Fossil-Free Combustion in Grate-kiln Pelletizing Plants Using Co-jet Burner

Presenter
Sofia Larsson, Luleå University of Technology

Project leader
Sofia Larsson, Luleå University of Technology

Partners
Luleå University of Technology, LKAB, Taoshi Energiteknik

Program Day 2023

SWEDISH MINING INNOVATION

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Background

Iron ore pelletizing process large contributor to CO_2 emissions

- ~3% of Swedish industry

Grate-kiln plants today

- Coal and oil used in flame in rotary kiln

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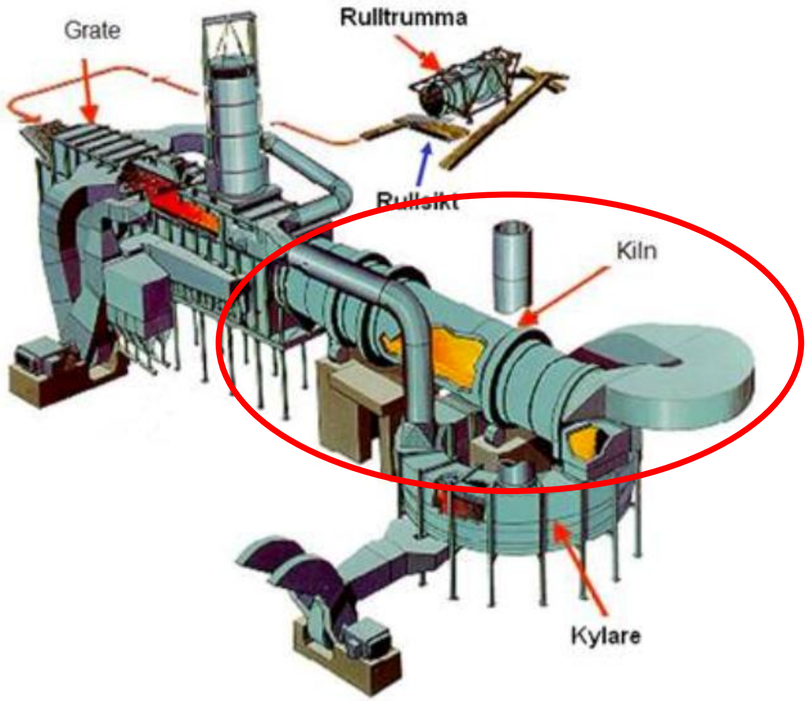
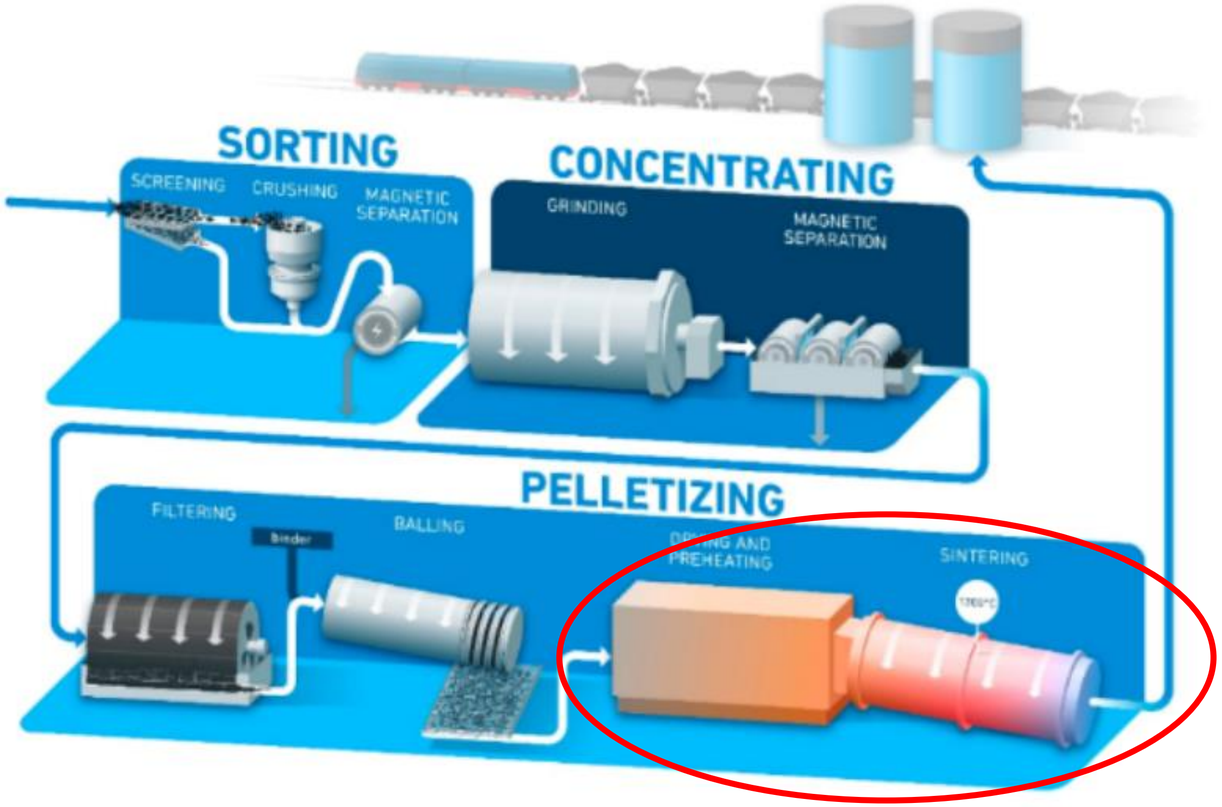
Main goal of the project

