ACT GLOBAL

ICAO: UNITING AVIATION ON CLIMATE CHANGE

ICAO Colloquium on Aviation and Climate Change

Sustainable raw material production for the aviation industry

BIOECa

BioEnergy & Agroenergetic Crops

INDEX

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A. Raw materials for the aviation industry

A.1 Biojetfuel value chain

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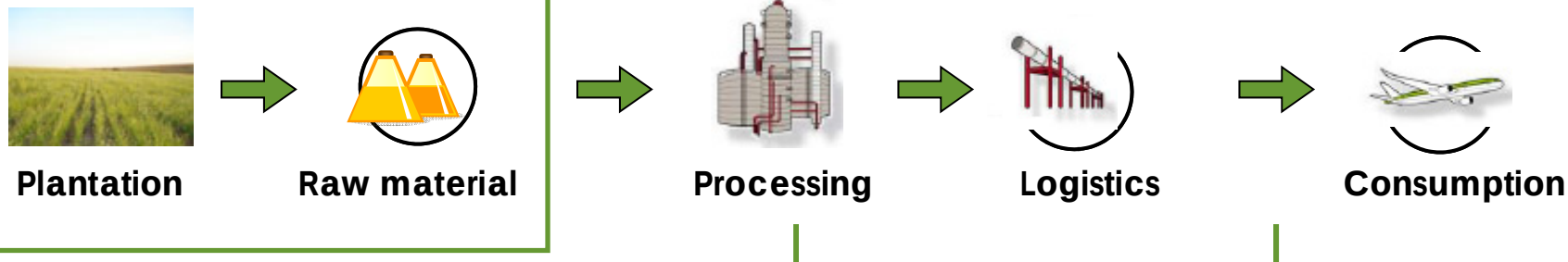
Major milestones

Processing: Several technological routes for the production of biojetfuel are being studied and developed. There are currently **tested and proven technology** processes for second generation feedstock, based on hydroprocessing vegetable oil.

Consumption: Prior to its use, the aviation sector will require certification. Certification is **planned for 2011**.

Biojetfuel feedstock projects



The assurance of raw materials in quantities and stable prices will be the biggest challenge for the development of the biojetfuel industry.

Proven technology

Certification planned for 2011

B.2 Aviation raw material requirements

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The aviation industry is committed to exclusively use biofuels that are not affected by certain **critical issues**, including **food supply, as well as land, water and environmental issues**.

In this sense, the aviation industry **will not use first-generation biofuel sources** -like soy or palm-, but it shall use biojetfuel feedstock crops that are grown in a sustainable way, not competing for land or water with food crops.

The aviation industry is seeking biofuels made from **second generation feedstocks** that comply with the following characteristics:

- crops that do not interfere with the **food sector**
- produced in **land** not used for food production / marginal land
- not requiring excessive **agricultural inputs**
- providing a **carbon footprint** reduction compared to jet fuel
- providing an equal or higher **energy content** than jet fuel
- not threatening **biodiversity**
- providing **socio-economic value** to local communities

B.3 Selected second generation feedstocks

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The aviation industry has initially selected four main potential second generation feedstocks: jatropha, camelina, algae and halophytes.

Based on the knowledge, experience and ongoing development of each of these raw materials, the following classification is presented:

Short term feedstocks

Camelina

→ Rotational crop
→ Minimal inputs
→ Grown in marginal land
→ Meal approved as animal feedstock

Jatropha

→ Perennial high oil yield
→ Non food feedstock
→ Grown in marginal land
→ Social benefits

Although very promising, jatropha projects are characterized by the need of manual harvest, the unstable, variable yield and the toxic meal.

Medium-long term feedstocks

Algae

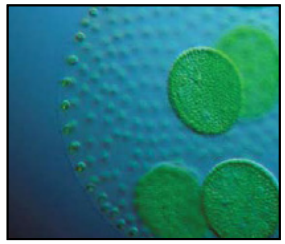
→ High growth rate
→ Very high production/yield
→ Grown in barren land

Halophytes

→ Saline habitat species
→ Grown in barren land

Harvesting, processing and infrastructure issues have to be solved before reaching commercial viability for algae. Limited experience in halophytes.



