

*Investigación en **sostenibilidad** y
Economía **Circular** desde la ingeniería*



Instituto Universitario de Investigación
en Ingeniería de Aragón
Universidad Zaragoza

I3A: Aragon Institute for Engineering Research
Instituto de Investigación en Ingeniería de Aragón

Research in sustainability and **Circular Economy** from engineering

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I3A of the University of Zaragoza



Universidad
Zaragoza



Placed at Campus Río Ebro (Zaragoza) next to the Engineering and Architecture Faculty (EINA)

OUR OBJECTIVES:

- The promotion of **scientific research** related to diverse fields of engineering.
- Contribute to economic development by **technology transfer** to the industrial sector.
- Support of high qualification **education**, at postgraduate and doctoral level.
- The **dissemination** of science and technology in society.

Research divisions

Research structured into 4 strategic research divisions

ICT Division

Technologies for the knowledge society

Processes & Recycling Division

Engineering to improve the environment

Industrial Technologies Division

Technologies for the factories of the future

Biomedical Engineering Division

Engineering techniques for the improvement of health



Processes & Recycling research areas



Processes & Recycling Division

Engineering to improve the environment

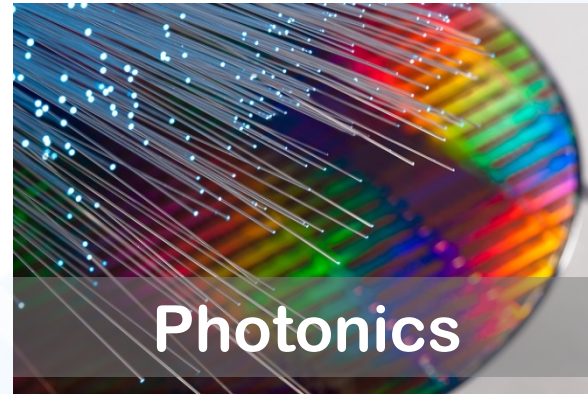
Leitmotive

- ▶ Energy and environment
- ▶ Hydrogen technologies
- ▶ Recycling and waste valorization
- ▶ Packaging, food quality and safety
- ▶ Agro-food technologies

Circular Economy Lab

Cutting-edge Labs

Home Appliance
Technologies



Circular Economy Lab

Since 2020



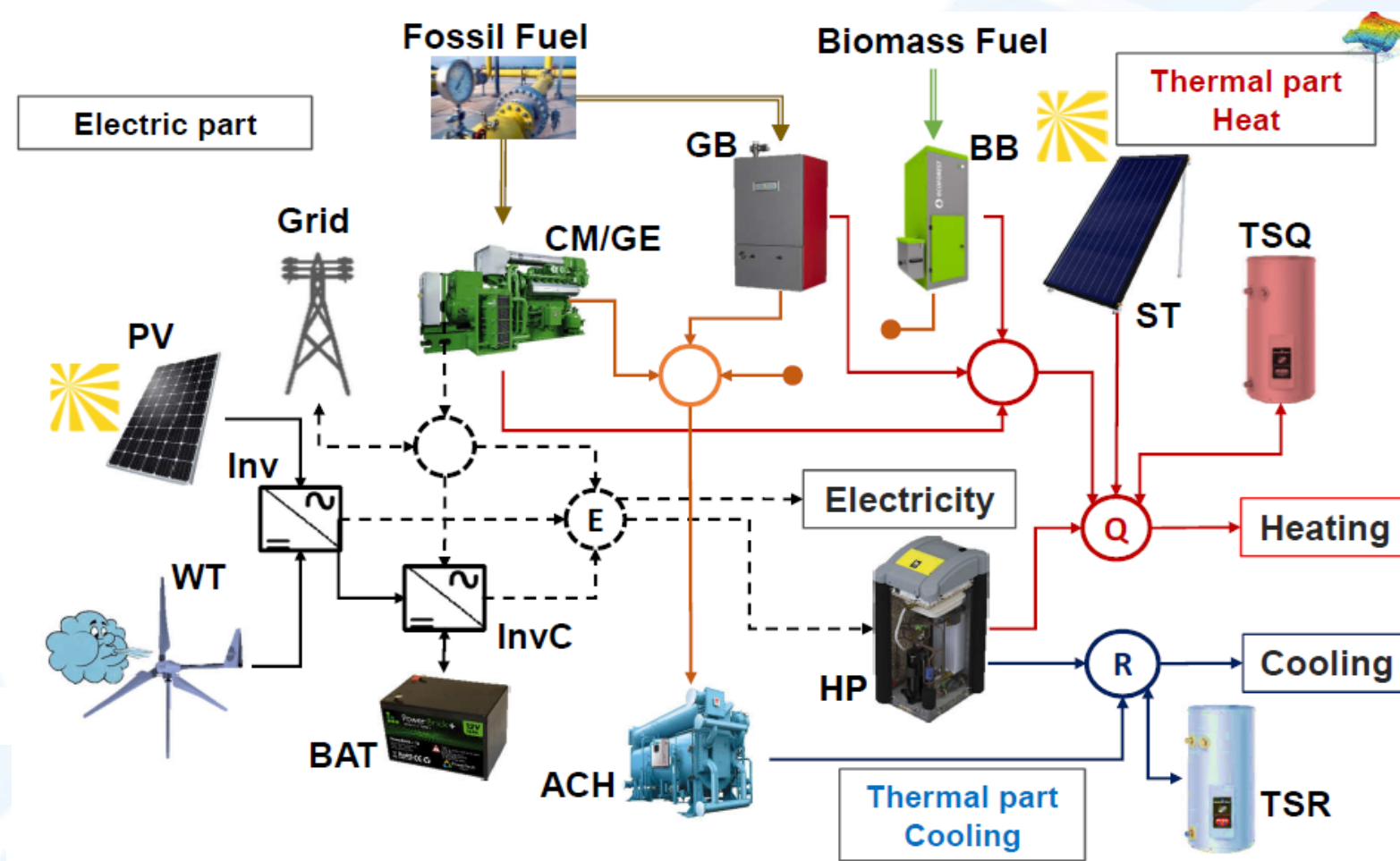
- **Energy and Environment**
 - Sustainable Thermal Systems
 - Thermal Energy Efficiency
- **Hydrogen Technologies**
 - Hydrogen as energy vector
 - e-Fuels: Power to Gas & Power to Liquids
- **Recycling and waste valorization**
 - Biogas upgrading/exploitation
 - Biofuels from wastes (liquid, solid and gas)...
- **Packaging, food quality and safety**
 - Active packaging from renewable sources
- **Agro & food technologies**
 - Green chemistry from agro



Image: European Parliament

- **Key enabling technologies (KETs)**
 - Internet of things (IoT)
 - Geospatial infrastructures, Agro-logistics

