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SET Plan Secretariat

SET-Plan – Draft declaration of intent on strategic targets in the context of Action 5

"Develop new materials and technologies for energy efficiency solutions for buildings"

CROSS CUTTING HEATING AND COOLING TECHNOLOGIES FOR BUILDINGS

1. Purpose of this document

This document[1] is intended to record the agreement reached between representatives of the European Commission services, representatives of the EU Member States, Iceland, Norway, Turkey and Switzerland, (i.e. the SET-Plan Steering Group) and representatives of stakeholders, on the definition of strategic R&I targets for the SET-Plan Action 5 on cross cutting heating and cooling technologies for buildings. It is the second declaration of intent under Action 5, the first one adopted in April 2016 containing targets for efficient solutions for buildings. With this declaration of intent, the interested parties agree to put forward their best efforts in a coordinated way between public and private sectors, and to jointly address all relevant issues in order to attain the agreed targets.

This agreement follows a broad consultation with a panel of Stakeholders' organisations (see Annex A) representing the different actors involved in the construction value chain, a broad range of heating and cooling and energy efficiency solutions as well as the research and academic community. This document takes into consideration the corresponding input paper available on SETIS[2] and the comments from the Stakeholders and representatives of the SET Plan Steering group, received until 7 November 2016.

2. Introduction

The total EU28 energy demand for heating and cooling (H/C) equals 51% of the total final energy. The majority of the demand for H/C is due to space heating (52%), process heating (30%) and water heating (10%) Space cooling is currently limited to below 3%, although the sector is growing fast.

[1] This document has no legally binding character, and does not prejudge the process or final form of any future decisions by the European Commission.
[2] https://setis.ec.europa.eu/towards-an-integrated-SET-Plan

Most of the energy sources used to satisfy the demand for H/C are fossil fuels, with natural gas having the lion's share (45%). With the exception of biomass (12%), the use of renewables for H/C is marginal,. However, an increased penetration of renewable technologies in the heating and cooling sector is crucial for the EU to meet its renewable target and its CO2 reduction target.
There is a great deal of scope for increasing energy efficiency in both the supply and use of energy in heating and cooling and every effort must be made to reduce the energy demands. Nevertheless, the limited use of modern, commercially available, more energy efficient and environmentally friendly H/C technologies in the building sector is due to various obstacles, ranging from social, financial, legal, cultural and technical to market barriers.

3. Policy framework

In order to address these barriers and achieve its climate and energy targets, the EU has put in place a comprehensive regulatory framework built around the Energy Performance of Buildings Directive (EPBD) (2010/31/EU), the Energy Efficiency Directive (EED) (2012/27/EU) the Renewable Energy Directive (RESD) (2009/28/EC), the Eco-design (2009/125/EC) and Energy-labelling (2010/30/EU) directives as well as the regulation on fluorinated greenhouse gases. With this legislative framework, the EU has set itself ambitious policy objectives. As part of the Energy Union Strategy[3] of 25 February 2015, the European Commission is currently reviewing both the EPBD the EED and the RESD in order to create the appropriate framework for progress. In addition, the communication published on 16 February 2016 (COM(2016) 51 final), entitled "An EU Strategy on Heating and Cooling" states that developing a strategy to make heating and cooling more efficient and sustainable is a priority for the Energy Union. In line with the G20 2020 statement about inefficient fossil fuel subsidies, the Commission is calling on Member States to focus incentives on non-fossil fuel based heating and cooling technologies.

In line with Action 5 of the Strategic Energy Technology Plan Communication, this declaration aims at defining how research and innovation could further underpin the implementation of this EU policy framework and promote highly efficient technologies for heating and cooling by focussing on the principal technological barriers. The technical barriers are presented in the relevant sections and input paper in SETIS[4] and summarised in chapter 5 of the present document. However, R&I objectives on non-technological elements e.g. on socio-economics, financing, legal and cultural barriers are also essential address. Whereas they are not the purpose of this specific action, they would require dedicated actions in close coordination with the upcoming review of legislation.

4. Targeted Technologies

[3] COM(2015) 80 final
[4] https://setis.ec.europa.eu/towards-an-integrated-SET-Plan

The use of renewable energy sources (RES) for heating and cooling, such as biomass, solar thermal, geothermal hydrothermal and aerothermal as well as residual heat sources from industrial and commercial processes and urban infrastructures such as steel plants, cement mills, data centres, supermarkets, sewage channels, offer a safe, reliable and increasingly cost-competitive solution to all heating and cooling needs. In order to realise this potential it is necessary, together with a high degree of ambition at political level, to identify specific key topics for the relevant technologies, as well as to exploit synergies among the renewable energy production, distribution and consumption, by investing in **"Cross-cutting technologies", i.e.** energy technologies or infrastructures which can be used either to enhance the thermal energy output of a RES, to enable a greater fraction of the output by the system to be used (i.e. increase the overall primary energy efficiency), or to allow the exploitation of RES which would be difficult or impossible to use in building-specific applications.

