



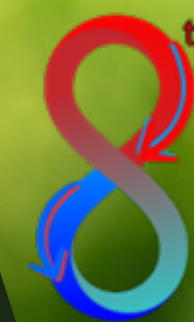
# Conversion Enhancement in a 10 kWth Chemical -Looping Combustion Unit: Effect of Random Metal Packings

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31 Aug – 4 Sept 2026, Manchester (UK)

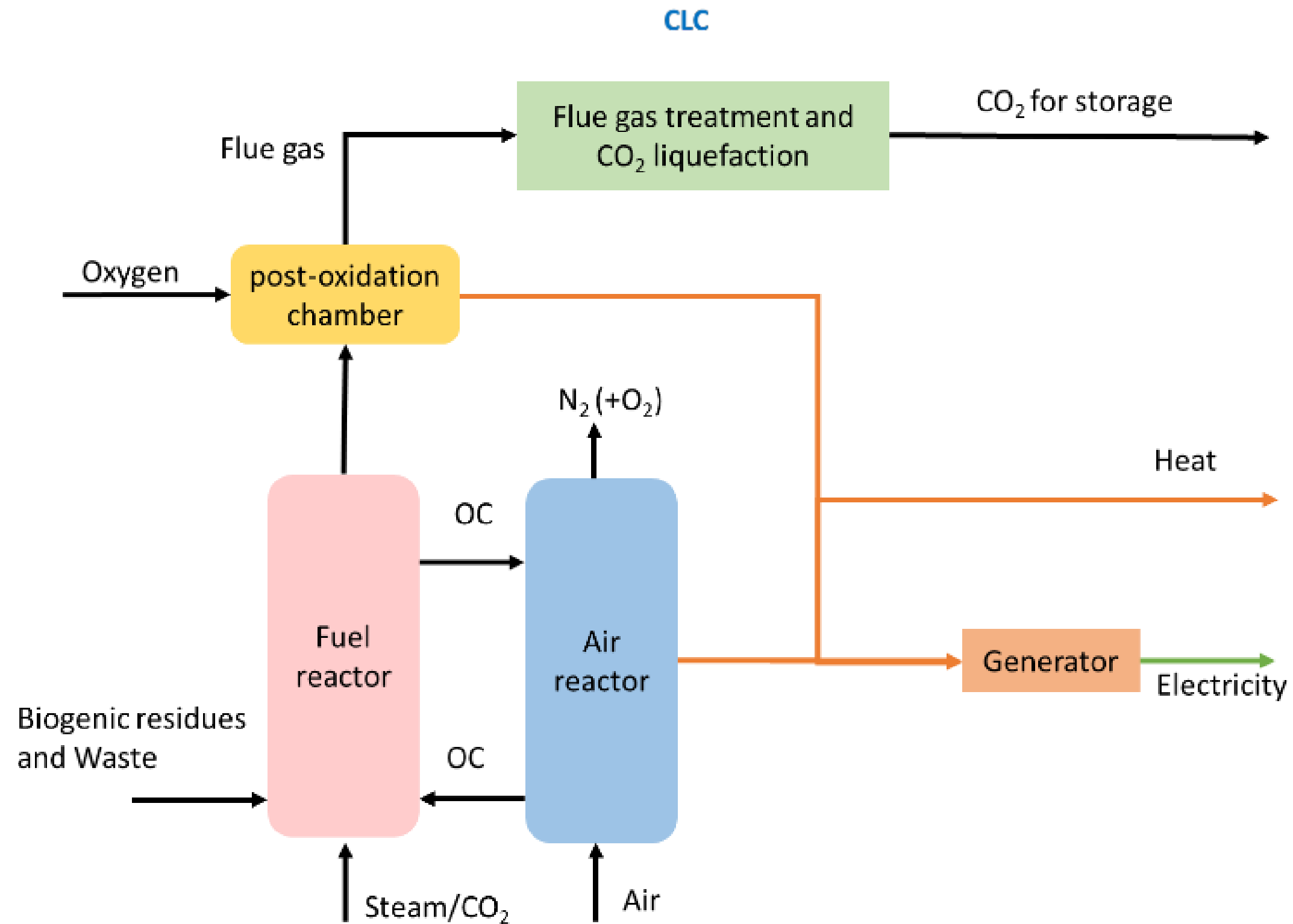


# Outline

- Introduction of chemical -looping combustion concept
- Aim of this work
- Experimental campaign
- Results
- Summary

