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FRONTSH1P CSS1: a Circular Systemic Solution for the valorisation of wood packaging waste

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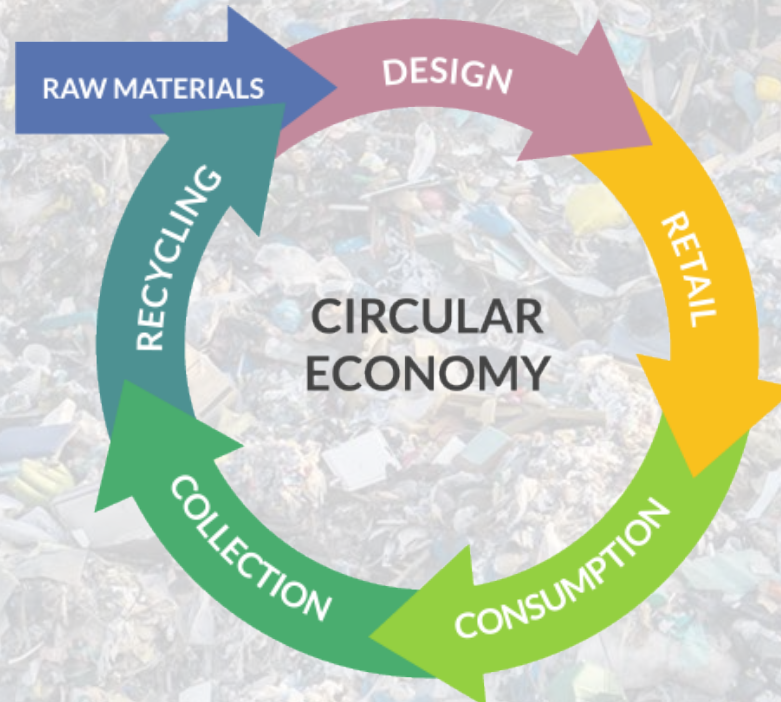


Today
 2.01×10^9 tonnes



2050
 3.40×10^9 tonnes

Open dump > Landfill > Recycling

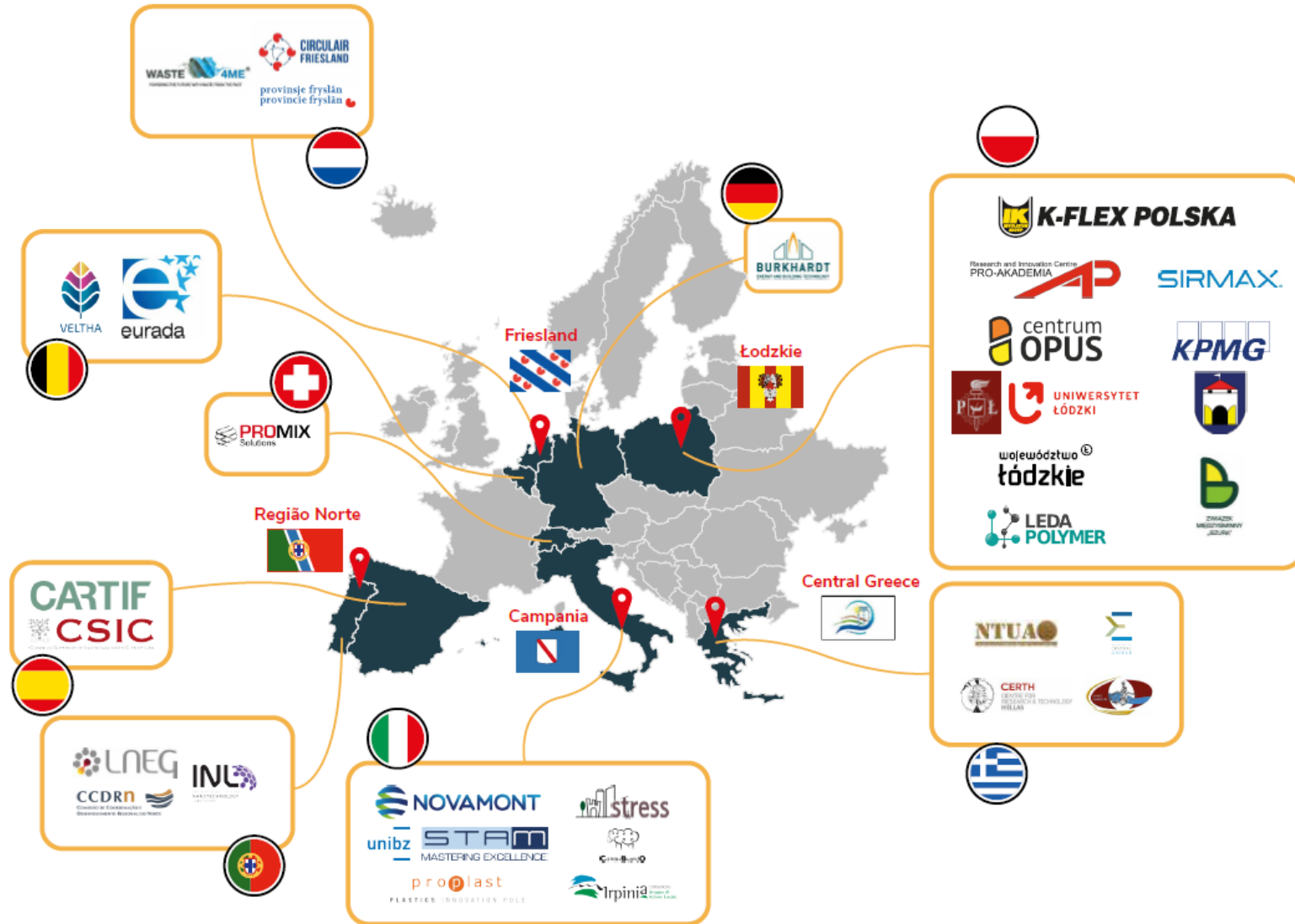


Source: <https://www.mvis-indices.com/mvis-onehundred/a-circular-economy-designing-out-waste>

