XERIC

INNOVATIVE CLIMATE-CONTROL SYSTEM TO EXTEND RANGE OF ELECTRIC VEHICLES AND IMPROVE COMFORT

Presentation of the XERIC project: objectives and results up to now

Thursday, November 23, 2017
XERIC ROUNDTABLE, 18:05-18:20

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European Commission

H2020 - GV - 2014 / GV - 2 - 2014 / RIA n° 653605

What is XERIC?

- **EC-funded** project
- Start: June 1, **2015**
- End: May 31, **2018**
- **8** partners + **1** third party

Aim

Developing an **innovative energy-friendly climate-control system** for electric vehicles capable of reducing noticeably the energy used by current AC systems.

How?

By building a **novel 3F – CMC contactor (gas – liquid)** and developing the related **system architecture**

www.xeric.eu

XERIC at a glance

Big increase in the driving range of Battery Electric Vehicles (BEVs)

XERIC impact

energy saving higher than **30 %** for air conditioning in **summer**

and higher than **50 %** for comfort conditions throughout the **year**

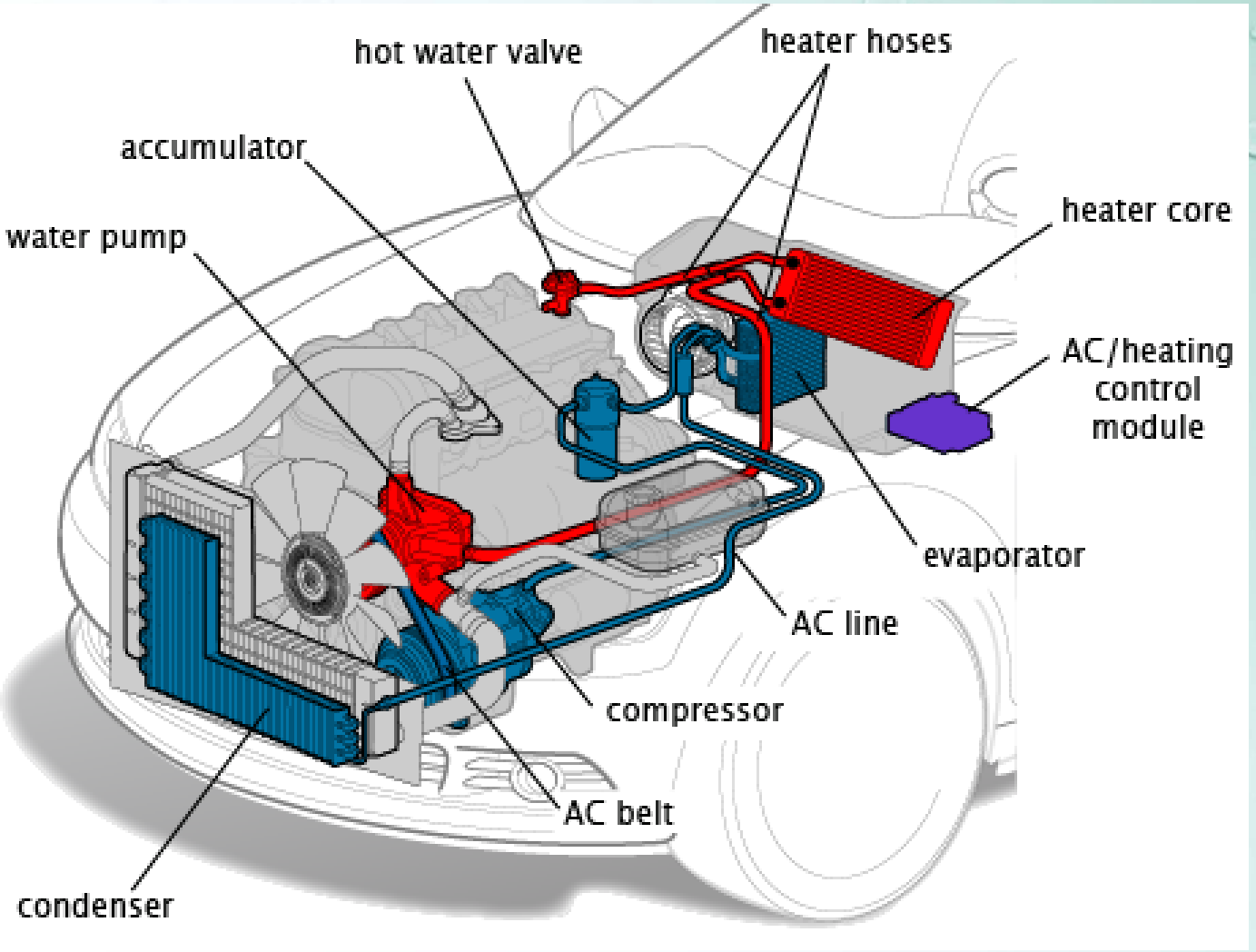
XERIC objective

To **develop a small-scale prototype** of an energy saving **climate control system for EVs** currently on the market.

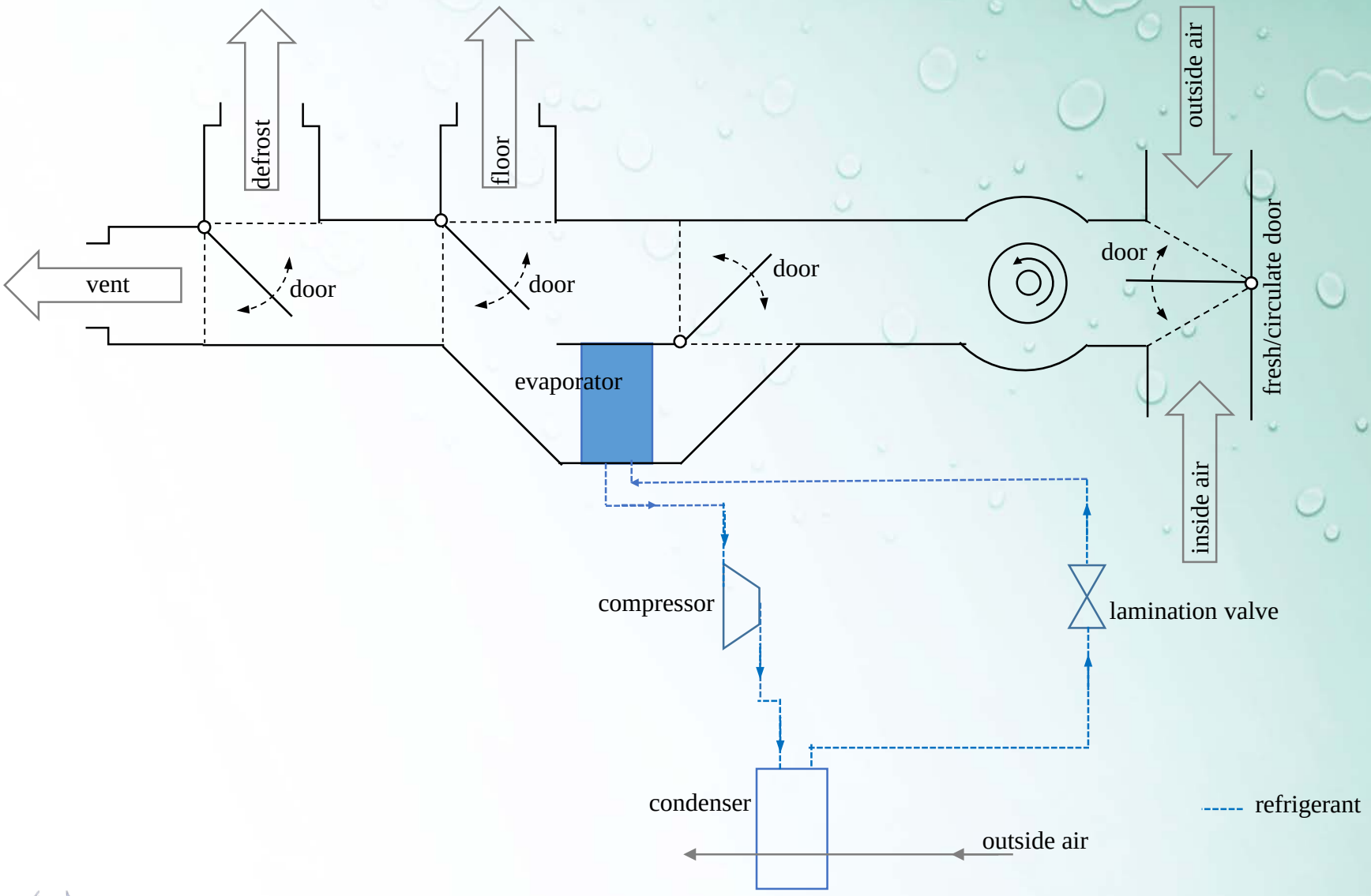
XERIC system will:

