Modeling of Combined Heat and Power Generation Unit for Dynamic Analysis of Integrated Thermal-Electric Grids

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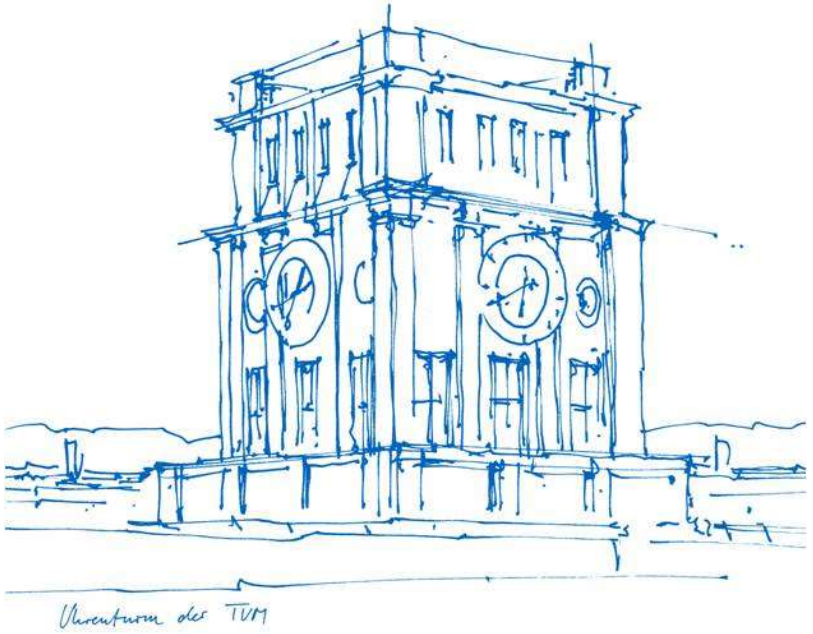
Center for Combined Smart Energy Systems (CoSES)

Munich, 02. February 2021.



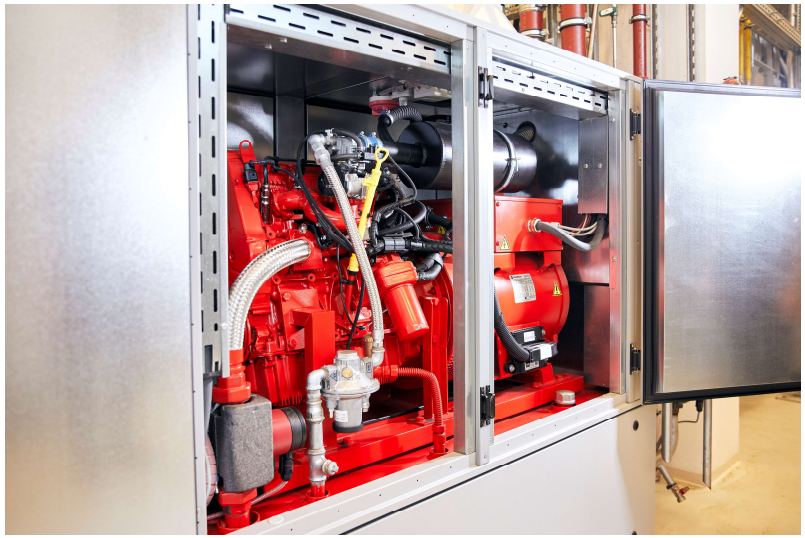
Outline

- **Introduction**
- Combined Heat Power Model
- Engine with Heat Exchangers
  - Mechanical Sub System
  - Exhaust Heat Exchanger
  - Engine Wall and Outlet Heat Exchanger
- Test Scenarios and Results
- Future Scope

Introduction

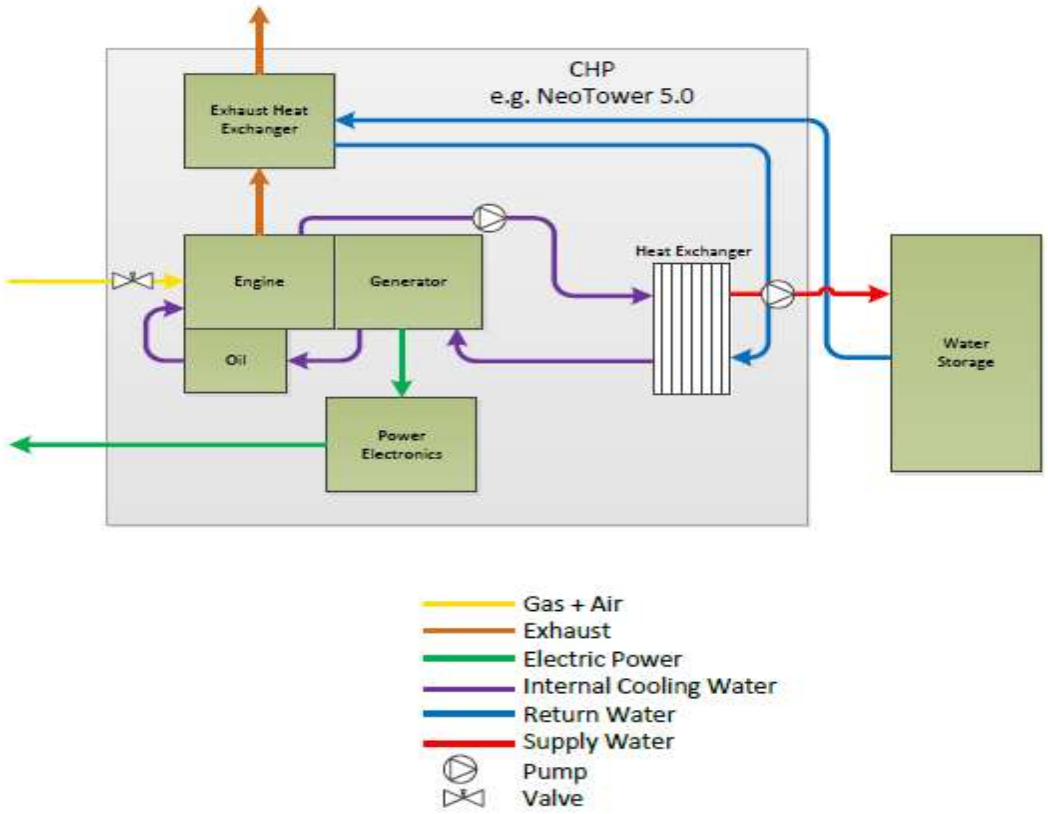
- Integration of heating and electric energy sectors
- Combined heat power (CHP) is the unit that generates electricity and useful heat at the same time.
- Different dominant time constants of electric and thermal systems

- Modelling a commercial micro-CHP unit



https://www.researchgate.net/publication/342927189_CoSES_Laboratory_for_Combined_Energy_Systems_At_TU_Munich