FRONT SHIP

- **Funded by the European Union in the framework of the Horizon 2020 Research and Innovation Programme under grant agreement No. 101037031**
- **TOPIC ID: LC-GD-3-2-2020**
- **Demonstration of systemic solutions for the territorial deployment of the circular economy**







region
łódzkie [®]



FRONTSHIP



Circular systemic solutions



CSS1: Circular approach to wood packaging waste



CSS2: Circular approach to food and feed



CSS3: Circular approach to wastewater and nutrients



CSS4: Circular approach to industrial and urban plastic/rubber waste

Circular systemic solutions



CSS1: Circular approach to wood packaging waste



CSS2: Circular approach to food and feed



CSS3: Circular approach to wastewater and nutrients



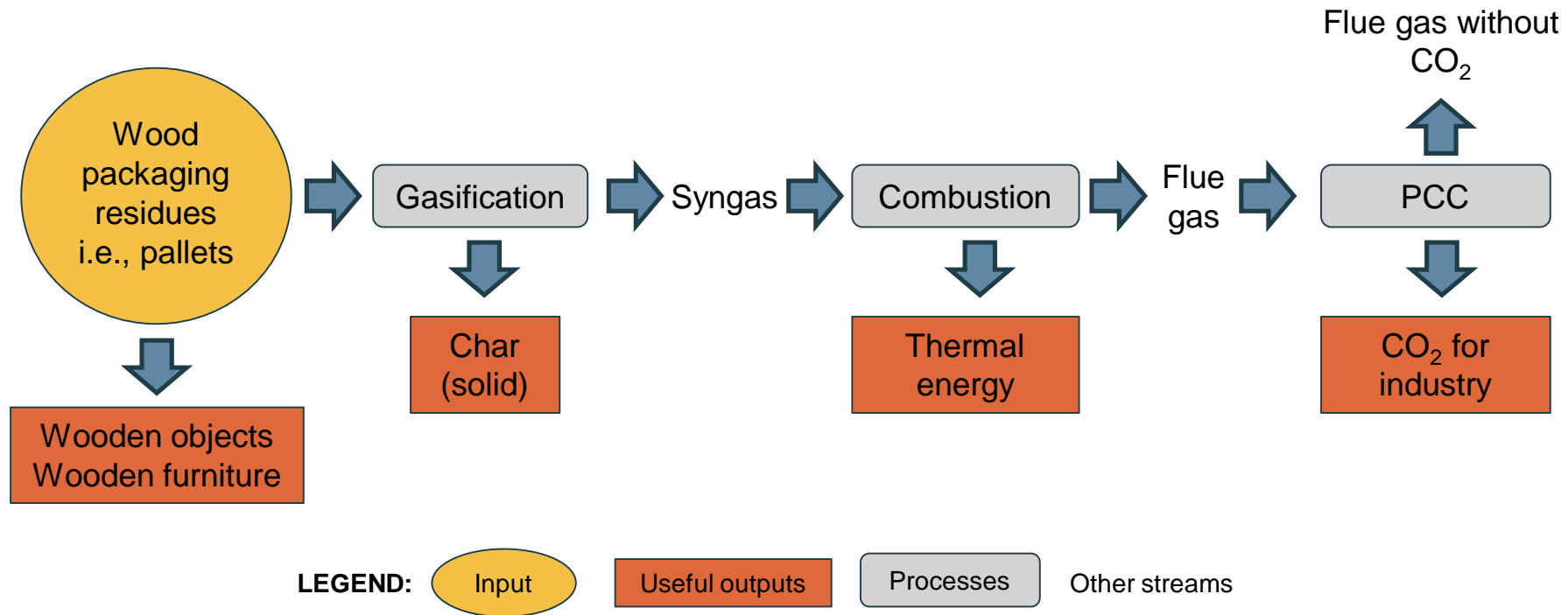
CSS4: Circular approach to industrial and urban plastic/rubber waste

CSS1 – Partners



CSS1 – Overview

Objective: Development of a circular economy concept based on the valorization of wood packaging waste (e.g., pallets) through refurbishing, reusing, recycling, energy recovery, and material valorization.



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CSS1 – Technical implementation

■ Wood packaging waste is sorted.

High quality wood will be reused, refurbished, and recycled.

Low quality wood and wooden residues will be **gasified** for heat and char production.

The gasifier will be connected to an existing industrial-scale **natural gas boiler** followed by a compact post combustion capture (PCC) unit for CO₂.

