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for Clean Energy Technologies

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Advanced biofuels production by combining thermochemical and biochemical processes towards a biorefinery concept

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GEPEA
Environnement • Énergie
Agro-alimentaire • Mer

Faculté des sciences de Bizerte

UNIVERSITAS INDONESIA
Veritas, Probitas, Iustitia
Est. 1849

GEPEA – RESEARCH UNIT (UMR-CNRS 6144)

~250 persons over 5 sites

Permanent researchers: **77 (~ 40 Full timer equivalent)**
Technnical and administrative staff: **55**

Post doctoral fellows ≃ **10-15**
PhD students ≃ **90-100**

5 multisite teams

Process engineering

BAM : Microalgae bioprocesses

MAPS : Food industry processes

TEAM : Processes for Air and water treatment and metrology

OSE : Optimisation – System – Energie

VERTE : Processes for energy and materials recovery from biomass and organic wastes

VERTE TEAM ACTIVITIES AT GEPEA – UMR-CNRS 6144

Oil & Fat wastes

Transesterification

Biodiesel

Biomass & agriculture wastes

Polymers & RDF

Dry

Wet

Pyrolysis & gasification

Anaerobic digestion

Hydrothermal liquefaction

Bio-oil

Syngas

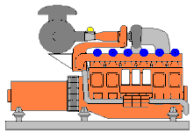
H_2

Biogas

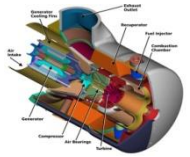
EtOH

Biocrude

Physical & Chemical characterisation. Gas & oil purification



Spark ignition engine



Gas turbine

Boiler

Heat / Electricity / Liquid Biofuels / Solid Fuel

Performance & emissions analysis / Combustion modelling
Energetic optimization

By-products

Char

Digestate

Lignin

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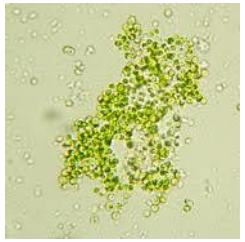
VERTE TEAM ACTIVITIES AT GEPEA – UMR-CNRS 6144