Sustainable Thermal Systems



Technologies

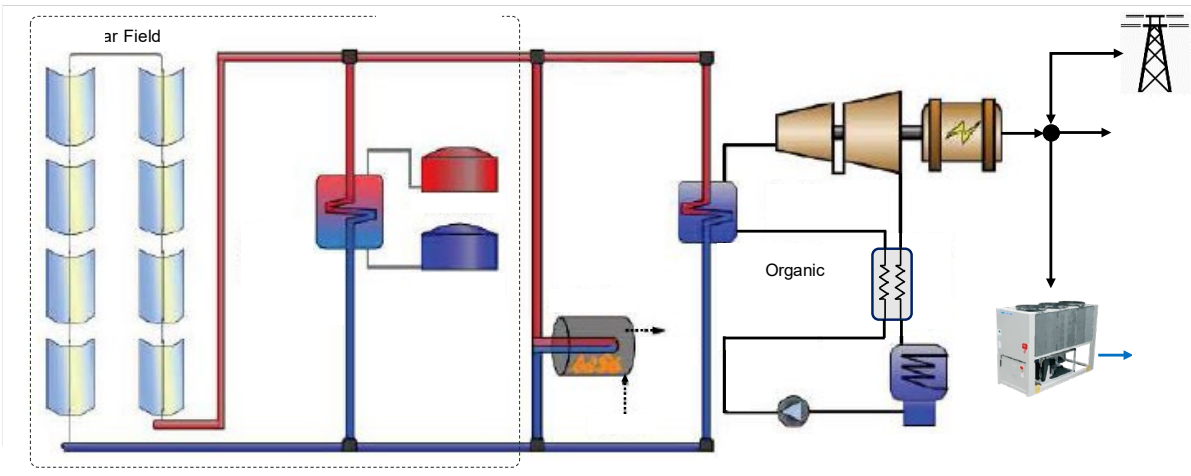
POLYGENERATION

SOLAR
(THERMAL, PV)

THERMOCHEMICAL
STORAGE (PCM)

HVAC

Thermal Energy Efficiency

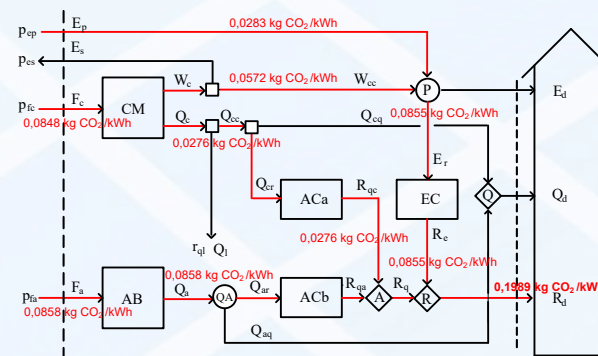


Technologies

DESIGN

MODELING

ASSESSMENT



ABENGOA



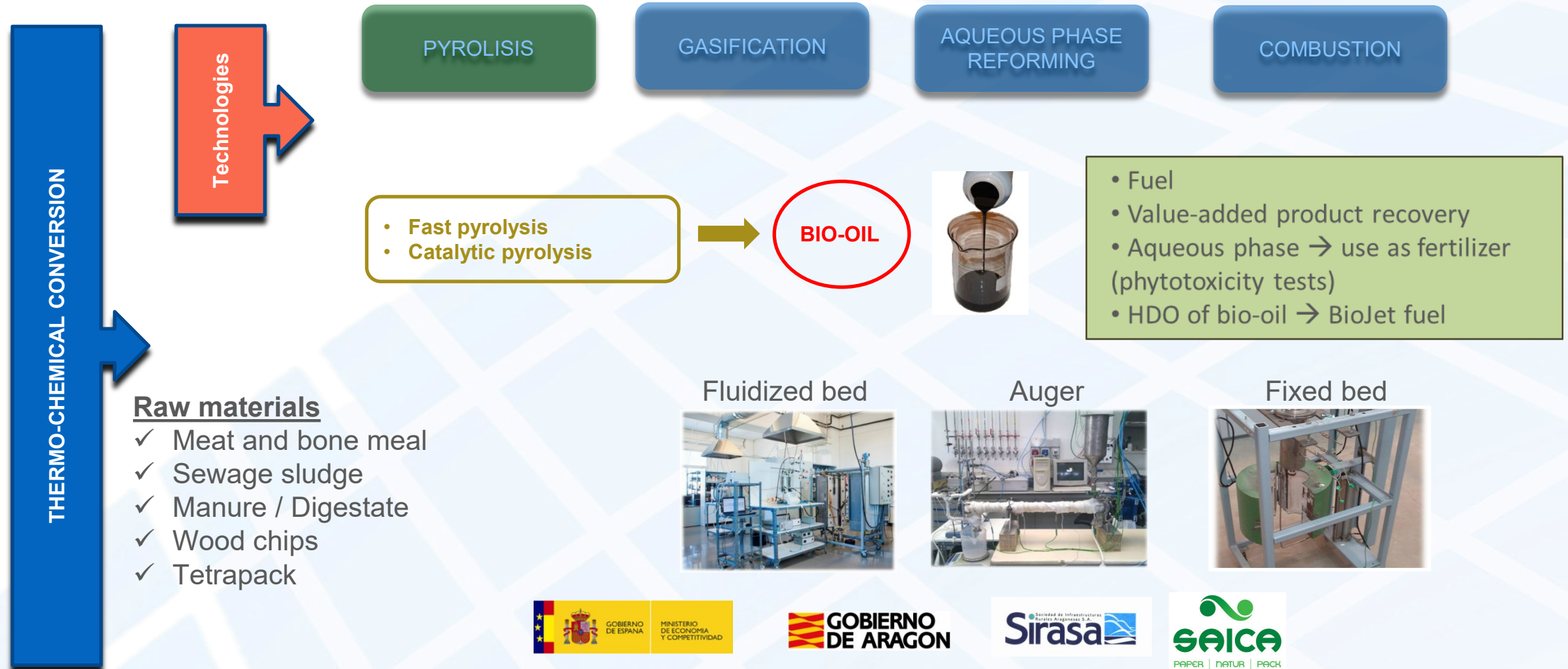
B/S/H/
POSC- AND SIMPLIS HOME APPLIANCE GROUP



