



# **Deliverable 7.1**

## **Paper on Policy and Regulatory Framework and Recommendations**



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## Abbreviations

- bioLPG: Liquefied Petroleum Gas or propane produced from renewable feedstocks such as plant and vegetable waste material
- CHCP: Combined Cooling, Heat and Power
- CHP: Combined Heat and power
- DHO: Domestic Heating oil
- DHW: Domestic heating water
- mGT: micro-Gas Turbine
- EED: Energy Efficiency Directive
- EMD: Electricity Market Design
- EPBD: Energy Performance of Buildings Directive
- EU ETS: EU Emissions Trading Scheme
- FPBO: fast pyrolysis bio-oil
- HPO: Hydrotreated pyrolysis oil
- HVO: Hydrotreated vegetable oil
- ICE: Internal combustion engine
- LPG: Liquefied Petroleum Gas
- PV: Photovoltaic Panel technology
- rDME: Renewable Dimethyl Ether
- RED: Renewable Energy Directive
- RES: Renewable Energy Source

## 1. Executive summary

EU’s policy and regulatory framework have set ambitious strategies, targets and policy measures to speed up the renovation of EU’s building sector, driving higher energy efficiency, increasing the uptake of renewable energy and reducing emissions, on the path to reaching net-zero emissions by 2050. The Fit4Micro solution, combining energy efficient micro-CHP with renewable energy sources and technologies, provides multiple benefits aligned with EU’s objectives on energy, climate and competitiveness.

A thorough assessment of EU’s energy and climate policies identifies many opportunities but also potential barriers for the market uptake of the Fit4Micro solution. At national level, support schemes and financing opportunities can be unlocked to facilitate the move to early commercialisation for the technology developed by Fit4Micro.

EU buildings are responsible for 40% of energy demand, of which 80% is represented by heating, cooling and hot water. Most energy consumed in buildings is produced by inefficient stand-alone boilers running on fossil fuels. Rural and remote communities, home to more than 130 million EU citizens residing in approximately 50 million households, experience further challenges related to poor grids connectivity and an ageing building stock.

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.

	Opportunities	Barriers	Policy recommendations
 <b>Energy Efficiency First</b>	Micro-CHP is recognised as a highly efficient buildings technology, with the ability to save primary energy across multiple energy sources (EED, EU Taxonomy, EU SET Plan).	Policies often focuses only on final energy reductions, while full energy chain primary energy savings are not fully considered (EED).	Prioritise energy efficiency first, advancing smarter ways to produce, store, consume and transport energy. Account for both final savings in buildings and primary energy savings, achieved upstream from the building itself.
 <b>Renewable Energy Integration</b>	EU policies promote renewable energy and <u>decarbonisation</u> heating and cooling in buildings (EPBD, EED, RED III, ETS2).	Renewable fuels mainly promoted for hard-to-decarbonise sectors (RED III).	Incentivise the efficient and cost-effective uptake of a range of renewable sources in the buildings sector across all energy vectors (electricity, heat and gas).
 <b>Emission reductions</b>	Prioritisation of buildings decarbonisation, including the new zero emissions buildings standard (EPBD). Push to reduce fossil fuel imports and boost homegrown sources, including sustainable bioenergy. (REPowerEU, EED, EPBD, RED III).	Full electrification or district heating are prioritized for buildings, which may sideline micro-CHP running on renewable and low carbon solutions in buildings (EPBD). Focus on direct on-site emissions. Indirect and marginal emissions not adequately counted (EPBD, EED, EMD, ESR)	Set a level playing for policies to accurately and consistently account both direct and indirect emissions for buildings. Define indicators that reflect marginal emission intensities, based on real-time use of energy.
 <b>Flexibility &amp; Security</b>	Support for security of supply and flexibility, including demand response and self-generation in buildings (Electricity Market Design, EPBD, EED).	No efficiency requirements for centralised gas power generation needed for security of supply. Distributed generation only eligible as flexible if “non-fossil” (EMD).	Put buildings at the centre of energy systems integration by promoting highly efficient hybrids and energy <u>communities</u> configurations that include micro-CHPs.
 <b>Clean Tech Recognition</b>	Micro-CHP, heat pumps, PV, and storage are recognized as clean technologies across different policies (NZIA, EU Taxonomy, EED, RED III).	Inconsistency between eligibility criteria for micro-CHP systems to qualify as a clean technology in different policies.	Support micro-CHP EU manufacturing, as well as the creation of local supply chains and upskilling of building professionals.

## 2. Introduction

Fit4Micro is a Horizon Europe project, which aims to develop a highly efficient micro-CHCP, based on an innovative micro-gas turbine technology. Designed with the capability to run on sustainable biofuels, the micro-CHP system has the potential to further increase the environmental sustainability of the building sector. The main objective of Fit4Micro is to design and demonstrate at TRL5 a highly efficient micro combined heat/cool and power system working on renewable energy. This system is user-friendly, meeting the highest comfort levels for building occupants, while keeping total cost of ownership to a minimum to ensure significant penetration of renewables at household level.

In cooperation with project partners, COGEN Europe has reviewed relevant strategies, policy frameworks, regulations and funding schemes at EU, national and regional level. Funding opportunities and financing schemes have been identified by liaising with EU officials, national or regional governments, researchers, trade associations and other energy experts. Key criteria for the screening have focused on several cross-cutting themes in energy and climate policy, including micro-CHP, energy efficiency, low carbon solutions, decentralised energy solutions, smart energy supply & demand response, aggregation, building retrofitting, emission reductions and innovation.

The present paper 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.

## 3. The EU Building Renovation: State of play

**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.

The building sector represents the largest energy consumer in Europe, being responsible for 40% of the total energy consumed in the EU. **Today, approximately 80% of the energy consumed in buildings is for heating, cooling and hot water, predominantly supplied by fossil fuels used in inefficient stand-alone boilers.** Almost 75% of the building stock is currently energy inefficient and more than 85% of today's buildings are likely to still be in use in 2050.



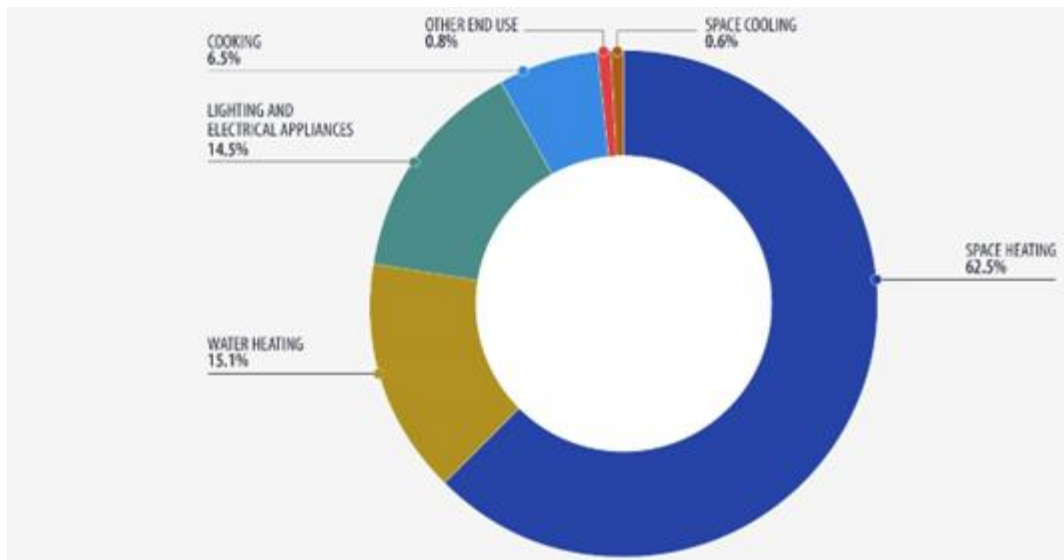


Figure 1 Energy Consumption in EU households, 2023 (% of total energy use)

Source: Eurostat, 2025

Zooming into the fuel and technology mix currently used in buildings, the latest data from Eurostat reveal that around 70% of heating and cooling demand is met with fossil fuels. This includes highly polluting and carbon intensive fuels, such as oil and petroleum products, as well as solid fossil fuels, covering up to 15% of heating and cooling demand.

	Energy use	Space heating	Space cooling	Water heating	Cooking	Lighting and electrical appliances	Other end use
Natural gas	29.48%	34.3%	0.0%	39.4%	32.8%	0.0%	0.0%
Electricity	25.93%	6.5%	100.0%	18.4%	51.6%	100.0%	72.3%
Renewables and biofuels	23.45%	33.0%	0.0%	16.2%	4.5%	0.0%	11.4%
Oil and petroleum products (excluding biofuel portion)	10.34%	12.7%	0.0%	10.3%	10.8%	0.0%	16.3%
Heat	8.47%	10.1%	0.0%	14.4%	0.0%	0.0%	0.0%
Solid fossil fuels	2.34%	3.4%	0.0%	1.2%	0.3%	0.0%	0.0%
<b>Total</b>	<b>100.0%</b>	<b>62.5%</b>	<b>0.6%</b>	<b>15.1%</b>	<b>6.5%</b>	<b>14.5%</b>	<b>0.8%</b>

Figure 2 Share of fuels in the final energy consumption in the residential sector by type of end use, EU, 2023 (%)

Source: Eurostat, 2025

**Building decarbonisation in rural and remote areas presents additional challenges, which require adapted solutions and strategies.** Rural areas are home to 137 million Europeans<sup>1</sup>. Most of the 49.2 million households located in rural areas are not connected to a gas grid and will primarily use fossil fuels for heating<sup>2</sup>. Moreover, studies have found that EU’s rural population is at higher risk of energy poverty<sup>3</sup>.

**In rural and remote areas, oil and petroleum products, as well as solid fossil fuels, are likely to cover even higher shares of heating and cooling demand, as these communities are less likely to be connected to gas**

<sup>1</sup> European Commission, 2025. [The EU rural vision](#).

<sup>2</sup> European Biogas Association & Liquid Gas Europe, 2025. [Outlook for renewable liquid gases](#) & [Strategic role of off-grid Renewable Gases](#)

<sup>3</sup> Joint Research Centre, 2025. [European rural areas face higher levels of energy poverty](#)

**grids or district heating networks.** Conversely, both renewable sources and less carbon intensive gas sources tend to be less used in rural heating and cooling demand.

Further exploring EU statistics on energy demand in buildings, we identify several **EU countries that use higher shares of oil and petroleum products in space heating, cooling and hot water production**, compared to the EU average (10-12.4%). These include **Germany (24%), Belgium (32.3%), Ireland (56.2%), Greece (40.9%), Spain (20.2%), Cyprus (60.3%) and Luxembourg (35%)<sup>4</sup>**, which can qualify as **potential target countries for the future switch to off-grid renewable gases and electrification** as a decarbonisation strategy.