Towards biorefinery concept

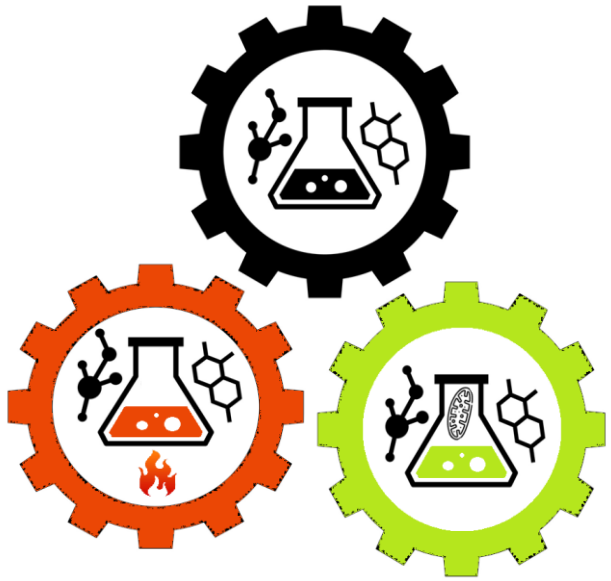

Organic Wastes


Plastics and Polymers




Microalgae **Sewage Sludge**

Chemical



Thermochemical **Biochemical**


Platform molecules and Green Chemistry

Carbonaceous materials

Fertilizers


Advanced Biofuels

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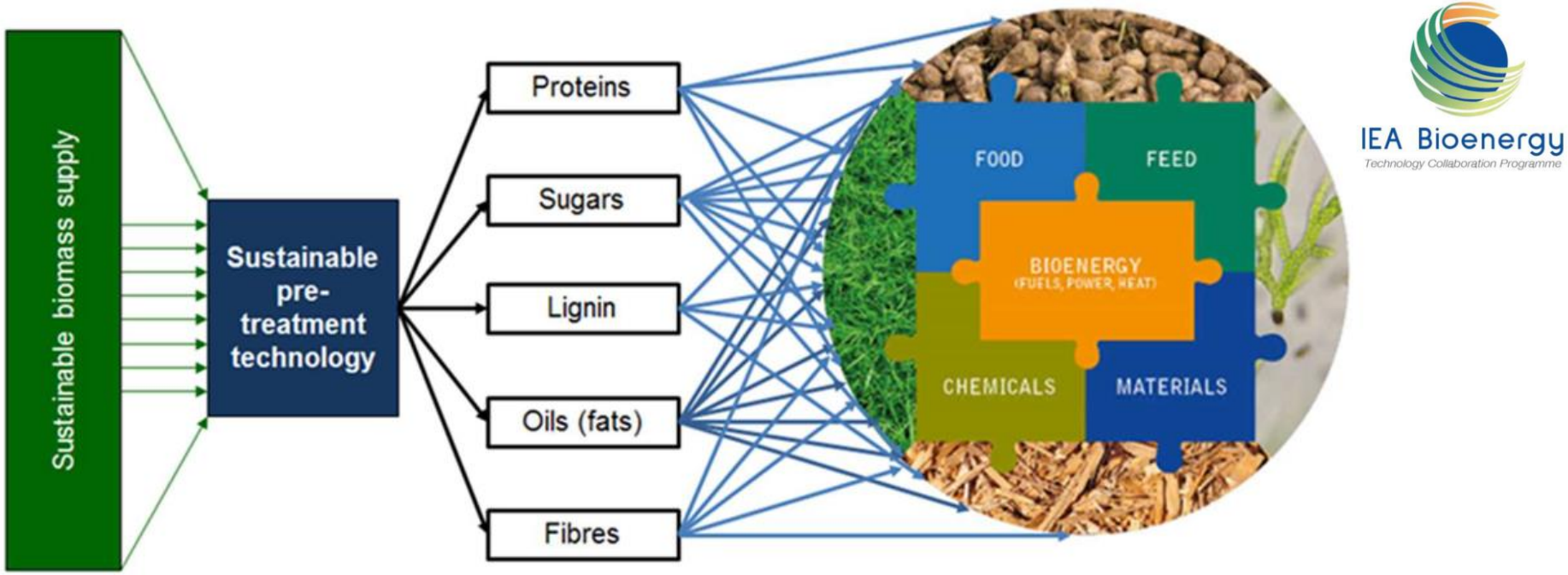
BIOREFINERY CONCEPT



*'Biorefining is the **sustainable** processing of **biomass** into a **spectrum** of, **marketable products and energy**', IEA Bioenergy, Global Biorefinery Status report*

BIOREFINERY CONCEPT

3 examples

Olive oil by-products Valorization pathways

2nd Generation bioethanol production from Palm oil by-products

3rd Generation Sustainable Aviation Fuel from microalgae (COCPIT Project)

OLIVE OIL BY-PRODUCTS

Olive oil by-products
Valorization pathways

- 36% carbohydrates
- 6% Lipids → Extraction is being performed industrially
- 60% FFA content

Objectives:

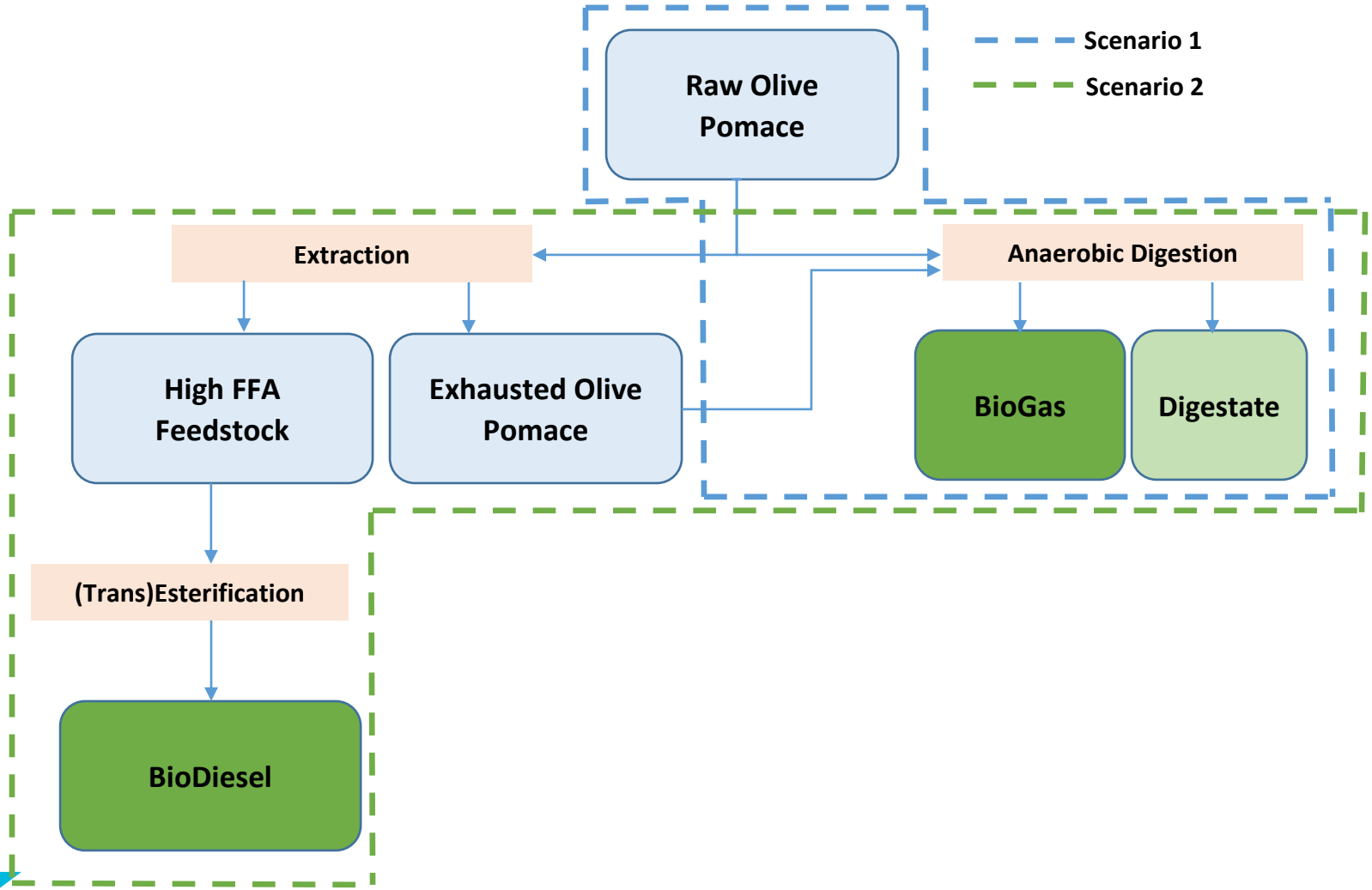
Comparing different valorization pathways based on experimental, labscale studies