Combined Heat and Power Plant



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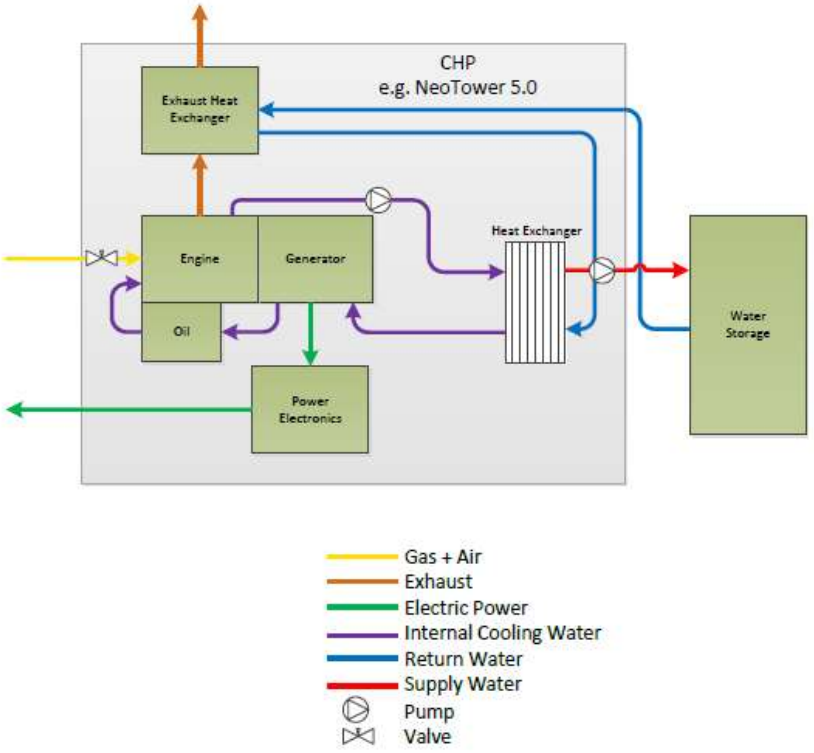
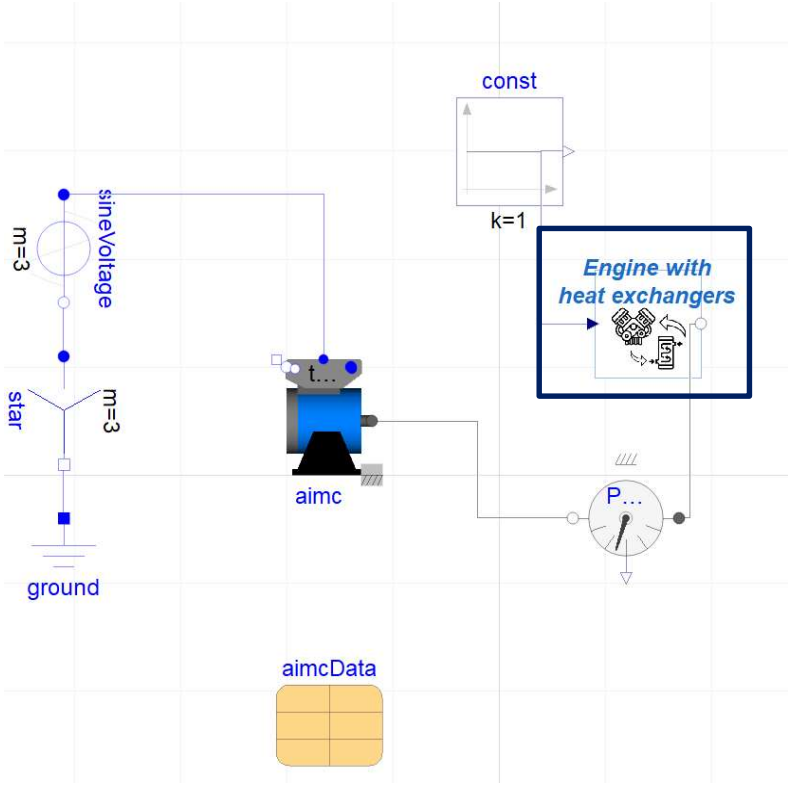
Combined Heat Power Model





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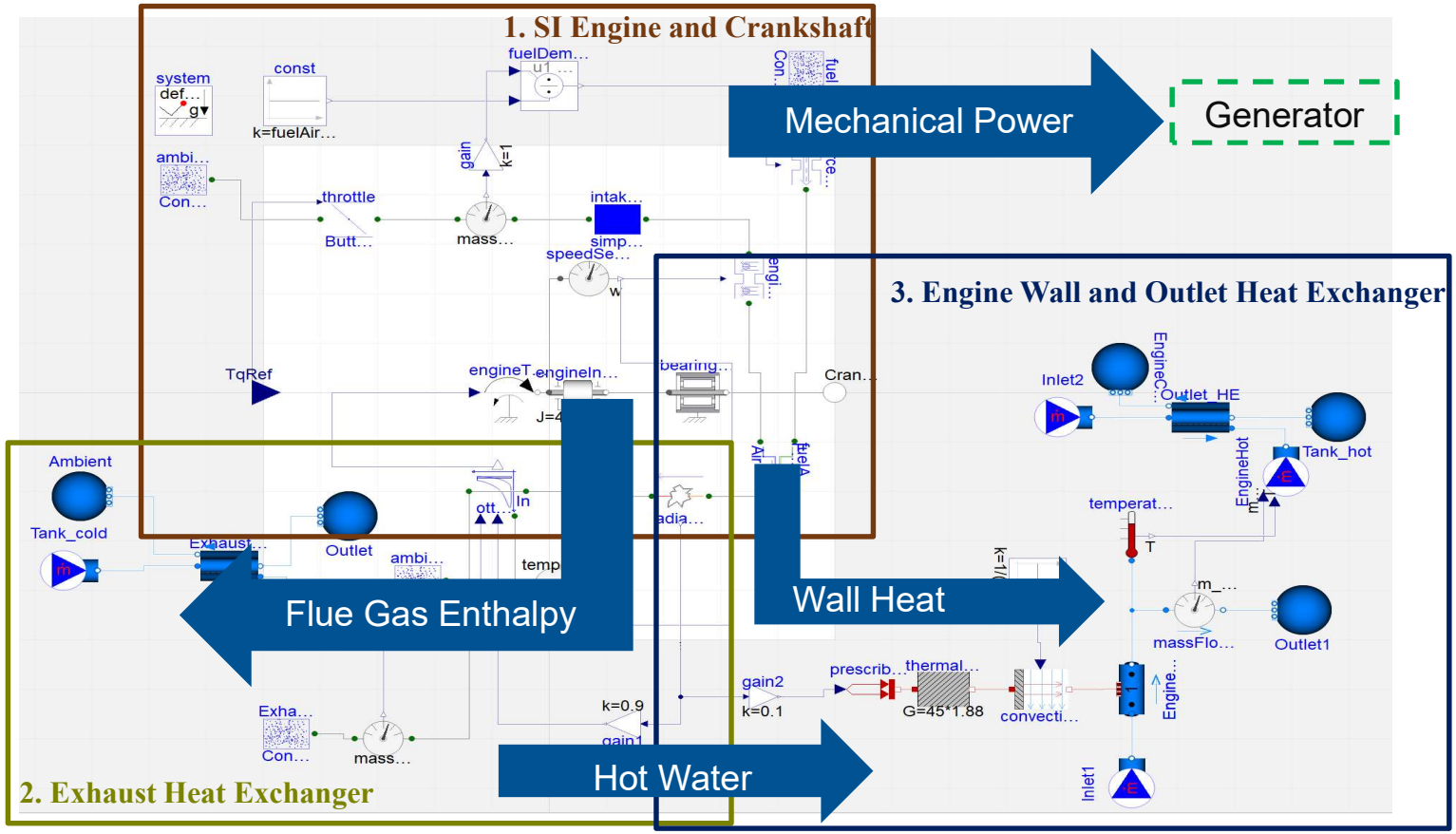
Energy Interaction and Interfacing



