



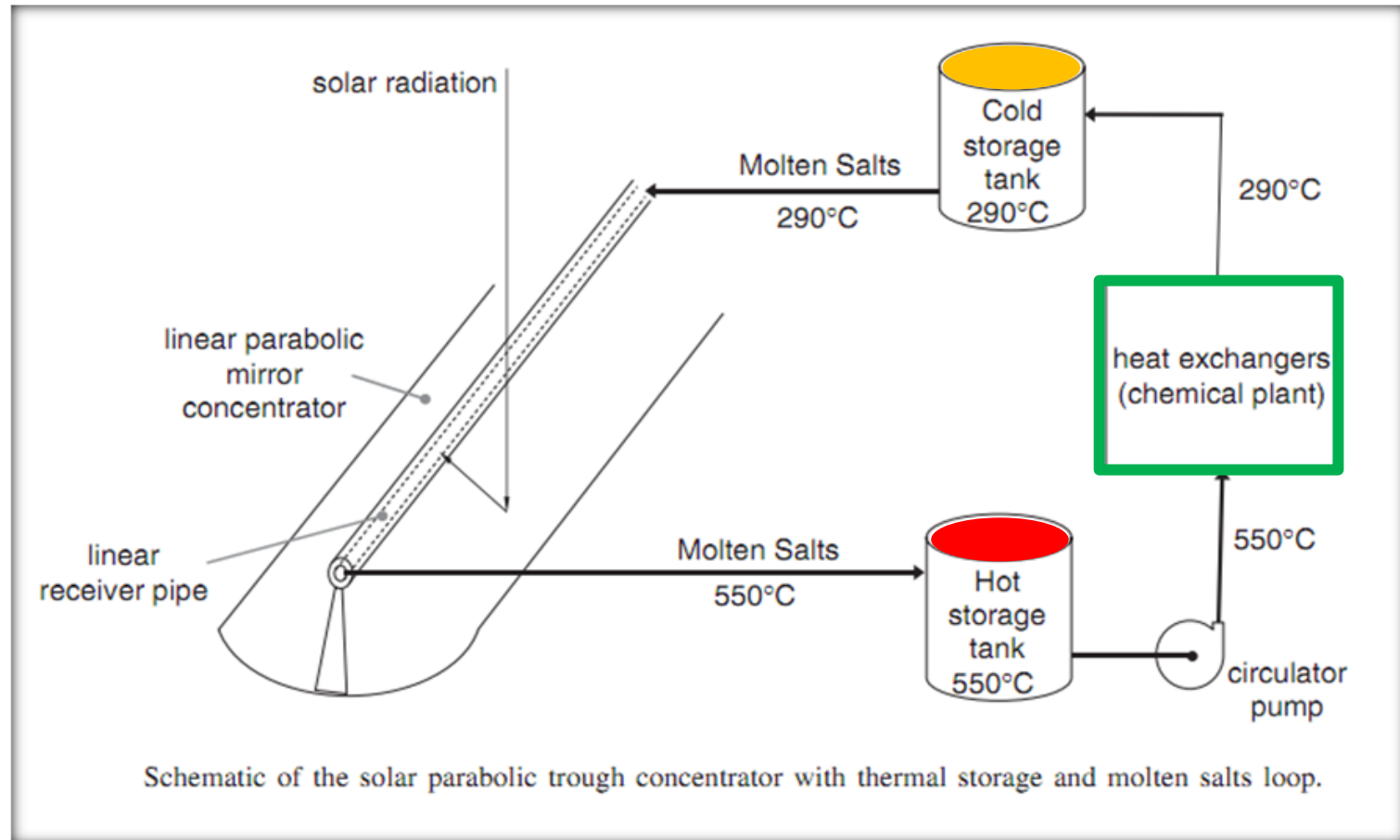
UNIVERSITÀ DEGLI STUDI DI PALERMO

DICGIM - DIPARTIMENTO DI INGEGNERIA CHIMICA, GESTIONALE, INFORMATICA, MECCANICA

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Molten salts heated in concentrated solar power plant will be studied as enthalpy source to drive chemical conversion processes for biomass valorization



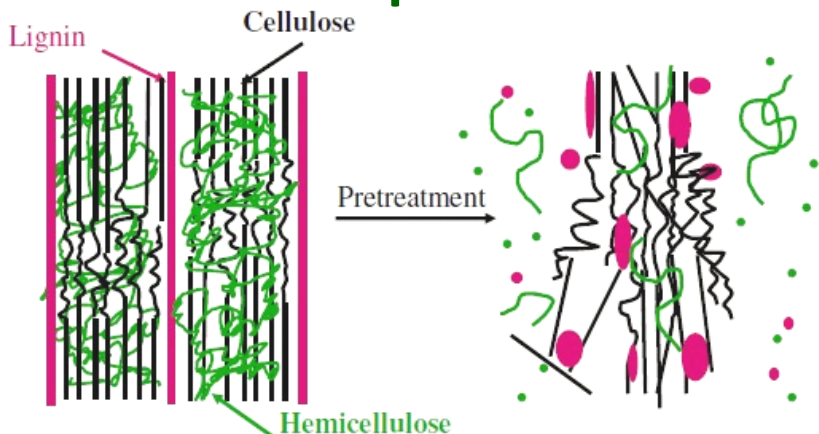
Molten salts: $\text{NaNO}_3/\text{KNO}_3$ 60/40 w/w