Small and large scale Heat Pumps, District Heating and Cooling (DHC), Micro CHP/CCHP and Thermal Energy Storage (TES) all fit the above definition very well, can be used in buildings, and represent the technology focus of this document.

Heat Pumps

Heat Pumps represent a versatile energy technology that can provide both heating and cooling in a great variety of building contexts and applications, combine high energy conversion with the capability of utilising different energy sources at useful temperature levels. The heat extracted from the environment by a heat pump is considered renewable as long as the relevant guidelines are followed[5].

Despite their benefits, heat pumps are being implemented below their potential rates in large parts of Europe due to lower price of less efficient technologies and low fossil fuels price. More specifically, the main barriers for electricity driven heat pumps are not only the investment cost, but also the current high electricity prices compared to the low natural gas prices.
The efficiency of the heat pumps depends on the energy carrier and the climatic conditions. However, as most heat pump systems, especially hybrid, are customised combinations of single components, the efficiency of the overall system also strongly depends on the installer's skills, technical knowledge and choice of the right components.

District heating and cooling (DHC)

District heating and cooling networks can integrate most of the renewable energy sources, waste heat and municipal waste and hence can also contribute to air quality objectives by substituting or avoiding domestic heating or cooling by solid fuel's combustion.
In many countries, district heating and cooling is seen as an attractive option for companies and consumers and as a means of improving energy efficiency and renewable energy deployment. Elsewhere, however, due to lack of investment or unfavourable price regulation, old systems exhibit low performances and record negative consumer perceptions.

[5] Commission Decision of 1 March 2013, OJ of the EU, L 62/27, 6/3/2013

The deployment of DHC differs widely between MS which has a major impact on the set of measures that result in optimal improvements. Furthermore, it has been shown that the share of DHC as well as the potential for new grids differs between urban and rural areas
Any approach that would seek to exploit the untapped energy efficiency potential would fail unless these differences were adequately considered.
Nevertheless, common solutions which could accelerate the decarbonisation of DHC networks comprise technologies allowing the integration in the system of much higher shares of RES and waste heat, the reduction of substations and the end-user connexion costs and the development of low-temperature heating networks.

Micro Combined Heat and Power/Combined Cooling Heat and Power (CHP/CCHP).

Combined Heat and Power (CHP) systems, are technologies acknowledged by the European Parliament in its resolution on an EU Strategy on Heating and Cooling (2016/2058(INI)). Designs include internal combustion engines, micro turbines, Stirling engines, fuel cells and steam engines. Micro CHP/CCHP have gained interest in recent years due to its potential of providing efficient, clean and cost effective energy requirements and have a large potential to become a highly important power generation and H/C source for homes and small businesses. Compact size, light weight, low maintenance, low noise, low emissions and multi-fuel capabilities make the Micro CHP/CCHP a promising technology for competitive, secure and sustainable micro-scale polygeneration, which integrated with RES would allow for CO_2 neutral power generation, eliminating transmission losses and reducing the cost of energy infrastructures.

The challenge is to develop the next generation of Micro CHP/CCHP by improving the existing technologies and minimising their equipment, operation and maintenance costs, in order to make them more competitive on the market, to smooth the integration of RES and storage and increase the technology flexibility and on the same time increase their energy efficiency.

Thermal Energy Storage (TES)

Thermal energy storage addresses the key bottleneck against the widespread and integrated use of renewable energy sources, as the renewable supply does not always coincide with demand for heating or cooling. Hot water stores are today a common solution used in combination with renewable technologies providing cost competitive solutions for energy storage. Numerous technologies in sensible, latent or thermochemical form can provide innovative storage solutions, each of them characterised by different specifications and specific advantages when coupled with renewable energy, time shifting supply to periods of the day or of the year with greatest demand.
In order to provide enhanced solutions for the market, it is important to provide more compact solutions, by increasing the storage density at the system level, and increasing their performance, either for daily or for seasonal storage. Performance improvement of the thermal energy storage technology can be found in improved materials for the system, improved system concepts and operational characteristics. The performance improvement

can be broken down into an increased energy efficiency from, increased system lifetime and reduction of operational & maintenance costs. Increased both storage energy and power density using phase change materials (PCM) and thermochemical materials

