Steady-State Experimental Characterization of a Flexible Humidified micro Gas Turbine

Marina Montero Carrero, Ward De Paepe,
Svend Bram, Francesco Contino
Vrije Universiteit Brussel

Alessandro Parente
Université Libre De Bruxelles

Why do we still study mGTs?

Why haven't mGTs succeeded yet

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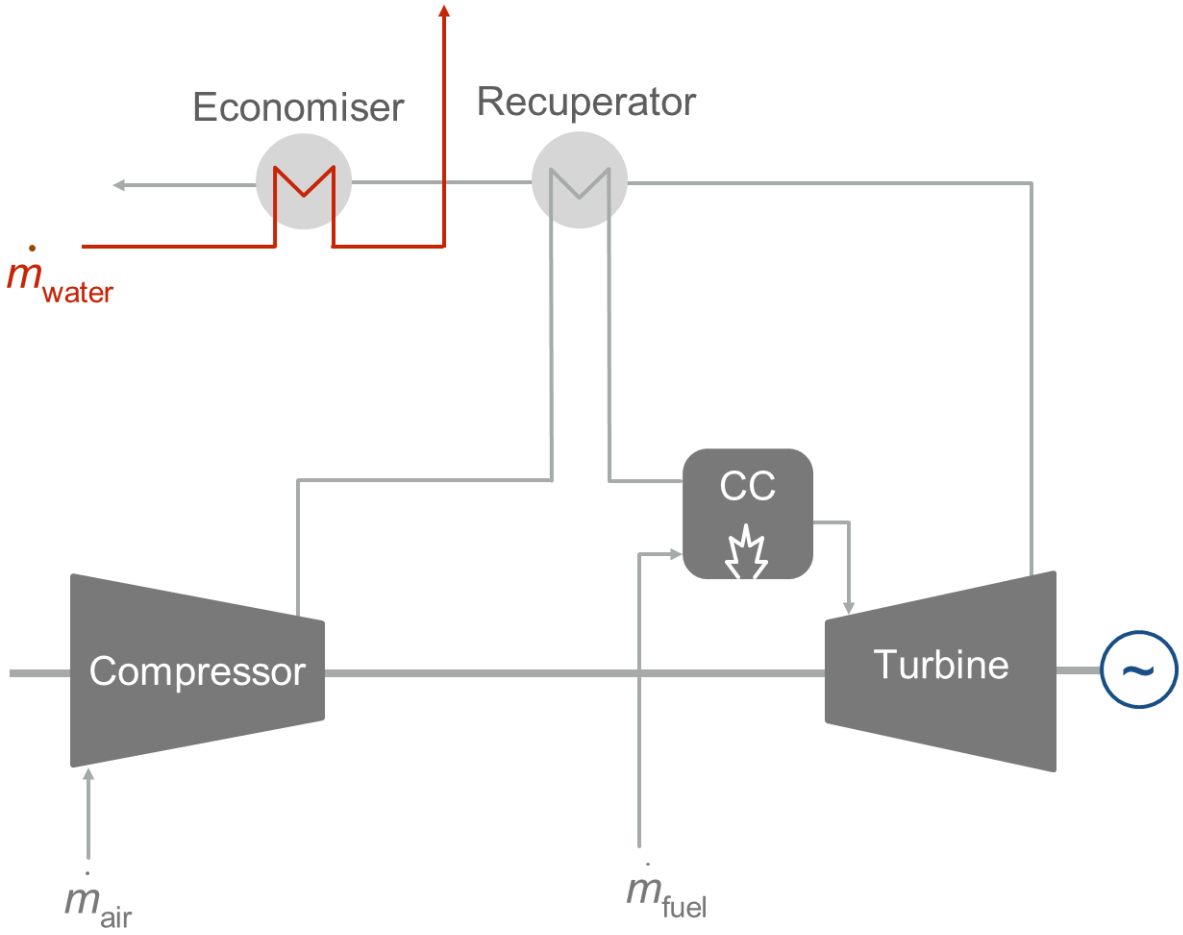
Micro Gas Turbines (mGTs) have very high Combined Heat and Power (CHP) efficiencies



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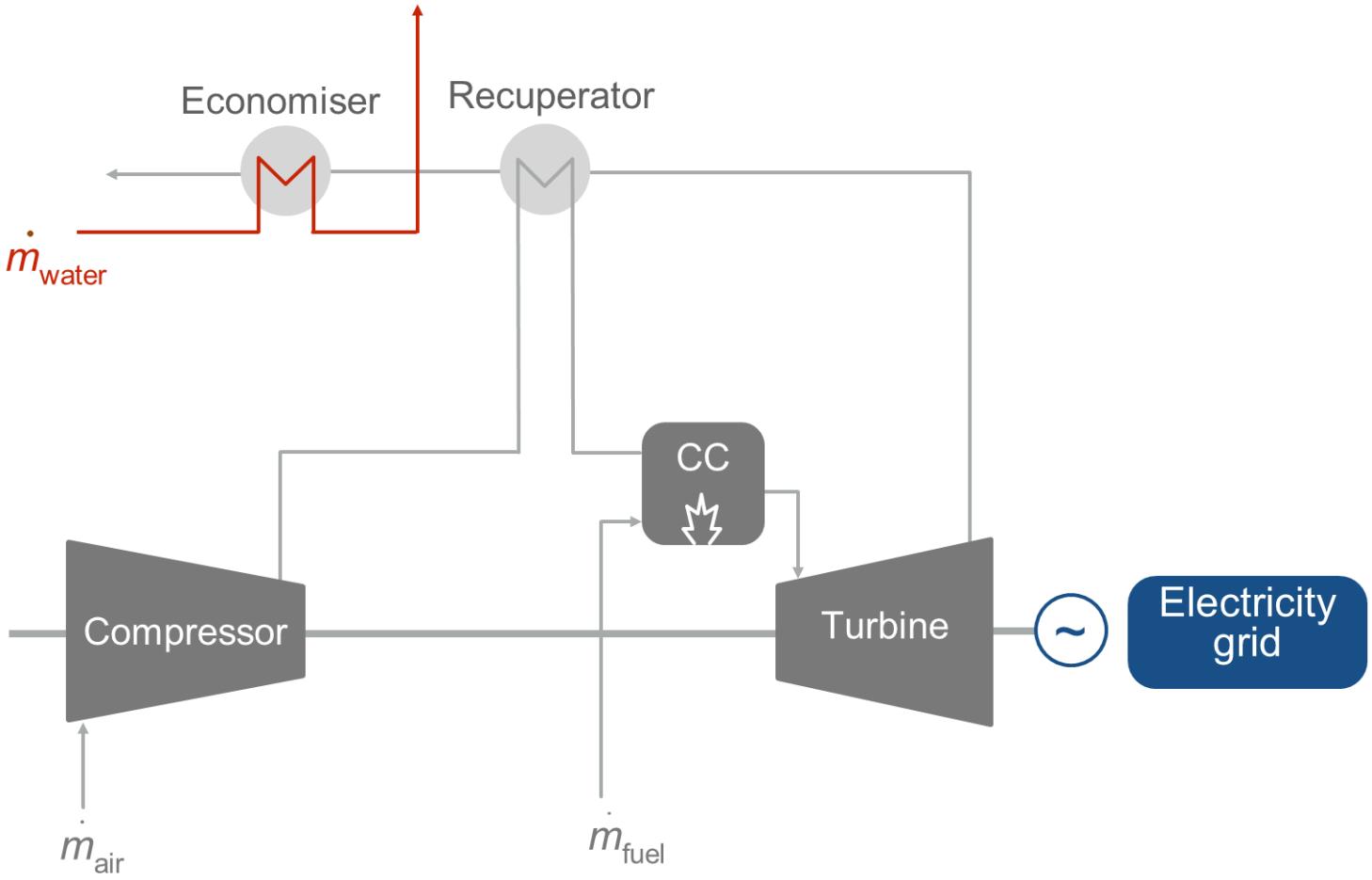

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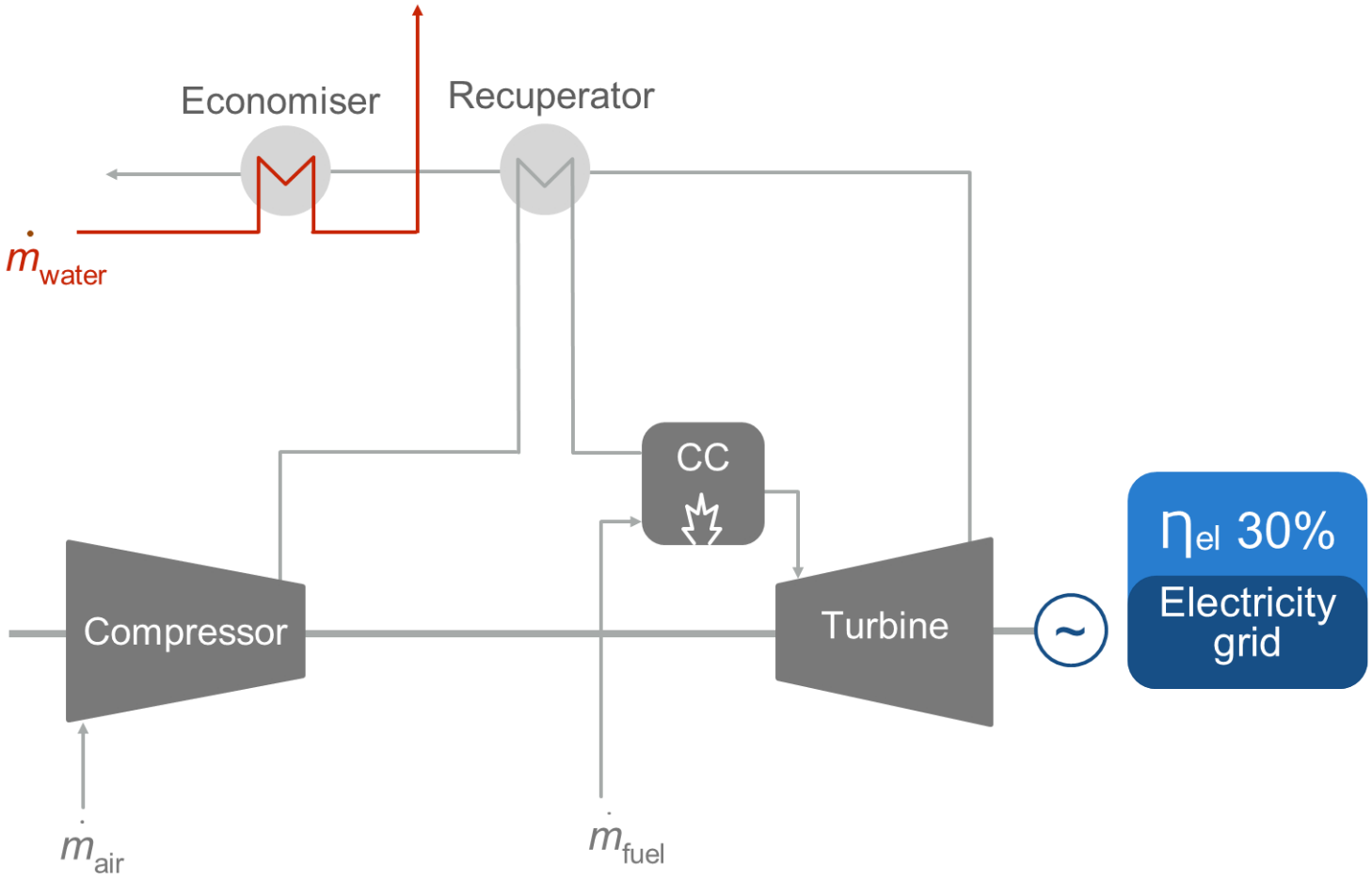

