Next Heat Pump Generation NxtHPG	**Grant Agreement Number:** 307169 **Acronym:** NxtHPG **Title:** Next Generation of Heat Pumps working with Natural fluids

D1.1 Review of cases where new heat pumps with natural fluids could have good prospects of application

Deliverable number:	**1.1**
Due date:	**31/03/2013**
Delivery date:	**12/04/2013**
Contract Start Date:	**December 1st, 2012**
Duration:	**48 months**
Responsible partner:	**Universitat Politecnica de Valencia**

SEVENTH FRAMEWORK PROGRAMME

Project funded by the EU

Document history

Version	File name	Authors	Revised	Approved	Date
1.0	NxtHPG_1.1	Carla Montagud			25/03/2013
2.0	NxtHPG_1.2	José Gonzálvez	x	x	26/03/2013
3.0	NxtHPG_1.3	José Miguel Corberán	x	x	08/04/2013
4.0	NxtHPG_1.3	Carla Montagud	x	x	11/04/2013

Executive summary

This deliverable corresponds to task WP1.1 *'Analysis of the cases of interest*' and describes the selection of the cases for which a prototype is going to be developed in the project.

As indicated in the DoW, the first objective of the project is the identification of the cases in which the development of a first series of heat pumps employing natural refrigerants can lead to cost effective and high efficient solutions with a fast commercial exploitation, and later to the successful deployment of the technology to other sizes, ranges and applications. Table 1 presents the final selection of the case studies considered in the project:

<table>
<tr><th>Case</th><th>Fluid</th><th>Source</th><th>T(ºC)</th><th>Sink</th><th>T(ºC)</th><th>Application</th><th>(kW)</th></tr>
<tr><td rowspan="2">1
(test
KTH)</td><td rowspan="2">HC
(Propane)</td><td rowspan="2">Air</td><td rowspan="2">-10 to 10
(environmental air)</td><td rowspan="2">Water</td><td>40 to 50</td><td>Heating
Water production</td><td rowspan="2">50
(*)</td></tr>
<tr><td>60</td><td>Low demand
of Sanitary hot water</td></tr>
<tr><td colspan="8">CASE 1 is an air to water heat pump for the production of hot water for heating applications also covering a low demand of sanitary hot water with the use of a de-superheater. An extra water-air hydraulic loop could be considered in order to have air to air heat pumps. It will be reversible on the refrigerant circuit, so providing heating and cooling.</td></tr>
<tr><td rowspan="2">2
(test
KTH)</td><td rowspan="2">HC
(Propane)</td><td rowspan="2">Water (brine)</td><td rowspan="2">-5 to15</td><td rowspan="2">Water</td><td>40 to 50</td><td>Heating water
production</td><td rowspan="2">100
(*)</td></tr>
<tr><td>60</td><td>Low demand
of Sanitary hot water</td></tr>
<tr><td colspan="8">CASE 2 is a ground source heat pump for the production of hot water for heating applications also covering a low demand of sanitary hot water with the use of a de-superheater. It will be reversible on the refrigerant circuit, so providing heating and cooling.</td></tr>
<tr><td>3
(test
UPVLC)</td><td>HC
(Butane)</td><td>Water</td><td>Neutral
loop at 25-30
(condensation) or
10-15(sewage water)</td><td>Water</td><td>60</td><td>Sanitary
hot water production</td><td>50
(*)</td></tr>
<tr><td colspan="8">CASE 3 consists in a heat pump booster from a neutral water loop, (10-30 ºC) (recovery of waste heat from condensation (25-30ºC) or sewage water (10-15ºC)), up to 60ºC for sanitary hot water production.</td></tr>
<tr><td>4
(test
ENEA)</td><td>CO2</td><td>Air</td><td>-10 to 10
(environmental air)</td><td>Water</td><td>60 (up to 80)
(inlet water
10)</td><td>Sanitary
hot water production</td><td>50
(*)</td></tr>
<tr><td colspan="8">CASE 4 is an air to water heat pump for hot water production at 60ºC or up to 80ºC for high temperature applications.</td></tr>
<tr><td>5
(test
ENEA)</td><td>CO2</td><td>Air</td><td>-10 to 10
(environmental air)</td><td>Water</td><td>70 to 80
(return water
40)</td><td>Heating
Water production</td><td>50
(*)</td></tr>
<tr><td colspan="8">CASE 5 is an air to water heat pump for heating applications. It targets the renovation market for the replacement of old gas boiler heating systems (5-6 family houses) with high temperature radiators as terminal units.</td></tr>
</table>

