XERIC

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Head WP5 / Dissemination - Communication

This project has received funding from the [European Union's Horizon 2020 research and innovation programme under grant agreement No 723970

Administrative information

This project has received funding from the European Union's Horizon 2020 research and innovation program : H2020 - GV - 2014 / GV - 2 - 2014 / RIA / GA n° 653605

Title : Innovative Climate-Control System to Extend Range of Electric Vehicles and Improve Comfort

Start Date: 1st June 2015 - Duration: 36 months
Budget : 4621280.00 € (Reimbursement rate : 100 %)

Project partners :

1. *GVS S.P.A. - Italy - Project Coordinator*
2. *TICASS SCRL - Italy*
3. *ITWM FRAUNHOFER - Germany*
4. *EUROPEAN MEMBRANE HOUSE aisbl - Belgium*
5. *FRIGOMAR SRL - Italy*
6. *UNIVERSITAT DUISBURG-ESSEN - Germany*
7. *VITO N.V. - Belgium*
8. *ASOCIACION DE LA INDUSTRIA NAVARRA - Spain*

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Questioning ?

Limited capacity of electric batteries

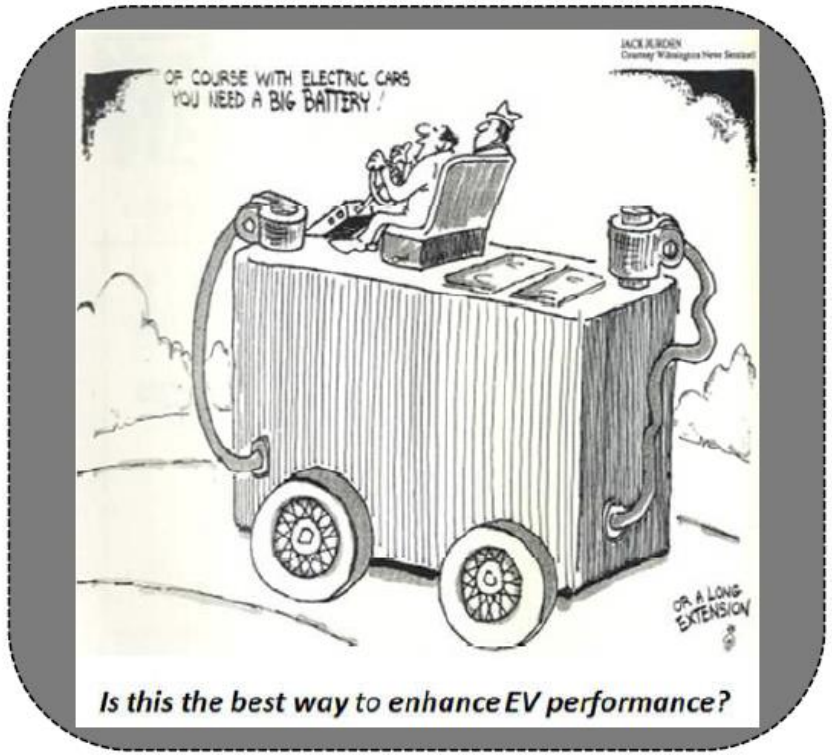
+

substantial amount of energy to run auxiliary equipment

=>

range capability of (EVs) dramatically affected.

(For instance, for the climate control system in summer conditions 40-60% of the available energy)



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Objective of the project

To develop an energy friendly climate control system capable to reduce drastically the energy used for passenger comfort (heating, cooling and dehumidifying) : summer or winter period in Europe but also in countries with more extreme climate conditions.

More specifically quantified targets:

- reduce more than 50% the energy for comfort,
- have a lifetime longer than 10 years,
- easy industrialization and customization,
- cost from 1,200 to 3,000 €

The core of the system : an innovative highly compact and energy efficient 3-fluids combined membrane contactor (3F-CMC) that simultaneously works with air, desiccant solution and refrigerant and whose concept is covered by very original patents belonging to consortium members.