Drawing energy balance

Drawing added value products balance

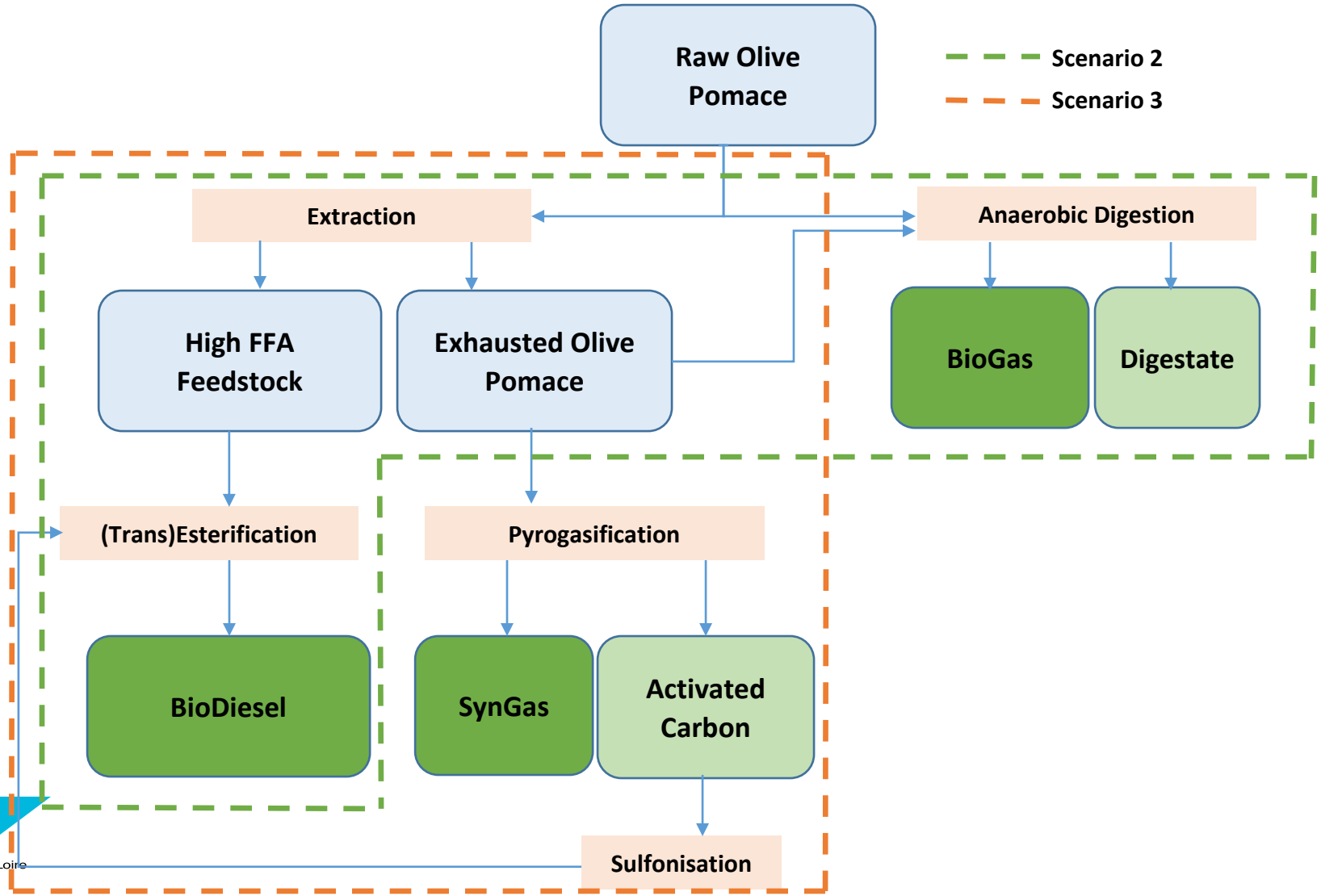
VALORIZATION PATHWAYS

Scenarios 1&2



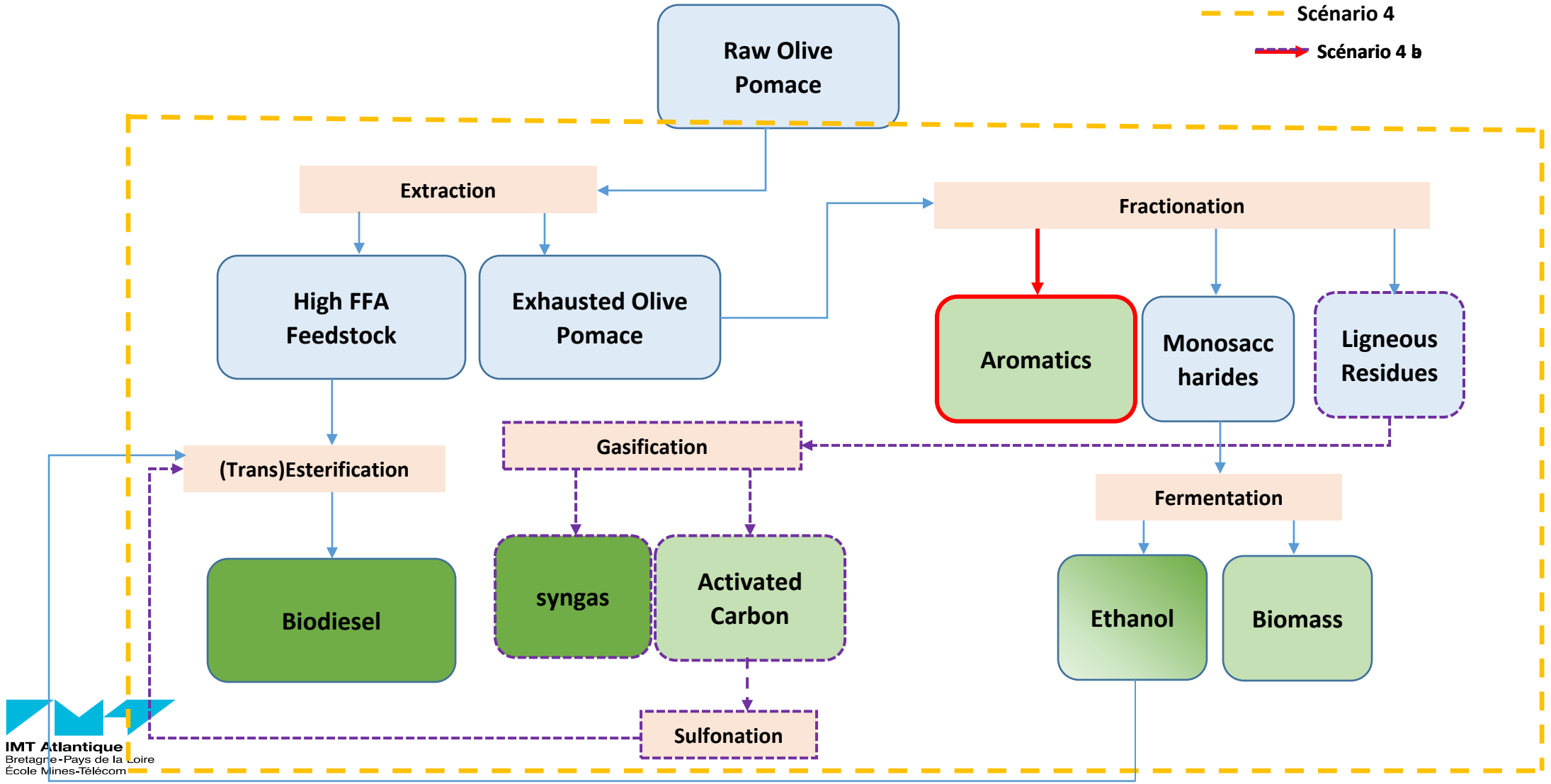
VALORIZATION PATHWAYS

Scenario 3



VALORIZATION PATHWAYS

Scenario 4



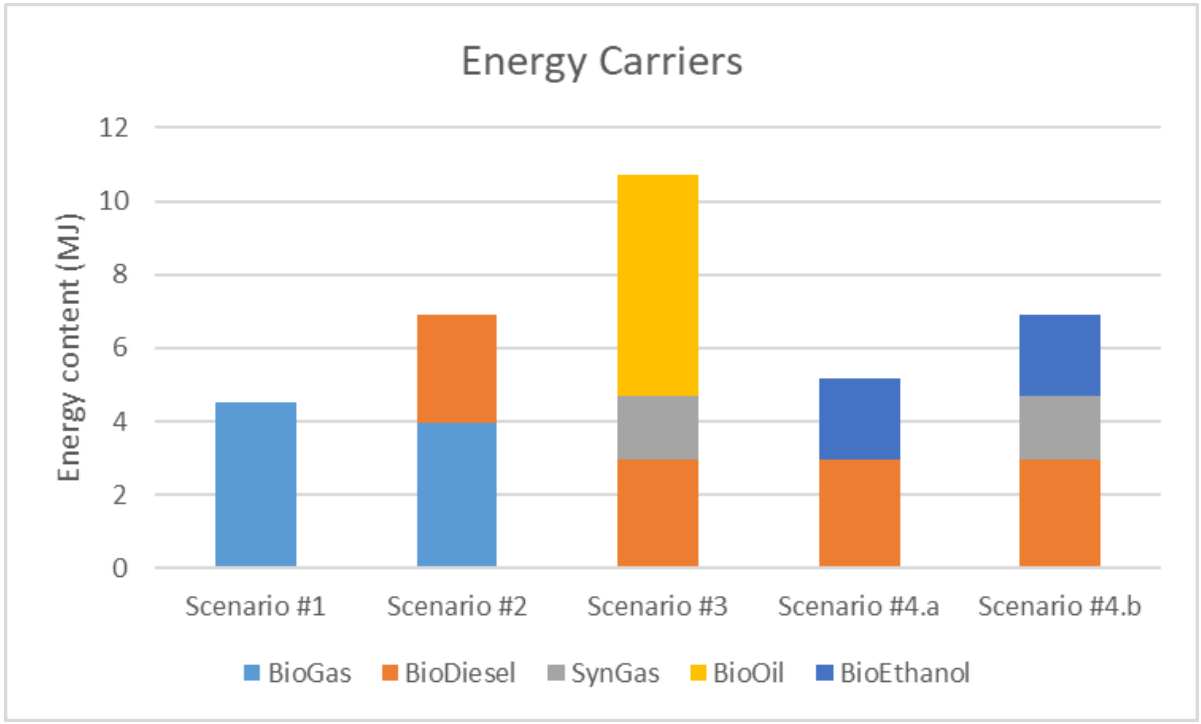
VALORIZATION PATHWAYS

