Fit4Micro solution for a microCHCP hybrid heating system running on biofuels

Fit4Micro

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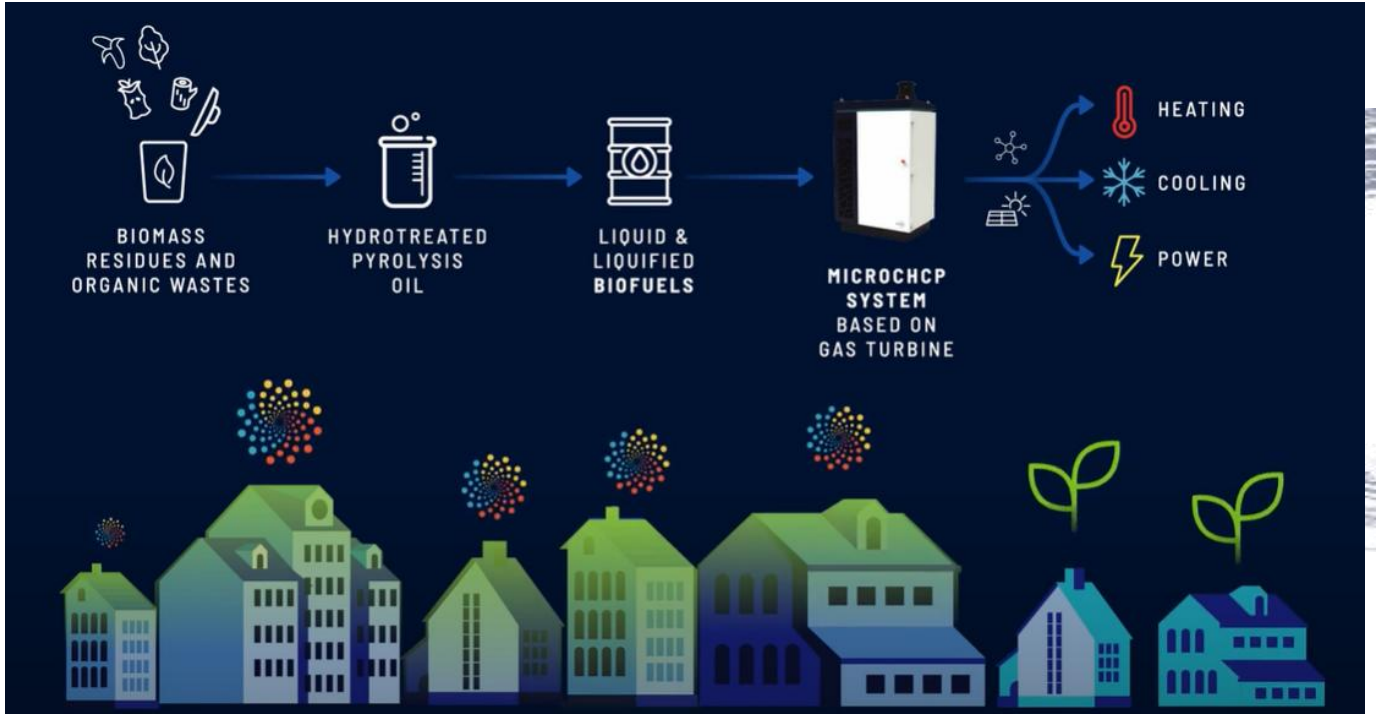
Switching fossil fuel off means ….
Multiple combined solutions

- Reduce energy consumption :
  - Lower heat demand
  - More efficient heating supply
  - Better distribution networks
- Use organic carbon fuels:
  - mix of green electricity
  - low-carbon gases
  - biofuels from biomass/biogas
- Increase use of electric or hybrid heat pumps