Reduce CO_2 emissions from grate-kiln pelletizing plants

- Replace fossil fuels with hydrogen
- Aimed at LKAB's rotary kiln





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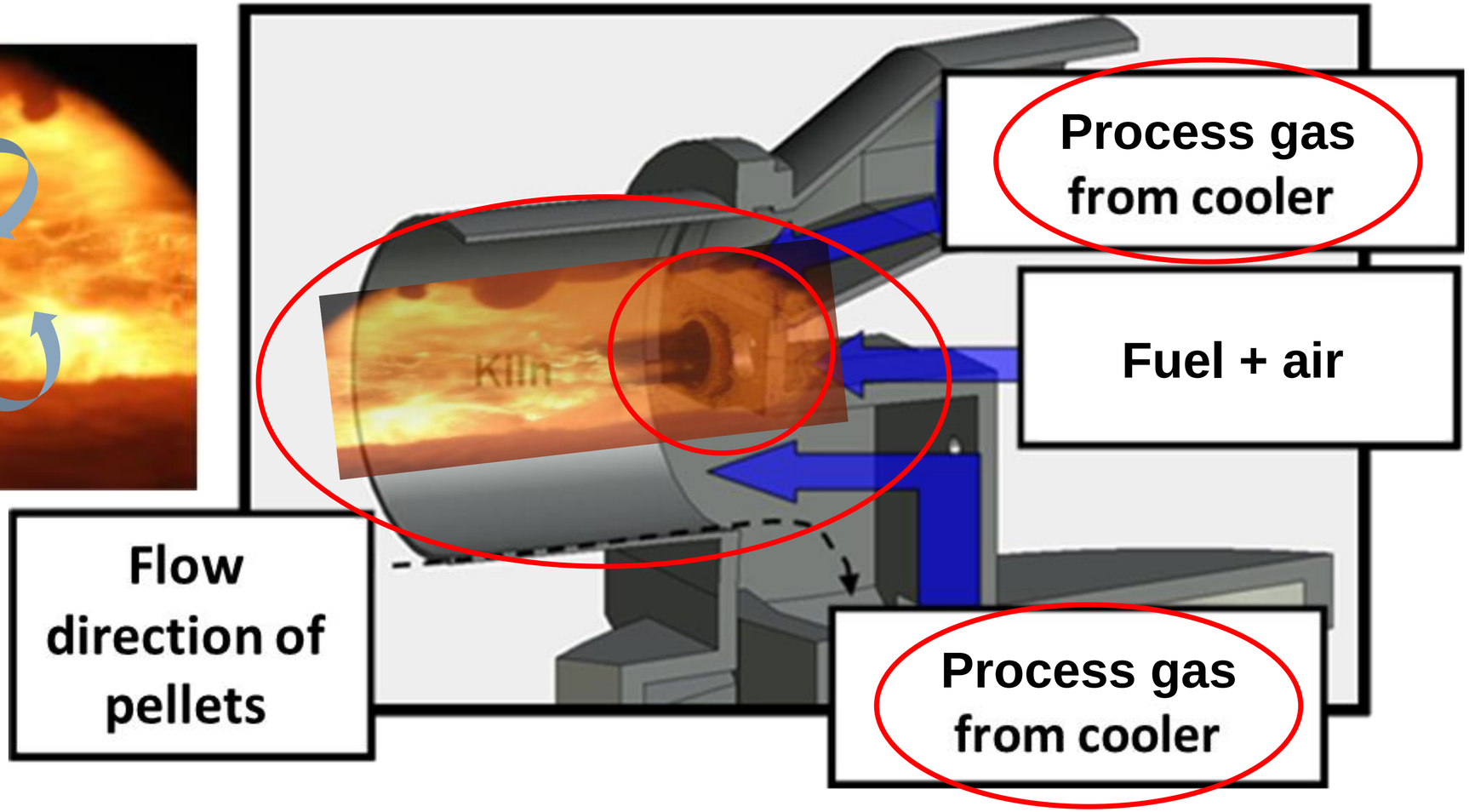
Challenge