Table 1: Selected case studies. (*) Capacity limited to lab restrictions

It should be pointed out that what has been decided is the application, with a first attempt on the operating conditions, refrigerant and the capacity, for each case study.

The details concerning the final definition of operating conditions, refrigerant, capacity and the design requirements for each case study, will be decided during the next three months in the framework of task WP1.3 '*Selection of case studies and definition of the characteristics and requirements for the prototypes'.*

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1. Introduction

As specified in the description of work, the first objective of the NxtHPG project is the identification of the cases in which the use of Natural refrigerants can lead to cost effective and high efficient solutions with a fast commercial exploitation.

The project targets the development of solutions with hydrocarbons or CO2 for 4 to 6 different case studies. The following table shows an initial set of 5 different cases which were already identified as of high interest in the project proposal.

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
1	HC (Propane)	Air	-10 to 10	Water	40 to 50	Heating water production	50 (*)	KTH
					60	Low demand of Sanitary hot water		
2	HC (Propane)	Water (brine)	-5 to15	Water	40 to 50	Heating water production	100 (*)	KTH
					60	Low demand of Sanitary hot water		
3	HC (Butane)	Water	Neutral loop at 25	Water	60	Sanitary hot water production	50 (*)	UPVLC
4	CO2	Air	-10 to 10	Water	60	Sanitary hot water production	50 (*)	ENEA
5	CO2	Water	5 to 25	Water	70 to 90	High Temperature water production	50 (*)	ENEA

Table 2: Case studies initially identified. (*) Capacity limited to lab restrictions

Work package WP1 titled *'Analysis of applications and case studies definition',* targets the following objectives:

- Analysis of the applications in which the deployment of heat pumps with natural refrigerants could lead to superior performance and have good prospects for implementation.
- Study of the operating conditions, design and safety requirements and possibilities and conditions for integration with other systems.
- Selection of a short series of case studies (4 to 6) for the development of optimized heat pumps with hydrocarbons and CO2.
- Definition of the complete set of design requirements and operating conditions for each case study.

The first task of work package 1, WP1.1 '*Analysis of the cases of interest*' consists in the analysis of the possible cases of interest and the selection of the most promising applications in which the use of natural refrigerants can lead to cost effective and high efficient solutions with a fast commercial exploitation.

From the starting date of the project, the 1st of December 2012, work has been carried out in the framework of WP1.1.

The first WP1 meeting took place in the kick off meeting, during which it was scheduled in the agenda some time for the WP1 discussion of the cases of interest. A review of the key research lines in the heat pumps sector was done by UPVLC. After that, a debate was initiated for each case of interest already identified in the proposal (see table 2). Each case study, the most interesting applications and the layout of the systems were analysed in more detail, some of them were discarded and other possible ideas were also proposed by the rest of participants.

As it was agreed during the kick off meeting, each working team, CO2 and HCs, (see figure 1) followed with the WP1.1 discussion and evaluation of possible applications along the next weeks, with the aim of emerging with a decision at the end of March 2013.

