Sustainable production of Cellulose-based products and additives to be used in SMEs and rural areas
Funded from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement **No 101007733**.

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CELISE Mid-Term Meeting

„Lignocellulosic biomass towards circular economy"

Maria Kochaniec, maria.kochaniec@pw.edu.pl
Warsaw University of Technology - WUT

25th July, 2023

General Description of WUT

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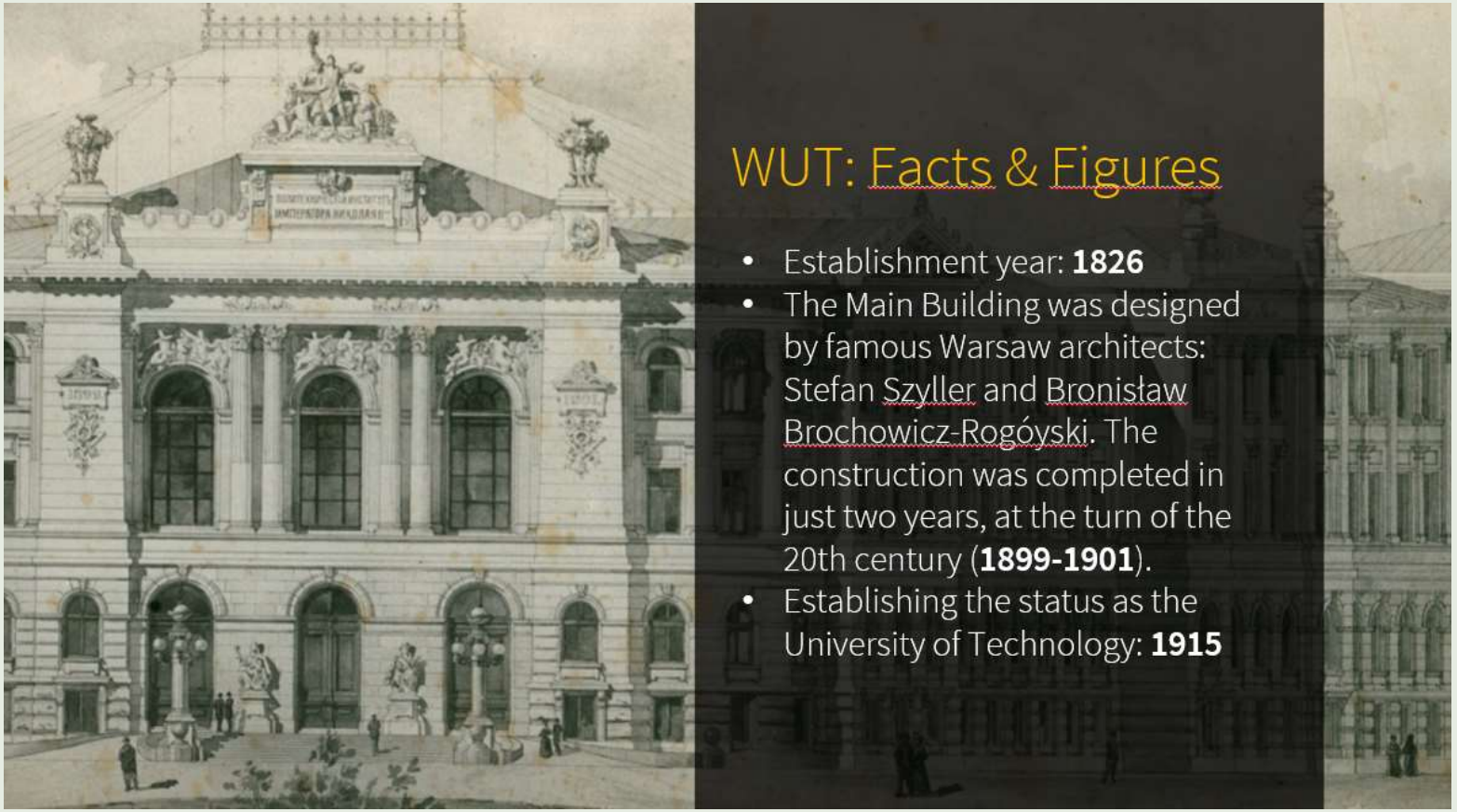

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Index

- Lignocellulosic Biomass
- Research works
- Results
- Research opportunities related to CELISE Project