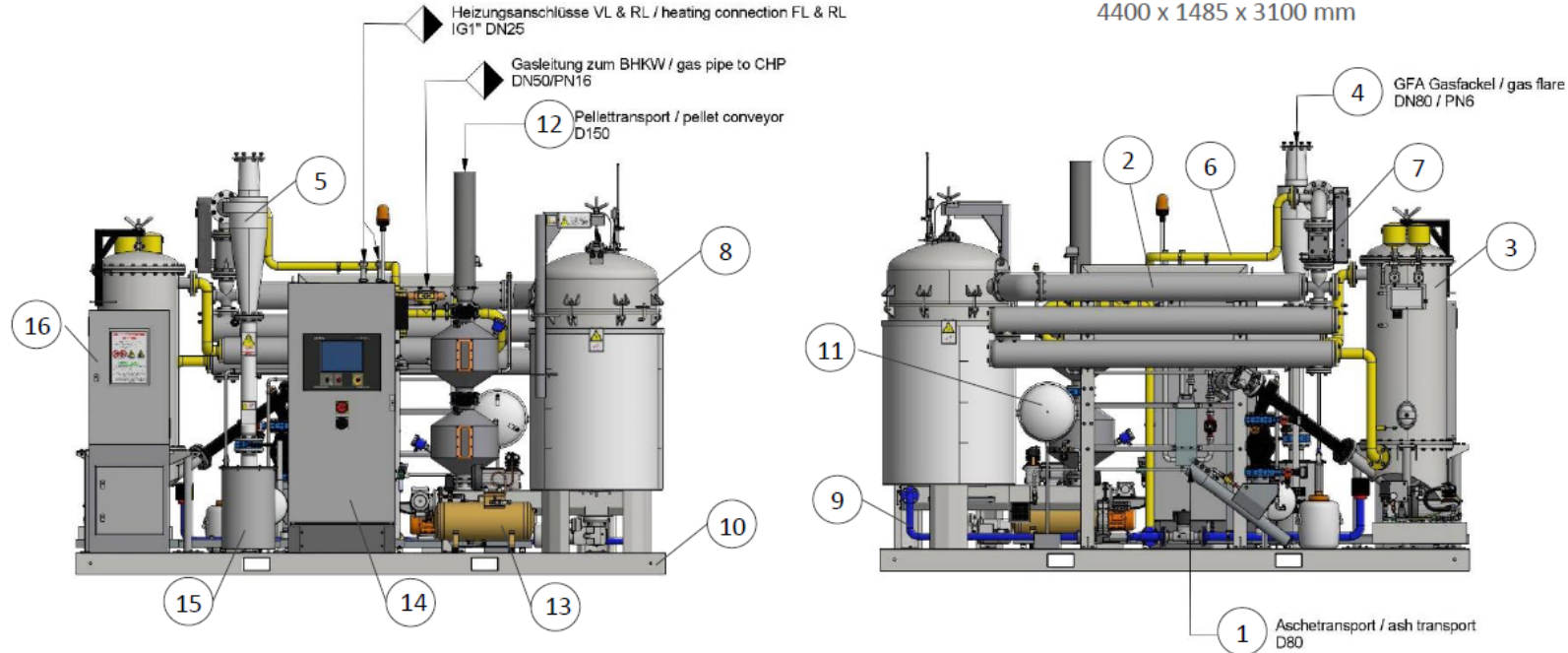
Char will be tested as compost and used as **pigment/filler for polymers**, while **CO₂** will be further exploited as **foaming agent** in the plastic industry.

CSS1 – Biomass gasifier



CSS1 – Biomass gasifier

Dimensions:
4400 x 1485 x 3100 mm



NR.	BEZEICHNUNG	NR.	BEZEICHNUNG	NR.	BEZEICHNUNG
1	Ash transport	7	Chimney valve	13	Compressed air supply unit
2	Gas heat exchanger	8	Gas reactor	14	Switch cabinet
3	Gas filter	9	Air supply unit	15	Dust storage
4	Connection gas flare	10	Gasifier base plate	16	Gas analysis (optional)
5	Dust separator	11	Extinguisher unit		
6	Gas pipe	12	Fuel supply		



