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WCCE10 ECCE11 ECAB4 Barcelona, Spain 1st - 5th October, 2017

10th World Congress of Chemical Engineering

10th World Congress OF CHEMICAL ENGINEERING | 11th European Congress OF CHEMICAL ENGINEERING | 4th European Congress OF APPLIED BIOTECHNOLOGY

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SABANA Sustainable Algae Biorefinery for Agriculture aNd Aquaculture

Sustainable integrated Algae Biorefinery for the production of bioactive compounds for Agriculture aNd Aquaculture (SABANA)

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ECAB'2017 Conference, Barcelonad (Spain)

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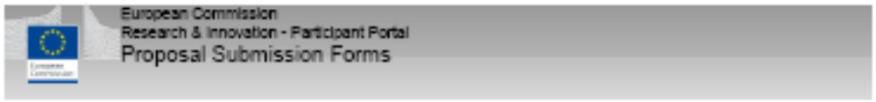
Diagnostic



Horizon 2020

Call: H2020-BG-2016-2017
(Blue Growth - Demonstrating an ocean of opportunities)

Topic: BG-01-2016

Type of action: IA
(Innovation action)

***Symptoms*:**

Despite the **large potential** of products derived from algae, implementation is still limited mainly due to **unfavorable economics**. At present, microalgae are being applied in a **limited volume** (< 10 000 tones dry weight/year) in various **niche markets** (including food supplements) and macroalgae mass production is facing several challenges including the lack of space to further expand.

***Treatment*:**

To reach broader economic viability, **costs** of algal biomass production need to be reduced and the **scale of production** needs to be increased significantly. Even when the price of biomass production is reduced, algal biomass needs to be **refined into multiple products** in order to increase its total value and achieve **economic feasibility**.

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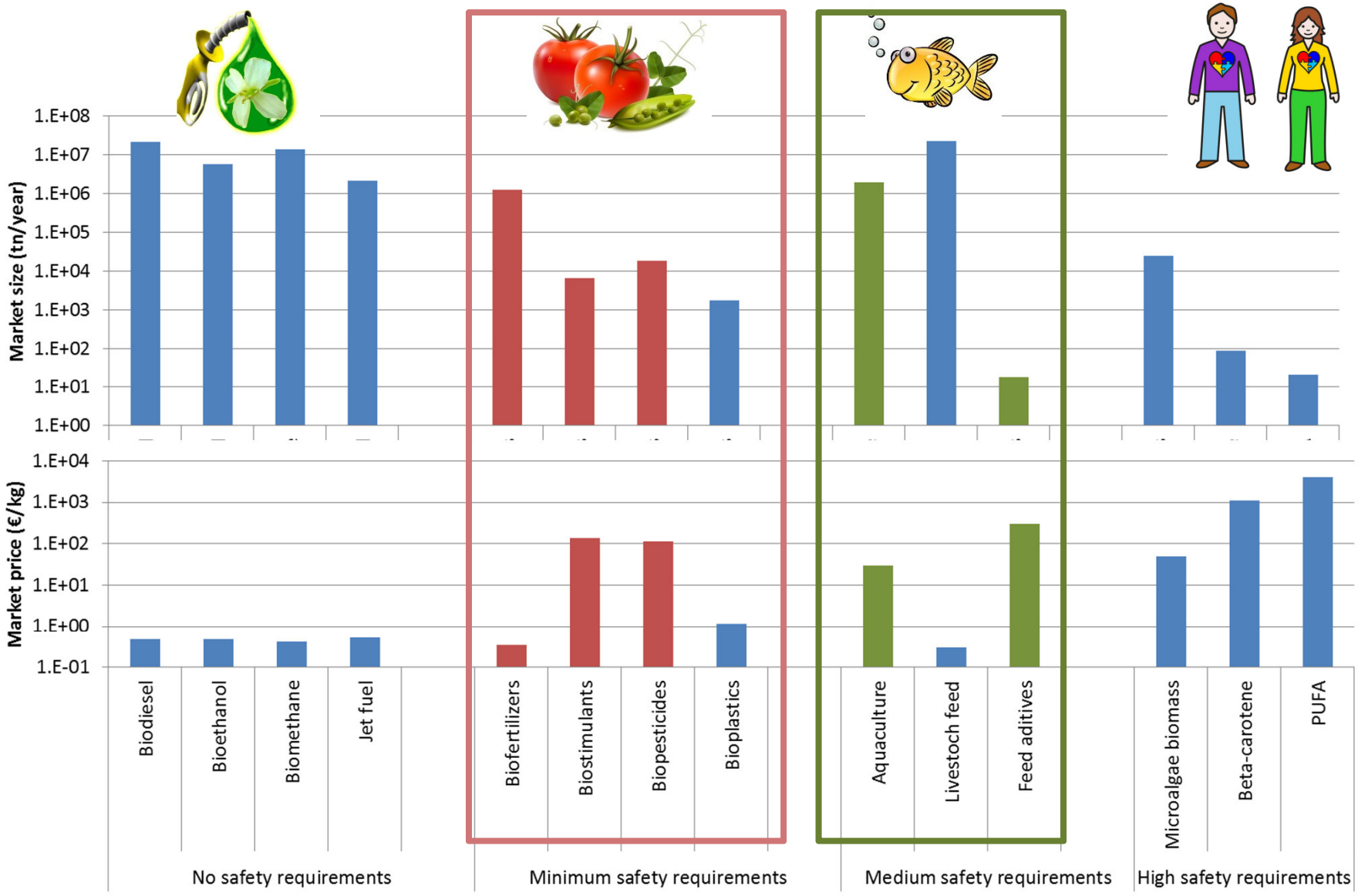
Market study