Lignocellulosic Biorefinery

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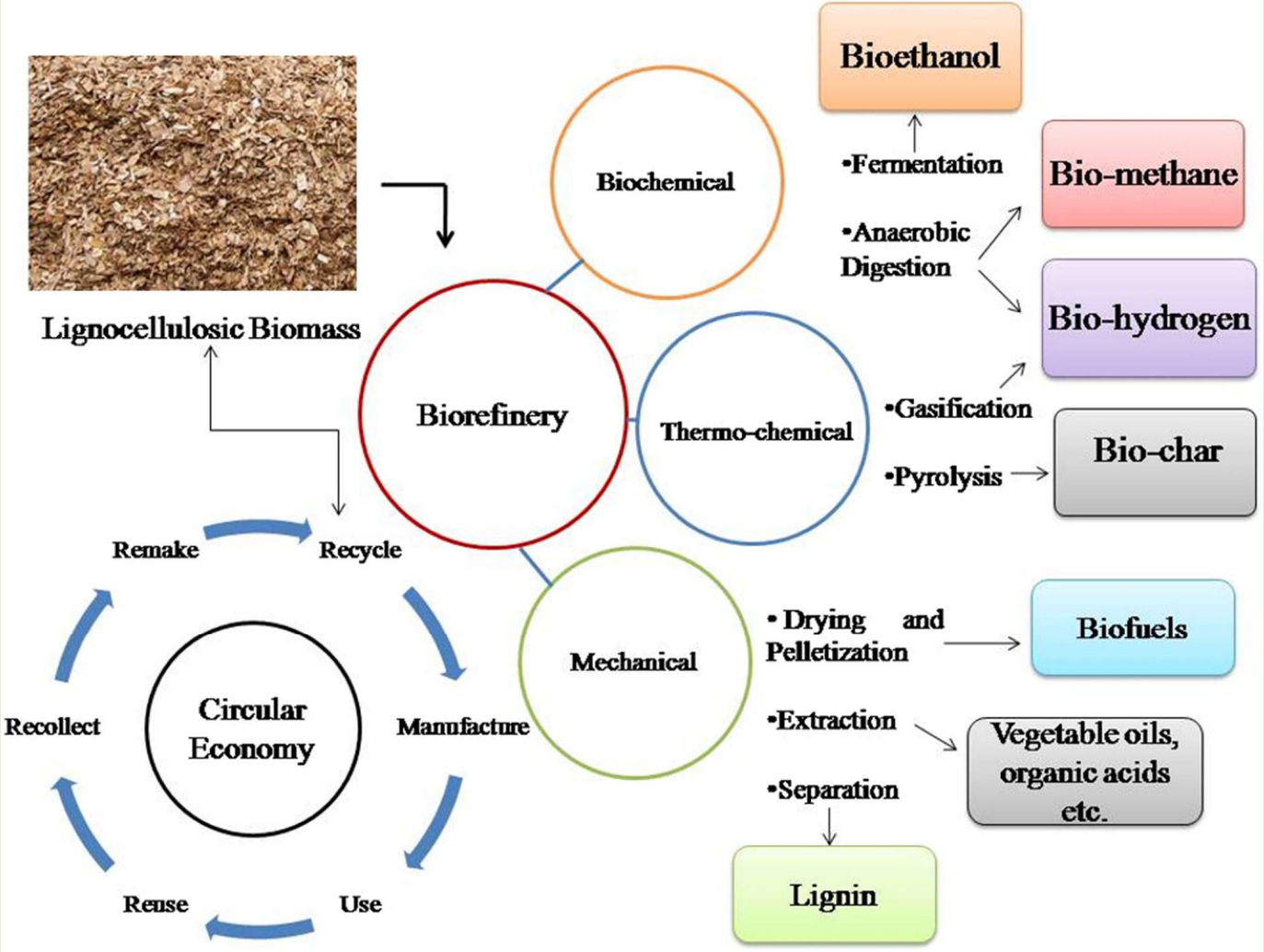
- second-generation biomass feedstocks with the global annual production of around 1.3 billion



Devi, A. *et al.* Lignocellulosic Biomass Valorization for Bioethanol Production: a Circular Bioeconomy Approach. *Bioenerg. Res.* **15**, 1820–1841 (2022)