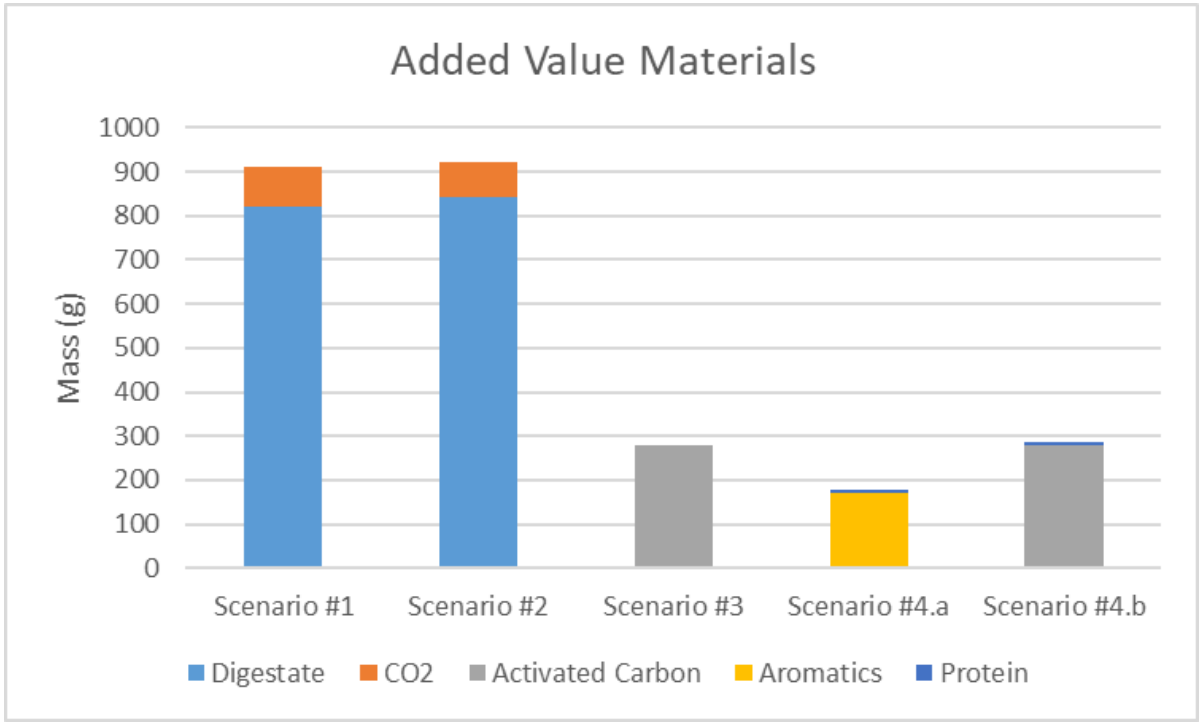
Comparison of different pathways

Energy and mass balances based on 1 kg of Raw olive Pomace (19 MJ/kg)

Scenario#1: Anaerobic Digestion
Scenario#2: Anaerobic Digestion + Transesterification
Scenario#3: Pyrogasification + Transesterification

