NxtHPG project

"Next Generation of Heat Pumps working with Natural fluids"

José M. Corberán

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Next Heat Pump Generation NxtHPG

Introduction

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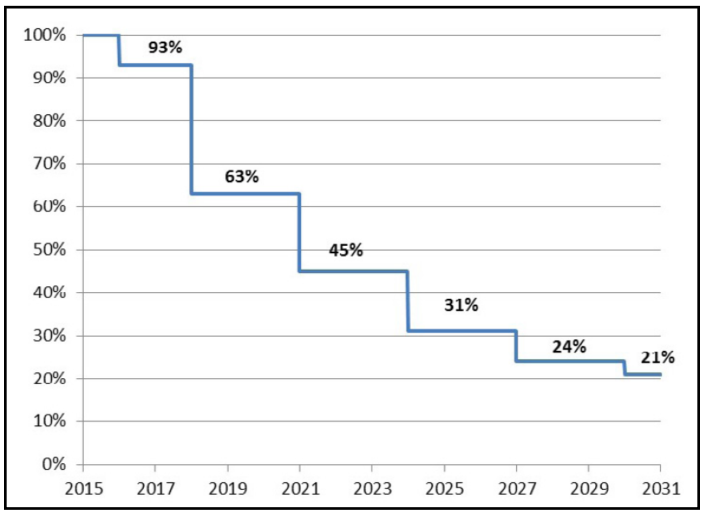
- The newly implemented **F-Gas Regulation (517/2014) imposes a large reduction in the use of HFCs in the EU**, and **will lead to a progressive drop on the availability of HFC refrigerants and** very probably **to a considerable rise of their cost.**
- **This 'phasing down'** which mainly started and affects the Refrigeration Sector **will certainly influence the air conditioning and heat pump sector**



Phase-down shchedule for the total bank of HFCs

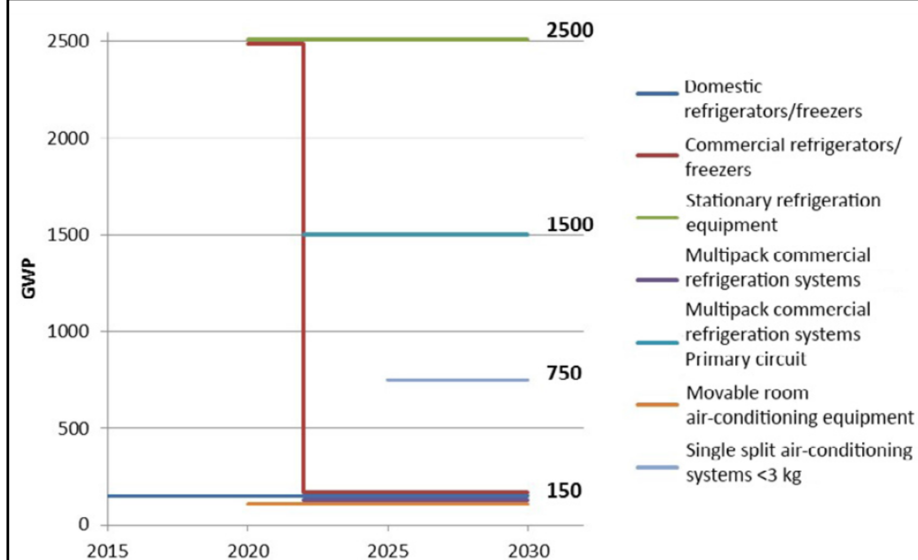


Figure 2: *Marketing bans (Annex III of EU F-Gas Regulation).*

Introduction

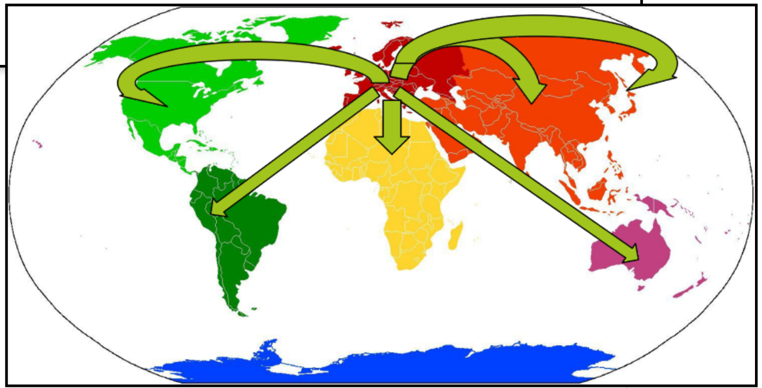
- **The barriers for the wide-spread use of natural refrigerants CO_2 and HCs for heat pumps are twofold**:
  - **Non-technical barriers**:
    - The most important barrier against hydrocarbons is the fear of possible accidents due to its high flammability.
    - No barrier to the development of CO_2 equipment except for their cost.
  - **Technical barriers**:
    - **Hydrocarbons (HCs)**:
      - No availability of scroll compressors for heat pumps
      - Not full availability of other components
      - Limitations on refrigerant charge
      - Safety
      - Maybe cost
    - **CO_2**
      - Limited availability of components (mainly compressors)
      - Transcritical cycle is not enough efficient except for certain applications
      - Maybe cost

