RHC ETIP Questionnaire

This questionnaire aims at collecting information on ongoing projects, both publicly and privately funded, in the renewable heating and cooling sector.

It is addressed to project managers, project coordinators, and heads of research units responsible for the development of renewable heating and cooling projects.

On the basis of the received input, a jury will select one or two relevant projects per technology, to be invited to present their results at the annual event of the RHC-ETIP, scheduled to take place on 21st June 2017 in Brussels.

Disclaimer: The provided information is confidential. The data provided will be solely used for the purpose of drafting the Deliverable 1.2 related to the Implementation of the five Technology Roadmaps of the European Technology and Innovation Platform on Renewable Heating and Cooling, which is part of the tender financed by the European Commission to support the activities of the RHC-ETIP, as well as to contact the winning projects for the RHC-innovation award.

1. This questionnaire concerns:
    a. A privately-funded project
    b. A publicly- funded project
        i. Local level
        ii. National level
        iii. European
        iv. Trans-national/ International
2. Project title and acronym
3. Description of the project, with a focus to its innovative component (up to 1.500 characters)
4. Type of research:
    a. Basic
    b. Applied
    c. Development
    d. Demonstration
    e. Innovation brought to the market
5. Technology Readiness Level (not compulsory)
6. Countries of implementation:
    - List of EU-28 countries
    - Other
7. Project duration (months)

8. Total project cost
9. Amount of co-funding from public sources
10. Name of funding programme (if applicable)
11. Would you be interested in presenting your project at the annual event of the European Technology and Innovation Platform on Renewable Heating and Cooling, taking place in Brussels on 20th June 2017?
    - Yes
    - No
12. Please, provide your contact details:
    - Name and Surname
    - Company
    - Country
    - Email
13. The project concerns the following technology (please, choose one):
    a. Biomass
    b. District heating and cooling
    c. Geothermal
    d. Heat pumps
    e. Hybrid systems
    f. Solar thermal
    g. Thermal Energy Storage
14. If Biomass, please, select the relevant research focus area(s) and research priority(ies):
    a. Sustainable, innovative and cost-efficient advanced fuel feedstock supply
        i. Did your project contribute to reducing the biomass supply costs for forest biomass? If yes, what is the value reached in 2017? *Reference value in 2013: 20-25 €/MWh=5.6–6.9 €/GJ (Nordic countries, Eastern EU) 25-35 €/MWh = 6.9–9.7 €/GJ (Central and Southern EU*
        ii. Did your project contribute to reducing the biomass supply costs for agrobiomass residues like prunings and straw? If yes, what is the value reached in 2017? *Reference value in 2013: 5–21€/MWh=1.2–5.9 €/GJ*
        iii. Did your project contribute to reducing CO2 emissions in the biomass supply chain (forest biomass)? If yes, what is the value reached in 2017? *Reference value in 2013: 5–7 kgCO2/MWh =*

1.4–1.9 gCO2/MJ

iv. Did your project contribute to increasing the share of agricultural and industrial biomass residues used in energetic value chains? If yes, what is the value reached in 2017? *Reference value in 2013: < 10%*

v. Did your project contribute to increasing the share of forest machinery based on diesel hybrid technology? If yes, what is the value reached in 2017? *Reference value in 2013: 0%*

vi. Did your project contribute to the decrease in production losses and the improvement of biomass from forestry and agriculture? If yes, what is the value reached in 2017? *Reference value in 2013: 10–30% of the yield*

vii. Did your project contribute to the reduction of fossil fuel consumption in biomass supply chain? If yes, what is the value reached in 2017? *Reference value in 2013: 2–4% of energy value of biomass fuel (about 3–4 litres/MWh)*

b. Innovative production and upgrading technologies for bio-oil

i. Did your project contribute to the reduction of production cost of bio-oil? If yes, what is the value reached in 2017? *Reference value 2013: approximately 50-70 €/MWh, 13.9–19.4 €/GJ*

ii. Did your project contribute to the setting up of a commercial plant? If yes, what is the number of running hours reached in 2017?

iii. Did your project contribute to the development of bio-oil upgrading technologies? If yes, what is the status of the developed technology in 2017?