Temperature range: 290-550 °C



Enthalpy storage to drive chemical conversion processes

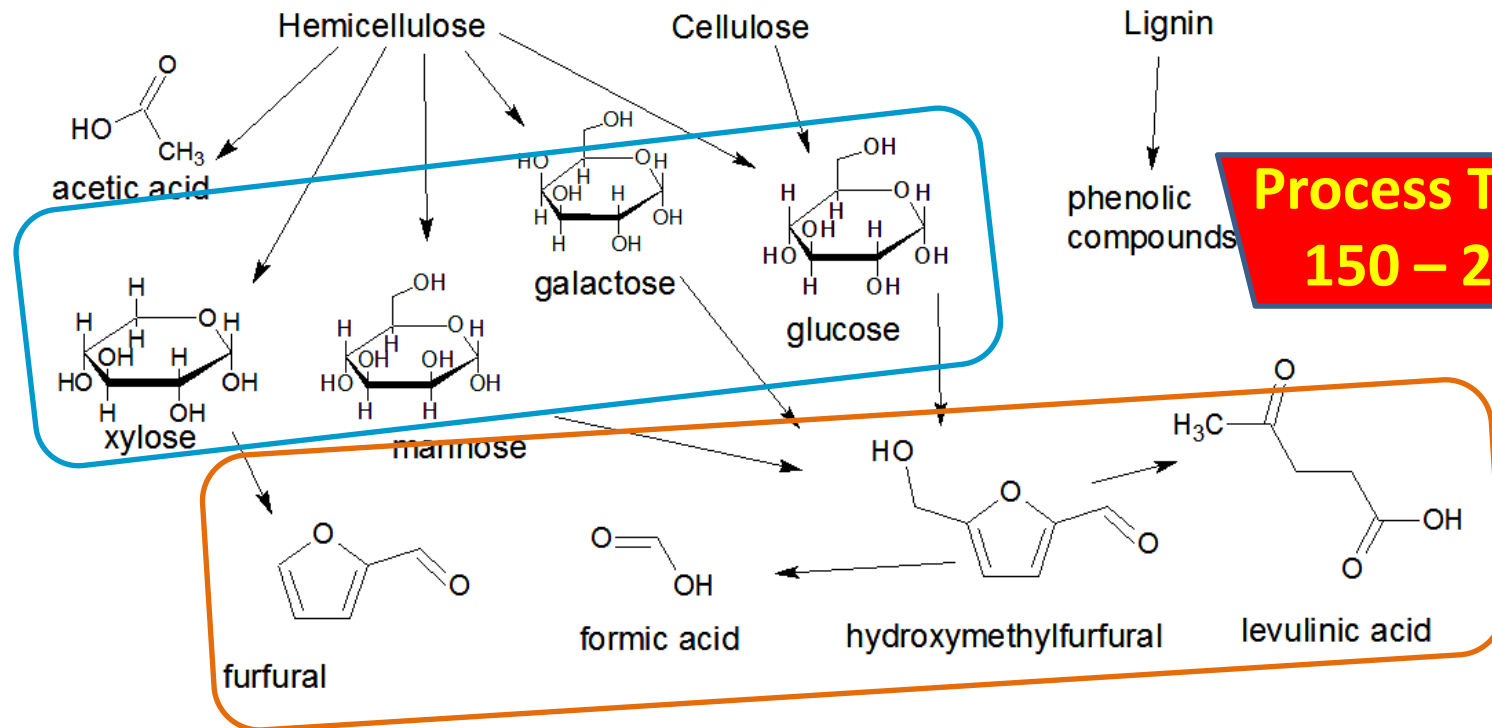
BIOREFINERY processes from LIGNOCELLULOSIC (LC) BIOMASSES



Thermochemical process with LC biomass conversion into:

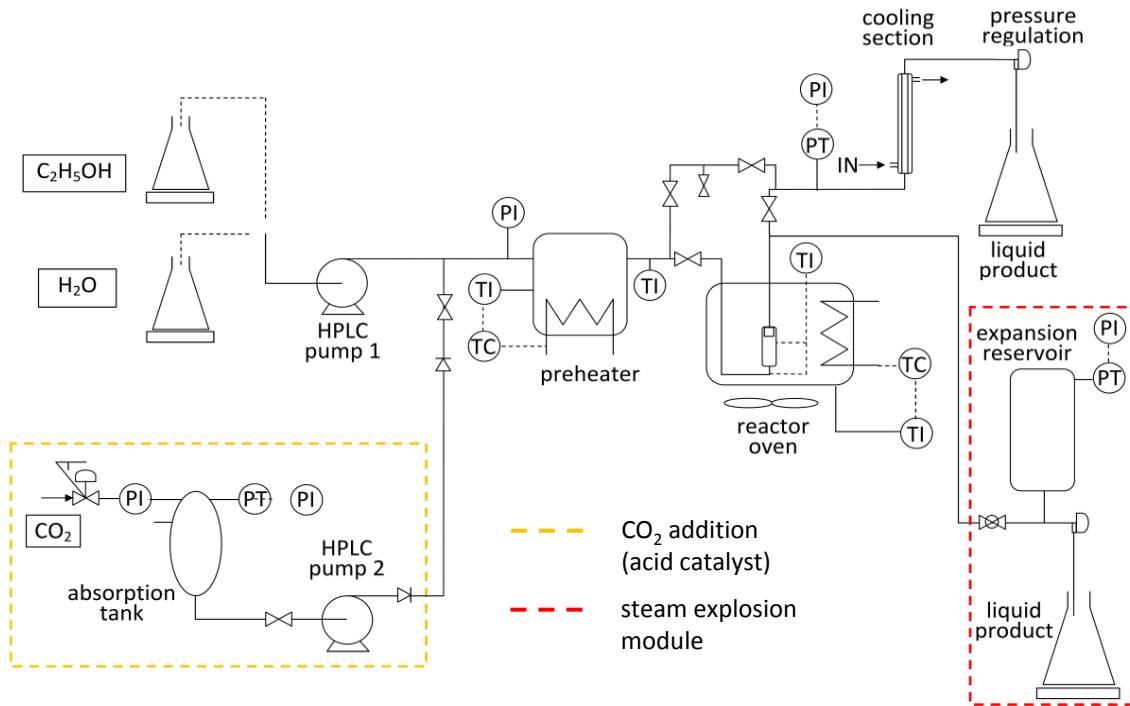
- fermentable sugars (to produce bioethanol)
- and/or
- platform chemicals

The pretreatment step is necessary to cleave the interconnections of the different biopolymers (hemicellulose, cellulose and lignin) in the matrix, to promote hydrolysis and further chemical conversion to sugars and/or platform chemicals:



Green biomass conversion

a) Lignocellulosic biomass pretreatment with compressed liquid hot water



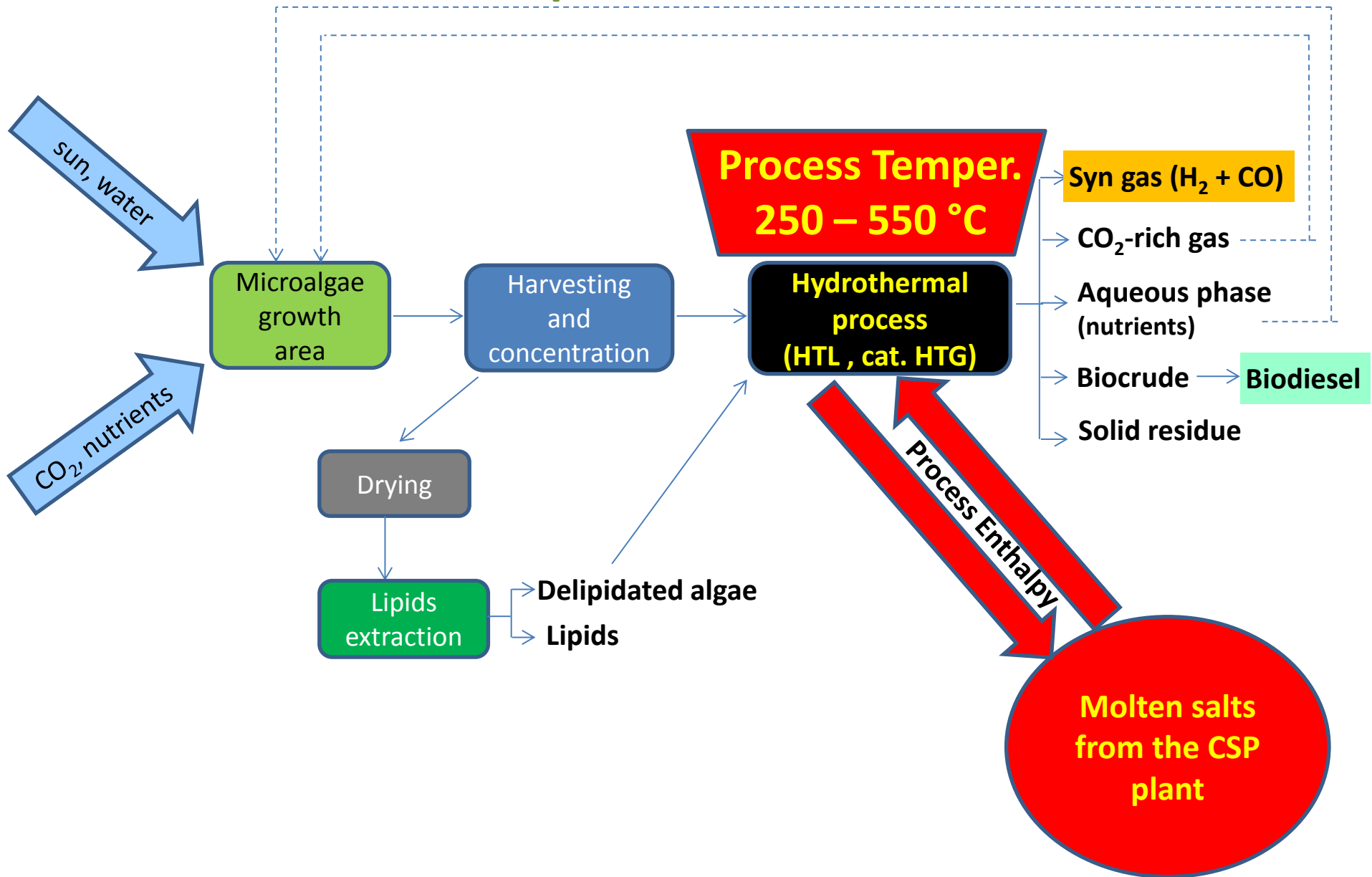
Lab-scale plant with flow-through layout