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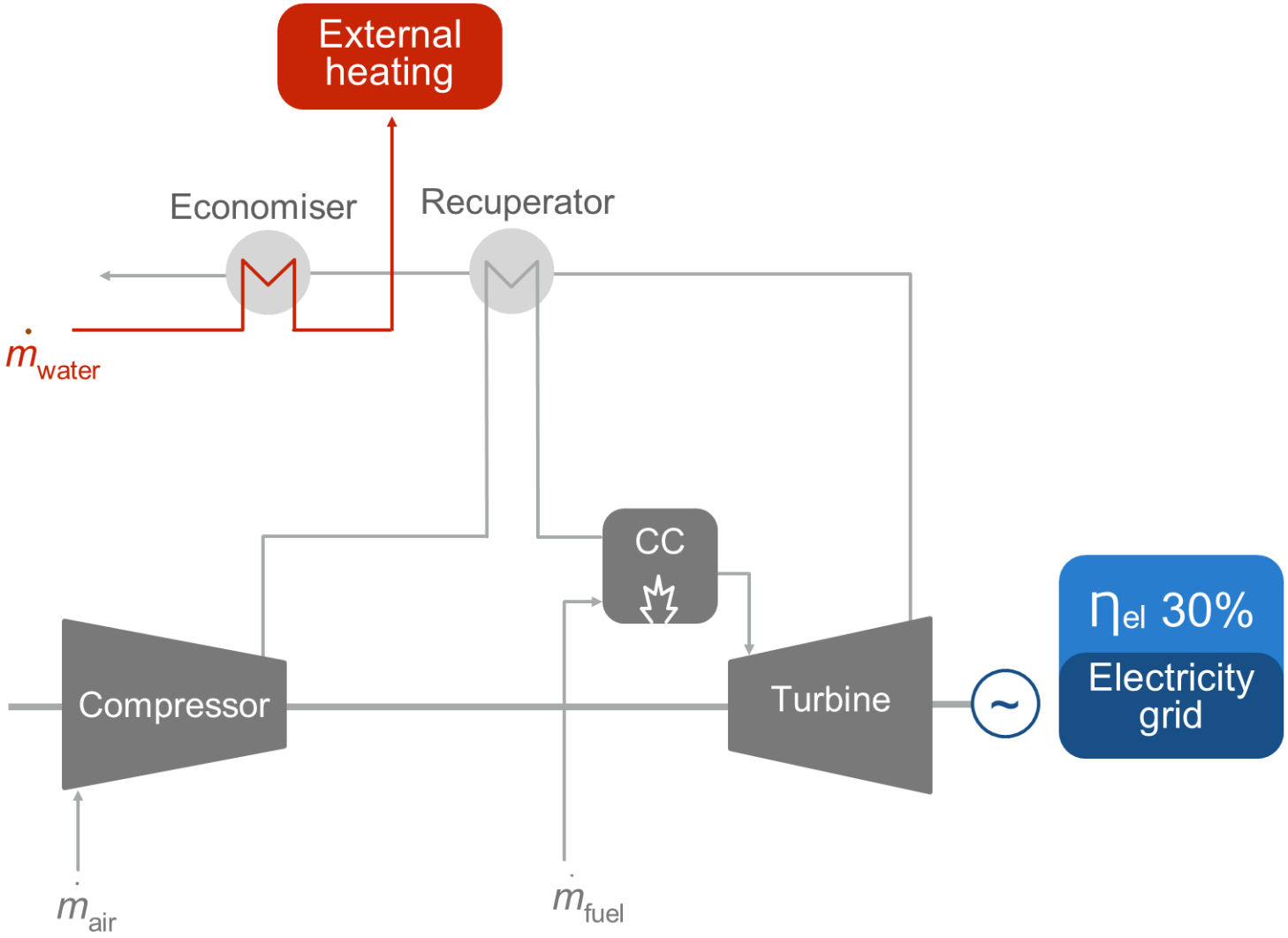

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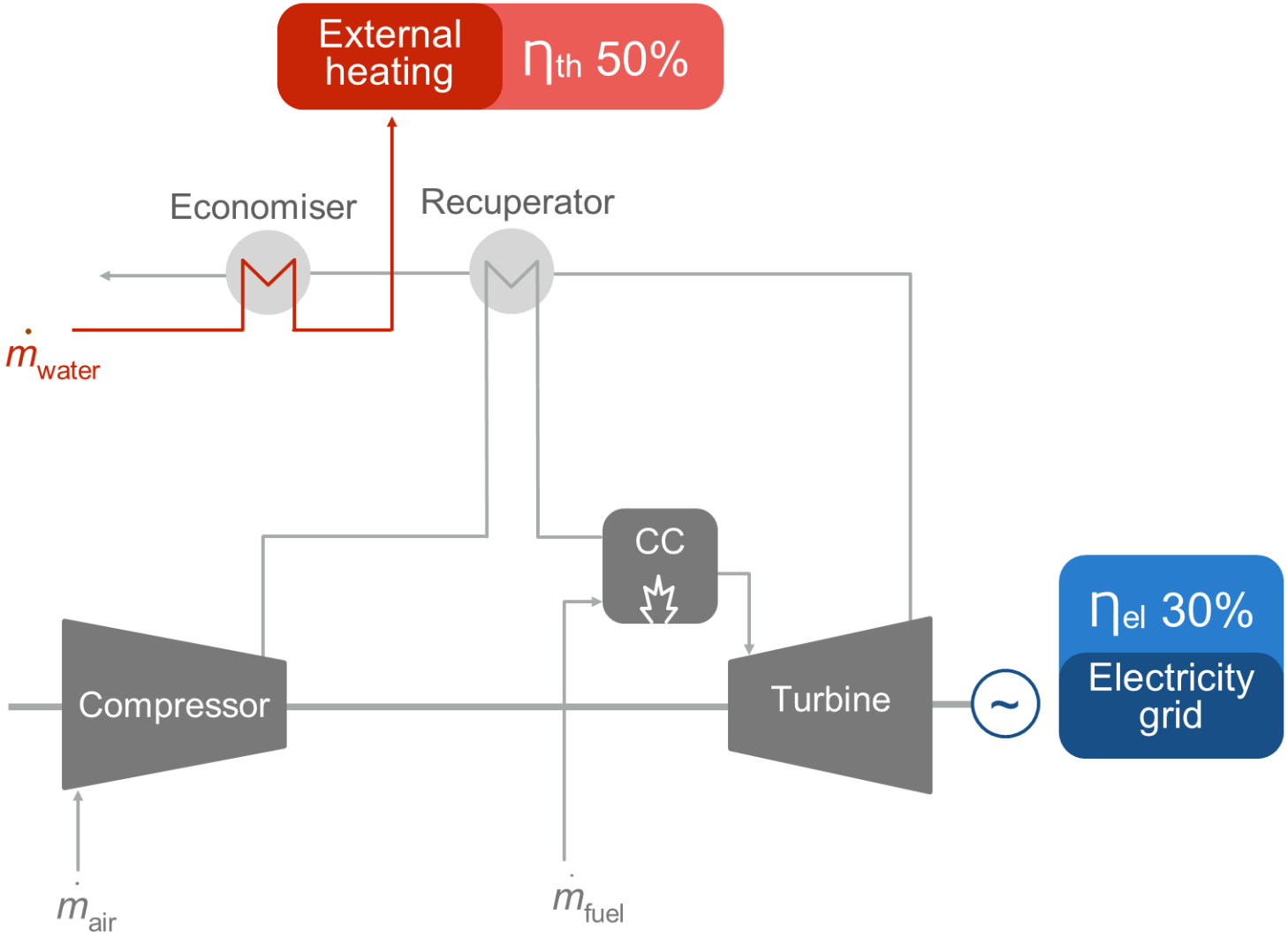

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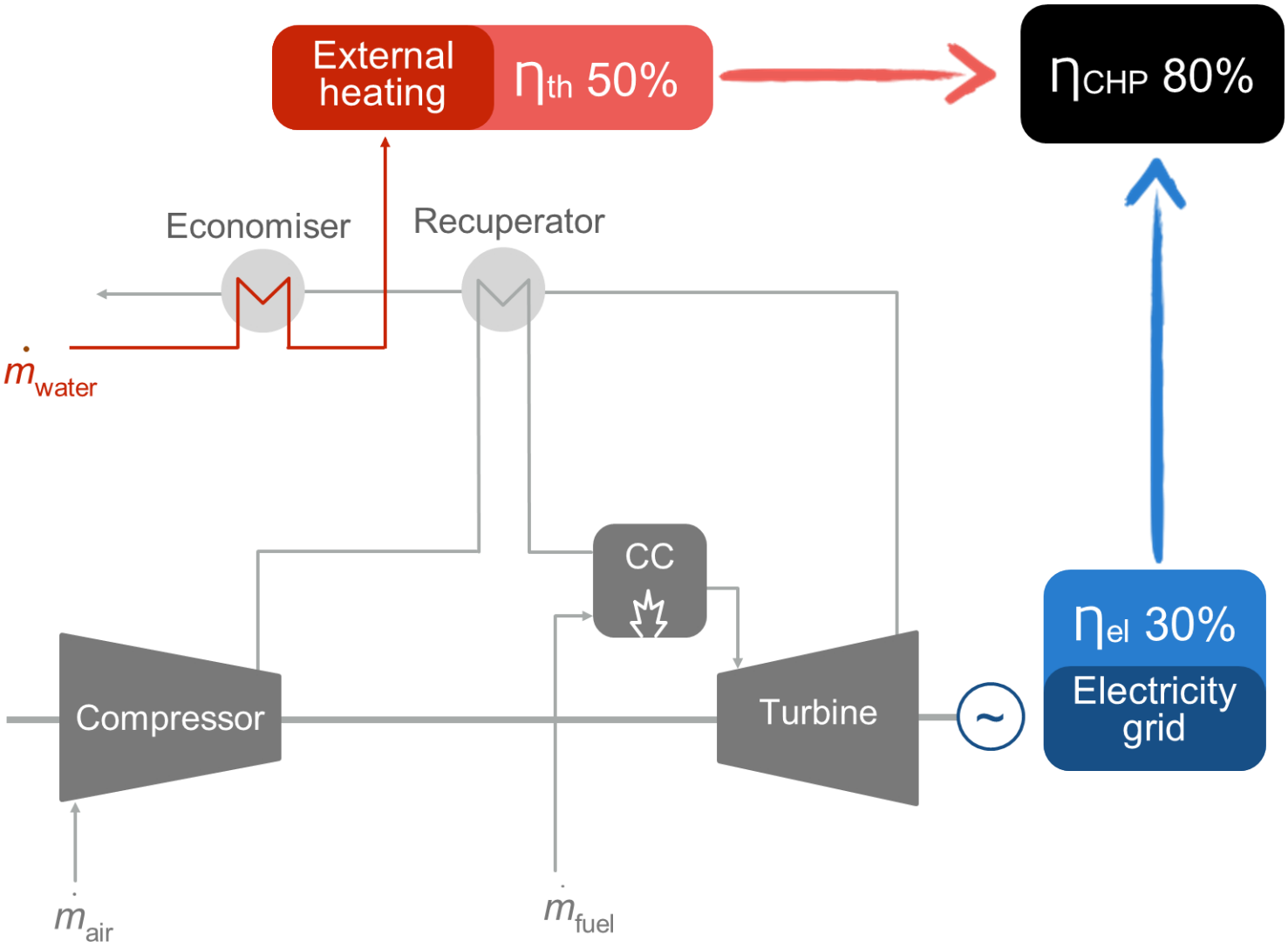

Why do we still study mGTs?