iv. Did your project contribute to the feedstock flexibility target? If yes, what type of alternative feedstock has been tested?

v. Did your project contribute to the quality improvement of bio-oil? If yes, what is the value reached in 2017? *Reference value 2013: Moisture content: 20-30 w%; Net calorific value: 14-18 MJ/kg; Kinematic viscosity at 40°C: 10-20 cSt; Solids content: < 0.5 w%; Ash content: <0.05 w%*

c. Thermally-treated biomass fuel production

i. Did your project contribute to increasing co-firing percentages? If yes, what is the value reached in 2017? *Reference value in 2013: 5-10% biomass co-firing of torrefied biomass with coal*

ii. Did your project contribute to reduce production costs? If yes, what is the value reached in 2017? *Reference value 2013: 32 – 43€/MWh (8.0– 11.9 €/GJ)*

iii. Did your project contribute to increasing the operational hours per year? If yes, what is the value reached in 2017? Reference value 2020: 8.000 hours/year
iv. Did your project contribute to increasing overall biomass-to-thermal treatment-pellets/briquettes energy efficiencies? If yes, what is the value reached in 2017? *Reference value 2020: > 90%*
v. Did your project contribute to increasing the flexibility of raw material input for torrefied pellets? If yes, what is the value reached in 2017? *Reference value 2020: Minimum share of agrobiomass 10%*
vi. Did your project contribute to improving health and safety risk of torrefied pellets? If yes, what is the value reached in 2017? *Reference value 2020: Risk avoiding guidelines and MSDS as a standardized procedure*
vii. Did your project contribute to increasing intermediate and long-term storage capacities of torrefied pellets? If yes, what is the value reached in 2017? *Reference value 2020: 10 to 15% of annual production to have a verified in large scale a quality that can be stored outdoors*
viii. Did your project contribute to increasing the trade of thermally treated pellets in the EU? If yes, what is the value reached in 2017? *Reference value 2020: about 1 – 2 million tons*

d. Upgrading of biogas to bio-methane

i. Did your project contribute to the diversification of raw material for biogas production? If yes, what is the yield of biogas per ha of non-food energy crops reached in 2017? *Reference value 2013: Biogas yield per ha of alternative energy crops is significantly lower than yield for maize*
ii. Did your project contribute to the increase of efficiency of biogas up-grading? If yes, what is the value reached in 2017? *Reference value 2013: Up-grading power consumption: Ø 0.25 kWh/Nm3*
iii. Did your project contribute to the cost reduction of biogas upgrading? If yes, what is the value reached in 2017? *Reference value 2013: A 500 Nm3/h upgrading plant costs about 7.500 €/Nm3 h*
iv. Did your project contribute to the improvement of load flexibility of biogas CHP systems? If yes, what is the value reached in 2017? *Reference value 2013: Part load operability of biogas CHP units > 60%*
v. Did your project contribute to the increase of efficiency of biogas

CHP systems? If yes, what is the value reached in 2017? *Reference value 2013: Electrical efficiency of biogas systems is 33-45%*

vi. Did your project contribute to the GHG emission reduction by the use of waste heat of biogas CHP units? If yes, what is the value reached in 2017? *Reference value: 2013: About 50% of European biogas plants have implemented appropriate use of "waste heat*

vii. Did your project contribute to the improvement of load flexibility of biogas CHP systems? If yes, what is the value reached in 2017? *Reference value 2013: Part load operability of biogas CHP units > 60%*

viii. Did your project contribute to the increase of efficiency of biogas CHP systems? If yes, what is the value reached in 2017? *Reference value 2013: Electrical efficiency of biogas systems is 33-45%*

ix. Did your project contribute to the GHG emission reduction by the use of waste heat of biogas CHP units? If yes, what is the value reached in 2017? *Reference value 2013: About 50% of European biogas plants have implemented appropriate use of "waste heat*

e. ***Cost and energy efficient, environmentally friendly micro and small scale CHP***