CSS1 – Biomass gasifier

Performance data

50 kW
Electrical output

110 kW
Thermal output

40 kg/h
Pellet-consumption

1,5 kW
Self-consumption electrical

25 %
Electrical efficiency

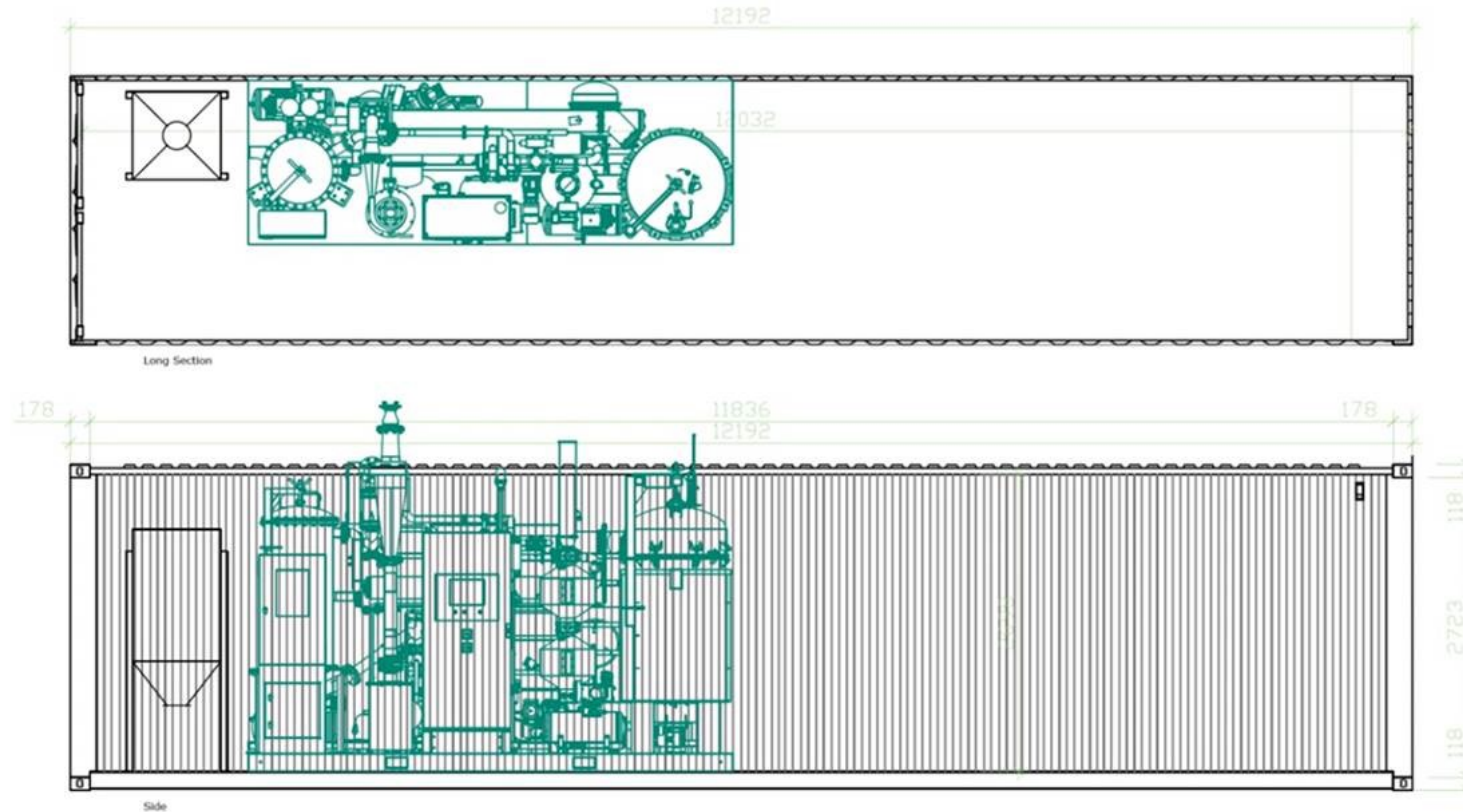
55 %
Thermal efficiency

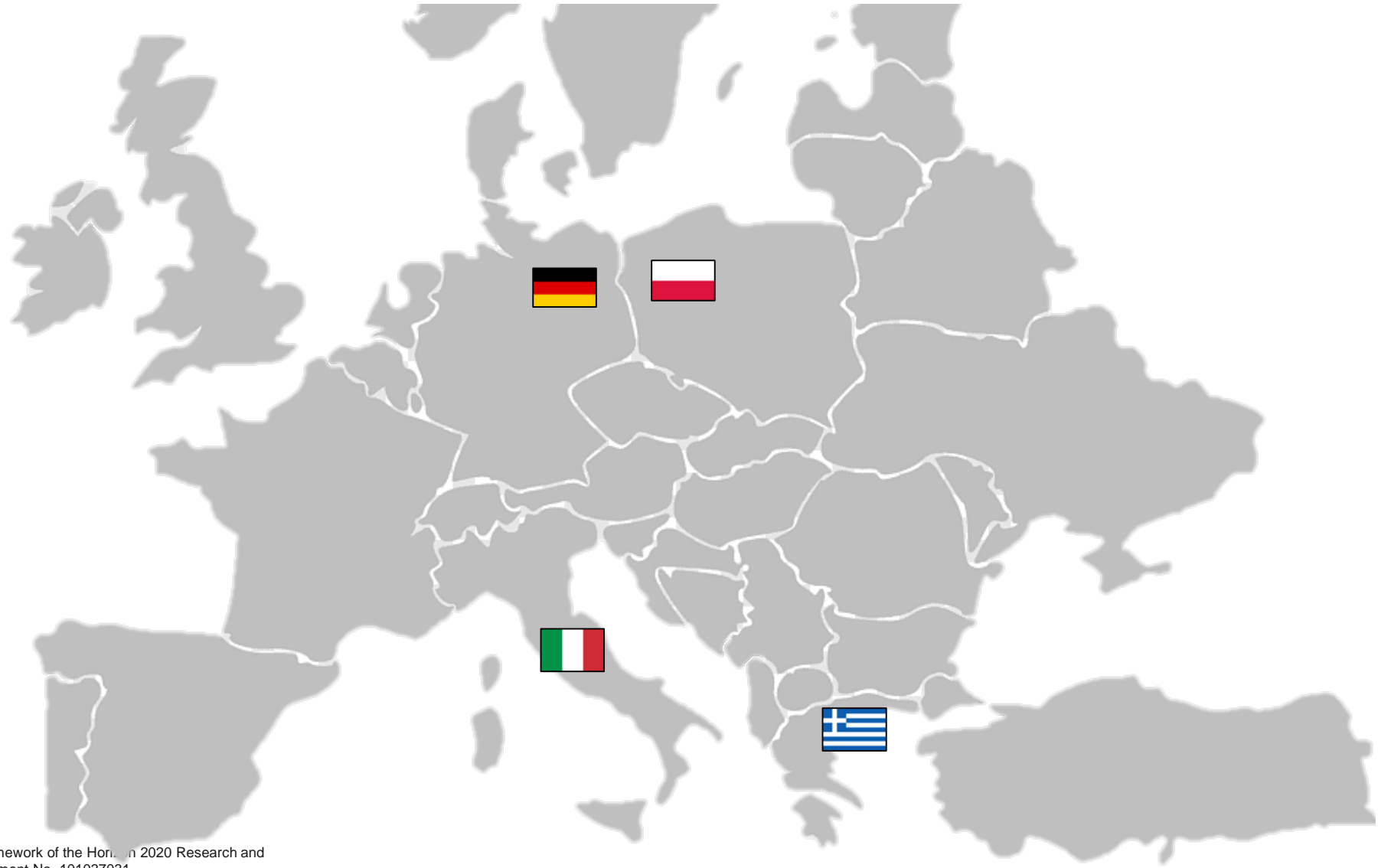
80 %
Total efficiency

WOOD PELLETS ↑ **AIR** ↑



CSS1 – Biomass gasifier





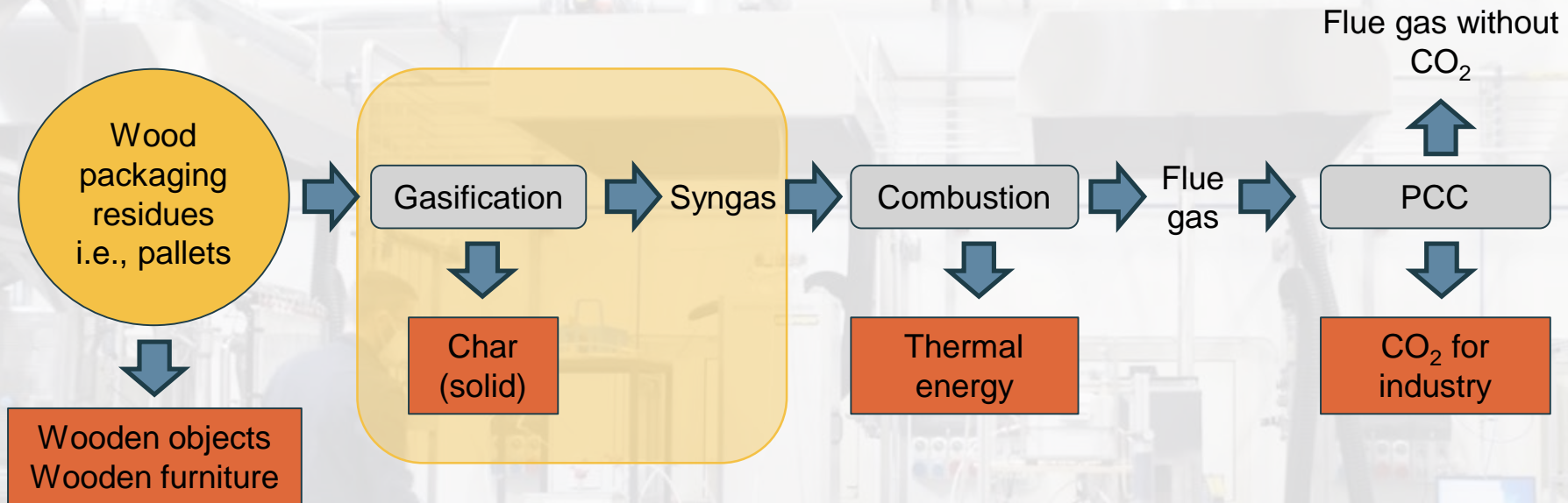


Expected delivery date:
end of July

CSS1 – Experimental activities



CSS1 – Experimental activities



LEGEND:

Input

Useful outputs

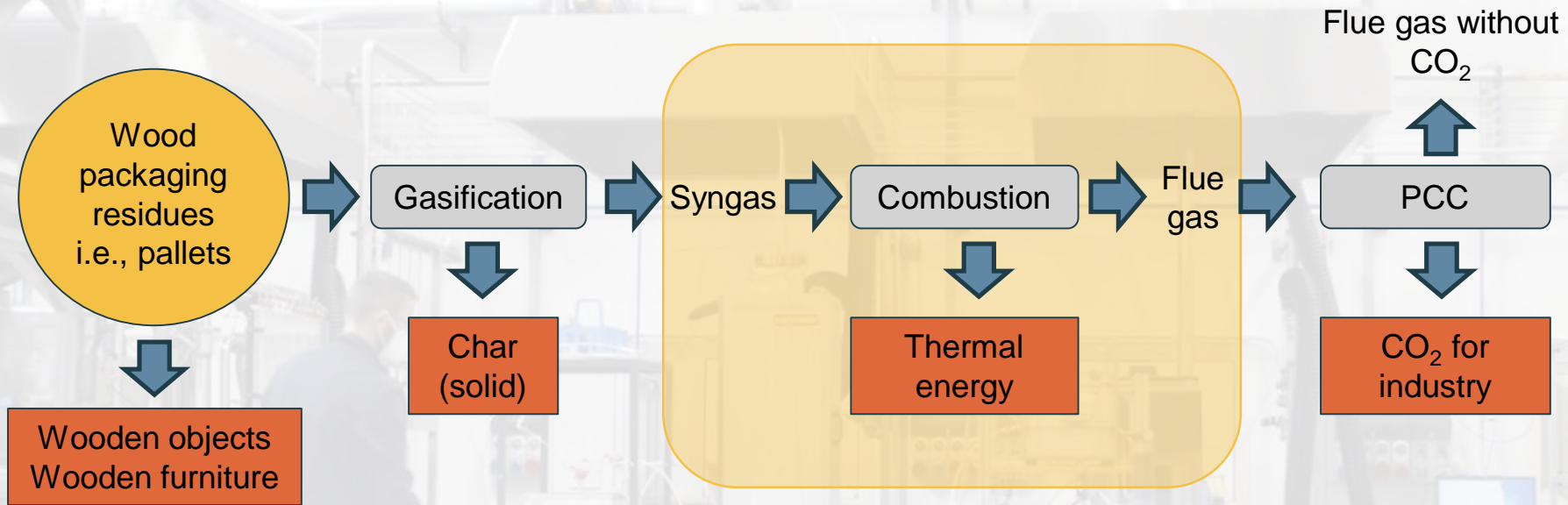
Processes

Other streams

CSS1 – Experimental activities

- **Optimisation** of the currently commercialised Burkhardt gasifier V4.50 for char production.
- **Tests** under different operative conditions with specific results description of char yield and properties as well as optimum management of all co-products.
- Development and calibration of a **gas-solid thermodynamic model**.
- Identification of the **optimal process conditions** in terms of char yield and cold-gas-efficiency.
- **Char characterization**.
- Assessment of char suitability as **filler for polymers and additive for compost**.
- Simulation of other potential **pathways for char utilization**.