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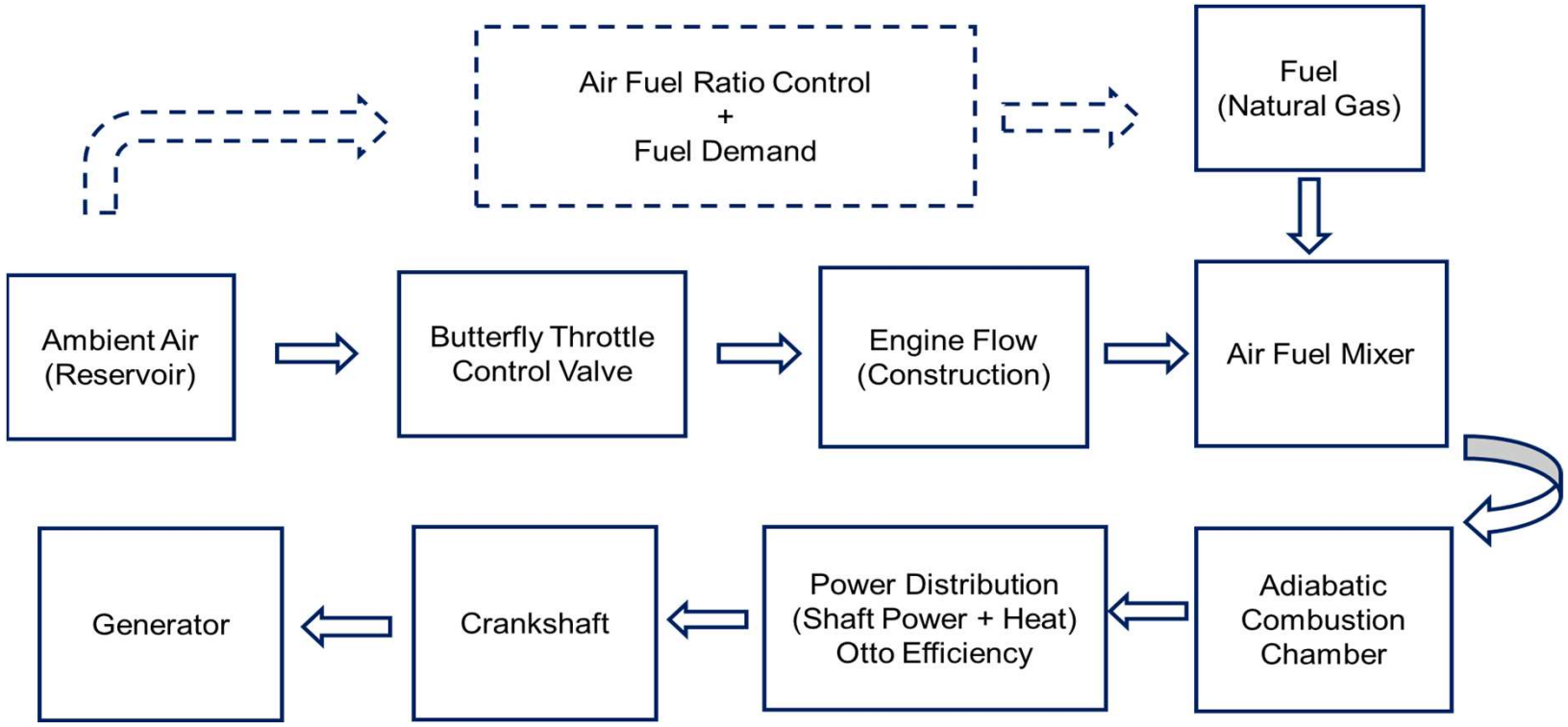
Mechanical Sub System



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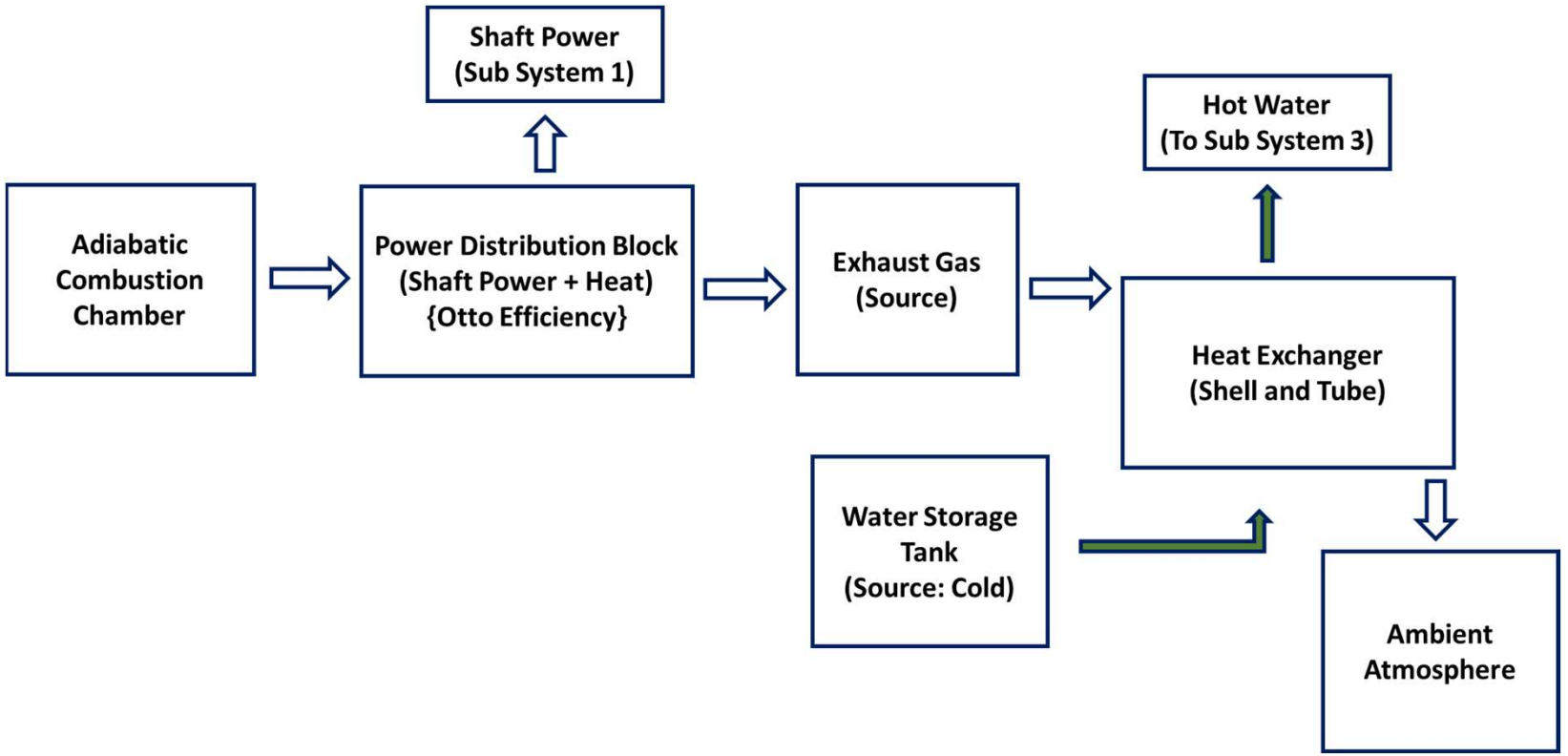
Exhaust Heat Exchanger