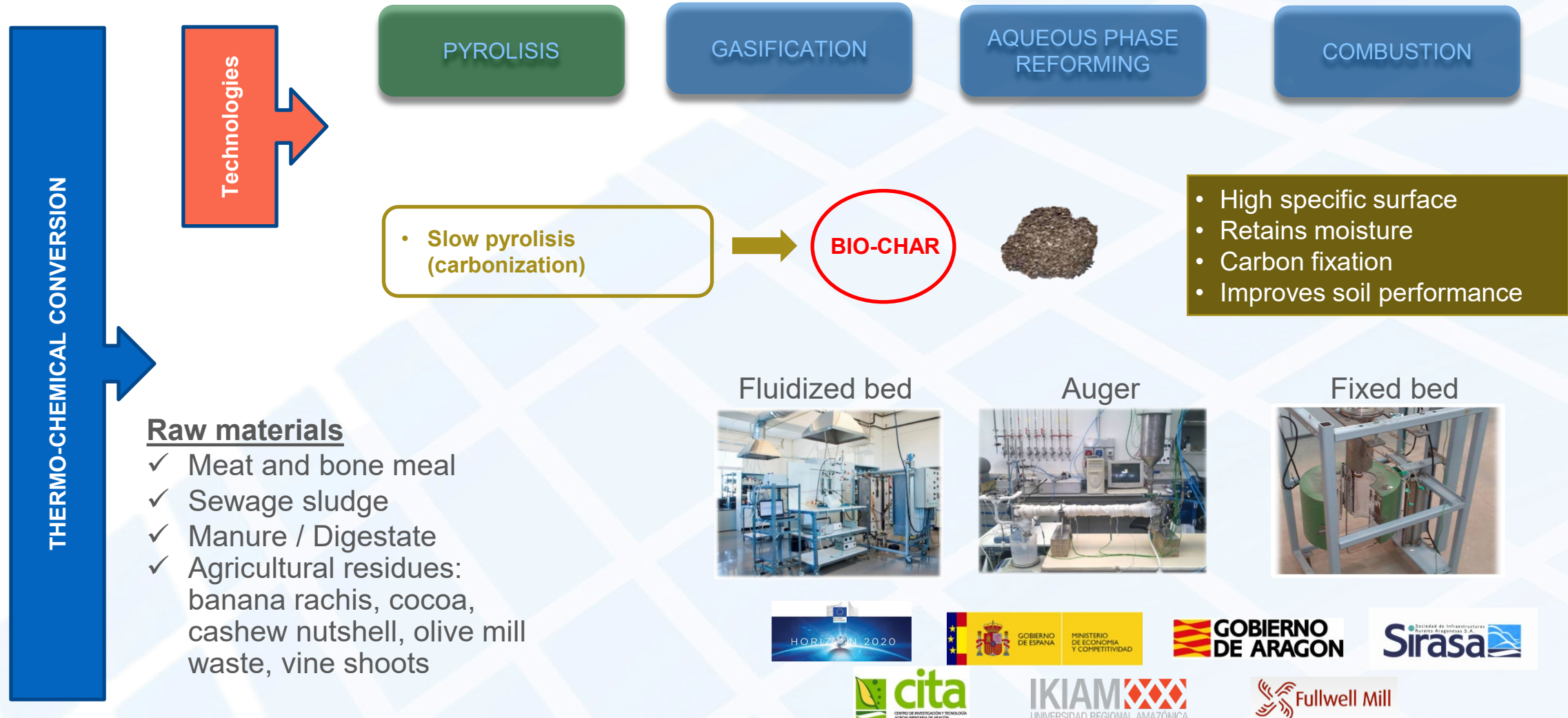
Biofuels from wastes (I)



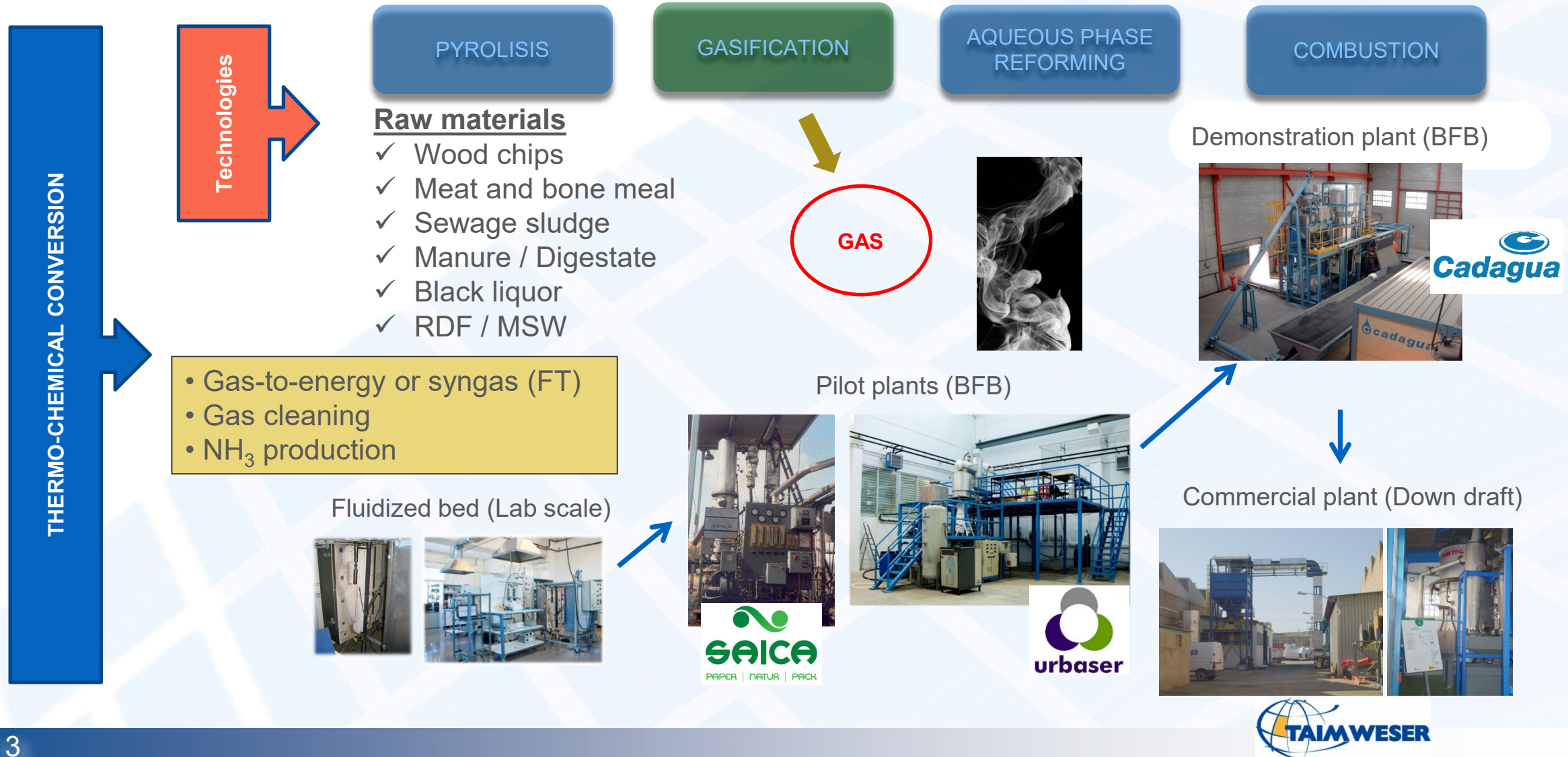
Biofuels from wastes (II)



