HERCULES
High-Temperature Thermochemical Heat Storage
Powered by Renewable Electricity
for Industrial Heating Applications

Funded by the Horizon Europe 2021
Programme of the European Union

Numerical modeling of the thermochemical heat storage system for the Steel industry

Renewable power generation from **wind** and **solar PV** provides the **most cost-effective source of electricity** at estimated LCOEs of 2.5 and 4.7 cents/kWh, respectively, for new generation resources [1]. However, the **transient nature** of these power sources requires **heat storage** solutions for their seamless integration with industrial heating systems.

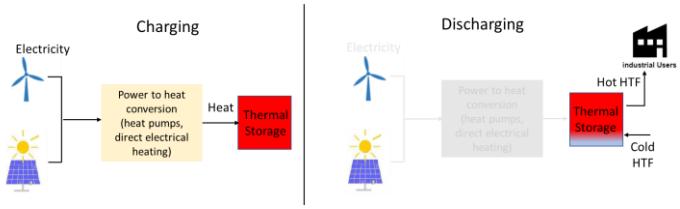

Fig 1. General scheme of thermochemical heat storage integration in power-to-heat systems

The objective of the HERCULES project is to **develop and test a high-temperature thermochemical heat storage system** for industrial process heat applications. This system consists of a well-insulated vessel filled with a **metal oxide reactive porous bed**. **Energy is stored** by **thermally reducing the reactive porous material** via electrical heating according to the **redox reaction**: $MO_x \leftrightarrow MO_{x-y} + \frac{y}{2}O_2$. **Energy is recovered** by **oxidation** when passing air from the ambient through the porous reactive bed. Both the **sensible heat** and the **enthalpy of reaction** are used to heat air that can be used for industrial heating purposes.

Assignment 1: Development of a numerical model for the thermochemical heat storage module.
Assignment 2: Development of a dynamic model for analyzing the system-level performance.

These models will consider the various aspects of the proposed systems, including energy and power density, various sources of irreversibility, and their impact on round-trip efficiency. They will be used to perform parametric studies and optimization of the proposed system. The final assignment tasks will be defined after consultation with the student.

Your background: We are looking for excellent master's students with a Mechanical Engineering or Sustainable Energy Technology background with a willingness to learn Modelica/Matlab.

Contact: Dr. A.K. Singh (a.k.singh@utwente.nl)