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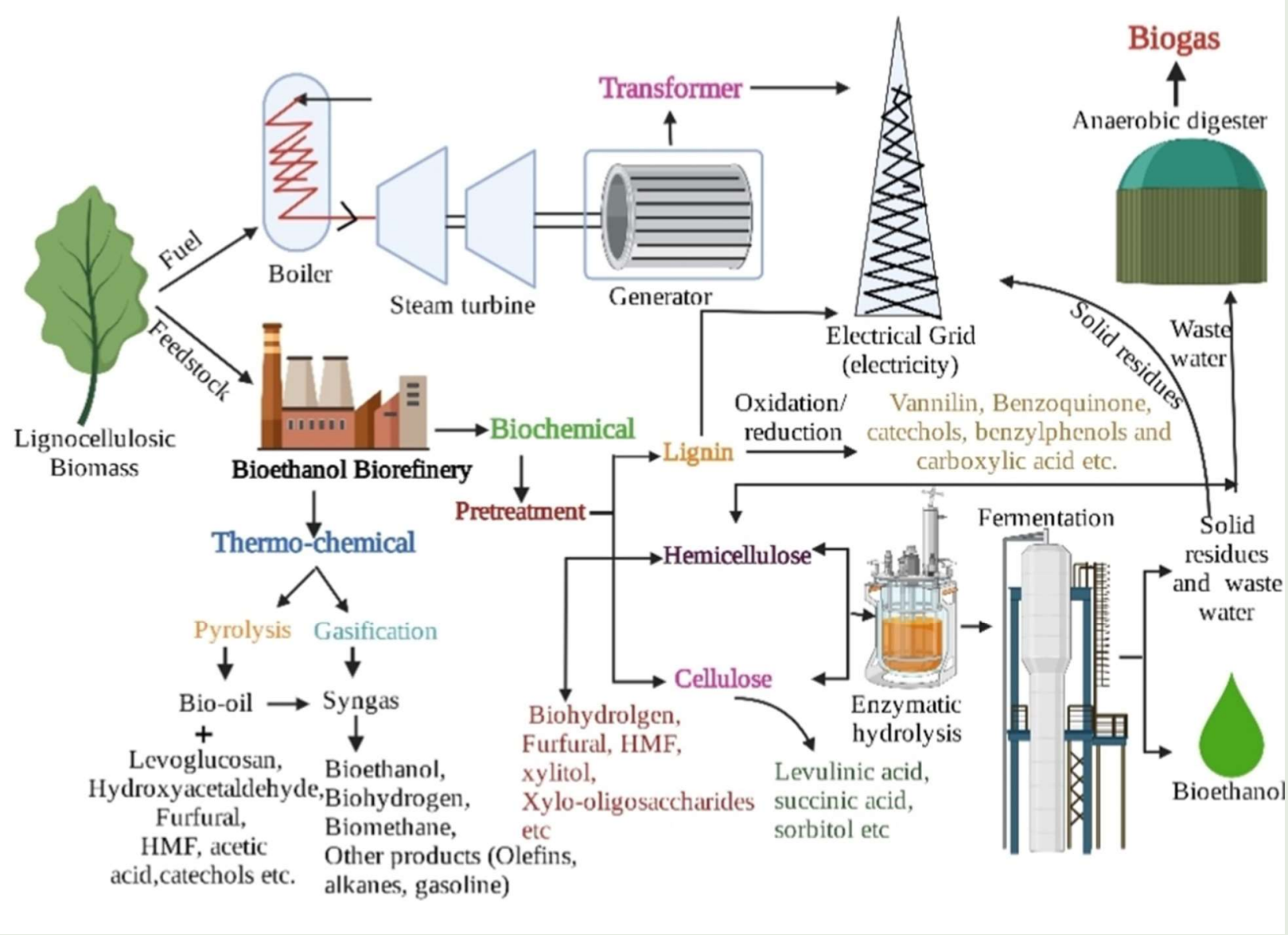
Lignocellulosic Biorefinery



Devi, A. *et al.* Lignocellulosic Biomass Valorization for Bioethanol Production: a Circular Bioeconomy Approach. *Bioenerg. Res.* **15**, 1820–1841 (2022)

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Research works

• Rapeseed straw for electricity generation

Straw residues from rapeseed cultivation

– in Poland ca. 15 Mt/year –

is renewable and inexpensive source of lignocellulos

Reducing sugars can be efficiently extracted from raw rapeseed straw by combination of hydrothermal pretreatment and enzymatic hydrolysis followed by utilization as a fuel in two-chamber microbial fuel cells for electrical power generation.