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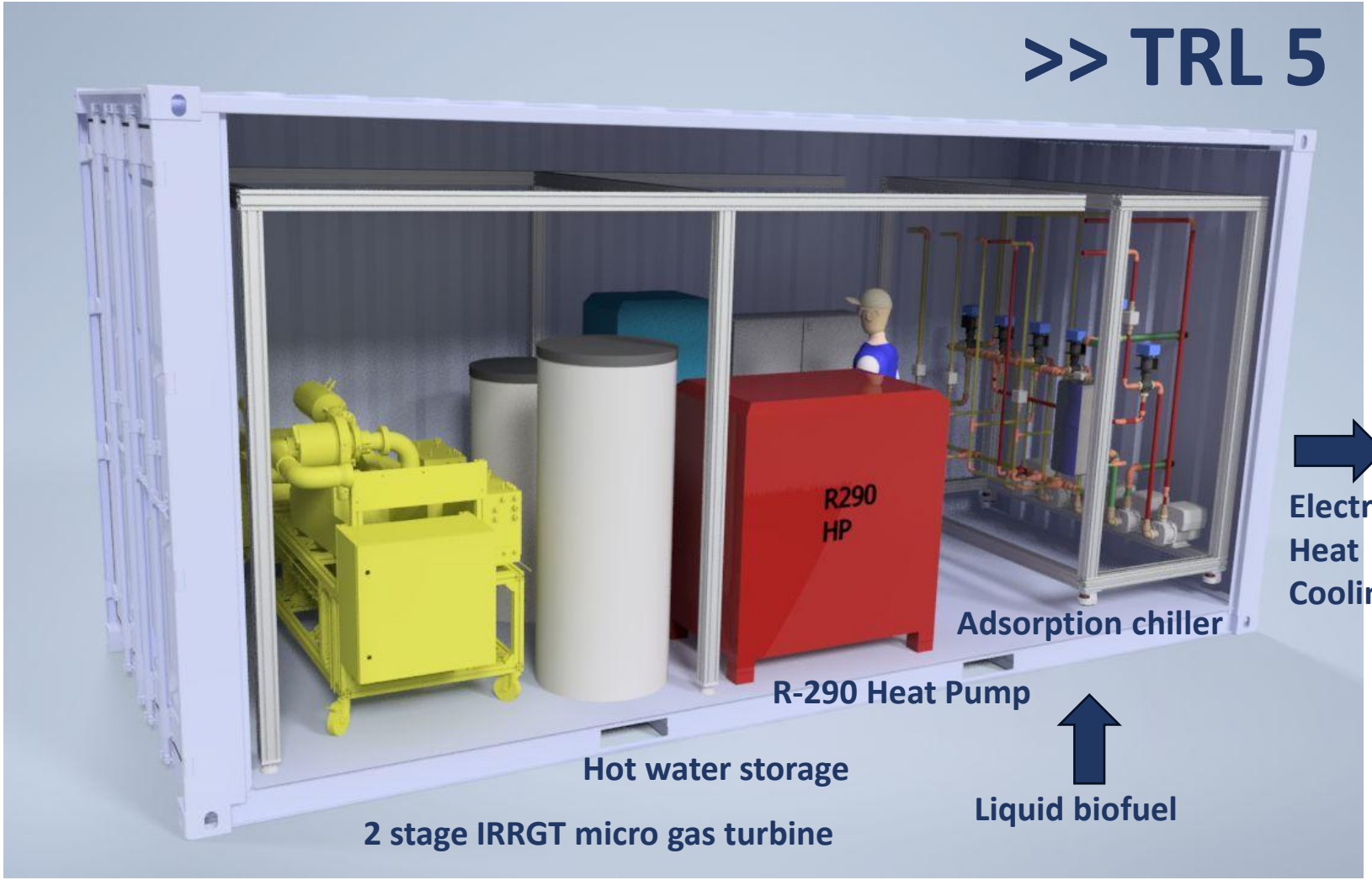
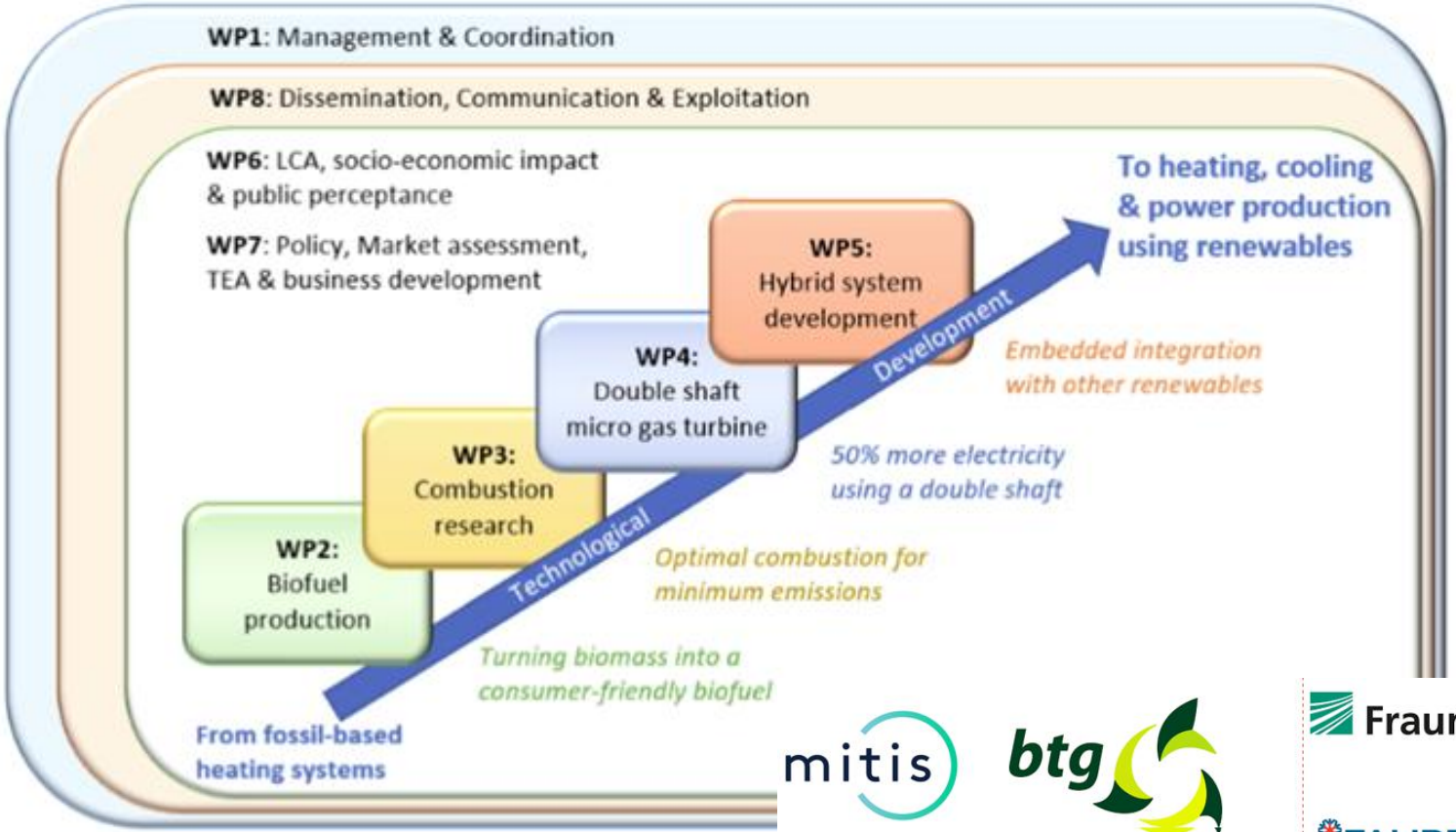