Process optimization toward:

fermentable sugars
 platform chemicals
 extractives recovery

BIOREFINERY processes from MICROALGAE

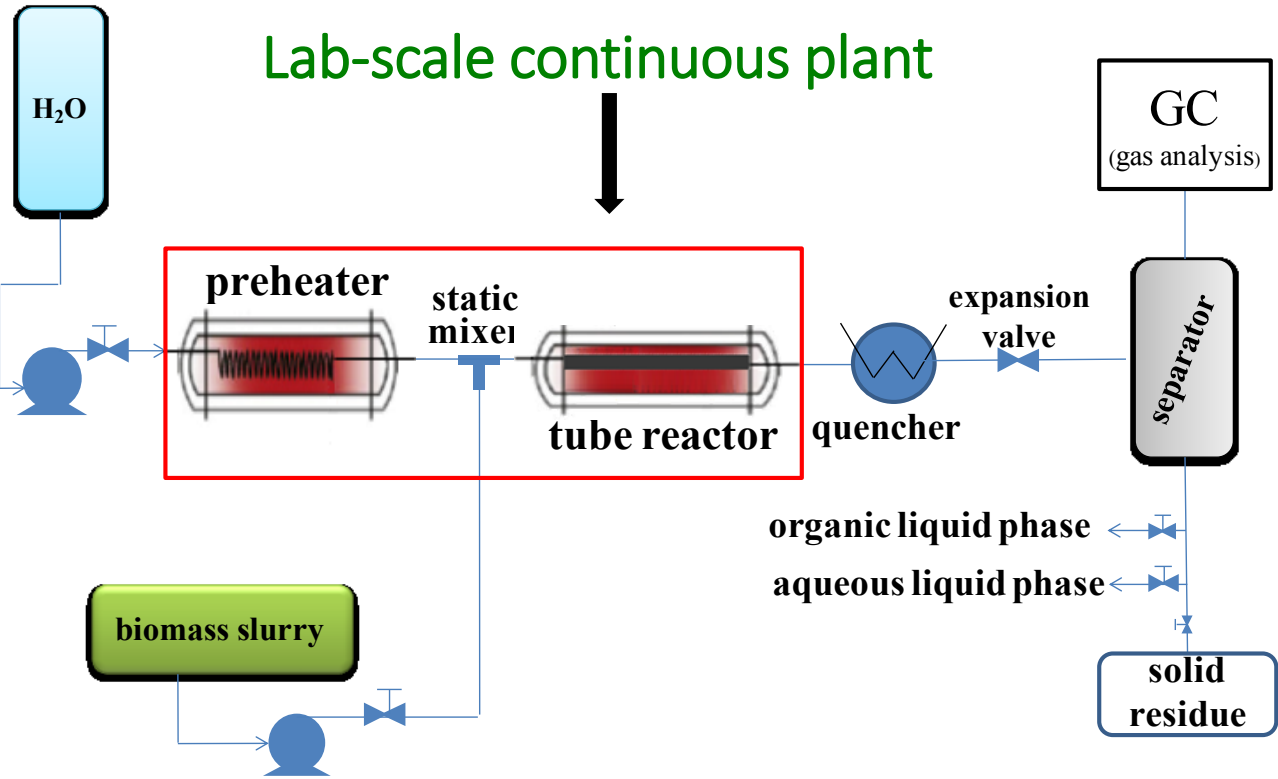


Green biomass conversion

b) Hydrothermal conversion of microalgae



Lab-scale continuous plant

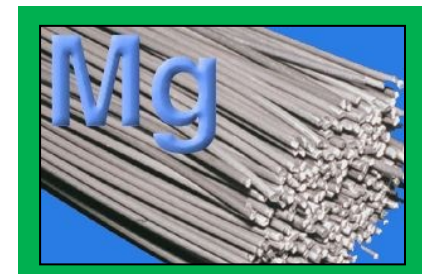