CSS1 – Experimental activities



LEGEND:

Input

Useful outputs

Processes

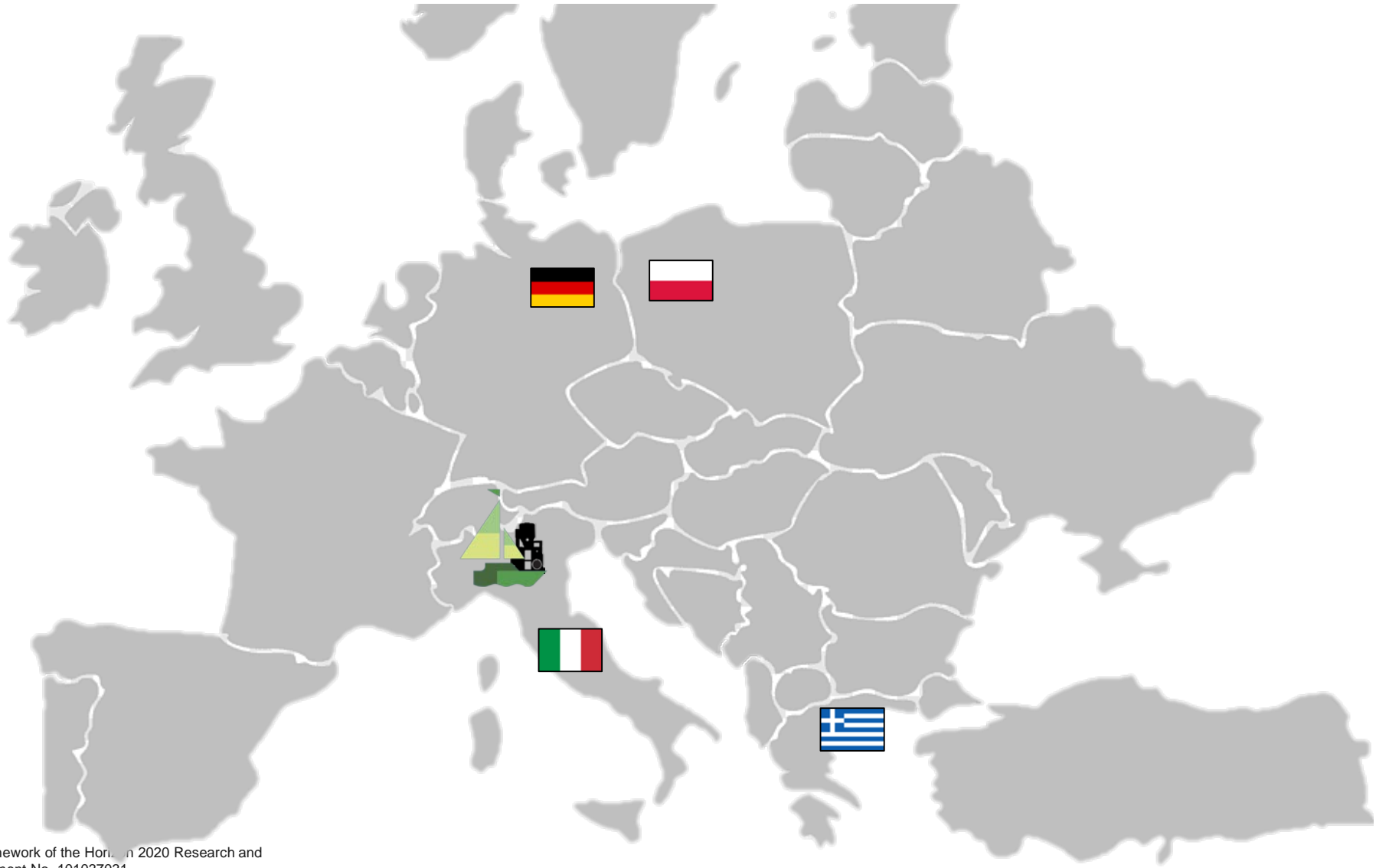
Other streams

CSS1 – Experimental activities

PRODUCER GAS COMBUSTION TEST RIG

- **30 kW** rated thermal power
- Up to **7 g/s syngas** mass flow rate
- Up to **20 g/s combustion air** mass flow rate
- In-house design and manufacturing of an **optimized combustion chamber**
- **Optical access** for flame analysis
- Optimal design of a **dedicated venturi mixer** for air-gas premixing
- **Flexible combustion air inlet strategies** (primary, secondary, and tertiary air lines)
- **Modulation of combustion air flow rate**
- Possibility of trying **different typologies of premixed burners**