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Market study

SABANA Sustainable Algae Biorefinery for Agriculture and Aquaculture

Agriculture market

Biofertilizer: microalgae can be used as biofertilizer releasing their components to the plants or by improving the nitrogen and phosphorous availability of plants.

Biostimulants: microalgae contain organic materials that, when applied in small quantities, enhance plant growth and development

Biopesticides: used primarily as preventative measures for diseases in plants, made from naturally occurring substances that controls pests by nontoxic mechanisms and in an eco-friendly manner

KOPPERT BIOLOGICAL SYSTEMS · SICIT 2000 · tradecorp nutri-performance · Valagro Where science serves nature · Agrinos · Arysta LifeScience · Biolchim Concimi speciali · BRANDT · cytozyme · Daymsa · GRAB Chemical · HUMIN TECH · ILSA The green evolution · ITALPOLLINA

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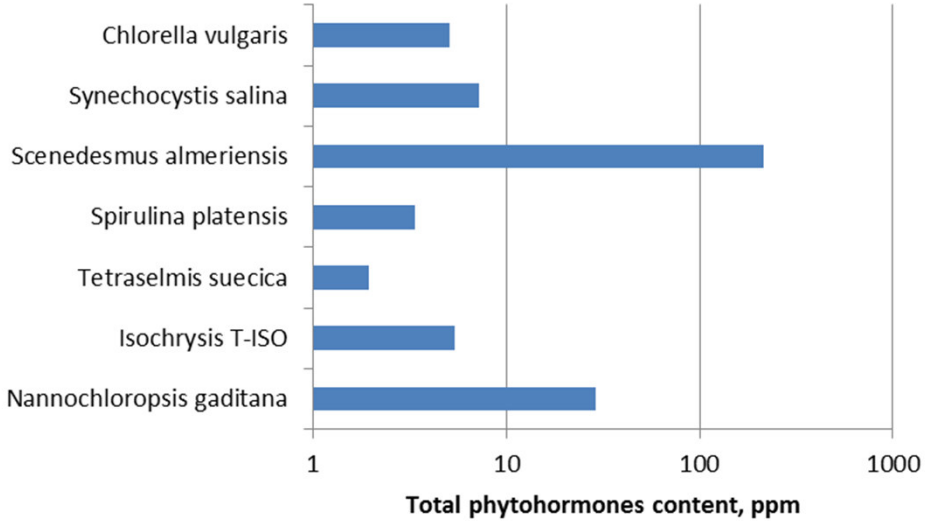
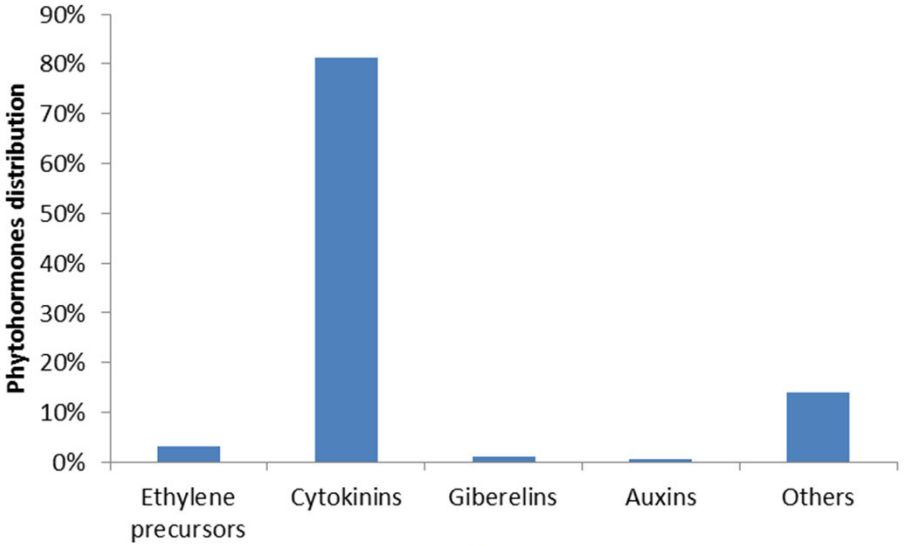
Market study