1. reduce more than **50%** the energy used all over the year for heating, cooling and dehumidifying air compared to existing systems;
2. reduce more than **30%** the energy used for air cooling/dehumidifying in extreme summer conditions (i.e., external air at T=30 °C and RH=60%) to guarantee comfort in the passenger cabin (i.e., T≈25 °C and RH≈50%);
3. guarantee the after-project **easy industrial scale-up** and the **customization** of system;
4. guarantee an adequate **working life**;
5. withstand the different external air temperature ranges **across Europe**;
6. **profitably use** the components currently installed in EVs;
7. guarantee a **reasonable cost** (to OEM), which depends on car size, when produced at industrial level.

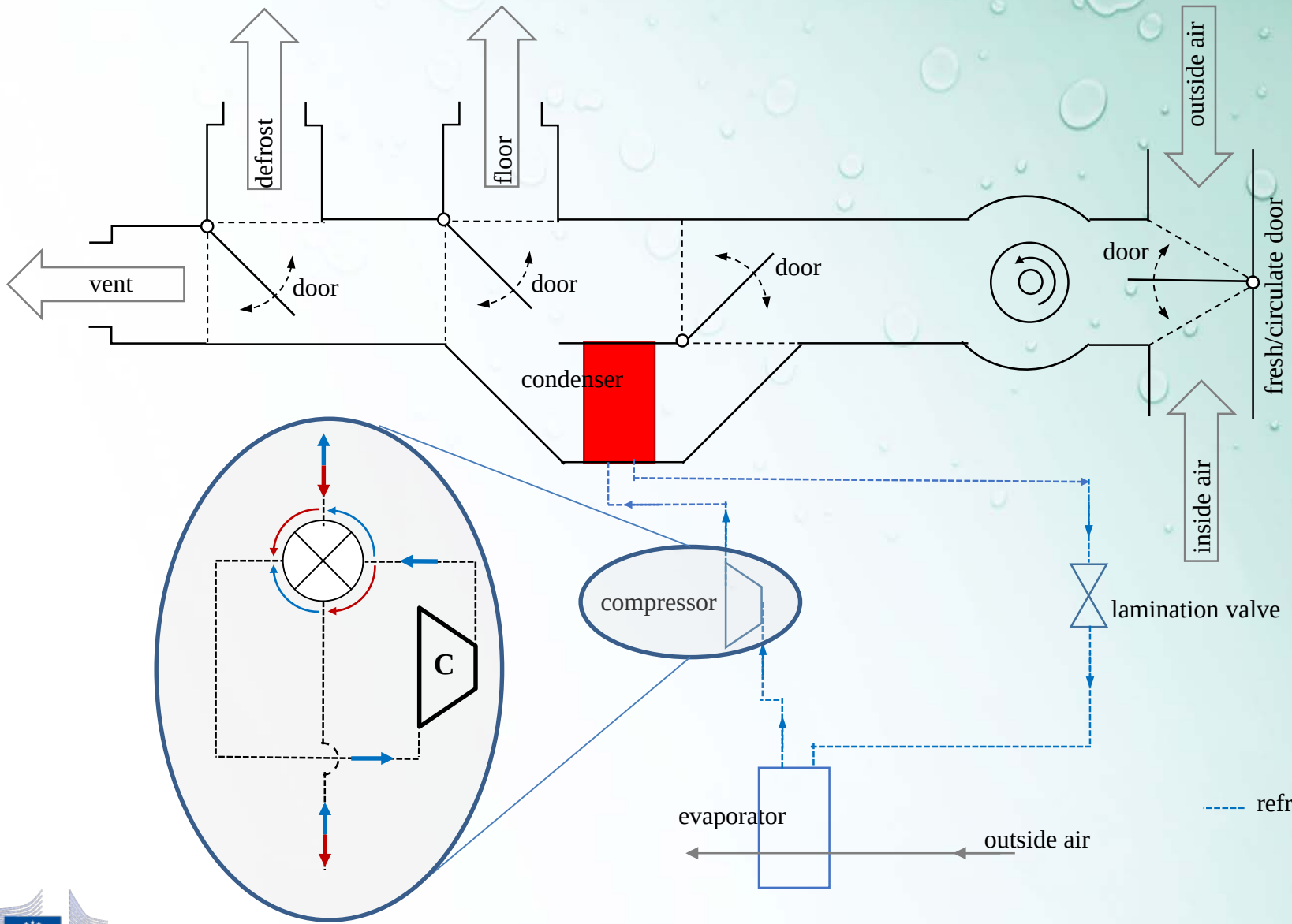
Air-Conditioning System in a traditional ICE car: Vapour Compression Cycle (VCC)