NxtHPG project strives to give a step forward to overcome these barriers and usher in **a new generation of heat pumps based on HCs and CO_2**

Introduction

- **CO_2 and HCs have been extensively proved in small refrigeration** equipment
  - Refrigerators, bottle coolers, freezers, display cabinets…
- **CO_2 and HCs are quickly spreading in Refrigeration, supermarkets, commercial malls…**
  - More and more components available
  - Increased skills to handle these refrigerants
  - Increased public awareness of the technology
  - Increased public acceptance

- **A new HP heat technology with Natural fluids could successfully deploy in Europe** without a strong competition from abroad, and once the technology is demonstrated, its deployment worldwide could easily follow.
  - Niche market → Global market



Project Objectives

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Next Heat Pump Generation NxtHPG

- **The first objective of the project is the identification of the cases in which the development of a new generation of heat pumps employing Natural refrigerants can lead to a fast commercial exploitation of the first series of heat pumps** developed here, and **later to the successful deployment of the technology** to other sizes, ranges and applications.

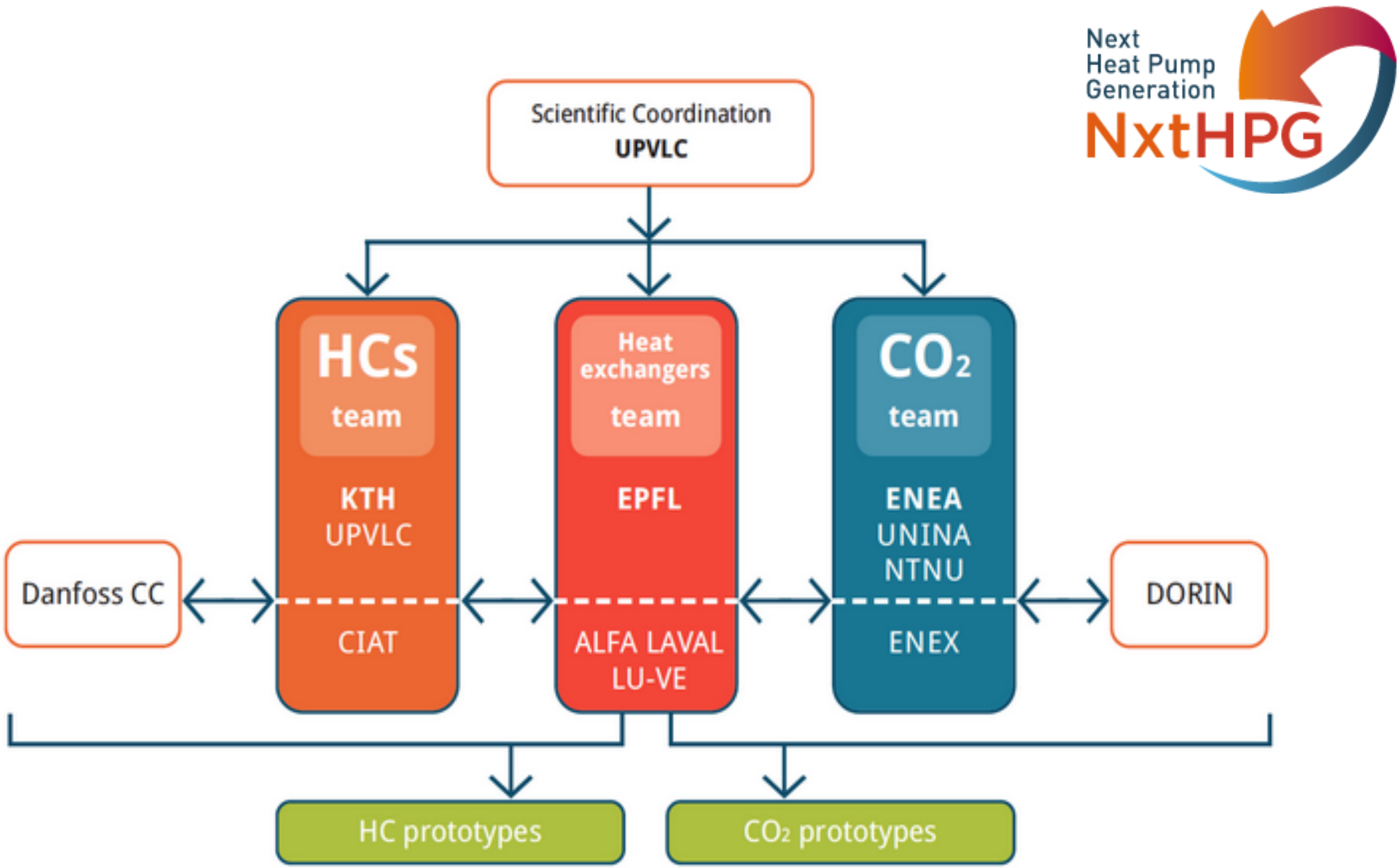
- **General objective: development of** a **set of safe, reliable, and high efficiency heat pumps working with natural refrigerants (Hydrocarbons and CO2)**
  - **Reach higher efficiency (10 - 20% SPF improvement) and lower Carbon footprint (20% lower TEWI)** than the current state of the art of HFCs/HFOs or Sorption heat pump technologies
  - Keep the **cost very similar or only a bit higher (10%)** in a way that the better environmental performance clearly compensates for the extra cost;