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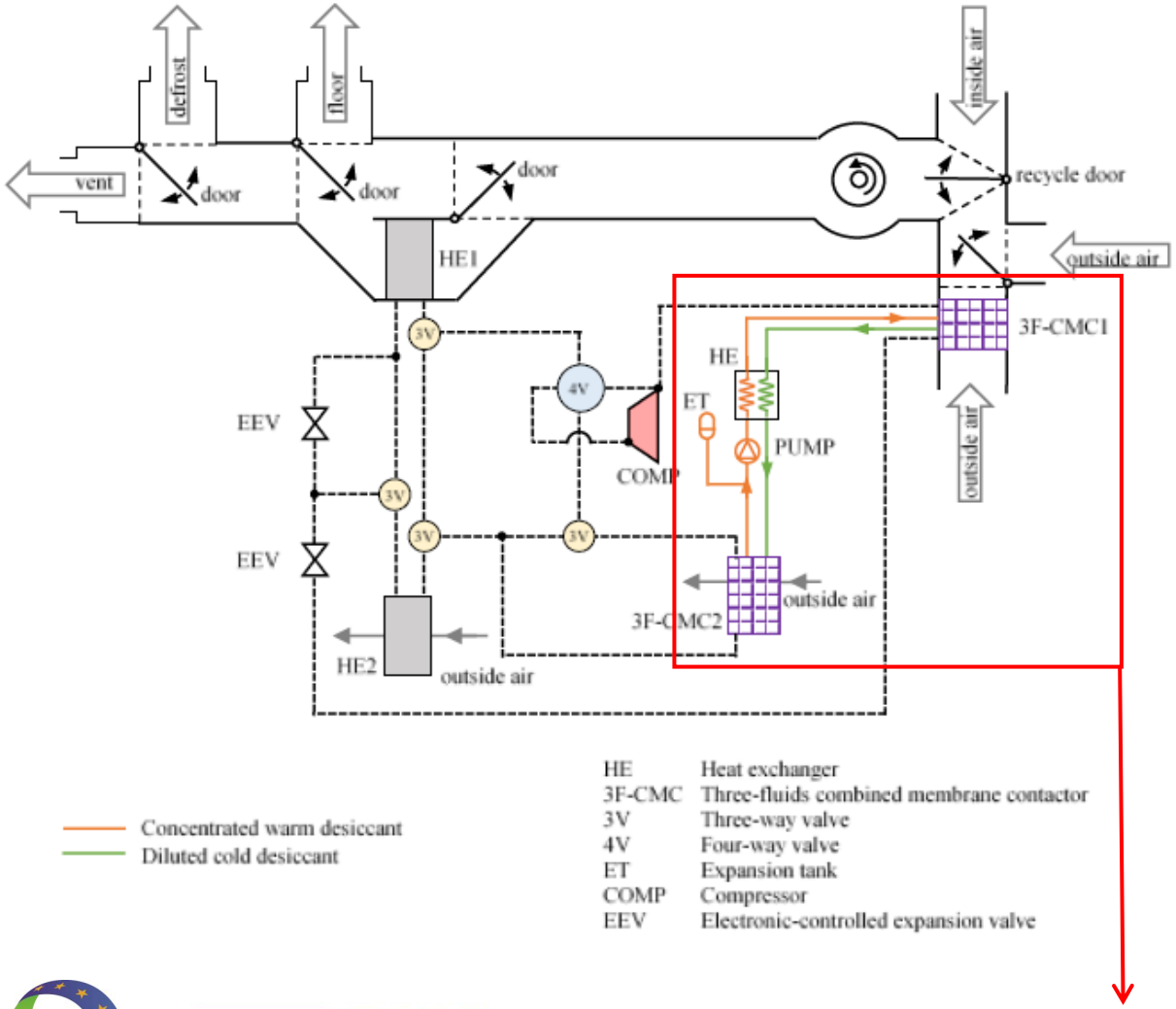
The whole system architecture

An Hybrid Air Conditioning systems, using a desiccant cycle to face the latent heat (air dehumification) and a Vapor Compression Cycle (VCC) to face the sensible heat (air cooling).

Major interest in comparison with traditional AC systems : the refrigeration cycle can operate at a higher evaporation temperature and at a lower condensation temperature (thermodynamics) !

=> Strong energy saving !



