Fit4Micro Newsletter
Issue 4 | October 2025

A clean way to power homes off the electricity grid

The Fit4Micro consortium is delighted to introduce its fourth newsletter edition. This newsletter reports the latest news and developments of the project that have occurred up to October 2025 including communication and dissemination actions.

Fit4Micro - Clean and Efficient microCHCP by microturbine based hybrid systems, is a Horizon Europe project aiming at developing a highly efficient microCHCP hybrid system running on sustainable liquid biofuels and able to provide renewable heating, cooling and power production for demand-driven applications such as multi-family houses specially at remote and/or off-grid locations, non-residential buildings and industrial facilities requiring cooling or water as refrigerant in their processes.
Fit4Micro system is based on a double shaft micro gas turbine combined with a humidification unit. A high GHG emission reduction is obtained by our flameless combustor using RED-III compliant biofuels. Its fast response time and fuel-flexible operation make it ideal for a highly efficient hybrid CHP system, resilient to changes in fuel and power markets and empowering the consumers through digital solutions. Fit4Micro can be integrated with a compression heat pump, an adsorption chiller and a solar PV system.

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1. Zero Emission Buildings: Smart Integration of Renewables, Energy Efficiency and Electrification

This webinar was organised by Fit4Micro project, 18 June 2025. Held in the context of the Sustainable Energy Days, the session focused on the theme: Zero Emission Buildings: Smart Integration of Renewables, Energy Efficiency and Electrification.

As Europe works towards climate neutrality, achieving zero-emission buildings is critical. This involves not only greater electrification and improved energy efficiency, but also the integration of renewable energy sources.

Yet, when these efforts are not aligned with infrastructure development, they can lead to higher costs-particularly affecting remote or off-grid communities vulnerable to energy insecurity.

Through the Fit4Micro project, which is developing a high-efficiency microCHP system powered by sustainable biofuels, this webinar explored how innovative technologies can improve energy performance in buildings and support the transition to low-carbon solutions. It also examined the links between energy efficiency and affordability, while addressing key issues such as energy poverty, sustainable heating and cooling, and the role of youth in driving the energy transition.
The event brought together a range of speakers and experts for a keynote address, panel discussion, and interactive Q&A, offering insights into the policy, technological and social measures required to make zero-emission buildings a practical reality. Key topics included energy labelling, heat pumps, and integrated building systems.

This was the agenda of the event:

Keynote Speaker:
Mr Radan Kanev, Member of the European Parliament
Accelerating the cost-effective transition to zero emissions buildings

Project presentation:
Dr. Michel Delanaye, CEO, Mitis & Fit4Micro Project Coordinator
Fit4Micro solution for a microCHCP hybrid heating system running on biofuels

Panel Discussion:
- Mr Hans Korteweg, Managing Director, COGEN Europe (Moderator)
- Dr. Michel Delanaye, CEO, Mitis & Fit4Micro Project Coordinator
- Dr. Søren Løkke, Aalborg University
- Dr. Victoria Taranu, BPIE
- Ms Alexandra Tudoroiu, COGEN Europe

Dr. Michel Delanaye confirmed that "we are combining different things into this project: the production of the biofuel and its usage to micro gas turbines and its connection with heat pumps, to produce heat and cooling and also electricity and at the same time also addressing the problematic of efficiency."
It was also suggested that a full, immediate transition from fossil fuels to complete electrification for heating (e.g., using heat pumps everywhere) posing a major challenge for the electrical grid, especially during wintertime, could be not feasible, and some form of combustion will need to be retained for heat production, particularly in larger buildings and cities.

For further information, video recording of the event is available in the project youtube channel

youtube.com/watch?v=zpkMui0Mn9w&t=1141s

and to this link of the project website,
Results webpage fit4micro.eu/results

Speakers, panellists and moderator of the webinar "Zero Emission Buildings: Smart Integration of Renewables, Energy Efficiency and Electrification". Source: Fit4Micro.

