

PYSOLO: INTEGRATION OF INDUCTION HEATING AND CONCENTRATED SOLAR POWER IN BIOMASS PYROLYSIS

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Introduction

The transition to a climate-neutral economy is a priority challenge in Europe, with a commitment to **reduce** net **GHG** emissions by **80-95%** by **2050**.



In this context, sustainable management of plastic waste and biomass is essential within the **circular economy**. **Pyrolysis** of lignocellulosic biomass is emerging as a **key technology** for obtaining **renewable energy vectors** and **value-added co-products** (bio-oil, biochar). However, conventional heating methods limit its efficiency and scalability.

The project

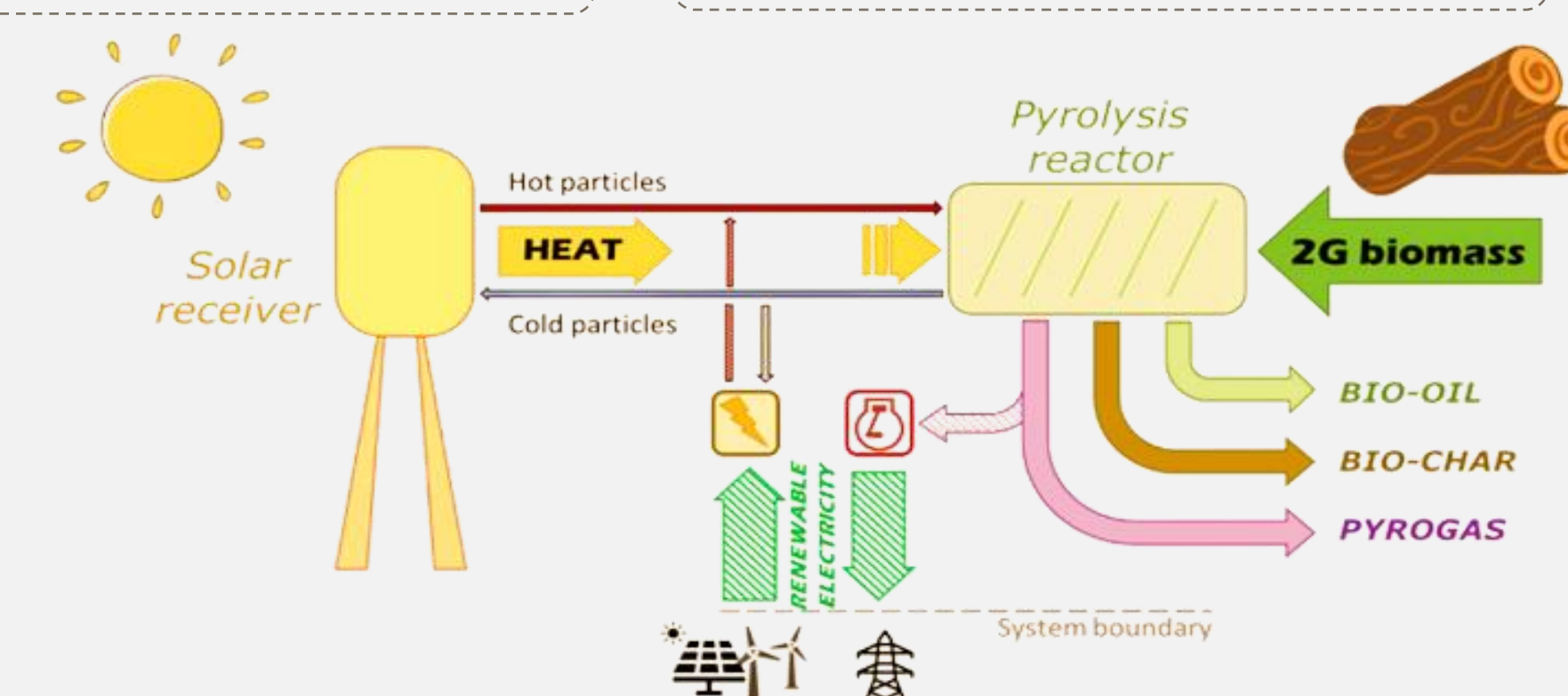


The **PYSOLO** project explores innovative alternatives based on **electromagnetic induction** and **concentrated solar power**, in line with the growing electrification of industrial processes, with the aim of:

Promoting the sustainable use and recovery of lignocellulosic waste

Reducing the environmental impact of processes

Improve conversion efficiency and selectivity



In this way, **PYSOLO** aligns itself with European **decarbonisation** and **circular economy** objectives, offering disruptive technological solutions for **energy transition** and **sustainable resource management**.