Long flame →
High inlet velocity
Slow mixing



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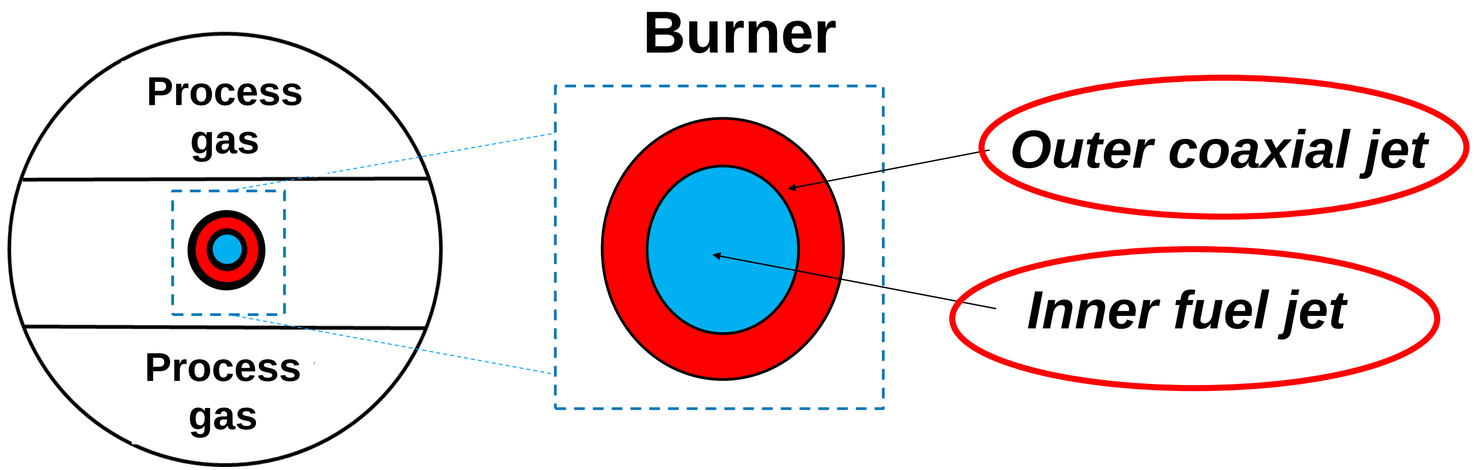
Solution

Not possible to use hydrogen using existing commercial equipment

- A different approach is needed!

Coaxial jet burner

- Control mixing and hence flame length



Coal

Co-jet

H2

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Goals of the project – in detail

- Validated flow field simulation model
- Experimental model
- Simulation model, incl. H_2 combustion
- Co-jet burner concept

- Environmental impact
  - Energy efficiency
  - Elimination of CO_2 emissions
  - Process efficiency

