Fit4Micro

Newsletter

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A clean way to power homes off the electricity grid

The Fit4Micro consortium is delighted to introduce its fifth newsletter edition.

This newsletter reports the latest news and developments of the project that have occurred up to January 2026 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. Paper on Policy and Regulatory Framework and Recommendation

The Fit4Micro solution responds to major challenges identified for EU's building stock, with a special focus on securing affordable supply of clean energy in remote and off-grids **buildings**. Combining micro-CHP with different renewable technologies helps meet both the high-level objectives and key targets set at EU and national levels. Yet certain policy measures and regulatory provisions fall short of fully capturing the benefits of the Fit4Micro solution.

The present paper identifies the policy opportunities and barriers to the market deployment **highly efficient hybrid solutions**, as developed within Fit4Micro project. To address policy gaps and regulatory barriers, key policy recommendations are proposed. It also assesses the relevant EU and national policy frameworks impacting the future uptake of the clean energy solution developed under Fit4Micro. It identifies support opportunities for the industrialisation of micro-turbine CHCP systems and their deployment as part of highly efficient hybrid systems, in combination with heat pumps, PV and storage options. Policies impacting the integration of sustainable biofuels, as a source to the micro-CHP are also considered. The paper also maps out policy barriers and makes recommendations to address political and regulatory risks in the short to medium term.

At EU level, policies and strategies analysed include the Renovation Wave, the Energy Performance of Buildings Directive (EPBD), Energy Labelling and Ecodesign Regulations on Space Heaters (Lot1), the Energy Efficiency Directive (EED), the Renewable Energy Directive (RED III), Electricity Market Design (EMD), EU Taxonomy, EU Electricity Network Codes and the Net-Zero Industry Act (NZIA). At national level, specific strategies, energy plans, policy and regulatory legislation were assessed for countries identified as relevant for early market uptake of the Fit4Micro technology.

In addition to gaining an in-depth understanding of the relevant EU and national policy framework impacting the Fit4Micro solution, the paper also makes comprehensive policy recommendations to help move towards a secure regulatory framework for this sector.

On the pathway to reach net-zero emissions by 2050, the EU has prioritised the building sector as hard-to-decarbonise. The **EU Green Deal** and subsequent Renovation Wave Communication adopted at EU level have identified multiple factors that are contributing to the slower adoption of energy efficiency and renewable energy solutions in EU's building stock.

To address the significant decarbonization challenges that buildings face and meet the objectives of the **EU Renovation Wave**, the more rapid adoption of building insulation, energy efficient solutions and renewable energy sources will be needed.
In response to the ambitious EU climate and energy objectives, a diverse range of clean buildings solutions are already available or soon to enter the market.

These include:
- Building insulation
- Energy efficiency heating & cooling generation: micro-CHP & heat pumps
- Efficient district heating: increasingly delivering renewable heat, cogenerated heat and waste heat
- On-site direct renewable sources: solar thermal installations, PV panels
- Renewable sources delivered through the grids: renewable electricity, biomethane
- Off-grid renewable gases: bioLPG, biogas, rDME
- Energy storage: thermal, batteries
- Smart energy approaches: smart controls, energy communities, energy systems integration

European households today can benefit from all these solutions, which can be combined in smart ways to reduce emissions, lower energy costs, increase energy resiliency and improve air quality for citizens.
Moreover, SMEs can make use of these clean energy sources to further increase their competitiveness. The **integration of different energy solutions** is also increasingly employed to decarbonize buildings, either onsite via hybrid systems or at local level via energy communities, as well as more extensively through integrated systems planning.