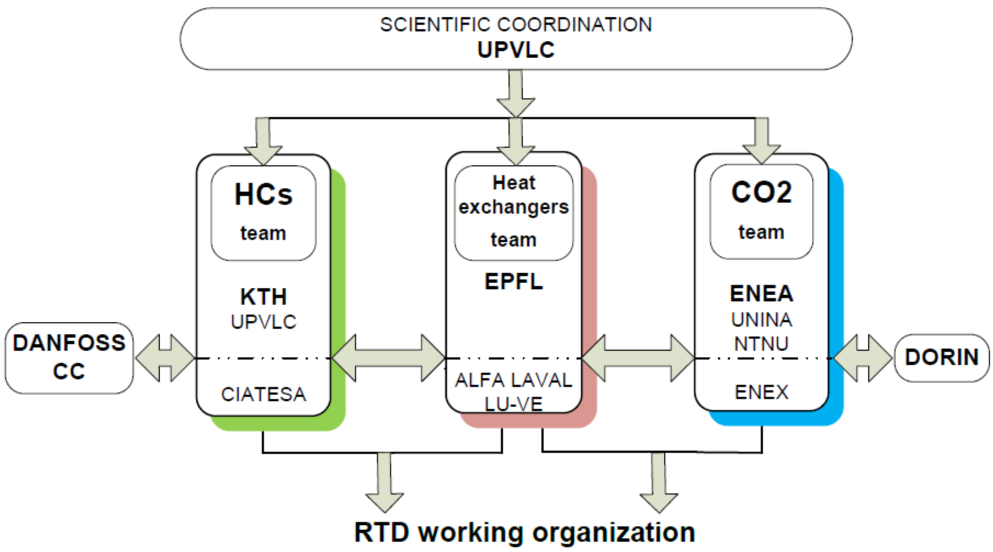

Figure 1: Working teams structure.

During this period of time, there were two coordination meetings, one for each team.

The coordination meeting of the CO2 team took place in Rome at ENEA premises on the 1st of February 2013. The case studies identified for each solution (having CO2 as refrigerant) during the kick off meeting were presented and discussed in detail. A preliminary technical evaluation of each solution was done and the final decision was made by mid-March 2013 with the approval of every participant in the project.

Regarding the HCs team, there was a coordination conference meeting on the 14th of February 2013. The meeting started with the presentation of a summary of the cases identified in the previous meeting of the CO2 team that took place in Rome at ENEA premises on the 1st of February 2013, indicating the challenges of each case and the issues to be decided. After that, a review of the safety design and standards for natural refrigerants was presented by UPVLC as well as the prospective of equipment evolution and the *'AIRAH 21/01/2013. DRAFT DISCUSSION PAPER. Transition to low-emission HVAC&R'*, and special attention was paid to the main parts regarding natural refrigerants equipment.

After the introduction of the identified case studies for the HC prototypes, a round table discussion took place with the participation of all attendants. After a long debate, it was agreed that the heat pump manufacturer of the HC's prototypes, CIATESA, should be the one making the final decision. The reason for this is that manufacturers must build something which they rely on. Therefore, the selected case studies should not only be innovative but also have potential for market exploitation.

Next section includes the summary of the results obtained from the different analysis and discussion of case studies and applications, which were carried out at each meeting.

2. Summary of WP1.1 meetings

This section presents the summary of the case studies definition at each WP 1.1 meeting, as well as the challenges that should be taken into consideration, and issues to be decided.

2.1 Kick off meeting

Day nine was initiated with a summary of WP1 discussion presented by UPVLC, where the ideas collected the day before were presented and analyzed by all the participants. Each case study, the most interesting applications and the layout of the systems were analyzed in more detail. The results of the discussion can be summarized in the following:

HCs prototypes:

- *CASES 1 and 2:* There is an agreement that they are both interesting and clear applications and there is potential market for them. The application would correspond to hot water production for heating (40-50ºC), with simultaneous production for low sanitary hot water demand at 60ºC.
    - *CASE 1:* is an air to water unit, and for this case, CIATESA proposes also to include an extra water to air heat exchanger in order to produce a variant for air to air heating applications.
    - *CASE 2:* is the same application as CASE 1 except for the heat source which could be groundwater or water coming from a BHEX (borehole heat exchangers) field.

CIATESA comments that units should have the refrigerant circuit reversible in order to provide cooling during summer in typical two pipes installations.