Today, building renovation remain too slow to achieve EU's energy and climate objectives. Across the EU **renovation rates were estimated at 1% per year**, while achieving 2030 targets would require it to double to 2%. Moreover, the **share of renewable energy for heating and cooling reached 26.2% in 2023**, which is well below the 47.3% of renewable shares in electricity use recorded for EU in 2024.

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<sup>4</sup> Eurostat, 2025. [Energy consumption in households](#)

## 4. Highly efficient hybrid systems for buildings: Benefits for an ambitious Renovation Wave in Europe

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<sup>2</sup>: 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 on-site via hybrid systems or at local level via energy communities, as well as more extensively through integrated systems planning.**

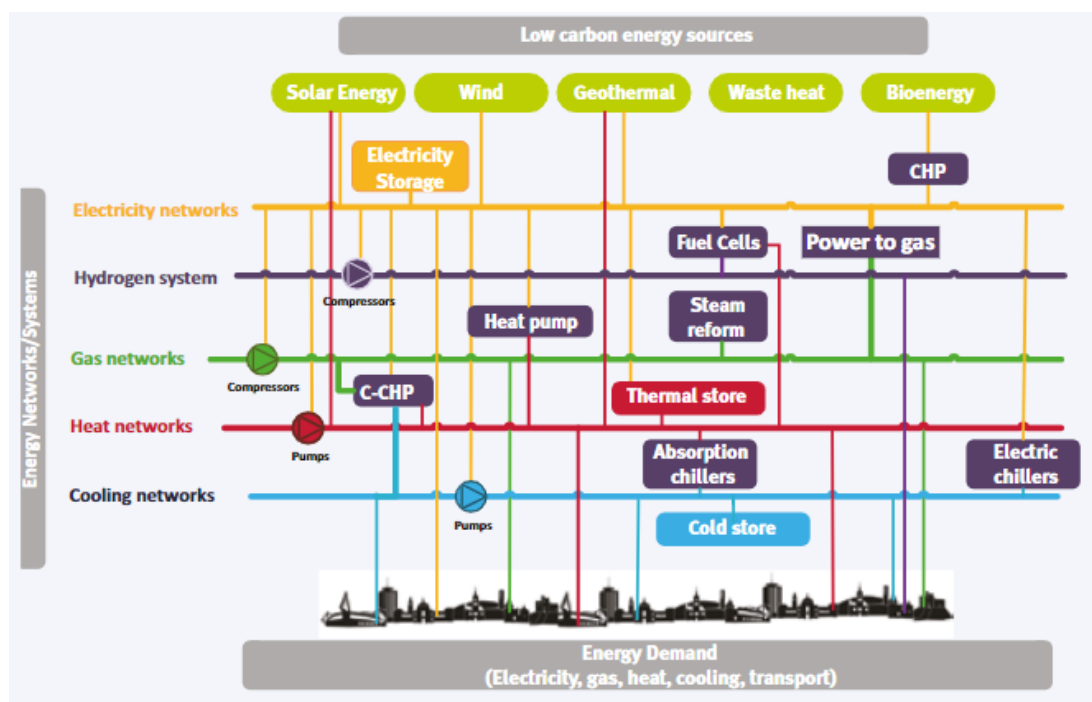


Figure 3 Areas for integration between different energy systems

Source: Imperial College London, 2018. [Unlocking the potential of Energy Systems Integration](#)

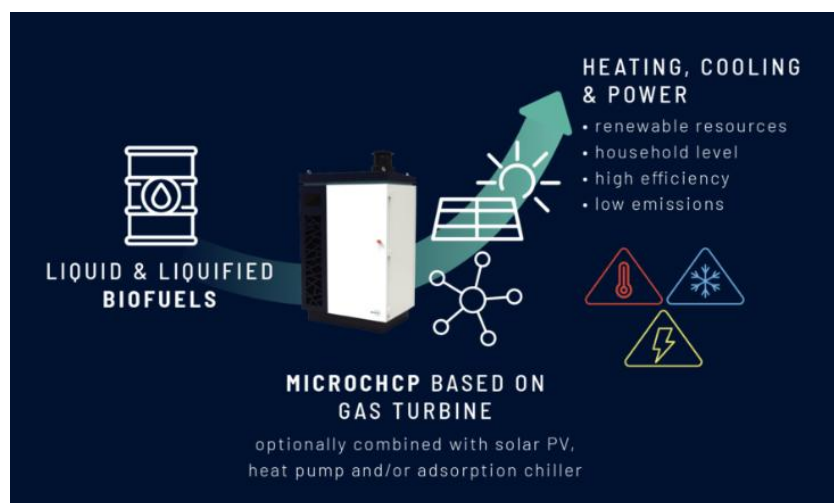
When turning to the segment of rural and remote communities in the EU, the following dedicated approaches have emerged:

## 4.1 Micro-CHP for enhanced resiliency

Micro-CHP is defined at EU level in the EED, as cogeneration (also known as combined heat and power or CHP) with an installed electrical capacity below 50 kWe. Micro-CHP is an energy efficient technology that simultaneously generates both heat and electricity for a single home or building. It is highly efficient, as both electricity and heat are produced in the same building where they are being used, thereby minimising both conversion and grid losses.

Micro-CHP solutions reduce strain on electricity grids by generating power locally during periods of high peak demand and/or low renewable electricity penetration. For this reason, it is well suited to complement electrification and intermittent renewable energy sources such as wind turbines and solar panels. It is equally a viable option for consumers that need the extra electricity for their electric vehicles or even in combination with a heat pump.

For rural and remote communities, micro-CHP further empowers consumers by providing a higher level of autonomy from power grids through the reliable production of electricity. Most micro-CHP installations today are utilising natural gas, when available, or LPG and in some cases biomass, when the customer is off-gas grid.



*Figure 4 Overview of technologies integrated as part of the Fit4Micro solution*

Micro-CHP systems deliver significant energy and cost savings for consumers, while providing multiple system efficiency benefits that go beyond the appliance efficiency level: 1) decentralised power production; 2) grid reinforcements avoided; 3) reduction in peak production requirements; 4) system resiliency. This non-intermittent flexibility capacity is key for space heating efficiency as heat electrifies.

Modelling undertaken in on micro-CHP solutions in general shows that the present and future customer case for micro-CHP depends on many variables, including the country's energy mix, the level of electricity and fuel prices, the evolution of renewable fuel sources, CAPEX/OPEX support levels<sup>5</sup>. For micro-CHP to be competitive with other building solutions (i.e. stand-alone boilers or heat pumps), some level of CAPEX and/or OPEX support will still be needed to bridge the gap between today's early market entry and mass

<sup>5</sup> CODE2 Project, 2012. [EU Micro-CHP Roadmap](#)

market adoption. This will ensure that the momentum achieved so far in scaling up production and reducing cost can continue in the next 5 to 10 years.

Looking into the long-term potential for micro- and small-scale CHP installed in buildings and commercial sites, there is a clear potential for growth. Optimising CHP uptake to complement electrification and weather dependent renewable electricity can deliver important flexibility, resiliency and cost-savings benefits on the path to reaching net-zero emissions by 2050. **A study finds that small scale/micro-CHP capacities embedded across buildings could reach 60 GW in 2050, accounting for the largest potential for further CHP deployment<sup>6</sup>. These CHP solutions are optimised to displace large scale centralised thermal power plants, needed provide balancing capacity to the power system. With distributed CHP in the economy, energy costs are estimated to be lower for both the consumer and the energy system as a whole.**

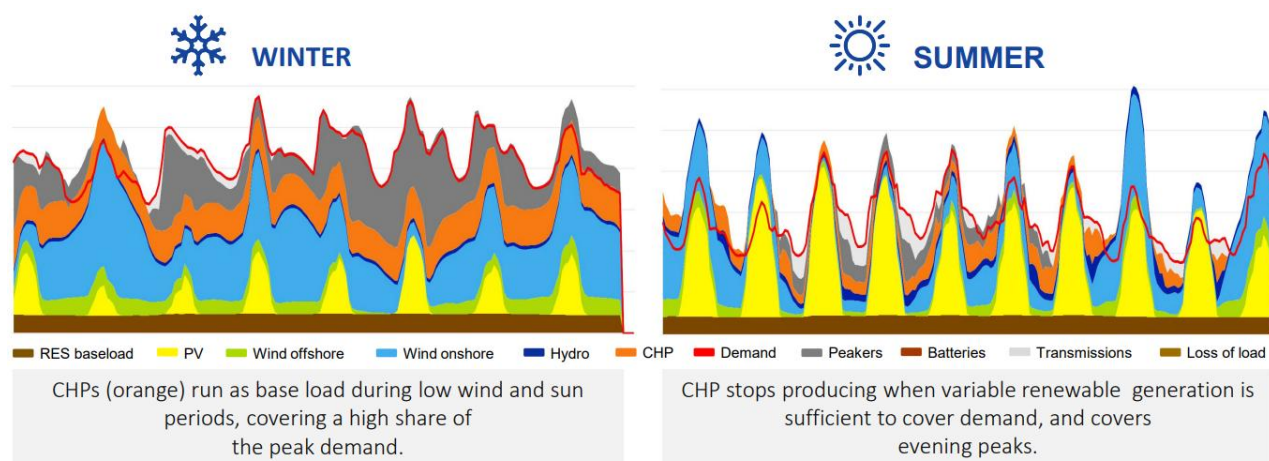


Figure 5 Role of CHP installations in balancing Germany's power system in 2050 (assuming a net-zero emissions economy)

Source: [Artelys](#), 2020

## 4.2 Hybridisation of heat pumps

While electrification of buildings has been identified as a key solution to decarbonise. The most ambitious scenarios project overall electrification rates to increase from 25% today to 35% by 2030 and 61% by 2050 according to the European Commission's [REPowerEU](#), the recent 2040 greenhouse gas (GHG) target [Communication](#) as well as Eurelectric's [Decarbonisation Speedways](#) projections. Complementing electrification, EU scenarios anticipate that the uptake of direct renewables energy use and energy efficiency will be needed to keep energy costs down and ensure energy system resiliency.

Barriers to the rapid and extensive electrification of buildings include:

- **High seasonal peak demand associated with space heating**, often 3-4 times higher than average electricity demand. Full electrification of buildings could increase in peak power demand by 50%-200%, even when highly efficient heat pumps are installed in well insulated buildings<sup>7</sup>. This would require significant and lengthy investments in grid and generation capacity upgrades.

