



**Carbon  
4 Retail  
Refrigeration**

*Natural Technologies  
for Sustainable Retail*



*Life C4R project has received funding  
from the European Union under grant  
agreement n° LIFE 17 CCM/IT/000120*



LIFE Project Number  
**LIFE17 CCM/IT/000120**

**Final Technical Report**

**Covering the project activities from 02/07/2018 to 01/07/2021**

Reporting Date  
**01/10/2021**

LIFE PROJECT NAME or Acronym  
**LIFE C4R**

Data Project

|                               |                       |
|-------------------------------|-----------------------|
| <b>Project location:</b>      | Italy, Romania, Spain |
| <b>Project start date:</b>    | 02/07/2018            |
| <b>Project end date:</b>      | 1/7/2021              |
| <b>Total budget:</b>          | € 2,583,226           |
| <b>EU contribution:</b>       | € 1,506,392           |
| <b>(%) of eligible costs:</b> | 60                    |



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Data Coordinating Beneficiary

|                                       |                                              |
|---------------------------------------|----------------------------------------------|
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## 1. Table of contents

## 2. List of key-words and abbreviations

|                   |                                                                            |
|-------------------|----------------------------------------------------------------------------|
| PC                | Project Coordinator                                                        |
| MB                | Management Board                                                           |
| FTE               | Full Transcritical Efficiency                                              |
| ETE               | Extreme Temperature Efficiency (product name, same as SUBCO <sub>2</sub> ) |
| BOM               | Bill of Material                                                           |
| DAI               | Request of Investment (Domanda Autorizzazione Investimenti)                |
| RDA               | Request of Purchase (Richiesta di Acquisto)                                |
| LCA               | Life Cycle Analysis                                                        |
| LCCP              | Life Cycle Climate Performance                                             |
| EOL               | End Of Life                                                                |
| CO <sub>2</sub>   | Carbon dioxide                                                             |
| DIRECT EMPLOYMENT | Employment directly by the refrigerator companies                          |
| EU                | Europe                                                                     |
| GHG               | Greenhouse gas                                                             |
| GWP               | Global warming potential                                                   |
| HCFC              | Hydrochlorofluorocarbon                                                    |
| HFC               | Hydrofluorocarbon                                                          |
| HPV               | High pressure valve                                                        |
| KPI               | Key performance indicator                                                  |
| LT                | Low temperature                                                            |
| M                 | Million                                                                    |
| MT                | Medium temperature                                                         |
| NR                | Natural refrigerant                                                        |
| SEA               | Socio-Economic assessment                                                  |
| SROI              | Social return on investment                                                |
| T                 | Ton                                                                        |
| WTP               | Willingness-to-pay                                                         |
| MTR               | Midterm report                                                             |



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## Executive Summary

The LIFE C4R project demonstrated the feasibility and efficiency of an innovative technological solution able to hugely impact GHG emissions and particularly HFCs reduction. The project focussed on the commercial refrigeration sector providing future R&D and market replication activities with the possibility to enlarge the field of application of such a technology even to cold transportation, households, industrial buildings, and others.

The LIFE C4R novel solution allows to combat climate change in the commercial refrigeration sector by replacing HCFC (hydrochlorofluorocarbon) and HFC (hydrofluorocarbons) greenhouse refrigerants with CO<sub>2</sub>, a natural, non-toxic, non-flammable fluid, additionally providing a substantial energy saving in a simple, efficient and reliable manner and at any latitude and temperature.

**Specific Objectives** are:

### Technical Objectives:

- High efficiency at all temperatures with no limits, not only at temperatures lower than 30°C
- Improved efficiency, minimum of 10% energy savings in commercial refrigeration systems in any country, with any external temperature
- Limited costs of equipment and controls, savings up to 30% compared to the current solution

### Environment Objectives:

- Reduce energy consumption of the refrigeration system by a minimum of 10% (up to 14%)
- Reduce refrigerant GWP to 1
- Reduce carbon footprint over the entire value chain based on a Life-Cycle climate performance (LCCP) approach
- Reduce EU GHG emissions by at least 1.5%

### Policy Objectives:

- To create an industrial standard that supports policy makers to further push the use of energy efficient natural refrigeration systems
- To perform several pilot projects in different EU Countries to stimulate the further uptake of this technology across Europe



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- To promote the conversion from the existing refrigeration solutions to new SIMPLE, GLOBAL and RELIABLE natural solutions for commercial retail

The initial phase of the C4R project has been dedicated to the industrial development of the C4R technologies starting from the tests performed by EPTA in laboratory.

LIFE C4R solution has been piloted first in Italy with 3 installations and then replicated directly in 4 retail stores in Romania and in Spain.

These different locations were required to make reliable verification of performances by changing three main parameters:

1. Size of the store, from 1000 to 6000 sqm
2. Climate conditions, from moderate to very hot
3. Different markets, which means habits, knowledge, skills, etc.

These pilots were needed to champion the performance and the energy efficiency also in harsh environments in order to prove their capability to stand any European climate or market situation.

The extensive observation of the pilots showed that the combined use of FTE 2.0 and ETE allows a reduction in the annual energy consumption ranging from 15% to 23%.

The data collected in real working conditions helped to model and forecast the behavior of the same system technologies applied under different conditions, allowing precise estimations to be used as a supporting tool in the sales and for the market uptake of the solution.

A full LCA analysis of the greenhouse gas emissions of the C4R technologies has been performed according to the standards of Life Cycle Climate Performance (LCCP).

The LCCP assesses the environmental aspects and potential impacts in terms of Greenhouse Gas (GHG) emissions associated with the technology through all stages of its life cycle, from “cradle” (refrigerant and product manufacturing), through use (energy usage), to “grave” (recycling and disposal).

The expected benefits described in the LIFE C4R project have been confirmed, and the LCA analysis has demonstrated that the proposed innovation exceeds the targeted reduction of electricity consumption and ensures a reduction of the impact on the environment in terms of CO<sub>2</sub>eq emissions of up to about 20%.

The LIFE C4R project achievements have been disseminated to stakeholders, academia, policy makers and the general public with a particularly intense communication activity including advertising videos, in-store communication, social media and newsletters, trade fairs, in-house



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events, conferences and of course 1-to-1 meetings with clients, contractors, service companies, engineers, consultants, etc.

We estimate that during the LIFE C4R project we have succeeded to reach 217.400 laymen individuals via dissemination and awareness raising activities (notice boards in the pilot stores and at our facilities/offices, magazines, international fairs and events, people in contact with our contact centers, readers of our online publications and social networks, etc.), and we plan 400.000 in total in 3 years.