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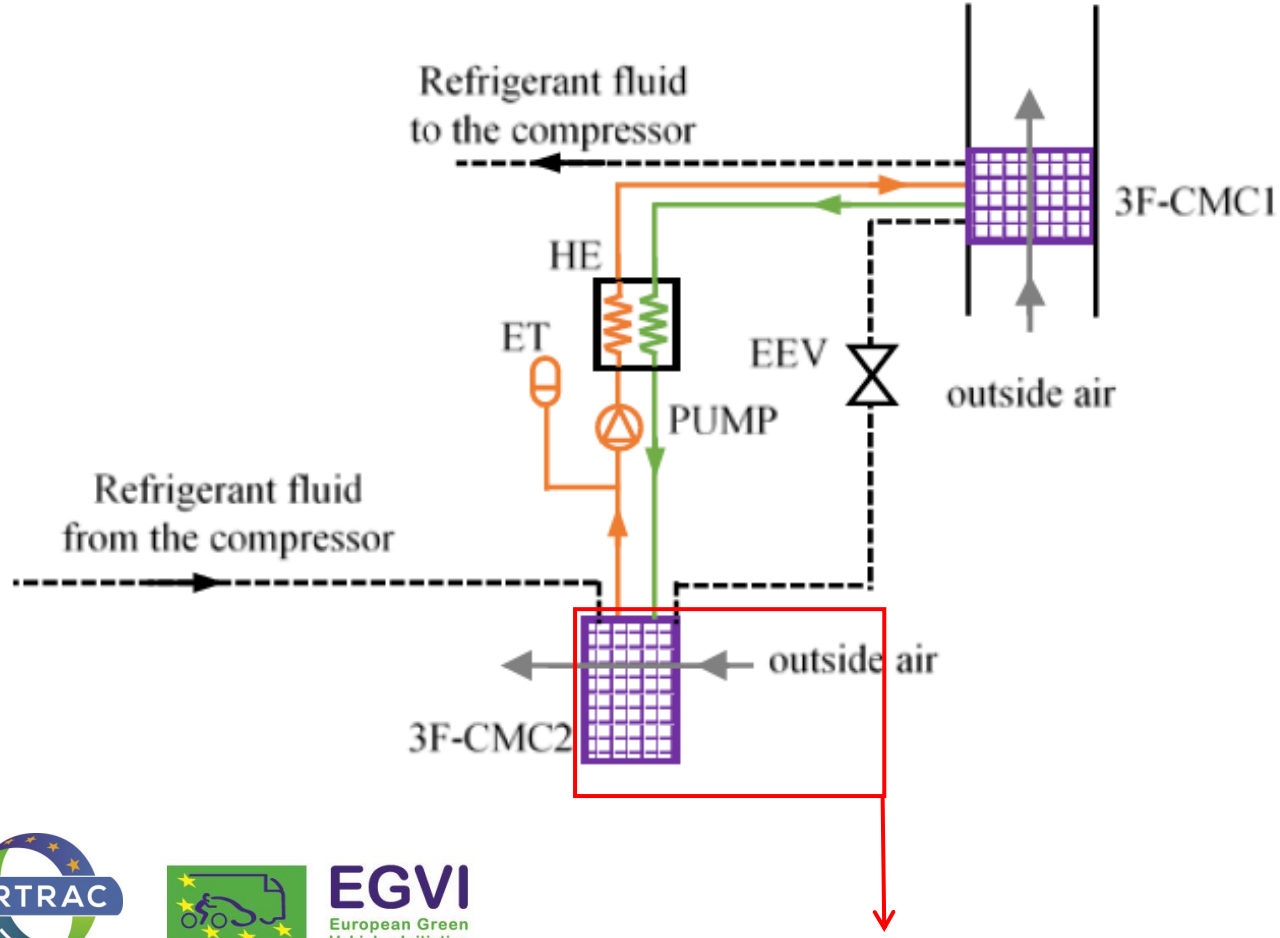
The desiccant loop with two 3F-CMCs.

3F-CMCs simultaneously are crossed by air (to be sent to passengers vane), an aqueous desiccant solution (to dehumidify air) and a refrigerant (to control the desiccant temperature and partly to cool the air). The desiccant is a salt aqueous solution (e.g. LiCl, CaCl2).

3F-CMC1 : used to dehumidify and to cool the process air for passengers' cabin

3F-CMC2 : regenerator to re-concentrate the weak solution from 3F-CMC1 by releasing vapor to an external air flow.