Why haven't mGTs succeeded yet

High CHP efficiencies

In comparison to piston engines
- lower emissions
- fuel flexible
- only one moving part

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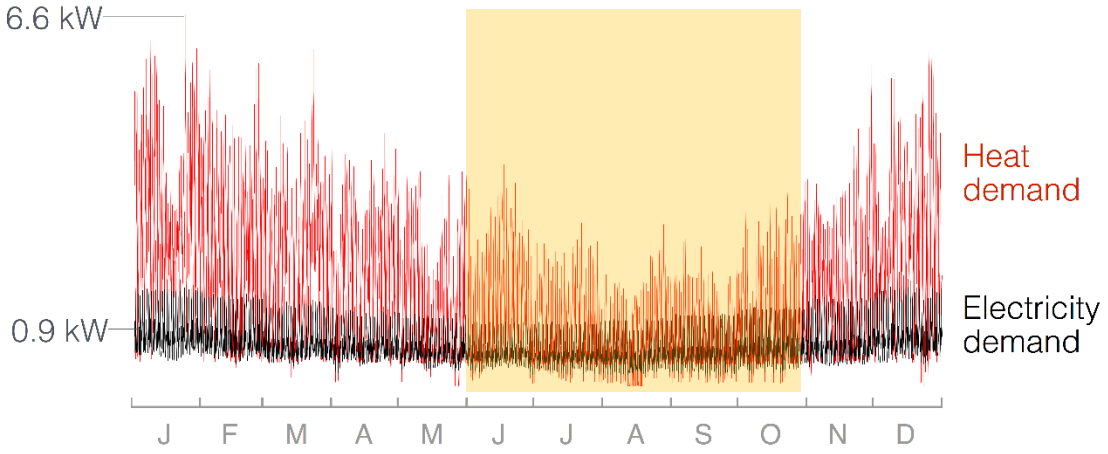
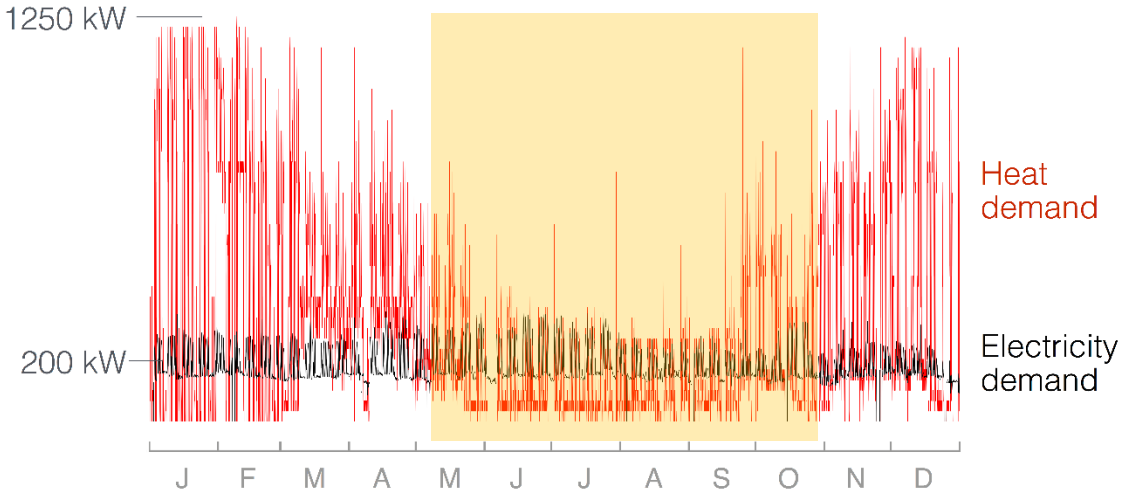
It is difficult to find users with demands that fit the output of mGTs

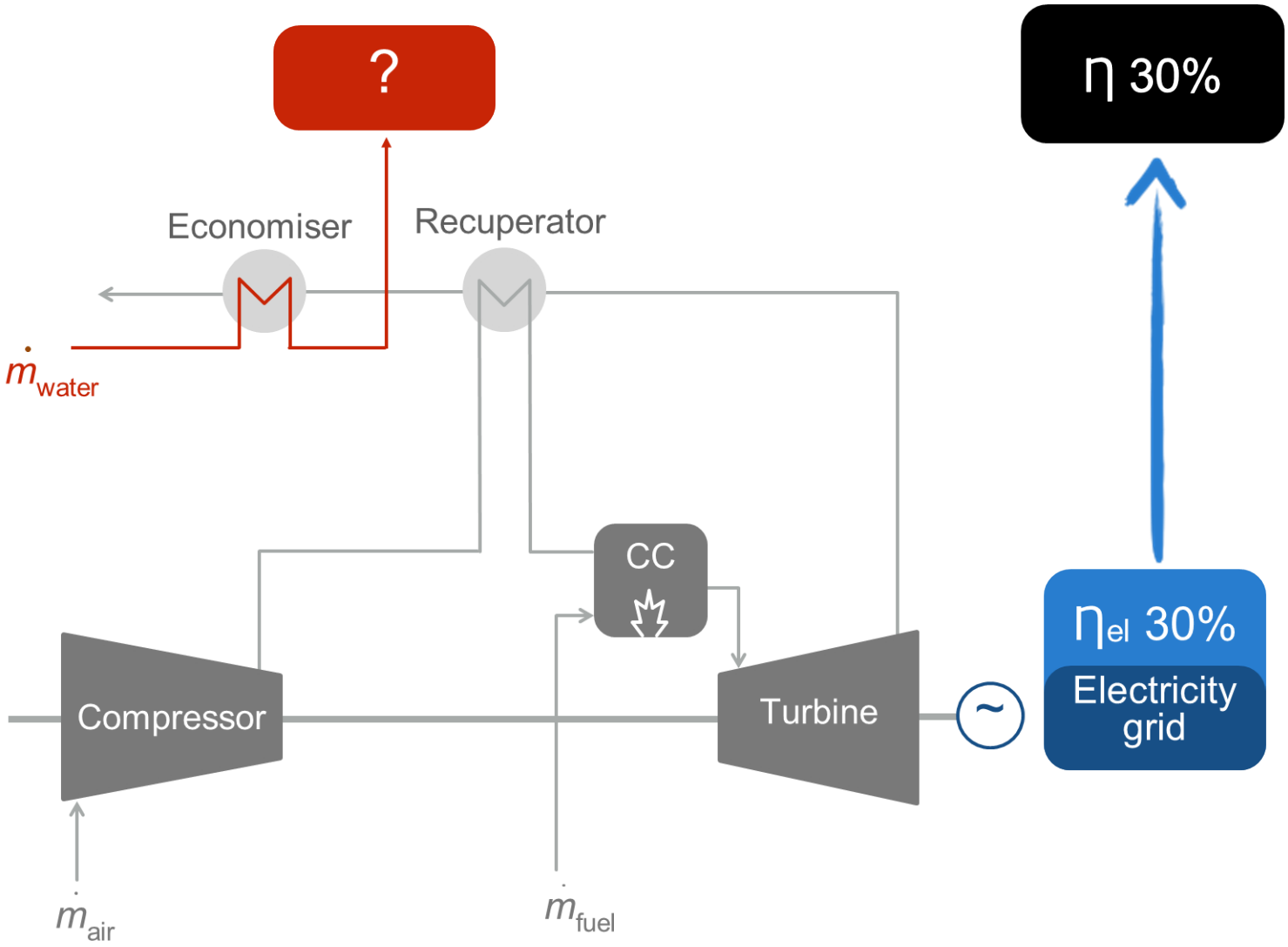
Average dwelling
in San Francisco



Noble House,
large office building
in London



If there is no use for the heat output,
the total efficiency is too low



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Why haven't mGTs succeeded yet

Heat and electricity production locked down

Lower electrical efficiencies than piston engines

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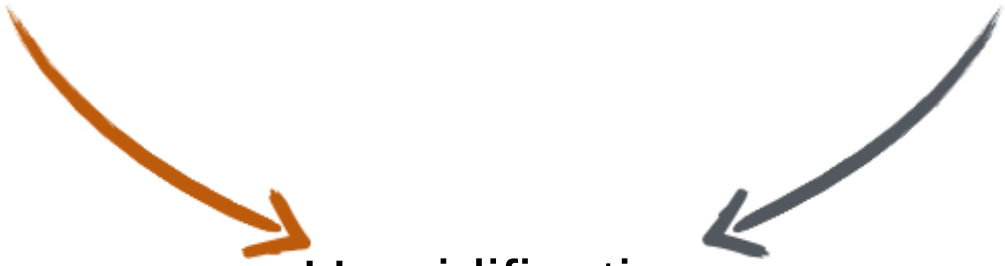
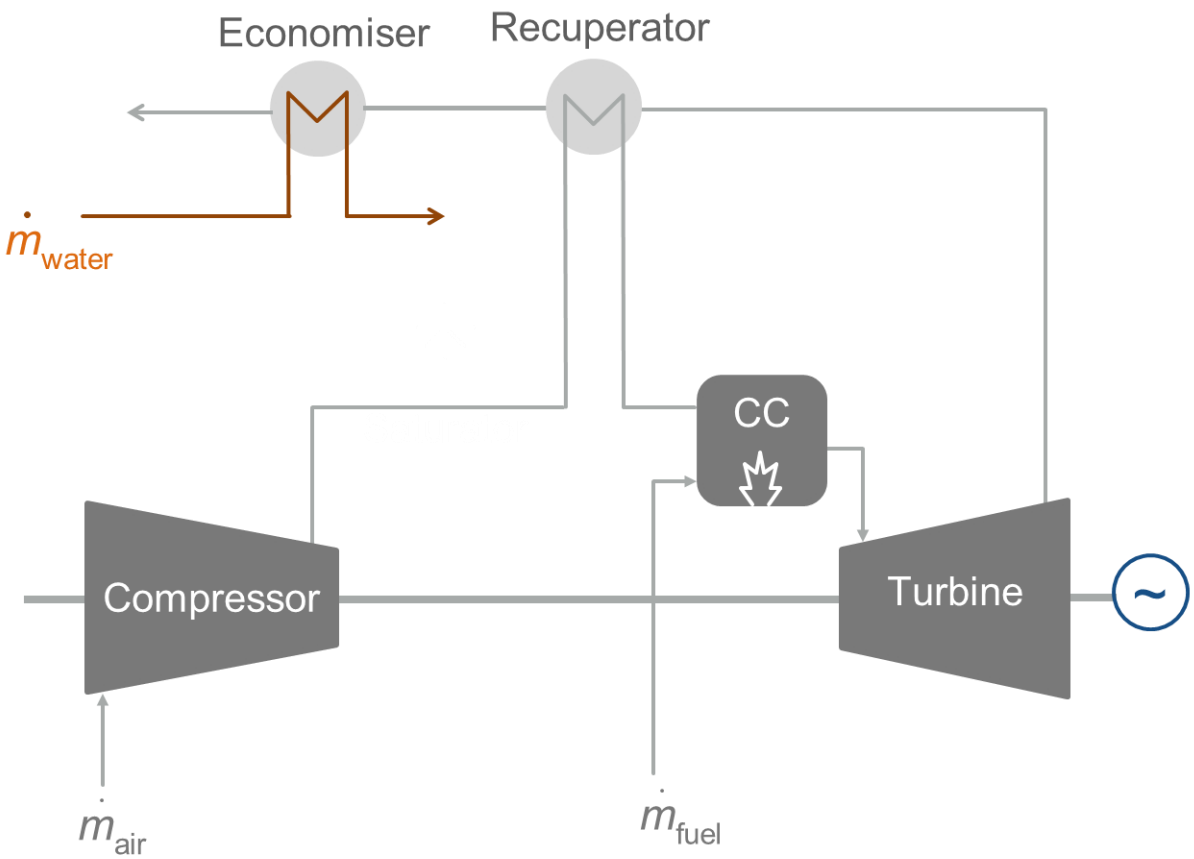


Humidification

Micro Humid Air Turbine (mHAT)