Besides we have reached 13.735 people with the C4R website, 200 NGOs and relevant key decision stakeholders, 250 professional experts in our field, and 200 members of interest group and lobby organizations by means of 90 articles in print media, 100 different videos, broadcast, leaflets, 500 information contact centers created, 20 events and exhibitions participated and/or organized, 40 printed notice and information boards.

In particular key customers, contractors, service companies, industry associations and policy makers from all over Europe have been engaged in order to foster a wide spreading of knowledge and fast adoption of the technology after the project end in order to ultimately make the C4R technologies the new industrial standard for the future in commercial refrigeration across Europe.

Besides the planned 7 pilots, additional 20 systems have been activated in several European countries and many more outside Europe, along with more than 100 commercial proposals for new installations. Yet the COVID-19 outbreak in February 2020 and the associated measures (lockdown, travel bans, restrictions on meetings, etc.) in place since then have delayed the commissioning of some of the pilots and limited the business opportunities for market uptake.

The C4R project shed a light on the future possibility to scale up these specific CO<sub>2</sub> technologies achieving a total energy saving in Europe of 94.8 TWh/yr, or 39 million CO<sub>2</sub>eqT (the CO<sub>2</sub> emissions of entire Belgium), while phasing out HCFC and HFC greenhouse gases.

The project focus was on the commercial refrigeration sector, yet it exists the possibility to enlarge the field of application to cold transportation, households, industrial buildings, and others.

The socio-economic analysis performed highlighted several LIFE C4R socio-economic impacts including economic growth and competitiveness of the EU commercial refrigeration equipment sector, job creation, safety increase in retails, impact on policy regulations at EU and national level.

Special efforts during the project were given to the multiple policy impacts of the project, especially in the



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European masterplans and regulations related to the carbon emissions from the cooling sector, i.e. refrigeration and air conditioning products and systems, which are strong emission contributors with the energy consumption of products and systems, and the use of climate impacting HFCs.

The European Green Deal is raising the EU climate ambition, and committing EU to net greenhouse gas emission reductions of at least 55% by 2030, and climate neutrality by 2050.

This means for EU countries to cut emissions, invest in green technologies and protect the natural environment. Rapidly reducing emissions from the cooling sector is more and more nowadays perceived as a major challenge.

As the EU is reviewing all its climate relevant rules in this precise moment, we have performed an intense lobbying actions to introduce the contribution of C4R, in the frame of:

- The 2014 EU F-Gas Regulation (EU) 517/2014, set to phase down the use of HFCs, by 79% by 2030 – its Review is expected in 2023, and will set a migration path to natural refrigerants
- At member state level as some EU Countries have an HFC tax in place already, namely Denmark, Norway and Spain
- The Ecodesign (EU) 2019/2024 and Energy Labelling (EU) 2019/2018 Regulations for commercial and professional refrigeration products, that create a selection of products and systems according to their energy performance and environmental impact
- New ISO/EN technical standards to guarantee the quality and environmental performances of the products circulating in the EU market
- At national level in our country, where fluorinated gases represent 4.4% of the total greenhouse gas emissions in terms of CO<sub>2</sub> equivalent in 2019 and where HFCs show an exponential increase between 1990 and 2019, from 0, 4 to 16.8 millions of CO<sub>2</sub> equivalent tons (MCO<sub>2</sub>eqT), thanks to the C4R project, we are advocating a structural program of retrofitting the existing highly climate-impacting commercial refrigeration systems with modern natural refrigerant technologies and improved energy efficiency, reaching a very good consensus at the Italian political level (Government, Parliament, Institutions).

Similar plans are also put in place in other continents that have followed the European environmental supremacy.

In the United States the Clean Energy Revolution and Environmental Justice Plan (US Green New Deal), targeting 100% clean energy and net-zero emissions by 2050 recommitted the US to the Paris Agreement on



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climate change. The AIM Act has directed EPA to phase down the production and consumption of HFCs by 85 percent over the next 15 years and several states adopt HFC use limits (California, New Jersey, Washington, Colorado, Virginia and Vermont).

In Asia most of the countries have ratified the Kigali Amendment, including China, India, Russia, Australia, New Zealand, etc., committing to start phasing down HFCs consumption by 85% by 2036, and have National Cooling Action Plans that are key drivers of natural refrigerant solutions and setting increased stringency of Minimum Energy Performance Standards (MEPS).

Therefore, the plans to phase out the climate impacting technologies replacing them with efficient and natural refrigerant based systems are global, hence the C4R project can accompany the transition to sustainability in commercial refrigeration worldwide.

The climate impact of the cooling equipment, including refrigerators and air-conditioners, is two-fold: they use huge amounts of electricity and often rely on super greenhouse gases.

F-gases or fluorinated gases, i.e. HFC refrigerants in commercial refrigerators, air conditioners and heat pumps have a significant impact on our climate: in the past they were responsible for depleting the ozone layer (today the ozone-depleting substances are banned), and today they are responsible for the current climate crisis, rapidly becoming the fastest-growing source of GHG emissions.

For this reason, the F-Gas Regulation (EU 517/2014) on fluorinated greenhouse gases, which took effect in 2015, limits the total amount of F-gases that can be sold in the EU phasing them down in steps to one-fifth of 2014 sales in 2030, bans the use of F-gases in many new types of equipment like supermarket refrigerators and freezers, air conditioning equipment and aerosols, and prevents emissions from existing equipment by requiring checks, proper servicing and recovery of the gases at the end of the equipment's life. The F-Gas Regulation is currently under Review process and is expected to raise its ambitions in response to the climate crisis.

CO<sub>2</sub> is a natural, non-toxic, non-flammable fluid, with the minimum GWP 1, i.e. nearly 4000 thousand times lower than the primary refrigerant used in the last 12 years.

As a matter of fact, CO<sub>2</sub> is and is perceived in the market as a fully environmentally friendly and safe refrigerant, compliant with the current and future legislation, and all environmental policies for fighting climate change.



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The heart of the project is the FTE system technology in its 2.0 version, that allows to fully replace old refrigerants with CO<sub>2</sub> in a simple, efficient and reliable manner, in any climate situation anywhere in the world.

Mechanically the FTE system operates with the same type of components as a basic CO<sub>2</sub> system, but it is much more efficient thanks to a better use of the heat exchangers located inside the medium temperature cabinets of the food store that are used to preserve and display the fresh food.