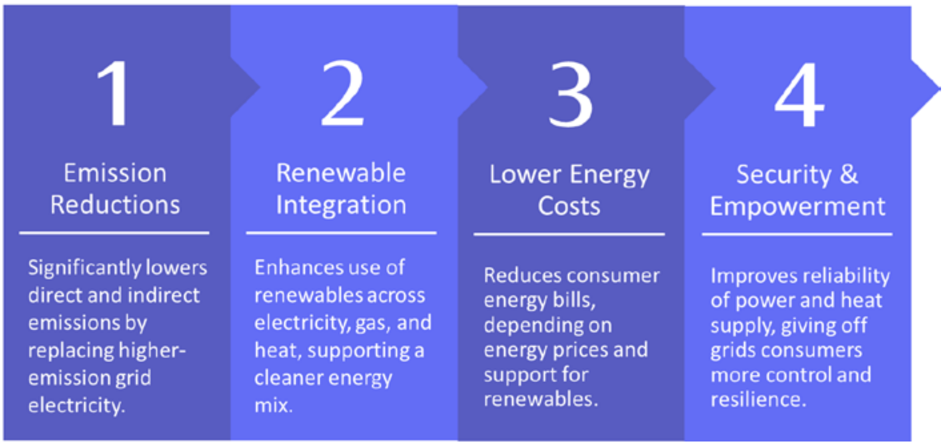
Hybridisation has been proposed for a more balanced pathway to deliver decarbonisation faster, more securely and at lower cost for consumers. For rural and remote areas, the combined use of on-site distributed solutions like PV, micro-CHP and heat pumps appears to be particularly fit to harness the full potential of energy efficiency and renewable energy solutions.

The solution developed by the Fit4Micro project consists of a highly efficient hybrid system that delivers an all-year round zero-emissions energy for buildings with limited access to energy grids, at lowest possible cost for the consumer and the energy system as a whole. Depending on the local circumstances, consumer needs and regulatory environment, different configurations can be achieved to optimise and smartly combine an innovative micro-CHP with heat pumps, storage and PV, as well the integration of a range of sustainable biofuels.

As highlighted in EU's Renovation Wave, adopted in the context of the EU Green Deal, and reinforced in the recently adopted EU Clean Industrial Deal, **EU's decarbonisation** cannot happen without a significant shift in how energy is supplied and consumed in the European building stock. In this context, the Fit4Micro solution is well positioned to contribute towards higher efficiency buildings and zero-emissions buildings.

Across the EU, national and regional strategies reviewed, there is a clear shift towards more ambition for building renovation, including higher shares of electrification, increase integration of renewable electricity, the uptake of renewable fuels and boosting energy efficiency. The Fit4Micro solution is well aligned with these clean energy, climate and competitiveness objectives.

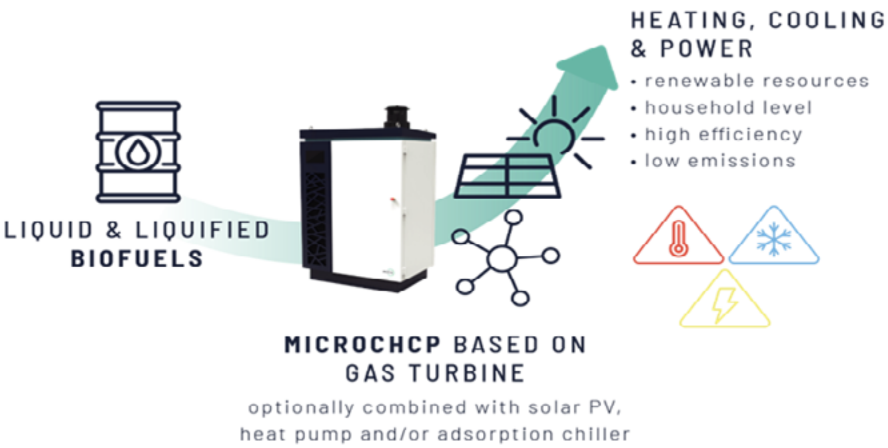
For further information, Deliverable 7.1 "Paper on Policy and Regulatory Framework and Recommendation".
Visit the Results webpage fit4micro.eu/results



Benefits of highly efficient hybrid buildings. Source: Fit4Micro D7.1.

2.Technical report on LCA assessment 1

The Life Cycle Assessment (LCA) in Fit4Micro project is conducted with the aim of facilitating decision support in technology development and support sustainable implementation of the technology. The primary objective of this study is to assess the environmental impact of the micro-gas turbine (mGT) system when fuelled with hydrogenated pyrolysis oil (HPO) in various use case scenarios and with different feedstock sources for the biofuel production process. Scenario development encompasses 18 different potential applications of the mGT in the future, spanning various building types, locations, and building standards.



The Fit4Micro technology and concept. Source: Fit4Micro project.

The main system comprises a micro turbine integrated with two technology options to meet demands for electricity, heating, and cooling.
The first option involves combining the micro turbine heat production with a compression heat pump, particularly relevant in cold climates. This setup may utilize part of the electricity generated by the turbine during cold periods, enhancing the overall heat efficiency of the system.
In warm climates requiring cooling, the main system can be augmented with an adsorption chiller. This chiller harnesses heat from the turbine, consuming electricity solely for pumping purposes.
The final possibility is to incorporate solar PV to supply electricity to the heat pump, consequently reducing the demand for biofuels. Thus, the system under study is a hybrid one.