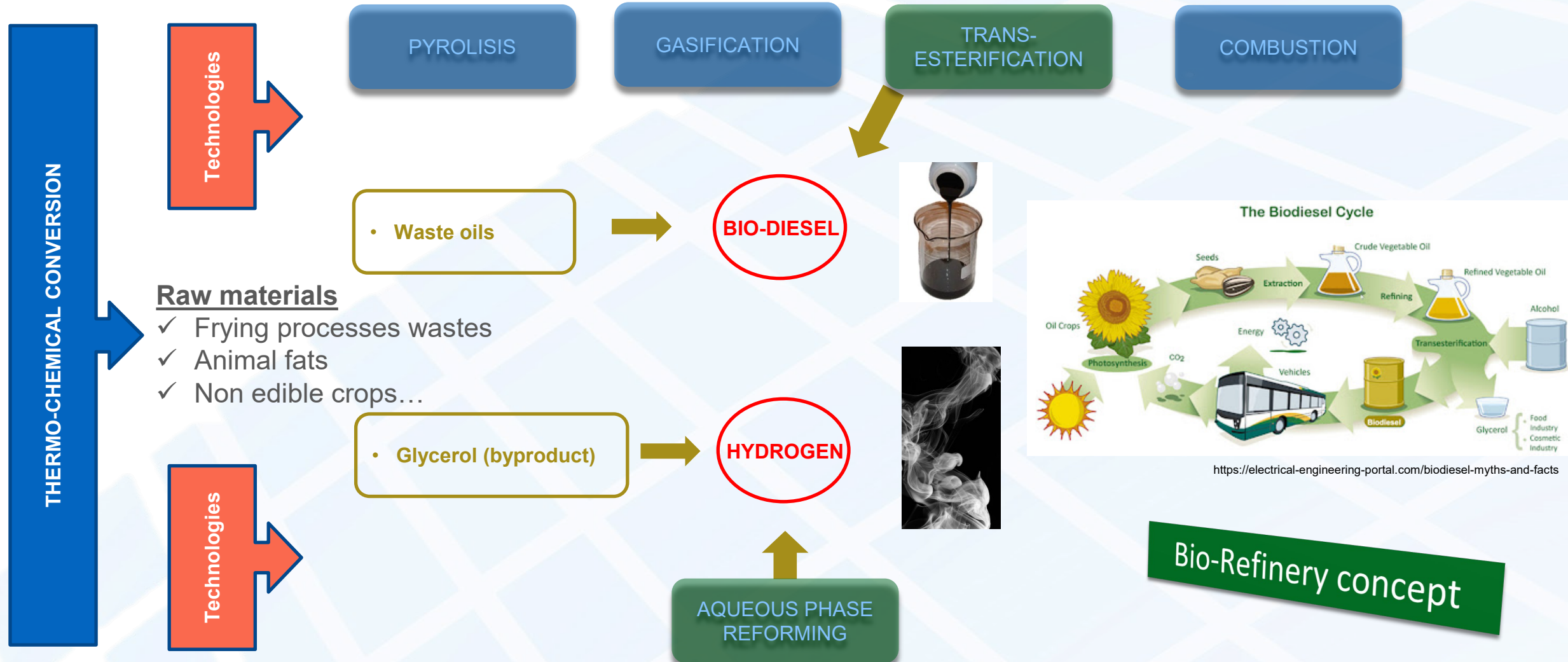
Biofuels from wastes (III)



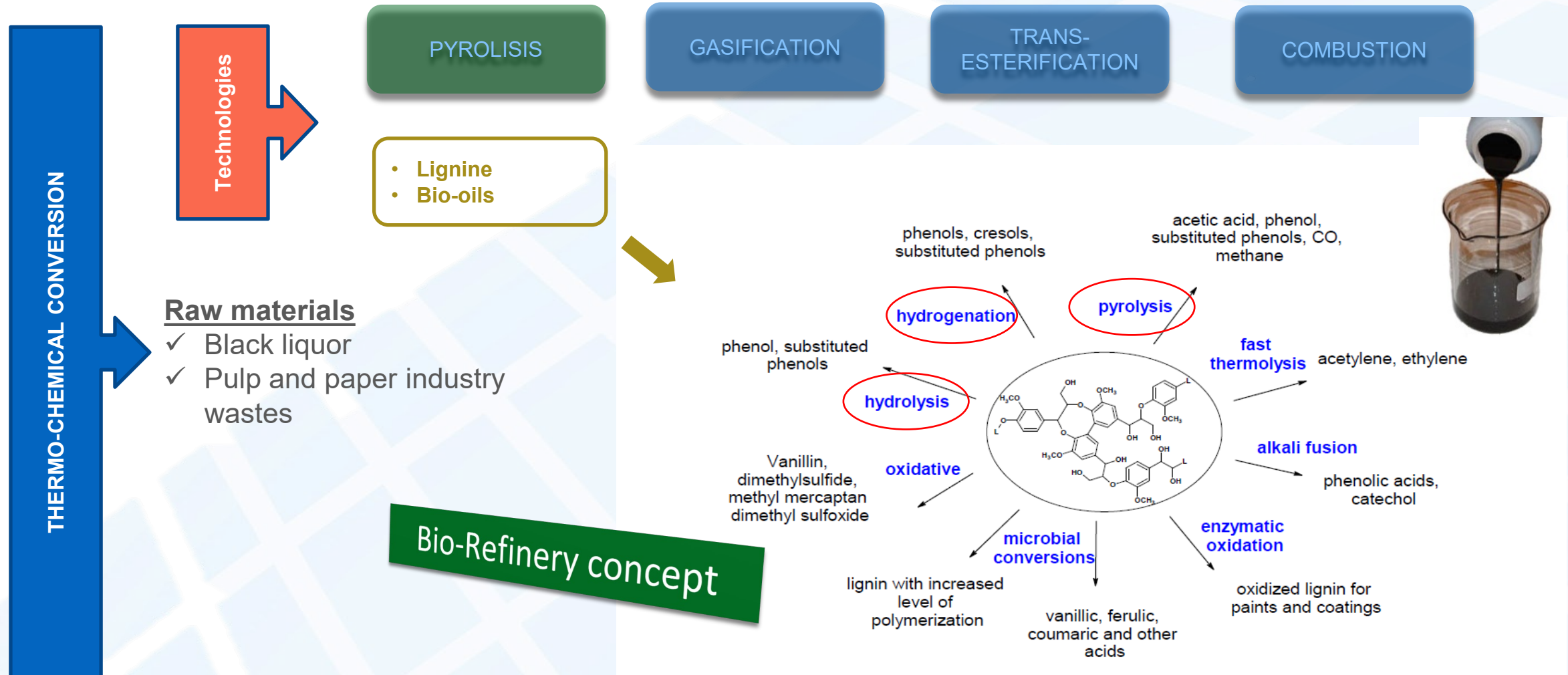
Biofuels from wastes (IV)