<sup>6</sup> Artelys, 2020. [Towards an efficient, integrated and cost-effective net-zero energy system in 2050. The role of cogeneration](#)

<sup>7</sup> D. Connolly, 2017. [Heat Roadmap Europe: Quantitative comparison between the electricity, heating, and cooling sectors for different European countries](#)

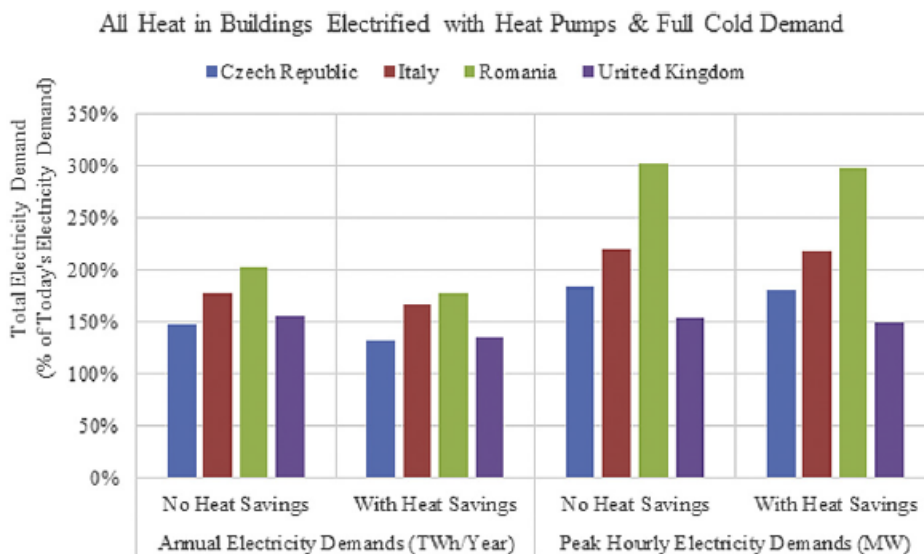


Figure 6 Electricity Peak Demand, when efficient buildings are electrified using heat pumps

Source: D. Connolly, 2017

- Relatively **high retail electricity prices compared to gas prices**, with spark spreads above 2 in most EU countries<sup>8</sup> and as high as 3.57 (in Belgium), 3.31 (Germany), 3.25 (Italy), 2.1 (Ireland). The spark spread will vary across different times of the year, which opens up opportunities for hybrid systems.
- **Insufficient availability of renewable electricity to fully cover the additional electricity demand** associated with the switch from gas to power-to-heat. This so-called marginal power mix will decarbonise slower, as most of the PV and wind generation will be used to meet existing power demand. Meanwhile, the additional power demand will in certain countries require the deployment of additional centralised gas power plants to ensure security of supply at all times<sup>9</sup>.
- **Need for costly power grid reinforcements** to ensure sufficient capacity to deliver electricity that meets supply and demand at all times, estimated at EUR 67 billion/year between today and 2050<sup>10</sup>

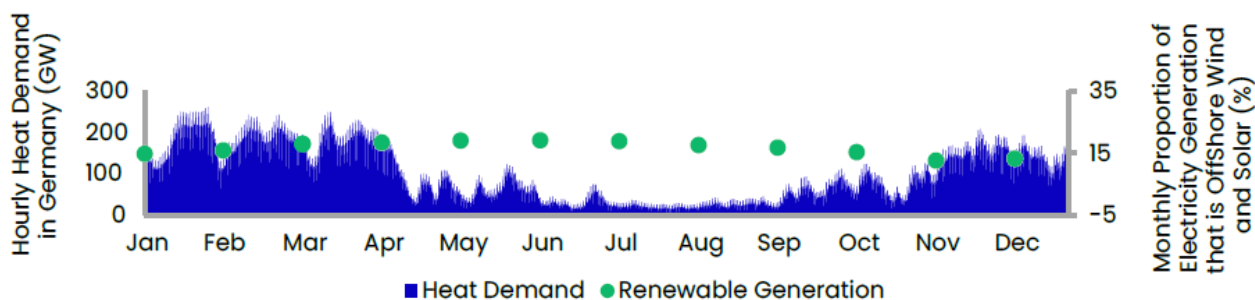


Figure 7 Heat demand variation vs. renewable electricity production

Source: European Biogas Association & Liquid Gas Europe, 2025

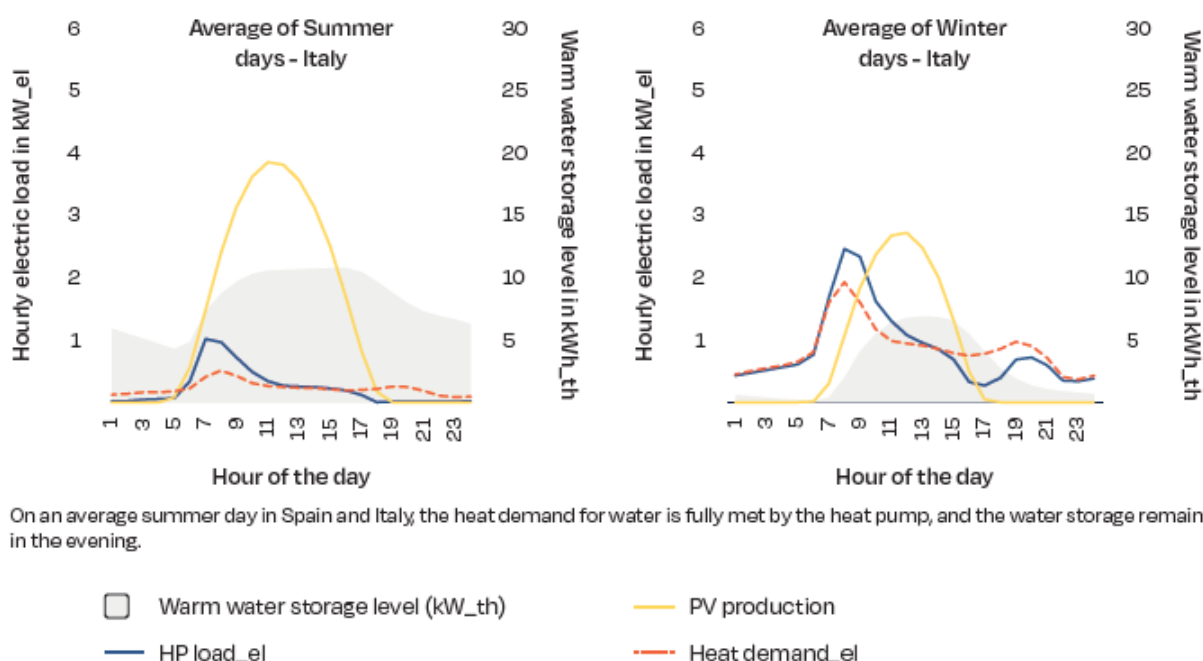
<sup>8</sup> European Commission, 2025. [Study on energy prices and costs](#)

<sup>9</sup> ENTSO-e, 2025. [European Resource Adequacy Assessment](#)

<sup>10</sup> Eurelectric, 2025. [Grids for speed Report](#)

To address these barriers, hybridisation has been proposed 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.

Firstly, the **combination of PV and heat pumps** allows for a a certain share heat, hot water or cooling demand to be covered efficiently with solar power, reducing reliance on grid electricity and the consumption of fossil fuels. This is especially relevant during the summer months and in countries with lower heating needs due to milder climatic conditions, as shown for Italy in the graph below. Yet, in colder countries, like Germany, modelling shows that PV generation would only cover 20% of the total demand during an average winter day.

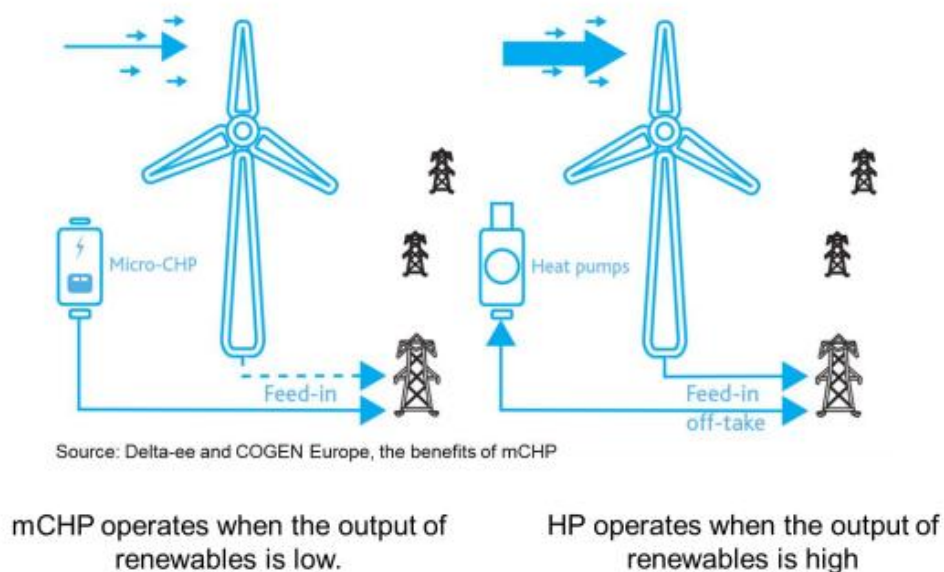


On an average summer day in Spain and Italy, the heat demand for water is fully met by the heat pump, and the water storage remains high in the evening.

*Figure 8 Winter and summer Day Average Germany and Italy - Hourly Electric Load and Buffer Storage Levels*

Source: Solar Power Europe, 2023. [Solar Power Heats](#)

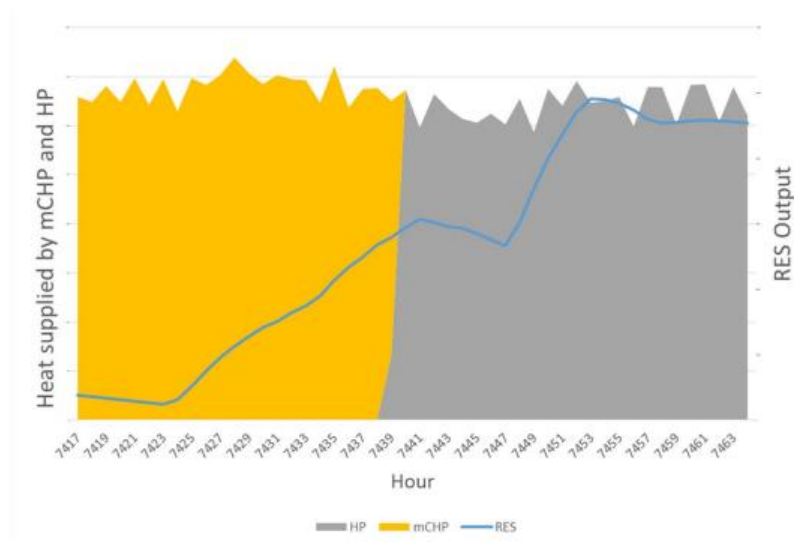
Secondly, the **combination of micro-CHP and heat pumps** allows for positive synergies from several perspectives. When these two systems are used together on-site or at neighbourhood level, emissions are lowered, operation costs are reduced, higher shares of renewable energy are used and strain on electricity grids is minimised. This can be achieved when the micro-CHP is optimised to respond to electricity grid signals, self-producing electricity during periods of high peak demand and/or low production of PV and wind. This allows for lower operating costs, as peak demand periods usually coincides with high electricity prices. Moreover, when PV and wind production is high, the hybrid system can prioritise the use of the heat pump to help integrate higher shares of low-priced renewable electricity.