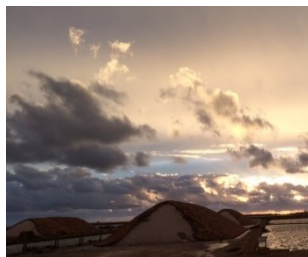
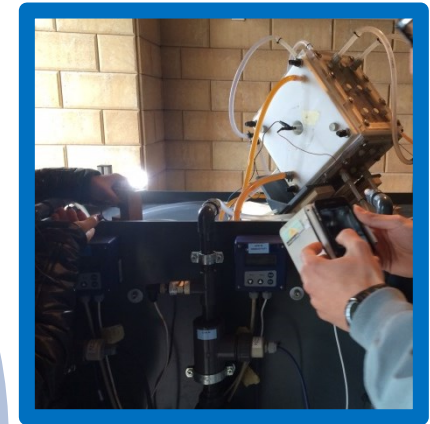
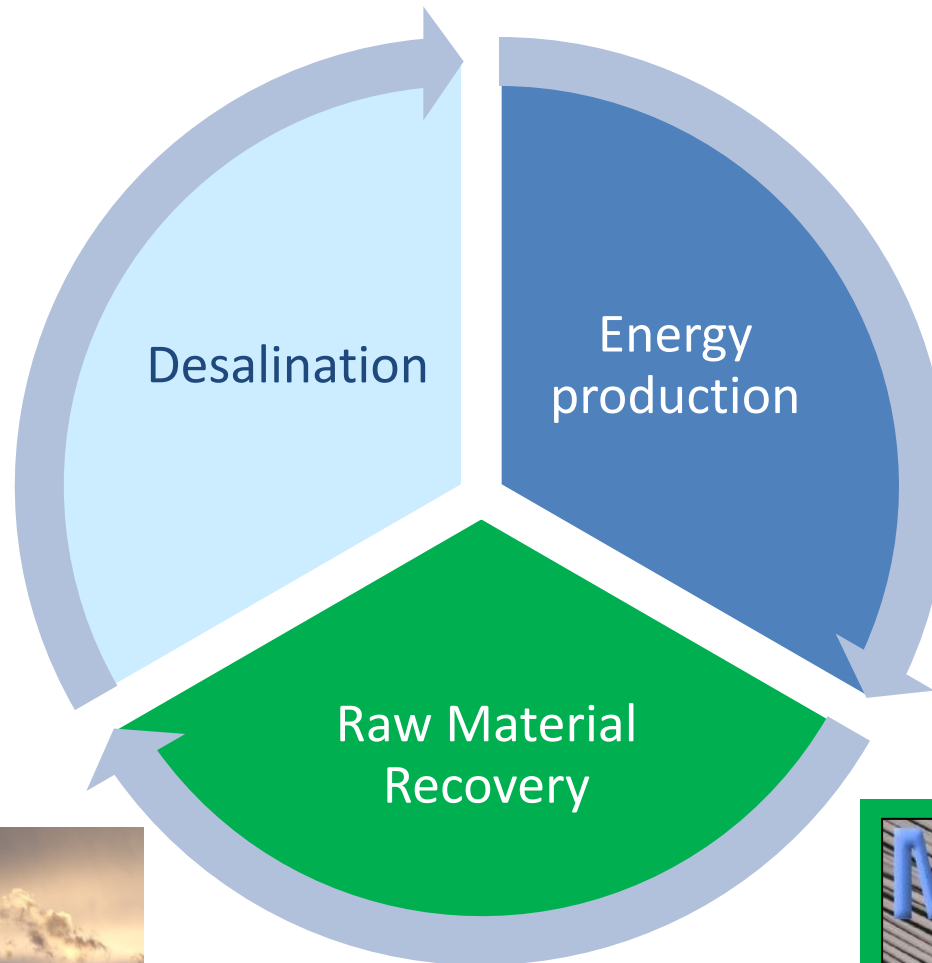


Lab-scale batch reactor

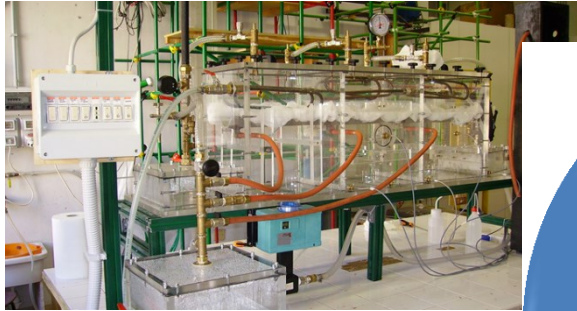


Process optimization \Rightarrow hydrothermal liquefaction (HTL) into biocrude
 \Rightarrow supercritical water gasification (SCWG) into H_2 rich gas