R290
HP
Electricity (20 kWe
Heat
Cooling
Adsorption chiller
R-290 Heat Pump
Hot water storage
Liquid biofuel
2 stage IRRGT micro gas turbine



Fit4Micro

- RIA 9 partners
- Budget: 5 MEUR
- Duration: 48 Mths
- 1/10/2022

mitis

btg

Science4Fuels OWI an der RWTH Aachen

UMONS University of Mons

Fraunhofer ISE

AALBORG UNIVERSITY

FAHRENHEIT Cooling Innovation.

etaflorence renewableenergies

COGEN EUROPE

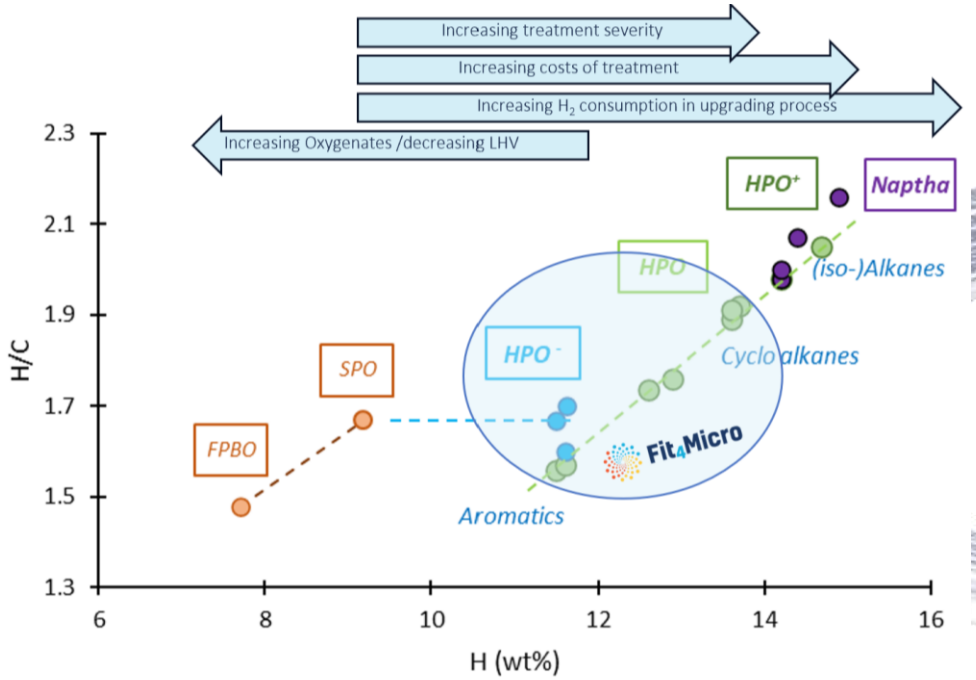
WP2: Biofuel production

SO-4: Production of truly sustainable 2nd generation liquid biofuels suitable to fuel the microCHCP system

- ✓ *Ex: KPI-4a: Production of **HPO with LVH > 40 MJ/kg** from residual biomass materials.*

SO-5: Achieving economically competitive operation for the microCHCP system.