Biofuels from wastes (V)



Added value products from wastes





Catalysis and Reactor
Engineering Group

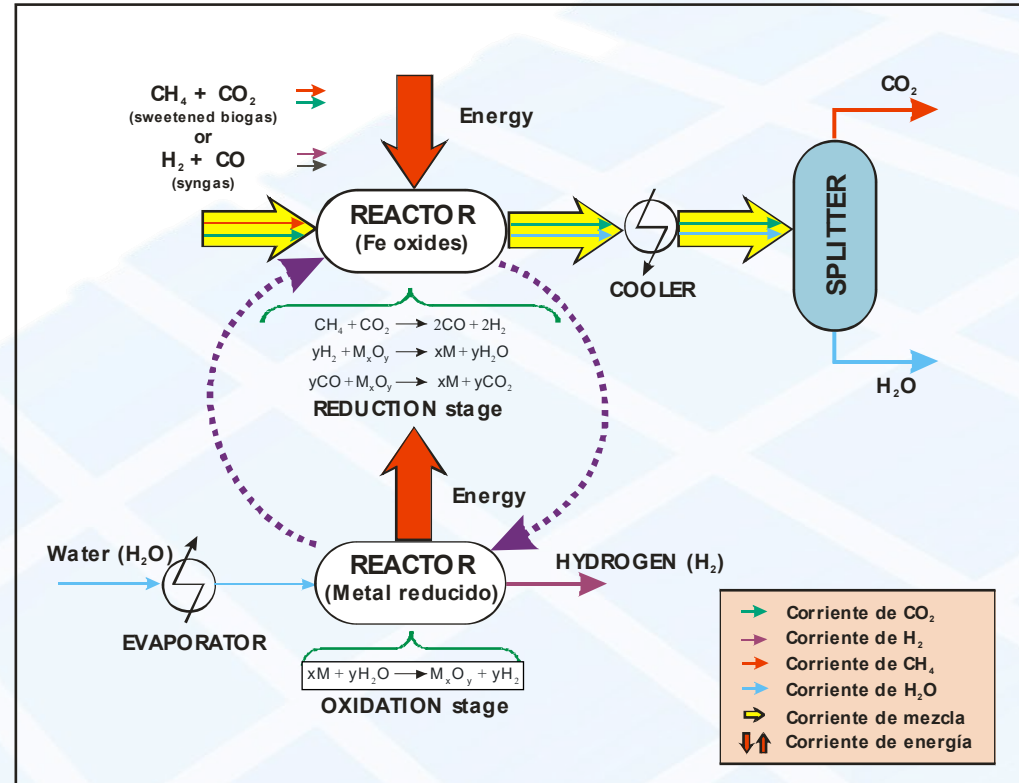
Technologies

STEAM IRON -
CHEMICAL LOOPING

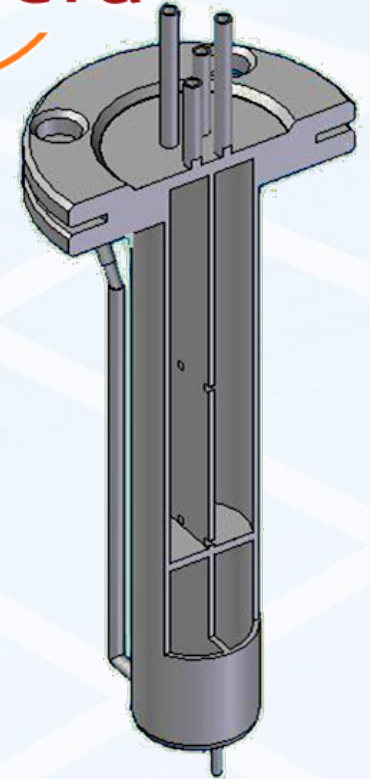
Raw materials

- ✓ Biogas
- ✓ Bioil
- ✓ Syngas streams
- ✓ Natural gas cracking exhaust
- ✓ ... reducing streams

Hydrogen as energy vector



sphera



Inter-Connected Fluidized
Bed Reactor (ICFBR)

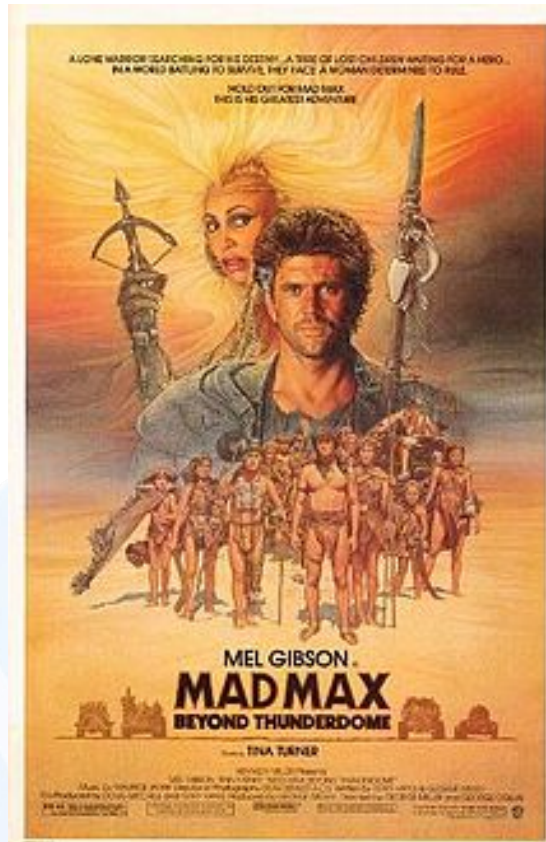
- High purity H_2 (>99.99 v%)
- CO_2 sequestration
- Auto-thermal

Naturgy

Biogas upgrading/exploitation

“Mad Max beyond Thunderdome”