- *CASE 3:* in principle, it is remained the original idea of producing a heat booster from a neutral water loop at ambient conditions (around 20ºC) up to sanitary hot water (60ºC). This idea seems to be in agreement with some of the detected future research priorities (recovery of waste heat from different sources such as sewage water). Additionally, the application is innovative and could have a good potential market in the future.

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
1A	HC (Propane)	Air	-10 to 10 (environmental air)	Water	40 to 50	Heating water production	50 (*)	KTH
					60 (de-superheater)	Low demand of Sanitary hot water		
1B (Extra loop Water to Air)	HC (Propane)	Air	-10 to 10 (environmental air)	Air	40 to 50	Heating water production	50 (*)	CIATESA
					60 (de-superheater)	Low demand of Sanitary hot water		
2 Geothermal heat pump	HC (Propane)	Water (brine)	-5 to15	Water	40 to 50	Heating water production	100 (*)	KTH
					60	Low demand of Sanitary hot water		
3A HP Booster	HC (Butane)	Water	Neutral loop at: 25-30 (condens. loop)	Water	60	Sanitary hot water production	50 (*)	UPVLC
			10-15 (sewage water)					

Table 3: HCs case studies preselected in the kick off meeting. (*) Capacity limited to lab restrictions

CO2 prototypes:

- CASE 4: There is an agreement that it is an interesting and clear application. The target temperature for the hot water production could be 60ºC and up to 80ºC. It would consist in an air to water heat pump where the heat source temperature could vary from -10ºC to 10ºC, being the water supply temperature of 60ºC and up to 80ºC. The application could correspond either to sanitary hot water or high temperature water production.

- CASE 5: given that CASE 4 could also be used for the high temperature water production, CASE 5 included in the proposal would only be a variant of CASE 4 with a different heat source (water to water heat pump with a heat source temperature of 5 to 25ºC). This could be covered as a variant of CASE 4. Among the ideas that were proposed by other partners, the following were collected:

  a) Hot water production for heating at high temperature (e.g. 80ºC) with a return moderate temperature (e.g. 40ºC). The application field would be the renovation market for the replacement of old boiler heating systems with high temperature radiators as terminal units. In order to get a high SPF of the system, it is important that the unit and the corresponding storage tank are optimized together. The layout of the system was thoroughly discussed and it was agreed among all participants involved that they would keep on studying it to find the best option.

  b) Air to Air heat pump for commercial buildings, where the supply air temperature would be around 45ºC, with the possibility of making it reversible. ENEA & UNINA mentioned that they had studied some modifications in the layout of the unit in order to improve the efficiency in those conditions and additionally reduce the consumption during defrost.

Finally, table 4 shows the summary of the CO2 case studies identified in the kick off meeting.

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
4	CO2	Air	-10 to 10 (environmental air)	Water	60 up to 80ºC (90ºC)	Sanitary hot water production	50 (*)	ENEA
5A Rooftop	CO2	Air	-10 to 10 (environmental air)	Air	15 (cooling) 45 (heating)	Air conditioning (Heating and cooling)	50 (*)	ENEA
5B Renovation of gas boilers	CO2	Air	-10 to 10 (environmental air)	Water	70 to 80	Water heating	50 (*)	ENEA

Table 4: CO2 case studies identified in the CO2 in the kick off meeting. (*) Capacity limited to lab restrictions

2.2 CO2 coordination meeting

CO2 prototypes:

Different possible configurations of CO2 compressors for case studies 4 and 5 were presented by DORIN. Experimental measurements were presented by ENEA for similar units for CASE 4 and CASE 5 as explained in the following:

- CASE 4:
  - Experimental results of an ENEA experimental plant for instantaneous production of sanitary hot water. The unit consisted of a 5 kW, air-water (source-sink) heat pump working with CO2.
- CASE 5:
  - Experimental preliminary results of an ENEA rooftop prototype were presented. The unit consisted of a 35 kW, air-air (source-sink) heat pump working with CO2.
  - Experimental results of an ENEA experimental plant for the air conditioning of offices. The unit consisted of a 25 kW, water-water (source-sink) multifunction heat pump working with CO2.