- ✓ *KPI-5b: Producing biofuels with cost price < 22 €/GJ **(~0.08 €/KW$_h$)***

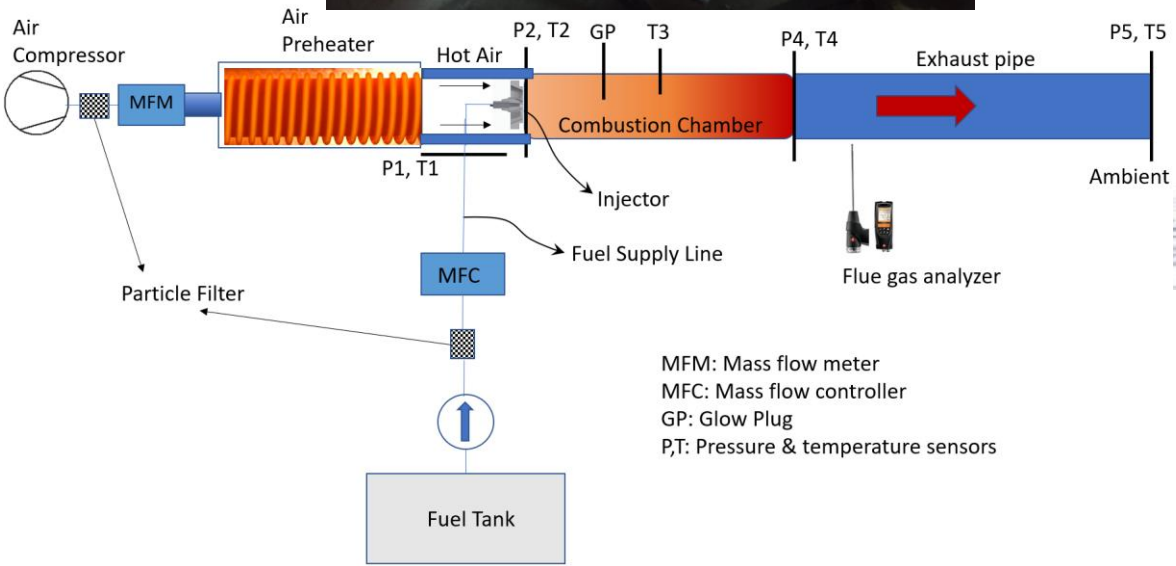


Product qualities as function of hydrogen content

WP3: Biofuel combustion research

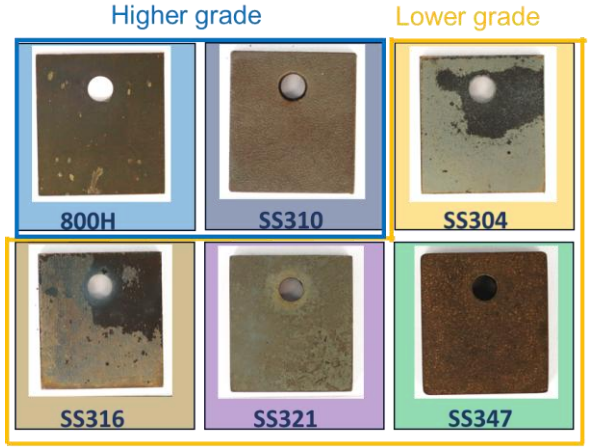
SO-3: Flameless combustion of liquid biofuels with same or higher efficiency than natural gas in the gas turbine cycle.

- ✓ *Ex: KPI-3b: Pollutant emissions to be 50% of the actual norms or lower, with* ***NO_x < 60 mg/kW$_h$ fuel***

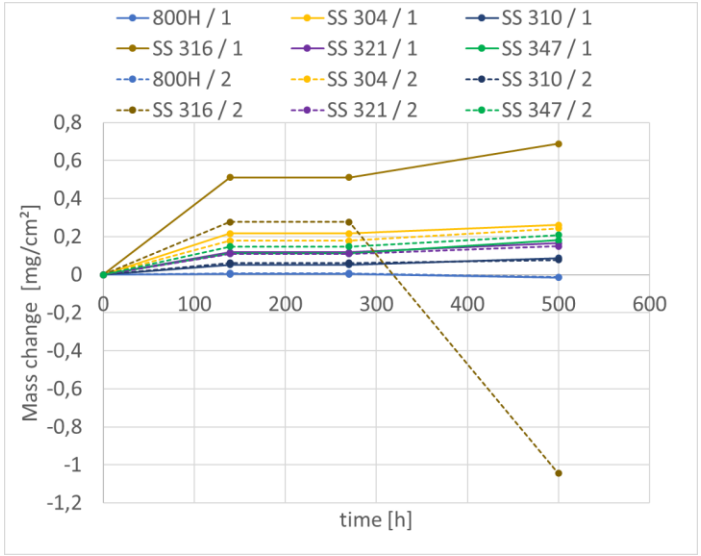


WP3 (contd.): High-temperature materials‘ assessment

- Determination of long-term stable, high-temperature, oxidation-resistant materials for the combustion chamber and turbine wheels that meet the requirements