To quantify the **environmental impact** of the mGT system across different building scenarios, the energy demand for heating and electricity was assessed for 18 use cases. The mGT system operates with a fixed output ratio of two-thirds heat and one-third electricity, and the total energy demand was used to estimate the required biofuel input.

The LCA results demonstrate that the environmental performance of mGT system is highly dependent on the choice and treatment of **biofuel feedstock**. Using a consequential modelling approach, the study shows that climate impact is influenced not only by emissions from combustion and operation, but also by the alternative use of the feedstock and the substitution effects when it is diverted from conventional applications.

For example, considering three alternative feedstocks utilised for the production of biofuel, forest residues (Scenario A1) and contaminated wood (Scenario A2) yield net negative GWP100 (average **Global Warming Potential** over 100 years) values, though via different mechanisms — biogenic carbon uptake in A1 and avoided incineration emissions in A2. In contrast, wheat straw (Scenario A3), when sourced from regions with fossil-intensive heat substitution, results in net positive GWP100, underscoring the importance of regional energy contexts.
The analysis highlights the role of induced production, which may be heat production. Scenarios where the bioresource used for feedstock to **fast pyrolysis bio-oil** (FPBO) alternatively would be used for heat production, the 'missing' bioresource is substituted via heat pumps powered by renewable electricity. In this case we see significantly improved climate performance of the mGT and biooil system. This suggests that sourcing feedstocks from regions e.g. with low-impact energy systems can substantially enhance the sustainability of the mGT system, compared to sourcing feedstock that may be substituted by higher impact resources and technologies. The regional sourcing aspect is relevant for bulky feedstocks where a low value to volume ratio mean that the resource only is likely to be transported shorter distances.

Moreover, the variation across building types, standards, and geographic locations confirms that use-case-specific modelling is essential. The mGT system's performance depends not only on feedstock but also on the local energy grid and heating supply, reinforcing the need for nuanced scenario development. This furthermore imply that the mGT system if implemented in an off-grid context likely will perform better if alternatives are based on more emission heavy technologies, which often are seen in off grid applications.

These findings emphasize that biofuel production must be evaluated within its broader system context — considering **regional energy mixes**, building energy demands, and substitution technologies. Feedstock scenarios where the feedstock for FPBO production is substituted by heat from heat pumps powered by renewable electricity show strong potential.

In the next version of this report, we will expand the scope to include a full range of use scenarios, each linked to specific future business-as-usual alternatives for heating, cooling, and hot water. Furthermore, the modelling will include aspects related to timing of emission and uptake, which will decrease the effect of CO2 uptake in woody biomass. This will support a more comprehensive understanding of environmental trade-offs, importance of biomass feedstock selection, and guide the strategic deployment of the mGT system in contexts where it offers the greatest sustainability advantage.

For further information, Deliverable 6.1 "Technical report on LCA assessment 1".

Note: to accommodate performance variations dependent on the specifics of use situations, the modelling is based on the use case scenarios presented in Deliverable 5.1 "Report on 4 use case definitions for system development and evaluations", and represented as 18 use case scenarios representing four geographical regions.
Visit the Results webpage fit4micro.eu/results

3.Report on HiL tests for the advanced mGT system

Hardware-in-the-Loop (HiL) testing is a key methodology for validating and commissioning complex control systems before they are deployed in real-world operation. Modern control architectures typically integrate multiple subsystems with varying priorities and hierarchical interactions. As a result, ensuring correct system behaviour prior to field operation is essential, particularly for advanced applications such as high-performance micro-gas turbines (mGTs).
HiL test bench is used to describe the dynamic behavior of the **system components**, which is developed in WP3 on high temperature material resistance and combustor performance and WP4 on humidified micro-gas turbine development, fit4micro.eu/activities

HiL provides a controlled environment in which real hardware components interact with a high-fidelity realtime simulation of the remaining plant. This setup acts as a digital twin, allowing the development team to test, optimize, and iteratively refine control strategies at a very early stage of the development cycle. By detecting errors and inconsistencies long before commissioning, HiL significantly reduces project risks and overall development time.