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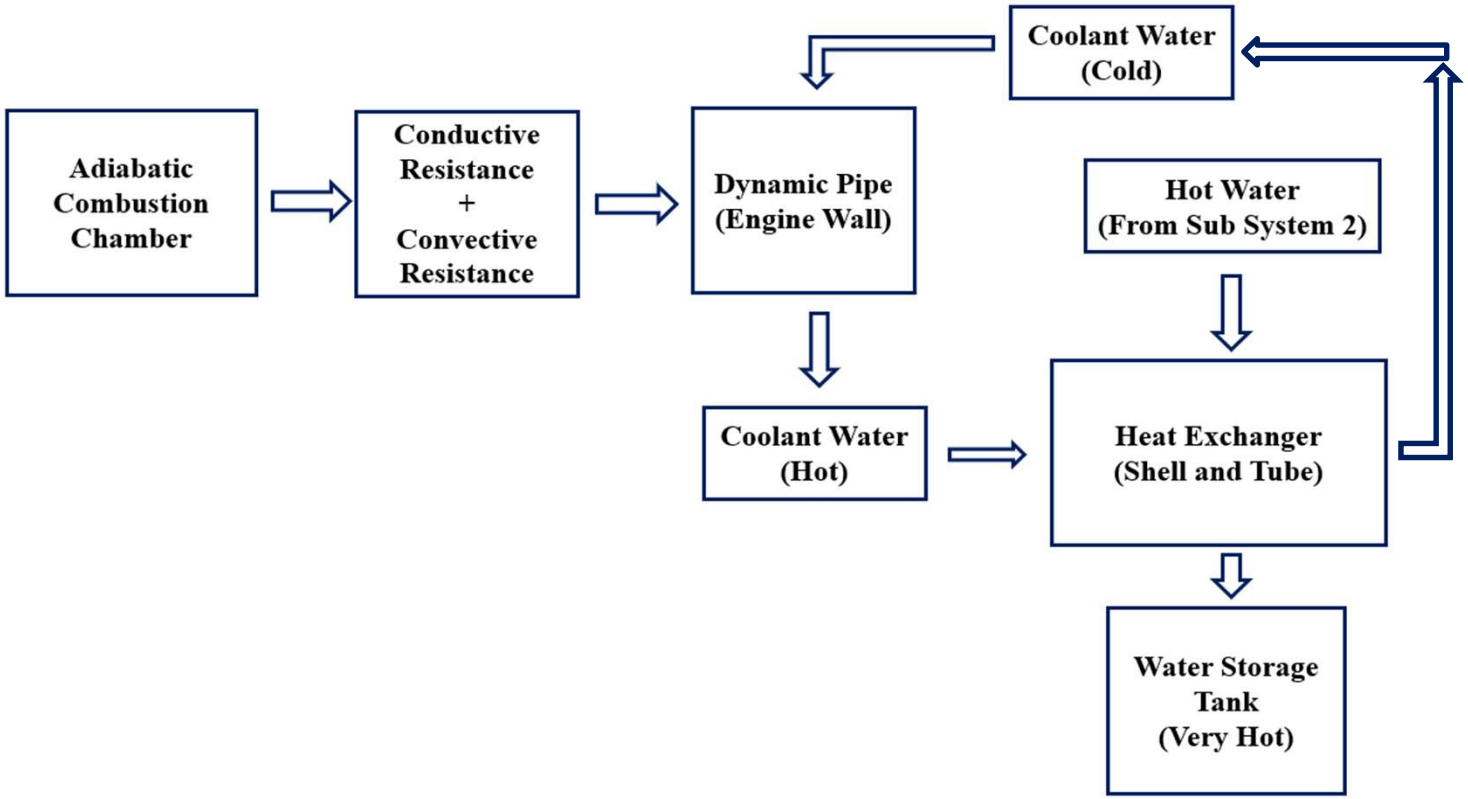
Engine Wall and Outlet Heat Exchanger



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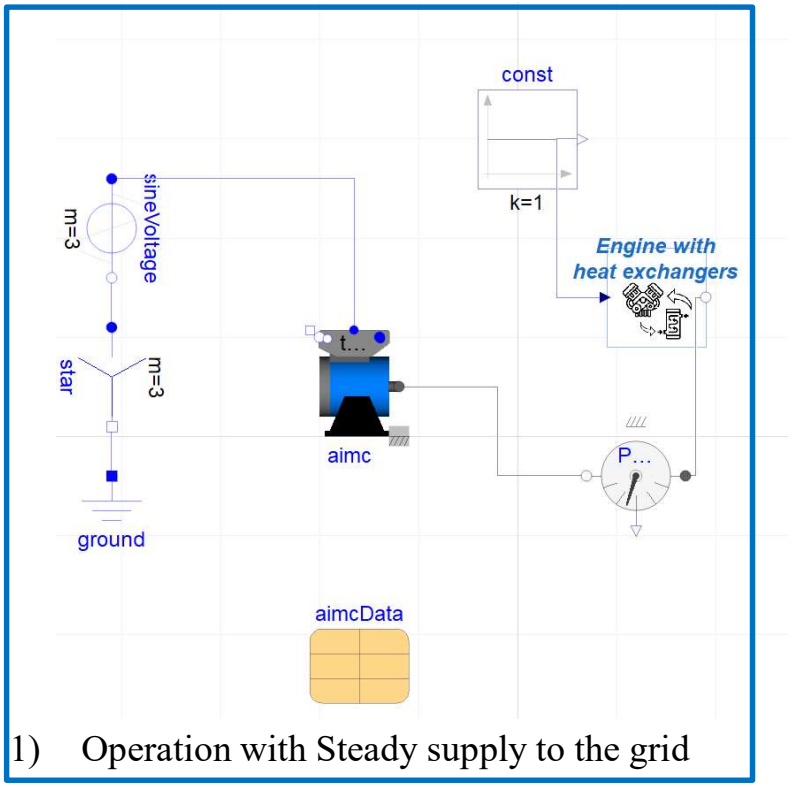
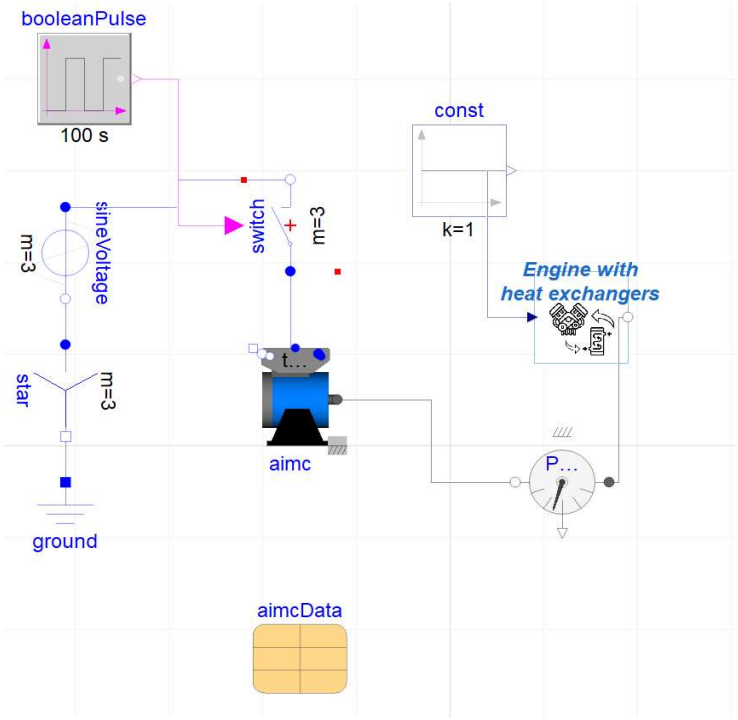
Test Scenarios and Results