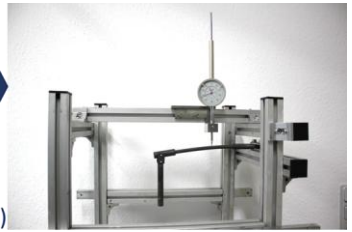
Photographs of 18x20 mm² alloy samples after 270 h



Furnace

100h

Bending measurement at RT (discontinuous)



WP4: Humidifed Intercooled Regenerative Reheat Gas Turbine Cycle

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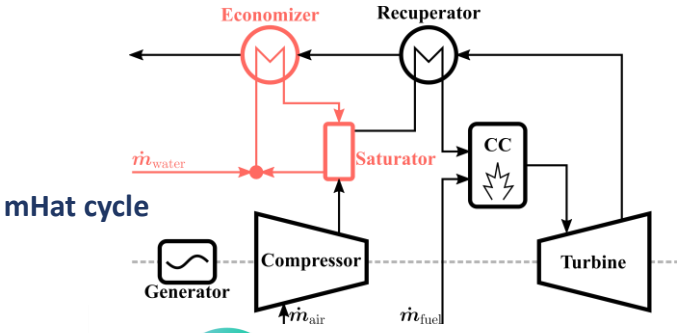
SO-1: Validation of the hybrid microCHCP (relevant environment)

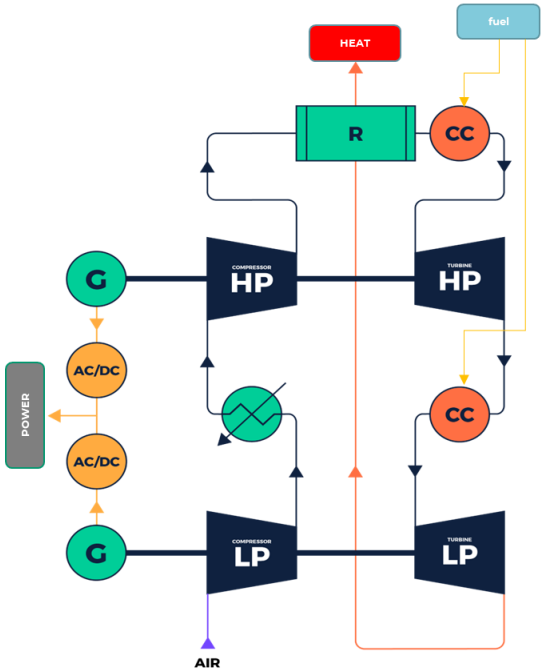
- ✓ *Ex: KPI-2a: Achieving at least **40%** electrical efficiency.*

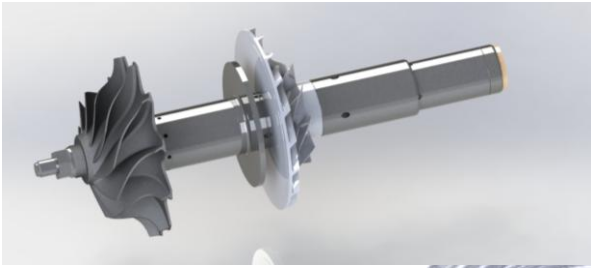
SO-5: Achieving economically competitive operation for the microCHCP system.