Project Organization

Project Organization

- **6 RTD European institutions:**
  - **UPVLC** Valencia, Spain
  - **KTH** Stockholm, Sweden
  - **EPFL** Lausanne, Switzerland
  - **ENEA** Rome, Italy
  - **UNINA** Naples, Italy
  - **NTNU** Trondheim, Norway
- **6 European OEMs:**
  - **DANFOSS CC** Compressors, France
  - **DORIN** Compressors, Italy
  - **ALFA LAVAL** Heat Exchangers, Sweden
  - **LU-VE** Heat Exchangers, Italy
  - **CIATESA** Heat Pumps, Spain
  - **ENEX** Heat Pumps, Italy
- **European Heat Pump Association:** **EHPA**

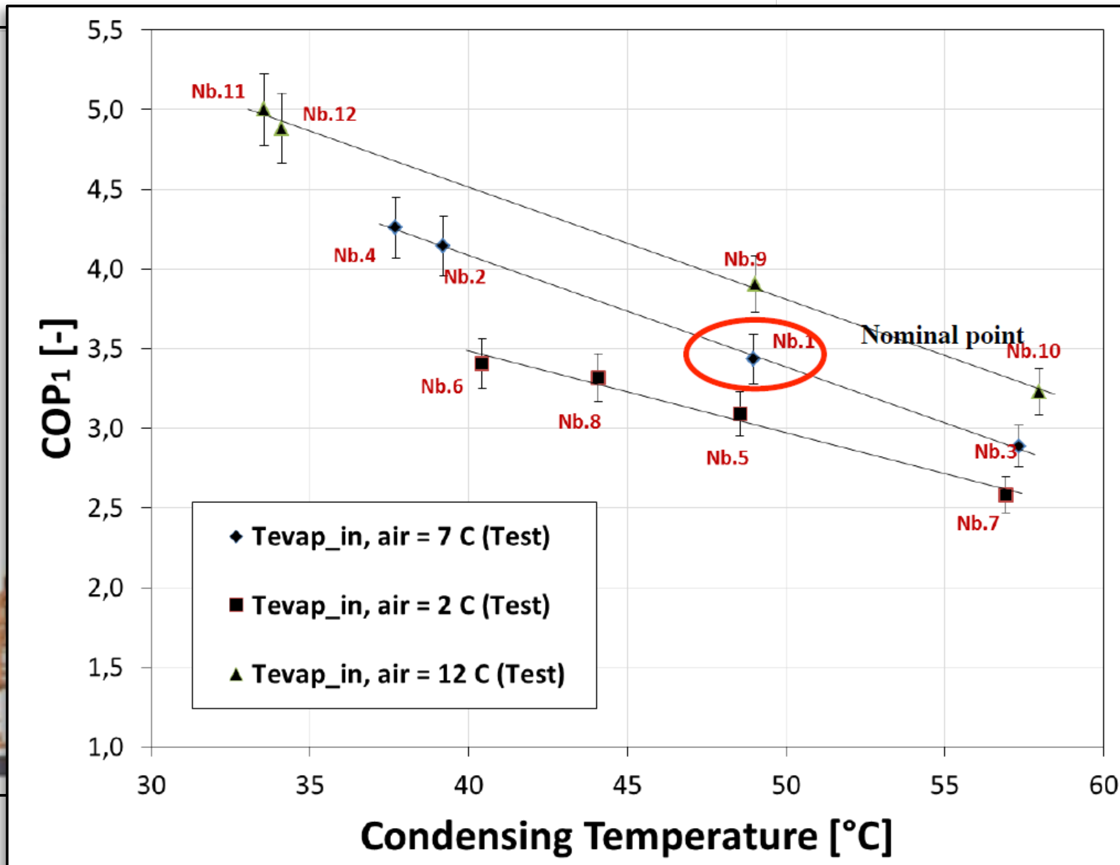
Project Organization



Prototypes

Prototype 1: Propane

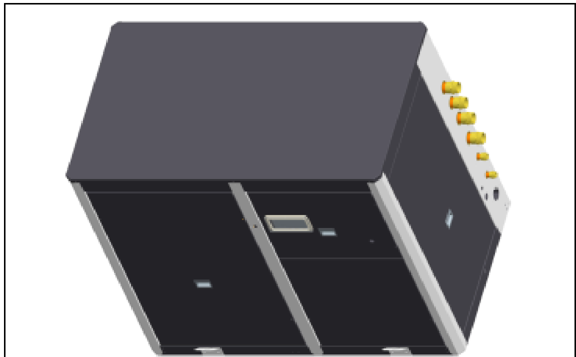
Air to Water HP (reversible)					Tested at KTH		
Case	Fluid	Source	T(°C)	Sink	T(°C)	Application	(kW)
1	HC (Propane)	Air	-10 to 35 (outdoor air)	Water	40 to 50	Heating Water production	40
					60	Low demand of Domestic hot water	