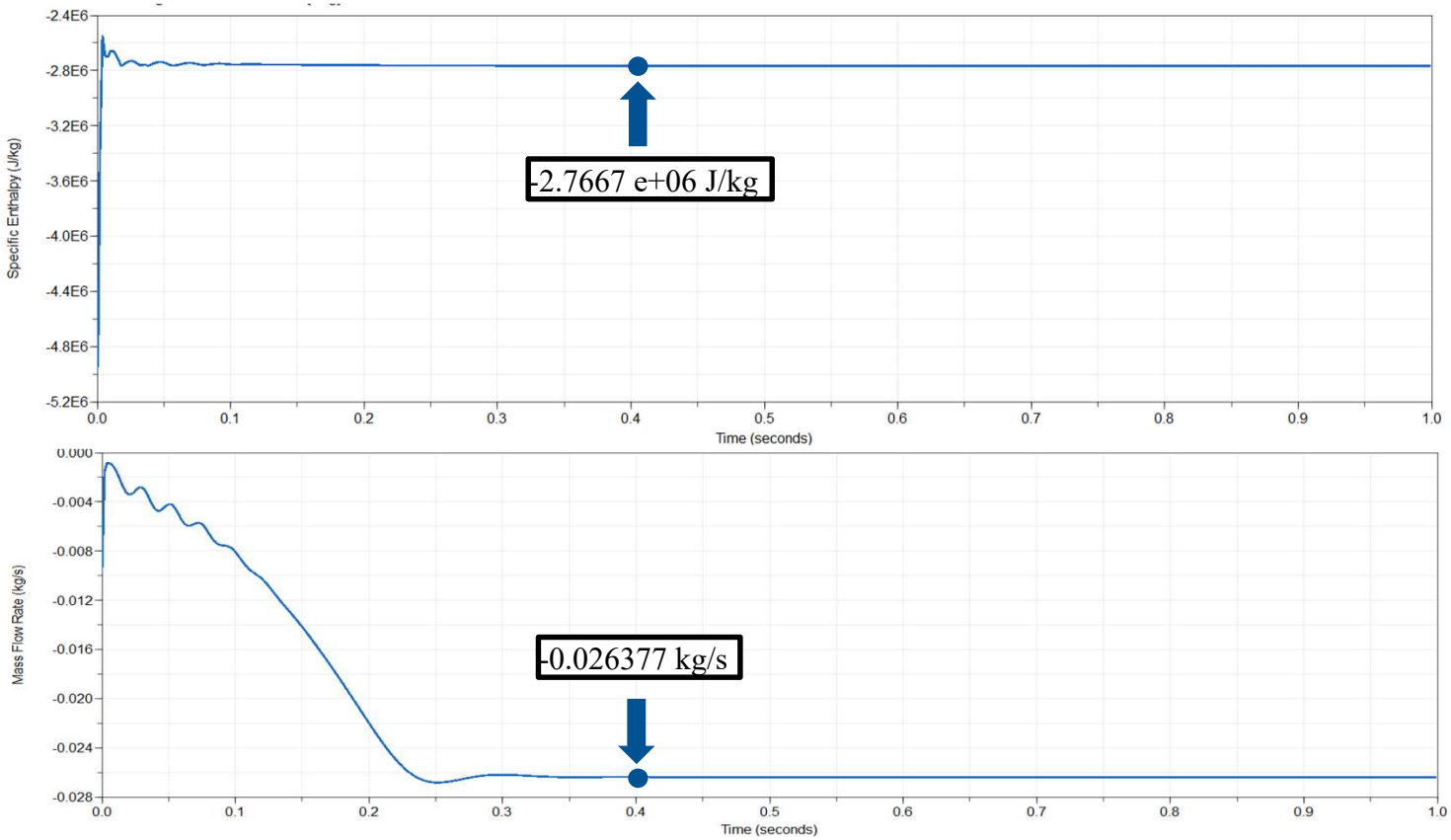


1) Operation with Steady supply to the grid



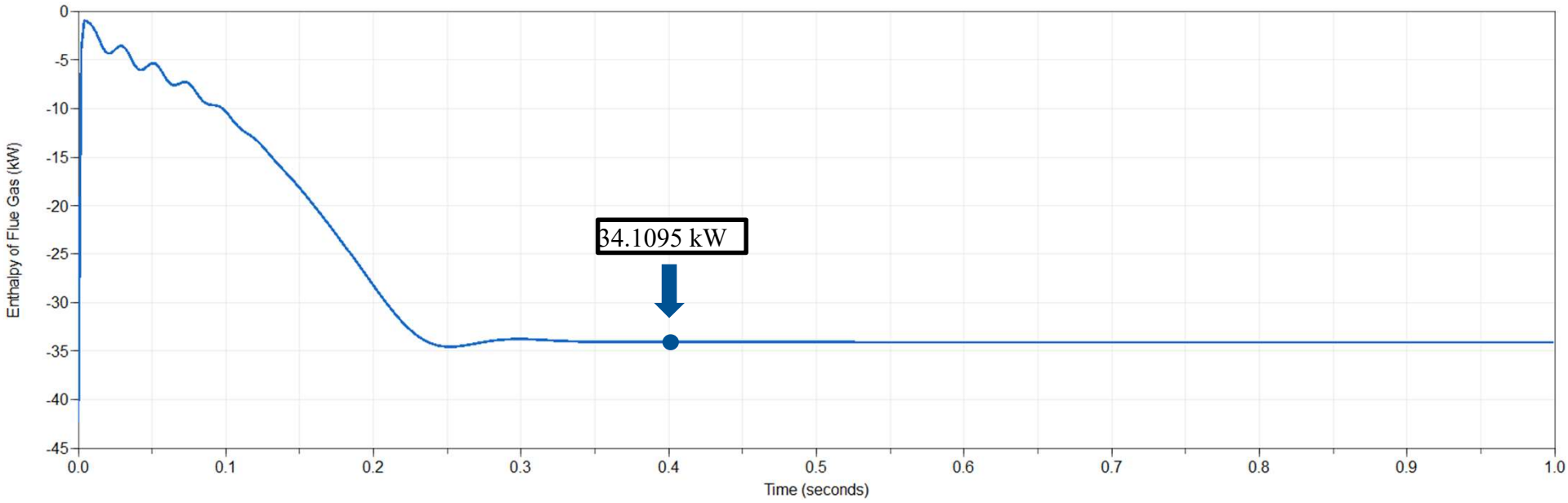
2) Operation with Fault/Dip in the grid

Heat of Combustion

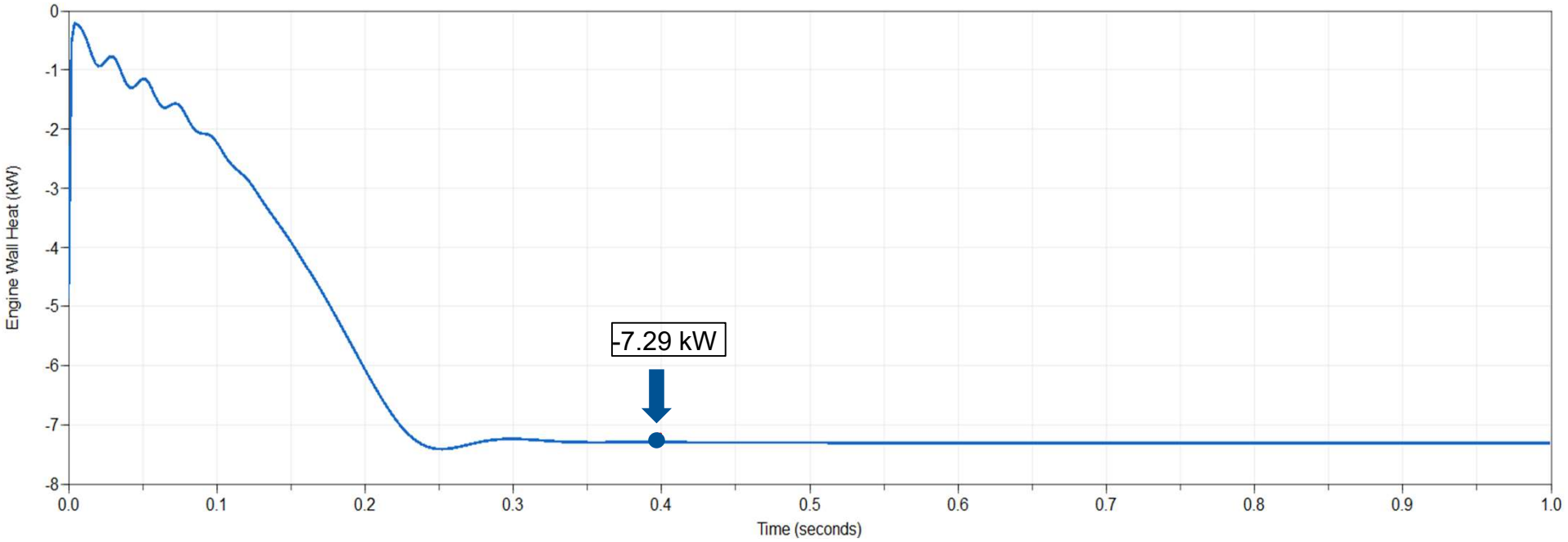


At the steady operation,