EV cars: heat pump system architecture in summer conditions



EV cars: heat pump system architecture in winter conditions



Innovative 3F-CMC

XERIC improves the VCC.

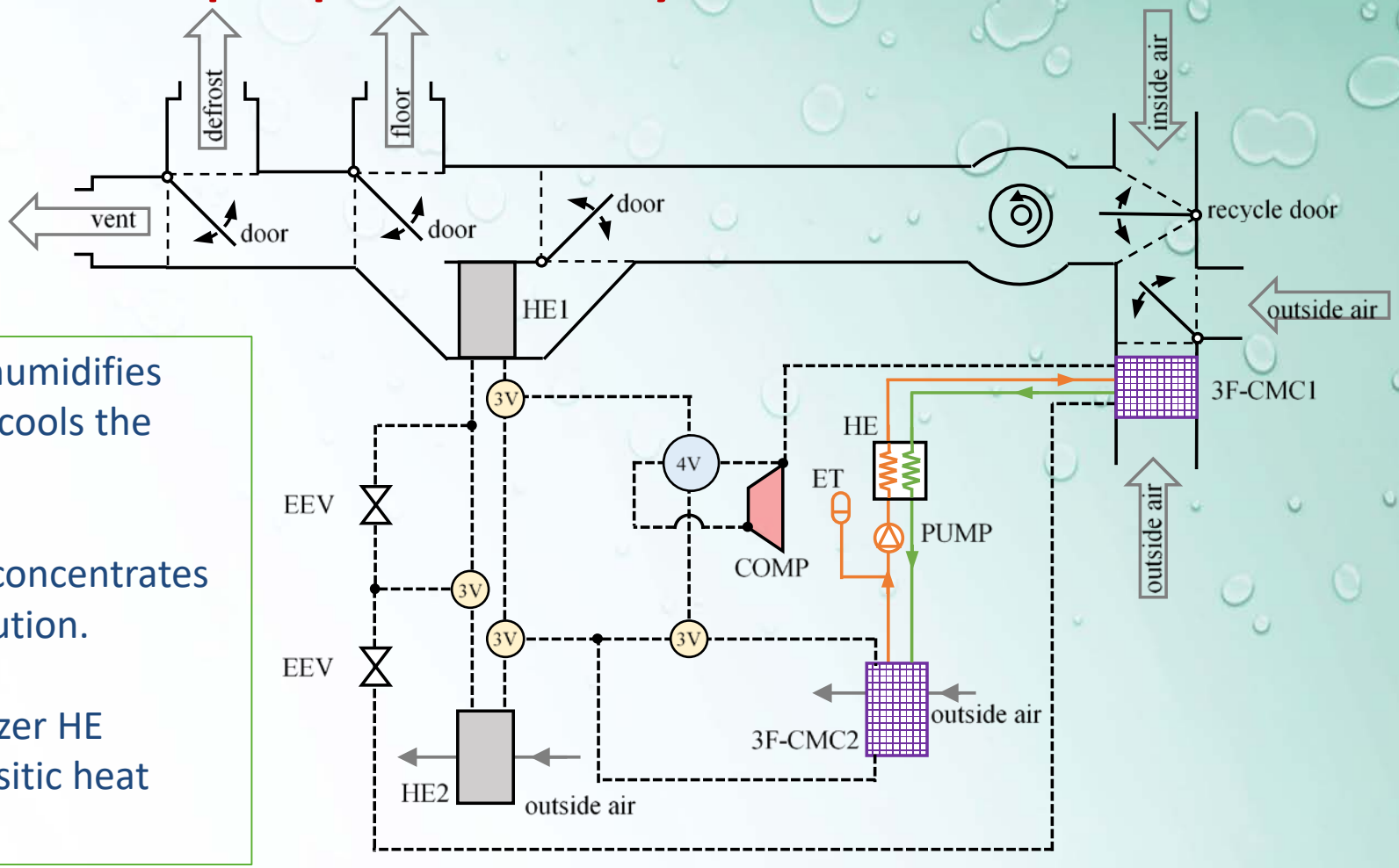
3F-CMC is a three-fluids heat and mass exchanger, where air is dehumidified and cooled by a liquid desiccant solution and a refrigerant, respectively.

