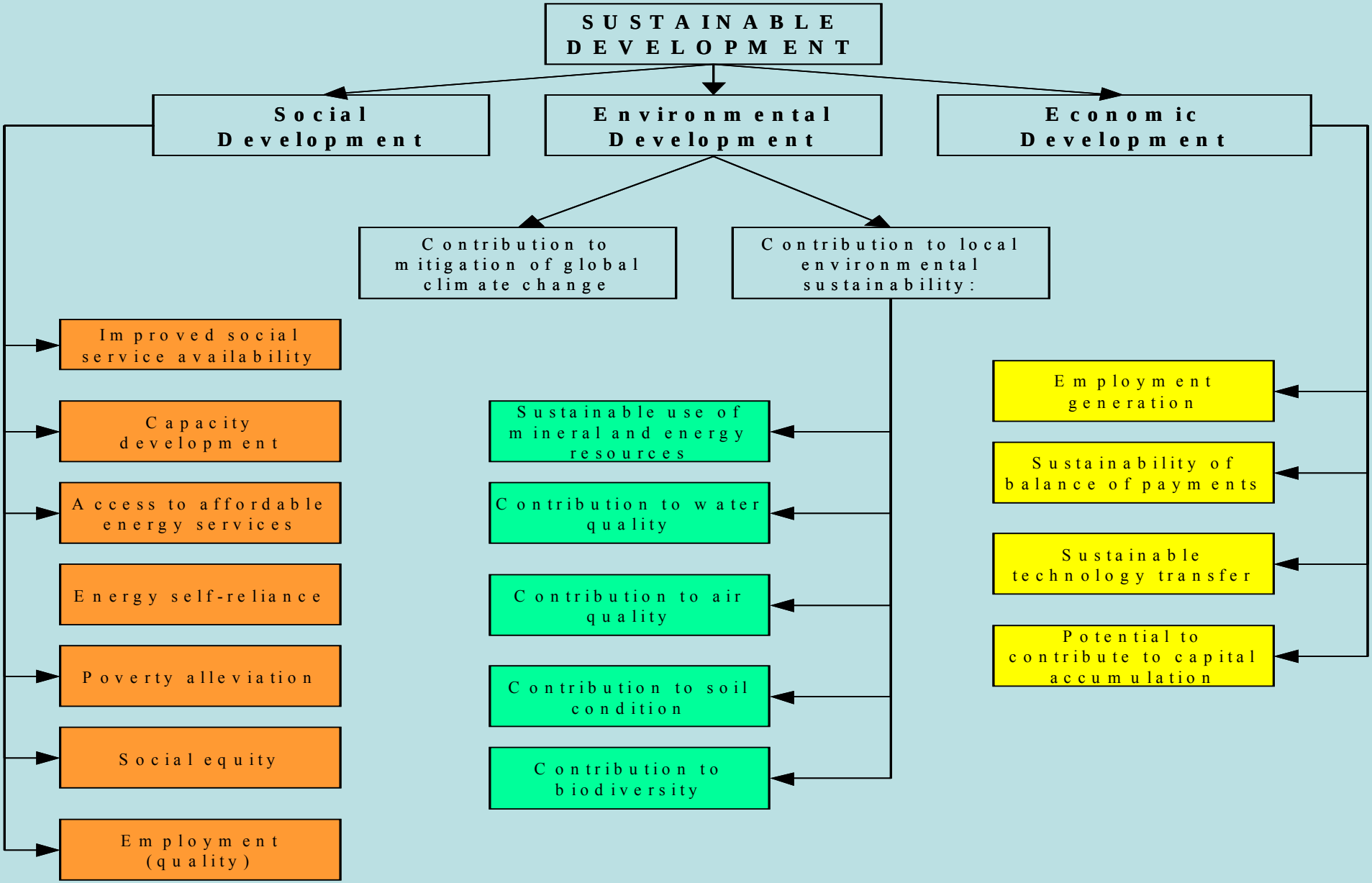
## Poverty alleviation

• Increase of the number of people living above poverty line.

## Social equity

• Contribution to empowerment of excluded social groups and wealth distribution.