Scenario#4.a: Hydrothermal fractionation + Ethylic fermentation + Transesterification
Scenario#4.b: Hydrothermal fractionation & carbonisation + Ethylic fermentation + Transesterification





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PALM OIL BY-PRODUCTS

2nd Generation bioethanol production from Palm oil by-products

- 60% carbohydrates
- No Lipids

Based on the earlier study and on the Indonesian biofuel market need the scenario #4 is the most Appropriate i.e.

Hydrothrmal fractionation followed by fermentation

Objectives:

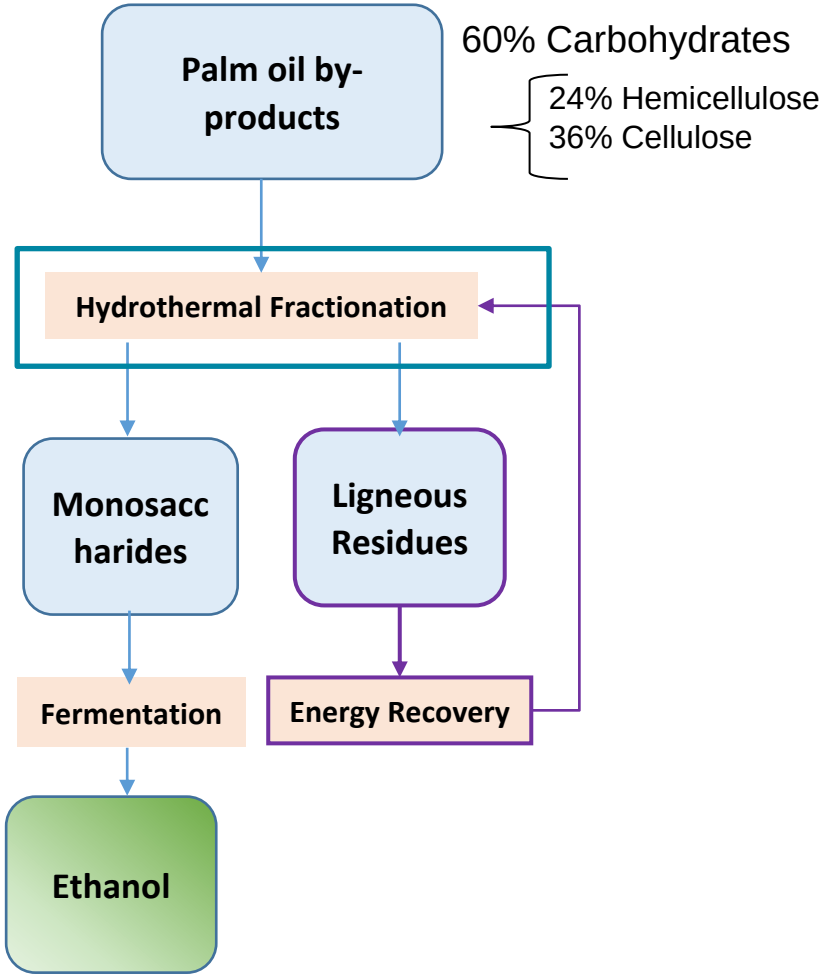
Comparing different hydrothermal fractionation pathways