Core of the 3F-CMC is a semi-permeable membrane.

Main advantages:

- high efficiency;
- tailored systems.

XERIC system architecture: heat pump + desiccant cycle



3F-CMC1 dehumidifies and partially cools the process air.

3F-CMC2 re-concentrates the weak solution.

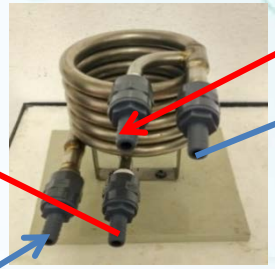
The economizer HE reduces parasitic heat transfer.

Concentrated warm desiccant
Diluted cold desiccant

HE	Heat exchanger
3F-CMC	Three-fluids combined membrane contactor
3V	Three-way valve
4V	Four-way valve
ET	Expansion tank
COMP	Compressor
EEV	Electronic-controlled expansion valve

Added components

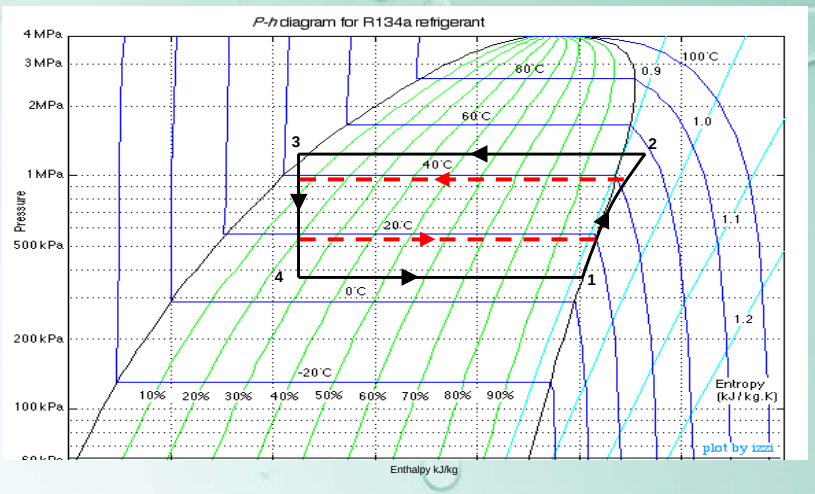
THE DEHUMIDIFICATION CIRCUIT



XERIC's energy efficiency throughout the year

- Summer and intermediate seasons:

  XERIC system allows the VCC to operate at higher evaporation temperature and lower condensation temperature.



- Raining days:

  XERIC system allows dehumidification only, with a small cooling effect.

- Winter:

  XERIC system works as a heat pump, which is far more efficient than an electrical resistance.