i. Did your project contribute to a reduction of the electricity production costs? If yes, what is the value reached in 2017? *Reference value 2020: Reduction of 50%* (Reduction of electricity production costs of biomass based systems through a technology specific mix of decreasing investment and maintenance costs, increasing electric efficiency and availability, energy efficient and cost effective storage systems, reduced electricity price for the end-consumer compared to electricity from the grid due to instantaneous use)

ii. Did your project contribute to increasing the minimum lifetime suitable components for bio-oil engines and turbines? If yes, what is the value reached in 2017? *Reference value 2020: 20.000 h (<5 kWel) / 35.000 h /50.000 h (>50 kWel))*

iii. Did your project contribute to improving the proven lifetime? If yes, what is the value reached in 2017? *Reference value 2020: 20.000 h (<5 kWel) / 35.000 h /50.000 h (>50 kWel))*

iv. Did your project contribute to improving electric system efficiencies based on solid state technologies? If yes, what is the value reached in 2017? *Reference value 2013: 1%*

v. Did your project contribute to improving electric system efficiencies based on thermodynamic cycles? If yes, what is the value reached in 2017? *Reference value 2020: 7% (<5 kWel) <10% -12% (5 - 50 kWel) 12-15 (<250 kWel))*

vi. Did your project contribute to the reduction of investment costs solid state technologies? If yes, what is the value reached in 2017? *Reference value 2013: 20-30 EUR/W (depending on materials and suppliers)*

vii. Did your project contribute to the reduction of investment costs thermodynamic cycle technologies? If yes, what is the value reached in 2017? *Reference value 2013: 4-25 EUR/W (depending on technology and fuel*

viii. Did your project contribute to the reduction of emissions? If yes, what is the value reached in 2017? *Reference value 2013: In compliance with EN303-5*

f. High efficient large-scale or industrial steam CHP with enhanced availability and increased high temperature heat potential (up to 600°c)- New CHP boilers

i. Did your project contribute to improving the net nominal electric efficiency? If yes, what is the value reached in 2017? *Reference value 2013: 32% (clean wood boilers) 29% (wide fuel mix boilers)*

ii. Did your project contribute to improving steam characteristics? If yes, what is the value reached in 2017? *Reference value 2013: 540°C / 140 bar (clean wood boilers) 500°C / 90 bar (wide fuel mix boilers*

iii. Did your project contribute to improving the total CAPEX? If yes, what is the value reached in 2017? *Reference value 2013: Between 2500 – 3000 €/kWe*

iv. Did your project contribute to the reduction of electricity production costs? If yes, what is the value reached in 2017? *Reference value 2020: Reduced by at least 5% (clean wood boilers) Reduced by at least 9% (wide fuel mix boilers)*

v. Did your project contribute to increasing the catalyst operating times? If yes, what is the value reached in 2017? *Reference value 2020: Conformity with IED*

vi. Did your project contribute to increasing ash utilization? If yes, what is the value reached in 2017? *Reference value 2020: 30% utilized*

g. High efficient large-scale or industrial steam CHP with enhanced availability and increased high temperature heat potential (up to 600°c)- Existing CHP boilers (retrofit targets)

i. Did your project contribute to increasing the agrofuels thermal share in fuel mixture in wood fired units? If yes, what is the value reached in 2017? *Reference value 2013: Typically limited to 10-20%*

ii. Did your project contribute to increasing operational electric efficiency? If yes, what is the value reached in 2017? *Reference value 2013: Can be as low as 5%*

iii. Did your project contribute to emissions reduction? If yes, what is the value reached in 2017? *Reference value 2020: Conformity with IED Increase catalyst operating times*

iv. Did your project contribute to increasing ash utilization? If yes, what is the value reached in 2017? *Reference value 2020: 30% utilized*

h. *High efficient biomass conversion systems for polygeneration*

i. Did your project contribute to improving the average annual efficiency? If yes, what is the value reached in 2017? *Reference value 2013: 45% in electricity production, about 65 – 85% in CHP production*

ii. Did your project contribute to emissions reduction (CO2, CO, NOx and SOx)? If yes, what is the value reached in 2017? *Reference value 2020: Emissions reduced by half compared to condensing power production*

iii. Did you project contribute to increasing efficiency in electricity production? If yes, what is the value reached in 2017? *Reference value 2020: > 30% (<10MWe); > 40% (<200 MWe)*