Drawing technoeconomic viability of the process on a representative industrial scale based

Comparison with Enzymatic fractionation pathway

PALM OIL BYPRODUCTS

Main results



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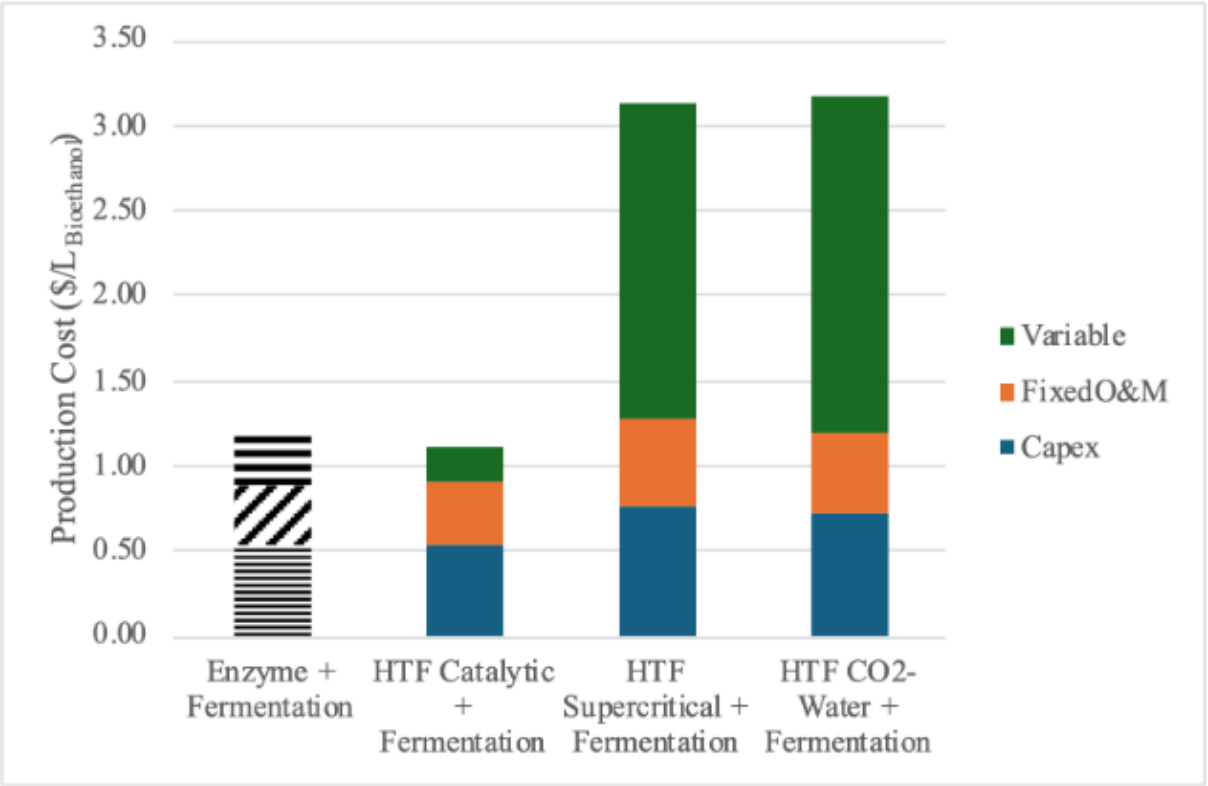
50 000 L bioethanol capacity plant

3 different hydrothermal fractionnation pathways

Excess heat selling price was not considered



OLEAGINOUS MICROALGAE STRAIN

3rd Generation Sustainable Aviation Fuel from microalgae (COCPIT Project)

To know more about COCPIT Project please visit our website

https://www.cocpit-horizon.eu/

Thank you For your attention!

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