By humidifying the compressed air
we increase electrical efficiency



By humidifying the compressed air
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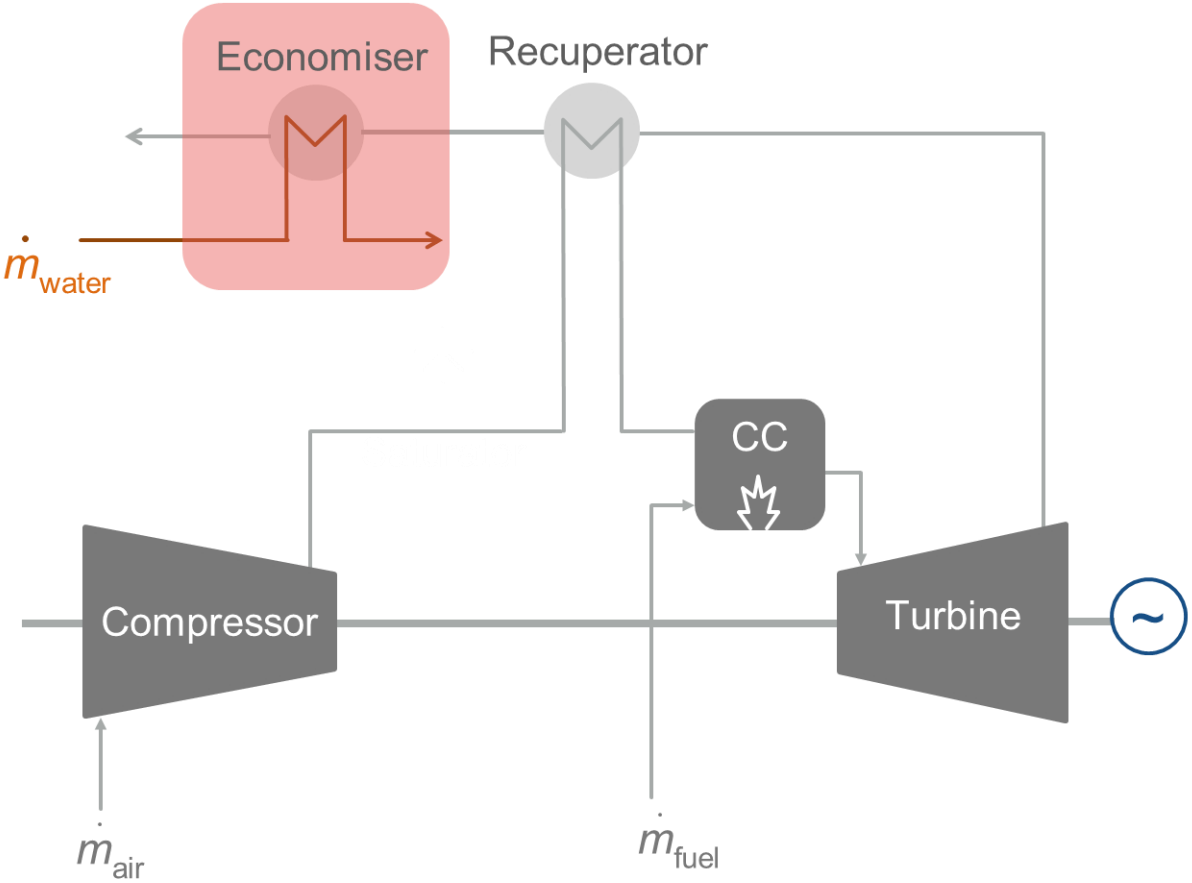

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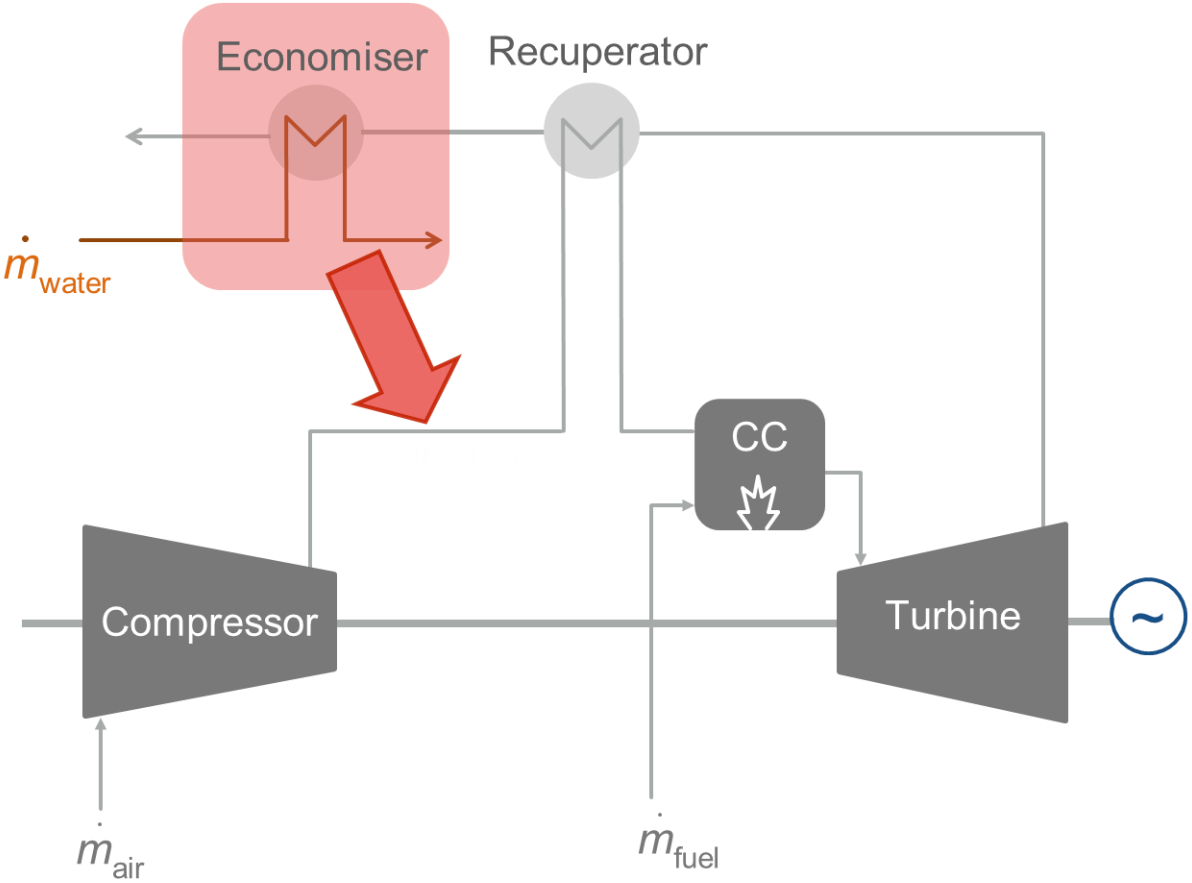

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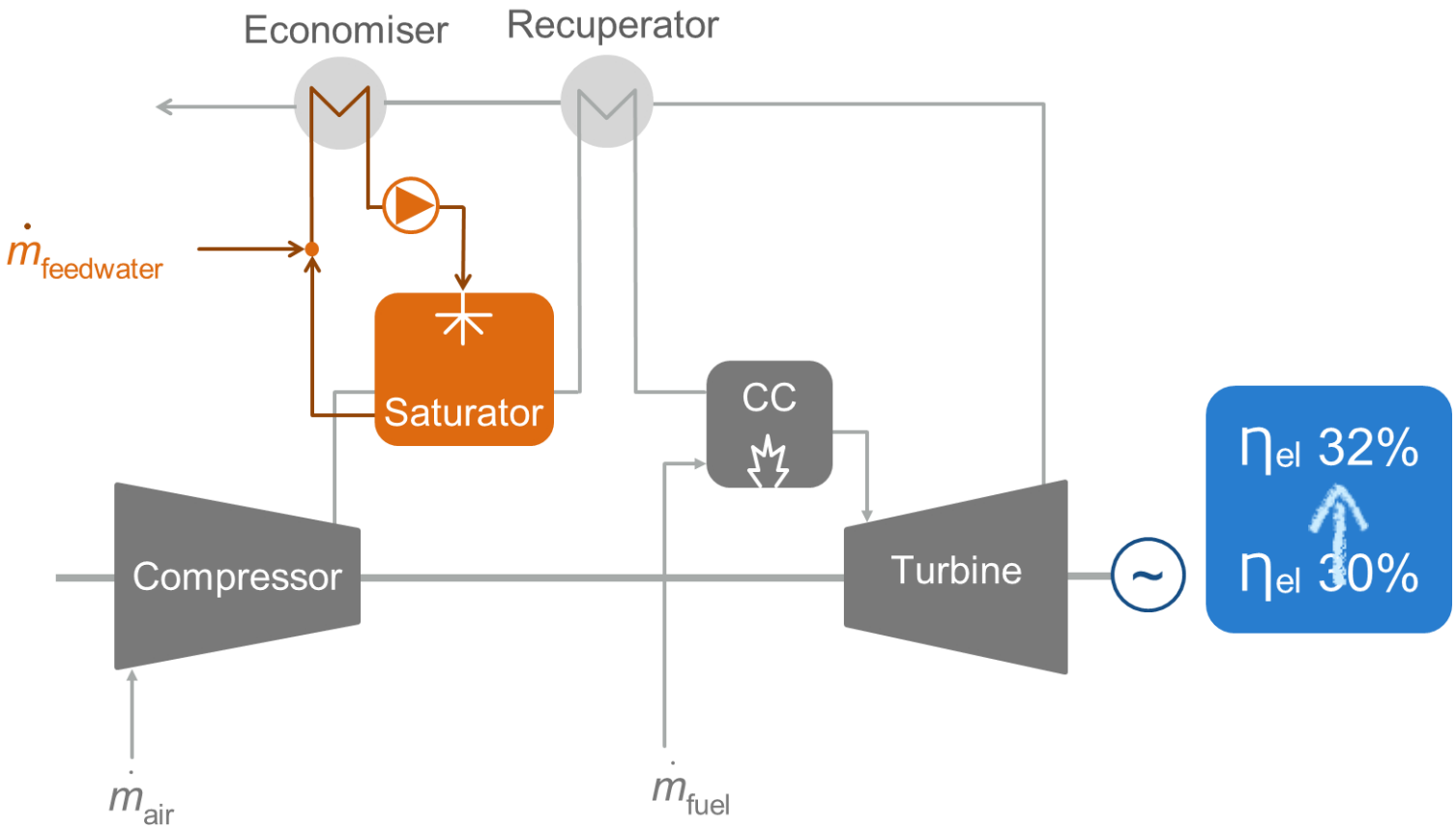
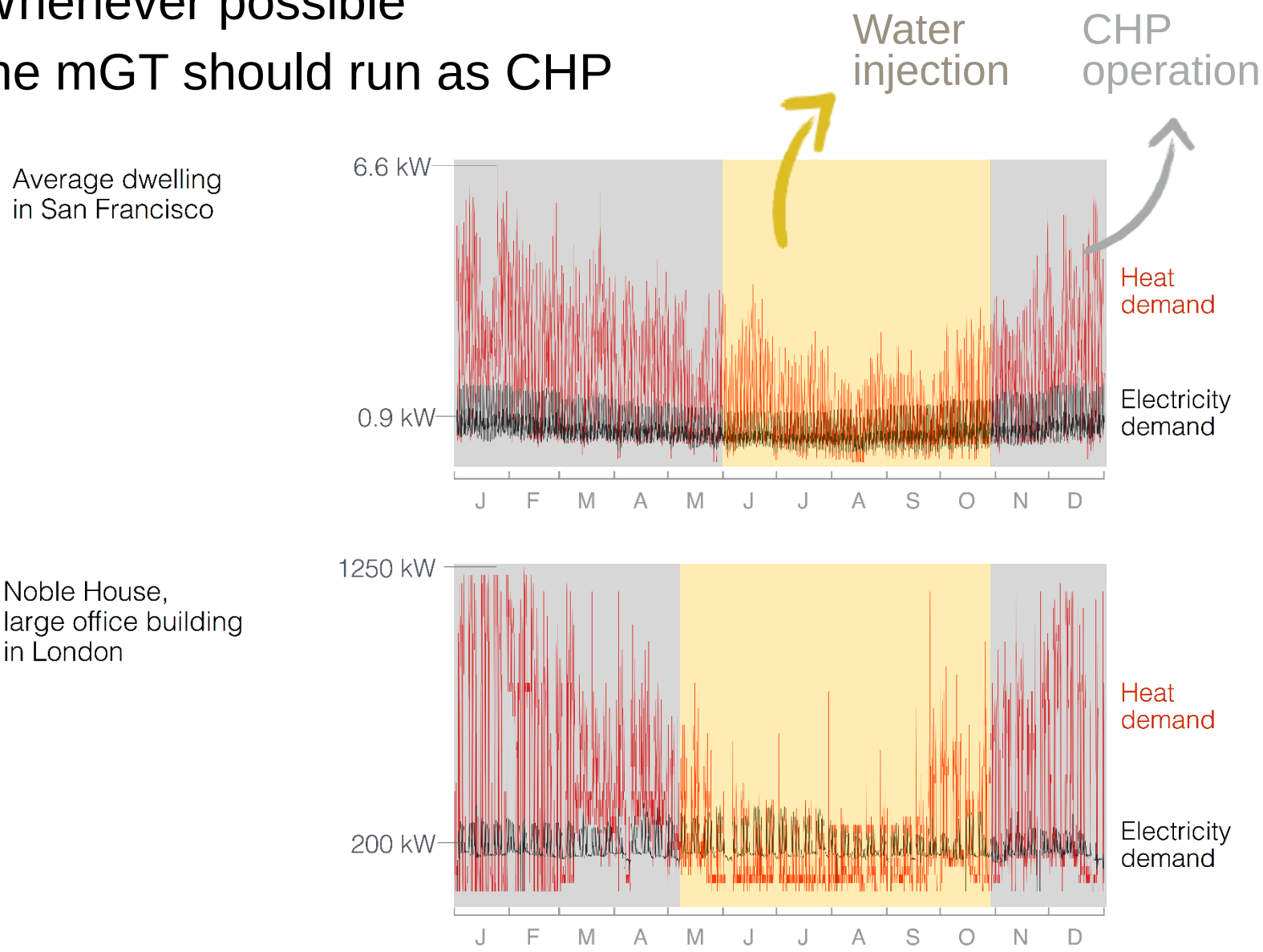