A discussion among all the members of the CO2 team took place and the following cases were finally identified:

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
4	CO2	Air	-10 to 10 (environmental air)	Water	60 up to 80ºC	Sanitary hot water production	50 (*)	ENEA
5A Rooftop	CO2	Air	-10 to 10 (environmental air)	Air	15 (cooling) 35 (heating)	Air conditioning (Heating and cooling)	50 (*)	ENEA
5B Mutli-functional	CO2	Air	-10 to 10 (environmental air)	Water	45 (heating) 12 (cooling)	Simultaneous heating and cooling demand	50 (*)	ENEA
5C Renovation of gas boilers	CO2	Air	-10 to 10 (environmental air)	Water	70 to 80	Water heating	50 (*)	ENEA

Table 5: Case studies identified in the HCs coordination meeting on 14th of February 2013.

(*) Capacity limited to lab restrictions

The following challenges and issues to decide were identified for each case:

CASE 4:

- **Challenges:**
    - High COP
    - Design of the gas cooler. There is a need for high pressure (>100 bar) brazed plate heat exchangers from ALFA-LAVAL
    - Improve the storage stratification (several tanks)
- **To decide:**
    - Water storage temperature in accordance with the regulations of legionella in the different countries
    - Stratification strategies and definition of layout of the system

CASE 5:

- **Challenges:**
    - 5 A: Improve the COP. Defrost process improvement and/or improvement of the refrigeration cycle.
    - 5 B: Find advantages of using CO2 in this kind of system and improve the cycle
    - 5C: Reasonable efficiency. Need of an optimization of the cycle (injection cycle with economizer)
- **To decide:**
    - Select the most suitable option (CASE 5A, CASE 5B or CASE 5C)

It was agreed that a preliminary assessment of the potential of each solution should be done and a decision should be taken before the end of February 2013.

2.3 HCs coordination meeting

The case studies identified for the HC prototypes were presented as well as the challenges of each case and the issues to be decided. A summary is presented in the following table:

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
1A	HC (Propane)	Air	-10 to 10	Water	40 to 50	Heating water production	50 (*)	KTH
					60 (de-superheater)	Low demand of Sanitary hot water		
1B (Extra loop Water to Air)	HC (Propane)	Air	-10 to 10	Air	40 to 50	Heating water production	50 (*)	CIATESA
					60 (de-superheater)	Low demand of Sanitary hot water		
2 Geothermal heat pump	HC (Propane)	Water (brine)	-5 to15	Water	40 to 50	Heating water production	100 (*)	KTH
					60	Low demand of Sanitary hot water		
3A HP Booster	HC (Butane)	Water	Neutral loop at: 25-30 (condens. loop)	Water	60	Sanitary hot water production	50	UPVLC
			10-15 (sewage water)					
3B Multifunctional	HC (propane)	Air	-10 to 10	Water	45 (heating) 12 (cooling)	Simultaneous heating and cooling demand	50	UPVLC
3C Renovation of gas boilers	HC (propane)	Air	-10 to 10	Water	70 to 80	Water heating	50	UPVLC
3D Back up heater for solar thermal	HC (propane)	Air	-10 to 10	Water	70 to 80	Water heating	?	UPVLC

Table 6: Case studies identified in the HCs coordination meeting on 14th of February 2013.
(*) Capacity limited to lab restrictions

CASE 1:

- **Challenges:**
  - Develop a compact unit with reduced refrigerant charge
  - High COP
- **To be decided:**
  - Reversible in the refrigerant circuit?
  - Layout of the system (de-superheater)
  - Refrigerant: propane, isobutane, butane…

CASE 2:

- **Challenges:**
  - Develop a compact unit with reduced refrigerant charge
  - High COP
- **To be decided:**
  - Reversible in the refrigerant circuit?