Biostimulants/biopesticides



		Regular	High	Premium
Biostimulants	€/L	5	10	20
Biopesticides	€/L	10	15	25



Major requirements:

- No large volumes requested, medium size facilities
- Enhanced biomass containing target compounds
- Demonstrate the bioactivity in real field conditions
- Safety and sustainability of produced biomass

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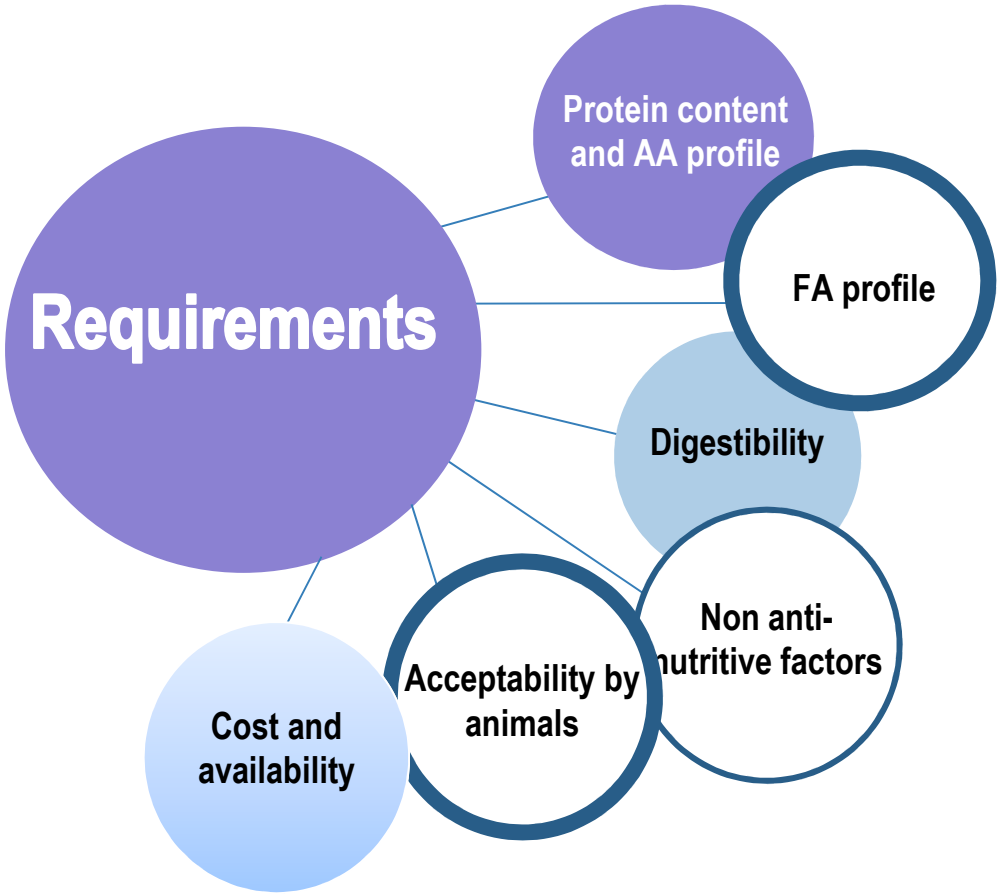
Market study

Aquaculture market



Whatever protein source an adequate biochemical composition and acceptability by animals is required, but also cost effective and available.