*Figure 9 Synergy between HP and micro-CHP following the availability of renewable electricity in grid*

Source: [ene.field project](#), 2017

Modelling a net-zero emissions scenario in 2050, the optimised operation of a heat pump and micro-CHP continues to be beneficial in terms of energy efficiency and renewable energy integration. The chart below shows the output of renewable sources (wind + PV) and the dispatch for micro-CHP and a heat pump in Germany for more than two days. During the first day, micro-CHP is operated due to the low production of RES (PV and wind). On the second day, the heat pump ramps up to integrate the high shares of PV and wind on the grid. The contribution of micro-CHP remains pertinent even in an energy system where the annual average penetration of renewable energy in the electricity mix is already very high.



*Figure 10 Synergy between HP and micro-CHP following the availability of renewable electricity in grid*

Source: [ene.field project](#), 2017

### 4.3 Utilisation of off-grid renewable gases

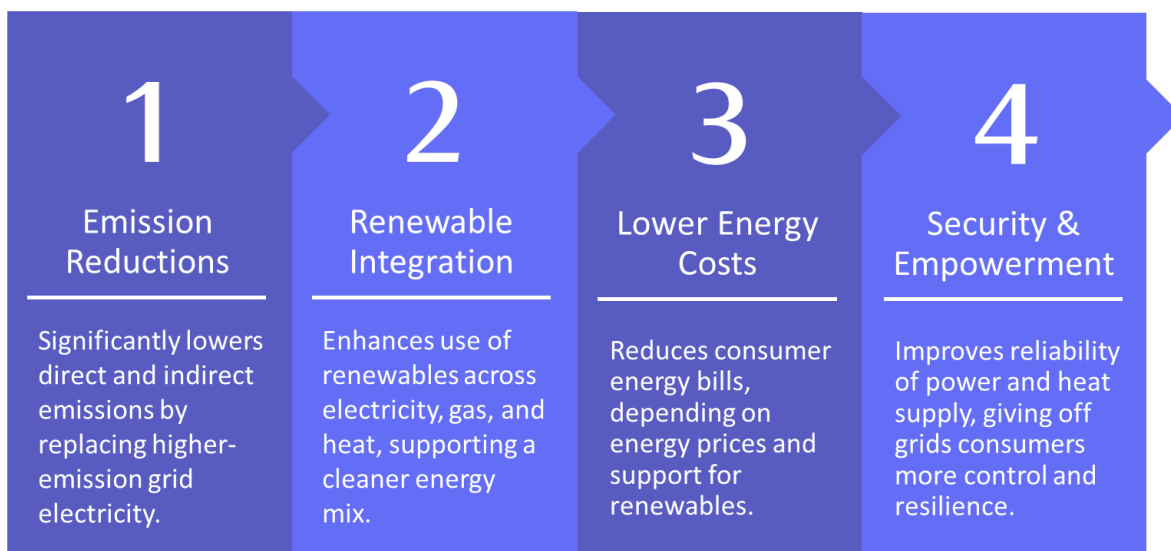
For buildings that are not connected to gas grids, the uptake of off-grid renewable gases can offer an alternative or complementary option for decarbonisation. Substituting fuel oil or LPG with bioLPG can ensure that efficient solutions like micro-CHP/hybrid heat pumps can further decarbonise, when other options are not technically feasible or too expensive.

Today, 26 million tons of LPG are across Europe, 20% of which is utilised in the residential and commercial sectors. The renewable gas sector estimates that **renewable liquid gas potential at 27.4 million tonnes (350 TWh) by 2050, expected to fully decarbonise the present demand of LPG<sup>11</sup>**. The benefits of employing these gases in heating and cooling include annual 90% CO<sub>2</sub> savings 68% NO<sub>x</sub> savings and 66% PM emissions savings<sup>12</sup>.

### 4.4 Fit4Micro solution: Key benefits

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**.

## Benefits of Highly Efficient Hybrid Buildings



<sup>11</sup> Liquid Gas Europe, 2025. [Outlook for renewable liquid gases](#)

<sup>12</sup> European Biogas Association & Liquid Gas Europe, 2025. [Strategic role of off-grid Renewable Gases](#)

## 5. Assessment of EU policy and regulatory environment

Over the past few decades, EU and national policies and regulations on energy efficiency and renewable energy have played an important role in driving building renovation. To unlock building renovation opportunities, the EU and national governments have introduced high-level strategies, targets, measures and increasingly strict efficiency requirements for both buildings and energy products used in buildings.

The benefits identified for the Fit4Micro solution are aligned with EU's high level policy objectives for climate, energy and competitiveness. Given its potential to scale up in the coming decade, the integrated system developed by Fit4Micro can deliver on EU's green ambitions, while supporting off gas grids communities.

For the Fit4Micro potentials to be realized, its early market adoption must overcome multiple hurdles such as higher upfront costs, higher operational costs, linked to the uptake of renewable fuels, lack of awareness among consumers and building professionals, as well as regulatory barriers. Reducing CAPEX can be achieved through the scale up of production, which depends on demand growth. In early stages of adoption, predictable, consistent and ambitious policies can play an important role in addressing barriers and increasing awareness around the technology.

To help anticipate and address some of the barriers and regulatory risk linked to the future deployment of Fit4Micro solution, this paper has mapped the relevant strategies and policy frameworks adopted or under discussion at EU, national and regional levels. The impacts of key EU strategies, policies and regulations are described in the overview below. Further details are provided in on policies in force and upcoming policies in Annex I and II respectively.

### 5.1 Building renovation policies

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.**

The *Energy Performance of Building Directive (EPBD)* is a key driver for building renovation, including the decarbonisation of energy supply in buildings. The main objectives of the 2024 EPBD revision are that **by 2030 all new buildings should be Zero-Emission Buildings (ZEB), and that by 2050 all existing buildings should be renovated so that they can meet the criteria for ZEBs.**

Another relevant provision in the EPBD is the **phase out of financial incentives installation of new stand-alone fossil fuel boilers**. Moreover, Member States are expected to adopt national building renovation plans, which shall include initiatives and policies to phase out fossil fuel boilers and more generally fossil fuels from heating and cooling.

Further EU policies impacting building decarbonisation include the joint implementation of the *EU Emissions Trading Scheme (EU ETS)*, *ETS2* and *Effort Sharing Regulation (ESR)*. Emission reductions in the centralised power system is covered under the EU ETS at EU level. Meanwhile, the decarbonisation of heating and cooling in buildings is covered by national effort sharing targets. Furthermore, the recently adopted ETS2 will help achieve emission reductions in buildings by applying a carbon price on fossil fuel use in buildings.

#### Impact on Fit4Micro:

- ✓ **ZEB definition:** Applied to the Fit4Micro solution, the ZEB definition can be met thanks to the combined use of efficient and renewable energy technologies. Some inconsistencies may occur when the energy vectors available – both electricity and off-grid gases - are not fully decarbonised. The EPBD allows for fossil fuels in grid electricity to be off-set via on-site PV on an annual basis. Yet, so far, no guidelines have been provided on the possibility to off-set fossil gas with green gas certificates (e.g. issued by local biogas producer).
- ✓ **Seasonality & marginal emissions:** The EPBD makes some references to indirect and life-cycle emissions linked to energy use in buildings. The directive recommends that the assessment of building performance accounts for more granularity in the energy mix used on an annual, seasonal, monthly, daily or hourly basis. This approach is not reflected in the ZEB methodology, which only allows to off-set fossil fuels in the power mix on an average annual basis, rather than reflecting how supply and demand are matched seasonally or closer to real-time.
- ✓ **Carbon pricing:** Applying a carbon price on fossil fuels used in buildings can ensure a more even playing field between lower carbon heat sources and stand-alone gas boilers using natural gas (or other fossil fuels) installed in buildings. It can either encourage a switch to electrification or the increased use of renewable fuels like bioliquids, or both – as it is the case for the Fit4Micro solution. However, the EU ETS sets a cap and price on emissions from large scale electricity production at EU level. Meanwhile, ETS2/ESR are applicable to distributed heat and electricity generation at national level. This fragmented approach in the design of the EU ETS, ETS2 and ESR could lead to market distortion in how decarbonisation is delivered between electricity, gas and heat.

## 5.2 Renewable energy policies

The **Renewable Energy Directive (RED)** sets an overall **binding target for renewable energy in EU's energy consumption of at least 42.5%** and up to 45% by 2030. Additional sectoral targets are also set for renewable energy in heating and cooling and renewable energy in buildings. The RED also sets criteria for **sustainable bioenergy sources**. In addition, the RED and secondary legislation establishes a framework to **define and promote renewable fuel of non-biological origin (RFNBOs)**, required to use renewable electricity, achieve at least 70% greenhouse gas (GHG) savings, and adhere to rules for temporal, geographical, and additionality correlation.

Building on the RED framework, other EU legislation incentivises the further adoption of renewable sources. The EED requires Member States to prioritise the use of renewable energy in heating and cooling either via district heating or in buildings. The EPBD incentivises the uptake of on-site renewable solutions in buildings, by requiring new buildings to install PVs and prioritising the uptake of heat pumps for the efficient supply of heat.

#### Impact on Fit4Micro:

- ✓ **Sustainable bioenergy:** Sustainability criteria for bioenergy can provide certainty to biofuel producers, ensuring the scale up in volumes and cost reduction. This will ensure that Member States can provide subsidies, while these clean sources are still more expensive than the fossil fuel alternatives. Generally, the use of a biofuel source in a condensing boiler ensures sufficient GHG emission reductions to meet the sustainability criteria. National policies would be needed to

consider further support to incentivise the more efficient use of biofuels in a micro-CHP. An additional consideration is represented by the potential competition between different applications for sustainable biofuels (i.e. building, transport) during the initial stages of adoption.