2. Material resistance of combustor and turbine components, report on testing

The design and development of a micro gas turbine (mGT) system, including its heat exchanger and combustion chamber, for operation with biomass-derived liquid fuels necessitates careful consideration of material degradation phenomena. The operational lifespan of metallic components in such environments is often influenced by a complex interplay of corrosion, creep, and fatigue mechanisms. Moreover, the chemical composition of biomass-based fuels can result in corrosive flue gas atmospheres, and cycle humidification may further intensify corrosion processes under high-temperature conditions.

High-temperature alloys represent a significant portion of the system's capital expenditure (CAPEX), due to their high cost. Therefore, the selection of cost-effective materials is crucial for ensuring the economic viability of the mGT system. At the same time, the materials used in energy systems such as the mGT must meet demanding lifetime expectations.

Early in the project, it became clear that the heat exchanger is one of the main cost drivers of the system, partly due to the quantity of material required. As such, corrosion testing efforts were primarily focused on candidate materials for the heat exchanger.

To improve energy efficiency and reduce costs, minimizing the wall thickness of the heat exchanger is desirable. However, thinner walls are more susceptible to aging and degradation via corrosion, further justifying the need for robust corrosion testing in this component.
Other critical components in terms of material degradation are the rotor shaft and tie-bolt (max temperature of 700°C), combustion chamber outer skin (max temperature of 1000°C) or heat exchanger enclosure skin (max temperature of 700°C).

These are more massive components or thicker sheets, compared with thin sheets inside the heat exchanger. They are more vulnerable to long-term creep and fatigue rather than corrosion. Accordingly, creep testing efforts were concentrated on materials intended for components.
Based on a preselection of promising material candidates, a comprehensive test campaign was conducted to evaluate their performance under conditions representative of actual mGT operation - including high temperatures, corrosive combustion gases, and mechanical loads. The objective of these investigations was to identify materials capable of ensuring long-term durability and minimizing the risk of premature failure or rapid degradation.

The findings of these tests are presented and discussed in the deliverable D3.2 "Material resistance of combustor and turbine components, report on testing".

For further information, video recording of high temperature material testing is available in the project youtube channel

https://www.youtube.com/watch?v=Ay4T1iQ2X00&t=3s

and to this link of the project website,
Results webpage fit4micro.eu/results

Laboratory tests and experiments performed by OWI, Germany: experts prepared innovative high temperature materials.
Source: OWI.

3.International events

As a selected EU project, the Fit4Micro project joined the European Biomass Conference and Exhibition (EUBCE) in June 2025. Its main results and activities were illustrated in several sessions and project booth in the Exhibition area.

Danish Rehman presented the results for combustion of BTG biofuels (Liquid HPO) in MITIS microturbine combustor at EUBCE 2025 in Valencia, Spain, during his presentation "Hydrotreated Pyrolysis Oil for Sustainable Microturbine Combustion: Experimental Evaluation under Flameless Conditions". This study explores the performance of a micro gas turbine combustion chamber operating in a flameless combustion regime using hydrotreated pyrolysis oil (HPO) derived from wood residues. Combustion tests revealed that NOx emissions decreased with increasing air-to-fuel ratios, with values below 10 ppm for HPO grades and 15 ppm for domestic heating oil at Lambda = 9 (equivalence ratio =0.1). He showed that for more refined grades of HPO, emissions are lower than 60 mg/kWh for atmospheric testing.

This oral presentation illustrated all the project activities: "Fit4Micro Solution for a MicroCHCP Hybrid Heating System Running on Biofuels". The related presentation document is included in the full open access conference proceedings database. The Scientific Programme of the EUBCE includes several other presentations and sessions dedicated to conversion processes and technologies for advanced biofuels production and utilisation.