Planned TRLs

TODAY

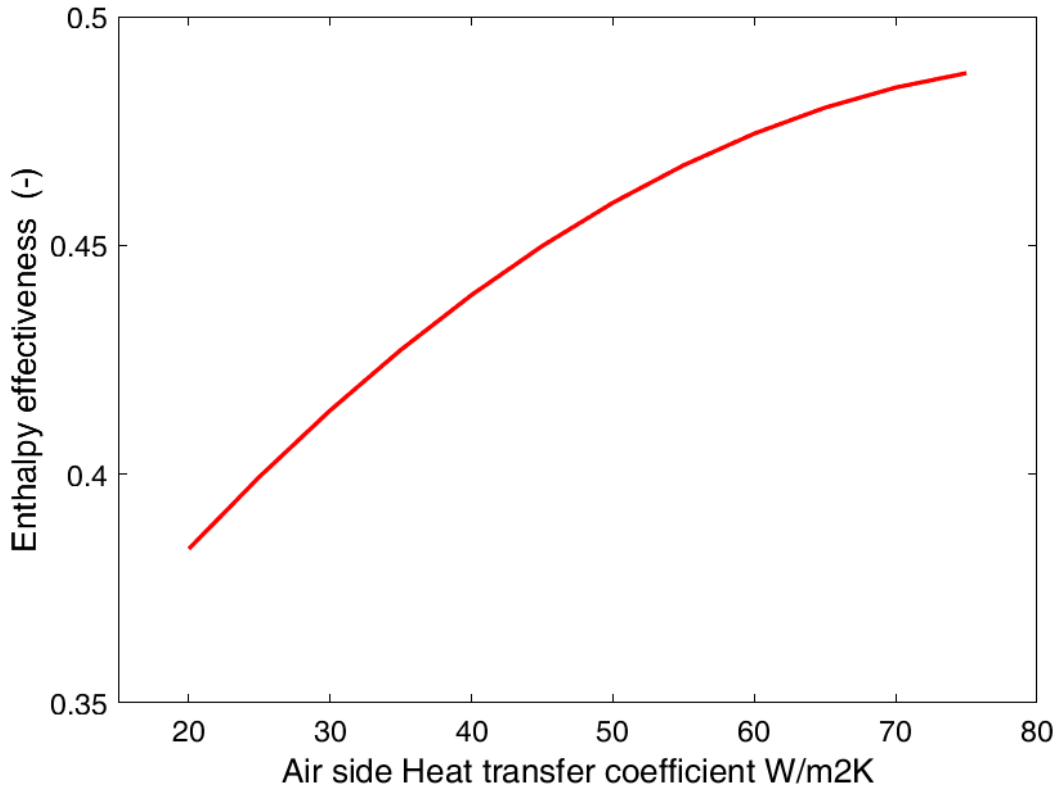
Project Stages						
PERIOD	Pre-Project (leading to 3F-CMC idea)	Project Development (AC system based on 3F-CMC)			After Project	
	2000 -2011	Year 1	Year 2	Year 3	Year 4	Year 5
POSITIONING OF THE PROJECT	TLR2 (technology concept formulated) & TLR3 (experimental proof of concept pre-tested)	TLR3 (3F-CMC: experimental proof of concept)	from TLR3 to TLR4 (climate control system development)	TLR 4 (lab validation of climate control system)	TLR 7 / TLR 8 (demonstration in operational environment / climate control system qualification)	TLR 9 (testing actual climate control system in operational level / competitive manufacturing)
TECHNOLOGY MILESTONES	Most science completed & engineering to be developed	3F-CMC design and preparation, • base hydrophobic membrane • testing equipment prepared	• design of optimized 3F-CMC and of CCS • hydrophobic membrane treatment ready • customized electronic control system ready • small scale CCS prototype ready	• CCS prototype validated in Lab • tool for evaluating CCS performance ready • tool for preventing frost formation ready • membrane scaling up done	Commercial grade prototype & first production runs	Optimization of production, standardisation of quality control & assurance, obtaining regulatory permissions
PATENT STATUS	Base patents issued	Adding to base patents			Adding to developed patents	
BUSINESS DEVELOPMENT	Idea & Opportunity analysis carried out	Surveys	Business Plan and expert surveys		Preliminary relationship with customers and strategic alliances	Delivering commercial products & Expanding customers portfolio
RISK LEVEL	Very high	High			Moderate in case of technical success of project	