Combustion Heat =
Specific Enthalpy * Mass Flow rate
= **73.04kW**

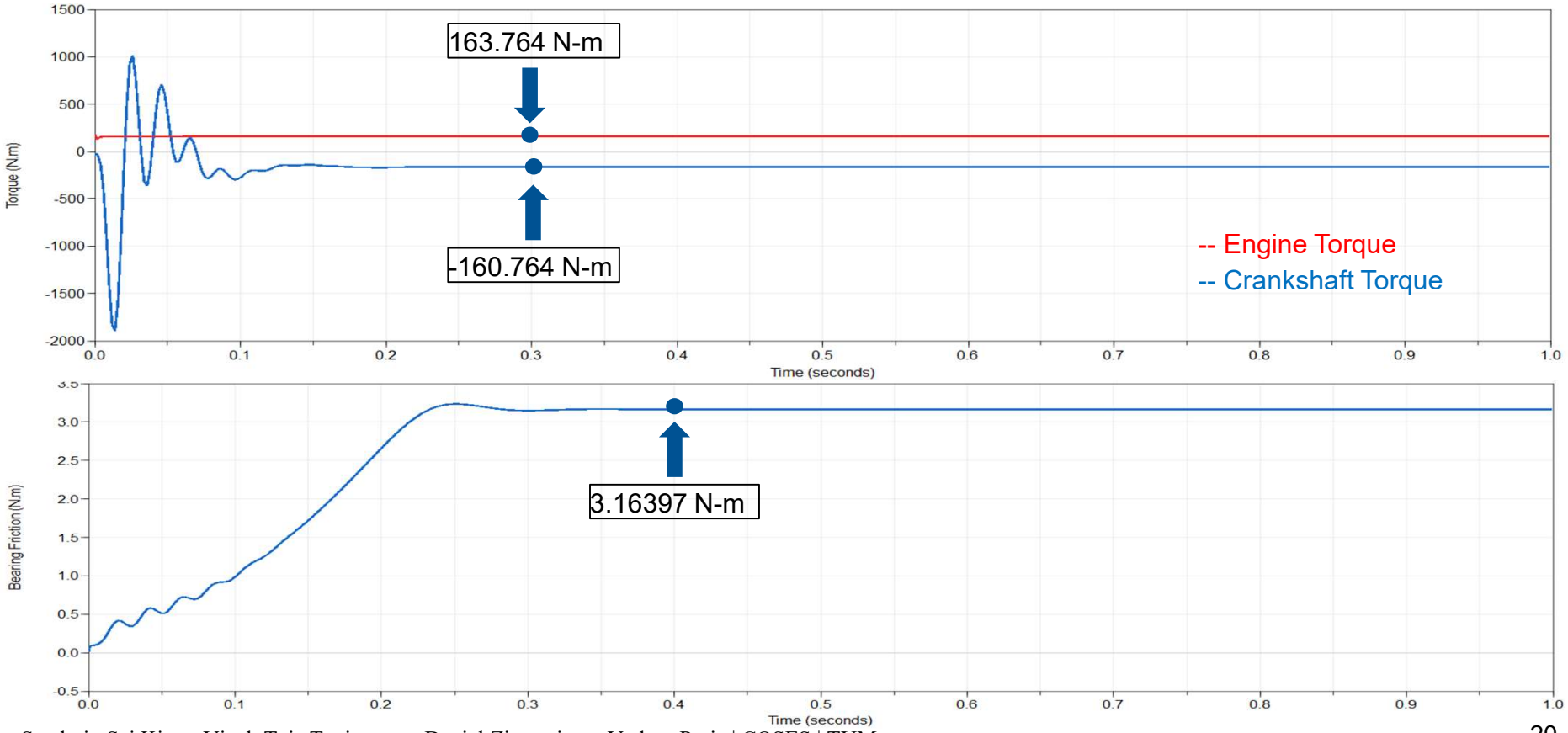
Heat of the Exhaust Flue Gas



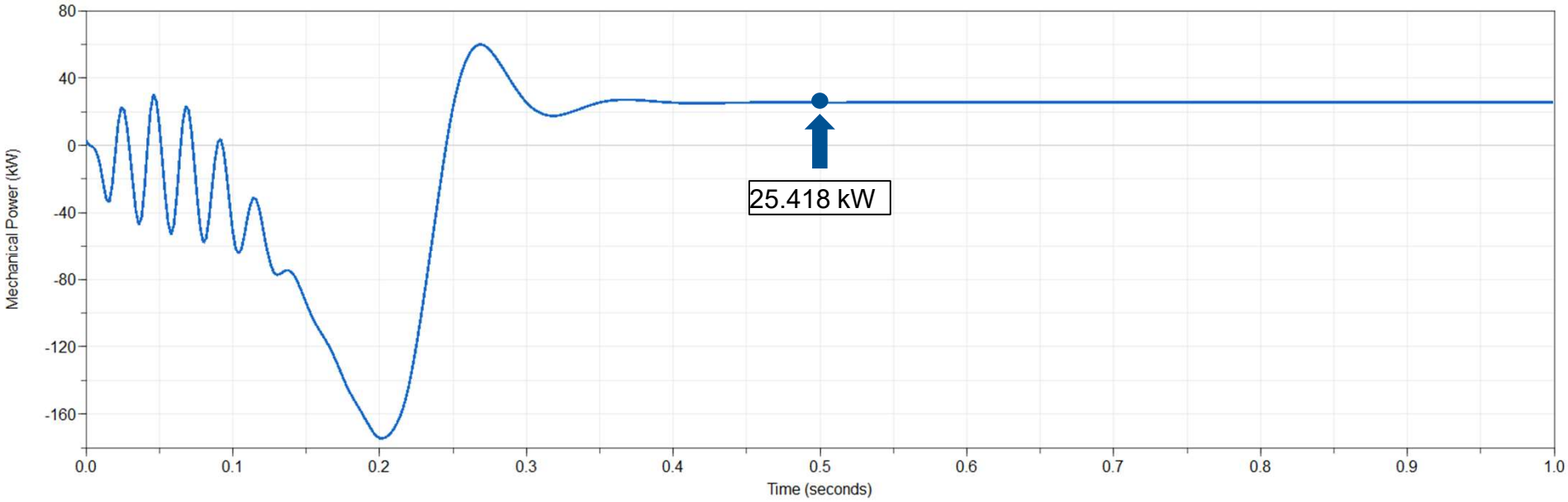
Heat Dissipation at the Engine Wall



Torque (Engine, Bearing Friction and Crankshaft)