Materials and methodology

Reactor and heating system



Auger-type reactor at TRL4 scale.

Reactor coupled to a **50 kW induction** module, powered by a **400 V three-phase** supply with a load current of up to **400 Arms**.

Thermal control through **temperature control points**.



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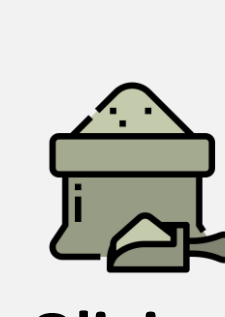
Selected heat carriers



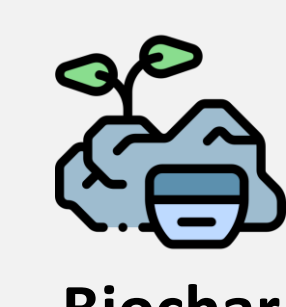
- ✓ Natural material with low absorption
- ✓ Heat carrier in pyrolysis processes



- ✓ High absorption and high conductivity
- ✓ High density: Favors the biochar separation process



- ✓ Mineral that is accessible and economically viable for industrial applications
- ✓ High catalytic activity due to high iron content



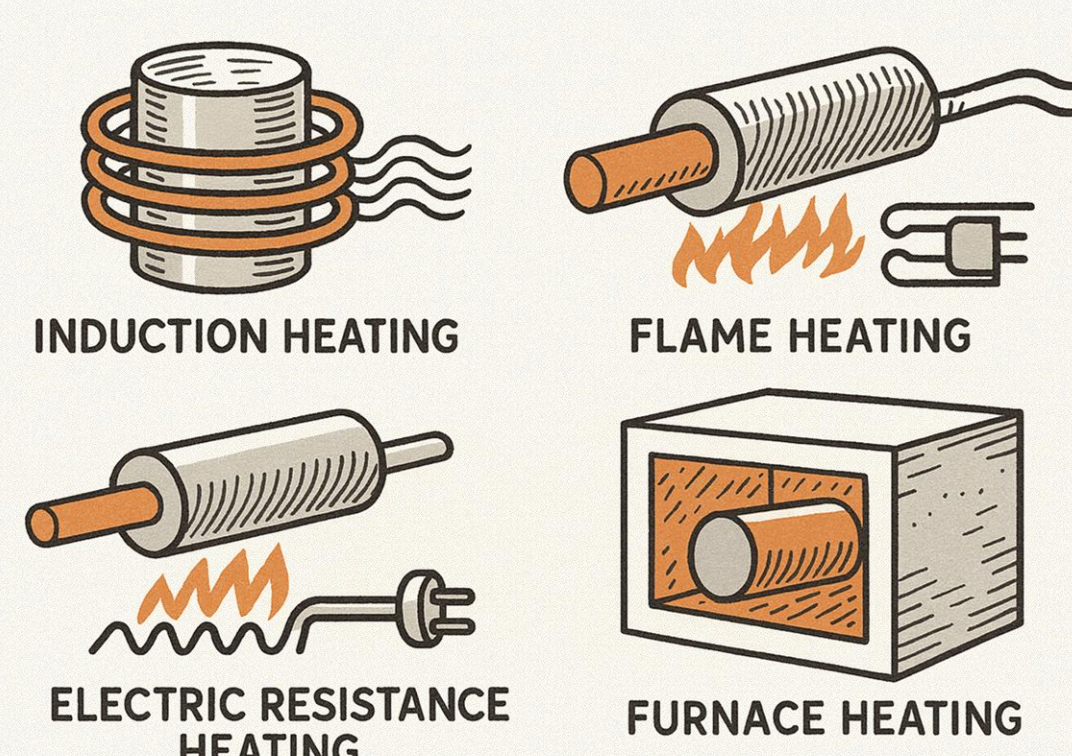
- ✓ Favorable catalytic properties
- ✓ Closed cycle, utilizing the generated char

International collaboration

DLR (Germany) is developing a **ID model** of a **solar rotary kiln** to evaluate its **integration with concentrated solar energy**.