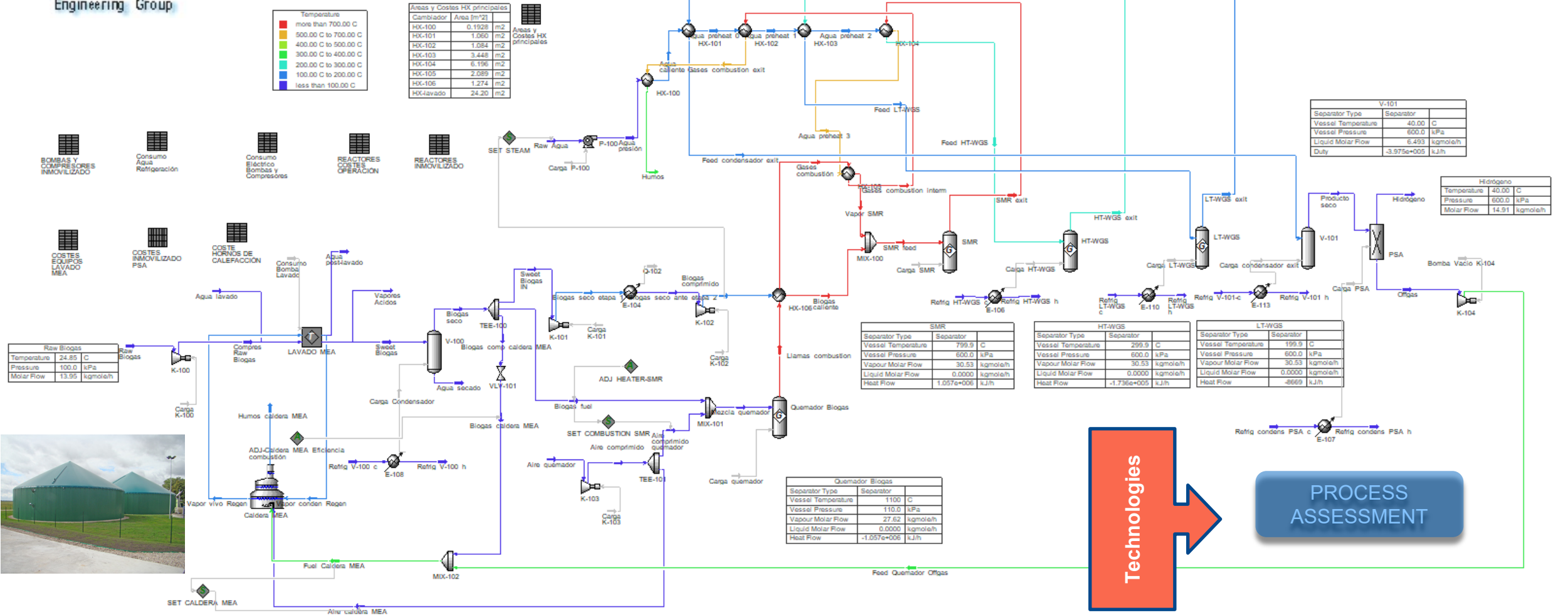
- Action movie of **1985**
- Australian post-apocalyptic film
- Directed by George Miller and George Ogilvie,
- Starring **Mel Gibson** and **Tina Turner**



After an apocalyptic war, traditional energy sources have run out. (post peak-oil premonition?)

“...In Bartertown, electricity, vehicles, functioning technology are made possible by a crude methane refinery, fueled by pig feces...”

Biogas upgrading/exploitation



e-Fuels: Power to Gas

Power-to-Gas

Power-to-Gas (P2G or PtG) is an alternative technology that converts **electrical power** to a **gas fuel**

SNG
(Synthetic Natural Gas)

2

**Methanation
catalytic reactor**

0

1

Electrolyzer

O₂

3

**Natural gas
distribution system**

SNG

Technologies

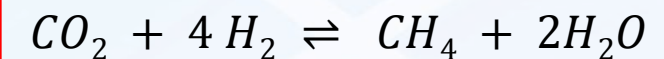
METHANATION

Wind or solar farm produces more energy than needed due to low demand

Excess electricity generated is funnelled into electrolyzers that split water into H₂ and O₂

H₂ produced is combined with CO₂ (biogas) and converted to CH₄ (*Sabatier reaction*)

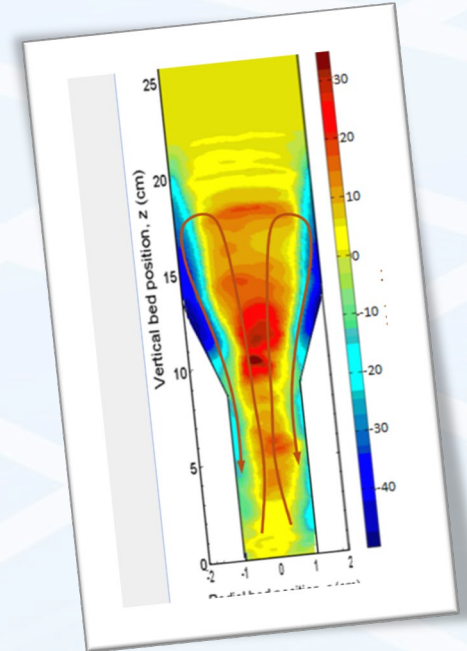
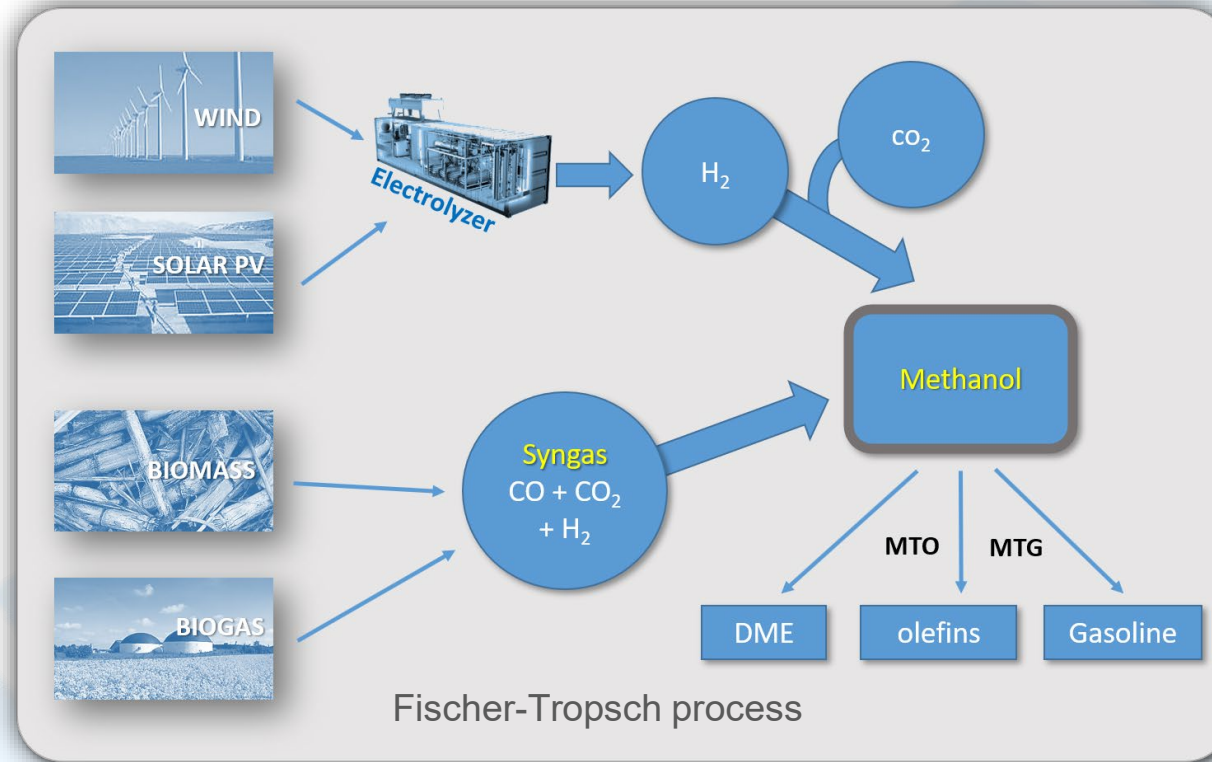
CH₄ is injected directly into the existing gas network (controlling its composition) and mixed with natural gas as a form of indirect energy storage