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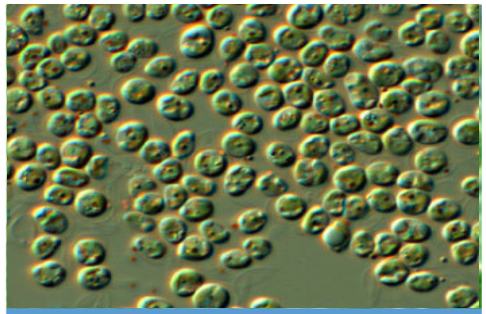
Market study

Alternative protein sources

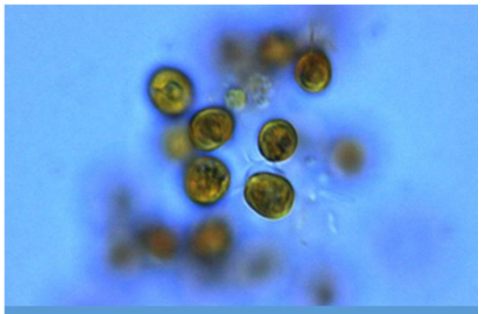
Microalgae	Proteins (%)	Lipids (%)	Carbohydrates (%)
Isochrysis galbana (T-iso)	38-47	17-24	24
Nannochloropsis sp	35-55	20-60	20
Tetraselmis sp	40-55	14-45	15-18
Scenedesmus sp	50-56	12-14	10-52

High proteins content
Adequate AA profile
Rich in vitamins and pigments



Nannochloropsis gaditana

OK High EPA content



Isochrysis galbana

OK High DHA content

Scenedesmus almeriensis

OK High linolenic content

Tetraselmis suecica

OK EPA and DHA content

Microalgae are proposed as alternative to fish meal by its adequate biochemical composition, different studies validating this application.

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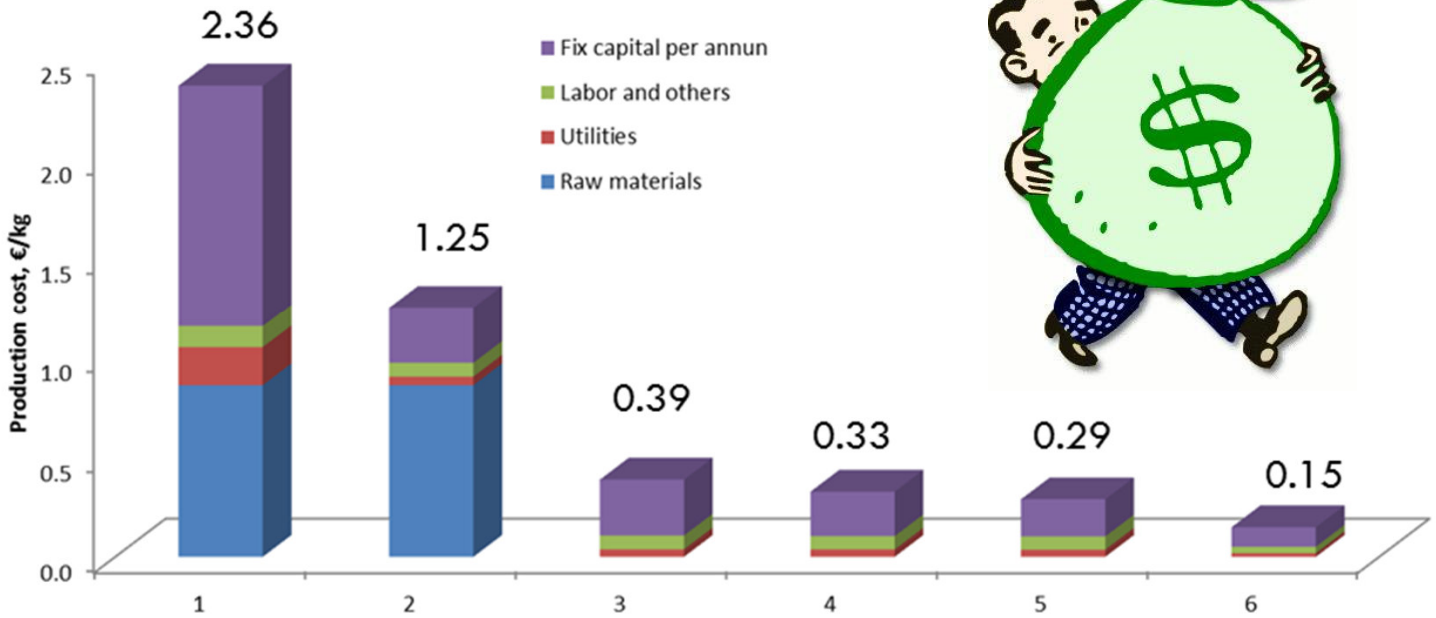
Production cost/sustainability