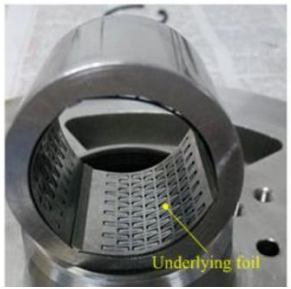
- ✓ *KPI-5a: Investment costs for the microCHCP < 2500/**500 €/KW$_e$** for a 20 KW$_e$ system, achieving pay-back times < 10 years. (*)*

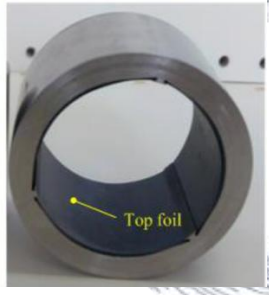


mHat cycle









	Steam injection	Water injection	saturator
	$\Delta\eta/\eta_{ref}$	$\Delta\eta/\eta_{ref}$	$\Delta\eta/\eta_{ref}$
μ10	+10.9%	+9.4%	+12.9%
μ20	+13.2%	+15.0%	+22.9%

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EUBCE 33rd European Biomass Conference & Exhibition

WP5: Integrated hybrid trigeneration system development & evaluation

- SO-6: Demonstrate and validate the sustainability of the HPO-fuelled microCHCP system by detailed LCA assessment.

✓ *KPI-6a: Primary energy savings > **100%** through improved fuel utilization efficiency.*

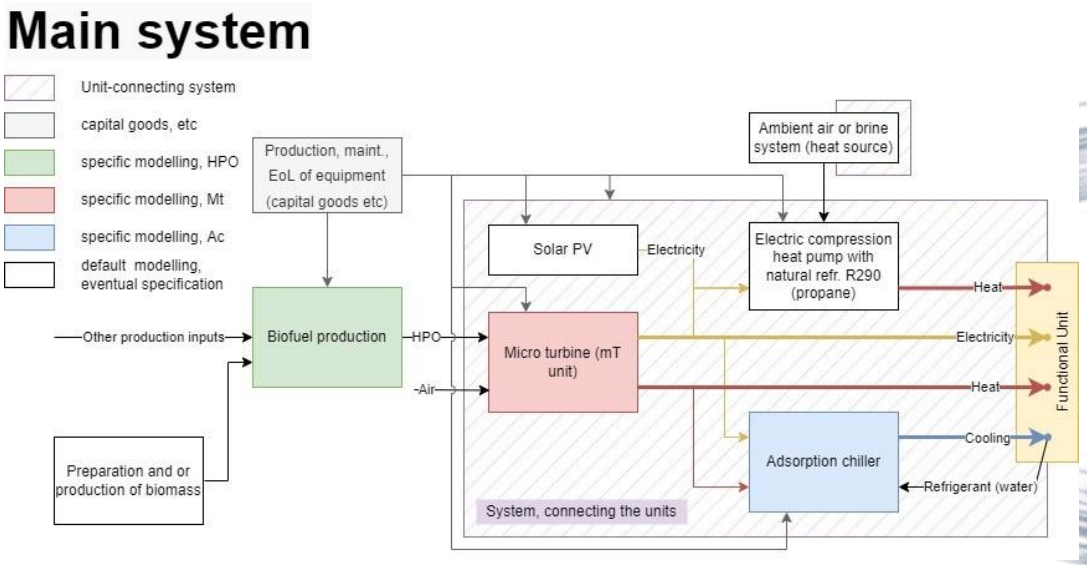
✓ *KPI-6b: GHG emission savings > **80%** compared to using domestic heating oil fuelled CHP system with similar H:P ratio (55% heat, 35% electric).*

✓ *KPI-6c: Reduction of GHG emissions for cooling by **100%** compared to compression cooling by using water as refrigerant.*

- Design at least 2 hybrid systems and variants for different use cases
- Develop robust and efficient control strategies
- Test a system demonstrator for two most promising use cases in a laboratory environment
- Optimize and evaluate systems based on system simulations

WP6: LCA, socio-economic impact, public acceptance

1. To determine the environmental sustainability performance of the microCHCP system fueled with HPO
2. To investigate the socio-economic impact of the Fit4Micro technology on the society.
3. To determine the public acceptance of the mGT based microCHCP system.
4. To perform a gender impact assessment for the microCHCP system.