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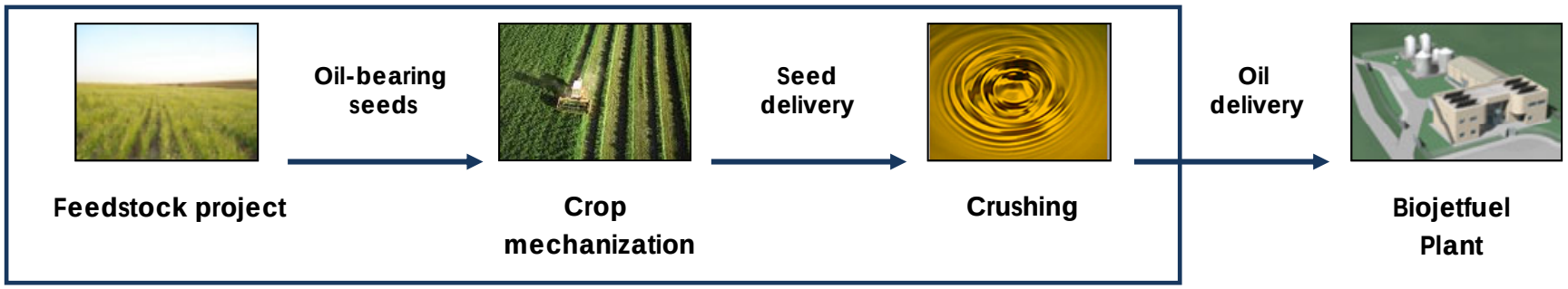
B. Large scale raw material production. Short term

B.1 Biojetfuel feedstock projects

Biojetfuel feedstock projects involve all the phases in a biofuels life cycle that are upstream of oil consumption in a Biofuel Plant.

- Plantation
- Crop mechanization: planting and harvesting
- Crushing: oil and meal production
- Associated storage and logistics



The aviation industry will require sustainable raw material production projects in the **short term**. In order to supply this industry, it will be necessary to implement **large scale agricultural production projects**.

In order to ensure these large scale agricultural deployments, it will be will be crucial to guarantee their **sustainability from all perspectives**. In this regard there are several critical issues associated.