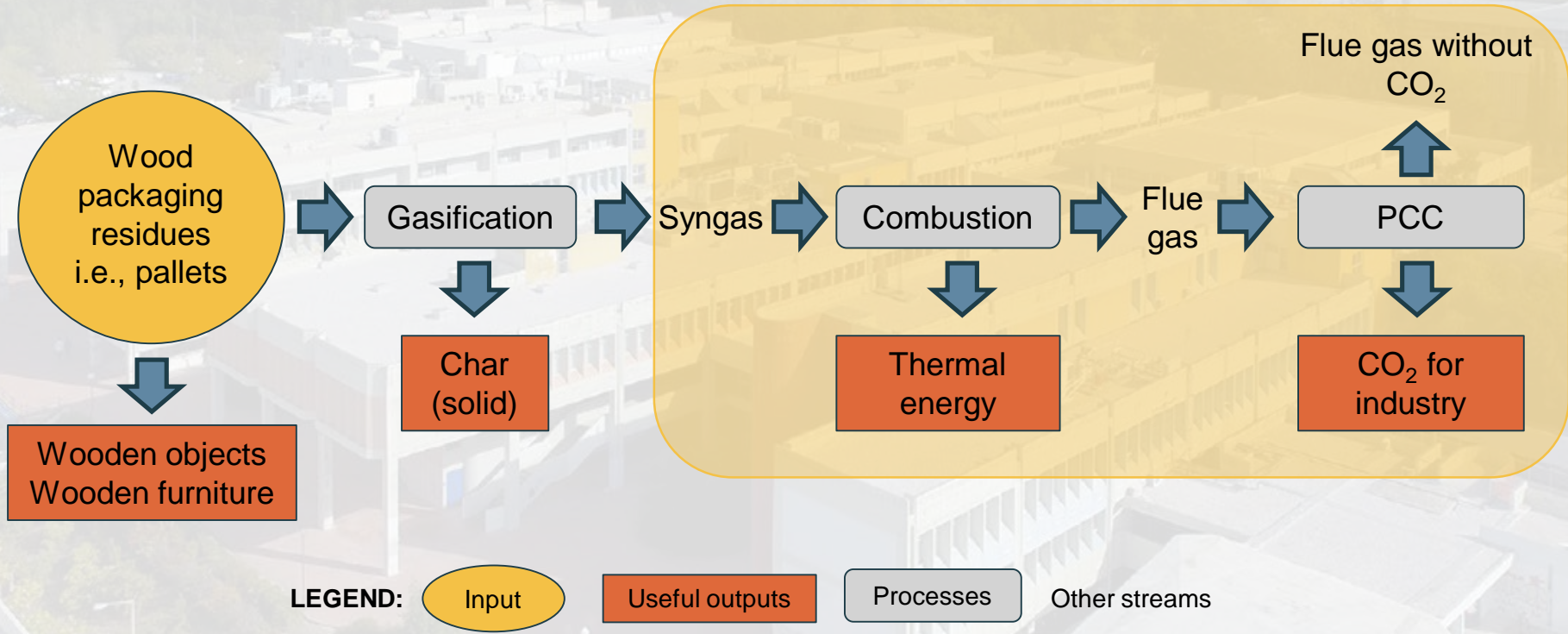
Expected delivery date:
end of 2022



CSS1 – Experimental activities



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CSS1 – Experimental activities