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Research works

Rapeseed straw and hydrolysis

Rapeseed straw was collected from a farm in northern Poland –

- cellulose (38%)
- hemicellulose (23%) and
- lignin (17%)

Before further treatment the straw was soaked in a phosphate buffer (KH_2PO_4, K_2HPO_4) at 80 ℃ until it turned into a homogenous pulp.

The hydrolysis of the pre-soaked biomass were conducted at a solid concentration of 10.0% (w/w) using the phosphate buffer for dilution.

MFC construction and operation

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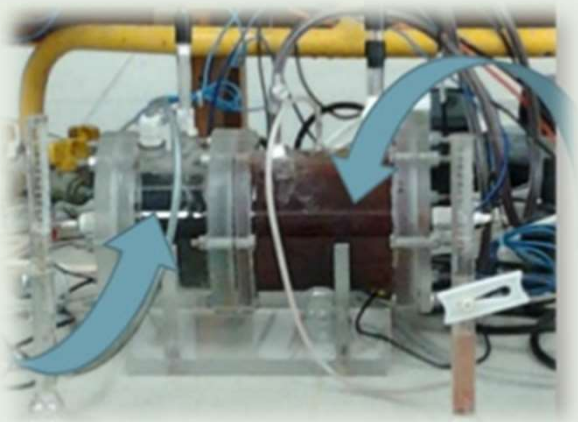

A dual-chamber (H type), two electrode fuel cell was used to monitor the biocatalyzed generation of electricity.

The anode electrode was made of graphite felt (Alfa Aesar, 99.9% purity) with a projected surface area of 0.5 dm^2. A cathode was also made of graphite felt additionally coated with a Pt/C catalyst.

Both chambers were equipped with an Ag/AgCl reference electrode.

Proton exchange membrane (PEM, Nafion 117, Dupont Co,) with 4.9 cm^2 cross section was installed between two chambers.

Milena Alicja Jablonska, Maria K. Rybarczyk, Marek Lieder, Electricity generation from rapeseed straw hydrolysates using microbial fuel cells, Bioresource Technology, 2016, 208, 117 – 122, DOI: 10.1016/j.biortech.2016.01.062