B.2 Sustainability issues

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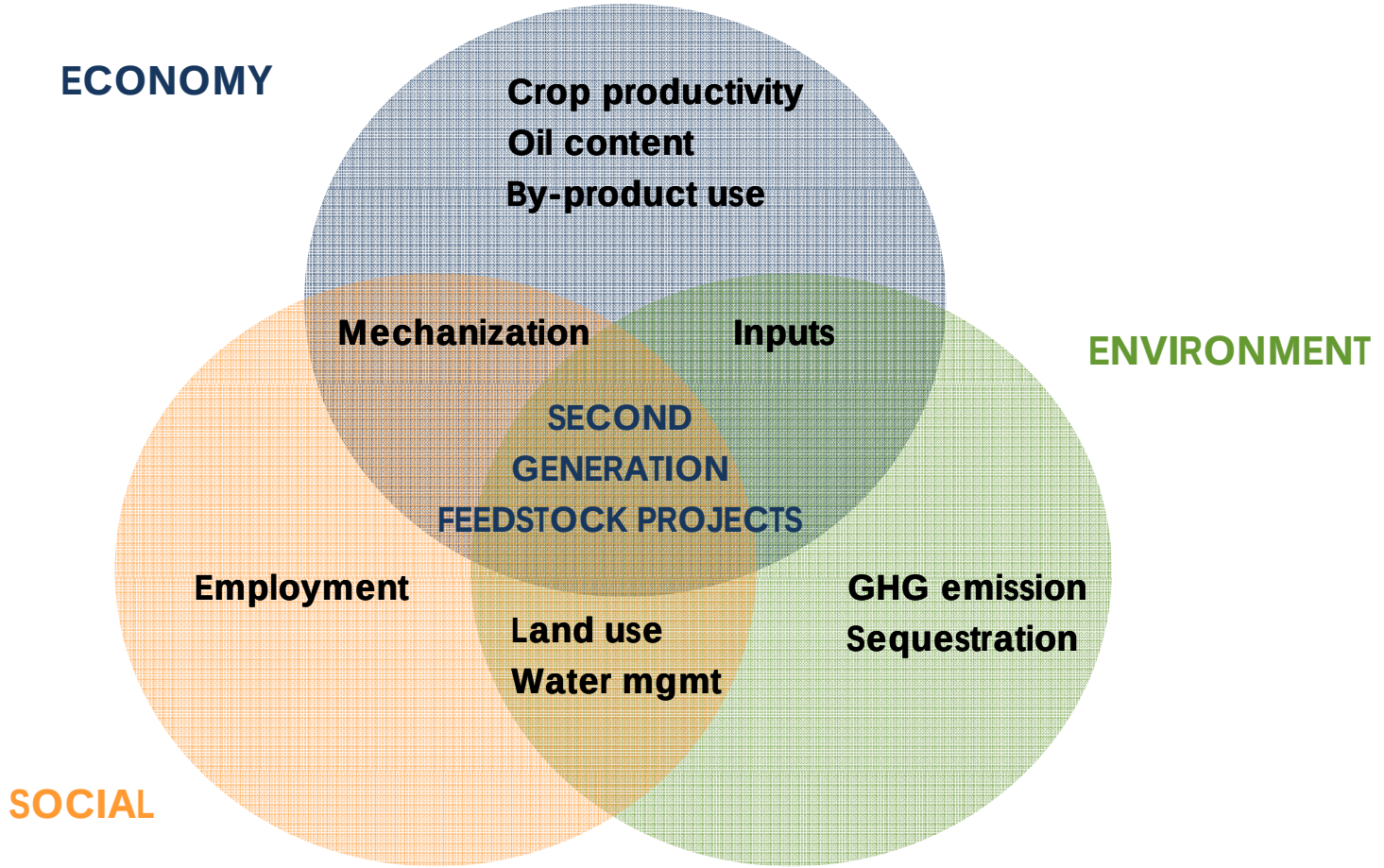
There are several issues to be tackled in order to ensure the sustainability of the project: **economic profitability** , **environmental respect** and **social commitment**.



B.3 Response & solutions

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Guaranteeing the sustainability for large scale biojetfuel feedstock projects depends mainly on four primary issues:

ECONOMY → **Short term second generation crops**

→ **Plantation management**

ENVIRONMENT → **Agricultural inputs**

→ **Production areas**

SOCIAL

B.3 Response & solutions

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a. Short term second generation crops

The main **technical criteria** required for developing viable, large scale biojetfuel feedstock projects in the **short term** for the production of **non-food raw material** are:

TECHNICAL CRITERIA	
HARDINESS	▪ Robust crop
TERM	▪ Annual crop
CYCLE	▪ Short
TECHNOLOGY	▪ Mechanized crop
RISK	▪ Extensive crop know-how
INPUTS	▪ Low agricultural inputs
INVESTMENT	▪ Low farm setup investment
EMISSIONS	▪ Significant GHG emission reduction

B.3 Response & solutions

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b. Production areas

The target production areas for the development of short term, large scale raw material production projects for the aviation industry must **not compete/interfere** with land devoted to **food production**.

Using **robust, annual, short cycle crops**, there are mainly **three different type** of production areas that can be used for biojetfuel feedstock production:

- **MARGINAL LAND**

  Robust crops, with little water requirements and adapted to harsh climate conditions, can be grown in land where food crops are not viable.

- **ROTATIONAL/FALLOW LAND**

  Rotational/fallow land can be grown with **annual** second generation crops, increasing next crops productivity and preventing soil erosion.

- **DOUBLE CROP LAND**

  Robust, annual and **short cycle** crops can be grown within the same growing season in a double cropping scheme, preventing soil erosion.

B.3 Response & solutions

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c. Agricultural inputs

A key issue related to the implementation of a sustainable feedstock project is **minimizing** the agricultural inputs –**chemical fertilizers and pesticides**-, which directly affect the crop yield and product quality.