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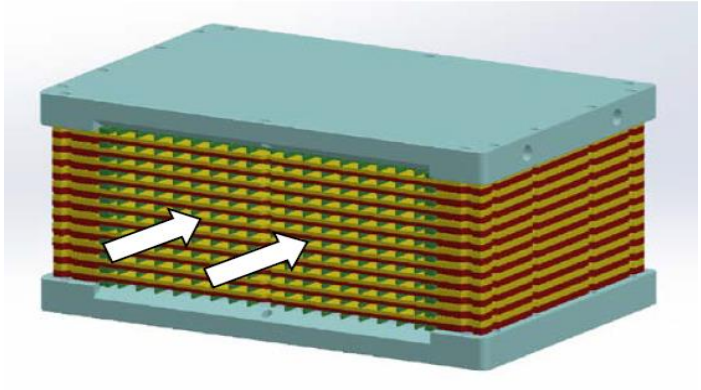
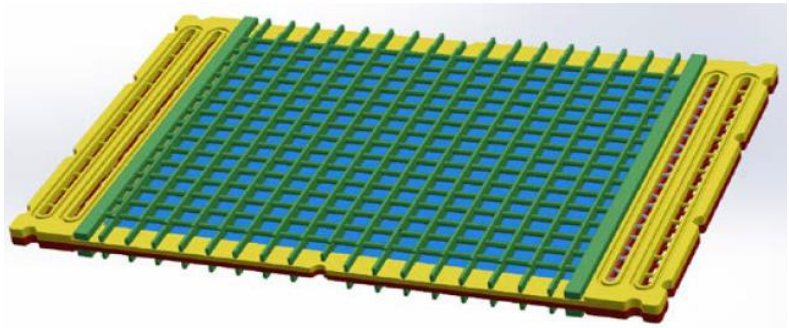
3F-CMC design

1 - CAD design of the 3F-CMC with inlet gaps through which the air flow takes place (white arrow)

2 - Desiccant (orange) and refrigerant (blue) flow in co-current/counter- current, in the direction transversal to the air stream

3 - Spacer made by longitudinal beams (yellow / red) to support the membrane (blue sheet) and to increase heat/mass transfer conditions (boundary layer) on the air side





Sensible and latent heat transfers between the air and the desiccant performed through a hydrophobic membrane permeable only to the vapor phase !

Refrigerant used to control the desiccant temperature and to maintain high mass transfer gradient.

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3F-CMC prototype

Stack of alternate sheets of spacers with membranes and mini-tube supports

Details of a spacer with membrane

Mini-tubes

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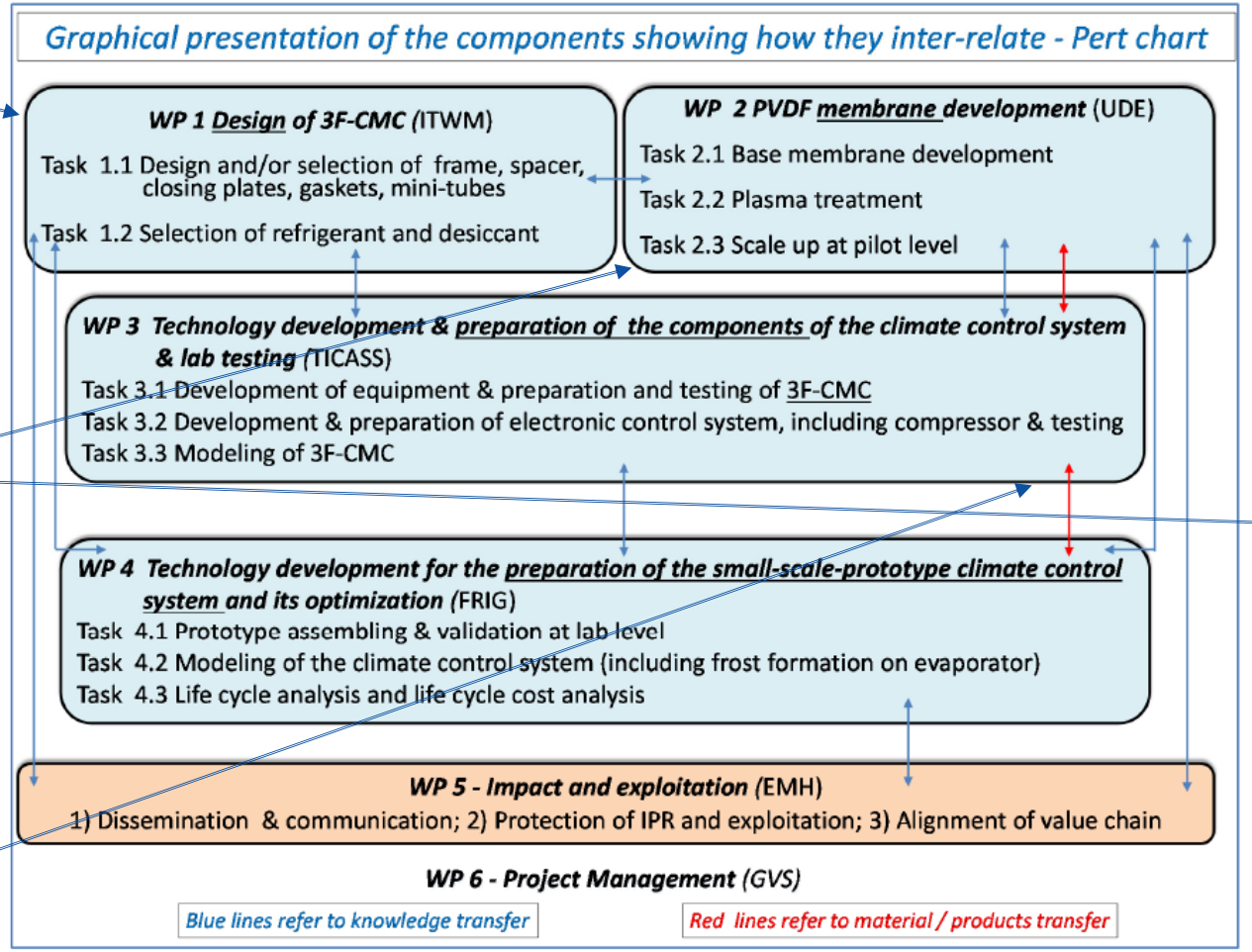
How do we relate to the program objectives?