- ✓ **RFNBOs:** Since RFNBOs can also be used for off-grid heat and power applications to ensure more rapid decarbonisation of buildings, their availability and cost can play a role in the future of Fit4Micro solutions. The criteria for RFNBOs are considered by some industry stakeholders as too strict<sup>13</sup> compared to other forms of electrification.
- ✓ **Renewable energy integration across electricity, gas and heat:** The implementation of different policies and targets in silo appears to narrow down options available for buildings towards a hierarchy of renewable energy sources. There is a tendency towards the prioritisation of on-site PV for electricity supply and heat pumps for heat supply, complemented by a de-prioritisation of thermal renewable technologies. This approach is supported without regard to local and building circumstances, including: 1) building age and insulation level; 2) local availability of bioenergy sources; 3) weather conditions impacting the magnitude of demand seasonality; 4) potential for useful solar power production, relative to demand and solar resource availability; 5) accessibility of energy grids – gas, electricity, heat.

### 5.3 Energy efficiency policies

EU's energy and climate policy has set "energy efficiency first" (EE1st) as the basis for our energy transition, to ensure that energy efficiency is maximised across the entire energy value chain and at system level. The **Energy Efficiency Directive (EED)** sets ambitious targets and policy measures to deliver energy savings across energy supply, transmission, distribution and demand. Other EU policies include further provisions to reinforce energy efficiency is prioritised, including via the **Energy Labelling/Ecodesign of Space Heaters (Lot1)**, the **Renewable Energy Directive** and the **Energy Governance Regulation**.

#### Impact on Fit4Micro:

- ✓ **Energy efficient supply:** The EED defines micro-CHP as a highly efficient energy solution, allowing Member States to provide subsidies when it achieves primary energy savings. However, most provisions relating to buildings in the EED target final energy savings. This makes it difficult to fully account for micro-CHP savings towards the binding final energy savings target or the energy savings obligation.
- ✓ **Energy efficiency of space heating:** The Energy Labelling and Ecodesign Regulations on Space heaters are key to ensure the phase out of least efficient boilers, while at the same time promote the uptake of highest efficiency heat pumps and micro-CHPs. The Fit4Micro assessment of upcoming Lot1 proposals shows that the methodology for micro-CHP falls short of fully accounting for the energy savings delivered by this solution. In particular, the value of distributed and dispatchable electricity produced by micro-CHPs is underestimated in the methodology proposed. An unfavourable method and labelling would result in lower visibility for micro-CHP and associated hybrid systems, despite their significant energy efficiency, decarbonisation and resiliency benefits.

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<sup>13</sup> Hydrogen Europe, March 2023. [Impact assessment of the RED II Delegated Acts on RFNBO and GHG accounting](#)

- ✓ **Efficiency of grids:** The EED proposes measures to improve the energy efficiency of grids. These include requirements on system operators to facilitate the connection and flexible operation of micro-CHP. Demand response must also be promoted. This can be achieved through smart grid tariffs design and other incentives like simplified grid connection.

## 5.4 Flexibility, Security of Supply and Smart Energy

As the EU energy system decarbonises via electrification and the uptake of intermittent renewable sources, energy security and flexibility needs are expected to increase. To respond to these challenges, the EU has adopted the Electricity Market Design in 2023 and is preparing an updated energy security framework for early 2026.

To ensure security of supply and a flexible energy system, several tools are available in the Electricity Market Design including capacity mechanisms and flexibility support schemes. Smart energy and digitalisation provisions are also embedded in other EU legislation, including the EPBD, EED, RED.

The EU has also been working on electricity network codes for the harmonisation, integration and efficiency of the European electricity market. In this context, the grid connection and operation of distributed generators, heat pumps and storage may be impacted.

### Impact on Fit4Micro:

- ✓ **Flexibility support schemes:** A framework for “non-fossil” flexibility support schemes is available for Member States, as proposed in the Electricity Regulation and reinforced in the Clean Industry State Aid Rules. Such schemes are meant to support demand response and energy storage and exclude flexible generation that relies on natural gas use. Depending on the detailed eligibility criteria for national support schemes, the Fit4Micro solution may be fully or partially remunerated.
- ✓ **Smart energy solutions:** The use of micro-CHP and PVs are recognised in the context of the Smart Readiness Indicator in the EPBD, which may be used to boost the energy performance of a building. Moreover, the optimal operation of micro-CHP and heat pumps may be promoted via a smart grid tariff design, as suggested in the Energy Efficiency Directive and the Energy Efficiency First Guidance. Yet, method are missing in assessing and monetizing the full system benefits of such hybrid solutions.
- ✓ **EU network codes:** EU network codes can have far reaching impacts on generators as small as 700 watts. For micro-CHP systems, grid connection rules introduce new requirements such as fault ride through or grid forming capabilities. When it comes to heat pumps, a demand response network code is currently under development. Depending on final technical requirements, re-design may be necessary leading to increased cost. Moreover, additional certification and administrative burden may need to be considered.

## 5.5 EU Clean Tech Innovation & Manufacturing

Given the war in Ukraine and other geopolitical developments impacting energy markets, the EU has shifted its focus on energy security, energy affordability and strategic autonomy. The notable Draghi Report<sup>14</sup> calls for increased support for EU clean tech manufacturing, to boost EU competitiveness and deliver on green ambitions. This approach has set the tone for the 2024-2029 EU legislative term.

**Impact on Fit4Micro:** Micro-CHP, heat pumps, PVs and energy storage are recognised across EU legislation, including the EU SET Plan, EU Taxonomy Delegated Act on Climate Mitigation and the EU Net-zero Industry Act. This visibility will be key to ensure that the micro-CHP gas turbines can move from innovation to industrialisation, increasing manufacturing capacity and distribution supply chains in the EU.

## 5.6 Overview of the EU Policy Framework & Impacts on Fit4Micro

As shown in the assessment of EU policies, the Fit4Micro solution responds to the high-level energy, climate and competitiveness objectives. Despite the alignment of technology benefits with policy objectives, our in-depth analysis of specific policy measures indicates that identified benefits may not be fully recognised or rewarded. In addition, there are regulatory barriers that may lead to additional cost to the manufacturer or the end user. Below is a mapping of potential impact of specific policies and provisions, associated with the Fit4Micro solution and its components:

	Micro-CHP (partial RES fuelled)	Micro-CHP (100% RES)	PV	Heat Pumps	Fit4Micro: Highly Efficient Hybrid
EPBD: ZEB	Red	Green	Green	Green	Orange
EPBD: Energy performance of buildings	Green	Green	Green	Green	Green
EPBD: Smart Readiness Indicator	Green	Green	Green	Green	Green
EED: Supply efficiency	Green	Green	Green	Green	Green
EED: Energy Savings obligation	Orange	Green	Green	Green	Green
RED: Sustainable criteria for bioliquid fuels	Orange	Orange	Green	Green	Green
RED: RES in heating & cooling	Orange	Green	Green	Green	Green
ETS2/Effort Sharing Regulation	Orange	Green	Green	Green	Orange
Energy labelling and ecodesign for space heaters Regulations	Orange	Orange	Green	Green	Green
Network Code on Requirements for Grid Connection	Red	Red	Orange	Orange	Orange

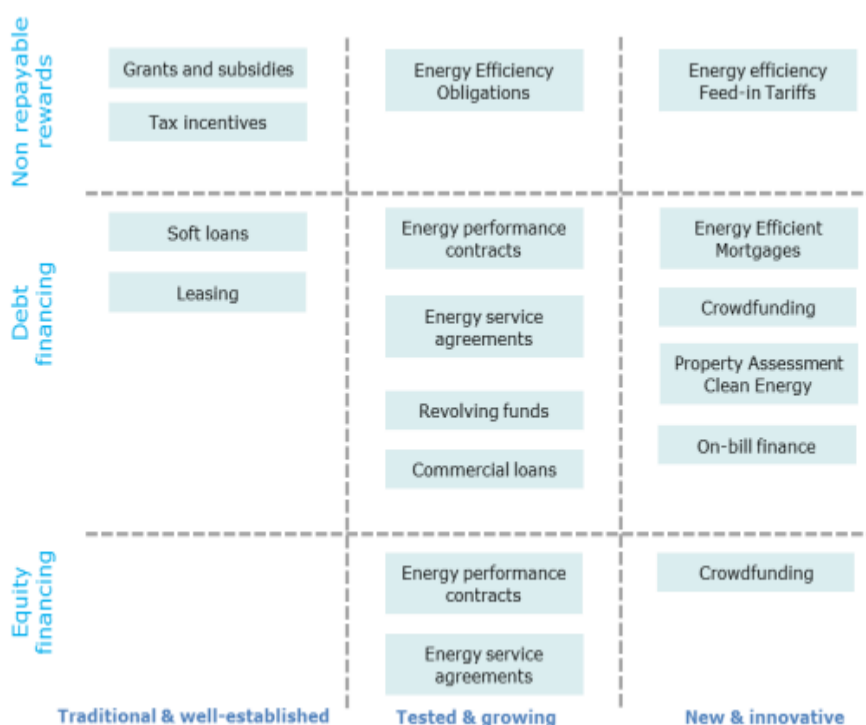
Technology not eligible/technical criteria too strict to justify certification
Solution benefits not fully recognised
Solution fully recognised and eligible

<sup>14</sup> Mario Draghi, 2024. [The Draghi report: A competitiveness strategy for Europe](#)

## 6. Overview & Assessment of National Strategies and Policies

Based on the priorities set in the EU climate and energy framework, as well as national priorities, dedicated support schemes have been available for clean buildings solutions in several major markets. National support schemes can have different designs and will apply to different technologies or hybrid systems.

The overview below showcases the plethora of funding and financing options for clean building solutions. Given that the Fit4Micro solution is meant to combine different technologies and optimise their operation, multiple support schemes may be bundled leading to several revenue streams/higher portion of combined CAPEX to be covered. A potential disadvantage to bundling support schemes could be the high administrative burden associated with the application process and possible reporting requirements. Moreover, compliance with technology-specific schemes may be difficult when the hybrid system is installed as a package, given that the benefits of each technology may need to be isolated and reported separately.



*Figure 11 Overview of funding and financial instruments for energy renovation investments in buildings*

Source: [JRC](#), 2019

In the case of Fit4Micro, different types of funding and financing resources were explored for the potential target countries identified, including Germany, Belgium, Italy. Some of the more relevant support schemes are outlined in Annex III.

## 7. Conclusions and policy recommendations

Against the background of the ambitious policies on buildings renovation adopted at EU and national levels, a range of clean buildings solutions are available to improve the energy performance of buildings, increase renewable energy use and mitigate increasing energy costs to European households and businesses. Moreover, buildings are at the intersection of energy infrastructure – electricity, gas, district heating – which must also evolve as energy sources diversify and decarbonise.

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.

Benefits associated with highly efficient hybrids for buildings can be unlocked by developing and implementing stable, ambitious and comprehensive policies. Yet, barriers remain in adequately assessing and accounting for the benefits of micro-CHP, individually or when hybridised with a heat pump, PV and storage.