15. If geothermal, please, select the relevant research focus area(s) and research priority(ies):

a. *Shallow Geothermal- Ground Coupling Technology Areas*

i. Did your project contribute to further decreasing energy input and reduced costs for operating the geothermal heat pump system?

ii. Did your project contribute to improve Seasonal Performance Factor in the order of 5 for 2020 ?

iii. Did your project contribute to improve Hellström-efficiency (a measure of the impact of borehole thermal resistance) of about 80% in 2020 ?

b. *Shallow Geothermal- Resources, New Systems And Integration Areas*

i. Did your project contributes to further decreasing energy input and reduced costs for operating the geothermal heat pump system?

ii. Did your project contributes to improve Seasonal Performance Factor in the order of 5 for 2020? *Clarification: This KPI refers* *to residential systems in heating mode; systems in commercial application and/or with heating and cooling already could achieve higher SPF*

iii. Did your project contribute to increase of efficiency by at least 25% through better overall system design and operation ?

iv. Did your project contribute to improve awareness of technology, Create skills and ensure quality ?

c. ***Deep Geothermal Resources***

i. Did your project contribute to decreasing geological risk to 2020 by 25% (expressed by reduced number of abandoned projects due to low temperature or flow) ?

ii. Did your project contribute to reducing of exploration cost by at least 25% in 2020, and 50% in the longer term compared to 2015?

d. ***Deep Geothermal Drilling***

i. Did your project contribute to reducing the unit cost of drilling (€/MWh) by 15% in 2020, 30% in 2030 and by 50% in 2050 compared to 2015 ?

e. ***Deep Geothermal Production***

i. Did your project contribute to improving efficiency and reduce operation and maintenance cost by at least 25%?

ii. Did your project contribute to improving system reliability and energy efficiency of operation, in particular by decreasing energy consumption of production pumps by at least 50%?

iii. Did your project contribute to increasing reservoir performance resulting in power demand of reservoir pumps to below 10% of gross energy generation and in sustainable yield predicted for at least 30 years by 2030?

iv. Did your project contribute to increasing heat exchange efficiency by 25% and component longevity in the thermal water circuit by 40 %?

v. Did your project contribute to Improving the overall conversion efficiency, including bottoming cycle, of geothermal installations at different thermodynamic conditions by 10% in 2030 and 20% in 2050?

vi. Did your project contribute to demonstrating the technical and economic feasibility of responding to commands from a grid operator, at any time, to increase or decrease output ramp up and down from 60% - 110% of nominal power?

f. ***Deep Geothermal- EGS Flagship Programme***

i. Did your project contribute to reducing of capital cost by at least 25% in 2020, and 50% in the longer term ?

ii. Did your project contribute to reducing of production costs below 10 €ct/kWhe for electricity and 5 €ct/kWhth for heat by 2025?

iii. Did your project contribute to increasing of conversion efficiency to 2020 by 25%, allowing for either higher efficiency (for production, turbine etc.)?

16. If solar thermal, please, select the relevant research focus area(s) and research priority(ies)

a. *Development of Solar Compact Hybrid Systems (SCOHYS)*

i. Did your project contribute to a reduction of the solar heat costs by over 10%?

ii. Did your project contribute to increased compactness with reduced space requirements and installation time?

iii. Did your project contribute to improved reliability and performance?

iv. Can you precise which application segment(s) is or are covered by your R&D project?

1. SCOHYS for single family homes (DHW and combi systems),
2. SCOHYS for multifamily homes (DHW)
3. SCOHYS for multifamily homes (combi systems).

b. *Solar-Active-Houses (SAH)*

i. Did your project contribute to reduction of solar heat costs of SAH with solar fraction of over 60%? If so, how does it compare to the solar heat costs of today's combi systems with 25% solar fraction?

ii. Did your project contribute to the development of the SAH concept, the design and the construction methods? If so, is it contributing concept that can be used by the whole construction sector as nearly zero-energy building concept?

c. *Solar Heat for Industrial Processes (SHIP)*

i. Did your project contribute to the integration of SHIP systems in relevant industrial applications? If so, which ones?

ii. Did it focus on one or more of the following priorities?