WP1 is nearly completed (TICASS, UNIGE, ITWM)

Concerning membrane development (UDE, VITO, GVS), a test plan for the plasma treatment (VITO) of UDE and GVS membranes is running with an evaluation of modified membrane properties. Depending on results the plasma treatment will be further evaluated on large scale sample. Scale up at pilot level to prepare continuously flat membranes has been started at GVS.

A first 3F-CMC prototype sent to TICASS on the 28th of August 2017 to check the sealing of the "desiccant path" and to preliminary check the refrigerant path of the prototype at high pressure. Since these tests prove that the 3F-CMC performs according to anticipated objectives, a second prototype was prepared by GVS and sent to TICASS on 10th of October 2017.



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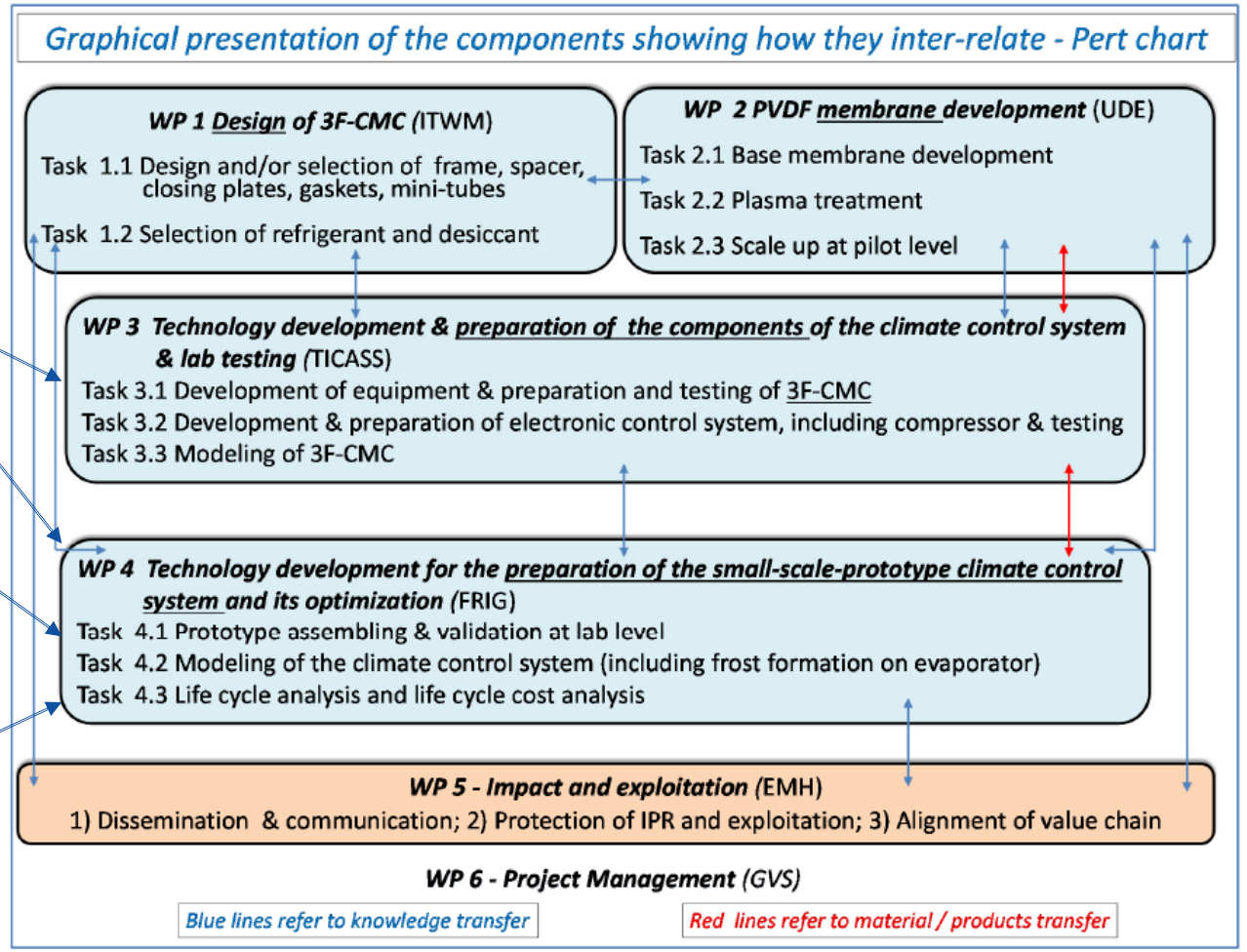
How do we relate to the program objectives?