To ensure the EU achieves its energy, climate and competitiveness objectives, the smart integration of energy efficiency, renewable energy and electrification will be key for Europe's diverse building stock. Reflecting on the findings of the policy and regulatory framework analysis, the paper makes recommendations on the implementation of existing policies and a direction for future strategies:

- **Energy Efficiency First:** Prioritise energy efficiency first at building level and in the many ways that buildings interact with the energy infrastructure around them, advancing smarter ways to produce, store, consume and transport energy.
- **Renewables in buildings:** Incentivise the efficient and cost-effective uptake of a range of renewable sources in the buildings sector across all energy vectors (electricity, heat and gas) and as part of hybrid systems that speed up the integration of renewables from different sources.
- **Wholistic approach to buildings energy performance and emission reductions:** Set up a level playing field and adequate methods to reduce energy demand, as well as both direct and indirect emissions associated with buildings. Develop building performance indicators that better reflect the seasonality of heating and cooling demand, including system efficiency and infrastructure implications for different renovation and decarbonisation approaches.
- **Energy systems integration:** Put buildings at the centre of energy systems integration by promoting hybrid solutions or energy communities configurations that ensure clean energy for the building occupants, while also reducing impact on power grids. Consider the positive contribution of self-production of dispatchable electricity with micro-CHP, and added value compared to the deployment of centralised back-up power plant capacities.
- **Net-zero industry leadership:** Support micro-CHP EU manufacturing, as well as the creation of local supply chains and upskilling of building professionals.

## Annex I: Adopted EU Strategies and Policies

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
EU	<a href="#">EU Green Deal Strategies</a> (2019)	Adopted in 2019 the EU's Green Deal sets out a plan to transform Europe’s economy, energy, transport, and industries for a more sustainable future. It aims to cut emissions by at least 50% by 2030, <b>rising towards 55%, while legally binding the 2050 neutrality goal through the European Climate Law</b> . Buildings are a key sector to decarbonise, including heating and cooling.
	<a href="#">EU Renovation Wave</a> (2020)	<p>As one of the key strategies stemming from the EU Green Deal, the Renovation Wave was adopted in 2020 to aiming to <b>double renovation rates until 2030</b> and beyond in order to reach carbon neutrality by 2050. This would ensure that at least <b>35 million buildings are renovated by 2030</b>.</p> <p>Key principles outlined to boost renovation rates include: 1) Energy Efficiency First; 2) Affordability; 3) Decarbonisation and integration of renewables; 4) Life-cycle thinking and circularity; 5) High health and environmental standards; 6) Tackling green and digital transition; 7) Respect for aesthetics and architectural quality.</p> <p>The Renovation Wave Communication highlights the importance of paying particular attention to heating and cooling. Moreover, the strategy anticipates highlights the role of <b>renewable gases</b> in enabling local synergies. Moreover, <b>prosumers</b> are identifies as playing a key role in the energy transition.</p>
	<a href="#">EU Strategy for Energy Systems Integration</a> (2020)	<p>The EU strategy on energy system integration creates a vision for the future energy that is more flexible and decentralized.</p> <p>The Strategy defines energy system integration as “creating stronger links between different types of energy carriers (such as electricity, liquid, gas and solid fuels, heat and cold), energy infrastructure and consumption sectors. This integration supports the optimisation of the energy system to deliver decarbonised, reliable and resource-efficient energy services, at the least possible cost.”</p> <p>The strategy proposes the prioritization of <b>direct electrification</b> for the integration of renewable electricity, especially for the decarbonization of buildings. It suggests that <b>electricity in heating demand should grow to 40% by 2030 and to 50-70% by 2050</b>.</p>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
		<p>Complementary solutions such as <b>renewable and low-carbon fuels</b>, including <b>renewable gases and liquids produced from biomass</b>, are mentioned as relevant for “end-use applications where direct heating or electrification are not feasible, not efficient or have higher costs”. Lifecycle GHG savings and sustainability criteria would need to be developed and implemented.</p> <p><b>Hybrid systems</b> are also mentioned as “opportunities for arbitrage between electricity and gas markets”.</p> <p>The strategy also delves into the digital/smart energy dimension as a key source of resiliency and security of supply “linking up the different energy carriers and through <b>localised production, self-production</b> and <b>smart use of distributed energy supply</b>”.</p>
EU	<p><a href="#">EU Taxonomy - Climate Delegated Act (2021)</a></p>	<p>Under the EU Taxonomy framework, the European Commission adopted in 2021 a first delegated act on sustainable activities for climate change mitigation and adaptation objectives of the EU Taxonomy (“Climate Delegated Act”) was published in the Official Journal.</p> <p>Applicable since 1 January 2022, the Climate Delegated Act maps technologies that are environmentally sustainable to guide investors towards environmentally sustainable activities. In Section 7.6, the Climate Delegated Act acknowledges the <b>Installation, maintenance and repair of renewable energy technologies</b> as a EU Taxonomy compliant activity. The specific technologies eligible under this activity include <b>PV</b>, solar heat, <b>heat pumps</b>, wind turbines, solar collectors, <b>thermal and electric storage, micro-CHP</b> and heat-exchanger/recovery.</p> <p>This offers an opportunity for micro-CHP to be financed and funded at national level, as part of green buildings initiatives both by private investors and public authorities.</p>
EU	<p><a href="#">EU Recommendation on the Implementation of Energy Efficiency First Principle (2021)</a></p>	<p>The <b>energy efficiency first principle (EE1st)</b> was introduced in the Energy Efficiency Directive (2018) and in the Regulation on the Governance of the Energy Union (2018). The EED revision of 2023 further reinforces its importance by broadening and strengthening the basis for implementation of the principle.</p> <p>The application of EE1st requires that: 1) only the energy really needed is production; 2) investments in stranded assets are avoided; 3) demand for energy is reduced and managed in a cost-effective way</p>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
		<p>To support Member States implement EE1st, the European Commission issued a recommendation showcasing best practices. The guideline outlines measures to foster demand response and other flexibility resources for the power system. The guideline advocates in particular that Member States may provide “Support for installation of smart equipment able to respond to grid signal such as <b>micro-cogeneration or other hybrid devices using renewable gas and electricity</b>. Such support should typically be granted through transparent, competitive and non-discriminatory processes.”</p> <p><b>Impact on Fit4Micro:</b></p> <p>The EE1st Guidance can represent a basis for better recognition and support for hybrid systems that include micro-CHP.</p>
EU	<a href="#">REPowerEU</a> (2022)	<p>As the energy price crisis emerged in Europe, REPowerEU identified the heating sector as a source of EU dependence on Russian gas. In this context, electrification of heating and cooling was prioritised and gas heating was targeted as a potential sector for the phase out of subsidies and/or a complete ban on installing stand-alone gas boilers.</p> <p>REPowerEU was adopted in 2022 in response to the war in Ukraine and the threat to EU’s energy security, as well as the energy price crisis that resulted from the geopolitical tensions. Impacts on fuel cell micro-CHP are mixed:</p> <ul style="list-style-type: none"> <li>• Gas phase out from all sectors is prioritized, with electrification as the alternative</li> <li>• Especially in buildings, the phase out of gas boilers and downgrade of all gas heating solutions is put on the table</li> <li>• Joint action to replace Russian gas with alternative gas sources: non-Russian importers, RES gases produced locally, clean hydrogen</li> </ul>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
EU	<a href="#">Energy Efficiency Directive</a> (2023)	<p>Initially adopted in 2012, the Energy Efficiency Directive (EED) was revised in 2018 and in 2023. The last revision, proposed under the Fit for 55 packages, further emphasises the <b>key role for energy efficiency first</b>.</p> <p>The EED proposes measures to promote energy efficiency across the entire energy value chain, in energy conversion, transmission, distribution and end use. An <b>energy efficiency target of -11.7% for 2030 (compared to projections of the 2020 EU Reference Scenario) is established at EU level</b>. While the EU target is expressed in both final and primary energy, the text clarifies that <b>only the final energy target is binding</b>. Member States are required to set indicative final energy national contributions to collectively achieve the EU’s binding final energy target.</p> <p>An additional sub-target is proposed for the <b>progressive reduction of final energy, under the Energy Savings Obligation</b>, whereby each Member State is expected to achieve new saving of 0.8% (between 1 January 2021 to 31 December 2023), 1.3% (1 January 2024 to 31 December 2025), 1.5% (1 January 2026 to 31 December 2027) and 1.9% (1 January 2028 to 31 December 2030). To achieve these targets, Member States can implement energy efficiency policies, <b>except for the promotion of the direct combustion of fossil fuels as of 1 January 2026</b>.</p> <p>As regards efficiency in heating and cooling (Article 26), <b>high efficiency cogeneration</b> is defined as combined heat and power (CHP) that:</p> <ul style="list-style-type: none"> <li>- <b>saves at least 10% in primary energy</b> compared to the best-in-class boiler and best-in-class power plant</li> <li>- <b>emits less than 270 g CO<sub>2</sub>/kWh</b></li> <li>- <b>micro-CHP complies with the high efficiency standard</b> if any primary energy savings are achieved</li> </ul> <p>Moreover, <b>efficient district heating</b> is defined as district heating that includes a <b>combination of high efficiency CHP, renewable heat and/or waste heat</b>. Schemes compliant with the <b>efficient district heating requirements can supply heat to zero emissions buildings</b>, as defined in the EPBD.</p> <p>Additional provisions related to grid and system efficiency, require Member States and System Operators to incentivise the grid connection of distributed CHP, including micro-CHP. Moreover, grid tariff design must follow energy efficiency first principles, including by:</p>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
		<ul style="list-style-type: none"> <li>- incentivising the <b>location of CHP systems near electricity demand points</b></li> <li>- <b>shifting of the load from peak to off-peak times</b> by final customers taking into account the availability of renewable energy, <b>energy from cogeneration and distributed generation</b></li> </ul> <p><b>Impact on Fit4Micro:</b></p> <ul style="list-style-type: none"> <li>✓ The high efficiency CHP classification ensures that <b>Member States can support CHP</b> as a key energy savings solution.</li> <li>✓ Yet, there is often a <b>conflict between the different energy savings objectives within the EED</b>, when it comes to accounting savings achieved by micro-CHP systems. Usually a micro-CHP installed on-site will marginally increase on-site energy consumption, which is overcompensated by primary energy savings achieved from avoided electricity from the grid. Based on this and given that Member States are only required to save final energy, <b>the value of micro-CHP is under-estimated in terms of contribution towards the binding EED final energy targets.</b></li> <li>✓ The <b>energy savings obligation is expressed in final energy savings</b>, giving the incentive to either insulate a building or fully electrify. A micro-CHP would be eligible for building-level savings if a special accounting method is introduced to allocate overall primary energy savings to electricity and heat, thus determining final savings compared to an alternative space heating solution.</li> <li>✓ The joint <b>interpretation of the high efficiency CHP, efficient district heating and zero emission buildings definitions, offer additional opportunities for micro-CHP, heat pumps and PV hybrids.</b> When combining several micro-CHP systems with heat pumps and other complementary solutions, as part of a small efficient district heating network, compliance with zero emission buildings criteria can be met more flexibly compared to the same technologies used together on-site.</li> </ul>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
EU	<p><a href="#">Recast Renewable Energy Directive (2023)</a></p> <p>Renewable Energy Directive (2018)</p>	<p>The RED III (Directive (EU) 2023/2413) has revised EU rules for the promotion of renewable energy, with the aim to further boost renewable energy generation and increase their uptake in different sectors. A special focus is placed on <b>renewable energy roll-out in heating and cooling, buildings and district heating</b>, via specific sub-targets. In addition, sustainability requirements have been updated for biomass fuels, as well as renewable fuels of non-biological origin (RFBNOs).</p> <ul style="list-style-type: none"> <li>• <b>Greenhouse gas saving thresholds for electricity, heating and cooling production from biomass fuels</b> applied to installations started after 2021 are at least 70 % until 31 December 2029, <b>and at least 80% from 1 January 2030.</b></li> <li>• <b>Biofuels, bioliquids and biomass fuels produced from waste and residues, other than agricultural, aquaculture, fisheries and forestry residues</b>, are required to fulfil only the greenhouse gas emissions saving criteria laid down in paragraph 10 in order to be taken into account for the purposes referred to in points (a), (b) and (c) of the first subparagraph. In the case of the use of mixed wastes, Member States may require operators to apply mixed waste sorting systems aimed at removing fossil materials. This subparagraph shall also apply to waste and residues that are first processed into a product before being further processed into biofuels, bioliquids and biomass fuels.'</li> <li>• Member States shall define an indicative national share of renewable energy produced on site or nearby and from the grid in final energy consumption in their buildings sector in 2030 that is consistent with an indicative target of at least a 49%. Moreover, Member States may count waste heat and cold towards the target up to a limit of 20%. For the purposes of Article 15a of the revised RED, <b>Member States can count all the renewable energy produced on-site and nearby in line with the definitions of the EPBD, in addition to all the renewable energy (for electricity, heating and cooling and gas) taken from the grid.</b></li> <li>• RED III includes an update on the <b>obligation to increase renewable energy in heating and cooling</b> by 1.1. percentage points as an annual average calculated for the period 2026 to 2030, starting from the share of renewable energy in the heating and cooling sector in 2020. The use of renewable electricity for the production of heating and cooling can be accounted based on the annual share of RES in electricity over the past 2 years, rather than on a real time use basis.</li> </ul> <p><b>RED II (Directive (EU) 2018/2001)</b> adopted in 2018 includes relevant provisions for Fit4Micro. It establishes a definition and favourable provisions for renewable energy communities. These communities are entitled to produce, sell, store and share their own renewable energy. Moreover, administrative procedures are simplified, including easy permitting.</p>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
		<p><b>Impact on Fit4Micro:</b></p> <ul style="list-style-type: none"> <li>✓ Given the use of bioliquid fuels in micro-CHP, <b>meeting the RED III GHG reduction sustainability criteria is more likely due to the efficiency benefits of CHP systems compared to lower efficiency alternatives.</b> The Directive proposes the Carnot method for the allocation of emissions from CHP to electricity and heat produced is also favourable, as it takes into account the useful heat output and temperature levels delivered.</li> <li>✓ The Fit4Micro solution can also be considered in the context of <b>renewable energy communities</b>, when Micro-CHP, PV, heat pump and sustainable biofuels are combined at a neighbourhood level or among several buildings. This configuration can also be conceptualised to fit the definition of an <b>efficient district heating</b>, whereby the CHP system acts as a back-up for both electricity and heat. Meanwhile, the heat pumps are used to upgrade heat. They can rely on both CHP and PVs for their electricity. Even if limited amounts of fossil fuels are still needed in the system, it can be compensated through the overproduction of PV for instance. Such a “microgrid” configuration would be eligible for the connection of <b>zero emission buildings.</b></li> </ul>
EU	<a href="#">EU ETS2</a> (2023)	<p>The EU ETS 2 system was introduced in 2023 to trigger <b>emission reductions in the buildings, road transport and additional sectors</b> – not currently covered under the EU ETS. It will complement other policies in the European Green Deal to help Member States achieved their targets under the <b>Effort Sharing Regulation (ESR)</b></p> <p>The ETS2 will become operational in 2027 and will introduce a <b>carbon price via a “carbon cap &amp; trade” system applied upstream on fuel distributors.</b> The carbon price set by the ETS2 will provide a market incentive for investments in building renovations and low-emissions mobility. Price stability mechanisms are set in place to ensure that carbon prices do not exceed €45/t CO2 equivalent during the first three years of the scheme.</p>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
		<p><b>Impact on Fit4Micro:</b></p> <ul style="list-style-type: none"> <li>✓ The impact on Fit4Micro solution will be indirect, by increasing the cost of fossil fuels used in buildings and <b>moving towards price parity with alternative renewable fuels or grid electricity, which already includes a carbon price</b>. For the micro-CHP component of the system, the impact of a carbon price is complex. On one hand, a carbon price can <b>initially incentivise the use of micro-CHP versus a heat-only boiler</b>, given its efficiency benefits. As the carbon price increases towards price parity with renewable alternatives, it may enable a switch to renewable fuels.</li> <li>✓ In addition, depending on the <b>price dynamics between clean electricity and clean gases</b>, the utilization of the micro-CHP and the heat pump in the hybrid system may vary seasonally, yearly and across the lifetime of the system.</li> <li>✓ When it comes to the different carbon price regimes applicable as a result of the EU ETS and ETS2, a <b>hybrid solution with micro-CHP may be disadvantaged compared to a fully electrified system</b>, despite reducing more CO2 overall. This contradiction occurs because the ESR targets apply to buildings at national level, excluding electricity supplied to buildings through power grids. Meanwhile, the EU ETS applies to grid electricity at EU level. Given this policy design, a fully electric heating system is considered as zero emissions under the ESR obligations, while indirect emissions are accounted at EU level. Meanwhile, a hybrid system increases emissions on-site, making it more difficult to meet ESR obligations, while reducing emissions at EU level under the EU ETS.</li> </ul>