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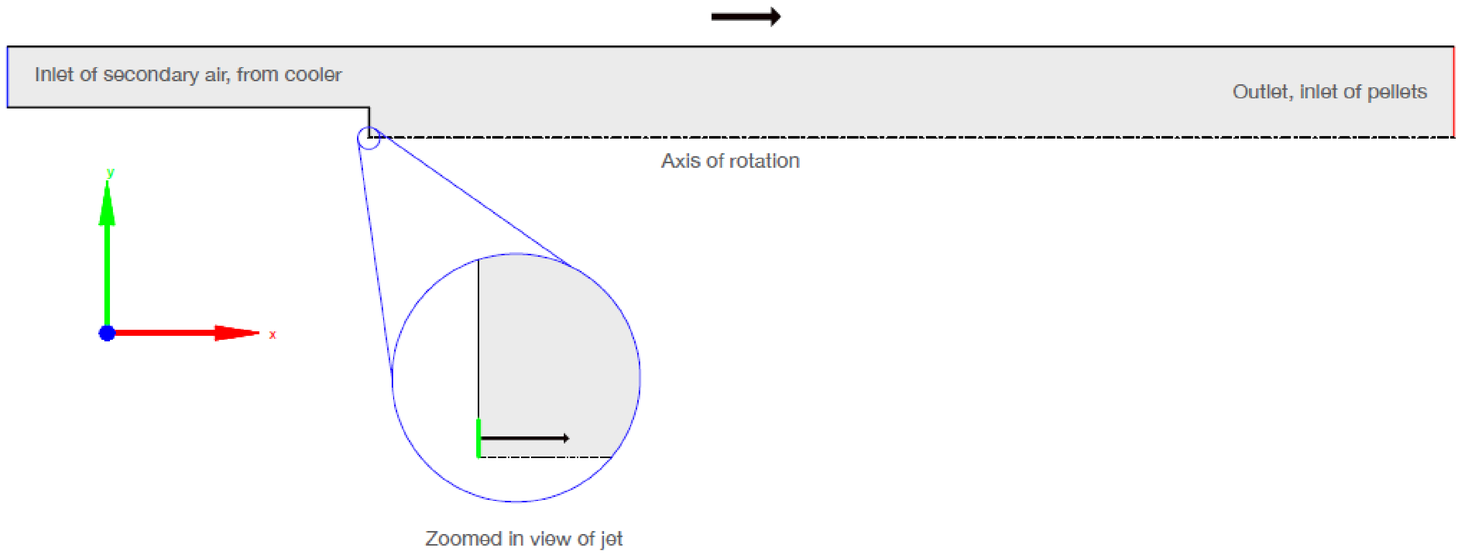
Project Plan