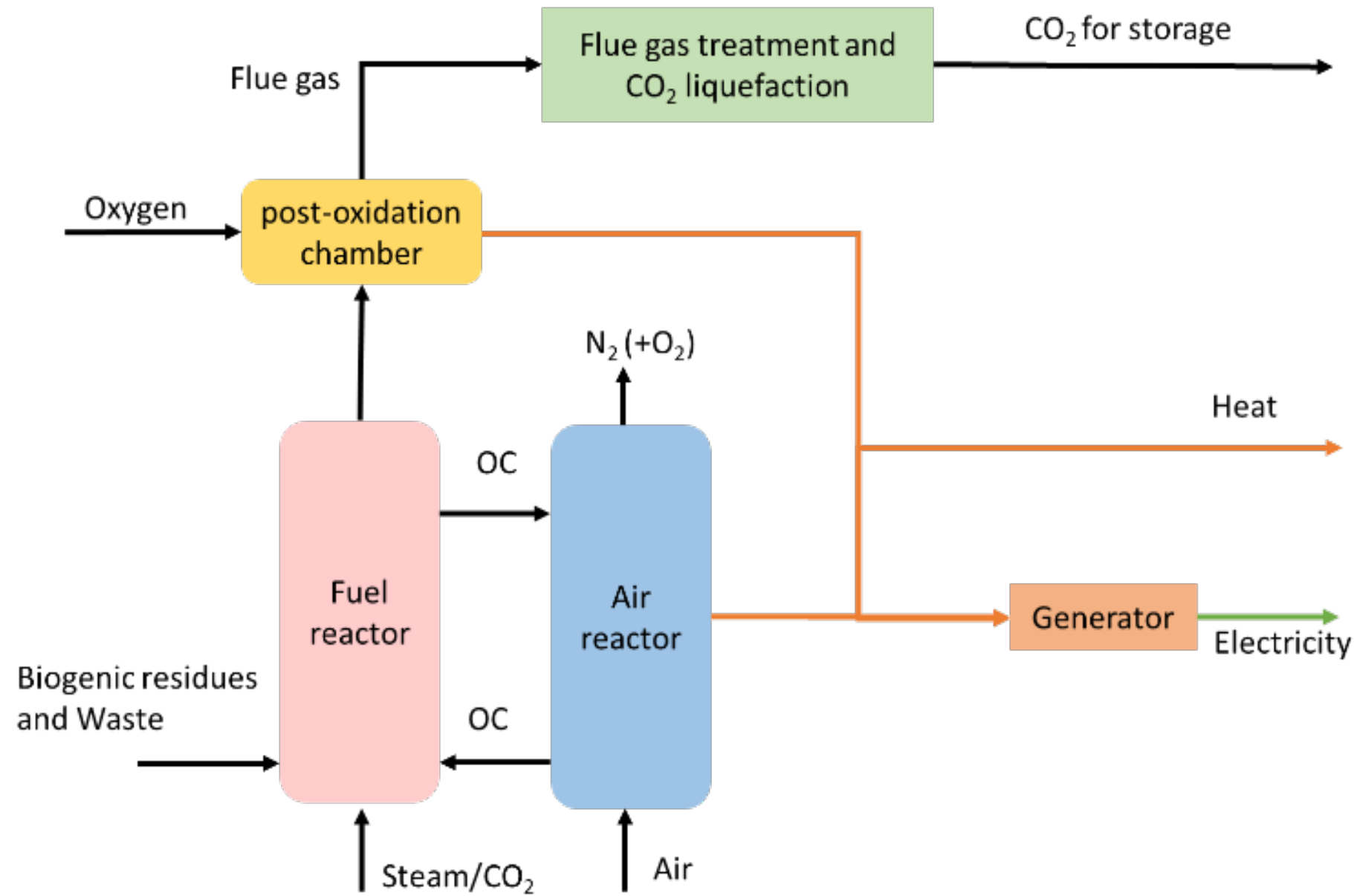


# Introduction

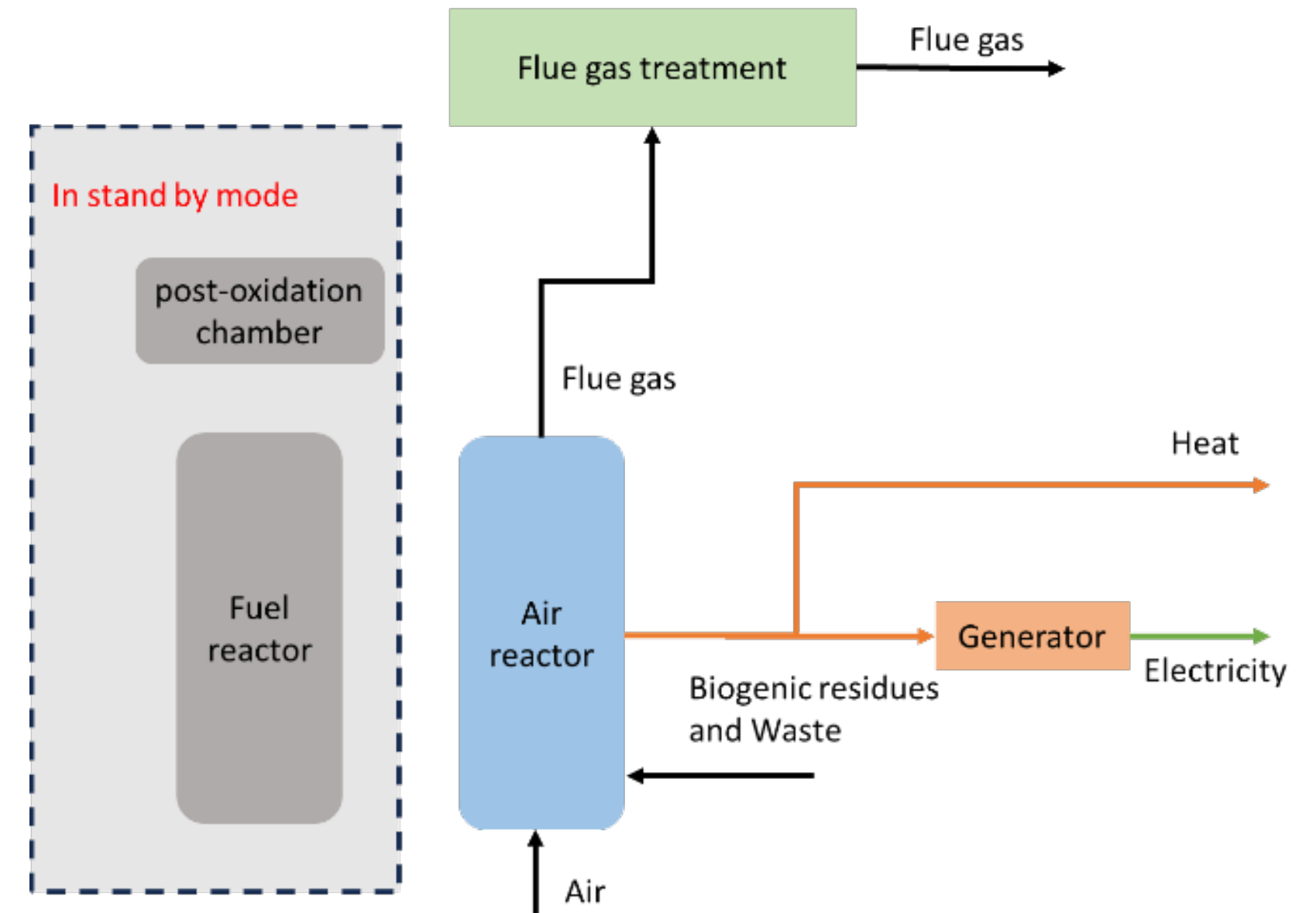


# Introduction

Operating in CLC mode



Operating in OCAC mode



<https://www.bioflexclcproject.eu/>

# Aim

- ❑ Maximize the gas conversion efficiency
  
- ❑ Chemical -looping combustion (CLC):
  - ❖ Optimize operating conditions
  - ❖ Evaluate the effect of internal packing
  
- ❑ Oxygen -carrier aided combustion (OCAC):
  - ❖ Investigate operating conditions on combustion performance