In the traditional refrigeration systems a part of the heat exchanger surfaces is dedicated to transfer additional heat to the refrigerant after its complete evaporation to avoid the presence of liquid sucked in by the compressors of the power rack that would irreparably damage them, and this introduces a considerable waste of energy and greater compression work.

In the FTE technology the heat transfer occurs along the entire length of the evaporator and the excellent heat transfer given by the liquid refrigerant results in a significant increase in performance and huge energy savings. The mixture of steam and liquid that results at the outlet of the heat exchangers is separated by gravity inside a liquid separator, called FTE module, and the accumulated liquid is directly supplied to the low temperature cabinets used for frozen food.

The optimal efficiency of the system is granted always, in summer and in winter, day and night, 365 days a year, and in any geographical area, because it does not depend on the external ambient temperature.

The key advantages are the simplicity, because the heat exchangers are used in an optimal way without the need of any sophisticated component, so it does not add considerable costs or complication, and its performance independent of the external temperature.

ETE is designed to complement FTE at extreme temperature conditions, as it supersedes the limits of CO<sub>2</sub> systems at temperatures well above 40°C, where generally it shows a decline in performance and an enormous increase in consumption.

It is a mechanical subcooling system, i.e. a system capable of helping the gas cooler to cool the refrigerant before its expansion in the high pressure valve, working with refrigerant CO<sub>2</sub>, fully integrated into the refrigeration power rack. ETE is automatically activated at the desired external ambient temperature in summer and allows the system to function and perform as if the external temperature were 10-12°C lower.

The expected benefits of the C4R technologies market uptake are:

- Environmental, a dramatic reduction of the polluting CO<sub>2</sub> emissions



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- Economic, as the energy savings, performances, environmental impact and return of investment of the proposed C4R technologies makes the C4R solution beneficial across all Europe, at any latitude and every climate
- Modernization of the food distribution network
- Free from the operating costs and bureaucratic burdens related to the use of HFCs
- The prices of natural refrigerants are low and stable, whereas HFCs' price has increased enormously (especially R404A, + 700% compared to 2018)
- Stop the illegal trade of HFCs
- Positive impacts on jobs creation, social wealth, European industry competitiveness, etc.

The market uptake of the LIFE C4R technologies, with the use of natural refrigerant CO<sub>2</sub> instead of climate altering HFCs and the increase in energy efficiency, can effectively support the transition towards the climate neutrality in the commercial refrigeration sector in Europe and worldwide.



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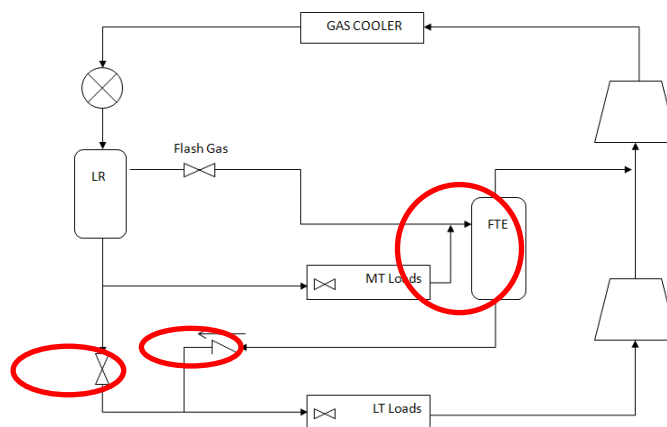
## 4. Technical Actions

### 4.1 C4R industrialisation stage

The task of this action was to realize the industrial development of FTE2.0 and SUBCO<sub>2</sub>:

- perform thermodynamic calculations for industrialisation of the production process;
- realise drawings of specific components and of sub-assembly integrated in the current product range of cooling packs;
- realise the mechanical design of the LIFE C4R FTE2.0 and SUBCO<sub>2</sub> prototypes;
- modify bill of materials (BOM) for the industrial stage;
- define manufacturing methods, tools and tests for factory serial production;
- obtain certification of compliance to standards required by PED, LVD, MD and EMC EU directives.

The FTE2.0 main components which needed to be sized and interfaced are indicated:



The task was to integrate the FTE technology (described in Chapter 4) in the power rack:

- Mechanically (one tank instead of two);
- Electrically (one board instead of two);
- Electronically (programmable controller instead of electromechanical).



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We have decided to achieve the tasks using a unique containing element for the refrigerant (for both liquid receiver and FTE module) and a dedicated Epta made controller.

The advantages of this technical approach are:

- FTE technology improved with a programmable controller instead of an electromechanical one
- Space of installation optimized locating the FTE 2.0 inside the power rack
- Efficiency increased thanks to new programmable features
- Reliability increased, as all the components are assembled and tested at factory
- Installation time reduced
- Space occupied in the technical room reduced

We have selected and industrialized FTE liquid modules (85 and 150 liters) to cover the entire range of cooling capacity from 30kW to 200kW refrigeration, eventually using multiple modules. Based on these two industrial equipment designs, two prototypes of the FTE2.0 system have been realised and certified.

We also succeeded to meet the specifications of the dedicated programmable controller:

- One neutral platform, independent of the control brand/type of the store
- Small dimensions
- Able to interface with supervision and telemonitoring system
- Two levels of access
- Smartphone and tablet mobile devices compatible
- Integrated in the main pack control board.

Additionally we were able to test and verify the following features:

- Programmable controller tested in the field with Carel and Danfoss supervisor systems
- Implementation and field test of the basic and the advanced software logics in PLC;

Similarly, the ETE main components which needed to be sized and interfaced are indicated:

- Evolution of the traditional HFC-based subcooling technology



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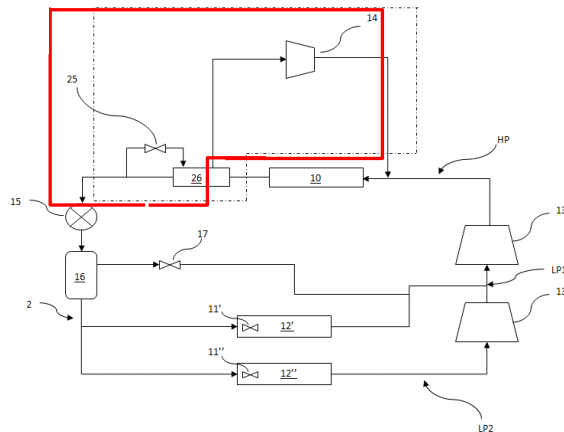
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- The proposed technology is 100% natural refrigerant based (CO<sub>2</sub>)
- Fully integrated in the basic transcritical CO<sub>2</sub> system.

The ETE module is composed of four basic elements: compressor, heat exchanger, EEV, controller.