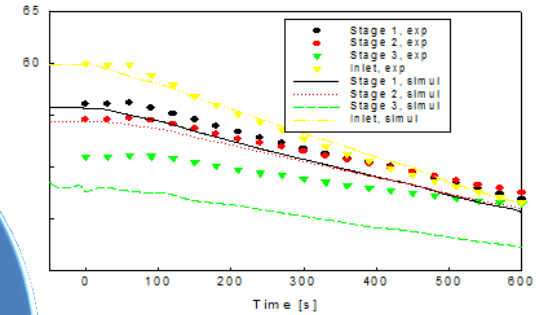
WATER TECHNOLOGY



DESALINATION

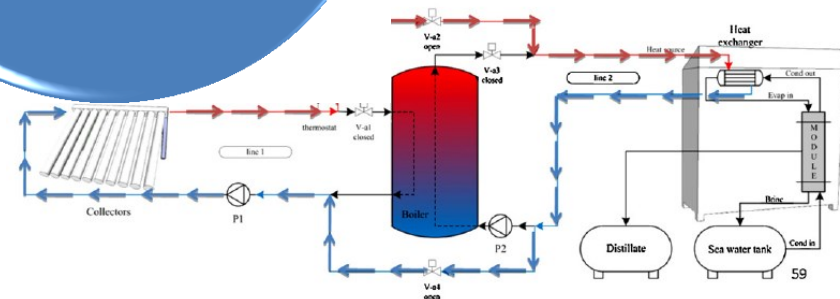
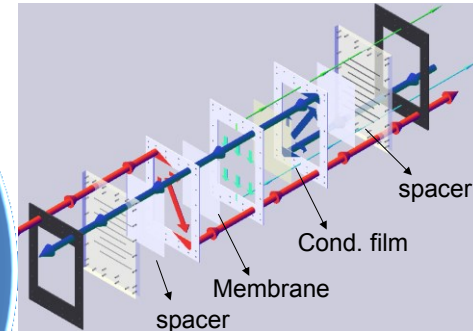