# Experiments



# Experiments

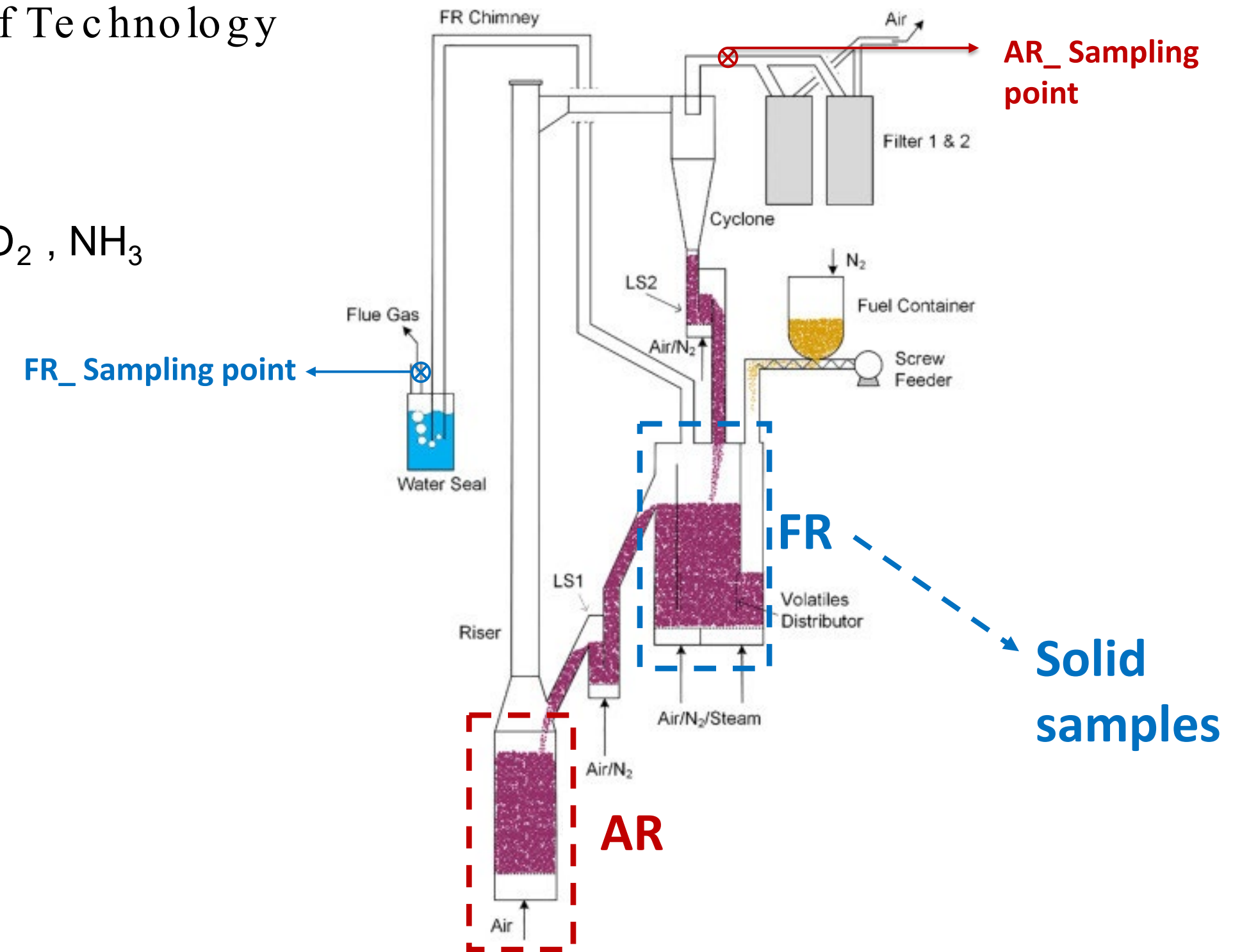
❑ 10 kW<sub>th</sub> CLC pilot plant at Chalmers University of Technology

❑ Gas analyzers:

❖ FR: NO , NO<sub>2</sub> , SO<sub>2</sub> , H<sub>2</sub>S, CO<sub>2</sub>, CO, CH<sub>4</sub>, H<sub>2</sub>, N<sub>2</sub> , O<sub>2</sub> , NH<sub>3</sub>