The advantages of the ETE technology are:

- Efficiency of the system increased with high external ambient temperatures
- Allows the CO<sub>2</sub> transcritical system to operate reliably with Text > 42°C and up to 50°C;
- Energy saving
- Supersedes the limits of CO<sub>2</sub> systems at temperatures above 40°C, where generally CO<sub>2</sub> systems show a decline in performance and an enormous increase in consumption
- Solves the technical issues of high pressure and high compressor discharge temperature high ambient temperature conditions

The ETE range has been developed in three sizes (from 10 kW to 80 kW refrigeration capacity) and integrated in the EPTA power rack product range. Three prototypes of the ETE system have been realised and certified in the product development phase.

Both the FTE2.0 and ETE systems are certified compliant with all the applicable standards required by PED LVD MD EMC UE directives.



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*CO2 transcritical power rack for medium-small stores with integrated FTE2.0*



*CO2 transcritical power rack for medium-large stores with integrated FTE2.0 and ETE*



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The EPTA IT production plant in Limana (BL) has been redesigned to guarantee the industrial production of FTE2.0 and ETE at the expected increased supply volumes.

Two FTE2.0 prototypes and three ETE prototypes have been manufactured with factory serial production and certified to guarantee readiness to start mass industrial manufacturing.

In particular, in order to achieve the C4R market uptake and greenhouse gas emissions (GHG) reduction targets we have invested in new industrial equipment that has been installed in the final test area for full volume production.

Besides a new pressure testing safety room for CO<sub>2</sub> transcritical systems, we have purchased, installed and commissioned an advanced automatic cutting machine for cutting the insulation material, important part of the FTE2.0 module, at high speed.



CO2 advanced automatic cutting machine for FTE2.0

The LIFE C4R solution is now optimised for high reliability and performances and the industrialized design needed for the market uptake. Methods for factory serial production been developed to react to customers' requests and to increase in volume with no latency.



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## 4.2 C4R Pilot realisation and validation in Italy

Although only two pilots were foreseen in Italy, we have decided to perform three off C4R Pilots in real store conditions in Italy, in order to assess the performance resulting from each FTE2.0 and ETE individually and then the synergy resulting from both applied together.

### 1<sup>st</sup> pilot project:

Retail: Conad Centro Nord

Location:, Carpenedolo in the North of Italy.

Reasoning behind the choice of this store: ideal because of the climatic profile of the lower Po Valley, which has high maximum summer temperatures (up to 40°C).

Technology implemented: FTE2.0 (Full Transcritical Efficiency)

Results achieved: With the pilot of Carpenedolo it was demonstrated the capability of the FTE technology to reduce the energy consumption of the system constantly and independently by external temperature (due to the very different external conditions from December to April). The reduction of average pack consumption was about 13% during the whole period analysed (at least 10% expected as project KPI). Compared to the same store with state-of the art CO<sub>2</sub> technologies (i.e. without the use of LIFE C4R innovations), the Carpenedolo store ensured:

- a saving of **16,999kWh/year**, equal to **18,417 washing machine cycles**;
- a yearly **money savings** for the store of 2,132€ thanks to energy savings;
- **a saving of 5tCO<sub>2eq</sub>/year**, as calculated by LCCP analysis.

### 2<sup>nd</sup> pilot project:

Retail: Iperconad

Location: Bologna in the North of Italy.

Reasoning behind the choice of this store: very warm area in summer, the Client is very much oriented to green technologies, so he is keen on being part of the C4R project and test the latest technologies of natural refrigeration.



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Technology implemented: ETE (Externe Temperature Efficiency)

Results achieved: With the pilot of Bologna, it was demonstrated the capability of the technology to reduce the energy consumption of the system of 17% when the external temperature is above ~26 °C. The reduction of annual pack consumption is 8%, compared with the same system layout but without the sub-cooling benefit. In total, **the plant of Bologna** ensured:

- a saving of **16,000kWh/year**, equal to **17,334 washing machine cycles**;
- a yearly **money savings** for the store of 2,006€ thanks to energy savings;
- **a saving of 4tCO<sub>2eq</sub>/year**, as calculated by LCCP analysis.

### 3<sup>rd</sup> pilot project:

Retail: Magazzini Gabrielli

Location: store in Perugia in the central part of Italy.

Reasoning behind the choice of this store: area with very low temperature in winter and very hot temperatures in summer, the ideal situation to prove the improvement of efficiency all year round, i.e. to prove that FTE2.0 is beneficial also in the coldest climate temperature vs a standard solution.

Technology implemented: FTE2.0 (Full Transcritical Efficiency) and SUBCO<sub>2</sub> - ETE (Extreme Temperature Efficiency)

Results achieved: With the pilot of Perugia, we have demonstrated the capability of the technology to reduce the energy consumption of the system constantly independent by external temperature (very different external conditions January/July/September).

The reduction of average pack energy consumption due to the effect of the FTE2.0 technology alone, activated all year round, is about 13% compared to the same system layout but considering an evaporation MT pressure less of 4 bar (average).

In summer period, when the external temperature is above 27 °C the energy saving is further increased thanks to the ETE activation. This second technology through the sub-cooling effect permits the further reduction of energy consumption of the MT compressors thanks to the strongly decrease of production of flash gas. The average reduction, in summer period, of pack consumption is about 18%, comparing with the same system layout but without the sub-cooling benefit, equivalent to an annual (extrapolated) energy



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saving of 8%.

The combined effect of the FTE2.0 and ETE technologies in summer time is to ensure a huge energy saving compared to a basic CO<sub>2</sub> transcritical system, which is an extraordinary result that allows to consider C4R extremely beneficial for all countries with severely hot ambient conditions in summer time, that is to say that the old “CO<sub>2</sub> equator” is completely erased with new modern C4R technologies.

Considering both FTE2.0 and ETE technologies applied, the combined annual energy saving achieved in the pilot in Perugia is 21% (13% from FTE2.0 + 8% from ETE), i.e:

- a saving of **55,000kWh/year**, equal to **59,584 washing machine cycles**;
- a yearly **money savings** for the store of 6,897€ thanks to energy savings;
- a **saving of 15tCO<sub>2eq</sub>/year**, as calculated by LCCP analysis.

### Final results and considerations on the 3 pilot projects in Italy

- Considering the first and third pilots (Carpenedolo and Perugia) we confirm that the FTE2.0 technology ensures an annual energy saving of about 13% compared to a standard CO<sub>2</sub> transcritical system all year round
- Considering the second and third pilots (Bologna e Perugia) we confirm that the ETE technology ensures a minimum additional energy saving of about 17% in the period when the external temperature is above 27 °C, i.e. when the ETE is activated, equivalent to an annual (extrapolated) energy saving of 8% (considered as relevant as the C4R targets are expressed on annual base).