5. Specific Targets

Coordinated R&I in technological and material developments represent an opportunity to accelerate greater energy efficiency in buildings by offering new/improved heating and cooling solutions that better respond to the market's needs. In particular, technological solutions have a key role to play in addressing market barriers. The identified technologies/sectors are very different between them with specific technological challenges which need to be addressed within each one of them. Nevertheless, the reduction of cost (equipment, installation and operation), the further improvement of the efficiency and their availability in a modular and plug in and play form, are common challenges of the identified cross cutting technologies.

Similar to the central position of buildings in the energy system, the R&I targets for SET-Plan Action 5, interlink with a number of other SET-Plan actions: Action 3 addresses neighbourhood/city level related to smart solutions to energy consumers, smart-homes, buildings-to-grid integration and smart cities and communities; Action 4 is related to the increase of resilience, security and smartness of the energy system; Action 1 is related to renewable energy. Sound coordination is required between the above implementation plans.

Targets by 2025:

Heat Pumps systems:

- Reduction by 50% of the global cost (equipment, sensors and installation) of the next generation for small and large size heat pumps compared to 2015 market prices

- Development of prefabricated, fully integrated cost-effective 'plug in and play' hybrid/multisource heat pump systems and integrated compact heating/cooling plants based on modular heat pumps.

District heating and cooling:

- Increase by 25% the amount of renewable heat or heat recovered from industrial installations in DHC networks, in a cost effective way, without jeopardising the quality of the service provided to the consumers.

- Decrease of the DHC substations reference cost for residential buildings by 20% compared to the 2015 prices.

Micro CHP/CCHP:

- Reduction by 50% of the equipment and installation costs compared to the 2015 market prices.

- Increase of the energy efficiency of Micro CHP/CCHP by 20% compared to the 2015 levels by:
  - increasing operational electrical efficiency close to nominal,
  - maintaining thermal efficiency of the entire operating range of micro and small scale CHP/CCHP.

Thermal Energy Storage:

- Improvement of 25% of performance (energy efficiency, system lifetime, O&M) above ground and underground energy storage compared to 2015 levels.

- Increase of 200% of storage density at the system level (including pumps, valves, pipes, short term buffer) from the current state-of-art of 60 kWh/m^3 [6]

Monitoring approach:

Monitoring will be done by analysing results of R&I actions and market survey.

[6] This value is achieved for the zeolite system in the EU-funded research project COMTES at http://comtes-storage.eu/

6. Next Steps

The interested parties agree to develop within 6 months a detailed implementation plan for the support of these targets by 2025; to determine joint and/or coordinated actions; to identify the ways in which EU and national research and innovation programmes could most usefully contribute in complement to other R&I efforts; to identify the contributions of the private sector, research organizations, and universities; to identify all issues of a technological, socio-economic, regulatory or other nature that may be of relevance in achieving the targets and report regularly on the progress with the purpose of monitoring the realisation of the targets and taking corrective action wherever and whenever necessary.

Annex A – List of consulted Stakeholders

List of Stakeholders consulted

- Energy efficient Buildings association (European construction technology platform)- ECTP
- Buildings Performance Institute Europe (BPIE)
- The European Alliance for Companies for Energy Efficiency in Buildings (EuroAce)
- European Heat Pump Association (EHPA)
- Federation of European Heating, Ventilation, and Air Conditioning Association (REHVA)
- The European Association for the Promotion of Cogeneration (COGEN Europe)
- Construction Product Europe (CPE) (http://www.construction-products.eu/).
- Renewable Heating & Cooling Technology Platform (TPRHC)
- Euroheat & Power (Association representing the District Heating and Cooling and Combined Heat and Power sector)
- Association of the European Heating Industry (EHI)
- European Insulation Manufacturers Association (Eurima)
- PU Europe, European Polyurethane Insulation Industry
- Eurovent (European Committee of Air Handling & Refrigeration Equipment Manufacturers)
- European Solar Thermal Industry Federation (ESTIF)
- European Platform of Universities in Energy Research and Education (EUA-EPUE))
- European Builders Confederation (EBC)
- European Energy Research Alliance **(**EERA**)**
- European Geothermal Energy Council (EGEC)
- European Turbine Network (ETN)
- Joint Programming Initiative (JPI) Cultural heritage
- European Biomass Association (AEBIOM)