1. Improved cost optimality
2. Increased solar fraction
3. adaptation to industry machinery standards
4. development of new ways to feed in solar heat into one industrial process

17. If district heating and cooling, please, select the relevant research focus area(s) and research priority(ies)

   a. ***Large scale demonstration of Smart Thermal Grids***

      i. Did your project contribute to a cost of delivered heat less than 90 €/MWh?

      ii. Did your project contribute to reducing the cost of delivered heat? If yes, what is the value reached in 2017? *Reference value 2012: 200 €/MWh*

      iii. Did your project contribute to increasing the average share of RES and surplus heat from industrial processes in Smart Thermal Grids? If yes, what is the value reached in 2017? *Reference value 2012: 11%*

      iv. Did your project contribute to improving the primary energy factor? If yes, what is the value reached in 2017? *Reference value 2012: 0.8*

      v. Did your project contribute to reducing the substations' reference manufacturing cost (in EU, residential buildings)? If yes, what is the value reached in 2017? *Reference value 2012: 5.000 to 10.000 €*

      vi. Did your project contribute to improving the average electricity consumption of substations for residential buildings? If yes, what is the value reached in 2017? *Reference value 2012: 4.380 kWh/year*

      vii. Did your project focus on smart substations? If yes, what is the value reached in 2017? *Reference value 2016: substations with platinum label*

   b. ***Develop and roll-out DHC driven white goods and low temperature solution for domestic hot water preparation***

      i. Did your project contribute to reducing the electricity consumption of white goods per year, average household? If yes, what is the value reached in 2017? *Reference value 2012: 850 kWh*

      ii. Did your project contribute to reducing the operating temperature of white goods connected to DH? If yes, what is the value reached in 2017? *Reference value 2012: 80 °C*

      iii. Did your project focus on the development of plug-and-play white good products available on the EU market?

   c. ***Optimised integration of renewable energy sources in DHC systems and enhancement of thermal energy storage at system level***

i. Did your project contribute to the improvement of the reference energy efficiency of DHC systems? If yes, what was the percentage increase with respect to the start of the project?

18. If heat pumps, please, select the relevant research focus area(s) and research priority(ies):

a. Cost competitive heat pump kit for houses with existing boiler

i. Did your project contribute to reduce Gas consumption with 90% of the thermal load covered by the HP by 2020? If yes, what is the value reached in 2017? Reference value: 2012: n.a; 2016: 80%; 2020: 90%
ii. Did your project contribute to improve the SCOP referred to electricity consumption? If yes, what is the value reached in 2017? Reference value: 2012: n.a; 2020: 4.5; 2030: 5
iii. Did your project contribute to improve the PER of the heat pump and gas boiler system referred to primary energy with a ratio of: 1 kWh electric = 2.5 kWh primary energy, average boiler efficiency 0.8? If yes, what is the value reached in 2017? Reference value: 2012: 0.8- gas boiler only; 2016: 1.4; 2020: 1.7
iv. Did your project contribute to develop the PER of the heat pump and gas boiler system referred to primary energy, with a ratio of: 1 kWh electric = 2 kWh primary energy, average boiler efficiency 0.8? If yes what is the value reached in 2017? If yes, what is the value reached in 2017? Reference value: 2012: 0.8- gas boiler only; 2016: 1.7; 2020: 2.0.
v. Did your project contribute to reduce the reference average cost of HP in the range 4-8 kW, including installation (Euro)? If yes, what is the value reached in 2017? Reference value: 2012: 6.000 – 8.000; 2016: 5.200 – 7.000; 2020: 4.000 – 5.500

b. Optimisation of thermally driven heat pumps and their integration in the boundary system

i. Did your project contribute to the reduction of the specific weight per power? If yes, what is the value reached in 2017? Reference value 2012: 12 kg/kW(heating); 2016: 10 kg/kW(heating); 2020: 9 kg/kW(heating)
ii. Did your project contribute to increase the thermal single unit SCOP (e.g. for air source)? If yes, what is the value reached in 2017? Reference value: 2012: 1.25; 2016: 1.4; 2020: 1.5
iii. Did your project contribute to increase the thermal system SCOP (e.g. for air source) If yes, what is the value reached in 2017? Reference value: 2012: 1.15; 2016: 1.25; 2020: 1.4
iv. Did your project contribute to the reduction of the specific unit cost (average for diff. technologies)? If yes, what is the value reached in 2017? Reference value: 2012: 450 €/kWt; 2016: 400 €/kWt; 2020: 350