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EU	<p><a href="#">Electricity Market Design (2024) amending Directive EU/2024/1711 amending Regulation EU/2024/1747</a></p>	<p>The new Electricity Market Design (EMD) was adopted in 2024, as part of the Green Deal Industrial Plan. The EMD includes the revised electricity rules as part of <b>Regulation (EU) 2024/1747</b> and <b>Directive (EU) 2024/1711</b>, with the objective to integrate more renewable electricity, support security of supply, boost flexibility and increase energy affordability.</p> <p>Key provisions for the Fit4Micro solution include the promotion of <b>Flexibility and Peak-Shaving Products</b>:</p> <ul style="list-style-type: none"> <li>- The Electricity Directive introduces <b>peak-shaving products</b> to reduce demand during peak demand periods. Such products are addressed at solutions that can engage in demand response. Minimum bids are to be set below 100 kWe, including through aggregation. Such a product <b>shall not imply starting fossil fuel-based generation located behind the metering point</b></li> <li>- It also promotes <b>non-fossil flexibility support schemes</b>, including payments for capacity from clean sources. Further conditions for non-fossil flexibility schemes are set out in the <a href="#">Clean Industrial Deal State Aid Framework (CISAF)</a> adopted in 2025.</li> </ul> <p>The Electricity Directive also defines <b>active consumers</b>, as those users that consume or store electricity generated within its premises located within confined boundaries or self-generated or shared electricity within other premises, or who sells self-generated electricity or participates in flexibility or energy efficiency schemes, provided that those activities do not constitute its primary commercial or professional activity. Taking into account the <b>energy communities</b> defined in the Renewable Energy Directive, the EMD clarifies and reinforces the right of energy communities to share energy between its members or shareholders. Energy communities are also incentivised to participate in all energy markets, by generating, consuming, sharing or selling electricity, or by providing flexibility services through demand-response and storage.</p> <p><b>Impact on Fit4Micro:</b></p> <ul style="list-style-type: none"> <li>✓ The EMD sets a <b>favourable framework for the uptake of on-site and distributed generation</b>. Flexibility support schemes can be accessed to support both demand response capabilities by the heat pump, as well as the positive impact of self-producing electricity at times of high peak demand on the grid via the PV or the RES-based micro-CHP. The exclusion of “fossil-based” on-</li> </ul>

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		<p>site generation from such schemes may <b>fully or partially exclude the contribution of the micro-CHP towards grid balancing</b>, as long as it is not fueled 100% with bioliquids.</p> <p>✓ The <b>definition of the peaking product may also unintentionally exclude hybrid systems</b> that must run on fossil gas part load, despite reducing emissions overall and relieving grid strain.</p>
EU	<p><a href="#">Energy Performance of Buildings Directive revision (2024)</a></p>	<p>The EPBD in force (reviewed in 2024) addresses the energy performance of buildings, requiring Member States increase ambition along several dimensions – renovation, decarbonisation, modernization &amp; digitalisation, financing &amp; technical assistance.</p> <ul style="list-style-type: none"> <li>• <b>Zero emission buildings (ZEB):</b> Standard applicable to new buildings and building renovations as of 2030 and public buildings as of 2028.</li> <li>• <b>Building renovation: Building certificates</b> are imposed for most buildings, for which micro-CHP is eligible as an efficient technology along RES solutions. When a building is sold or rented, energy performance certificates must be issued and inspection schemes for heating and air conditioning systems must be established.</li> <li>• <b>Smart buildings:</b> The EPBD introduces the Smart Readiness Indicator (SRI) a voluntary European scheme for <b>rating the smart readiness of buildings</b>, which specifies the positive impact of self-consumption micro-CHP.</li> </ul> <p>According the EPBD, a ZEB:</p> <ul style="list-style-type: none"> <li>• Has very low energy demand, achieved through high energy efficiency.</li> <li>• Produces zero on-site carbon emissions from fossil fuels.</li> <li>• Has zero or very low operational greenhouse gas emissions, considering both direct and indirect emissions.</li> <li>• Meets its energy needs from renewable sources, which can include:             <ul style="list-style-type: none"> <li>○ On-site or nearby renewable energy (e.g. solar PV, geothermal, biomass).</li> <li>○ Renewable energy from energy communities.</li> <li>○ Efficient district heating and cooling.</li> <li>○ Other carbon-free sources.</li> </ul> </li> <li>• Should be supported by demand-side flexibility capabilities</li> </ul>