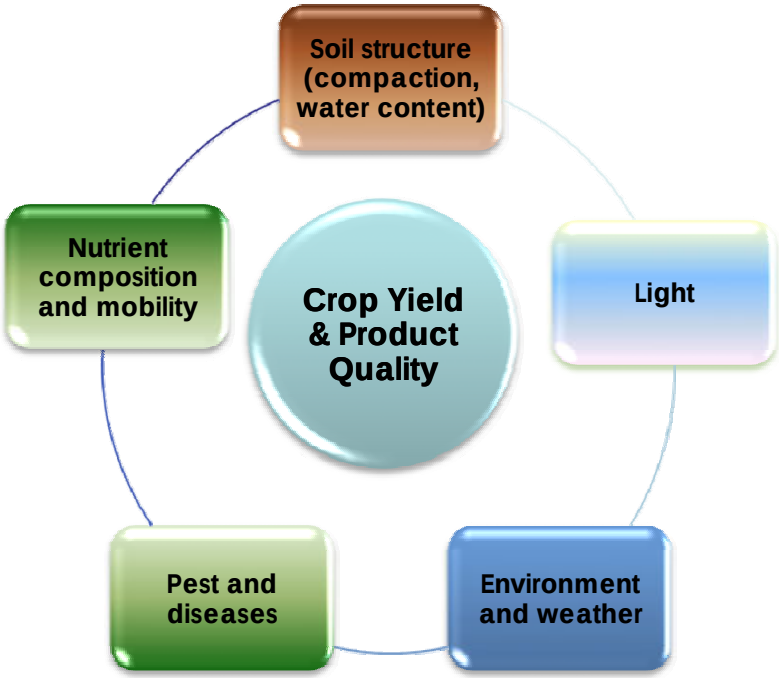
Reducing the agricultural inputs will bring two beneficial effects:

- GHG emission reduction – related to NOx
- Reduce the crop implementation costs

In order to achieve this goal it can be implemented:

→ **Biofertilization programs**

→ Systems for the efficient use of the inputs



d. Plantation management

Managing the plantations in a **highly efficient** manner implies integrating different **production technologies**, as well as **advanced management systems** that minimize agricultural inputs, secure production goals and maximize crop productivity.

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C. BIOECA

C.1 Objectives

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BIOECA is a company that specializes in the **implementation of integral and sustainable projects** aimed at supplying the biofuel industry with **competitive, non-food feedstock raw materials**.

Our company's mission is to ensure **on-budget, on-time** delivery of raw materials for different sectors of the bio energy industry, including **biodiesel** and **biojetfuel**.

BIOECA focuses in developing **short term second generation** projects with **camelina**, a non food, non invasive annual crop.

	Camelina Sativa
PRODUCTIVITY	▪ High yield and oil content
HARDINESS	▪ High drought and cold weather tolerance
CYCLE	▪ Annual, very short cycle(<100 days)
TECHNOLOGY	▪ Mechanized ▪ Technological package developed (US)
INPUTS	▪ Low agricultural inputs
INVESTMENT	▪ Low farm setup investment
LAND	▪ Marginal, fallow and double crop
EMISSIONS	▪ High GHG emission reduction

C.2 Technological capabilities

BIOECA has incorporated **partners** and **technology collaborators** from complementary industries, in order to ensure the viability and success of the projects.

I. Genetic material

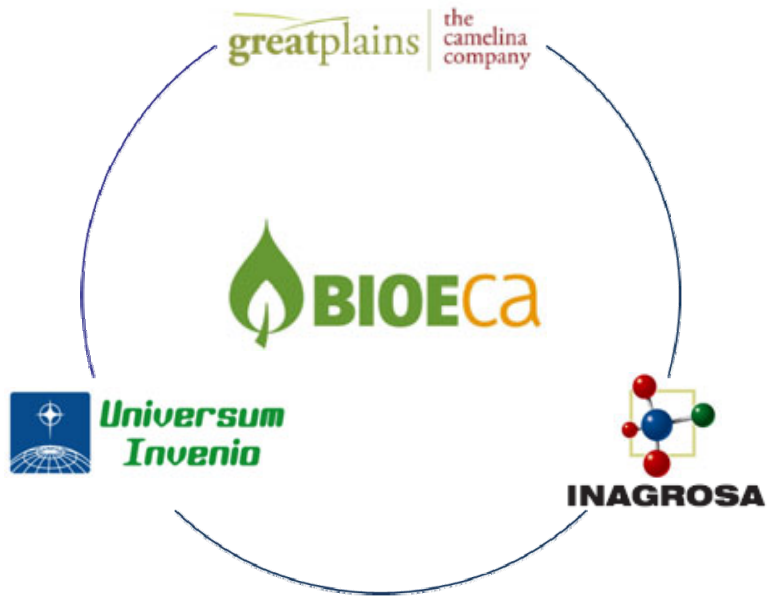
Camelina Company: Extensive agronomic and genomic intellectual property with exclusive access to the majority of the world's Camelina germplasm.