### FTE2.0

| INDICATOR OF PROGRESS           | REAL RESULTS CARPENEDOLO              | REAL RESULTS PERUGIA                  |
|---------------------------------|---------------------------------------|---------------------------------------|
| Energetic Efficiency            | +13%                                  | +13%                                  |
| FTE2.0. Running                 | >8760 hours<br>(commissioned 05-2019) | >8760 hours<br>(commissioned 12-2019) |
| Energy saved at least 6 months  | 11 MWh/yr                             | 22 MWh/yr                             |
| Energy saved at least 12 months | 16 MWh/yr                             | 33 MWh/yr                             |



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### ETE

| INDICATOR OF PROGRESS                | REAL RESULTS BOLOGNA | REAL RESULTS PERUGIA |
|--------------------------------------|----------------------|----------------------|
| Energetic Efficiency (annual impact) | +8%                  | +8%                  |
| Degree of average sub-cooling        | 19 K                 | 17 K                 |
| Working hours                        | 77% (*)              | 92% (*)              |
| Energy efficiency at least 6 months  | 16 MWh/year (**)     | 21 MWh/year (**)     |
| Energy efficiency at least 12 months | 16 MWh/year          | 21 MWh/year          |

(\*) ETE theoretical working hours are hours in which external temperature is above 27°C.

(\*\*) considering summer period. ETE is the technology developed to increase energy saving in hot climate.

### TOTAL

| INDICATOR OF PROGRESS                | GRANT AGREEMENT | REAL RESULTS |
|--------------------------------------|-----------------|--------------|
| Energetic Efficiency FTE2.0          | +9-14%          | +13%         |
| Energetic Efficiency ETE             | +6-12%          | +8%          |
| Degree of average sub-cooling        | 1-3 K           | 18 K         |
| FTE2.0. Running                      | >8000           | >8760 hours  |
| Working hours ETE                    | >80%            | 85% (*)      |
| Energy efficiency at least 6 months  | 34 MWh/year     | 70 MWh/year  |
| Energy efficiency at least 12 months | 68 MWh/year     | 86 MWh/year  |

(\*) ETE theoretical working hours are hours in which external temperature is above 27°C.

In particular analyzing the behavior of the C4R technologies applied individually and simultaneously we have been able to prove that there is no mutual impact, i.e. FTE2.0 does not influence the function of ETE, and viceversa. The positive effects on reliability, performance and efficiency of the single technologies are complementary and apply without any mutual impact.



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### 4.3 Replication Pilot realisation and validation in Romania

LIFE C4R solution has been piloted first in Italy with 3 installations and then replicated directly in 4 retail stores in Romania and in Spain.

These different locations were required to make reliable verification of performances by changing three main parameters:

1. Size of the store, from 1000 to 6000 sqm
2. Climate conditions, from moderate to very hot
3. Different markets, which means habits, knowledge, skills, etc.

These pilots were essential to champion the performance and the energy efficiency also in harsh environments in order to prove their capability to stand any European climate or situation.

The data collected in real working conditions helped to model and forecast the behavior of the same system technologies applied under different conditions, allowing precise estimations to be used as a supporting tool in the sales and business activity.

#### **1<sup>st</sup> replication project:**

**Retail:** Auchan

**Location:** store in Timisoara in the Western part of Romania.

**Reasoning behind the choice of this store:** area with very low temperature in winter and very hot temperatures in summer, the ideal situation to prove the improvement of efficiency all year round, i.e. to prove that FTE2.0 is beneficial also in the coldest climate temperature vs a standard solution.

**Technology implemented:** FTE2.0 (Full Transcritical Efficiency) and SUBCO<sub>2</sub> - ETE (Extreme Temperature Efficiency)

**Results achieved:** With the pilot of Timisoara, we have demonstrated the capability of the technology to reduce the energy consumption of the system constantly independent by external temperature (different external conditions June/December/March).

The reduction of average pack energy consumption due to the effect of the FTE2.0 technology alone, activated all year round, is about 12% compared to the same system layout but considering the relevant



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MT evaporation pressure increase.

In the summer period, when the external temperature is above 26°C the energy saving is further increased thanks to the ETE activation. The average reduction of pack consumption in summer is about 30%, compared with the same system layout but without the sub-cooling benefit. This energy saving achievable in the summer time is equivalent to an annual (extrapolated) energy saving of 6%.

Considering both FTE2.0 and ETE technologies applied, the combined annual energy saving achieved in the pilot in Perugia is 18% (12% from FTE2.0 + 6% from ETE).

In total, **the plant of Timisoara** ensured:

- a saving of **38,000kWh/year**, equal to **41,167 washing machine cycles**;
- a yearly **money savings** for the store of 4,765€ thanks to energy savings;
- **a saving of 10tCO<sub>2eq</sub>/year**, as calculated by LCCP analysis.

## **2<sup>nd</sup> replication project:**

Retail: Mega Image

Location: store in Sibiu, Transylvania.

Reasoning behind the choice of this store: very cold in winter and mild in summer, the temperatures go down to -25°C in winter, so it is the ideal location for testing the FTE2.0 technology in extreme temperature conditions. Besides, the Client is very much oriented to green technologies, so he is keen on being part of the C4R project and test the latest technologies of natural refrigeration.

Technology implemented: FTE2.0 (Full Transcritical Efficiency)

Results achieved: With the pilot of Sibiu, we have demonstrated the capability of the FTE2.0 technology to perform reliably at very cold temperatures, proving to be efficient even in very cold climates and therefore ideal also in northern Europe and close to the north pole.

We also proved the capability to reduce the energy consumption of the system constantly independent by external temperature (very different external conditions).

The reduction of average pack energy consumption is about 12% for the whole period analysed comparing with the same system layout but considering an evaporation MT pressure less of 4 bar (average).

In total, **the plant of Sibiu** ensured:

- a saving of **11,999kWh/year**, equal to **13,000 washing machine cycles**;



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- a yearly **money savings** for the store of 1,505€ thanks to energy savings;
- **a saving of 3tCO<sub>2eq</sub>/year**, as calculated by LCCP analysis.