Whenever possible
the mGT should run as CHP



mHAT facility at VUB lab

Full load, full water injection experiments
in constant power output mode

Full load, full water injection experiments
in constant rotational speed mode

Experiments with water injection
result in an electrical efficiency increase

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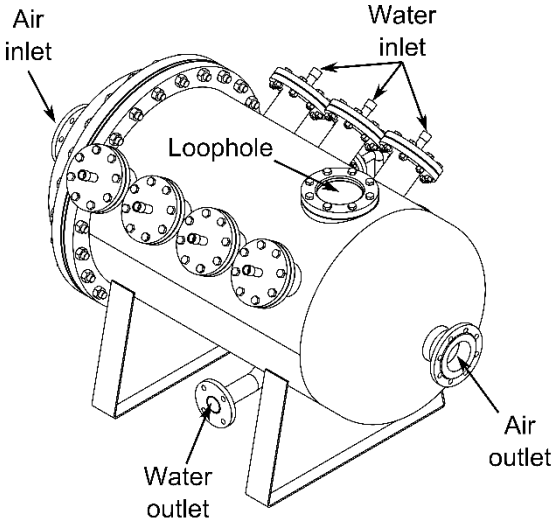
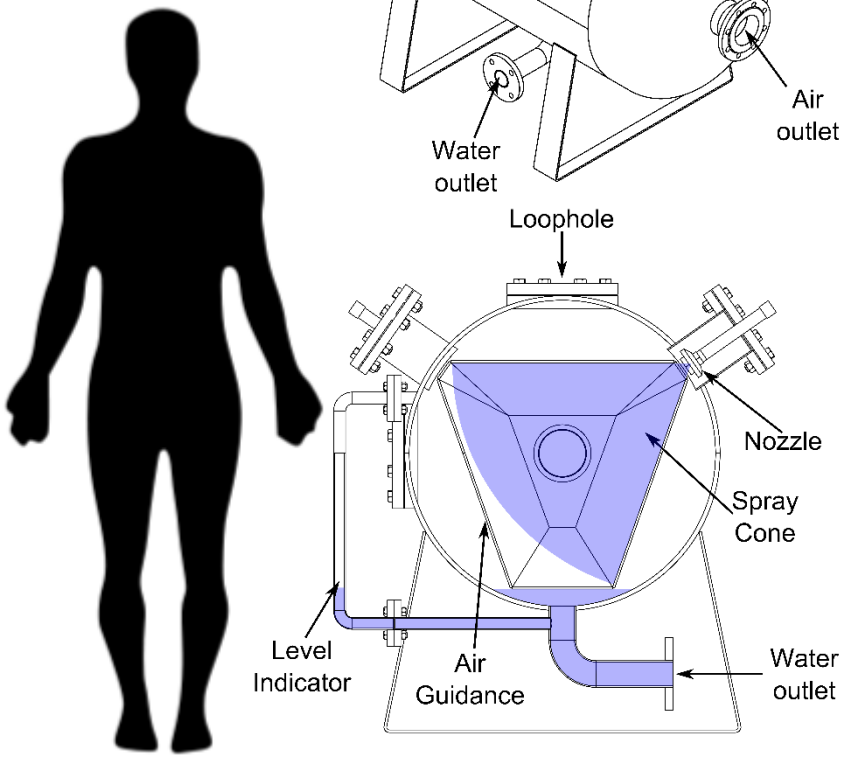
A novel spray saturation tower was developed to saturate the compressed air of the T100 at VUB





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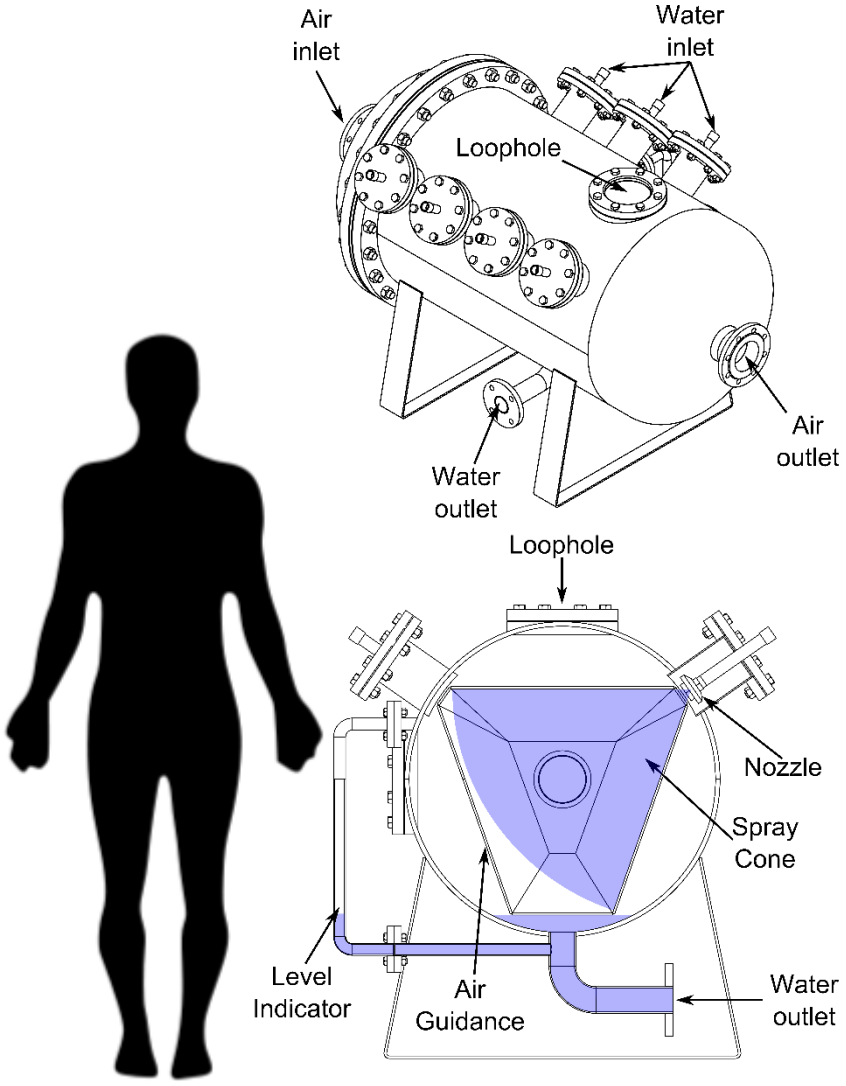