Central
Industrial and
Power
production
systems

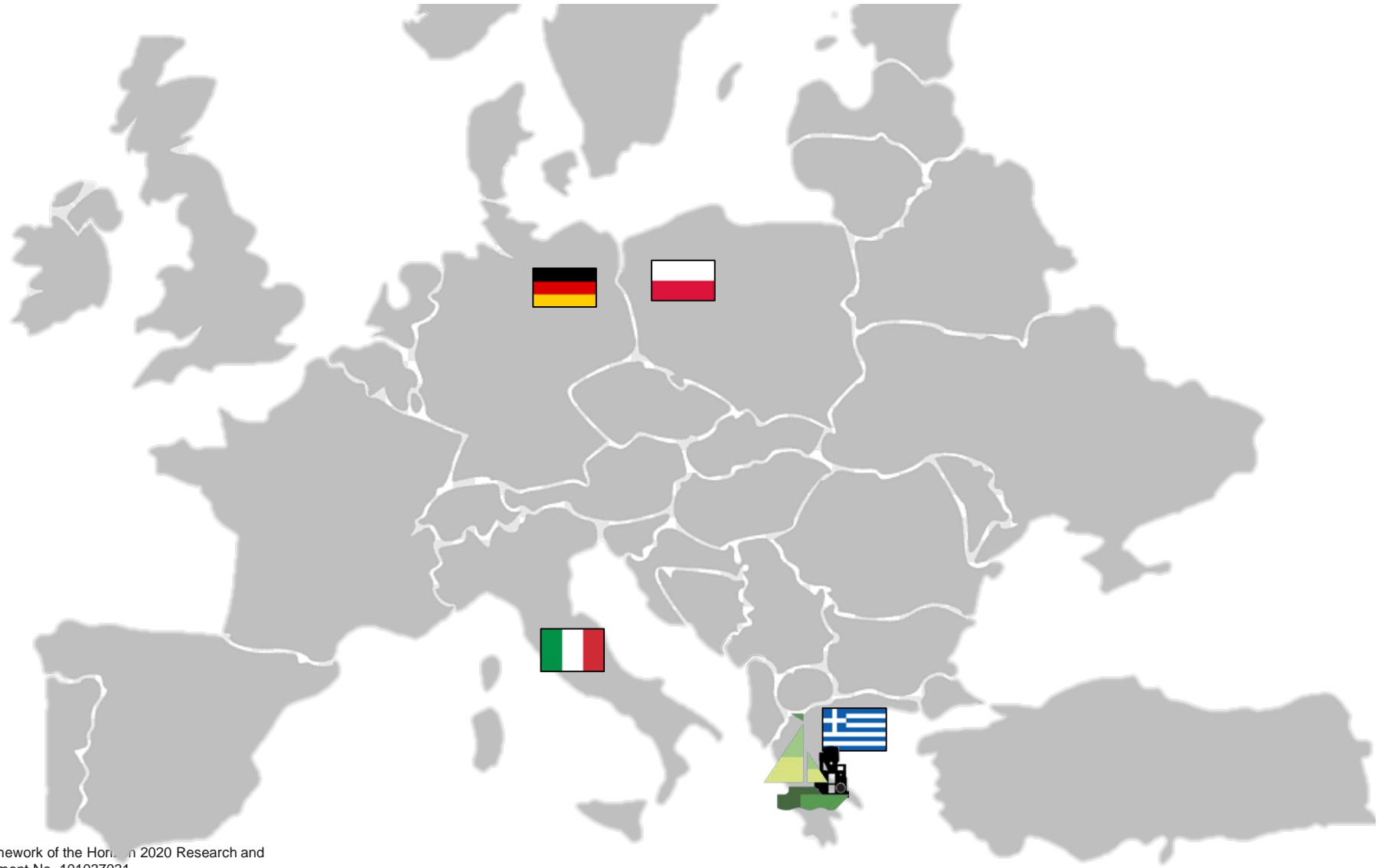


National
Technical
University
of Athens

Decentralized
Energy
Systems



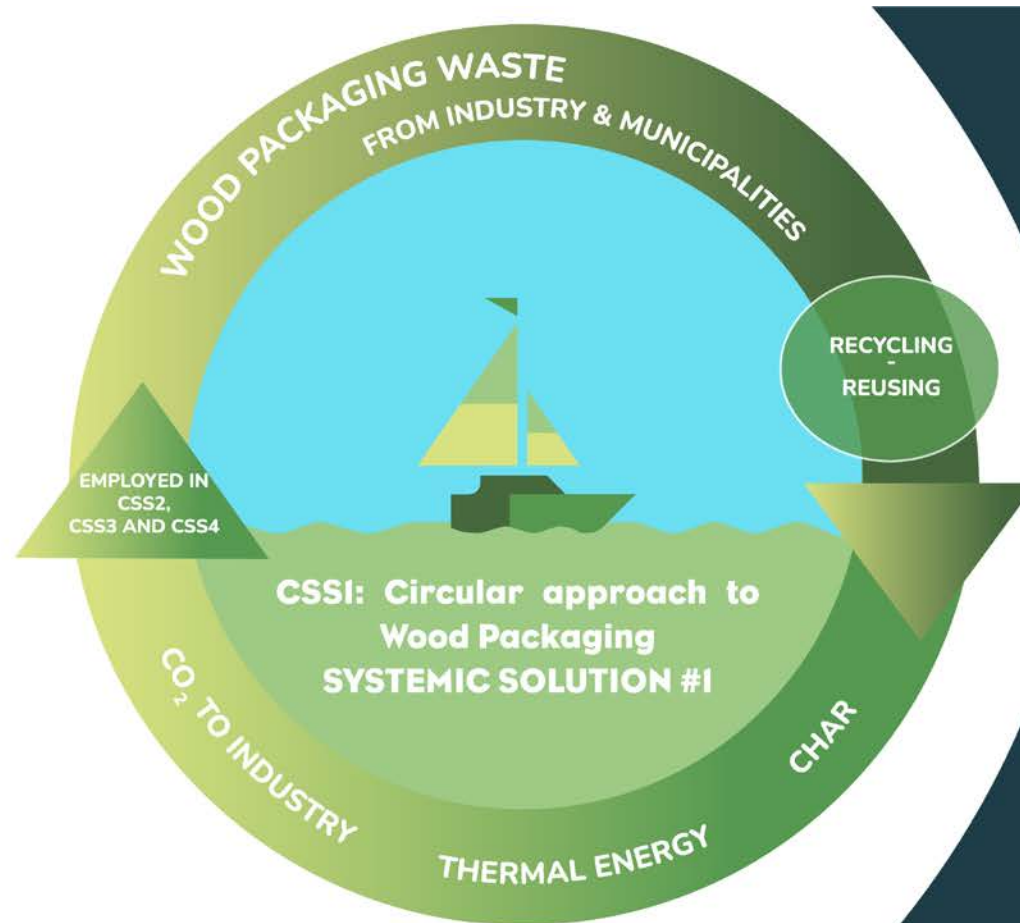
- Study, tests, and development of a modular and compact **PCC unit** operating with appropriate solvents for CO₂ capture such as alkaline salts or amines.
- Validation of the CSS1 model with **demo plant** data.
- **Dynamic process analysis** of the overall CSS1 value chain to establish a robust operation of the system meeting all the requirements in terms of flexibility.
- Development of sophisticated **dynamic models coupled with advanced process control methodologies**.



CSS1 – Experimental activities



CSS1 – Ambition



CSS1 Key Impacts by 2030 in the Łódzkie Region

- 9,6 M €/year of increased turnover
- 4,500 t/year of wood coming from wood packaging (with consequent forest preservation)
- 180,000 new pieces of furniture per year
- More than 1,500 new jobs created along the whole value chain in the Region
- 3,240 MWh/year of renewable thermal energy production
- 270 t/year of char produced
- 3,250 t/year of CO₂ captured and used
- > 80% direct GHGs reduction in heating residential and industrial applications

Conclusion

CSS1 will **not only** lead to the minimization of waste, preservation of resources and reduction of GHGs emissions, **but also** to the production of low-impact products (wooden goods, renewable heat, char, CO₂).

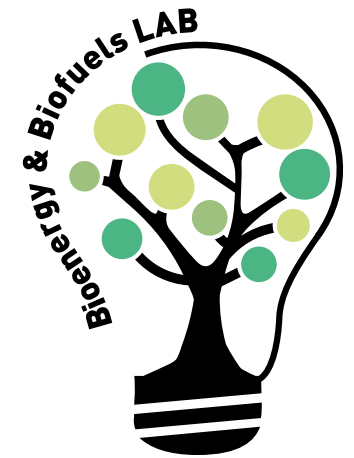
Moreover, **citizens** can play an active role in each stage of the valorisation chain, increasing their awareness on **sustainability and circular economy**, and indirectly benefitting from the environmental advantages that the CSS will bring.



CORFU2022

9th International Conference
on Sustainable Solid Waste
Management

15-18 JUNE 2022



Thank you for your attention

FRONTSH1P CSS1: A CIRCULAR SYSTEMIC SOLUTION FOR THE VALORISATION OF WOOD PACKAGING WASTE

FRONTSH1P

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