Integration with wastes treatment



Scenario	Inputs	Reactor	Productivity	Harvesting
1	Water, CO2 and fertilizers	Raceway	Real	Centrifugation
2	Water, CO2 and fertilizers	Raceway	Real	Flocculation-Sedimentation+Centrifugation
3	Free flue gases and wastewater	Raceway	Real	Flocculation-Sedimentation+Centrifugation
4	Free flue gases and wastewater	Raceway	Real	Flocculation-LamellarSedimentation+Centrifugation
5	Free flue gases and wastewater	Raceway	Real	Flocculation-LamellarSedimentation+Filtration
6	Free flue gases and wastewater	Raceway	Theoretical	Flocculation-LamellarSedimentation+Filtration

Utilization of wastewater is the best option to reduce the production cost

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Production cost/sustainability

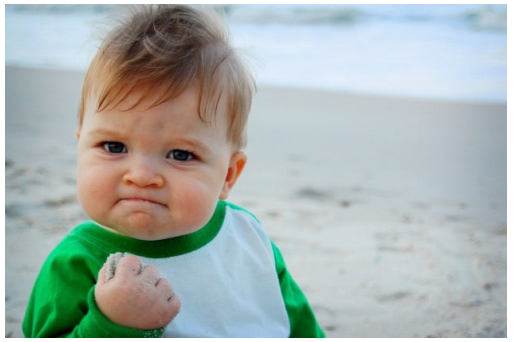
Integration with wastes treatment

Conventional technology for wastewater treatment imposes a high cost and energy consumption, nutrients being lost

Wastewater treatment cost: Aqualia (250 plants=500 Mm^3/yr)

- Water treatment cost=0.2 €/m^3
- Energy consumption= 0.5 kWh/m^3

- Advanced treatment processes (A2O, AO, UCT type):
  - Complex processes
  - Removal of nitrogen = 5-8 €/kg
  - Removal of phosphorous = 13-20 €/kg



Nutrient losses

- Nitrogen removal/losses=25.000 t/yr
- Phosphorous removal/losses =5.000 t/yr

} "Microalgae=0.5 Mt/yr"

Conventional treatments are designed to remove nutrients, not to produce biomass, employing a large amount of energy to do it

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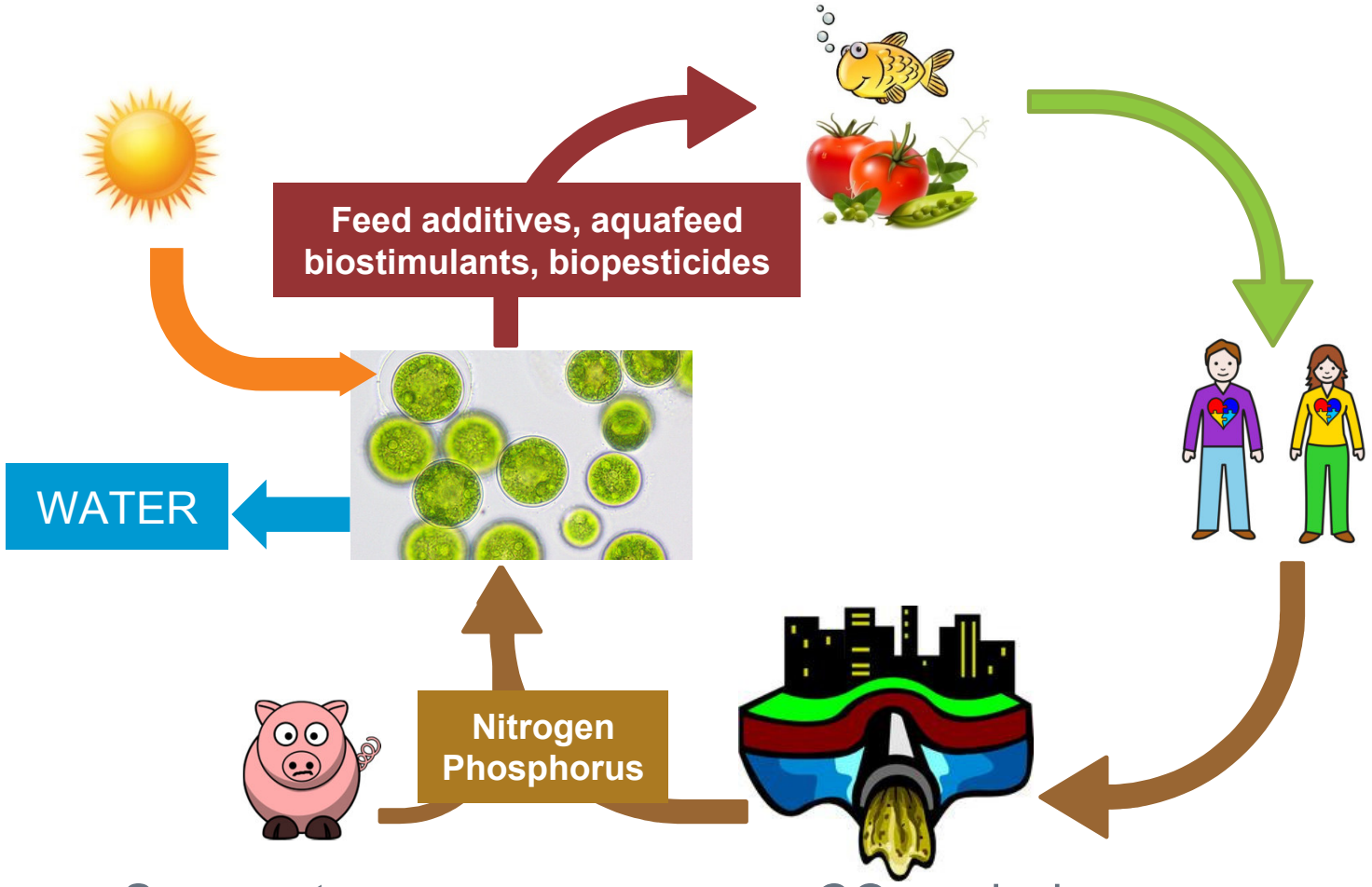
Objective of SABANA