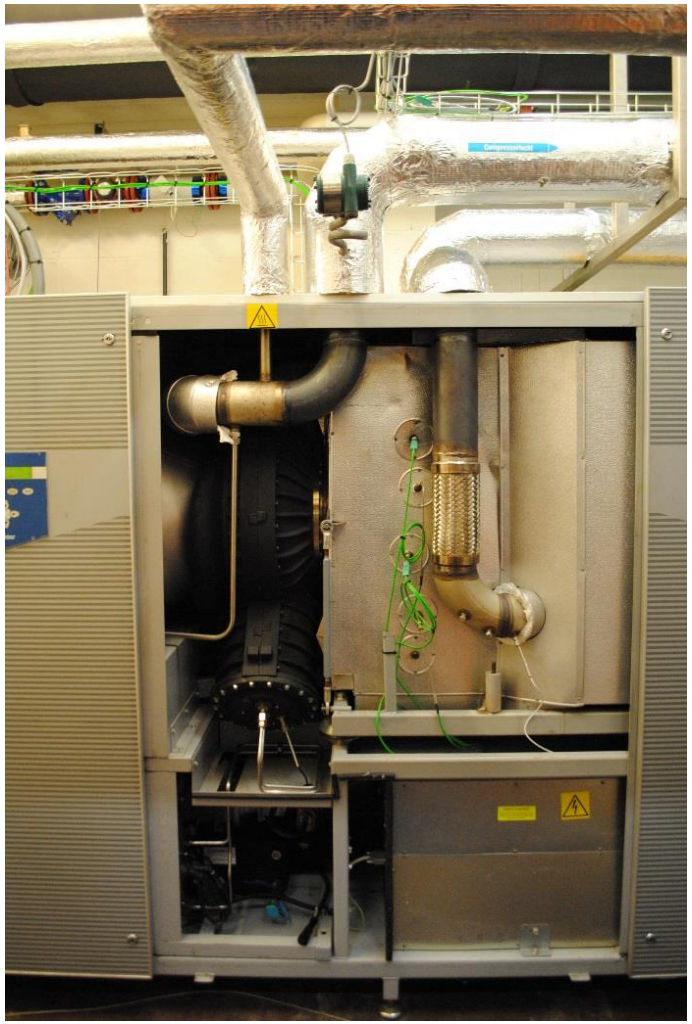

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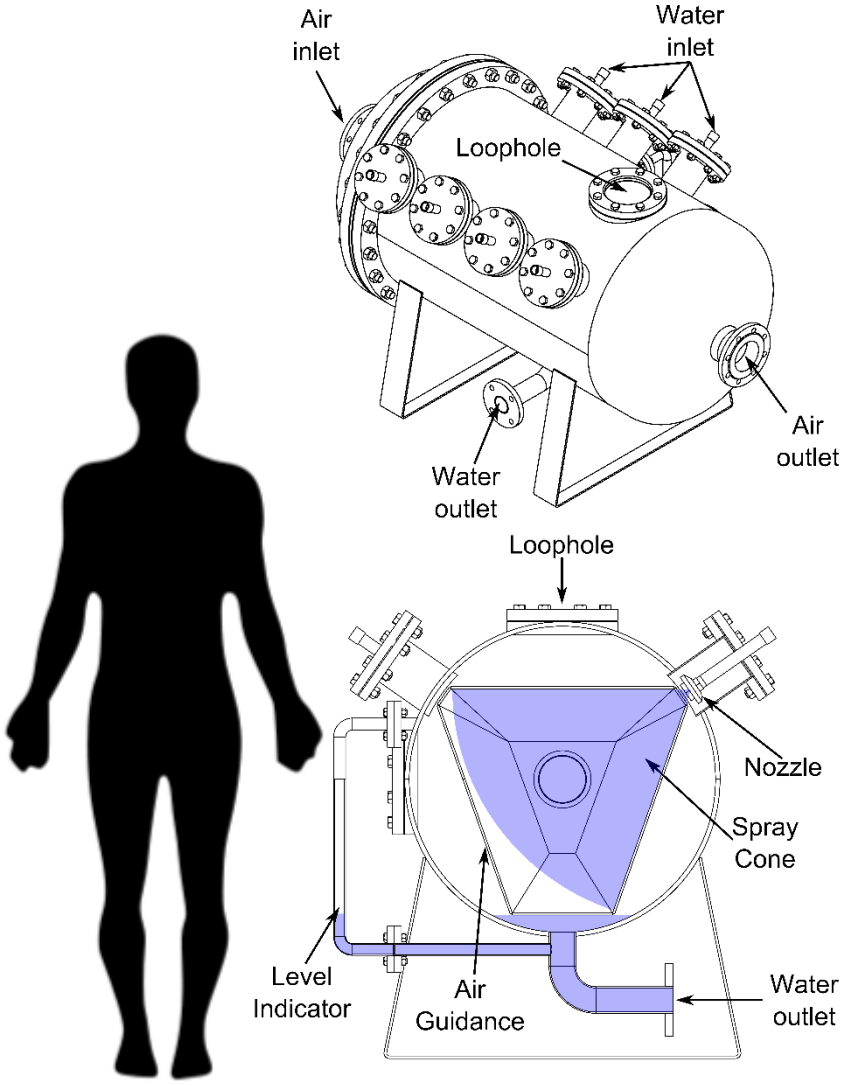
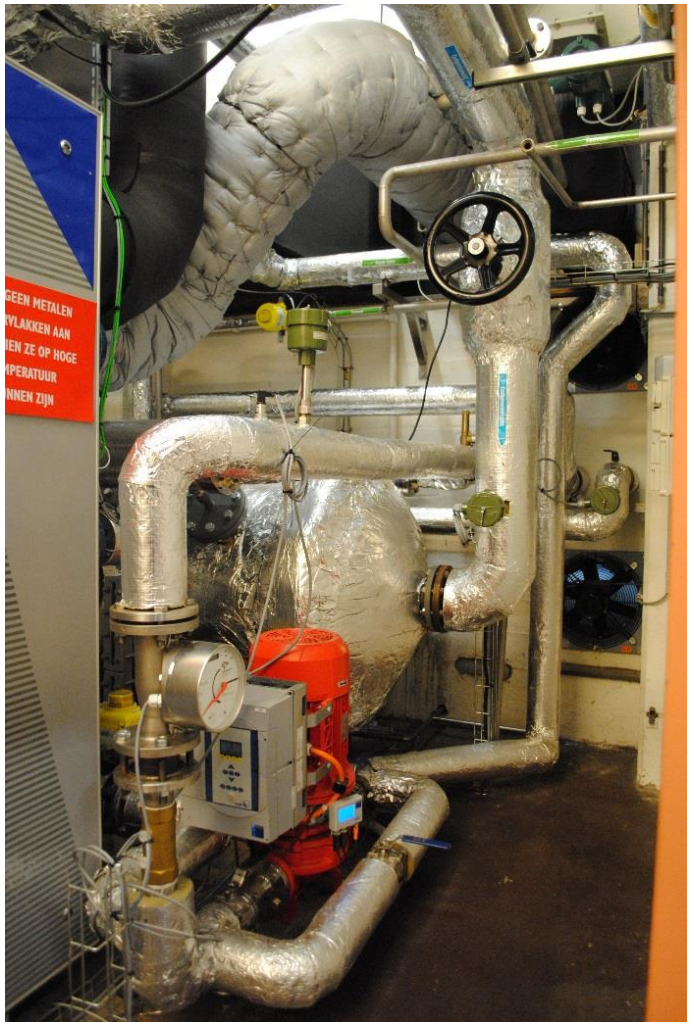
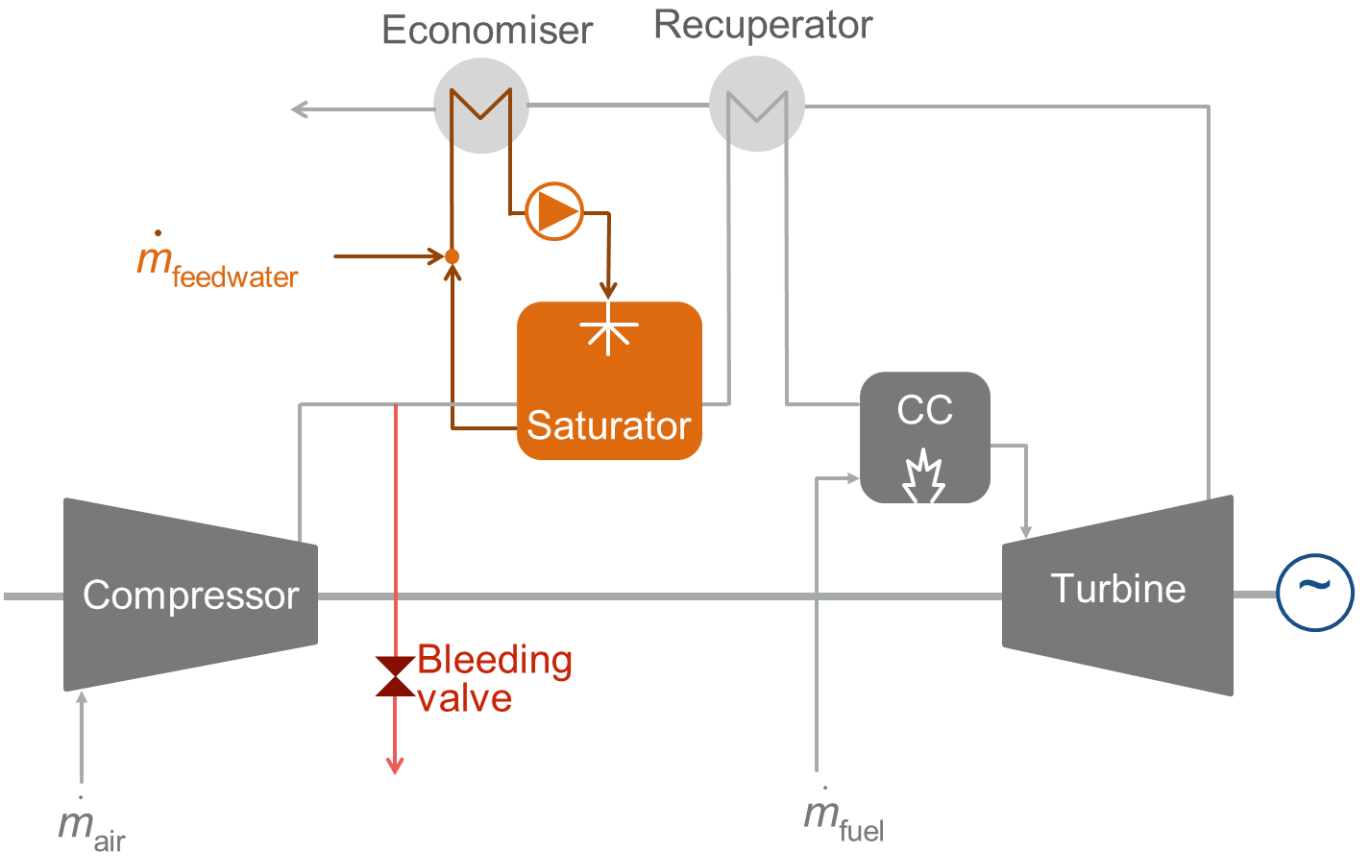
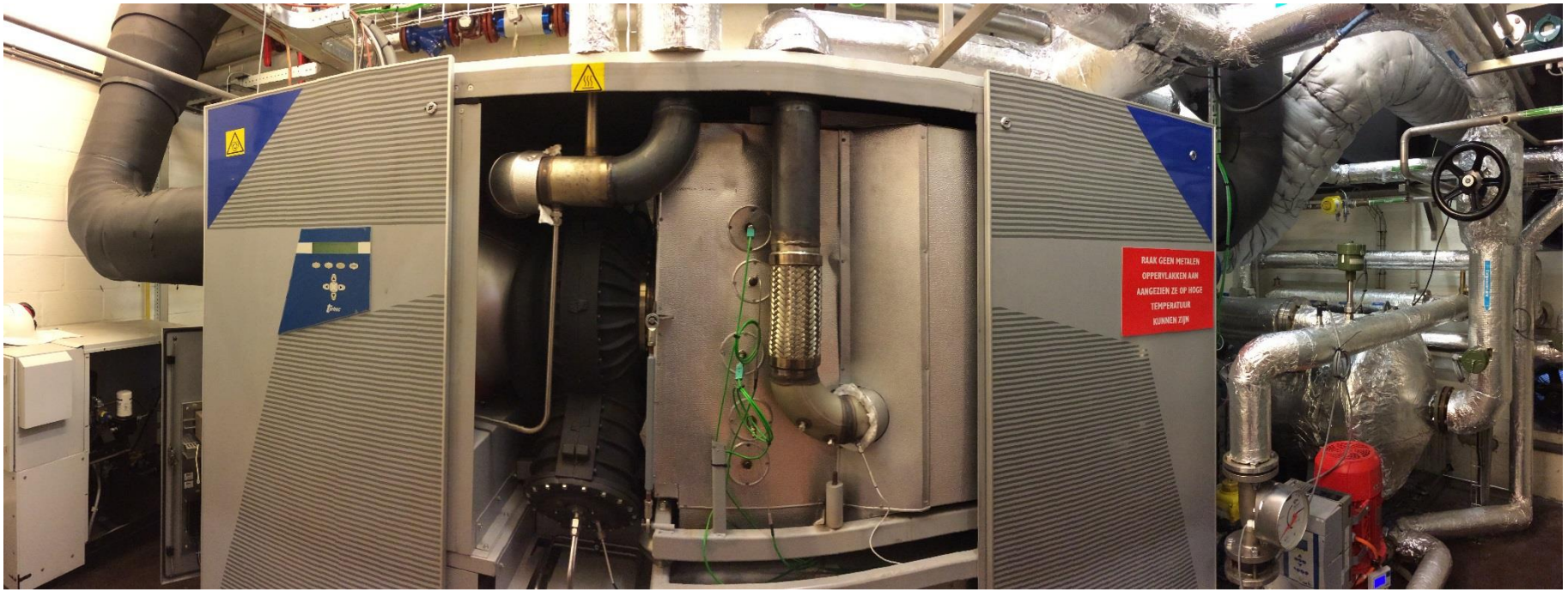




A bleeding valve was introduced
to protect the compressor



Our T100 mGT has been running as an mHAT for the last two years



Preliminary tests focused on:

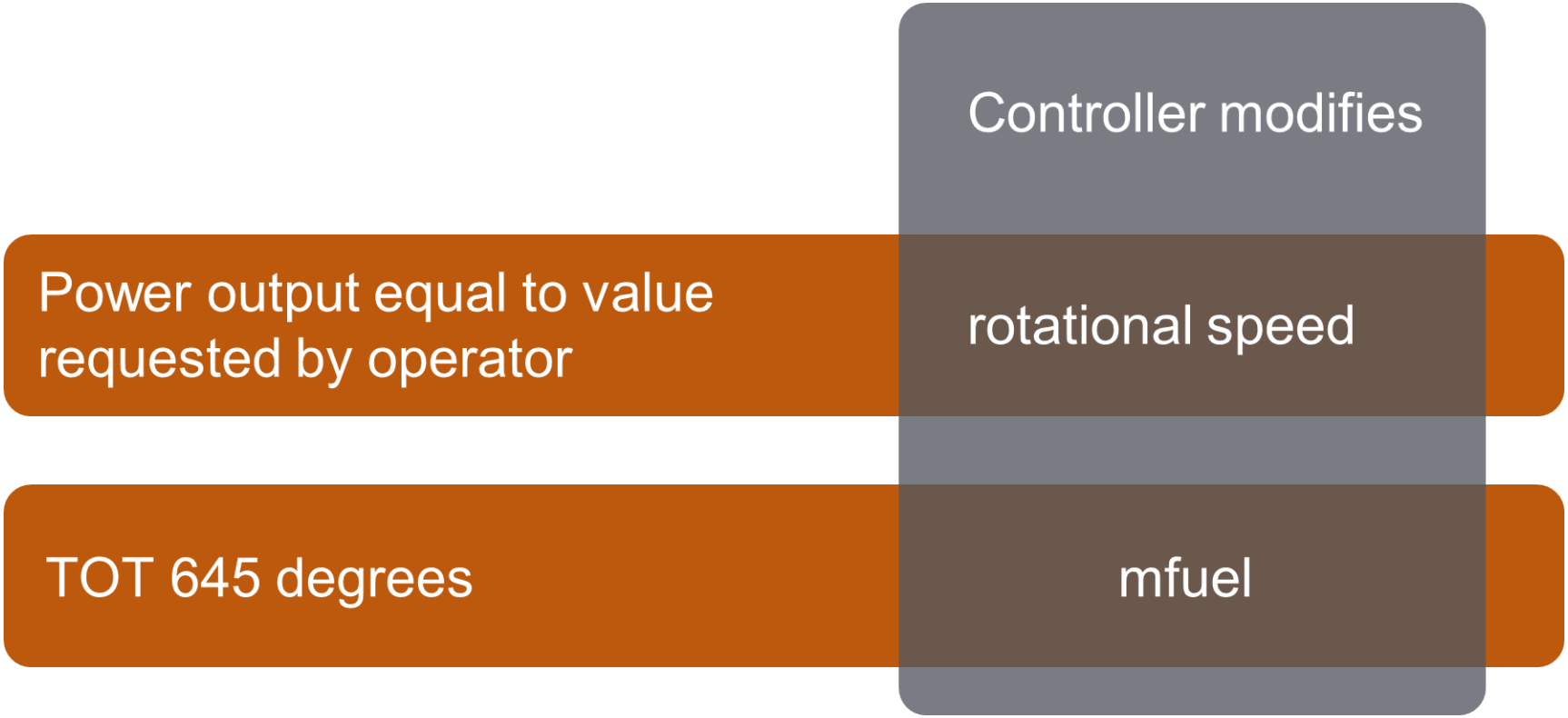
Wet start-up procedure
Part load
Part humidification

mHAT facility at VUB lab

Full load, full water injection experiments in constant power output mode

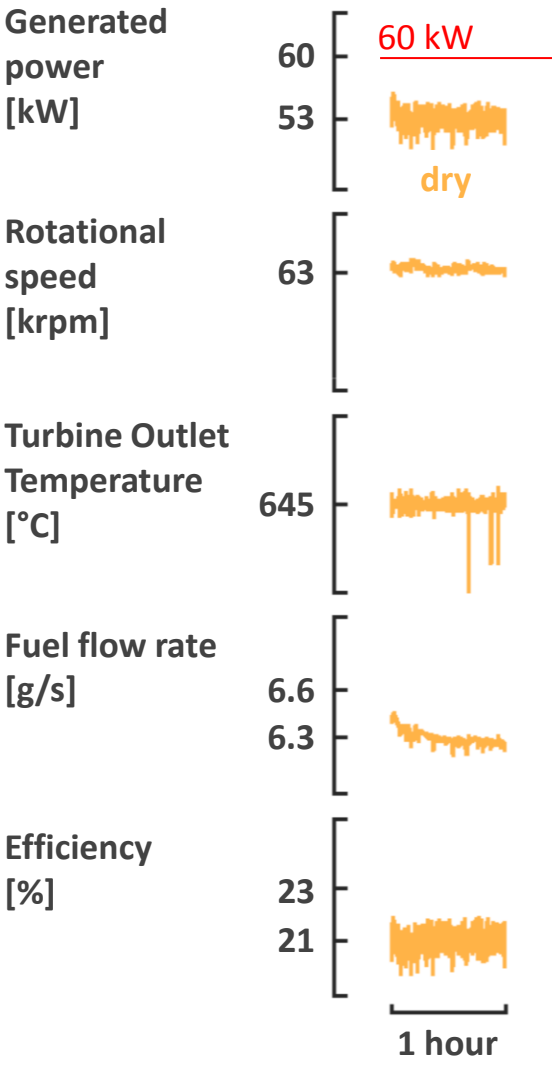
Full load, full water injection experiments in constant rotational speed mode

The default controller settings
keep power output and TOT constant



In dry operation

the requested rotational speed is not reached



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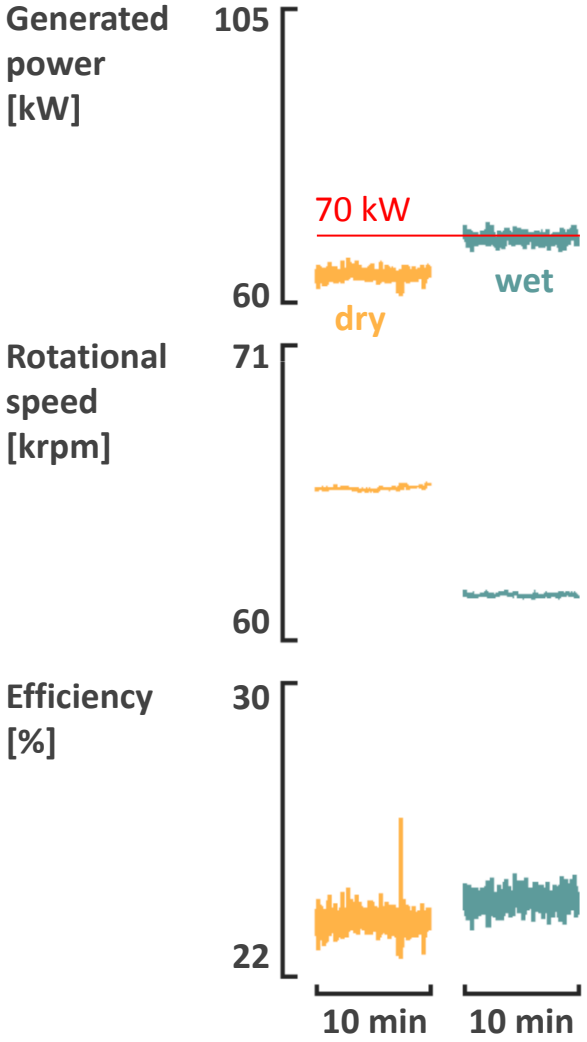