Materials testing and high temperature material assessment at OWI. Source: OWI.

Key advantages of the HiL approach include:

- Reduced commissioning costs: Issues can be identified and corrected before on-site testing begins, avoiding expensive hardware damage or downtime.
- Enhanced safety: Critical states and extreme operating conditions can be tested without endangering personnel or equipment.
- Accelerated development and optimization: The digital twin environment enables rapid iteration, parameter tuning, and scenario testing that would be impractical or unsafe on the real system.
- Improved system robustness: Comprehensive testing ensures the control system performs reliably under a wide range of operational scenarios, including fault conditions.
- Application-specific adaptability: HiL facilitates targeted development for different operating strategies or configurations.

This study focuses on the HiL testing of the **combustor test** stand at OWI. The test configuration included the MITIS combustor integrated with the heat exchanger, water injector (to simulate the effects similar to that of the micro-gas turbine), air supply, fuel supply system, and all relevant sensors and actuators. The purpose of including the water injector after the combustion chamber was to reduce the temperature of the exhaust gases after the combustion process to a suitable level (≤ 750 °C), such that the maximum temperature limit at the recuperator inlet is not exceeded as per the system specifications.
Through HiL testing, the behavior of the integrated system could be assessed under realistic dynamic conditions while enabling safe, efficient, and repeatable optimization of its control strategies.
The early stages of testing are involved with creation and validation of the control algorithm, that is later extracted and deployed inside a **hardware controller**. The Software-in-the-loop (SiL) testing process was first undertaken to test the control algorithm inside a digital software environment, namely MATLAB and SIMULINK. In order to validate the control algorithm, a virtual twin of the plant was created to emulate the static and dynamic behavior of the real plant.

The validation of the control algorithm was carried out first in the MATLAB and SIMULINK environment with the help of the **virtual twin model of the plant**. The performance of the control algorithm was analyzed for all the given operating modes of the plant. This initial testing concluded obtaining important results, such as identification of important control variables of the plant and their optimal setpoints, sensitivity of control parameters to the transient behavior of the plant, etc. Each of the control algorithm subsystems viz. the state machine, triggered operation state systems, output regulation system, and error assessment system were tested for their individual as well as combined performance.
In conclusion, the hardware-in-the-loop testing of the controller was the **final testing stage** before its deployment with the actual hardware mGT plant. The controller development as well as testing was carried out in parallel to the hardware development and commissioning of the actual mGT system. The main benefit of the selected approach was the reduction of costs in the development, testing and commissioning phases for the mGT system. A robust controller was developed through a systematic and structured procedure, tailored to the user and system specifications and operation guidelines, without the need for an actual plant.
For the optimal controller performance, the developed controller must also be tested together with the **real mGT plant**. However, the HiL testing has already saved a huge amount of time and reduced the costs substantially for the initial commissioning tests, as they were already conducted without the need for the hardware components of the plant.
The future scope of work should consider testing the currently developed hardware controller together with the real mGT, to further fine-tune the performance of the controller in different operating modes, especially for the two-staged micro-gas turbine using liquid fuel as the energy source and operating in low as well as high pressure ranges.

For further information, Deliverable 5.3 "Report on HiL tests for the advanced mGT system".
Visit the Results webpage fit4micro.eu/results

4. New project video: project partners interviews

Project partners interviews were recorded during the Fit4Micro monitoring meeting at BTG in Enschede, The Netherland. This meeting referred to the year 3 of the project. All project partners were interviewed to describe the current status, development and goals of their activities related to Fit4Micro, youtube.com/watch?v=daZaEBoMbLU

Michel Delanaye, **Mitis**, Fit4Micro coordinator, describes the objectives and main goals of the project, confirming that "so overall we have a nice consortium with eight partners and together we are building the next generation power generation system and heat system and cooling system for buildings"; then, Evert Leijenhorst from **BTG** shows the implementation of a suitable and sustainable biofuel for micro turbine, in particular, the production of hydrotreated HPO from woody biomass, concluding that "we determined the optimum fuel properties to have a good combustion process and also to comply with all flue gas emission regulations together with partners in FIT4Micro".