CASE 3

- **Challenges:**
  - Develop a compact unit with reduced refrigerant charge
  - High COP
- **To be decided: (in collaboration with EHPA)**
  - 3C: Heat pump capacity→ renovation of individual boilers or central heating (whole building)
  - 3D: potential of the application (in terms of COP), capacity and layout of the system

As there were several options regarding CASE 3 and only one must be selected, a discussion took place among all participants and it was finally agreed that the final decision should be made by the heat pump manufacturer, CIATESA. Further information regarding CASE 3 options was exchanged between CIATESA and the rest of the HCs team members on the last two weeks of February 2013 in order to make a final decision on March 2013.

3. Final conclusions

After the work carried out during the first task of work package 1, WP1.1, titled *'Analysis of the cases of interest'*, the selected applications in which the use of a natural refrigerant solution is clearly feasible and shows clear advantages from the environmental and efficiency point of view, as well as a high potential of commercial exploitation by the European Heat Pump Industry are presented in the following for both selected natural fluids: Hydrocarbons and CO2. The challenges of the development of these prototypes in the framework of the NxtHPG project will mainly consist in developing a high capacity and compact unit, with low refrigerant charge and high COP. The details concerning the operating conditions, refrigerant, capacity and the design requirements, will be decided during the next three months (from April 2013 until June 2013) corresponding to task WP1.3 *'Selection of case studies and definition of the characteristics and requirements for the prototypes'*. However, a preliminary proposal is presented in the following tables for each case study identified, as well as the responsible partner that will carry out the tests campaign of each prototype.

HCs prototypes

The heat pump manufacturer for the HCs prototypes will be CIATESA. Table 7 presents a summary of the selected case studies for HCs prototypes.

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
1A	HC (Propane)	Air	-10 to 10 (environmental air)	Water	40 to 50	Heating water production	50 (*)	KTH
					60 (de-superheater)	Low demand of Sanitary hot water		
1B (Extra loop Water to Air)	HC (Propane)	Air	-10 to 10 (environmental air)	Air	40 to 50	Heating water production	50 (*)	CIATESA
					60 (de-superheater)	Low demand of Sanitary hot water		
2 Geothermal heat pump	HC (Propane)	Water (brine)	-5 to15	Water	40 to 50	Heating water production	100 (*)	KTH
					60	Low demand of Sanitary hot water		
3 HP Booster	HC (Butane)	Water	Neutral loop at: 25-30 (condens. loop)	Water	60	Sanitary hot water production	50 (*)	UPVLC
			10-15 (sewage water)					

Table 7: Case studies summary for HCs prototypes. (*) Capacity limited to lab restrictions

CASE 1 (A and B) and **CASE 2**, were agreed by all participants from the very beginning as being of interest and high potential.

CASE 3, on the contrary, was not so clear and several options were considered along the selection process which has been presented on the previous sections. Finally, **CASE 3A** was identified as the most appropriate solution, as it is not only an interesting and innovative application but also promising in terms of commercial exploitation as it was specially stressed by the heat pump manufacturer CIATESA.

After a review of the design and safety standards for hydrocarbon refrigerants, the following design requirements were identified:

- Heat pump indirect system: the heating and cooling system must be indirect in order to avoid the risk of the refrigerant being spread through the distribution system. The internal loops would need to be correctly vented, or double wall heat exchangers should be used in order to avoid the leakage of refrigerant coming into the water.

- Entire system in open air: the refrigerant charge restrictions were considered according to the design and safety standard regulations of natural refrigerants. After carrying out a thorough review, it was decided that the system should be located in open air with an occupancy level of the type 'Only authorized access', which would imply no refrigerant charge limitation.

DCC checked the available compressor sizes and has identified one with a capacity of 53 kW working with R407C as the most suitable for the range of capacities involved in the selected case studies. A solution for CASE 2 could be a tandem of two of this type of compressors.

CASE 1 description:

As shown in table 7, **CASE 1** includes **two options which are described in the following.**

The selected case study corresponds to **CASE 1A**, which is an air to water heat pump for the production of hot water for heating applications, also covering a low demand of sanitary hot water with the use of a de-superheater.

In order to reach the potential market in commercial centers that might be interested in equipment working with natural refrigerants, Rooftop units (air to air) should also be considered as they are the most usually installed in this kind of sectors. Therefore, the heat pump manufacturer would like to include an extra option in CASE 1, which will be described below.