The first step is the biggest stride

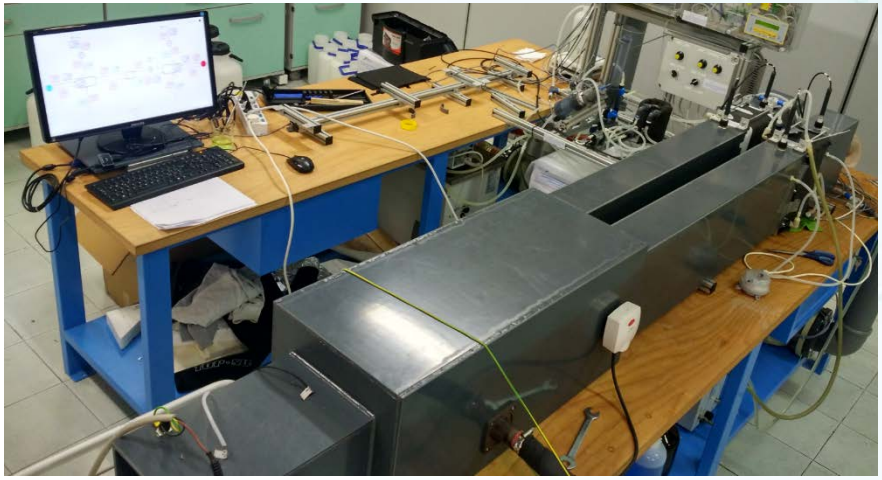
1. Theoretical studies and numerical modeling
2. 3D CFD numerical simulations
3. 3F-CMC design (development of all its parts)
4. Creation of a predictive numerical tool validated by experimental tests
5. Optimized XERIC architecture

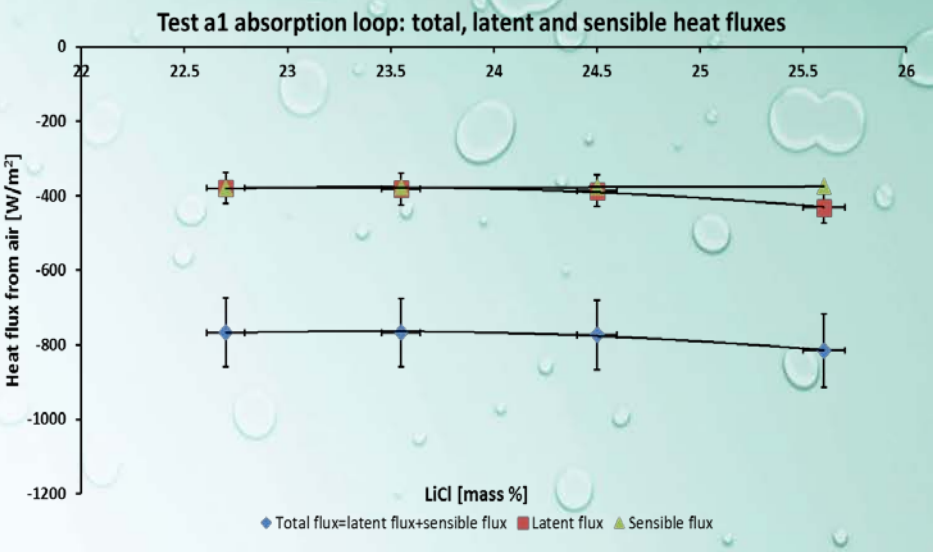
Predictive numerical tool

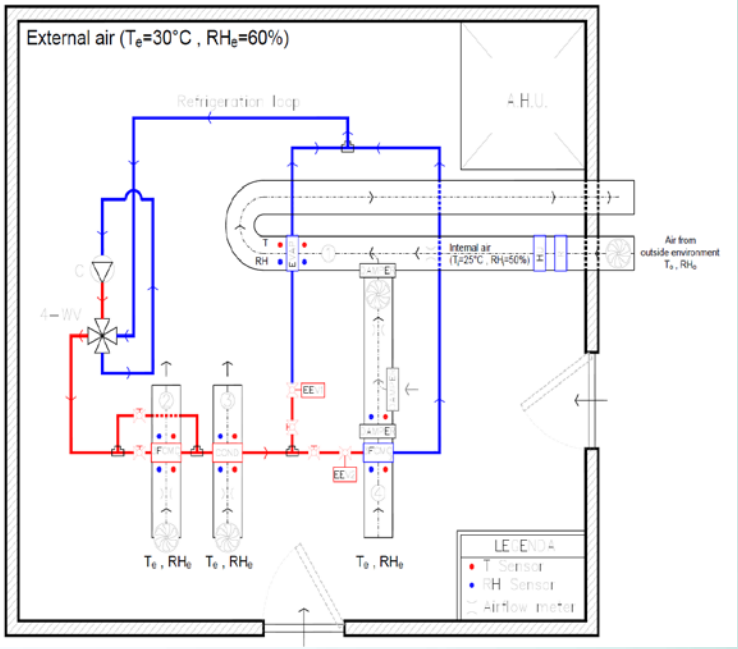
$$\varepsilon_h = \frac{\text{moist air enthalpy variation through 3F-CMC1}}{\text{moist air enthalpy variation for an infinite counter-current 3F-CMC1 surface}}$$