Siri Harboe-Minwegen, **OWI**, introduces the activities focused on tests on materials for the combustion chamber and turbine wheels, and on for the development of optimized liquid fuel atomizers and flameless combustors for the use of liquid biofuels; then, Danish Rehman, Mitis, specifies that "it is testing the biofuel for flameless combustion chamber to optimise the combustion chamber and to optimise the injection system to achieve the lowest emissions in the market" and "we are also in parallel testing and developing the two stage cycle at Mitis to increase the electrical efficiency of the system";

Ward De Paepe, **University of Mons**, confirms that "traditional micro-gas turbine, like any cogeneration application cannot change its heat production without changing the electricity production. However, the humidification technique developed in Fit4micro is a unique solution to this problem, providing flexible heat production".

Gerrit Füldner, **Fraunhofer ISE**, states that "we have done measurements already on heat pump that will be integrated into the system, and we have done measurements on an adsorption chiller which makes cold from heat".

According to Søren Løkke, Aalborg University, "the assessment of such technology system is really interesting because it is not just about the technology, the integrated system. It is also about where does the fuel come from." Hans Korteweg, **COGEN Europe**, reports that "Cogen

Fit4Micro project video. Source: Fit4Micro project.

Europe's role within the Fit4Micro project is to look at the political and policy implications for the technologies that are being assessed and designed for this project".
For further information, project partners interviews recorded during the Fit4Micro monitoring meeting are available in the project YouTube channel
and to this link of the project website,
Results webpage fit4micro.eu/results

5. Recent and future Fit4Micro project events

Fit4Micro Project was presented at COGEN Europe's Annual Conference 2025 held at the Renaissance Hotel in Brussels 'European Quarter' on Thursday, 4 December 2025.
This one-day event brought together senior executives from companies and organisations with an interest in energy efficient technologies, together with policymakers from the European Union institutions and other stakeholders.

The programme included a series of panel sessions focusing on challenges and opportunities for cogeneration in the context of the EU's Clean Industrial Deal and policies to promote the decarbonisation of Europe's energy system.

Fit4Micro presented at COGEN Europe's Annual Conference, 4 December 2025, Brussels. Source: Cogen Europe.

KEY 2026 at Rimini Fiera, in Emilia-Romagna region in Italy, will host the project workshop titled "Fit4Micro – Clean and Efficient MicroCHCP by Micro Turbine Based Hybrid Systems".
This workshop is organised in collaboration with Italcogen, the Italian member of Cogen Europe, to officially present Fit4Micro in Italy to regional, national and international stakeholders interested in highly efficient and sustainable heating, cooling and electricity cogeneration with micro turbines mainly for the building, industrial and commercial sectors. It will on Friday, 6th of March 2026, from 12:00 to 13:30 at the Energy Distribution Arena, Pad. A5.
Please visit this webpage [Fit4Micro – Clean and Efficient MicroCHCP by Micro Turbine Based Hybrid Systems]for further information on this workshop.

Fit4Micro is also organising another project workshop. This event will be hosted by EUBCE at the World Forum in The Hague, The Netherlands, in the afternoon of the 21st of May 2026, and it will present a series of final project activities and results, as for example concerning the production of sustainable biofuel for micro turbines, to international attendees, mainly experts in bioenergy and bioeconomy.
The agenda will be available online very soon, for further information on EUBCE 2026 please visit the event website [eubce.com].

The project consortium is also planning to apply for a stand at EUSEW 2026 Energy Fair in Brussels, on 9-11 June 2026. The European Sustainable Energy Week (EUSEW) Energy Fair is an integral part of EUSEW, serving as a platform for showcasing innovative projects and technologies in clean energy and energy efficiency in an interactive setting. The event brings together a diverse range of exhibitors to share their contributions to the EU's clean energy transition goals.
University of Mons will be presenting their advances in the project at ASME Turbo Expo 2026 2024 (Turbomachinery Technical Conference and Exposition) in June 2026 in Milan, Italy. In the past, University of Mons and Mitis presented their carried out project activities at ASME Turbo Expo Conference in 2023, 2024 and 2025, a Conference where global experts and turbomachinery engineering leaders from industry, academia, and government gathered to actively address the 2050 goals for a sustainable future.
Six project webinars will be arranged in the period from February to September 2026 to present carried out activities and achieved results for every work package of Fit4Micro, with the main topics as follows: analysis and determination of the environmental sustainability performance of the system; materials for the combustion chamber and new combustors; microturbine coupled to a humidification technique; integrated hybrid trigeneration system; policy regulation and market assessment; production and supply of hydrotreated HPO (biofuel) from woody biomass.

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).

PARTNERS

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