# SD criteria: objective-tree



# International Bioenergy Programme

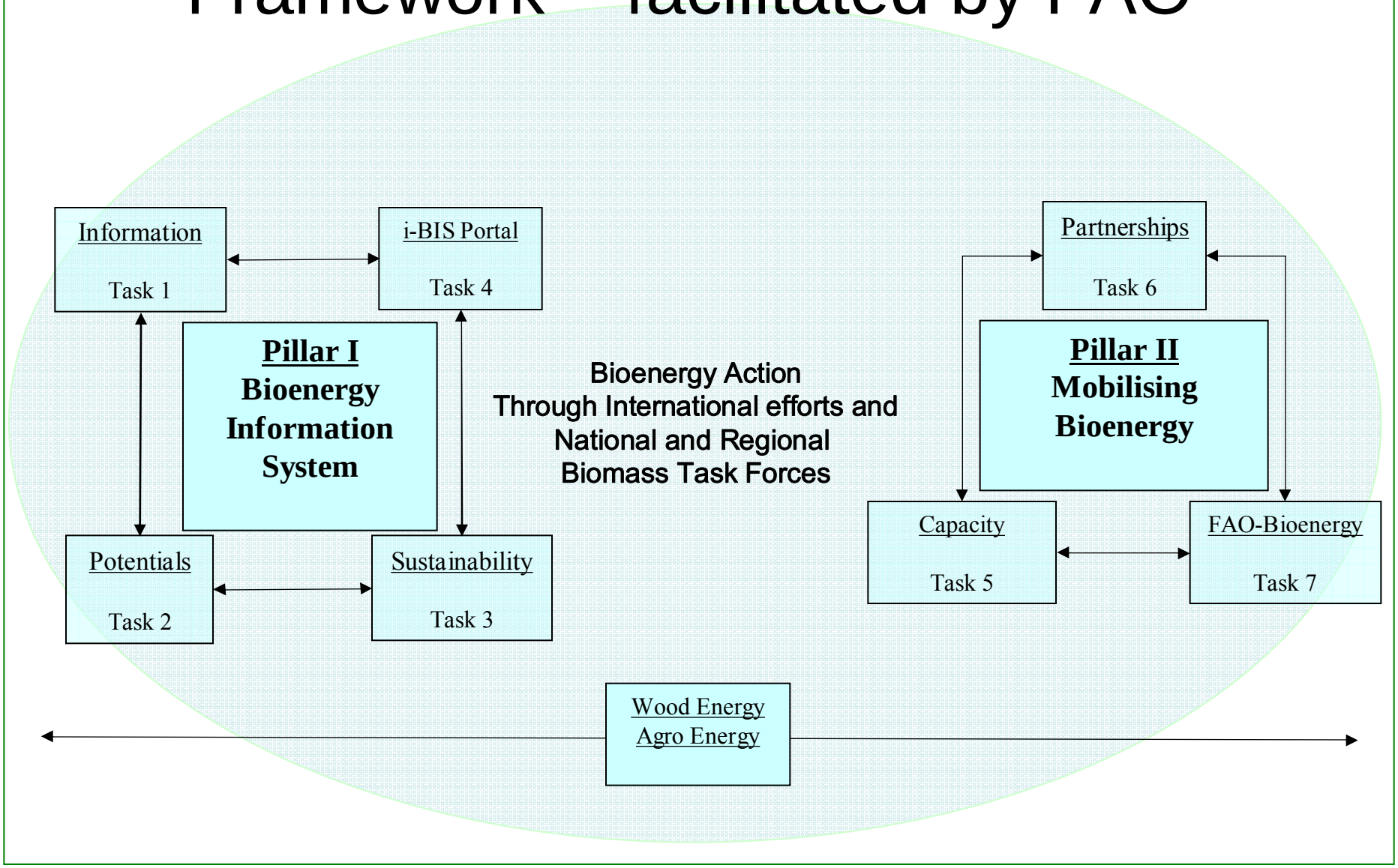
# IBEP

# to be launched in 2006

# Vision of International Bioenergy Programme:

Promote and monitor the sustainable use of modern biomass energy systems for sustainable development, energy security and climate change mitigation.

# International BioEnergy Programme Framework – facilitated by FAO



## International Bioenergy Programme - Tasks/Objectives

1. **Information.** Assist project development by providing examples of success and failure.

2. **Potentials.** Develop tools to quantify the potential bioenergy resource base on a country-by-country level and therefore highlight opportunities.

3. **Sustainability.** Assist in the development of sustainability strategies and assurance schemes aimed at ensuring the sustainable development of bioenergy.

4. **i-BIS (Interactive Bioenergy Information System).** Provide detailed 'real-time' data on consumption patterns and existing activities.

| | |
|---|---|
| **5. Capacity and Stakeholders.** | Provide an enabling environment for establishing and developing bioenergy programmes and projects. |
| **6. Partnerships.** | Assist international bodies to collaborate in the development of coherent national and international bioenergy programmes. |

# FAO data and Information for decision making on bioenergy

- **Farming practices**
- **Forest Resources Assessment - FRA**
- **Land type and use**
- **Water**
- **Wood energy (40 years old)**
- **Agricultural production – including by-products**
- **Rural institutions**
- **Livelihoods**
- **Nutrition**
- **GTOS**
- **Fisheries**

# Thank you !

www.fao.org

http://www.fao.org/sd/en2_en.htm

http://www.fao.org/forestry/index.jsp