CASE 1B option would consist in the same prototype as CASE 1A but with the addition of one extra water-air heat exchanger and the corresponding hydraulic loop. As it is planned in Annex I (DoW) of the project Grant Agreement, only two prototypes will be tested at KTH premises. Therefore, regarding CASE 1B, it is agreed that just in case that they have the resources (it was not planned in the project that CIATESA carried out the tests of the units), prototype CASE 1B might be tested in CIATESA premises during the second experimental test campaign corresponding to work-package WP8.

Additionally, and following the request of the heat pump manufacturer CIATESA to cover the market of southern European countries where there is a need for both heating and cooling, CASE 1A and CASE 1B must be reversible on the refrigerant circuit.

CASE 2 description:

CASE 2 would consist in a high capacity ground source heat pump for the same application as CASE 1, it is to say, heating and cooling in buildings, but employing a geothermal energy source. For the same reason as explained above for CASE 1, it must be reversible on the refrigerant side.

CASE 3 description:

CASE 3 is based on the idea of producing a heat booster from a neutral water loop at temperatures around 25-30 ºC in the case of water coming from a condensation loop, or 10-15ºC in the case of waste heat loop as for instance sewage water, up to 60ºC (suitable for sanitary hot water). This idea seems to be well in agreement with some of the detected future research priorities in the field of heat pumps (recovery of waste heat from different sources such as sewage water). Additionally, the application is innovative and could have a good potential market in the future.

CO2 prototypes

The heat pump manufacturer for the CO2 prototypes will be ENEX. Table 8 presents a summary of the selected case studies for CO2 prototypes:

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)	Test rig
4	CO2	Air	-10 to 10	Water	60 up to 80ºC	Sanitary hot water production	50 (*)	ENEA
5 Renovation of gas boilers	CO2	Air	-10 to 10	Water	70 to 80	Water heating	50 (*)	ENEA

Table 8: Case studies summary for CO2 prototypes. (*) Capacity limited to lab restrictions

Finally, the testing limitations of the laboratories where the test campaigns are going to be carried out, and the availability of suitable components, especially compressors, will of course be taken into account for the final selection of the size, although the consortium will try to do its best in order to be the least restrictive.

CASE 4 was agreed by all participants from the very beginning as being of interest as it was an already existing and clear application, and the use of CO2 for sanitary hot water production has been proved to be very efficient in cases where the temperature glide needed is very high. On the contrary, **CASE 5** was not so clear, and from the kick off meeting several other options were proposed and have been discussed along task WP1.1 duration.

Finally, CASE 5B was discarded, mainly because it is a case that could perfectly be covered by other HCs like propane which present a higher COP for this kind of applications. **CASE 5A** was also discarded after a preliminary technical evaluation where the COP values obtained were around 2.8 in the point near EUROVENT rating conditions (20ºC Indoor 7(6) ºC Outdoor), and this value is far from CLASS A defined by EUROVENT. **CASE 5C** was the final selected one as it shows the best potential to compete with conventional refrigerants in terms of efficiency. Also it has been identified as promising in terms of commercial exploitation by the heat pump manufacturer ENEX.

CASE 4 description:

CASE 4: it will consist in an air to water heat pump for sanitary hot water production of high capacity. Given the advantage of CO2 for this application, CASE 4 targets high temperature water production (80ºC), being the water inlet temperature at about 10ºC. This kind of application seems to have a great potential market.

CASE 5 description:

CASE 5: it will consist in an air to water heat pump for water heating. The application field would be the renovation market for the replacement of old gas boiler heating systems with high temperature radiators as terminal units, in a 5 to 6 family buildings. The water supply temperature would be around 80ºC, and the return water temperature from the application would be 40ºC. It is identified by the HP manufacturer, ENEX, as being of high interest and potential market. Statistics about the most frequently installed capacities at each European country depending on the type of building will be supplied by EHPA and will be considered during WP1.3 in order to decide the capacity of the prototypes to be developed.