Renewable Heating & Cooling
European Technology and Innovation Platform

RHC-ETIP BACKGROUND PAPER

Missing integration of RHC technologies in the SET-Plan and insufficient R&D funding for RHC technologies within H2020

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History and objectives of the RHC-ETIP

The European Technology and Innovation Platform on Renewable Heating and Cooling (RHC-ETIP) was founded in 2008. On recommendation from DG ENER, the RHC technologies solar thermal, geothermal, biomass and heat pumps as well as related cross-cutting technologies like district heating and cooling, storage and hybrid systems were integrated in one Platform. The Platform was endorsed in 2008 and the endorsement was reconfirmed in 2013 by the European Commission.

The Platform aims at increasing awareness on the following points:

a) none of the European energy related goals on energy security and decarbonisation can be achieved without a strong contribution of the heating and cooling (H&C) sector,

b) the H&C sector requires a fundamental transformation to increase energy security and decarbonise the energy sector in Europe,

c) the key role of Renewable Heating & Cooling (RHC) technologies was a long time neglected, now they need to be seriously integrated in the European energy policy,

d) the technological potential of RHC technologies is huge, but untapped since their innovation potential has, to a large extent, been ignored and RHC-technologies have received only small R&D funding in comparison to the electricity sector,

e) the deployment of RHC technologies creates and maintains jobs in a sector dominated by European companies with a high share of SMEs in all European countries.

This is why the RHC-ETIP highly appreciates the EU strategy on heating and cooling from February 2016, which states "***Heating and cooling consume half of the EU's energy and much of it is wasted. Developing a strategy to make heating and cooling more efficient and sustainable is a priority for the Energy Union***."

RHC technologies are an important pillar of the decarbonisation strategy

Decarbonizing the H&C sector requires three types of actions: (1) increasing energy efficiency significantly, (2) increasing the share of (renewable) electricity for H&C combined with a stronger

coupling of the electricity and H&C sector, and (3) replacing fossil fuels by renewable heating sources such as biomass, solar thermal, and geothermal.

Astonishingly, the ongoing discussion on the future of H&C is mainly focused on efficiency in buildings and electrification of the heating sector, and is **neglecting the 3rd pillar of the H&C strategy, the important role of renewable heating and cooling**.

But **the contribution of RHC technologies is essential**, because:

a) **It is not realistic to expect a reduction of heating demand by more than 50% in Europe on the long run**, even if space heating demand of buildings is reduced significantly by the introduction of nearly zero-energy buildings, and if domestic hot water and process heat generation, distribution and consumption become more efficient.

b) **Only a limited part of the heating sector can be electrified** in a cost-effective and sustainable way, since the seasonality of the heat demand has a mismatch with the sustainable electricity generation, especially with PV.

c) **The cheapest and most sustainable way to generate the remaining heat demand will be by using renewable energy heating sources, such as solar thermal, geothermal, and biomass.** In contrast, fossil fuels combined with CCS will be more costly, more risky, and less flexible.

SET-Plan: RHC technologies are not sufficiently covered

The RHC-ETIP participates in activities of the SET-Plan, which provides the ETIP framework. The Integrated Roadmap of the SET-Plan[1], to which the RHC-ETIP contributed actively, stated rightly in Theme 10 "*Accelerating the development of renewable electricity and heating/cooling technologies*" that the large scale expansion of Renewable Energy Sources (RES) "*requires the use of all renewable energy sources in Europe".* Necessary actions are described for all RES: "*Wind energy, photovoltaic energy, concentrating solar power, solar heating and cooling, ocean energy, geothermal energy, hydropower, and combined heat and power from biomass*".

The Communication on the SET-Plan[2] published in September 2015 listed ten actions to accelerate the energy system transformation and create jobs and growth. The aim of becoming number one in renewable energy shall be achieved by two actions. Action 1 aims to sustain technological leadership by developing highly performant renewable technologies and their integration in the EU's energy system. The Commission considers "*that it makes sense to continue to support the development of the next generation of renewable technologies and the improvement of their performance, from basic*

[1] JRC: Strategic Energy Technology (SET) Plan, Towards an Integrated Roadmap: Research & Innovation Challenges and Needs of the EU Energy System, JRC93056, December 2014
[2] European Commission: Communication from the Commission, Towards an Integrated Strategic Energy Technology (SET) Plan: Accelerating the European Energy System Transformation, C(2015) 6317 final, September 2015

research all through the innovation chain to demonstration projects. This applies in particular to offshore wind, ocean energy, bioenergy, geothermal technologies, solar thermal, and technologies that convert power into chemicals and fuels." This implies that **RHC technologies are regarded as important as Renewable Electricity technologies in technological development**. Action 2 aims to reduce the cost of key technologies. RHC-ETIP roadmaps are fully in line with this action, since one of the main goals is to increase the competitiveness of the RHC technologies, therefore research, development and innovation (RDI) measures are identified and described in detail.