All the Simulink blocks of each components of the XERIC system are now developed, tested and debugged. The next step : their connection and a complete simulation tool of the whole climate control system in order to forecast the XERIC energy performance (TICASS, UNIGE, ITWM).

About the Life Cycle Cost Analysis (AIN) : collecting information about costs, for the different life cycle phases: production, use and disposal /recycling.

Tests conducted by Frigomar with its modified climatic chamber for normal conditions, or in relation with climatic chambers of third parties at extreme summer conditions (external air T=30°C and RH=60%) and extreme winter conditions (external air T=-5°C and RH=60%).



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Communication - Impact - Exploitation - Networking

- **A website regularly updated , brochures and bi-annual newsletters distributed to more than one hundred people. XERIC database : 160 representatives of which 25% industry, 65% universities, and 10% others**

- **An official twitter account created and regularly fed for the project following the recommendation of the General Director of EU Research: @XERICproject**

- **Organization of 3 industrial workshops with the participation of JOSPEL and OPTEMUS (Clustering)**
  - 1st workshop :“Improving energy efficiency in electric vehicles” - November 24, 2016 in Bologna, IT. More than one hundred participants coming from 11 countries. 13 presentations, cross participations in B2B meetings, new professional contacts.
  - 2nd workshop : “Electric Vehicles and Renewable Energy” - April 11-13, 2017 in Monaco (EVER 2017) - April 11-13, 2017 . 2 Awards deserved : Best Session (EMH) and Best Paper on Ecological Vehicles (Carlo ISETTI et al.)
  - 3rd workshop – “Breakthrough technologies in climate control systems” - November 23- 24, 2017 during the Genoa Smart Week in Italy.

- **Patent Analysis and Mapping (PAM) document already produced => Preparation of an “Exploitable Result Chart” to bring innovative research to the market; listing of internal (or external) agreements for further exploitation of the XERIC results ; alignment of the value chain => Towards an Exploitation Strategic Agreement for the period after the end of XERIC as announced in the CA (Project officer from the EMH with the support of a specialized lawer**

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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	

Fig. 20 - Outline of the stages of the project from the preliminary idea to the expected commercial exploitation

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Communication-Networking-Exploitation-Impact

- Following the Pilot Call for Common Dissemination Booster (CDB) published end of June by the EU, XERIC, JOSPEL and OPTEMUS have prepared a joint application for benefiting from three services around the thematic "Energy efficiency for electric vehicles":
  - Portfolio Identification Service
  - Stakeholders/End-user mapping
  - Portfolio Dissemination Plan Development

  Applications have been accepted and the CDB group should start with the services during the 1st semester 2018.

- The project has also positively answered to the invitation of INEA to be part of the European Commission's Exhibition Stand in the frame of the Transport Research Arena (TRA) VIENNA 2018.

- Keep also in mind that the "Innovative Climate-Control System (developed within XERIC) to Extend Range of Electric Vehicles and Improve Comfort" would have the capacity to be easily extended to other important markets which represent major environmental and societal issues such as non-electric vehicles and other transport systems , building industry…

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