❖ AR: NO , SO<sub>2</sub> , O<sub>2</sub>, CO<sub>2</sub> , CO

❑ Campaign duration: 36 h of fuel operation



# Experiments

❑ CLC experiments with packings

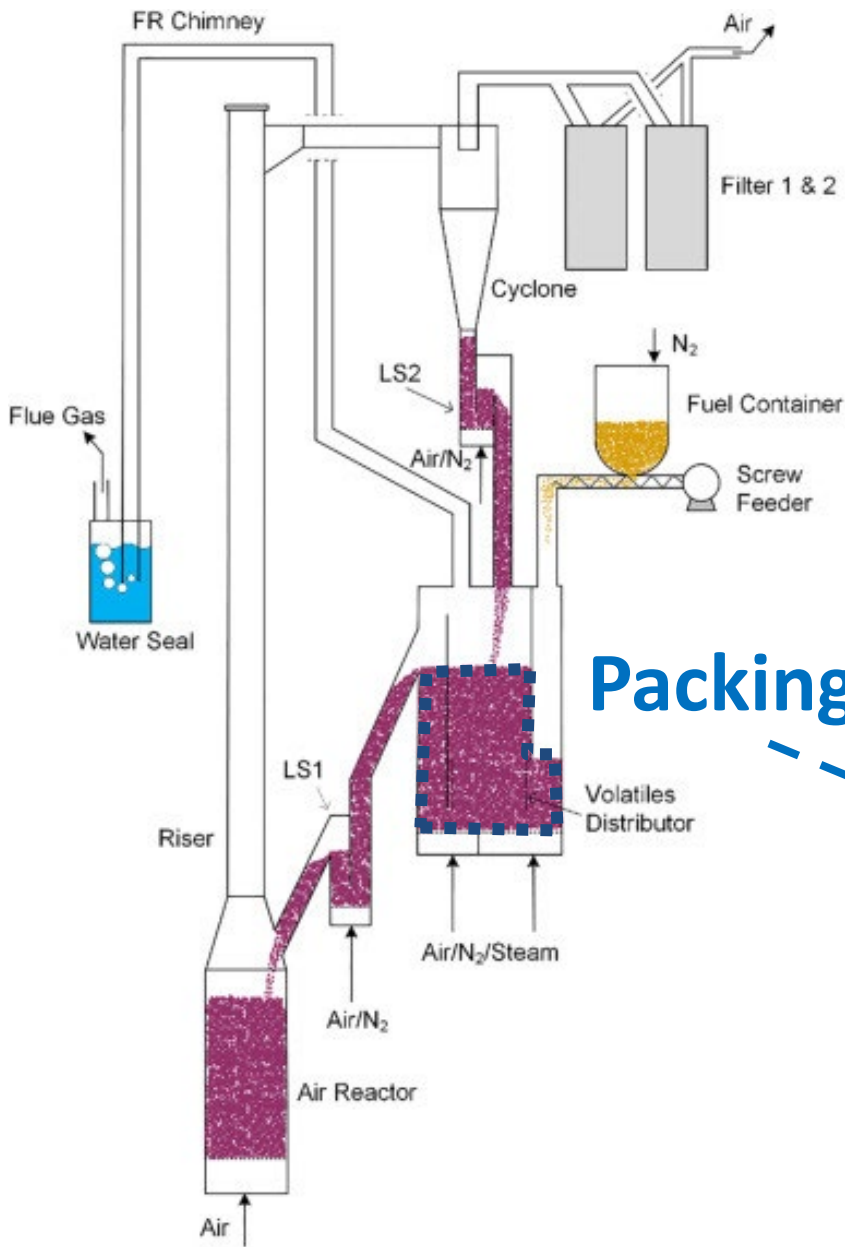
❖ Packing: RMSR 25 mm ( RVT Metal Saddle Ring )

| Packing | Void factor (-) | Bulk density (kg/m <sup>3</sup> ) |
|---------|-----------------|-----------------------------------|
| RMSR    | 0.96            | 204                               |



❖ Fuel: Black Pellets

❖ Oxygen Carrier: Ilmenite concentrate  
( $\text{FeTiO}_3$ ,  $\text{Fe}_2\text{TiO}_5$ ,  $\text{Fe}_2\text{O}_3$ ,  $\text{TiO}_2$ ,  $\text{Fe}_3\text{O}_4$ )



## □ Gas conversion efficiency

$$\eta (\%) = 100 - \left[ 100 \times \frac{0.5x_{CO,out}^{FR} + 2x_{CH_4,out}^{FR} + 0.5x_{H_2,out}^{FR}}{\Phi_0(x_{CO_2,out}^{FR} + x_{CO,out}^{FR} + x_{CH_4,out}^{FR})} \right]$$

## □ Relative solids circulation in the reactor system (circulation index)

$$CI \left( \frac{kPaL}{min} \right) = \Delta P_{Riser} F_{AR} \frac{T_{AR}}{273}$$

Linderholm C, Schmitz M. Chemical-looping combustion of solid fuels in a 100 kW dual circulating fluidized bed system using iron ore as oxygen carrier. J Environ Chem Eng 2016;4:1029–39. <https://doi.org/10.1016/j.jece.2016.01.006>

Gogolev I, Linderholm C, Gall D, Schmitz M, Mattisson T, Pettersson JBC, et al. Chemical-looping combustion in a 100 kW unit using a mixture of synthetic and natural oxygen carriers – Operational results and fate of biomass fuel alkali. International Journal of Greenhouse Gas Control 2019;88:371–82. <https://doi.org/10.1016/j.ijggc.2019.06.020>



Questions / Comments