WP7: Policy, market assessment

1. Monitored and assessed key policy files that have the potential to impact the uptake of micro-CHP and hybrid heating solutions.
2. Market assessment
3. Techno-economical analysis
4. Business development

Opportunities

- Increased focus on energy efficiency, especially for renewable gases
- Need to accelerate the decarbonisation of buildings
- Moving away from the combustion of fossil fuels in buildings (incl. natural gas)
- RES gases/bioenergy of strategic importance to displace Russian gas
- Electrification requires scaling up the deployment of flexible generation
- Micro-CHP & hybrids recognised as green investments

Threats

- Prioritising electrification and district heating for buildings
- Prioritising gas, even renewable gases, for hard-to-decarbonise industrial customers (vs. space heating/electricity)
- Promoting "non-fossil"/non-gas flexibility options, namely demand-side response and storage

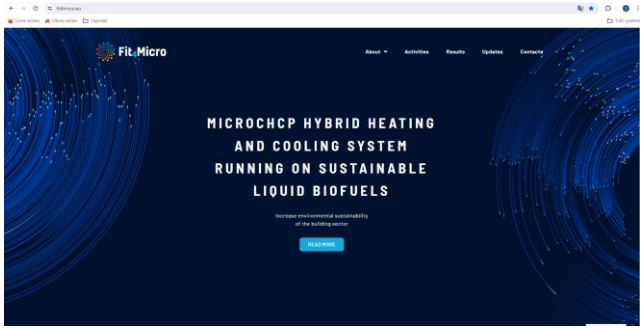
WP8: Where to find us ?

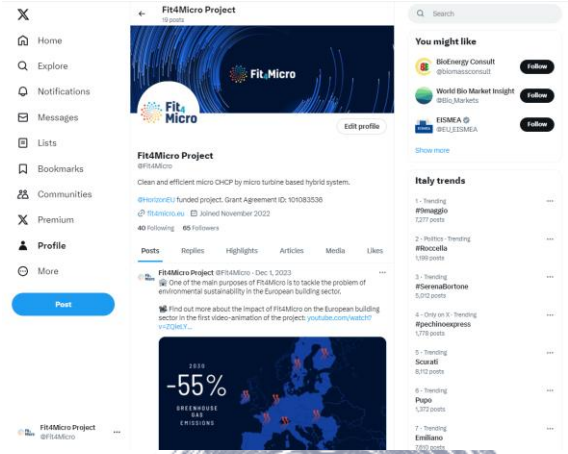
fit4micro.eu

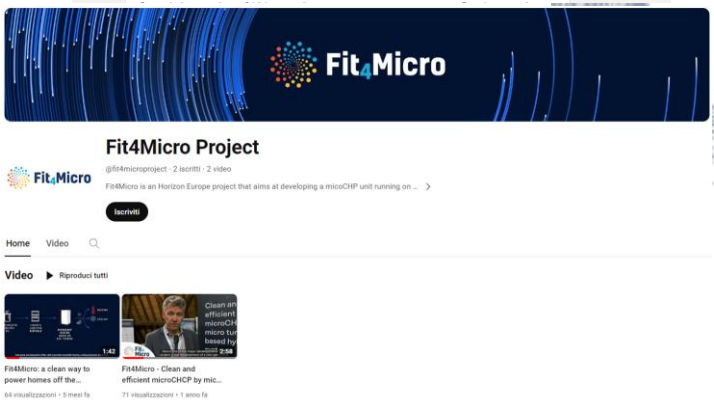
@Fit4Micro

Fit4Micro Project

info@fit4micro.eu







Thank you!

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