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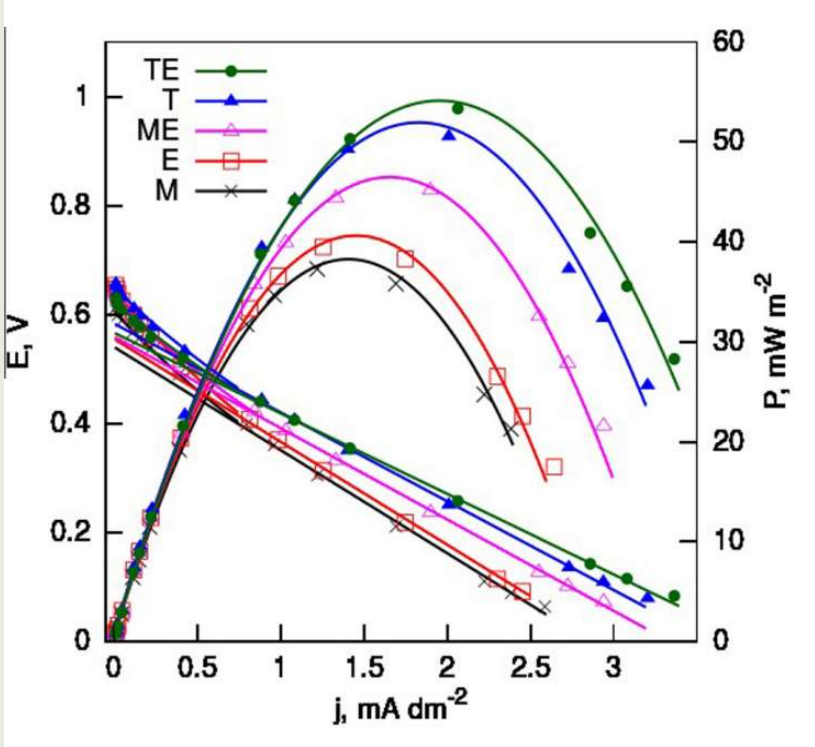
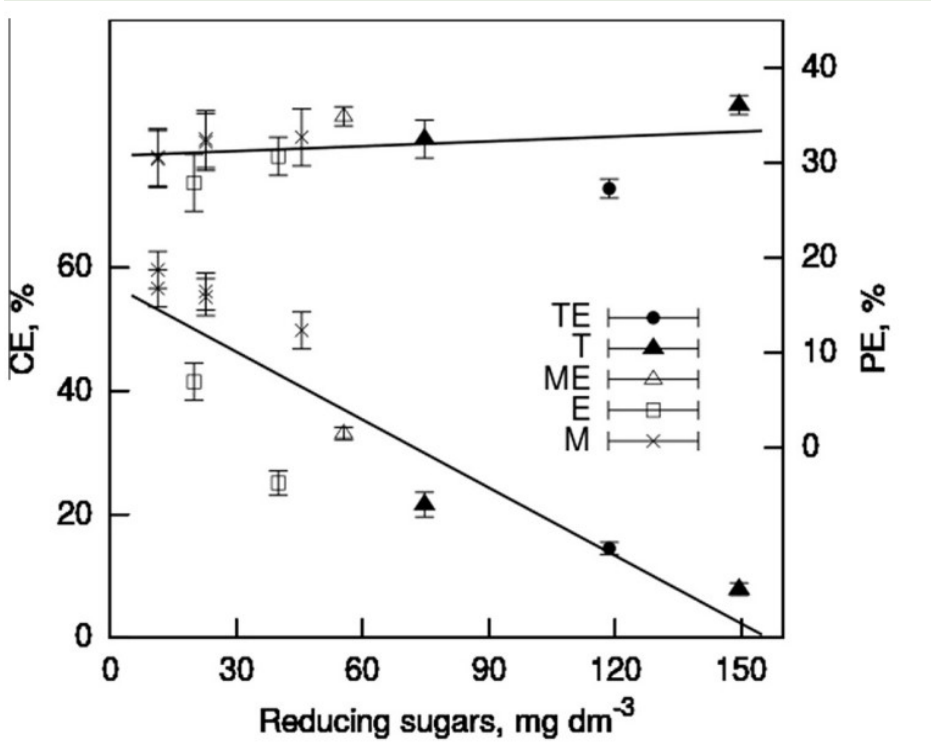
Results

Electricity was produced using hydrolysate concentrations up to 150 mg/dm^3. The power density reached 54 mW/m^2, while CEs ranged from 60 to 10%, corresponding to the initial reducing sugar concentrations of 10 to 150 mg/dm^3.





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Main expertise and capacities

- Biomass characterisation;
- Biochar from hydrothermal processes;
- Design of functional materials for sorbents and energy storage;
- Collaboration with several industrial companies.

- Visitors will have access to the host group facilities from Chemical Laboratory and to the other research infrastructure located at WUT.
- Biomass treatment and modifications will be performed using technological line for conducting hydrothermal reactions including carbonization and lab-scale reactors for lignocellulosic HTC treatment.