Save water, save energy, save CO_2 emissions,
recover nutrients…, thus be sustainable

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Major challenges

- **Large scale production**: To develop robust and scalable technology for microalgae production (including harvesting and processing), in continuous mode all the year around, at minimum cost. Economic analysis must to be used in decision making.
- **Sustainable production:** To integrate the treatment of wastes to increase the sustainability of the entire process. Life Cycle Analysis determines what is possible or not.
- **Markets/commercialization:** Only products now requested by the markets and that legally accepted are considered. Business plan is the driver of the project.

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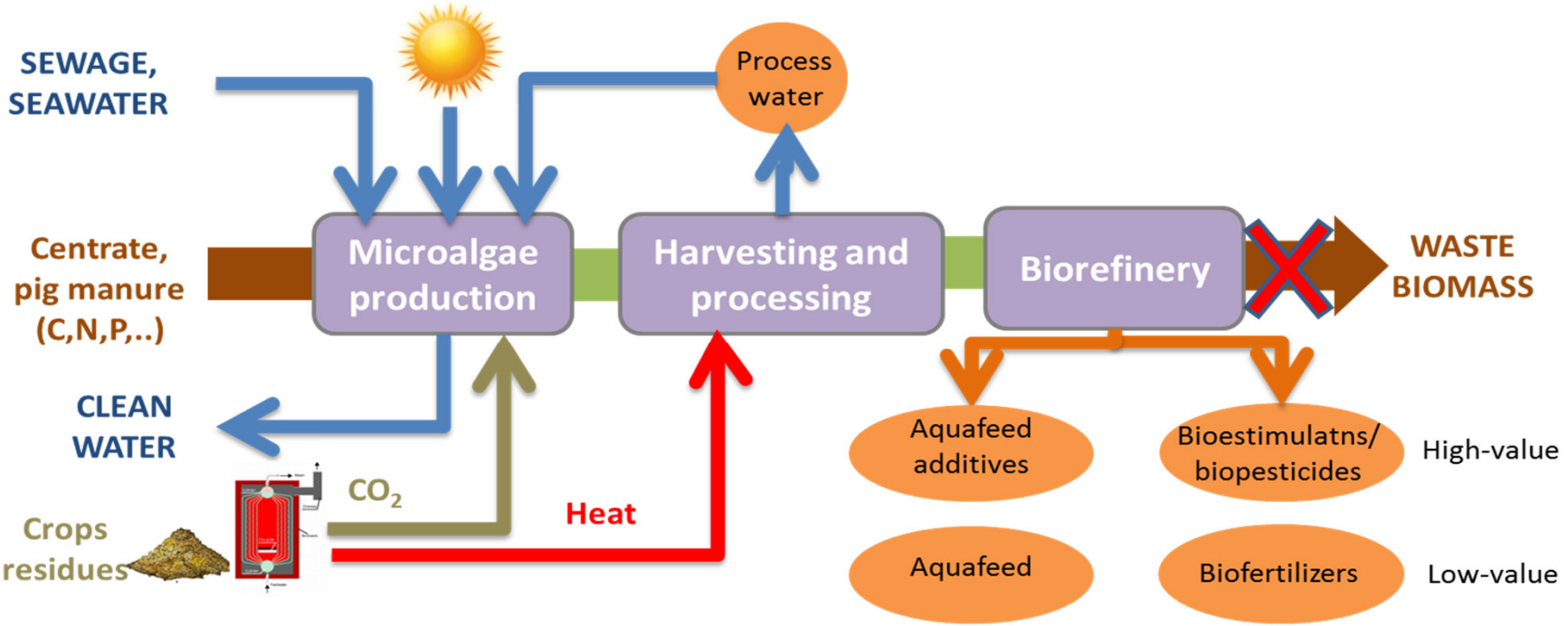
Block diagram of the project