Danish Rehman presentation at EUBCE 2025.
Source: ETA

Fit4Micro project was also presented at TurboExpo in June 2025 as follows:

- Ward De Paepe from UMONS participated in the Tutorial of Basics around **Micro-Gas Turbine: Technological Advancements and Market Research**, where he gave an overview of 15 years of numerical and experimental work on different advanced cycles for improved micro gas turbines performance, with a specific focus on cycle humidification, the option implemented in the Fit4micro project to enhance cycle performance and enable flexible heat-to-power ratios.
- Aggelos Gaitanis from University of Mons, Belgium, presented "**Dynamic modeling and experimental insights in a 10 kWe micro gas turbine prototype: experimental validation and testing**": for this paper, a dynamic real-time 0D model of a 10 kWe mGT prototype has been constructed and validated. The mGT prototype of 10 kWe was designed and manufactured by MITIS SA to target the residential energy market. This real-time framework of the 10 kWe prototype offers potential for optimization of mGT within distributed energy applications, and provides a modular basis for further improvement by studying humidified and 2-stage mGT cycles and innovative control strategies.

Danish Rehman presentation at TurboExpo 2025.
Source: MITIS

- Danish Rehman from MITIS, Belgium, presented "**Experimental Analysis of Structural Characteristics and Viscous Energy Dissipation in Cantilever Gas Foil Radial Bearings**": gas foil bearings are self-lubricating aerodynamic bearings which offer a low-cost alternative to traditional hydrodynamic oil bearings. Turbomachines with air bearings guarantee a low maintenance and oil free operation which is why most of the micro gas turbine manufacturers opt for these bearings. He presented the experimental work that MITIS has carried out for the development of radial bearings.

4. European Micro Gas Turbine Forum

The European Micro Gas Turbine Forum (EMGTF) is a biannual event designed to bring together all key stakeholders in the micro gas turbine (mGT) ecosystem.

Its mission is to foster the commercial deployment of micro gas turbines by offering a high-level in-person platform where experts, researchers, industry leaders, and investors can share knowledge, collaborate, and co-design the roadmap for the future of mGT technology.
Designed to address critical industrial activities necessary for mGT advancements.

These sessions, which cover operational, environmental, and cost perspectives, presented recent technology developments and innovative solutions, ensuring a balanced view of current and future industrial and research needs.
The event took place on 15-16 October 2025 in Brussels, Belgium.
This Forum started with the presentation "Unpacking micro Gas Turbine (mGT) Technology" delivered by Ward de Paepe from University of Mons, and then he chaired the Technical Session: mGT in Advanced Energy Systems.

During the second day, a presentation of Fit4Micro project, titled "Fit4Micro: Hybrid heating and cooling system running on sustainable liquid biofuels", was delivered by Danish Rehman from MITIS.

He presented the biofuel production, in particular referred to the HPO, hydrotreated pyrolysis oil; the biofuel combustion research, focusing on the flameless combustion od liquid biofuels; high-temperature materials' assessment; humidified intercooled regenerative reheat gas turbine cycle; integrated hybrid trigeneration system development and evaluation, with the definition of use cases and system design, including heating and cooling case testing; policy and market assessment, and high-level findings.

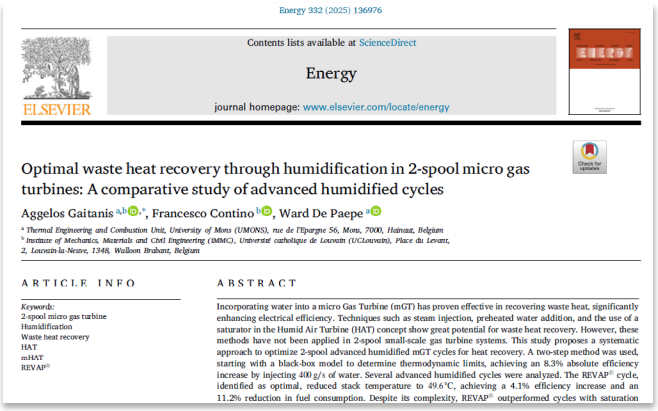
Previuosly, Hans Korteweg from COGEN Europe delivered the "Keynote session: Policy as a Key Enabler for Cogeneration and mGT Deployment".
Fit4Micro was also one of the media sponsors and project partners, having its spot in the expo hall.

Hans Korteweg presentation at EMGTF 2025. Source: ETN Global (Linkedin).