Key findings

Induction vs. conventional



Advantages over heating with flame, electric resistance, or conventional furnaces

Improves the process's energy efficiency
Heat is produced directly within the workpiece, reducing energy losses

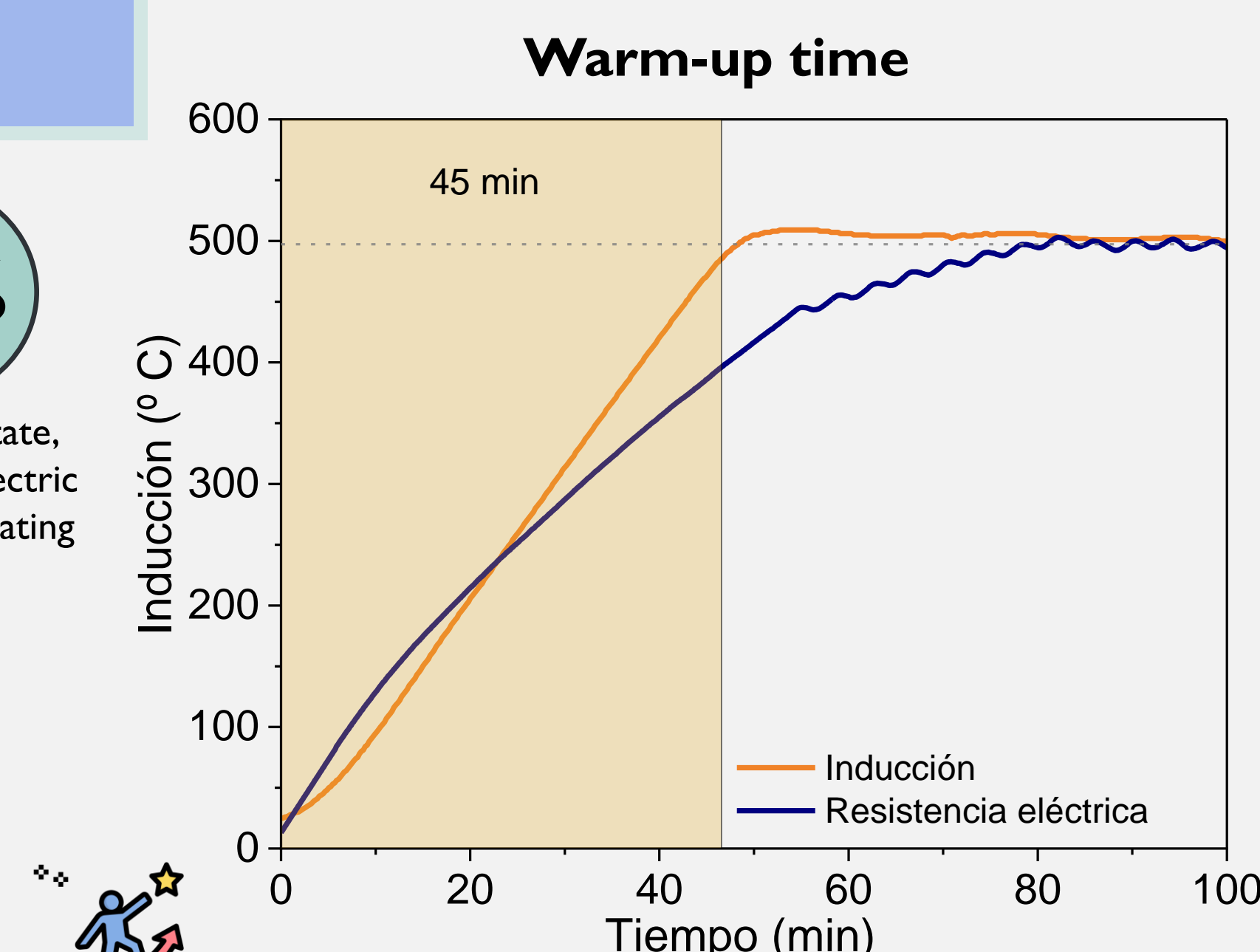
64 %
At steady-state, relative to electric resistance heating



High-precision temperature control
Precision and adjustment of setpoint temperatures



Ramp rate
Less time needed to reach the desired temperature



The process is accelerated by **induction heating**, reducing the heating time by **more than 50%**.