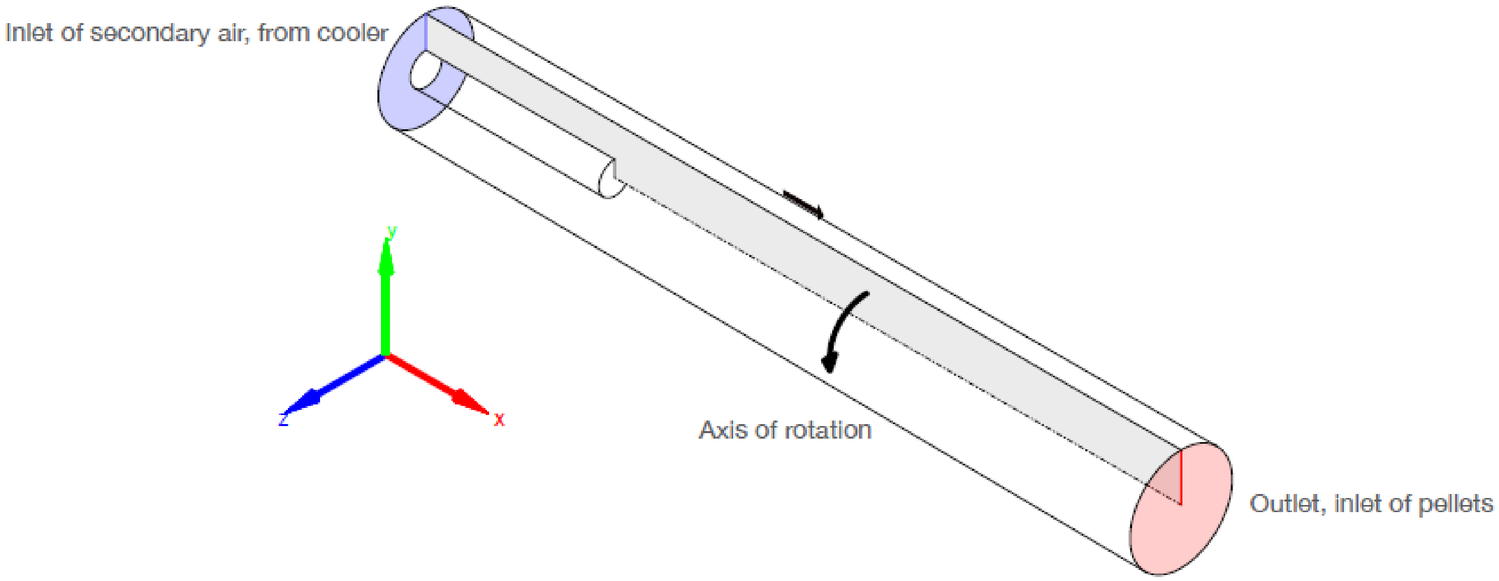
Simplified simulations

- Fast results
- Find trends
- Parameter sensitivity study

Investigate co-jet

- H_2 as fuel
- Compare to fossil fuels (coal)





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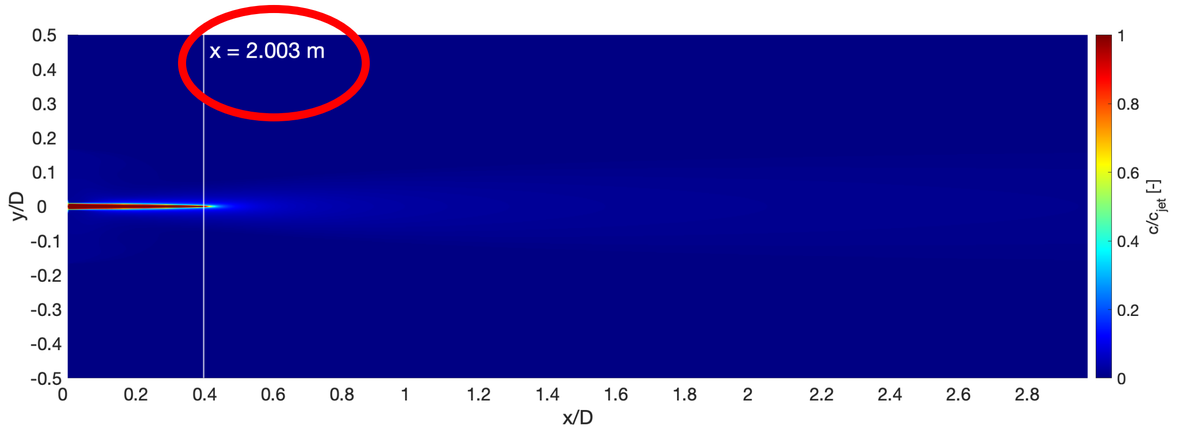
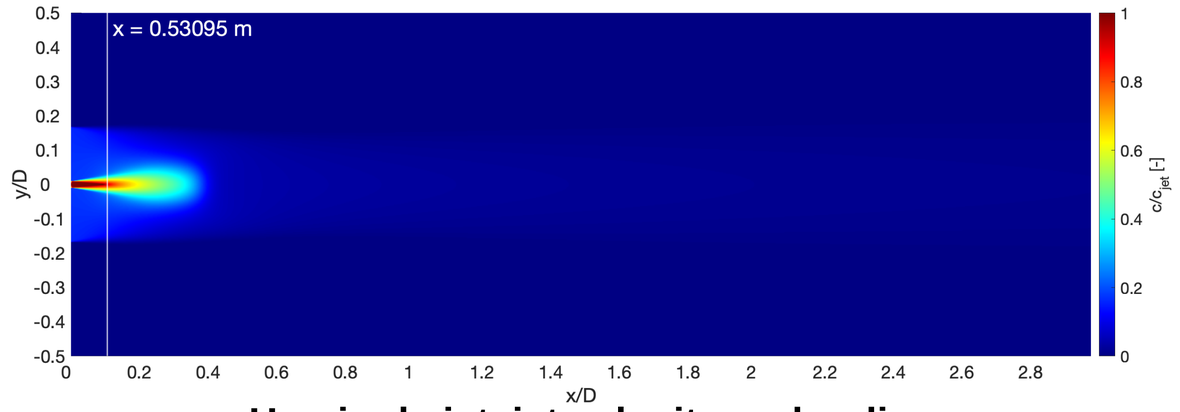
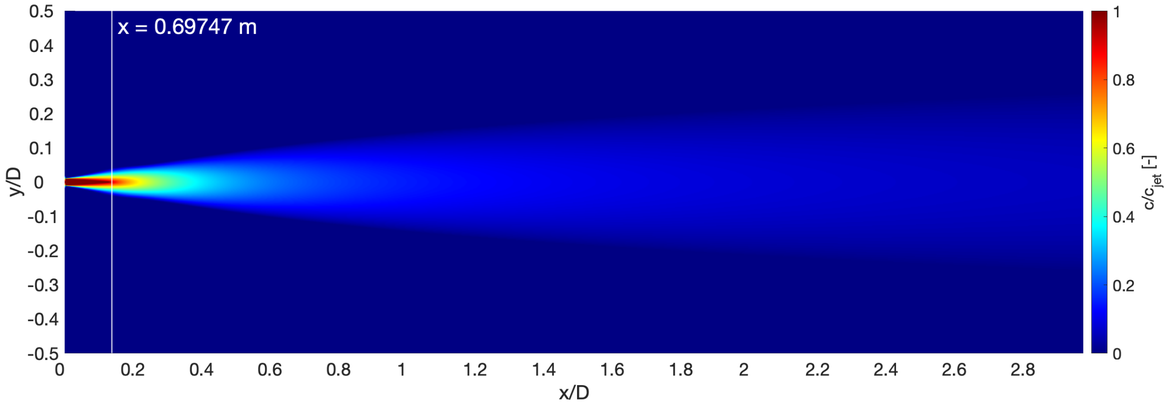
Project results so far