II. Biotechnology

INAGROSA: Biofertilization programs developed with exclusive in-house technology.

III. Precision agriculture/Project Deployment

Universum Invenio: Proprietary management systems enabling the online handling, monitoring, and control of large scale plantations by neural computing.



The company's technological capabilities focuses on two main lines:

→ **The development and adaptation of new varieties to local weather and soil conditions and their implementation in large scale sustainable feedstock projects.**

→ **Control, management, and optimization of large scale agro industrial exploitations.**

C.2 Technological capabilities

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Great Plains- The Camelina Company: Largest Camelina producer in the world and market and technology leader for the crop. Great Plains has an extensive proprietary germplasm bank, giving it the ability to produce new and improved varieties with adaptability to different weather conditions (www.camelinacompany.com).

INAGROSA

INAGROSA: A company with a great commitment with environmental preservation that produces ecological plant nutrition products (bio stimulants and bio fertilizers). INAGROSA intervenes in a variety of farming projects through its vast distribution network in more than 56 countries (www.inagrosa.es).

Universum Invenio

UNIVERSUM INVENIO: Company dedicated to research, development, and commercialization of agricultural production technologies, as well as consulting services in production and operations' management. Established in Hong Kong, it maintains R&D agreements with leading Universities and Institutes in Europe, United States and Asia. It has more than 20 years of experience in the R&D field.

C.3 Current developments

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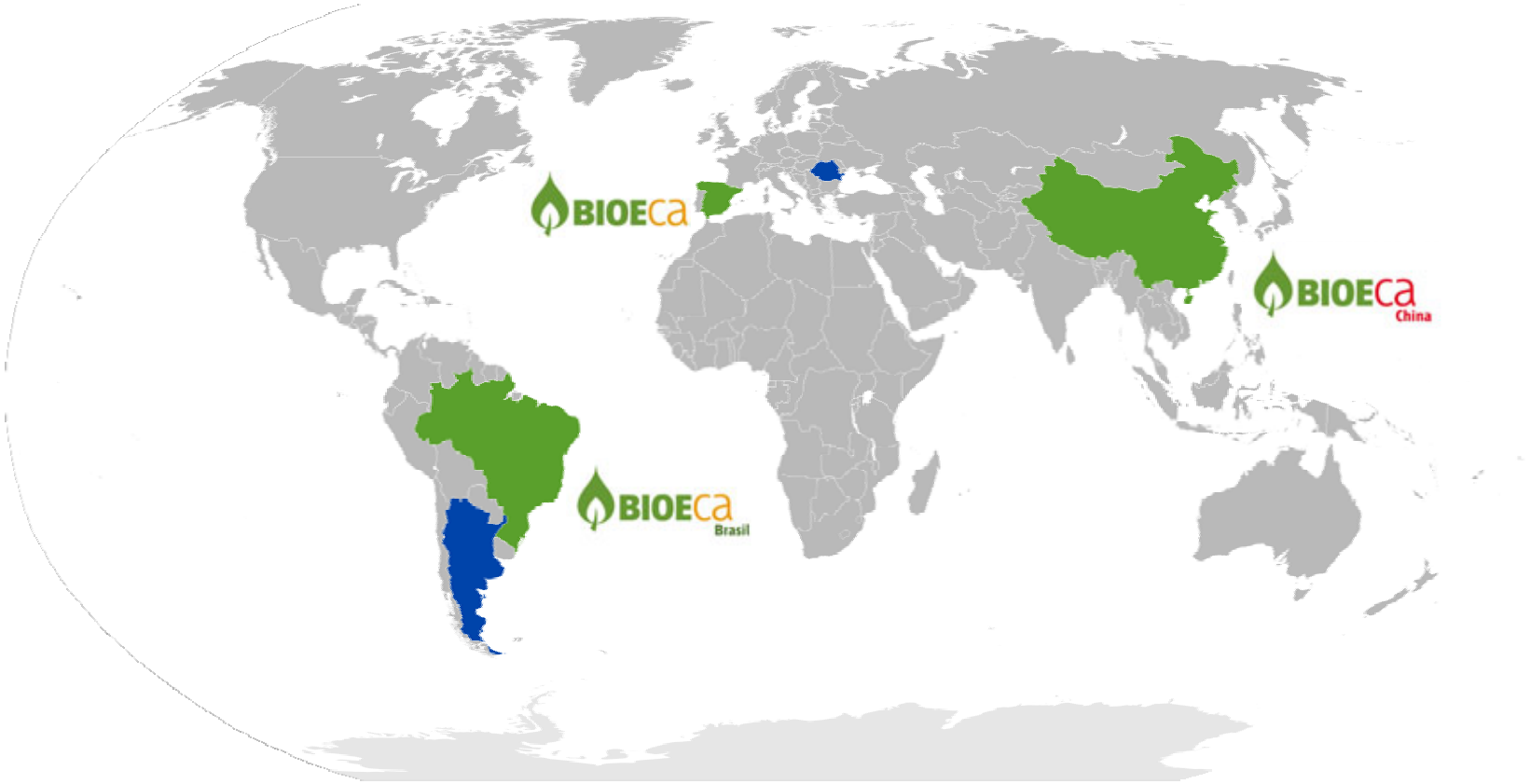