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		<p>The EPBD also requires that Member States phase out any financial incentives for the installation of new stand-alone boilers powered by fossil fuels at the latest from 1 January 2025.</p> <p>Member State shall establish a national building renovation plan to ensure the renovation of the national stock of residential and non-residential buildings, both public and private, into a highly energy-efficient and decarbonised building stock by 2050. These plans shall include policies and incentivise for the phase out of fossil fuels from heating and cooling and the complete phase out of fossil fuel boilers by 2040.</p> <p><b>Impact on Fit4Micro:</b></p> <ul style="list-style-type: none"> <li>✓ The <b>zero emission buildings</b> definition is an opportunity for the Fit4Micro system where the micro-CHP can use 100% sustainable biofuels or when one or several micro-CHPs are installed outside the building, as part of a renewable energy community or an small efficient district heating network. The challenge with the ZEB definition for the Fit4Micro solution is the narrow focus on direct/on-site emissions (disregarding indirect/upstream emissions). This gives an advantage to electricity-based heating or efficient district heating. On-site gas-based micro-CHP would only be eligible if 100% renewable energy is used, an option which may not be affordable or fully available in coming years.</li> <li>✓ In <b>existing buildings</b>, micro-CHP can contribute towards the higher performance of buildings and <b>improved building certificate rating</b>. The implementation of the <b>smart readiness indicator</b> can also positively capture the resiliency benefits of Fit4Micro solution.</li> <li>✓ EPBD provisions linked to the <b>phase out of fossil fuel boilers, as well as support schemes linked to stand alone fossil boilers</b>, would also favor the implementation of the Fit4Micro solution.</li> </ul>

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EU	<a href="#">Net-zero Industry Act Regulation (2024)</a>	<p>In 2024, EU legislators adopted the Net Zero Industry Act (NZIA) establishing a framework of measures for strengthening Europe’s net-zero technology manufacturing ecosystem. The initiative aims to support EU-based manufacturing of net-zero technologies, in response to increasing global competition in the supply of clean technologies. The aim is that the Union's overall strategic net-zero technologies manufacturing capacity approaches or reaches at least 40% of annual deployment needs by 2030.</p> <p><b>Impact on Fit4Micro:</b> Key net-zero technologies identified in NZIA include: <b>Solar photovoltaic</b> and solar thermal, Electrolysers and fuel cells, Onshore wind and offshore renewables, <b>Sustainable biogas</b>/biomethane, Batteries and storage, Carbon capture and storage, <b>Heat pumps</b> and geothermal energy, Grid technologies. While <b>micro-CHP</b> solutions are not explicitly included, manufacturer can get access to favourable provisions under more general categories such as “energy efficiency technologies” or “Sustainable biogas”.</p>
EU	<a href="#">EU Clean Industrial Deal (2025)</a>	<p>The EU Clean Industrial Deal (CID) aims to <b>lower energy prices</b>, creating quality jobs and the right conditions for companies to thrive. To achieve this, it outlines areas policy intervention for the upcoming EU legislative term pertaining to energy-intensive industries and the <b>EU clean-tech sector</b>.</p> <p><b>Impact on Fit4Micro:</b> Given the recognition for heat pumps, PV, renewable fuels and to a certain extent micro-CHP solutions, the Fit4Micro package should be promoted as a key <b>EU-made clean tech</b>. It should be eligible for fast permitting and for the scale up of manufacturing capacity, in upcoming stages of industrialisation. Such <b>grants or loans</b> may be available via the upcoming <b>EU funding, via the EU SET Plan and/or via the European Investment Bank</b>.</p>
EU	<a href="#">Affordable Energy Action Plan (2025)</a>	<p>In the context of the CID, the European Commission proposed an Affordable Energy Action plan, focused on: 1) roll-out of <b>clean energy, accelerating electrification</b>; 2) completion of the internal energy market with physical interconnections; 3) <b>use energy more efficiently</b> and cut dependence on imported fossil fuels.</p>

## Annex II: Upcoming EU Strategies, Policies and Regulations

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
EU	<a href="#">Energy Labelling/Ecodesign Lot1</a> (Q4 2025/Q1, 2026)	<p>In 2018, the European Commission launched the revision of EU regulations on ecodesign/energy labelling of sFit4Micro heaters. This revision originally focused on: 1) rescaling space heaters labelling from A+++ to G back to A to G; 2) modification of micro-CHP methodology; 3) extension of scope from 400 kW to 1 MW.</p> <p><b>Lot1 Commission proposed method</b> takes a “final energy efficiency” approach, by adding the heat output of micro-CHP and the electricity output converted into heat via a coefficient of 2.65. This is then divided by the total fuel input, as shown below.</p> <div style="text-align: center;">  </div> <p>Translated in the Lot1 definition, this allocation method becomes:</p> $\eta_s = \frac{\text{space heating demand}}{\text{annual energy consumption required to meet this demand}}$ $\eta_s = \frac{Q_{th}(kWh_{th}) + 2.65 \left( \frac{kWh_{primary}}{kWh_{el}} \right) * Q_{el out}(kWh_{el})}{Q_{prim in}(kWh_{primary})}$ <p>This would result in the following simplified formula:</p> $\eta_s = \eta_{th} \left( \frac{kWh_{th}}{kWh_{primary in}} \right) + 2.65 \left( \frac{kWh_{primary in}}{kWh_{el}} \right) * \eta_{el} \left( \frac{kWh_{el}}{kWh_{primary in}} \right)$ <p>According to the impact assessment provided by the European Commission, micro-CHP systems would be labelled as B, C or D, depending on the electrical/heat efficiencies of the system. Yet industry calculations estimate that most micro-CHP packages would</p>

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
		fall under D/E labelling (when a micro-CHP is part of a package with supplementary boilers). <b>This may disqualify some micro-CHP packages from national subsidies, funding programmes, green public procurement rules and building certificates eligibility.</b>
EU/national	<a href="#">Network Code on Requirements for Generators (2016/ongoing revision)</a>	<p>The grid connection code on Requirements for Generators (NC RfG) imposes grid connection technical requirements on all generators above 800 W. "Small" Type A generators, defined as generators between 0.8 kW and 1 MW, are bound to comply with minimum requirements, including active power reduction. Fuel cell micro-CHPs part of the FIT4MICRO project are both below and above the 800 W threshold. <b>Active power reduction according to a specific doop curve is a challenging technical requirement for some fuel cell technologies.</b> It can be achieved via randomised disconnection of a group of fuel cells that are programmed to do so. Re-design of the system to ensure compliance is possible, but too expensive at this stage of market introduction. At national level, implementation has been patchy. <b>In Germany, micro-CHP has received derogation from this requirement. In Belgium, the expiration of the temporary derogation offered to fuel cell micro-CHP indicates that further efforts are needed to re-establish a basis for homologation.</b> Meanwhile, in the UK and the Netherlands the grid codes are less premissive, despite efforts by the industry experts. The status of implementation in Italy is not known at this stage.</p> <p>The <b>ongoing revision of the NC RfG</b> pursues the extension of technical requirements for small generators with inverters, including grid forming (versus grid following) capabilities. Experts involved in the process have made recommendations on behalf of the fuel cells sector, asking for provisions to derogate or to voluntarily provide those grid services against certain level of remuneration (rather than as a default).</p>
EU	Heating & Cooling Strategy (H1, 2026)	<p>In the context of the EU Clean Industrial Deal, the European Commission plans to publish a Heating &amp; Cooling Strategy in early 2026. The Heating and Cooling Strategy will aim to accelerating the decarbonisation of heating and cooling. It will:</p> <ul style="list-style-type: none"> <li>• help bring <b>renewable energy technologies and energy efficiency solutions</b> to industry, <b>households and businesses</b>;</li> <li>• address <b>inefficiencies at the interface of supply and demand</b>, and at planning level;</li> <li>• advance <b>energy system integration</b> of heating and cooling;</li> </ul> <p>These elements are critical for the success of the Fit4Micro solution, as it can outline further measures to realise the fully potential for renewable and energy efficient heat.</p>

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EU	Electrification Action Plan (H1, 2026)	<p>The upcoming Electrification Action Plan aims to promote the switch from fossil fuels to electricity by addressing the key barriers, and by building on existing EU legislation and the Action Plan for Affordable Energy.</p> <p>Relevant objectives for Fit4Micro include:</p> <ul style="list-style-type: none"> <li>• greater <b>energy system efficiency</b></li> <li>• acceleration of cost-effective and <b>system-friendly electrification</b> in the EU, in terms of both supply and demand</li> <li>• a more <b>flexible electricity system</b> that keeps system costs</li> <li>• necessary conditions on the electricity generation side to achieve its objective, with <b>growing and diversified, clean, home-grown electricity matching demand for electrification</b>, accompanied by growing storage capacities to spread that generation over time</li> </ul>

## Annex III: National Support Schemes & Financing Opportunities

Country/ Region	Strategy/ Policy/Programme /Funding scheme	Description & Relevance for Fit4Micro Solution
Italy	Tax credits for green technologies  <a href="#">110% Superbonus</a>  <a href="#">Home Bonus</a>	<p>The Italian Government extended a new incentive program that reimburses homeowners for up to 110% of the cost of building improvements that increase energy efficiency through December 2023. The program covers 110% the cost of purchase and installation of more energy-efficient heating and cooling systems and extends this subsidy to all related improvements that ensure or improve their efficiency.</p> <p>Home Bonus is dedicated to the energy saving measures and the use of renewable energy sources that take advantage of the tax deductions of 50% envisaged for building renovations – including for heat pumps and micro-cogenerators (P e &lt;50kW e ).</p>
Germany	KfW Funding & Financing for energy efficient buildings (2025)	<p>In 2024, Germany adopted its "Building Energy Act" (GEG) is a law that sets standards for building energy efficiency and the use of renewable energy. As of January 1, 2024, amendments require that new heating systems use at least 65% renewable energy to help phase out fossil fuels by 2045. The law applies to new construction and existing buildings, but there is no immediate obligation to replace functioning heating systems.</p> <p>In this context funding and cheap financing is available via KfW promotional bank. Schemes generally provide grants/CAPEX support for the purchase of heat pumps, PV and renewables based micro-CHP in buildings. This is the case for the following schemes:</p> <ul style="list-style-type: none"> <li>- <a href="#">Heating subsidies for private individuals – residential buildings</a>: For the purchase and installation of a new, climate-friendly heating system. Eligible costs amount to up to 70% of the installed cost. Eligible technologies include heat pumps, biomass heating, solar thermal, fuel cells, hydrogen boilers and innovative renewable solutions</li> <li>- <a href="#">Renewable energies – standard</a>: Subsidized loan for heat and power production in buildings, including micro-CHP</li> <li>- <a href="#">Residential building loan</a></li> </ul> <p>In addition, the German CHP Law (KWKG) allows for feed-in tariffs and premiums for the production of electricity from micro-CHP systems.</p>