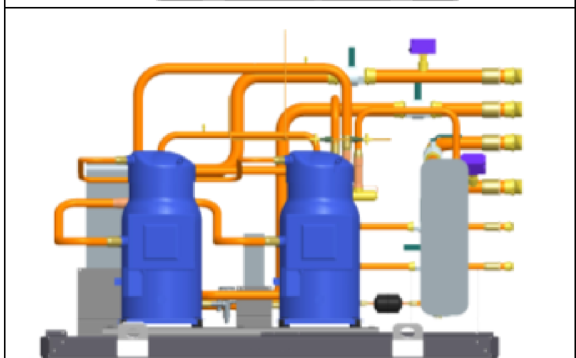


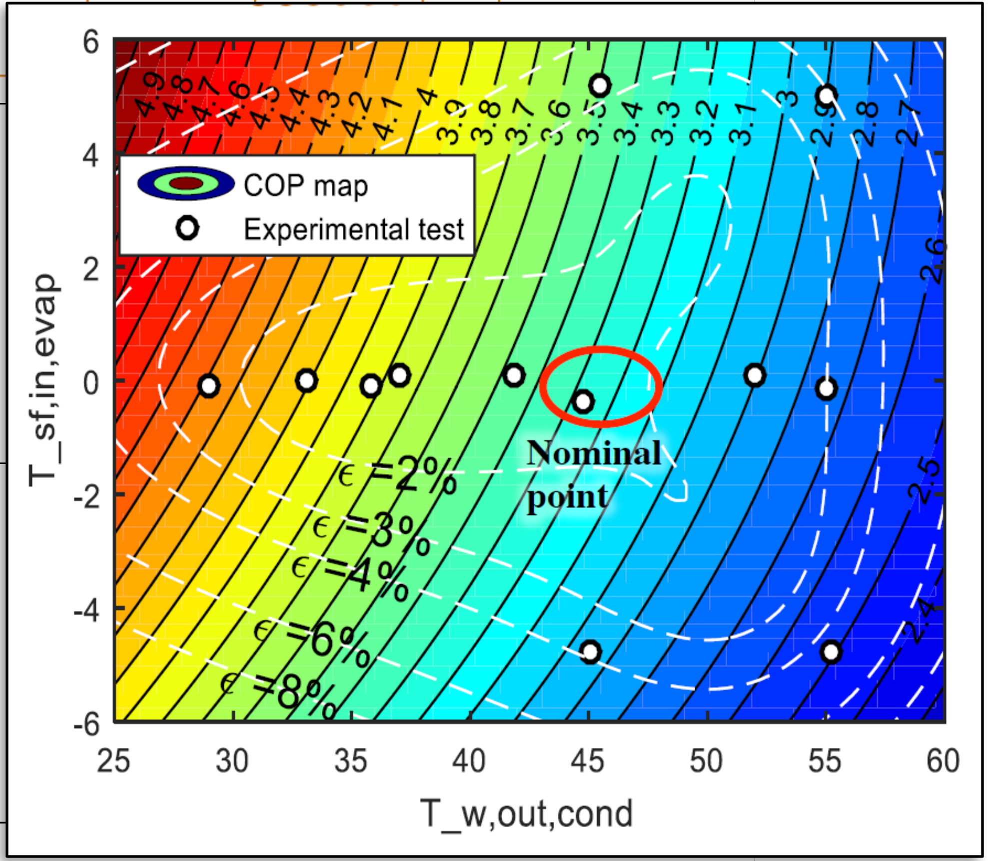
Prototype 2: Propane

Ground to Water HP (reversible) — Tested at KTH

Case	Fluid	Source	T(°C)	Sink	T(°C)	Application	(kW)
2	HC (Propane)	Water (brine) from a ground coupled heat exchanger	-5 to15	Water	40 to 50	Heating water production	60
						Low demand	