LARGE SCALE BIOMASS PRODUCTION

INTEGRAL UTILIZATION OF BIOMASS

DEMO1 SCALE=1 ha

DEMO2 SCALE=5 ha

DEMO3 SCALE=20 ha

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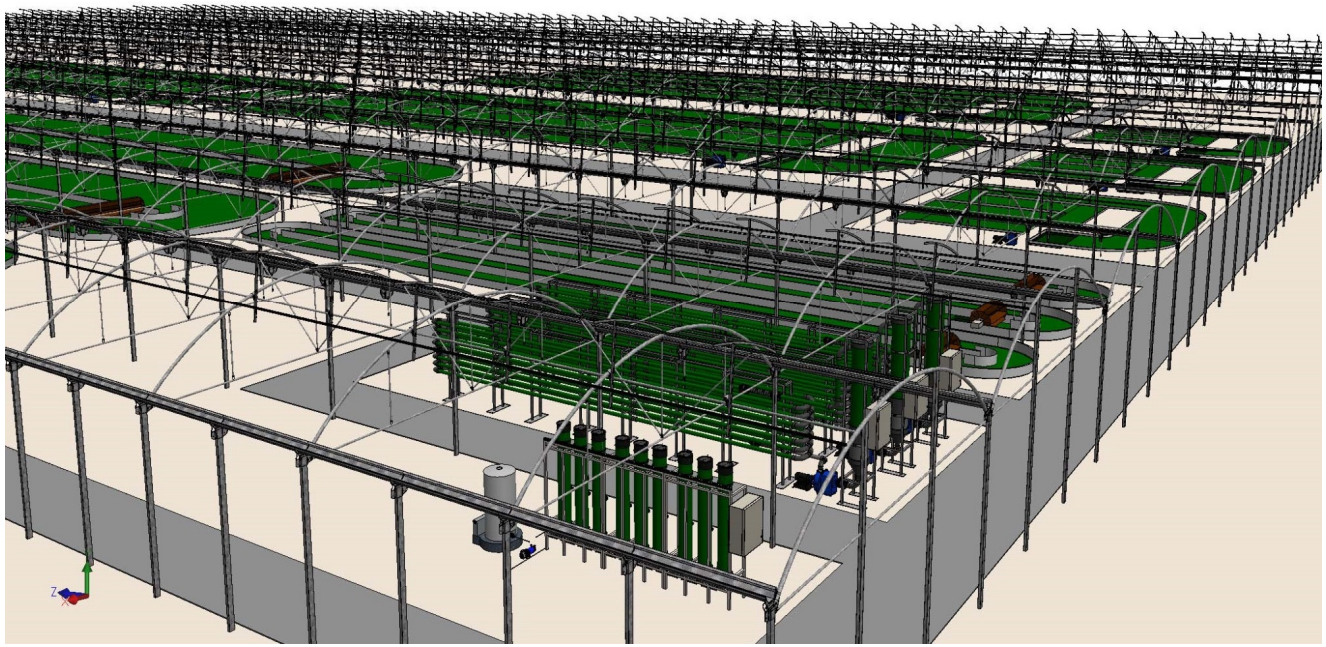
Research-Innovation (1 ha)



Start point:

- Only open reactors in continuous mode, from 100 m^2 to 5000 m^2
- Improvement of Raceway and Thin-layer cascade reactors
- Mass transfer, energy consumption and photosynthetic efficiency
- Non-usable water, recycling of nutrients from wastes
- Optimizing the design, operation and control by adequate modelling