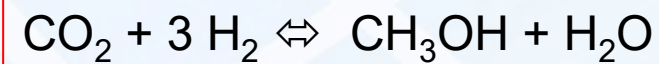
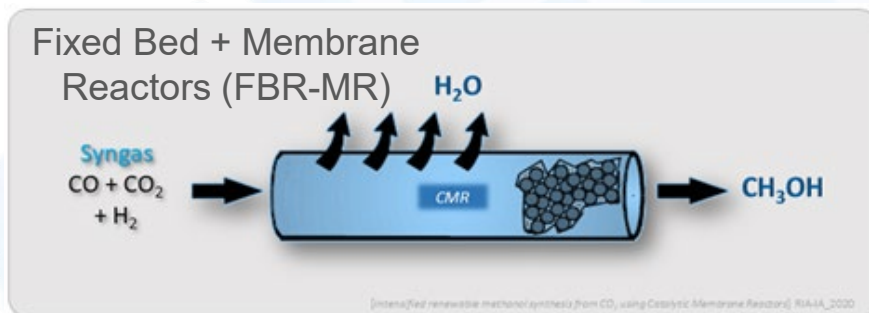
e-Fuels: Power to Liquids

Raw materials

- ✓ Renewable energy
- ✓ Sequestered CO₂
- ✓ Gasification gases
- ✓ Syngas
- ✓ Biogas
- ✓ ...

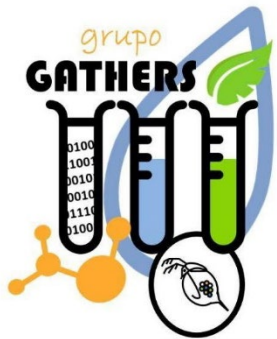


Fluidized Bed + Membrane Reactors (FLBR-MR)

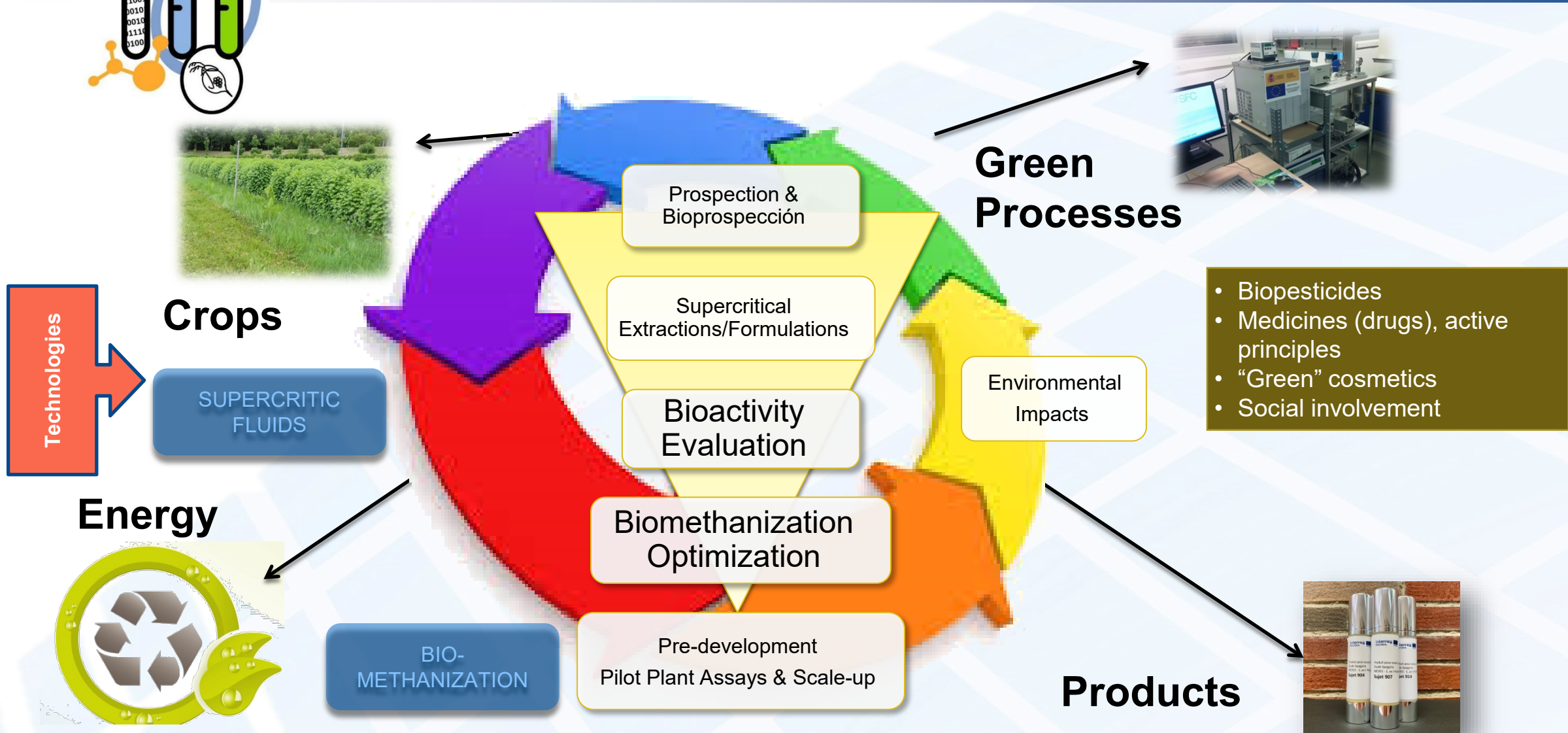


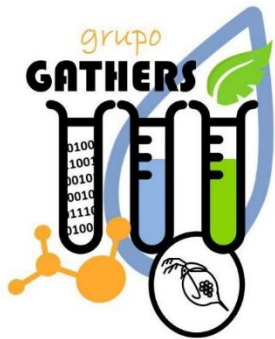
Technologies

HYDROGENATION



Green chemistry from Agro





Green chemistry from Agro

Another Dimension of Research



**Universidad
Zaragoza**



**Research
Centers**



**Ayuntamiento
de Huesca**



**Territorial
Administration**

**Special
Employment
Centers**

**Collaborating
Institutions:**



**Interreg
POCTEFA**



Agro-food sust. active Packaging

Raw materials

- ✓ Wood
- ✓ Non edible crops
- ✓ Agricultural residues



Wood



Annual
crops



Agricultural
residues

- Natural cellulose nanofibers
- High tensile strength
- Antimicrobial coatings
- Antioxidant properties

Technologies

Renewable,
degradable and
sustainable



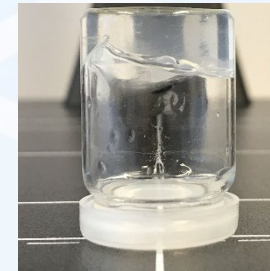
Semi-soft cow's raw
milk cheese

ACTIVE
PACKAGING PROD.