CELISE Project

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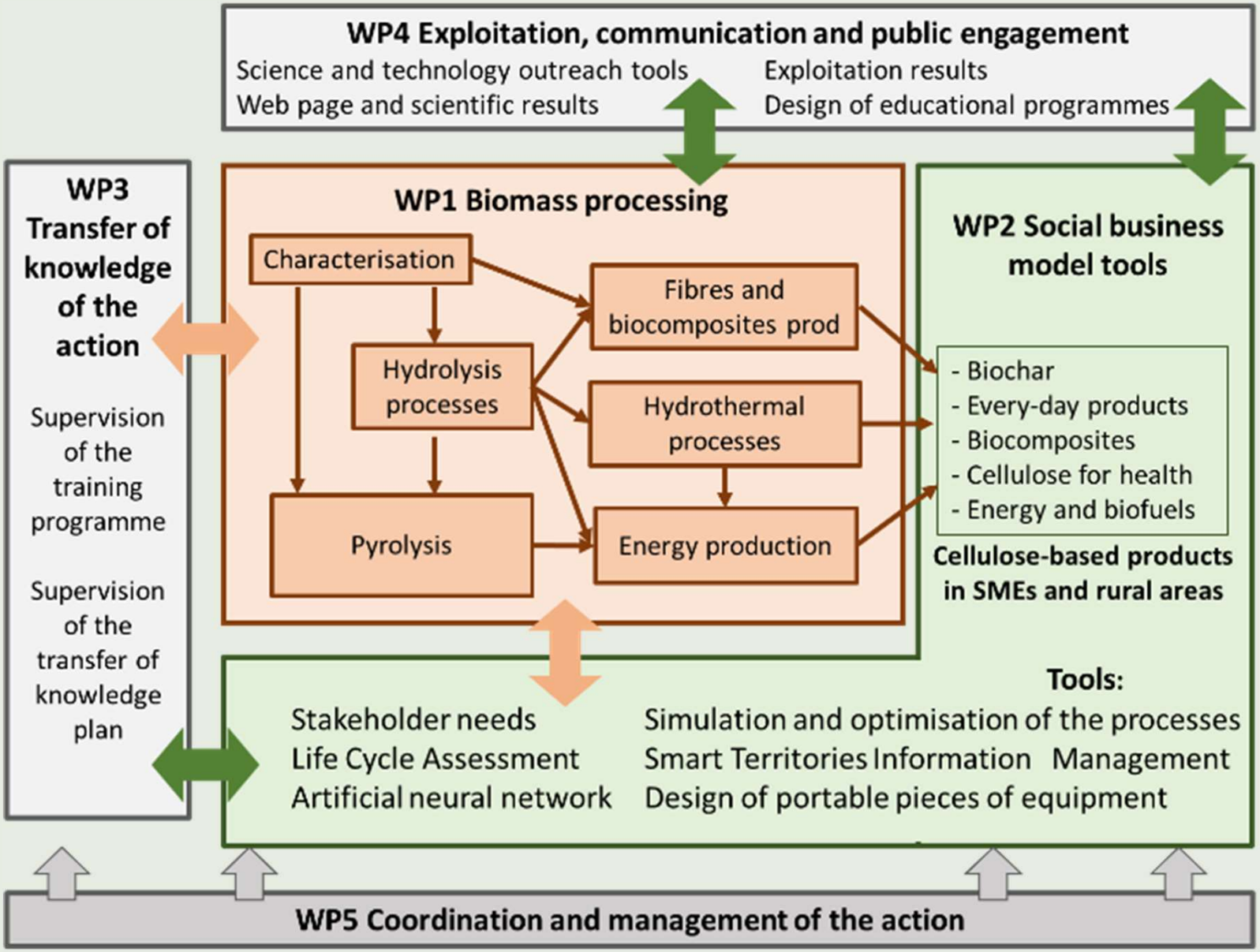

Research opportunities related to CELISE Project

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RICE HUSK

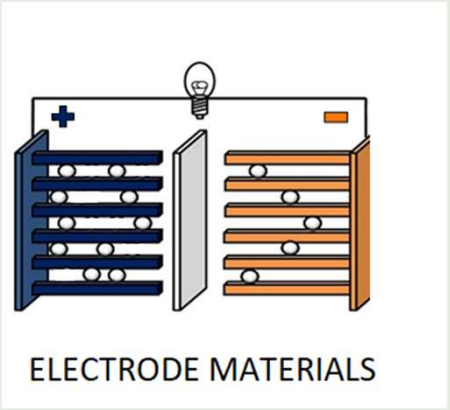
(22% lignin,
38% cellulose,
20% hemicellulose)