Multi Stage
Flash

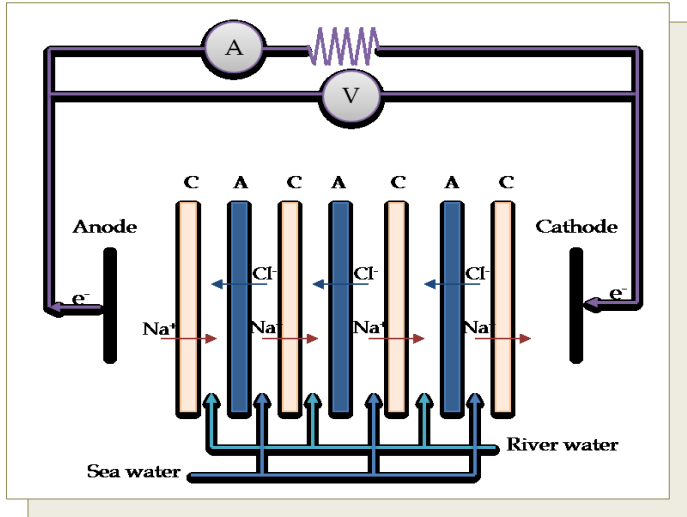


Multi Effect
Distillation

Membrane
Distillation

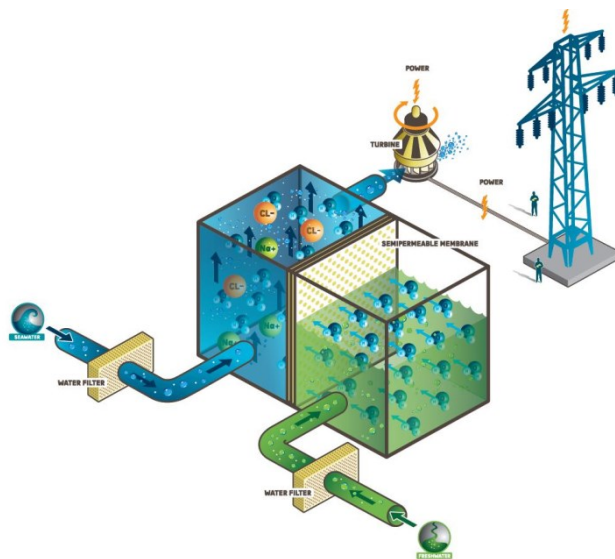


ENERGY PRODUCTION



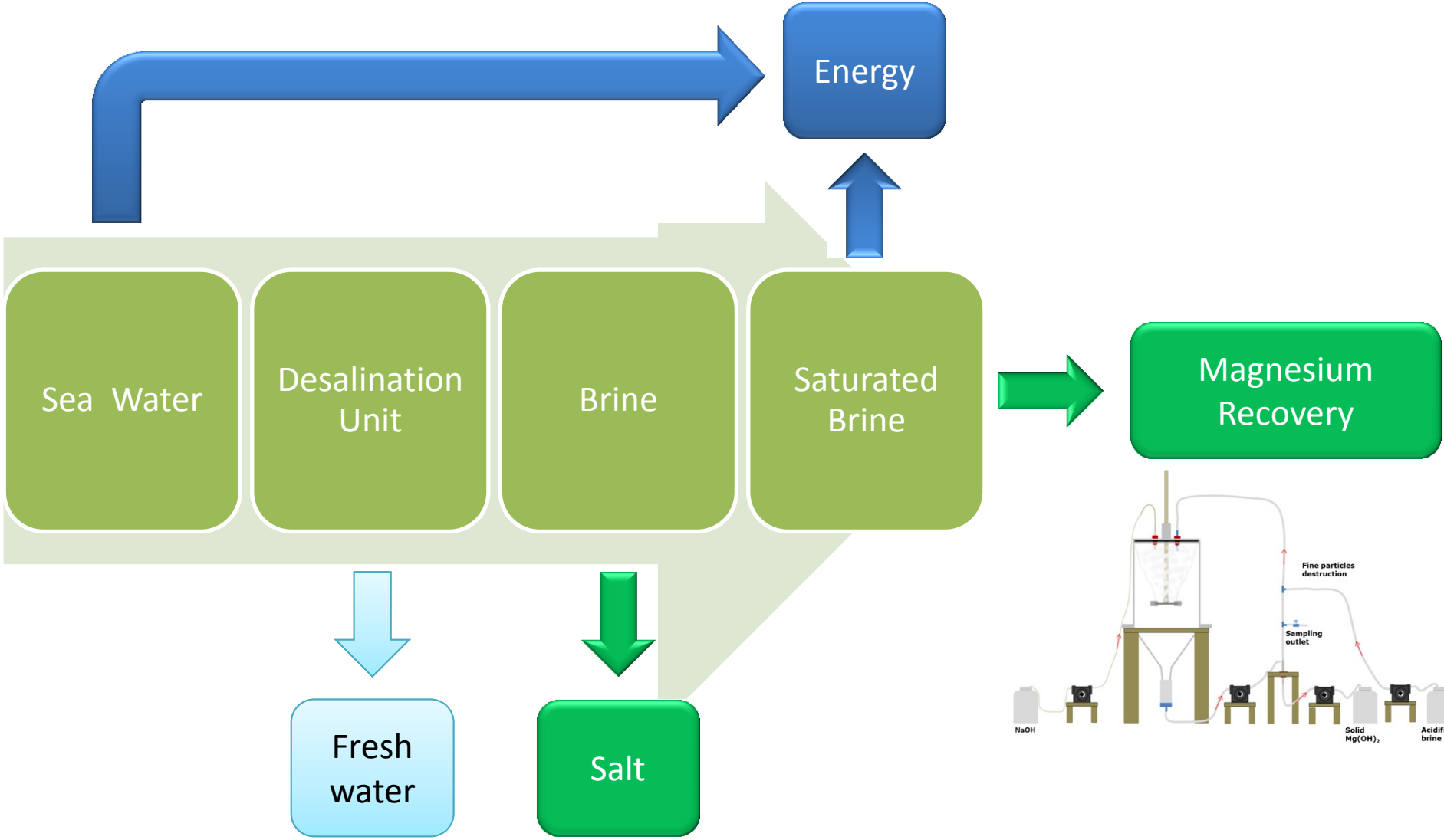
Reverse ElectroDialysis (RED)

- electrical power generation
- abatement of pollutants resistant to biological processes