But RHC technologies are still not fully accepted in the SET-Plan yet. In the ongoing process of setting priorities and developing Declarations of Intent, only electricity technologies are covered in Action 1&2. Only on wind, PV, CSP/STE, ocean energy, and deep geothermal, the sectors together with the SET-plan steering committee, have adopted Declarations of Intent (see Fig. 1), based on issue papers published by the Commission. **Until now, only an Issue Paper on "Cross Cutting Heating and Cooling Technologies for Buildings" was published recently, but no Issue Papers on key RHC sources are published, and it is not known whether they will be in future.**

Key Actions: priorities	Consultation	Adoption of Declarations of Intent
1&2 – Renewables: Wind	Done	Jan. 2016
1&2 – Renewables: PV	Done	Jan. 2016
1&2 – Renewables: CSP/STE	Done	Jan. 2016
1&2 – Renewables: Ocean energy	Done	Sept. 2016
1&2 – Renewables: Deep geothermal	Done	Sept. 2016
3.1 – Consumers at the centre	Done	Expected Oct. 2016
3.2 – Smart cities and communities	Done	Expected Oct. 2016
4 – Energy systems	Done	Expected Oct. 2016
5 – Energy efficiency in buildings	Done	April 2016
6 – Energy efficiency in Industry	Done	April 2016
7 – Transport: e-mobility (batteries)	Done	July 2016
8 – Transport: renewable fuels	Done	Expected Nov. 2016
9 – CCS/CCU	Done	Sept. 2016
10 – Nuclear	Done	Sep. 2016

Fig. 1: Overview of Declarations of Intent status, 4 October 2016
(source: DG RTD, see also https://setis.ec.europa.eu/towards-an-integrated-SET-Plan)

The fact that only Renewable Electricity technologies are presented as key actions gives the wrong impression that RHC technologies are not able to sustain technological leadership and reduce cost or that they are less important to achieve the SET-Plan goals. But this is for sure not true!

The missing Issue Paper on key RHC technologies is a major shortcoming in the SET-Plan process, which is supposed to cover all energy technologies with the potential to contribute to the transformation to a sustainable energy system. Even if some RHC technologies are tackled individually as part of other actions (e.g. Action 3.2 Smart cities and communities, Action 5 Energy

efficiency in buildings and Action 6 Energy efficiency in industry), a lot of relevant RHC technologies are not covered yet, e.g. large biomass and geothermal heat and power stations, solar thermal process heat systems, and different heat pump technologies. **The complexity and importance of the H&C and RHC sector makes it necessary to have specific Issue Papers dedicated to the RHC sector, and its technologies.**

H2020: RHC technologies are not sufficiently supported

Since 2011, RHC-ETIP has published several strategic documents describing the research and innovation priorities, which are needed to unlock the huge technological potential of the RHC technologies. The documents were developed jointly by the RHC industry and research community. A positive outcome of this work was the integration of some R&D topics identified by the platform roadmaps into the H2020 calls 2014-2017.

However, in H2020, all renewable energy technologies have to compete for the same budget in the related LCE[3] calls, including electricity against the heating technologies. **The analysis of the results of the H2020 calls 2014 – 2016 shows the unintended result of this concept: RHC technologies receive significantly less funding than technologies related to Renewable Electricity**.

There are two effects causing this very disappointing finding for the RHC sector. Firstly, in the related LCE calls from 2014 to 2016, only 22% of the projects were submitted by the RHC sector, while 78% came from renewable electricity technologies. The main explanation being that the distribution of call topics per LCE call does not cover RHC technologies sufficiently. Secondly, only 12% of the funded projects came from RHC and 88% from renewable electricity. This means that the success rate of RHC proposals is much lower than for Renewable Electricity proposals. One could argue that RHC proposals are much lower rated than the electricity ones, but there are several high ranked proposals from the RHC sector on the reserve list, which are not funded. It is not the lack of proposals with sufficient score, which leads to the much lower success rate for RHC proposals.

The only way to overcome this shortcoming for the RHC technologies in H2020 funding and to create a level playing field between the sectors is to separate the H2020 LCE calls in calls for RHC technologies and calls for Renewable Electricity technologies. This approach would pay due respect to the fact that the RHC sector is, in contrast to the Renewable Electricity sector, much more diverse in technological applications and in markets, is mainly dominated by SMEs and has much smaller R&D capacities in industry as well as in universities and research institutes. This is the result of continuously neglecting the huge innovation potential of RHC technologies and the low R&D funding of RHC technologies both at European as well as at national level.