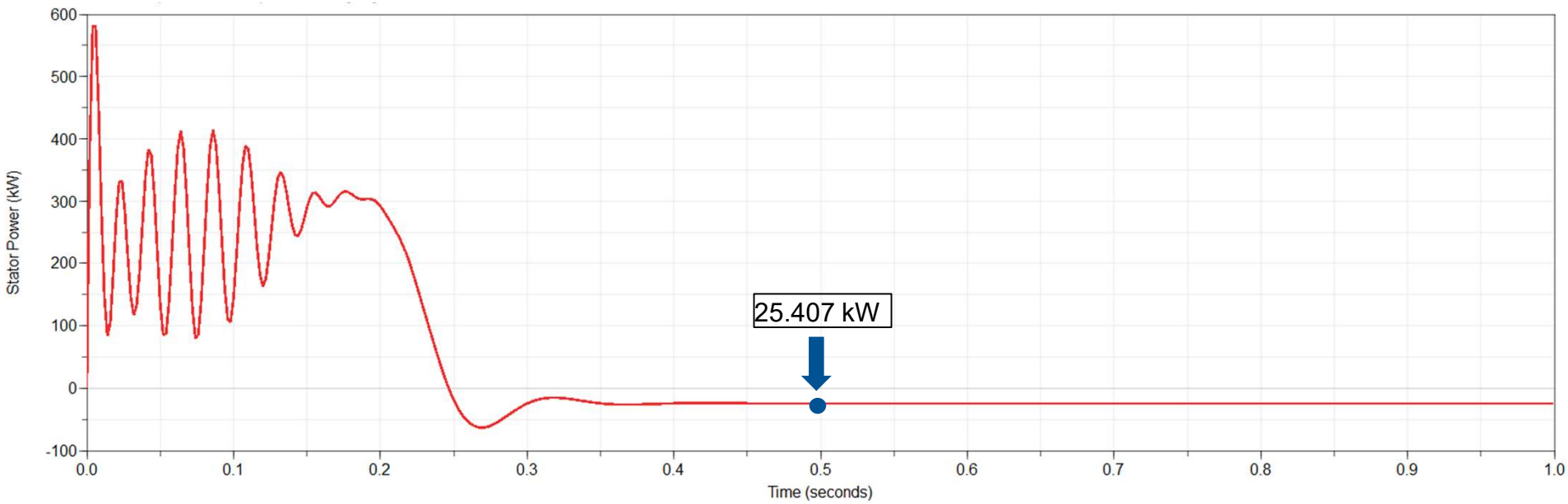


Mechanical Power (Shaft Power)

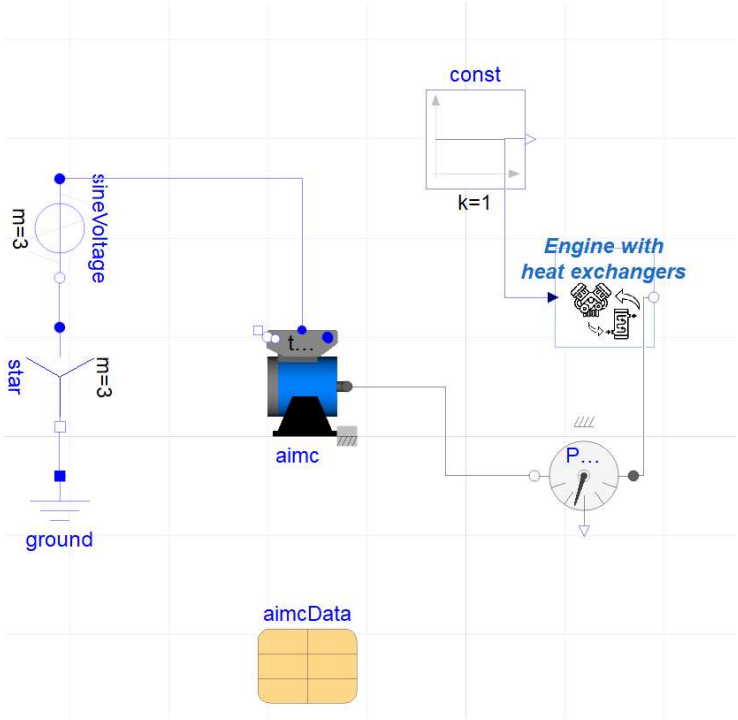


- The power response stabilises in 0.5s.

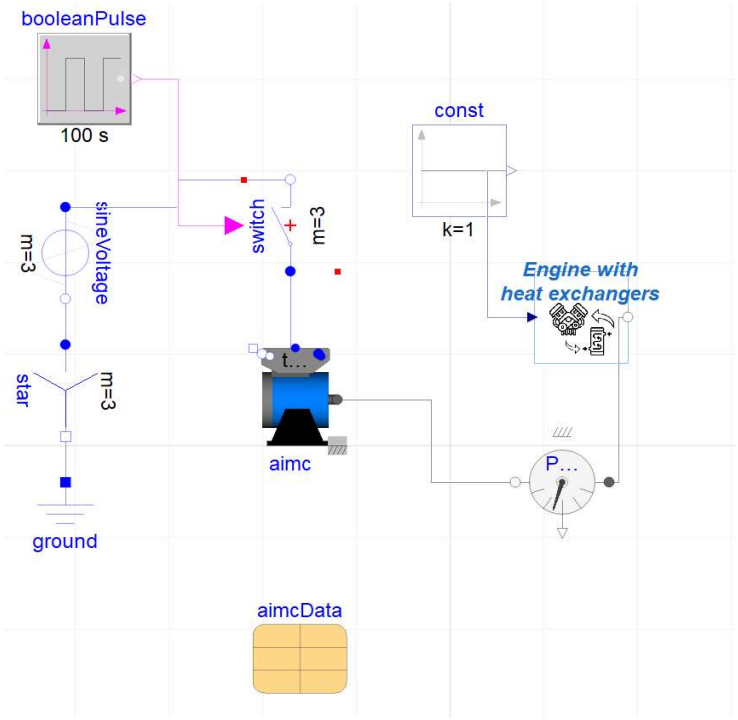
Electrical Power (Stator Power)