### Final results and considerations on the 2 replication projects in Romania

Considering both the Timisoara and the Sibiu replication projects we can confirm the annual energy saving of about 12% for systems running with FTE2.0 technology compared to a traditional CO<sub>2</sub> transcritical system, and the energy saving of about 30% for a system running with ETE technology for the period when the external temperature is above 27°C, i.e. when the ETE is activated, equivalent to an annual (extrapolated) energy saving of 6% (considered as relevant as the C4R targets are expressed on annual base).

#### FTE2.0

| INDICATOR OF PROGRESS           | REAL RESULTS TIMISOARA                | REAL RESULTS SIBIU                    |
|---------------------------------|---------------------------------------|---------------------------------------|
| Energetic Efficiency            | +12%                                  | +12%                                  |
| FTE2.0. Running                 | >8760 hours<br>(commissioned 06-2020) | >8760 hours<br>(commissioned 11-2020) |
| Energy saved at least 6 months  | 17 MWh/yr                             | 8 MWh/yr                              |
| Energy saved at least 12 months | 25 MWh/yr                             | 12 MWh/yr                             |

#### ETE

| INDICATOR OF PROGRESS                | REAL RESULTS TIMISOARA |
|--------------------------------------|------------------------|
| Energetic Efficiency (annual impact) | +6%                    |
| Degree of average sub-cooling        | 14 K                   |
| Working hours                        | 95% (*)                |
| Energy efficiency at least 6 months  | 13 MWh/year (**)       |
| Energy efficiency at least 12 months | 13 MWh/year            |

(\*) ETE theoretical working hours are hours in which external temperature is above 27°C.

(\*\*) considering summer period. ETE is the technology developed to increase energy saving in hot climate.



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### TOTAL

| INDICATOR OF PROGRESS                | GRANT AGREEMENT | REAL RESULTS |
|--------------------------------------|-----------------|--------------|
| Energetic Efficiency FTE2.0          | +9-14%          | +12%         |
| Energetic Efficiency ETE             | +6-12%          | +6%          |
| Degree of average sub-cooling        | 1-3 K           | 14 K         |
| FTE2.0. Running                      | >8000           | >8760 hours  |
| Working hours ETE                    | >80%            | 95% (*)      |
| Energy efficiency at least 6 months  | 34 MWh/year     | 38 MWh/year  |
| Energy efficiency at least 12 months | 68 MWh/year     | 50 MWh/year  |

(\*) ETE theoretical working hours are hours in which external temperature is above 27°C.



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## 4.4 Replication Pilot realisation and validation in Spain

The goal of this action was to build a solid case study that shall trigger the deployment of FTE2.0 and SUBCO<sub>2</sub> in Spain. In particular to prove the reliability, performance and savings in extremely hot climate conditions.

### **1<sup>st</sup> replication project:**

Retail: Consum

Location: Benicassim in Spain.

Reasoning behind the choice of this store: Consum is the largest cooperative of the Spanish Mediterranean region.

Technology implemented: FTE2.0 (Full Transcritical Efficiency) and SUBCO<sub>2</sub> - ETE (Extreme Temperature Efficiency)

Results achieved: Compared to a system developed with HFC, the Benecassim store ensured:

- a saving of **52,000kWh/year**, equal to **56,335 washing machine cycles**;
- a yearly **money savings** for the store of 6,520€ thanks to energy savings;
- a **saving of 14tCO<sub>2eq</sub>/year**, as calculated by LCCP analysis.

### **2<sup>nd</sup> replication project:**

Retail: ALDI

Location: Colmenar, Spain.

Reasoning behind the choice of this store: very hot in summer, with temperature historically up to 50°C, and cold in winter time as the pilot is in the very central part of Spain. Therefore it is the ideal location for testing the FTE2.0 and ETE technologies in extreme temperature conditions and prove how they perform in such extreme climate conditions. Besides, the Client is a very important retailer who has several hundreds of stores located all over Europe and therefore at many different climate conditions. The retailer is very much oriented to green technologies, since all of its stores are running with CO<sub>2</sub> refrigerant. It is therefore a



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potential target to adopt C4R technologies for many more stores in the future.

**Technology implemented:** FTE2.0 (Full Transcritical Efficiency) and SUBCO<sub>2</sub> - ETE (Extreme Temperature Efficiency)

**Results achieved:** With the pilot of Colmenar, we have demonstrated the capability of the FTE2.0 and ETE technologies to perform reliably at very hot temperatures, proving to be efficient even in extremely hot climates and therefore ideal also in south and Mediterranean Europe.

The reduction of average pack energy consumption given by the FTE2.0 technology is about 7% for the whole period analysed comparing with the same system layout but considering an evaporation MT pressure less of 2,5 bar (average). In summer, which for this store corresponds to the observation period, when the external temperature is above 27°C the ETE technology ensures a substantial energy saving. From June to mid October 2021, the average reduction of pack consumption from ETE is about 25%, compared with the same system layout but without the sub-cooling benefit.

The commissioning of the store in Colmenar has been particularly delayed in reason of the COVID-19 situation. However we have observed the system and collected the data until end of September 2021 in order to have a significant test outcome and we have included all the information in the technical reports.

### **Final results and considerations on the 2 replication projects in Spain**

Considering both the Benicassim and the Colmenar replication projects we can confirm the annual energy saving of about 10% for the systems running with FTE2.0 technology compared to a traditional CO<sub>2</sub> transcritical system and an observed energy saving of about 27% for the period when the external temperature is above 27 °C for the system running with ETE technology compared to a traditional CO<sub>2</sub> transcritical system.



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### FTE2.0

| INDICATOR OF PROGRESS           | REAL RESULTS BENICASSIM               | REAL RESULTS COLMENAR                 |
|---------------------------------|---------------------------------------|---------------------------------------|
| Energetic Efficiency            | +13%                                  | +7%                                   |
| FTE2.0. Running                 | >8760 hours<br>(commissioned 12-2019) | <8760 hours<br>(commissioned 06-2021) |
| Energy saved at least 6 months  | 15 MWh/yr                             | 8 MWh/yr                              |
| Energy saved at least 12 months | 23 MWh/yr                             | 11 MWh/yr                             |

### ETE

| INDICATOR OF PROGRESS                | REAL RESULTS BENICASSIM | REAL RESULTS COLMENAR |
|--------------------------------------|-------------------------|-----------------------|
| Energetic Efficiency (summer period) | +30%                    | +25%                  |
| Degree of average sub-cooling        | 14K                     | 13K                   |
| Working hours                        | 98% (*)                 | 57% (*)               |
| Energy efficiency at least 6 months  | 30 MWh/year (**)        | 16 MWh/year (**)      |
| Energy efficiency at least 12 months | 30 MWh/year             | 16 MWh/year           |

(\*) ETE theoretical working hours are hours in which external temperature is above 28°C.