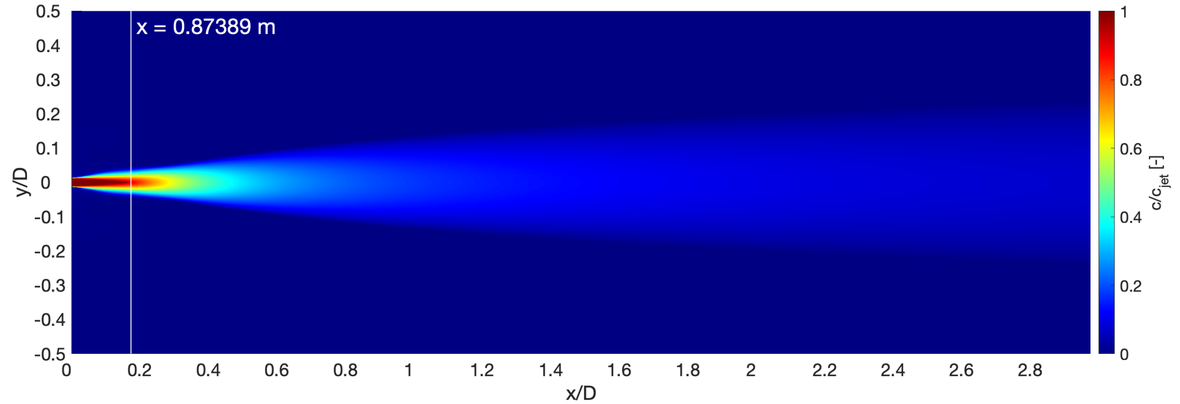
Base case – coal, single jet



H_2, single jet, jet velocity and radius same as base case



H_2, single jet, jet power and kinetic energy same as base case



H_2, co-jet, M_{jet}=0.5

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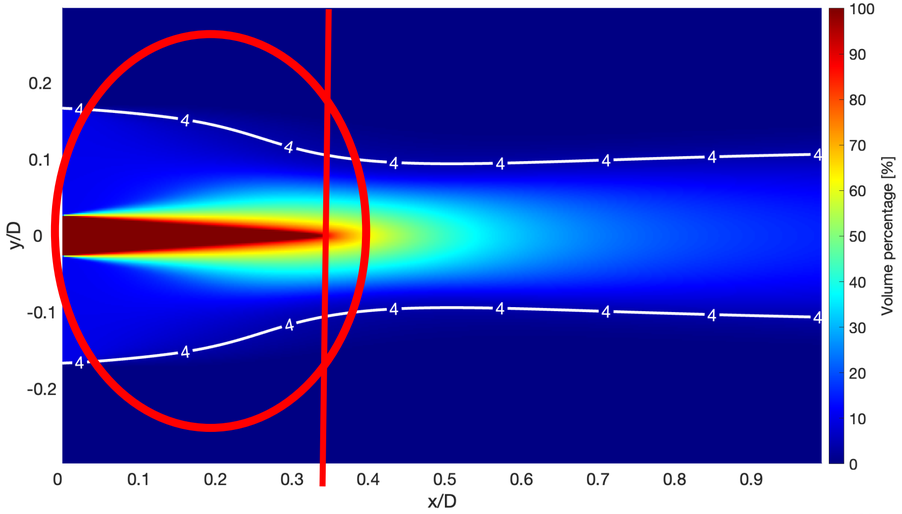
Project results so far