€/kWt

v. Did your project contribute to the reduction fof the value of electricity consumption for single unit (e.g. for air source)? If yes, what is the value reached in 2017? Reference value: 2012: 40 We/kWth; 2016: 30 We/kWth; 2020: 20 We/kWth

vi. Did your project contribute to increase the value of COPelectric (water cooled)? If yes, what is the value reached in 2017? Reference value: 2012:>10; 2016:>15; 2020; >20

vii. Did your project contribute to increase the value of COPelectric (air cooled)?)? If yes, what is the value reached in 2017? Reference value: 2012: >6.5; 2016: >8.5; 2020: >11

c. ***Process integration, optimization and control of industrial heat pumps***

i. Did your project contribute to set-up real-life plants of absorption heat pumps using new working pairs (avoiding crystallization effects)? If yes, could you provide the example? Reference value: 2012: n.a.; 2016: 1 demo plant with avail-ability rate of 70%; 2020: 4 plants with availability rates of 95 %

ii. Did your project contribute to set-up real-life plants of compression heat pumps with high evaporation temperatures and high condensation temperatures? If yes, what is the value reached in 2017? Reference value: 2012: Tcond/Tevap= 80/40 °C; 2016: 1 demo plant with availability rate of 70 % with Tcond/Tevap = 120 / 60 °C; 2020: 4 plants with availability rates of 95% with Tcond/Tevap= 130 / 70 °C)

iii. Did your project contribute to achieve a CO2 emission reduction compared to gas fired system? If yes, what is the value reached in 2017? Reference value: Tcond/Tevap = 80 / 40 °C) (2012: 20%; 2016: 30%; 2020: 40%

iv. Did your project contribute to increase the reference sCOP value compression HP? If yes, what is the value reached in 2017? Reference value: at ΔT = 35 K, Tevap = 40 °C) (2012: 3.5; 2016: 4; 2020: 5)

v. Did your project contribute to increase the reference sCOP value absorption HP If yes, what is the value reached in 2017? Reference value: 2012: 1.1; 2016: 1.3; 2020:1.5

vi. Did your project contribute to reduce the average system cost? If yes, what is the value reached in 2017? Reference value: 2012: 500-600 €/Kw; 2016: 400-500 €/Kw; 2020: < 400 €/Kw

d. ***Booster Heat Pump for DHC***

i. Did your project contribute to the development of the evaporating/condensing temperatures for industrial waste heat? If yes, what is the value reached in 2017? Reference value: 2012: 40/80

Carnot efficiency factor: 0.3; 2016: 50/90 Carnot efficiency factor: 0.3; 2020: 70/130 Carnot efficiency factor: 0.4

ii. Did your project contribute to the development of the evaporating/condensing temperatures (°C) for waste water used in low temperature DH? If yes, what is the value reached in 2017? Reference value: 2012: 15/65 Carnot efficiency factor: 0.35; 2016: 15/65 Carnot efficiency factor: 0.4; 2020: 15/65 Carnot efficiency factor: 0.45

iii. Did your project contribute to set-up a number of successful demo applications to industrial waste heat? If yes, could you provide the example? 2017? Reference value: 2012: n.a.; 2016: 2; 2020: 5

iv. Did your project contribute to set-up a number of successful demo applications to low temperature DH? ? If yes, could you provide the example? Reference value: 2012: n.a.; 2016: 1; 2020: 3

v. Did your project contribute to increase the sCOP value compression HP (at ΔT = 35 K, Tevap = 40 °C) If yes, what is the value reached in 2017? Reference value: 2012: 3.5; 2016: 4; 2020: 5