(\*\*) considering summer period. ETE is the technology developed to increase energy saving in hot climate.

### TOTAL – combined results

| INDICATOR OF PROGRESS                | GRANT AGREEMENT | REAL RESULTS |
|--------------------------------------|-----------------|--------------|
| Energetic Efficiency FTE2.0          | +9-14%          | +10%         |
| Energetic Efficiency ETE             | +6-12%          | +27%         |
| Degree of average sub-cooling        | 1-3 K           | 13K          |
| FTE2.0. Running                      | >8000           | >8760 hours  |
| Working hours ETE                    | >80%            | 77% (*)      |
| Energy efficiency at least 6 months  | 34 MWh/year     | 65 MWh/year  |
| Energy efficiency at least 12 months | 68 MWh/year     | 76 MWh/year  |

(\*) ETE theoretical working hours are hours in which external temperature is above about 27/28 °C.



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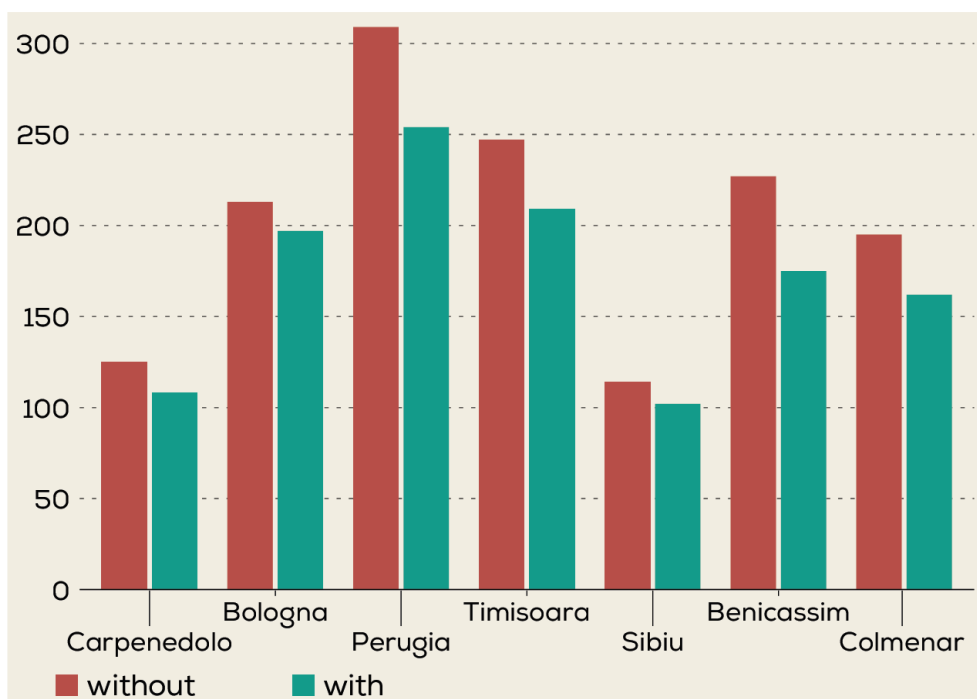
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**Comparison of the annual energy consumption of the pilot stores  
with and without the C4R technologies applied (MWh/year)**



*Annual energy consumption (MWh/year) for each store, with Life-C4R technologies and without.  
An energy saving between 15% to 23% is observed*



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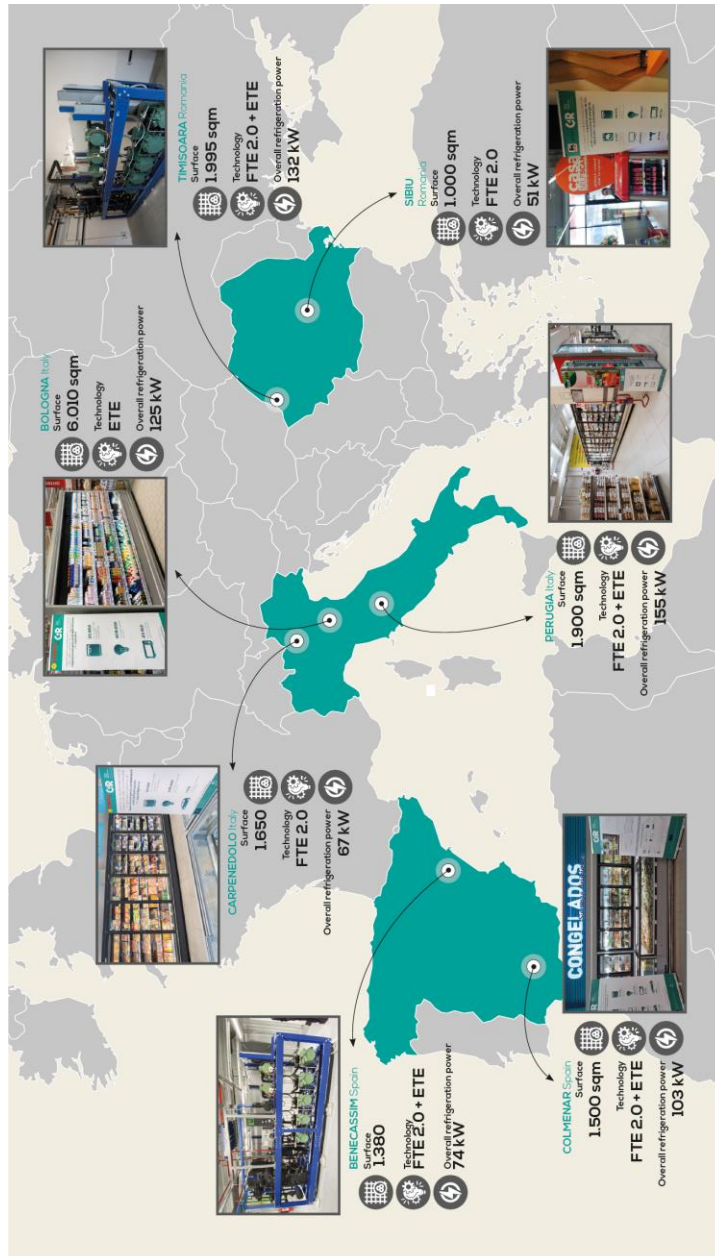