Ongoing projects

Projects under prospection

C.3 Current developments

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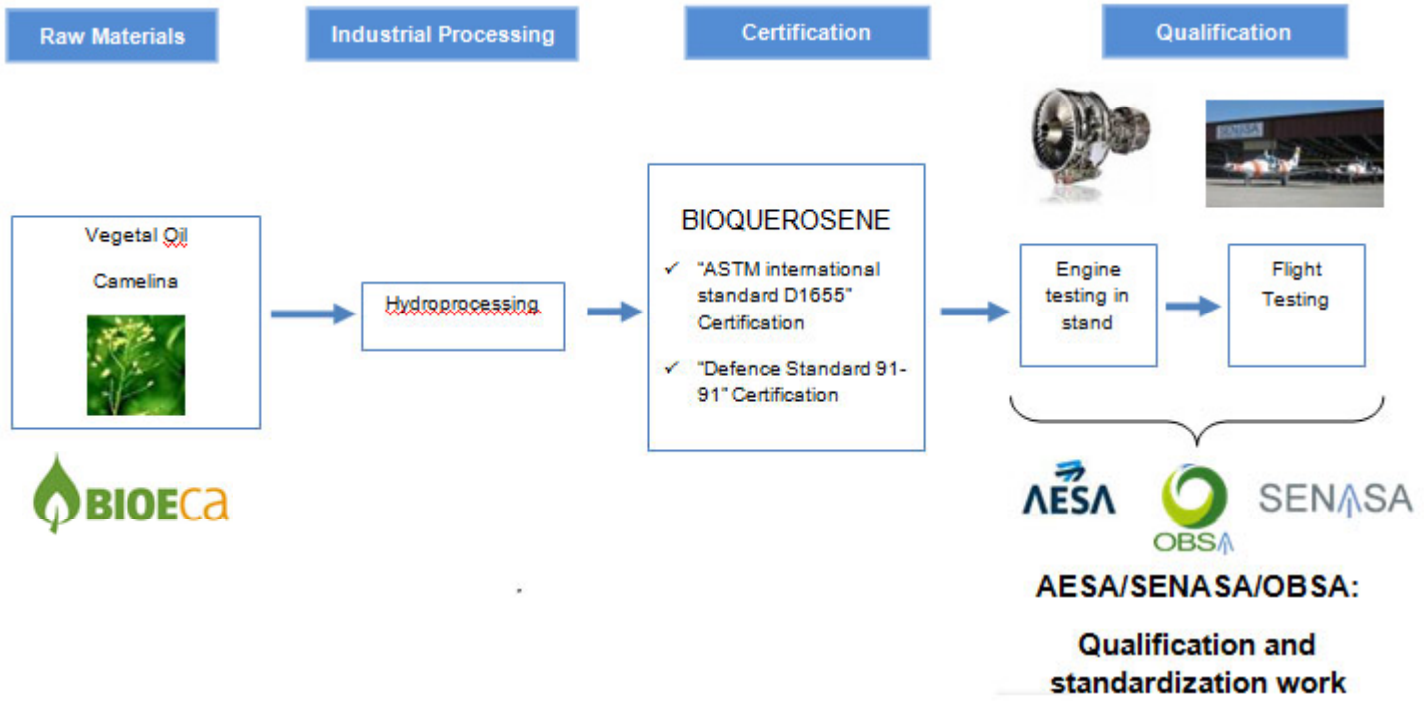
SPANISH PROGRAM ON BIOJETFUEL DEVELOPMENT AND QUALIFICATION