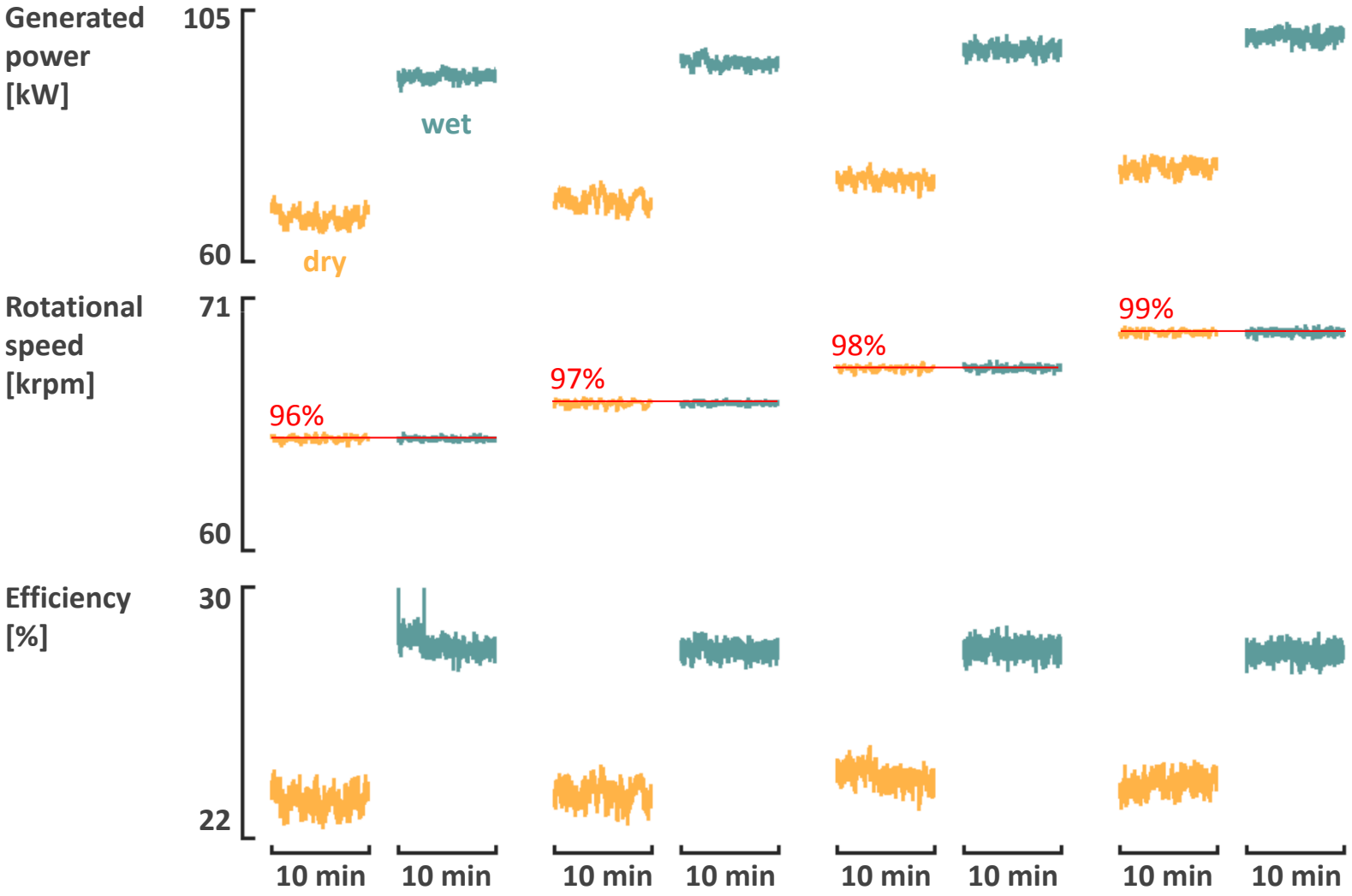
mHAT facility at VUB lab

Full load, full water injection experiments
in constant power output mode

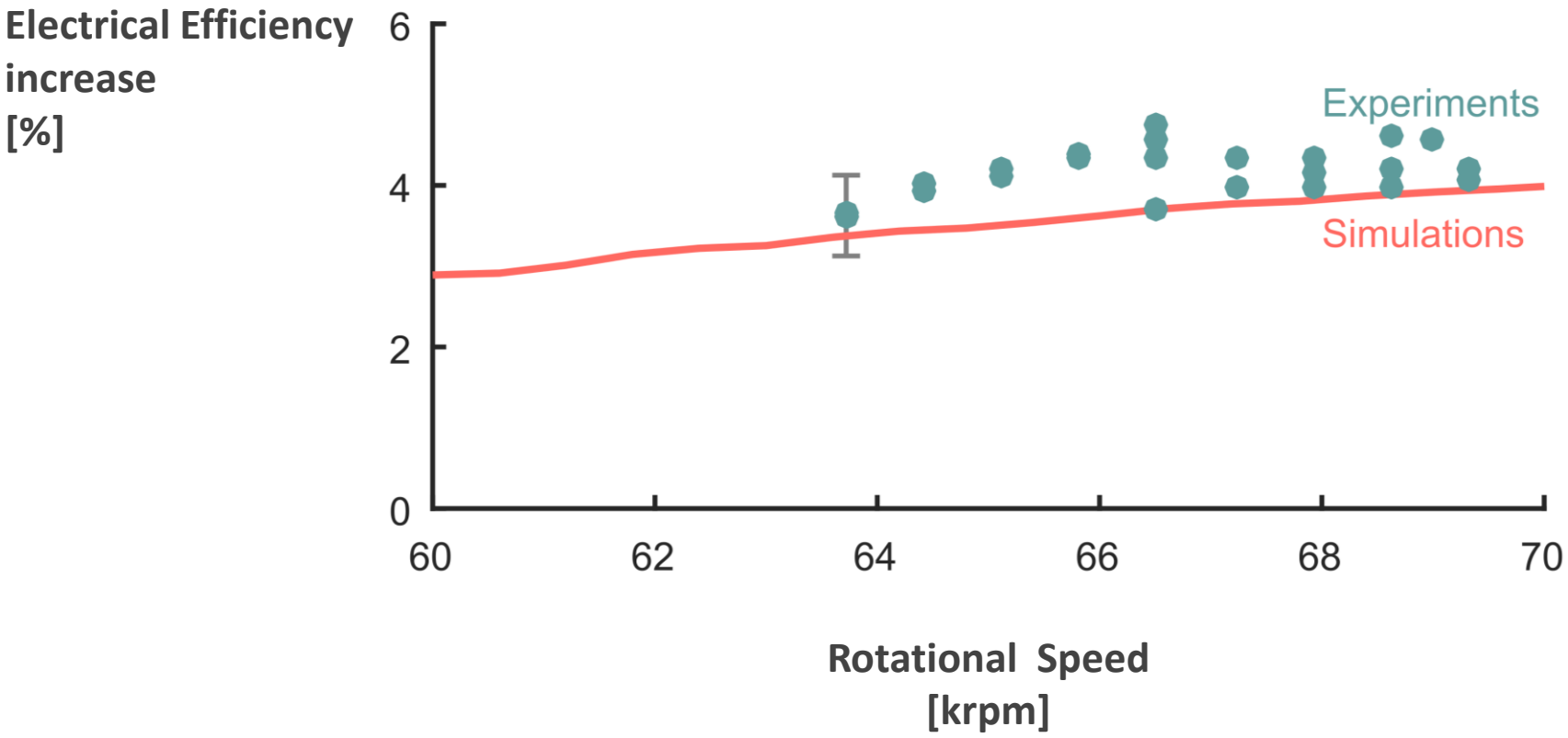
Full load, full water injection experiments
in constant rotational speed mode

- Global performance
- Component performance

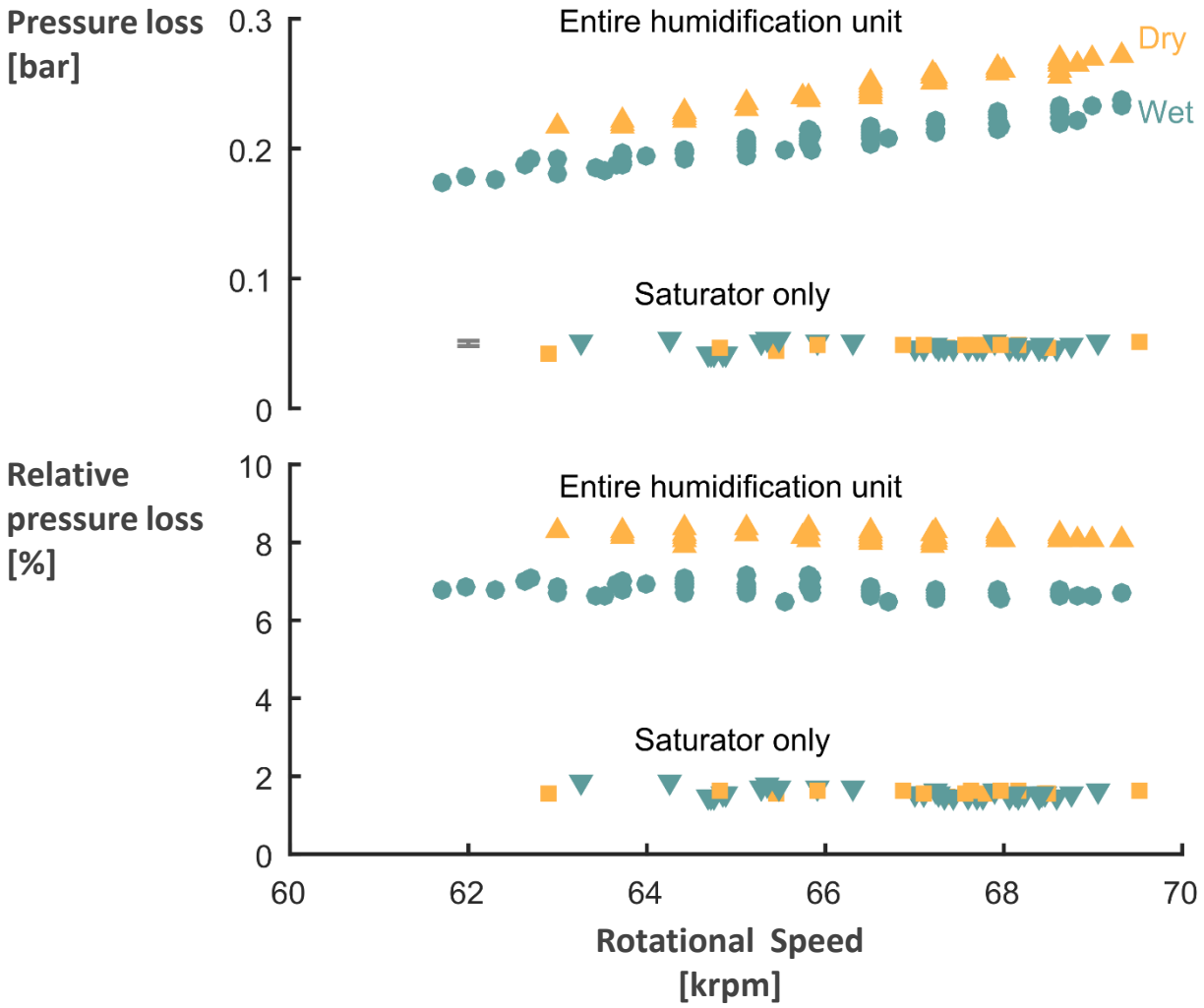
By controlling the rotational speed
wet and dry efficiencies can be compared



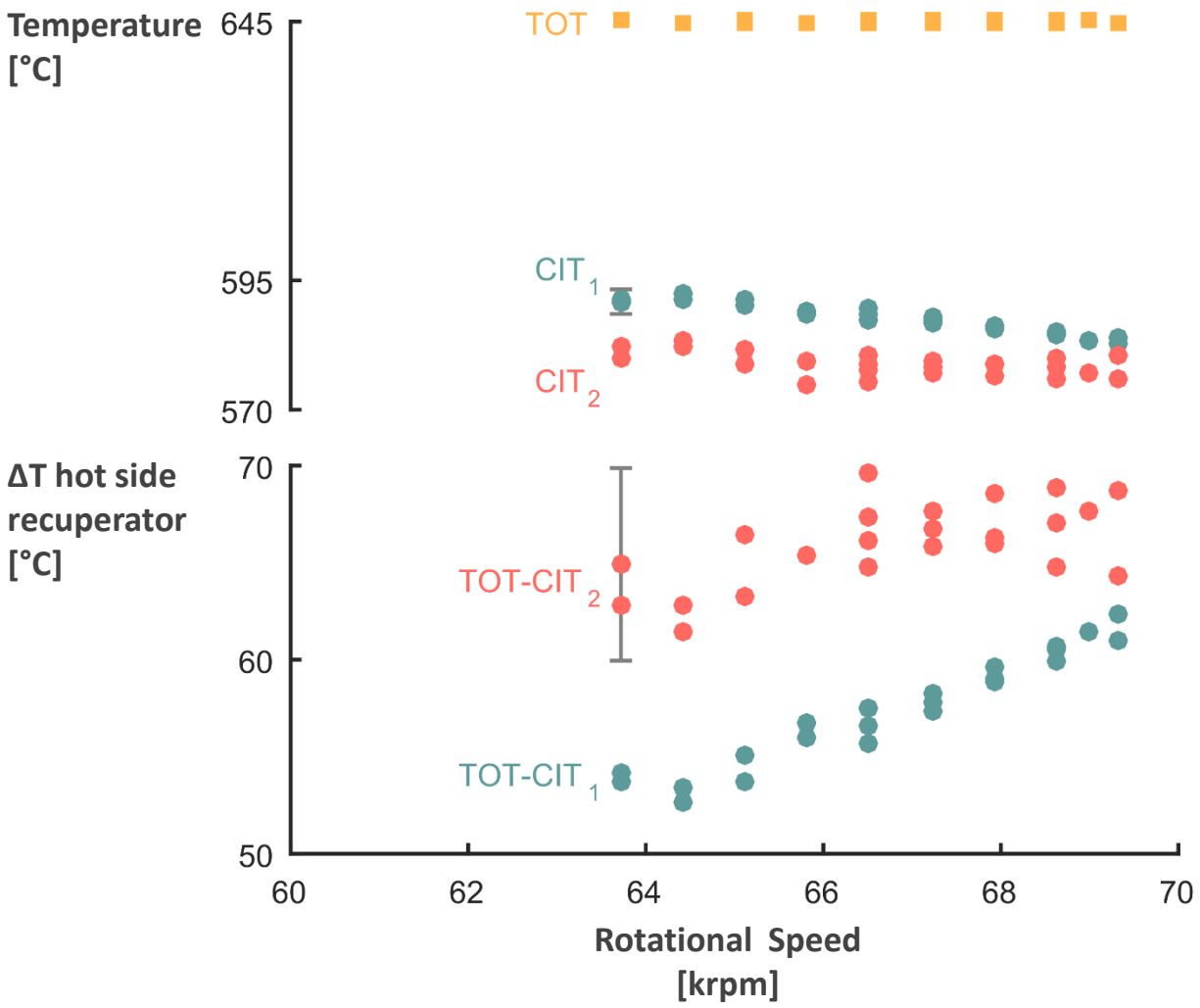
Experiments show that water injection results in an electrical efficiency increase



The pressure loss of the saturator is limited
but the total loss of the humidification unit is high



The recuperator has a favourable off-design behaviour with water injection



The T100 mHAT is fully operational
at nominal conditions

First tests at full load showed that results
with default settings were not comparable

The controller of the T100 unit was modified
to operate in constant rotational speed mode

**Water injection brings about an increase
in electrical efficiency**

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