vi. Did your project contribute to reduce the heat generation costs (baseline 2012)? If yes, what is the value reached in 2017? Reference value: 2012: n.a.; 2016: 10%; 2020; >30%)

e. ***High capacity heat pump for simultaneous production of cold and hot water for heating/cooling the building***

i. Did you project contribute to increase of the sCOP referred to electricity consumption of air-to-air HP? If yes, what is the value reached in 2017? Reference value: 2012: 7; 2016: 8; 2020: 10

ii. Did your project contribute to develop the minimum value of refrigerant charge? If yes, what is the value reached in 2017? (Kg of refrigerant per kW of HP capacity)? Reference value: 2012: n.a.; 2016: 0.2; 2020: 0.1

f. ***New concepts for industrial heat pumps***

i. Did your project contribute to increase the temperature of the delivered heat? If yes, what is the value reached in 2017? Reference value: 2012: 100°C; 2018: ≥ 150°C; 2020: ≥200°C.

ii. Did your project contribute to the development of the temperature lift? If yes, what is the value reached in 2017? Reference value: 2012: 60K; 2018: 70K; 2020: > 70K)

iii. Did your project contribute to reduce the payback time (years)? If yes, what is the value reached in 2017? Reference value: 2012: 5; 2018: < 5; 2020: < 3

g. ***Development of a heat pump for near-zero energy buildings (single family houses)***

i. Did your project contribute to increase the sCOP? If yes, what is the value reached in 2017? Reference value: 2012: 3.5; 2020: 5; 2025: 6.
ii. Did your project contribute to increase the production of DHW? If yes, what is the value reached in 2017? Reference value: *2012: n.a.; 2020: 30%; 2025: 40%.*

h. Enhanced industrial compression heat pumps

i. Did your project contribute to increase the Carnot Efficiency Factor (to be achieved through optimized components and integration)? If yes, what is the value reached in 2017? Reference value: 2012: ≥ 0.30; 2018: ≥ 0.35; 2025: ≥0.40?
ii. Did your project contribute to the development of the maximum evaporating temperature of the heat source? ? If yes, what is the value reached in 2017? Reference value 2012: ≥ 40 °C; 2018: ≥ 70 °C; 2025: ≥100 °C.
iii. Did your project contribute to increase the maximum condensing temperature for process integration? If yes, what is the value reached in 2017? Reference value 2012: ≥80 °C; 2018: ≥ 120 °C; 2025: ≥ 150 °C.
iv. Did your project contribute to reduce the production cost of the heat pump unit? If yes, what is the value reached in 2017? Reference value 2012: 300 €/kW; 2018: 200-300 € /Kw; 2025: <200 €/Kw.

19. If thermal energy storage, please, select the relevant research focus area(s) and research priority(ies):

a. Next generation of Sensible Thermal Energy Storages

i. Did your project contribute to reducing the end-consumer cost of modular polymer containment of 1000-liter tank for retrofit (excluding insulation and VAT), with six double ports with diffusors, no heat exchanger? If yes, what is the value reached in 2017? *Reference value 2012: 400 - 900 €*

ii. Did your project contribute to reducing the heat loss related to storage vessel with capacity of 1.000 L? If yes, what is the value reached in 2017? *Reference value 2012: 150W – 200W (Label C, D)*

iii. Did your project contribute to reducing the cost to customer (excl VAT) of high performance insulation, including possible damage protection (e.g. for VIP) and thermal Resistance (Rc) = 7 m2·K/W? If yes, what is the value reached in 2017? *Reference value 2012: 300 €/m2*

b. Increased storage density using Phase Change Materials (PCM) and Thermochemical Materials (TM)

i. Did your project contribute to developing stable, micro encapsulated salt hydrate PCM? If yes, what is the price (€/kg)? *Reference value 2012: only paraffin PCM available; price over 8€/kg*

ii. Did your project contribute to developing micro-encapsulated PCM for medium and high T? If yes, what is the price (€/kg)?

iii. Did your project contribute to developing novel heat exchangers including PCM?