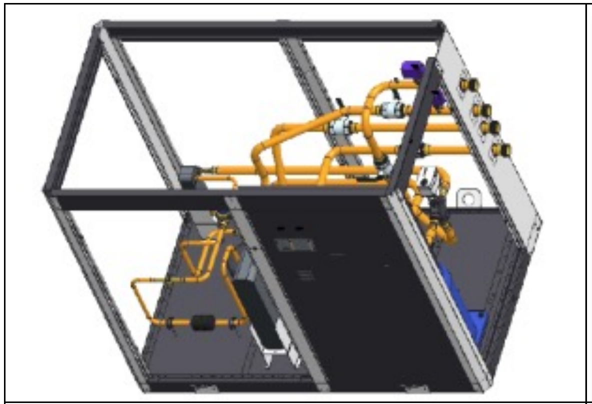


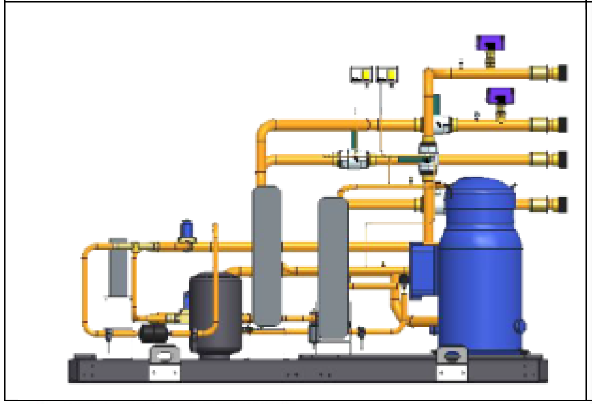


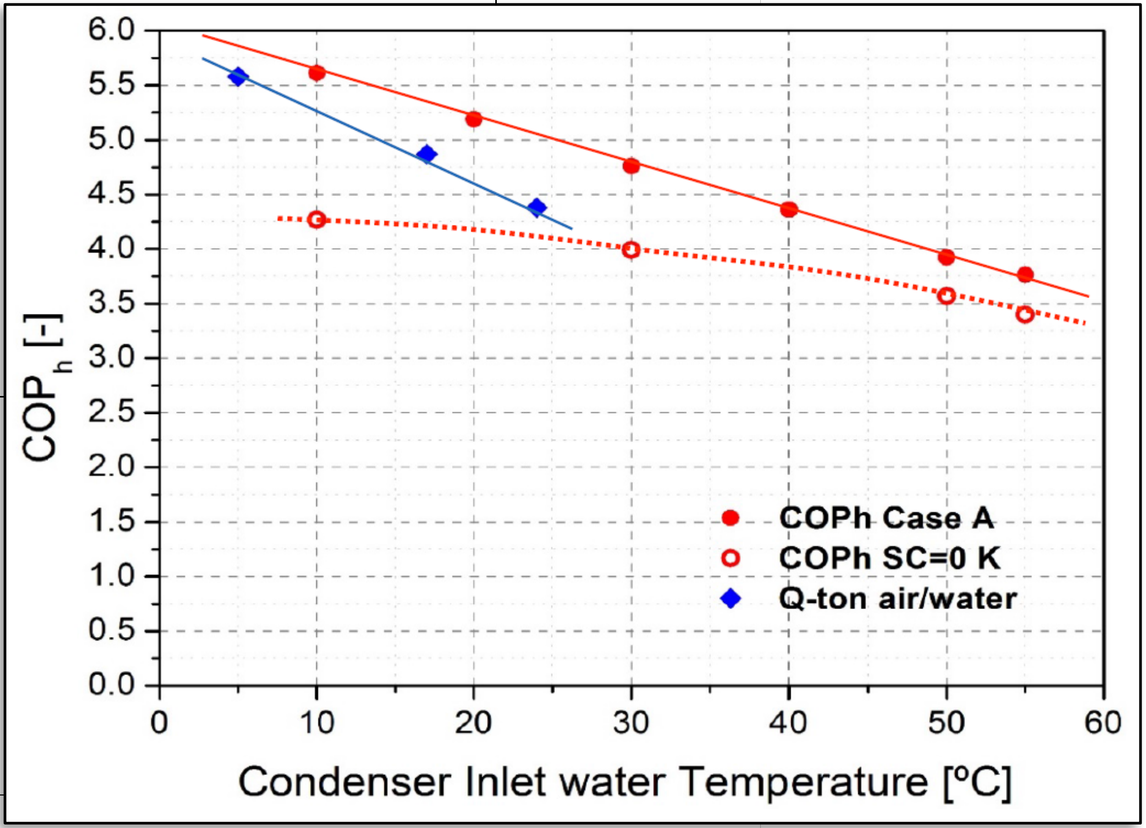


Prototype 3: Propane

HEAT PUMP BOOSTER – SHW						Tested at UPVLC	
Case	Fluid	Source	T(°C)	Sink	T(°C)	Application	(kW)