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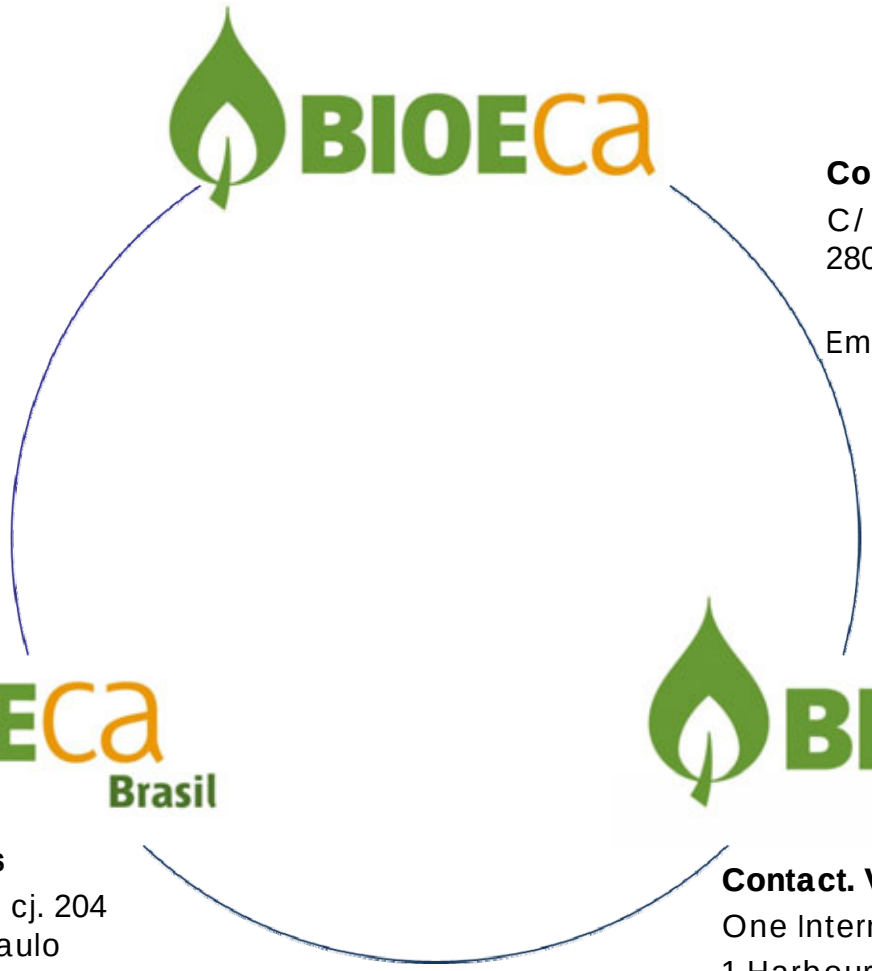

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