iv. Did your project contribute to improving the level of maturity of novel Thermo-Chemical solar collector concepts? If yes, please, specify the Technology Readiness Level achieved[1]

v. Did your project contribute to an improved seasonal solar TCM? If yes, what is the value reached in 2017? *Reference value 2012: 60 kWh/m3/system*

vi. Did your project contribute to developing novel TC materials at laboratory stage?

c. Improvements in Underground Thermal Energy Storage (UTES)

i. Did your project contribute to improving energy storage efficiency (defined as the ratio "heat out" /"heat in")? If yes, what is the value reached in 2017? *Reference value 2012: 60%*

ii. Did your project contribute to improving the lifetime of the UTES at elevated T? If yes, what is the value reached in 2017? *Reference value 2012: 10- 20 years*

iii. Did your project contribute to reducing the maintenance cost as share of operational costs? *Reference value 2012: 4-8%*

d. Improving the efficiency of combined thermal energy transfer and storage

i. Did your project contribute to reducing the viscosity of the fluid [μ (Pa•s)], which positively relates with the energy required for pumping? If yes, what is the percentage reduction reached in 2017? *Reference value 2012: Water: 0.001002; Slurries: > 0.001; Mineral Oil (Therminol VP-01 at 400ºC): 0.00000039049; Silicone (Syltherm 800 at 400ºC): 0.00025; Molten salts: 0.000031-0.0005435 depending on the mixture*

[1] TRL1- Basic principles observed and reported
TRL2- Technology concept and/or application formulated
TRL3- Proof of concept established
TRL4- Laboratory testing of prototype component or process
TRL5- Laboratory testing of integrated system
TRL6- Prototype system verified
TRL7- Integrated pilot system demonstrated
TRL8- System incorporated in commercial design
TRL9- System ready for full-scale deployment

ii. Did your project contribute to reducing the annual electricity consumption for pumping (reference: DHW system)? If yes, what is the percentage reduction reached in 2017? *Reference value 2012: 75 kWh*

iii. Did your project contribute to reducing the storage volume through increase of energy density? If yes, what is the percentage reduction reached in 2017? *Reference 2012: Water at 20 ºC: 1000; Slurries: n.a; Mineral Oil at 400ºC: 694; Silicone at 400ºC: 547; Molten salts (60%NaNO3 + 40%KNO3) at 400ºC: 1787 depending on the mixture; 2020: 20% reduction storage volume through increase of energy density*

20. If hybrid systems, please, select the relevant research focus area(s) and research priority(ies):

a. *Automation, control and long term reliability assessment*

i. Did your project contribute to the reduction of the reference system final customer price (for Central Europe) for single family houses? If yes, what is the value reached in 2017? *Reference value 2012: 800 – 1,500 €/kW*

ii. Did your project contribute to improving the primary Energy Ratio of a reference system? If yes, what is the value reached in 2017? *Reference value 2012: 0.8*

iii. Did your project contribute to the increase in the system efficiency as a result of the integration of smart controllers? If yes, what is the percentage reduction reached in 2017?

iv. Did your project contribute to increasing the share of systems with integrated automation and control? If yes, what is the percentage increase reached in 2017?

b. *Integration, automation and control of large scale hybrid systems for non-residential buildings*

i. Did your project contribute to the definition of processing algorithms and set of standards for the construction of large scale hybrid systems?

ii. Did your project contribute to improving the Primary Energy Ratio of a reference system? If yes, what is the value reached in 2017? *Reference value 2012: 0.8*

iii. Did your project contribute to the average increase to the payback time, compared with conventional alternatives (n. of years)? If yes, what was the number of years reached in 2017?

c. *Next generation of highly integrated, compact hybrid systems*

i. Did your project contribute to increasing the renewable fraction of the reference hybrid system? If yes, what is the value reached in 2017? *Reference value: 2020: 50%*

ii. Did your project contribute to reduce the reference system cost? If yes, what is the value reached in 2017? *Reference value 2012: 800 – 1,500 €/Kw*

iii. Did your project contribute to improving the capacity of the system to automatically detect failure and react? If yes, what is the value reached in 2017? *Reference 2012: limited*

iv. Did your project contribute to improving the Primary Energy Ratio of a reference system? If yes, what is the value reached in 2017? *Reference value 2012: 0.8*