3	HC (Propane)	Water (Neutral loop)	10 to 15 (Sewage water) or 25 to 30 (Condensation loop)	Water	60	Domestic hot water production	50







Prototype 4: CO2

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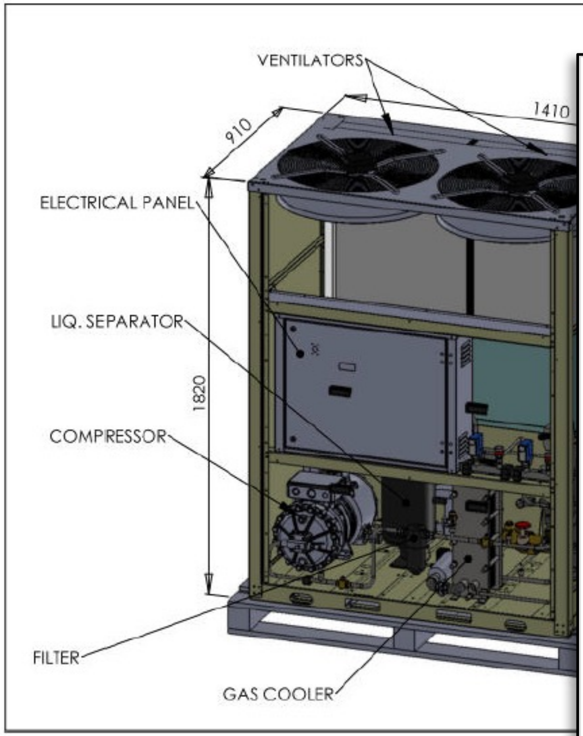
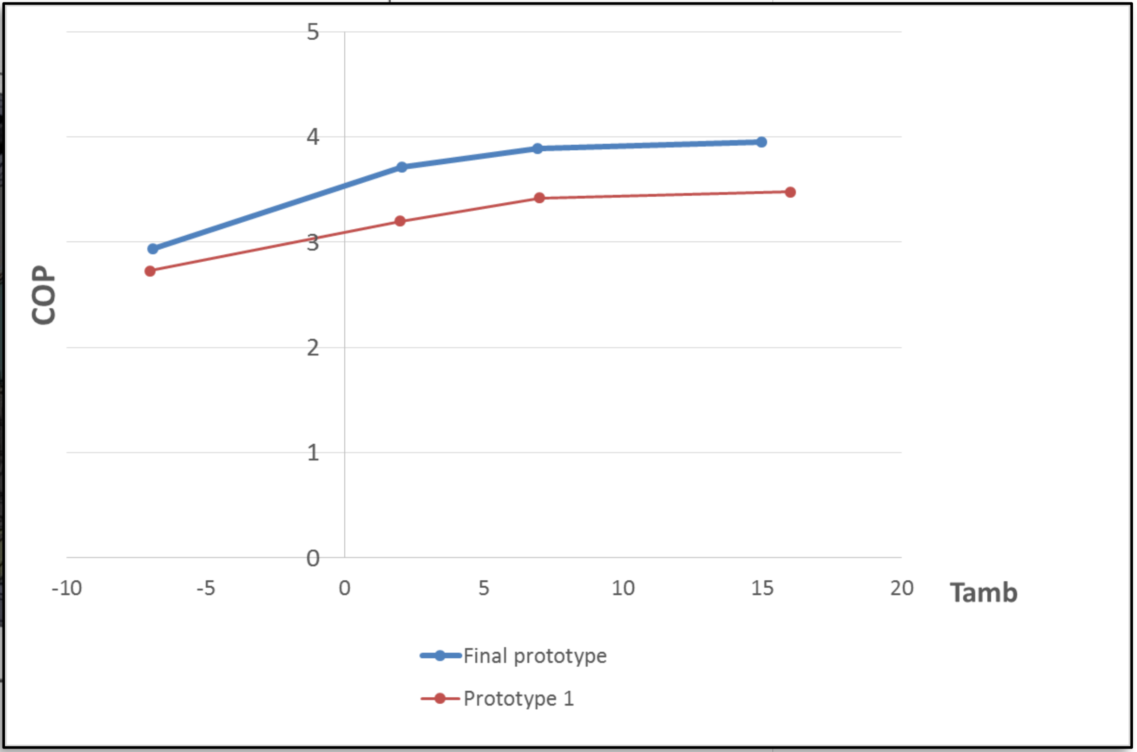
AIR - DHW PRODUCTION   Tested at ENEA