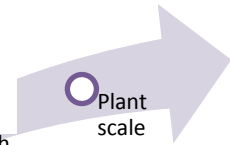
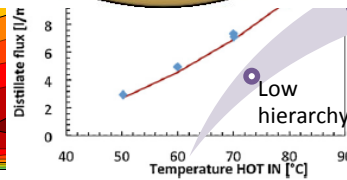
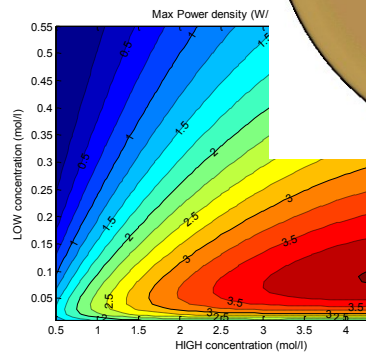
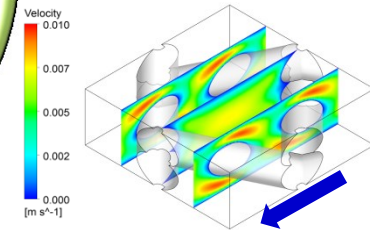
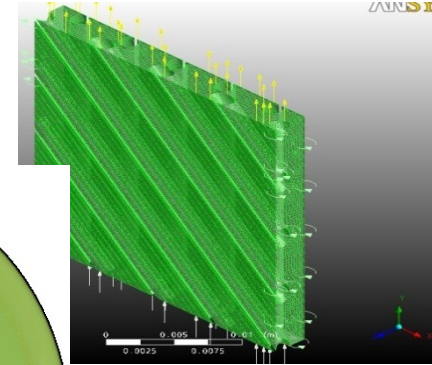
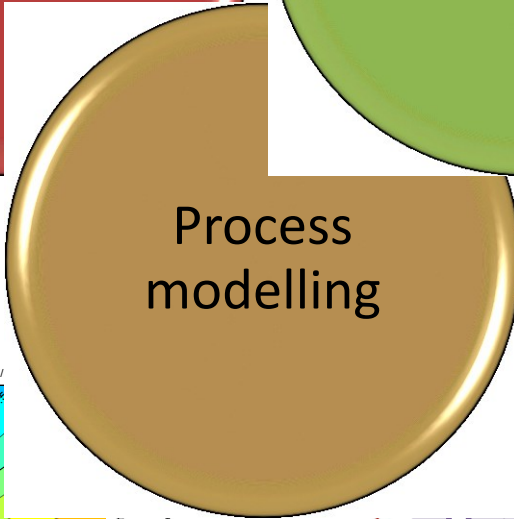
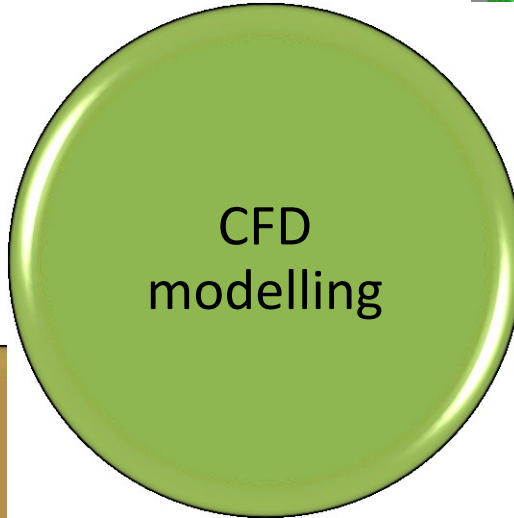
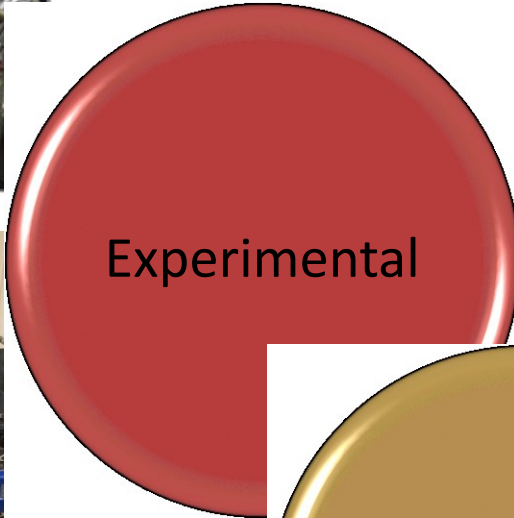
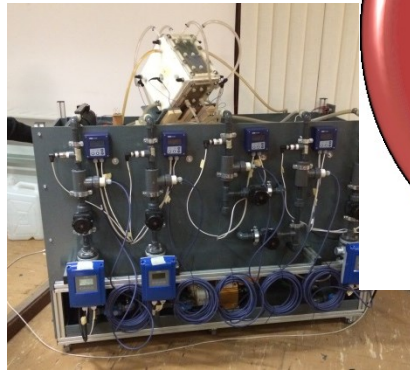
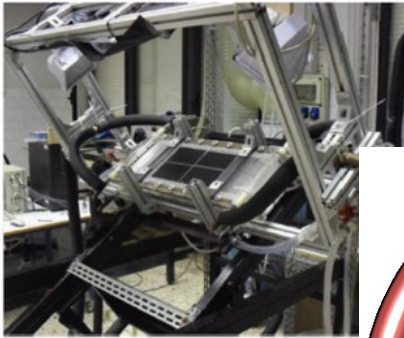


Pressure Retarded Osmosis (PRO)

RAW MATERIAL RECOVERY



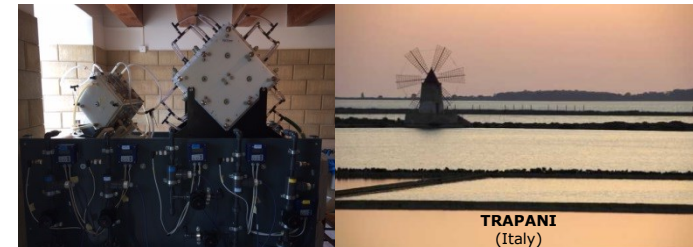
Research approaches



Plant scale

Recent PROJECTS

Projects funded by EU FP7 Program



Recent AWARDS

Best paper published in 2012:
Cipollina et al., Development of a Membrane Distillation module for solar energy seawater desalination, Chem. Eng. Res. Des.



IChemE
Institution of Chemical Engineers
Senior Moulton Medal 2013



Additional available facilities

Processing

- high-pressure bench-scale batch reaction systems equipped with reactors with and without windows for visual inspection (view cell)
- high pressure ISCO extractor
- high-pressure piston pumps
- batch and batch continuous recirculation electrochemical reactors

Characterization

Analysis and spectroscopy

HPLC

GC

LC-MS

FTIR and UV-Vis

fiber optic UV-VIs

micro-Raman

ICP-OES

TGA

Surface characterization

SEM

TEM

mercury porometer

gas porosimeter

Malvern particle size analyzer

XRD

Electrochemical analyses

Potentiostats

Electroanalytical apparatuses

Calorimetric analyses

DSC

Calorimeter