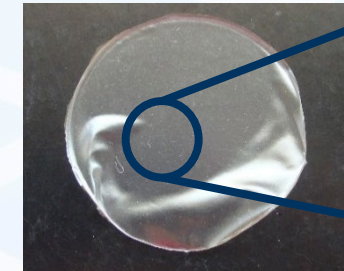
Polyoxometalates
(POMs)
(trans. Mo,W,V,Nb,Ta)

Antimicrobial compound
(e.g. Listeria)

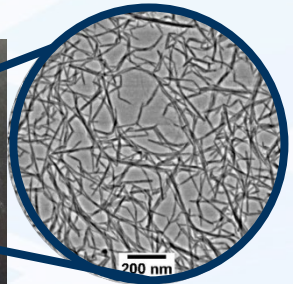
ACTIVE
PACKAGING
(CNF-LAE)



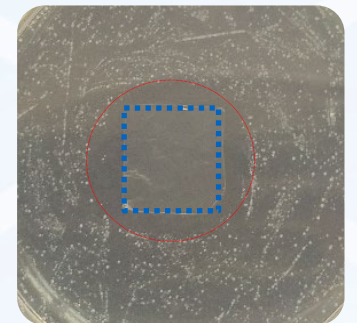
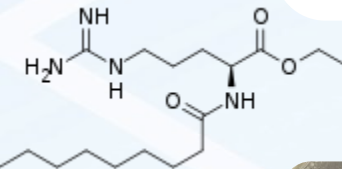
Hydrogel



Film



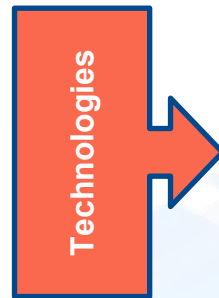
Ethyl Lauroyl arginate
(LAE)



Key Enabling Technologies

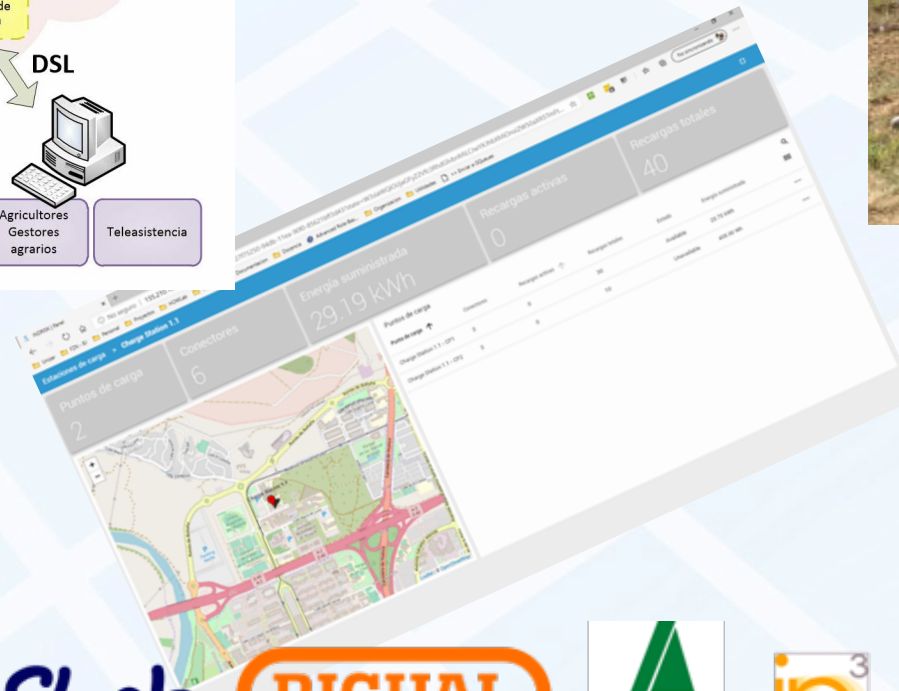
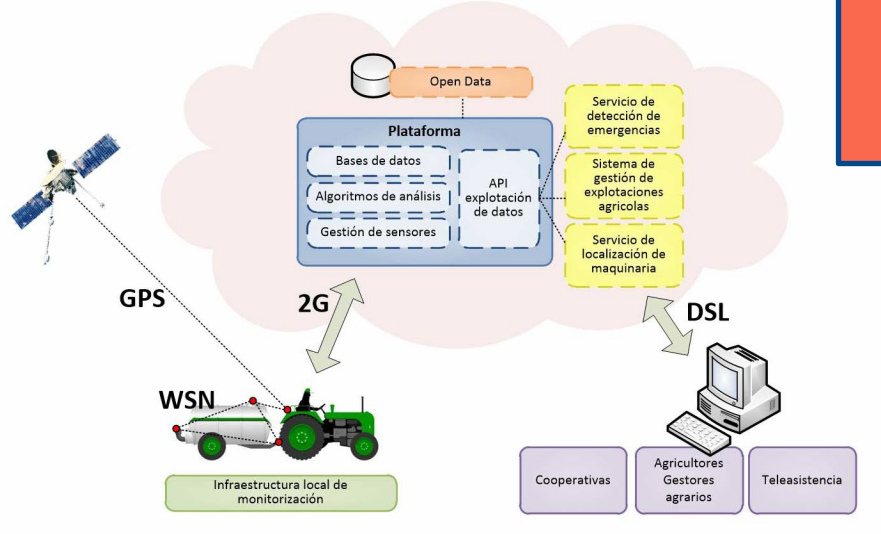


HOW
Universidad Zaragoza



IoT

GeoSpatial
Infraestructures



- Slurry and manure trazability (via GPS)
- Electric vehicle fleet management and optimization
- Optimization of fertilizers in open field (via GPS)

h2i
ANALYTICS

Signos
IoT

7eData
BUSINESS

GeoSLab

RIGUAL



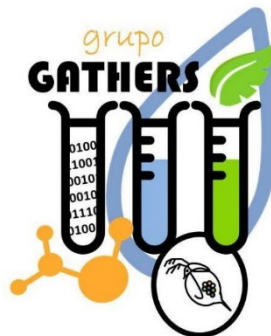
IAAA
Grupo de Sistemas de
Información Avanzados
Universidad Zaragoza



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