Results and Inferences

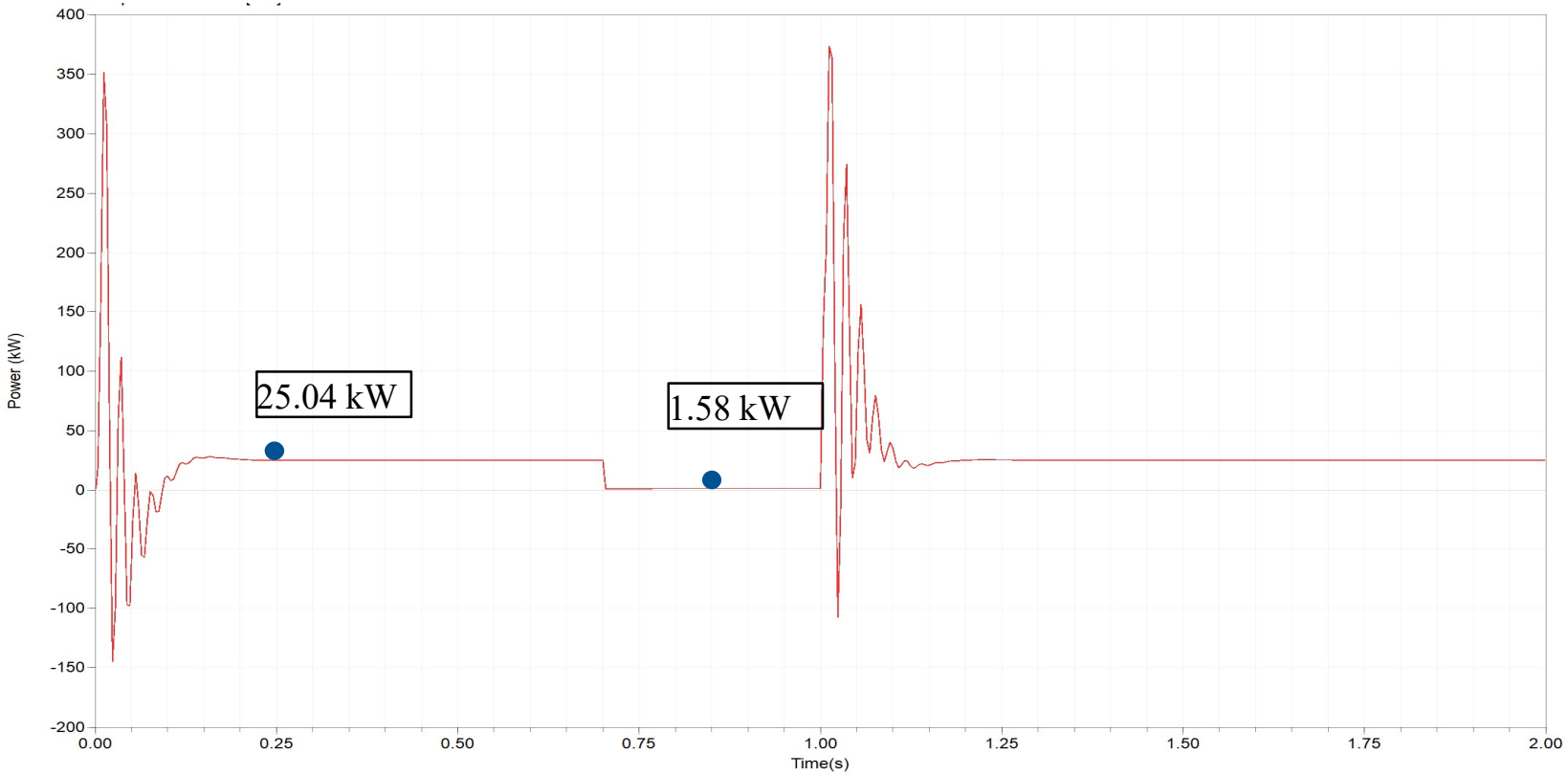


1) Operation with Steady supply to the grid

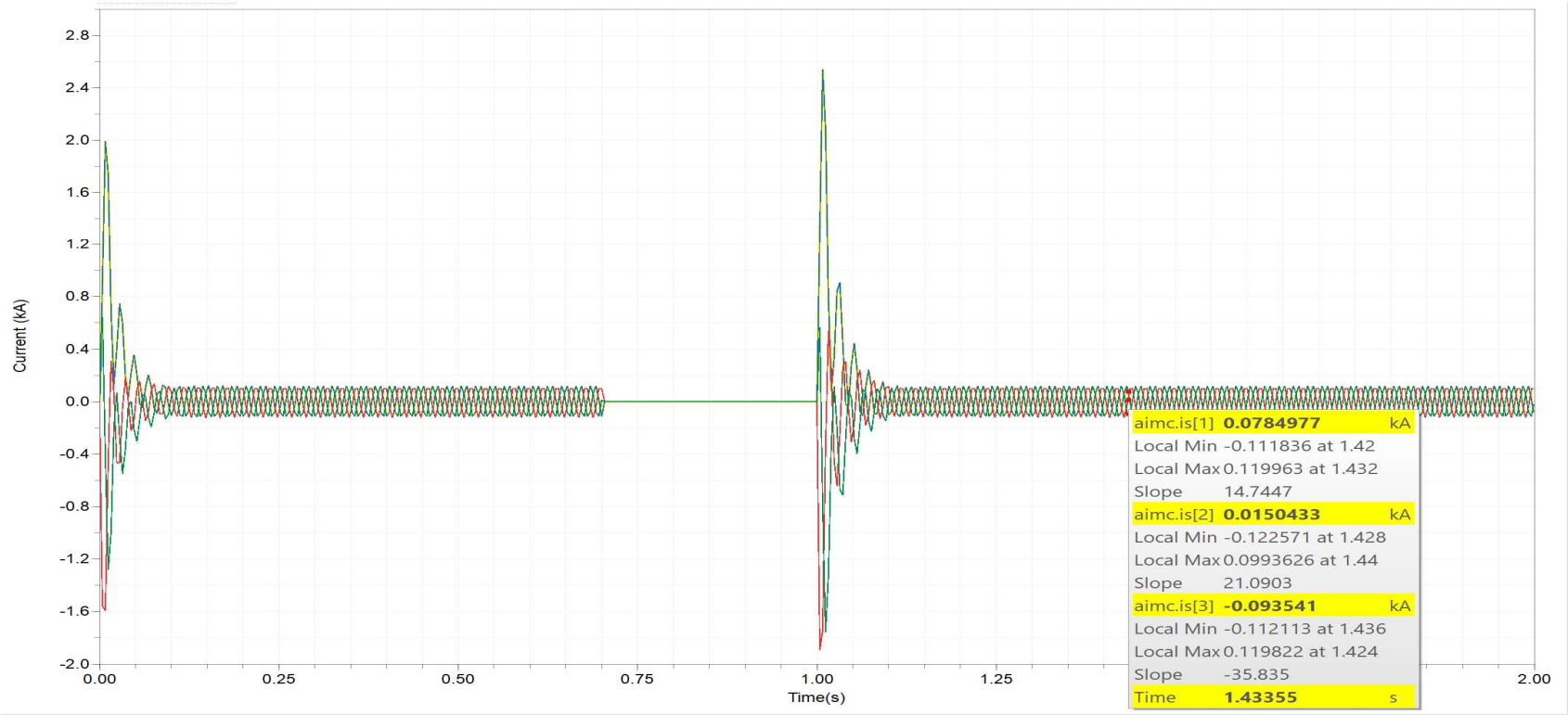


2) Operation with an emulated fault in the grid

Electrical Power



Electrical Current



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Future scope

- Condensing heat exchanger
- Calibration of parameters with that of lab CHP
- Experimental validation
- Contribution to the open source world

Thank You!

Questions?