Power assessment according to PHC

Power consumption

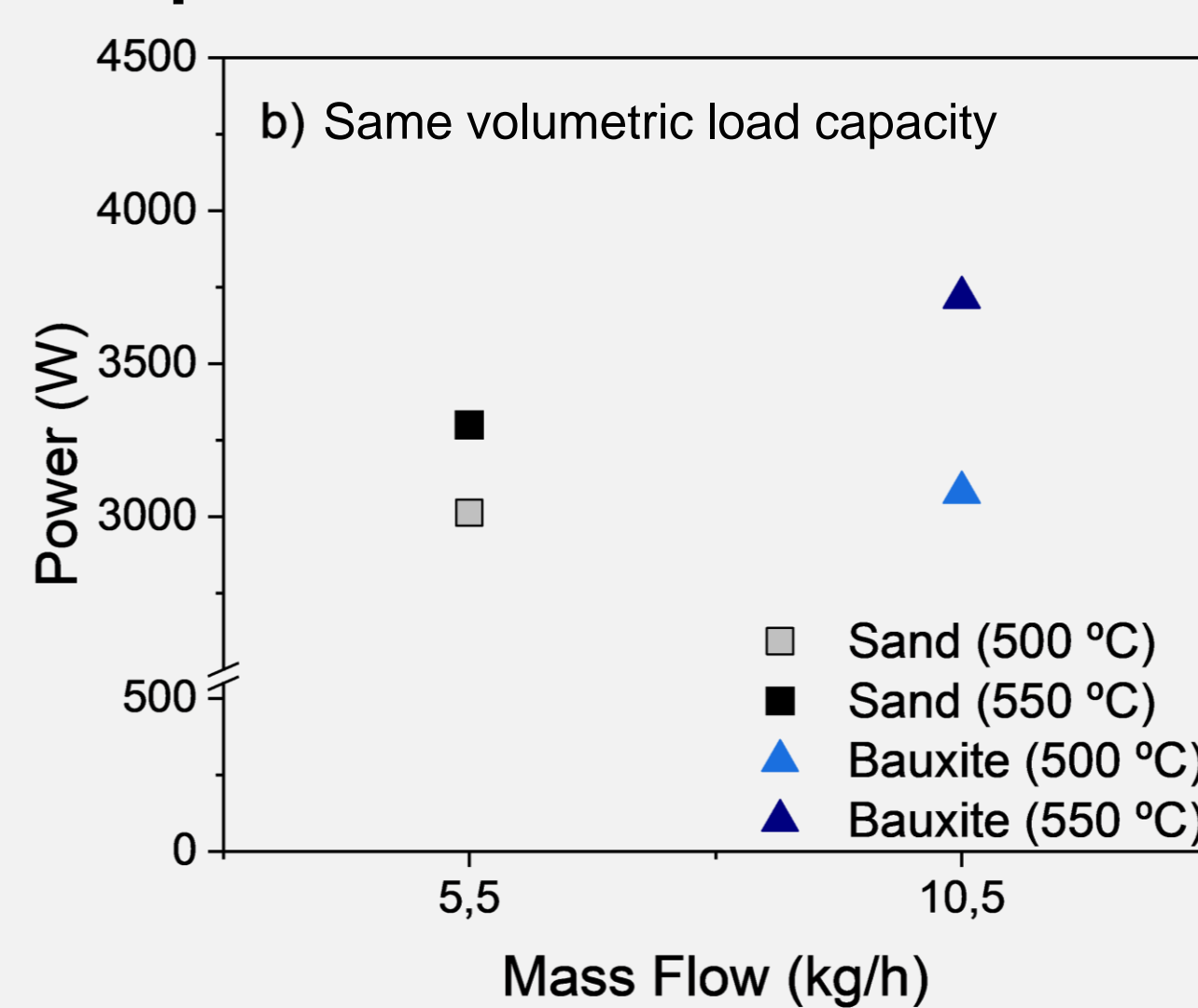
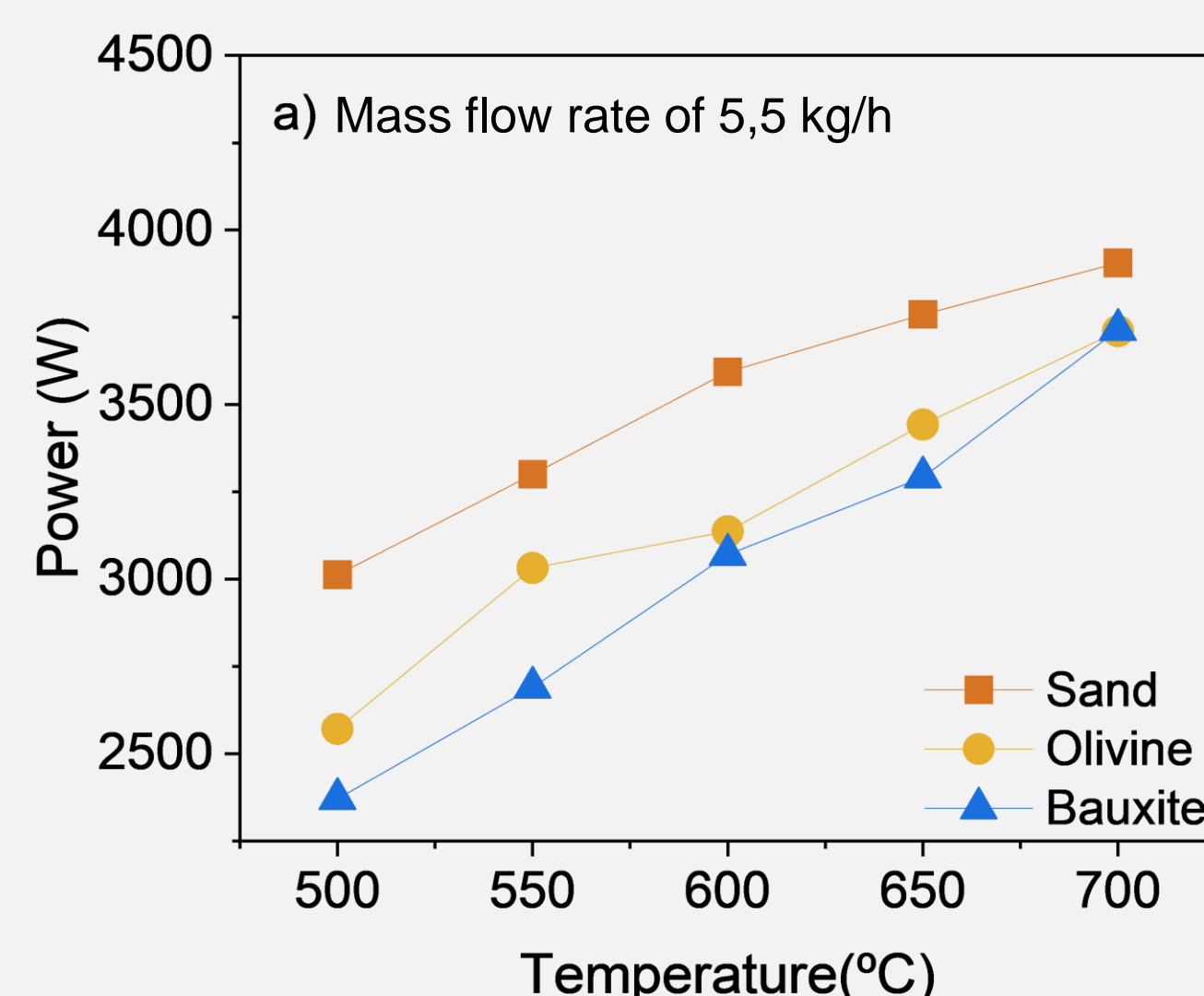


Figure 1a: Sand needs more power to reach the same temperature as **bauxite** and **olivine**.

Figure 1b: At the same power, **bauxite** allows heating **almost twice the mass** compared to **sand**.

Bauxite ▲

High thermal adaptability; its density enables heating of greater mass under comparable power conditions

Sand ■

Thermally stable up to 700 °C; larger reactor volumes decrease temperature uniformity

Olivine ●

More irregular energy consumption profile, likely due to calcination processes that alter its thermal properties during the experiment

Conclusions

Induction = efficient, fast, and scalable heating

Bauxite → better performance (15% lower consumption vs. sand)

Integration with **concentrated solar energy** enhances sustainability

Induction as an enabling technology for a **sustainable biorefinery** in line with **European climate targets**