CLEAN AND EFFICIENT MICROCHCP BY MICRO TURBINE-BASED HYBRID SYSTEMS: THE FIT4MICRO PROJECT

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ABSTRACT: The main aim of the Horizon Europe Fit4Micro Project is to develop a microCHCP unit running on sustainable liquid biofuels. The application of this unit is foreseen at multi-family houses and at remote or off-grid locations. This technology will lead to very high electrical efficiencies (>40%) and a flexible heat/power ratio. Moreover, the usage of a truly advanced and RED II compliant biofuel will guarantee a high GHG emission reduction. This flexible hybrid energy system is based on a double-shaft micro gas turbine (mGT) combined with a novel humidification unit, and will be able to provide renewable heating, cooling and power production, mainly for domestic usage. The Fit4Micro solution contributes to make Europe the first enabled circular, climate-neutral and sustainable economy.
Keywords: biofuel, biomass, combined heat and power generation (CHP), microturbine, renewable energies, cooling.

1 FIT4MICRO PROJECT WITHIN THE EU CONTEXT

The overall objective of the Horizon Europe Fit4Micro Project is to implement a microCHCP hybrid heating and cooling system running on sustainable liquid biofuels for domestic usage, in order to increase environmental sustainability of the building sector.
Today, the current renovation rate of existing buildings is low, risking substantial delays to achieving the EU's CO_2 reduction targets. Moreover, the energy demand in the European building sector is very diverse, and the differences in seasonal demand and local energy infrastructure are an additional obstacle to the transition towards a sustainable building sector.

As highlighted in the Renovation Wave Strategy of the European Green Deal, renovating buildings is fundamental in order to reach the EGD objectives: it presents an opportunity in terms of decarbonisation, improving energy efficiency, empowering consumers and boosting the local economy. Decarbonisation of heat is a major challenge for the EU: the modification of millions of individual homes to improve energy efficiency would present significant challenges. In this regard, a hybrid microCHCP system can significantly increase the socioeconomic and environmental sustainability at household level: the Fit4Micro solution aims at increasing the share of renewables at consumer level and the socioeconomic and environmental sustainability of these renewables.

2 FIT4MICRO PROJECT FEATURES

Fit4Micro is a Horizon Europe Research and Innovation Action, with title "Clean and efficient microCHCP by micro turbine-based hybrid systems".

The project consortium has put together 9 partners from 5 countries with long-term expertise in renewable energy applications, from technologies development to the market implementation.
Fit4Micro Project is coordinated by MITIS (Belgium).
Partners include:
- Two universities: University of Mons (Belgium) and University of Aalborg (Denmark)
- Two research institutions: Fraunhofer ISE (Germany) and OWI Aachen (Germany)
- Two industry partners: FAHRENHEIT (Germany) and MITIS (Belgium)
- Two SMEs: BTG Biomass Technology Group (The Netherlands) and ETA Florence Renewable Energies (Italy)
- One European Association: COGEN Europe (Belgium).

3 SCIENTIFIC INNOVATION AND RELEVANCE

The technology developed in Fit4Micro is based on a hybrid heating system. These systems have several advantages compared to pure electrically driven ones: they can supply heat at a similar temperature to gas or oil boilers, with little impact on efficiency. For this reason, they are particularly attractive in the retrofit market for hard-to-treat homes.

In order to implement the Fit4Micro solution, the research's starting point is the innovative Intercooled Regenerative Reheating Gas Turbine (IRRGT) prototype from MITIS, which works with flameless combustors that can achieve very low emissions and high fuel flexibility. This turbine will be improved during the project implementation, aiming at increasing its current design efficiency from 29.6% to 40%. Then, a prototype combustor will be developed and built, in order to advance flameless combustion with liquid biofuels for use in the turbine.

Finally, for enabling the use of biomass-based fuels at off-grid locations, Fit4Micro will widen the feedstock

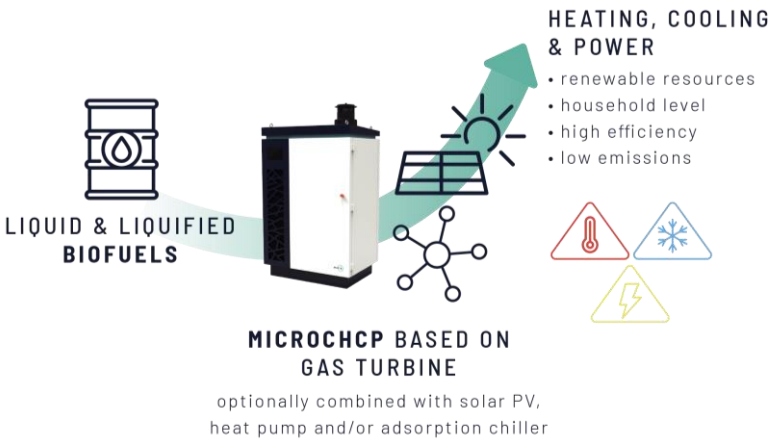

Figure 1: The Fit4Micro technology

base in order to allow a widespread implementation of biomass fuelled microCHCP systems.

The Fit4Micro project investigates those systems in which the solution provides an improvement to the climate performance. These results will assist decisionmakers in implementing the technology in order to obtain the highest emission reductions.

The development of this hybrid heating system significantly increases the socioeconomic and environmental sustainability in household sector, replacing fossil fuels with biofuels. Moreover, activities in Fit4Micro contribute to increase the share of renewables at consumer level: one of the main outcomes of the project concerns the production of low-cost biofuel with good technical characteristics.

In the long run, one of the main expected outcomes is the availability of renewable fuels for domestic usage.

Another important key result will be the launch on the market of the first low power two stage microturbine, with efficiency larger than 35%.

4 THE EUROPEAN BUILDING SECTOR

Today, European buildings represent a hard-to-decarbonize sector. This sector still accounts for a fossil fuel dependency of 75%. Moreover, 36% of GHG emissions are due to the building sector.

Within this context, almost 80% of existing buildings have to reach net-zero emissions by 2050, in order to meet the 2050 objectives in terms of GHG emissions.

As a consequence, flexible solutions are required for adapting the building sector to climate change requests.

In the EU28, residential sector current investments in energy renovations are about 200 billion Euros per year and another 300 billion Euros for non-energy renovations in the residential sector.

The annual amount of deep renovations in residential buildings in the EU28 is only around 0.2%, with relatively small variation when looking at individual Member States.

The average total annual energy renovation rate of residential buildings for the period 2012-2016 based on floor area is estimated to be at around 12% for EU28 as a whole.

Table I: Energy renovation in residential buildings (average 2012-2016)

Countries	Total
EU28	12.3%
Austria	11.6 %
Belgium	15.6 %
Bulgaria	20.1 %
Croatia	21.7 %
Cyprus	15.5 %
Czech Republic	13.7 %
Denmark	7.5 %
Estonia	11.2%
Finland	9.9%
France	13.3%
Germany	9.8%
Greece	8.9%
Hungary	8.9%
Ireland	8.0%
Italy	13.7%
Latvia	9.8%
Lithuania	8.9%
Luxembourg	7.1%
Malta	13.0%
Netherlands	12.7%
Poland	17.4%
Portugal	16.3%
Romania	24.1%
Slovakia	9.7%
Slovenia	9.8%
Spain	17.0%
Sweden	13.0%
United Kingdom	7.9%

Another 200 billion appears to be invested in non-residential buildings. Further significant growth would occur if renovation activities moved towards a level that ensures a decarbonized building stock by 2050. Then energy renovation investments would probably exceed those in non-energy renovation.

5 REFERENCES

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7 LOGO SPACE