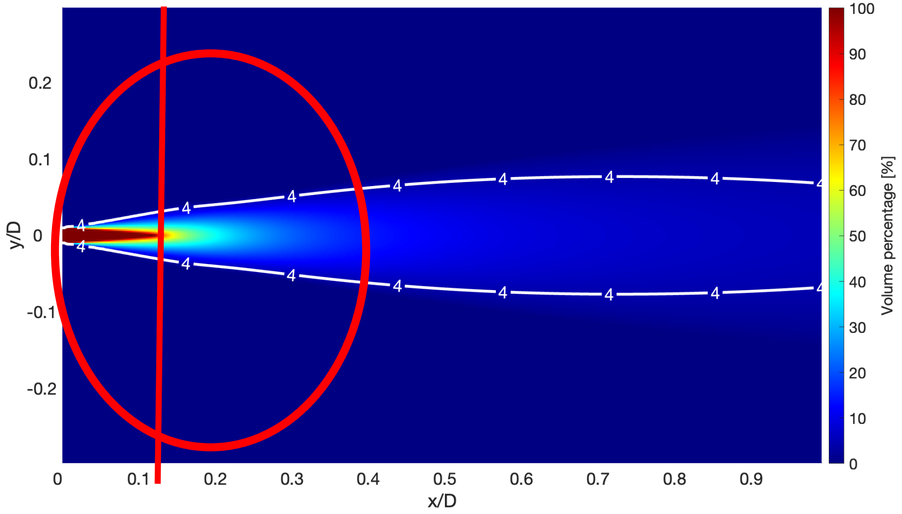
”Bad” configuration

- Accumulation of H_2

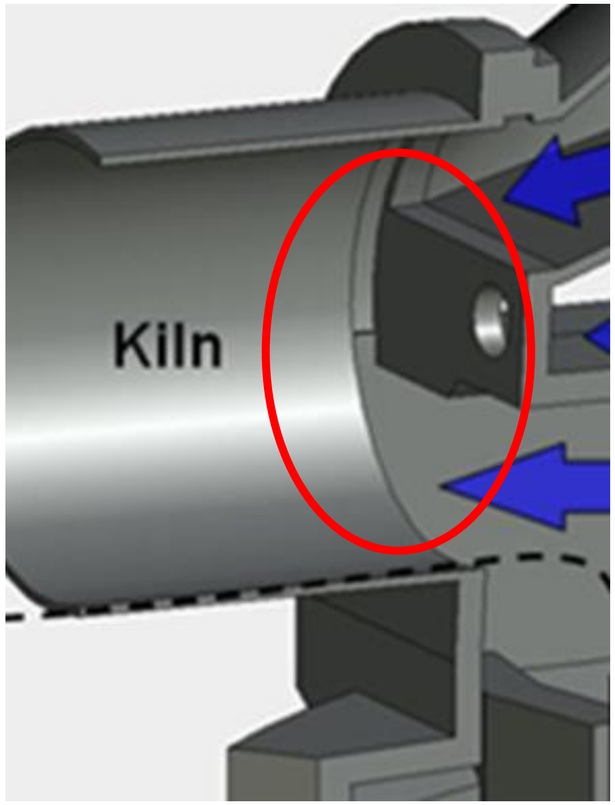


”Good” configuration

- No recirculation of H_2



Hydrogen flammability range 4-75 vol%



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Dissemination

Two articles/papers planned

- One journal (in progress)
- One conference

Conferences

- Fluid mechanics
- Mining

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Next Steps

Still in the early phases

Move onto more realistic simulations

- 2D → 3D
- Experimental validation
- Reactions
- Combustion

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