5. Optimal waste heat recovery through humidification in 2-spool micro gas turbines: A comparative study of advanced humidified cycles

In this paper, published in September 2025 (Energy, Volume 332, https://doi.org/10.1016/j.energy.2025.136976), University of Mons and Université catholique de Louvain (Belgium) authors presented the results of simulations focusing on advanced humidification in a 2-spool mGT. A two-step method was utilized to identify the optimal thermodynamic conditions for water injection.
Incorporating water into a micro Gas Turbine (mGT) has proven effective in recovering waste heat, significantly enhancing electrical efficiency. Techniques such as steam injection, preheated water addition, and the use of a saturator in the Humid Air Turbine (HAT) concept show great potential for waste heat recovery.

However, these methods have not been applied in 2-spool small-scale gas turbine systems. This study proposes a systematic approach to optimize 2-spool advanced humidified mGT cycles for heat recovery.
A two-step method was used, starting with a black-box model to determine thermodynamic limits, achieving an 8.3% absolute efficiency increase by injecting 400 g/s of water. Several advanced humidified cycles were analyzed.



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Optimal waste heat recovery through humidification in 2-spool micro gas turbines: A comparative study of advanced humidified cycles

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ABSTRACT

Incorporating water into a micro Gas Turbine (mGT) has proven effective in recovering waste heat, significantly enhancing electrical efficiency. Techniques such as steam injection, preheated water addition, and the use of a saturator in the Humid Air Turbine (HAT) concept show great potential for waste heat recovery. However, these methods have not been applied in 2-spool small-scale gas turbine systems. This study proposes a systematic approach to optimize 2-spool advanced humidified mGT cycles for heat recovery. A two-step method was used, starting with a black-box model to determine thermodynamic limits, achieving an 8.3% absolute efficiency increase by injecting 400 g/s of water. Several advanced humidified cycles were analyzed. The REVAP® cycle, identified as optimal, reduced stack temperature to 49.6°C, achieving a 4.1% efficiency increase and an 11.2% reduction in fuel consumption. Despite its complexity, REVAP® outperformed cycles with saturation

First page of the paper published in September 2025, University of Mons and Université catholique de Louvain.
Source: ScienceDirect website.

Part of the water injection system at University of Mons.
Source: UMONS.

Research focused on improving gas turbine (GT) performance has long aimed at recovering heat from exhaust gases. Exploration of various cycle configurations, such as combined, evaporation, steam injection, gas/gas recuperation, and chemical recuperation cycles, suggests that combined cycles would likely remain dominant for large-scale production. However, the mechanical complexity of these cycles and increased cost might limit their use in small-scale operations, where alternative configurations could be more suitable.
Incorporating mixed air/water working fluids in GTs can greatly enhance electrical efficiency, specific power output, and reduce NOx emissions.

For further information and to download this paper, please check this publication webpage:

sciencedirect.com/science/article/pii/S0360544225026180?dgcid=coauthor

ABOUT THE PROJECT

The core activity of FIT4MICRO is to design a technology that will guarantee an improvement in energy efficiency rates of existing buildings, through the reduction of energy consumption and the replacement of fossil fuels with biofuels.
The project has a total duration of 48 months from October 2022 to September 2026 and is funded by the European Union under the Horizon Europe programme.

The project Consortium during the meeting and visit at BTG in Enschede, The Netherlands.
Source: Fit4Micro project.

FIT4MICRO is coordinated by MITIS, a clean-tech startup developing flameless combustion microturbine working with air foil bearings, with the main aim of providing immediate and drastic emission reductions during primary energy conversion. The project consortium has put together 8 partners from 5 countries with long-term expertise in renewable energy applications, from technology developments to the market implementation, including:

- two research institutions: Fraunhofer ISE and OWI Aachen (Germany);
- one industry partner: MITIS (Belgium);
- two SMEs: ETA Florence Renewable Energies (Italy) and BTG Biomass Technology Group (The Netherlands);
- two universities: University of Mons (Belgium) and Aalborg University (Denmark);
- one European association: COGEN Europe (Belgium).

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