Case	Fluid	Source	T(°C)	Sink	T(°C)	Application	(kW)
4	CO2	Air	-10 to 10 (winter) 20-35 (summer)	Water	60 (up to 80)	Domestic hot water production	30

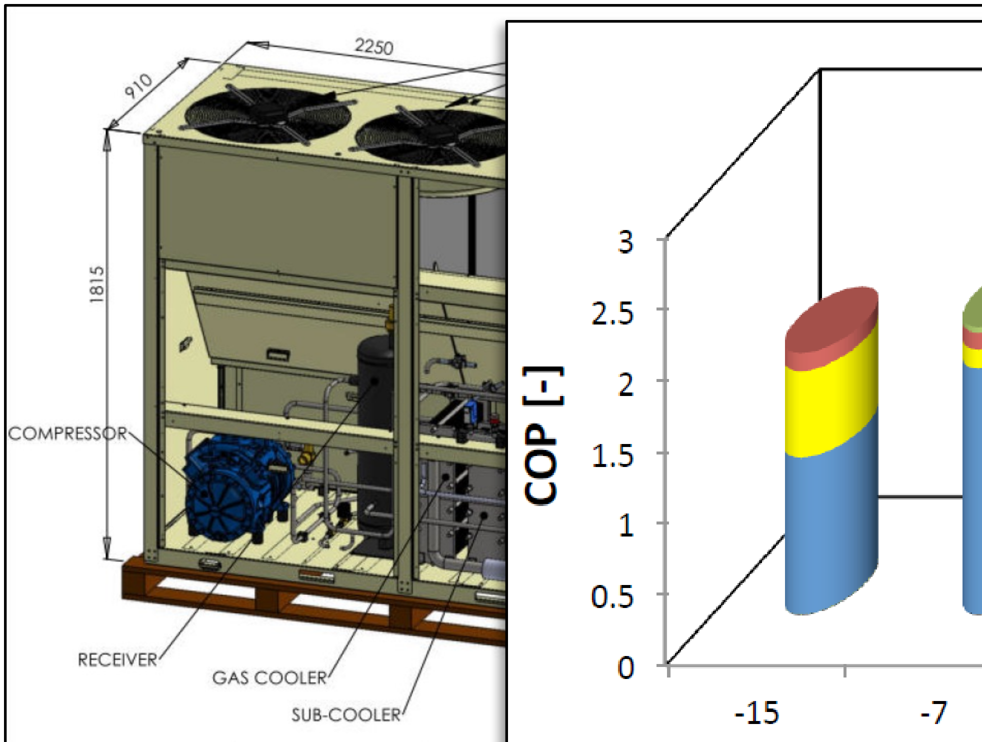


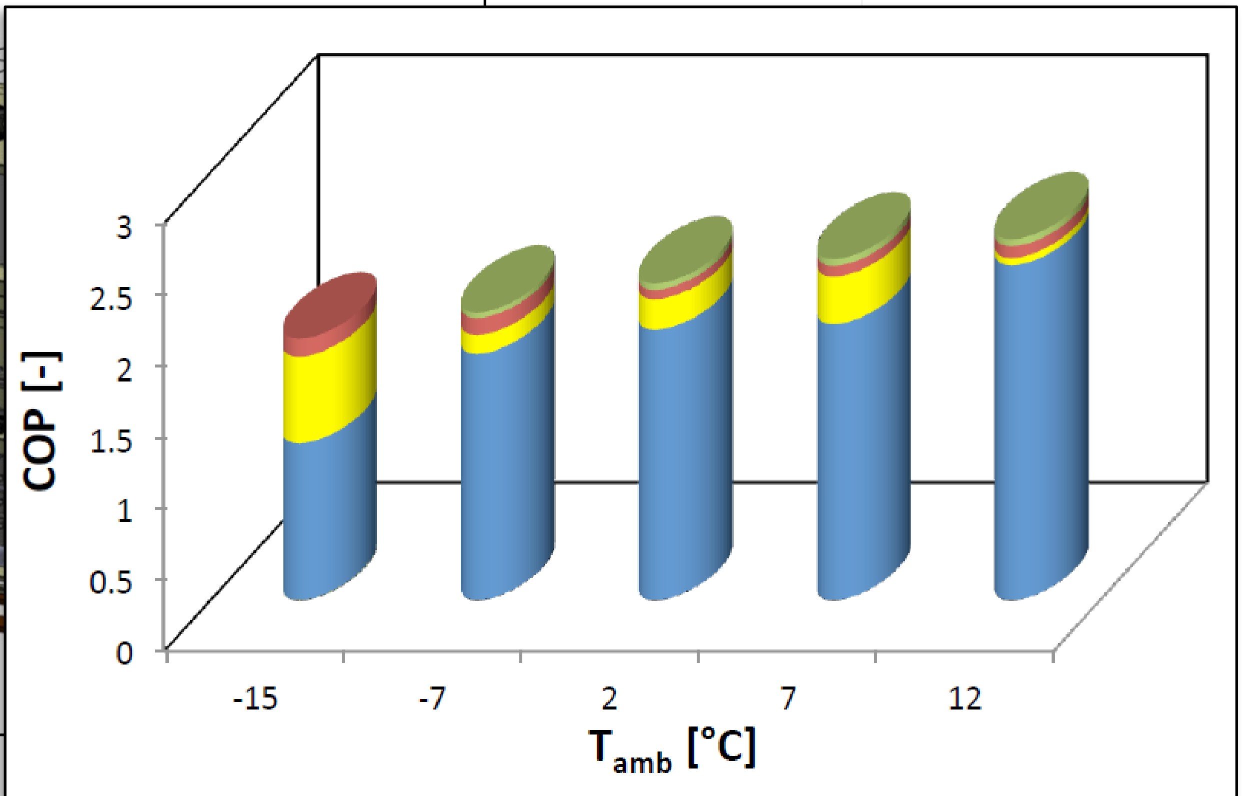


Prototype 5: CO2

AIR – High T HEATING WATER Tested at ENEA

Case	Fluid	Source	T(ºC)	Sink	T(ºC)	Application	(kW)
5	CO2	Air	-10 to 35	Water	80 (return water 40)	Heating & DH water production (DHW in summer)	50





Conclusions

Conclusions

- **The project have involved a large group of OEMs of both components and heat pumps** who have provided their best technology to reach the project objectives.
- **5 cases have been selected because** they offer both an **interesting market** and because a solution with a **natural fluid fits well with the application**.
- A completely dedicated prototype has been manufactured for each application: **3 employing propane and 2 employing CO2**.
- **Each prototype has been especially designed** taking into account the specific characteristic of **the application**.
- The prototypes have been fully tested along two testing campaigns and **interesting innovations and improvements have been found** along the project duration
- Final results prove considerable **high performance and reliable and safe operation**

Thank you very much for your attention

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