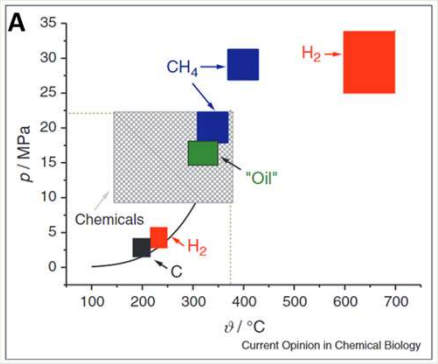
DISSOLVING HTC

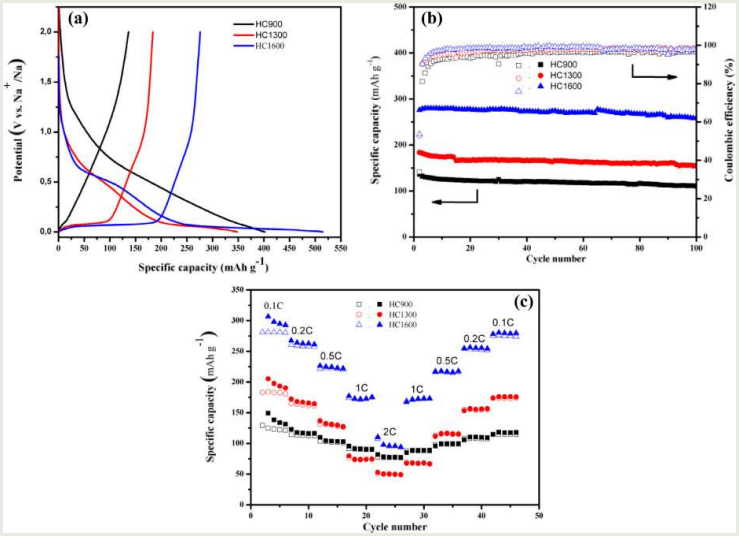
aqueous acidic solution

CARBONIZATION

T=900ºC - 1300ºC
under N_2 atmosphere







M.K. Rybarczyk, H.-J. Peng, C. Tang, M. Lieder, Q. Zhang, M.-M. Titirici, Green Chem., ***2015****, 18, 5169–5179.*
M.K. Rybarczyk, y. Li, M. Qiao, Y.-S. Hu, M.-M. Titirici, M. Lieder, Journal of Energy Chemistry, ***2019****, 29, 17-22.*

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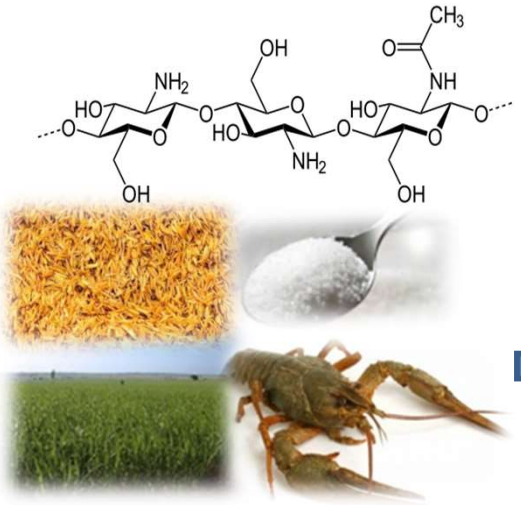
Acknowledgements

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 101007733

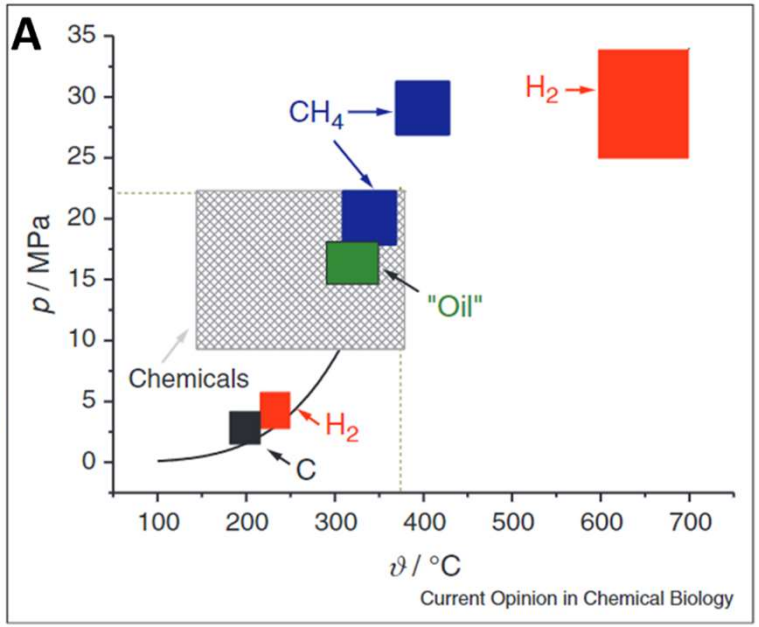
Dziękuję za uwagę

Motivation



HTC

180-250 °C



CARBONIZATION