[3] LCE = Competitive Low-Carbon Energy Call

The competition between RHC technologies and Renewable Electricity technologies in the same call is a systematic fault. If non-electricity RHC technologies are needed to decarbonize the H&C sector (as shown above), it is not constructive to allow that almost only R&D projects on electricity technologies are funded (which is not intended, but obviously almost the case). The continuation of this mechanism will never enable the RHC technologies to regain the leeway of technological development in comparison to Renewable Electricity technologies. **This is why it is absolutely necessary to separate the RHC from Renewable Electricity related topics in H2020 calls and allocate separate budgets for them in order to create a level playing field.**

The huge innovation potential of RHC technologies

Sometimes there are concerns that spending a higher budget on RDI projects in RHC technologies will not have sufficient impact on energy security and reduction of energy cost and CO_2 since the their potential of technological improvements could be limited. But such concerns are unsubstantiated. The RHC-ETIP roadmaps have identified a huge innovation potential of RHC technologies and describe plenty of innovations and related RDI projects on component and system level, which will lead to strong efficiency improvements and cost reductions.

Already during the last two decades, a lot of innovations were developed and brought to the market in RHC technologies, mainly developed by SMEs and smaller research institutes. European industries and research institutes are global leaders in most RHC technologies. Unfortunately, the awareness of these innovations is not very high.

Therefore, a list of examples of innovations in the RHC sector is presented below.

Exemplary innovations in the RHC sector

Most of the innovations listed below were achieved within the last decade.

Solar Thermal

- The production cost of a typical high-efficient flat plate collector panel was halved between 1995 and 2010, resulting in a learning curve factor of 23%.
- A new smart absorber coating technology allows limiting the maximum temperature of solar thermal collectors, increasing the security of the system and reducing the system costs.
- Smart controllers including weather forecast information were developed, which allow increasing the system performance by up to 30%.
- Large solar collector fields were optimized to be integrated in district heating systems, which reduced the heat costs significantly to about 4-5 €ct/kWh.

Shallow Geothermal Systems

- The Coefficient of Performance (COP) has been increased from about 2.6 to close to 5 during the last decade due to improved heat pump technologies and ground coupling methods.
- The introduction of heat pump systems providing cooling, heating and DHW systems has opened new markets (e.g. Southern Europe). There are 1.7 Millions of installations across Europe totalizing 67% of the geothermal energy. Europe is a world leader in this field.
- New drilling technologies and coupling systems like geostructure coupling or coaxial borehole heat exchangers were introduced in the market and lead to considerable cost reductions.

Heat Pumps

- The maximum temperature of small heat pumps was increased from 50°C to 65°C.
- The seasonal performance factor of small heat pumps was increased by 30%.
- The temperature range of large heat pumps was increased from 55°C to 90°C.
- The efficiency of high temperature heat pumps was increased by 25%.
- Smart capacity control of heat pumps was developed providing flexibility to the electricity grid.
- Natural refrigerants and refrigerants with low global worming potential (GWP) were developed.
- Integrated systems of heat pumps with solar PV and wind were developed to provide sustainable heating solutions for buildings.

Biomass

- Two pre-commercial plants for the production of bio-oil based on pyrolysis processes for heat and power generation have started operation in Europe. Recent successes include feedstock flexibility, improvement of bio-oil quality and the reduction of production costs.
- Co-firing of up to 30% of torrefied biomass was demonstrated with net thermal efficiency between 84% and 92%.
- Up to 50% cost reductions have been achieved for biogas up-grading to biomethane.
- Biogas CHP systems were optimized to provide generation flexibility to contribute to power balancing in PV/wind dominated electricity systems.
- A lifetime of 50.000 operating hours has been achieved for biomass stirling engines.
- Net nominal electric efficiencies of 36.5% have been achieved in 2016 with large biomass CHP plants (in line with roadmap targets).
- A prototype pellet stove with 13 kW heating capacity was developed with extremely low CO and dust values below detection limits.

District heating

- Advanced district heating and cooling systems were developed, able to deal with both centralised and decentralised, hybrid sources e.g. solar thermal, biomass, geothermal, heat pumps, waste heat, waste-to-energy, excess renewable electricity, and stored heat.
- Smart systems have been developed to predict renewable energy generation and energy demand in DH&C networks, which improves the system efficiency by up to 30%.