Up to 60 t/year dry matter

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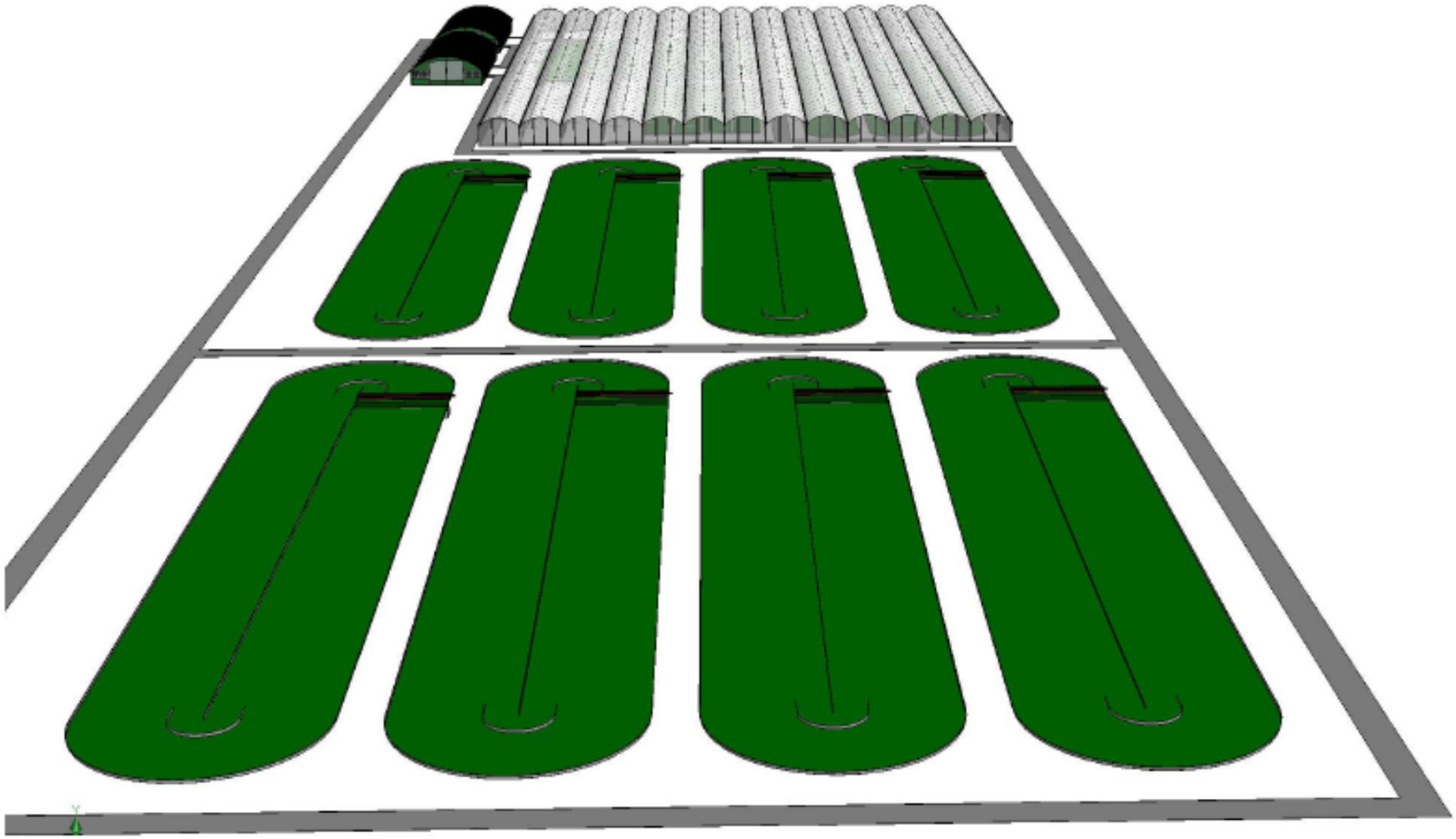
Innovation-production (5 ha)



Up to 300 t/year dry matter

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Additional objectives

- **Dissemination activities:** Organization of conferences, participation in meetings, workshops with industrial sector, newsletter, papers, etc.
- **Formation:** To stablish a **Training Center** for teaching and collaboration with other institutions, organization of international courses, etc.
- **Collaboration:** With other EU projects, with companies associations, Public bodies, etc.
- **Share research:** Creation of a **Data Center** for online availability of real data from the reactors in operation, access to models developed during the project, simulation tools for different scenarios, etc.

YOUR COLLABORATION IS WELCOME

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Excellent partners

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