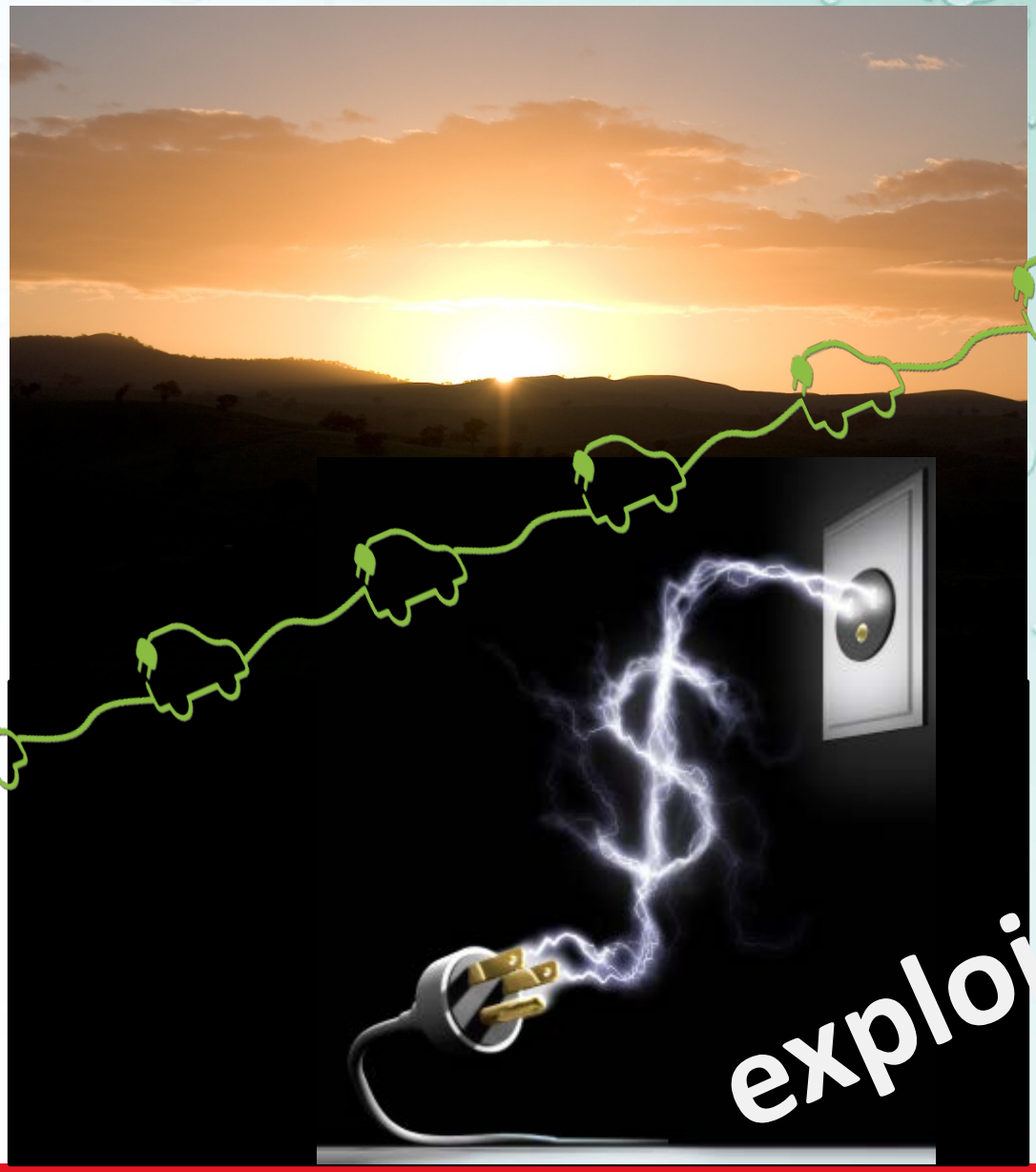
Tests in the lab







Visual summary of XERIC



30 %

patents

50 %

tation

Thank you for your kind attention!