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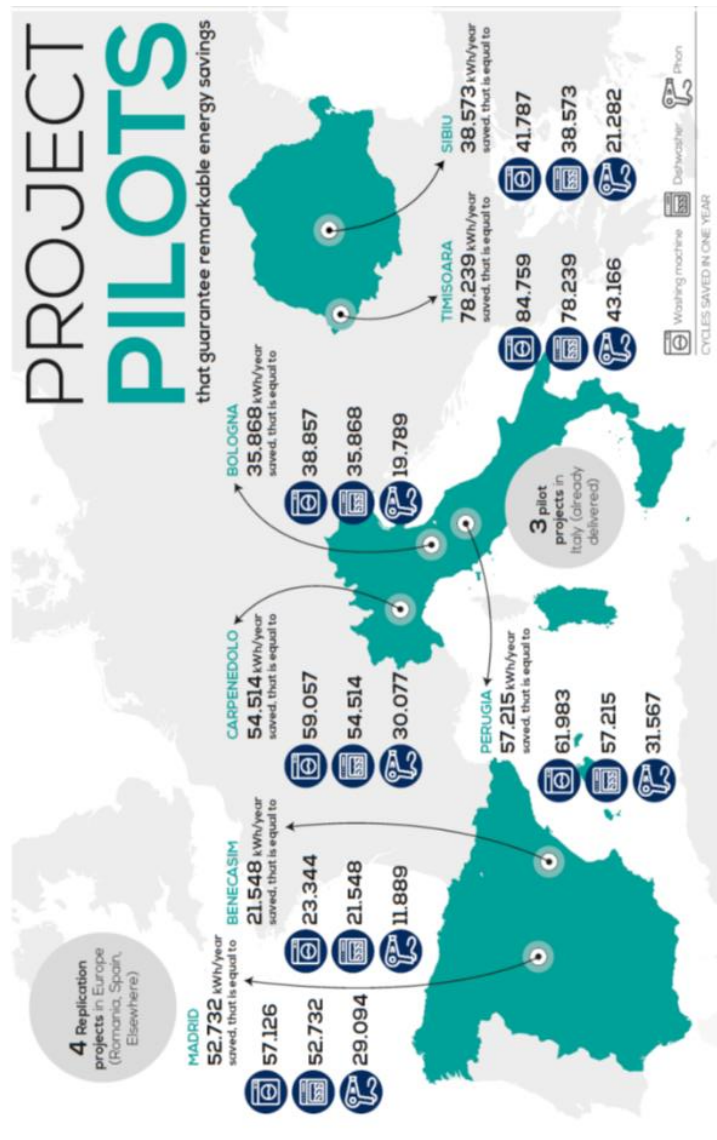


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**In-store communication**



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## 4.5 Business Cases, Business Plan and transferability

Although the COVID-19 pandemic has severely slowed down the commercial activity during 2020 and also during part of 2021, we have continued to invest in the dissemination and the commercial activity in Europe, with particular focus on complete turn-key systems operating with the LIFE C4R technologies.

We can say that without any doubt now the C4R technologies have been appreciated as leading environmental technologies and are nowadays very well accepted in all the European markets.

The environmental benefits of the LIFE C4R project have been demonstrated and will be used to further support the technical, commercial and political roll out and massification of the technologies as they are key to reach a higher degree of decarbonization of the commercial refrigeration sector and other cooling industry.

Regarding the transferability of C4R we have performed the following activities in cooperation of the University of L'Aquila, that is particularly advanced in this particular material and systems assessment.

- Experimental analysis aimed at determining if the sizing criteria of the liquid receivers in use today are adequate or if further reduction possibilities could be envisaged without compromising the effectiveness of the separation
- Verification of collector sizing criteria for transcritical plants, further verification that the design criteria used are optimized in terms of BOM and industrial costs
- Examination of energy recovery systems with Expander
- Theoretical analysis and simplified simulation model - of particular significance for the application of FTE in hot climates - of the recovery potential from RES sources
- Bibliographic study of mechanical wear in refrigeration machines for the dual purpose, to understand if the process parameters improve the reliability, in particular those of FTE between Tdishc and refrigerant oil mixture, but also thinking about active systems for predictive (or analytical instrumental) monitoring of the usury.

Besides the following transferability actions have been planned.

Technical:

- Evaluate the possible adoption of the C4R technology in other sectors such as industrial refrigeration, air conditioning, process cooling. In fact the C4R technologies can offer reliability and efficiency advantages in any cooling system based on 2 levels of operating



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temperatures, like in the refrigeration we have medium temperature appliances (fresh food products) and low temperature appliances (frozen food products). This can well be the case of industrial refrigeration, with areas where the food is prepared and others where it is stocked at different temperatures. Similar situations are frequent in the A/C applications, where for instance we find the cooling of technical rooms (telecom shelters, etc.) and living offices, and in the process cooling (food production and packaging, pharmaceutical industry, etc.)

### Commercial:

- Intensify the commercial activity with the participation of multi-annual tenders
- Increase in capillarity and acceptance in new markets where the solution has not been commercialized yet
- Evolve the case study and benchmark information to keep it always updated and effective to stand the competition and increase the customer perception
- Increase the standing of the solution by the most important European end-users and contractors to become their standard reference solution

### Dissemination

- Attend to the most important exhibitions in our industry and business sector
- Perform a robust communication plan with seminars and public presentations, especially involving stakeholders not yet informed about the environmental impacts of the cooling products (ordinary people, students, journalists, etc.)
- Pursue the optimal presence in the press (magazines, videos, articles, etc.)

### Lobbying

- Continue and further enhance the contact with European and national policy makers to obtain acts and incentives that can drive the market towards and generate new sales and projects for natural refrigerant based equipment with the best energy saving technologies. In particular we are focusing at national level on the introduction of retrofiting plans, i.e. replacing all the cooling appliances (refrigerators and freezers, power racks, heat exchangers, cold rooms, etc.) of supermarkets that operate with HFCs with new more efficient equipment based on natural refrigerants, to cut the overall carbon emissions of the store. The incentives may include funds and tax reliefs for the retailers, or any other kind of advantage offered to create a sale benefit for the store (examples are the installation of charging stations for cars in the parking, roads/roundabouts for better circulation or bicycle lines to the store, etc.).



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- Advocate the uptake of natural refrigerants in the frame of the Reviewed F-Gas Regulation

The European Union in general is recovering from the pandemic, our economies are growing and we see the opportunities for many new C4R installations scaling up as our economies are and are expected to grow also during the course of 2022 and the following 2-3 years.

The outlook is positive both economically, socially and sustainability wise for the next 3-5 years and we will continue to put in place an intense commercial activity to increase the market penetration of the C4R systems and seize every opportunity to establish these technologies as the future market standard for commercial refrigeration systems.



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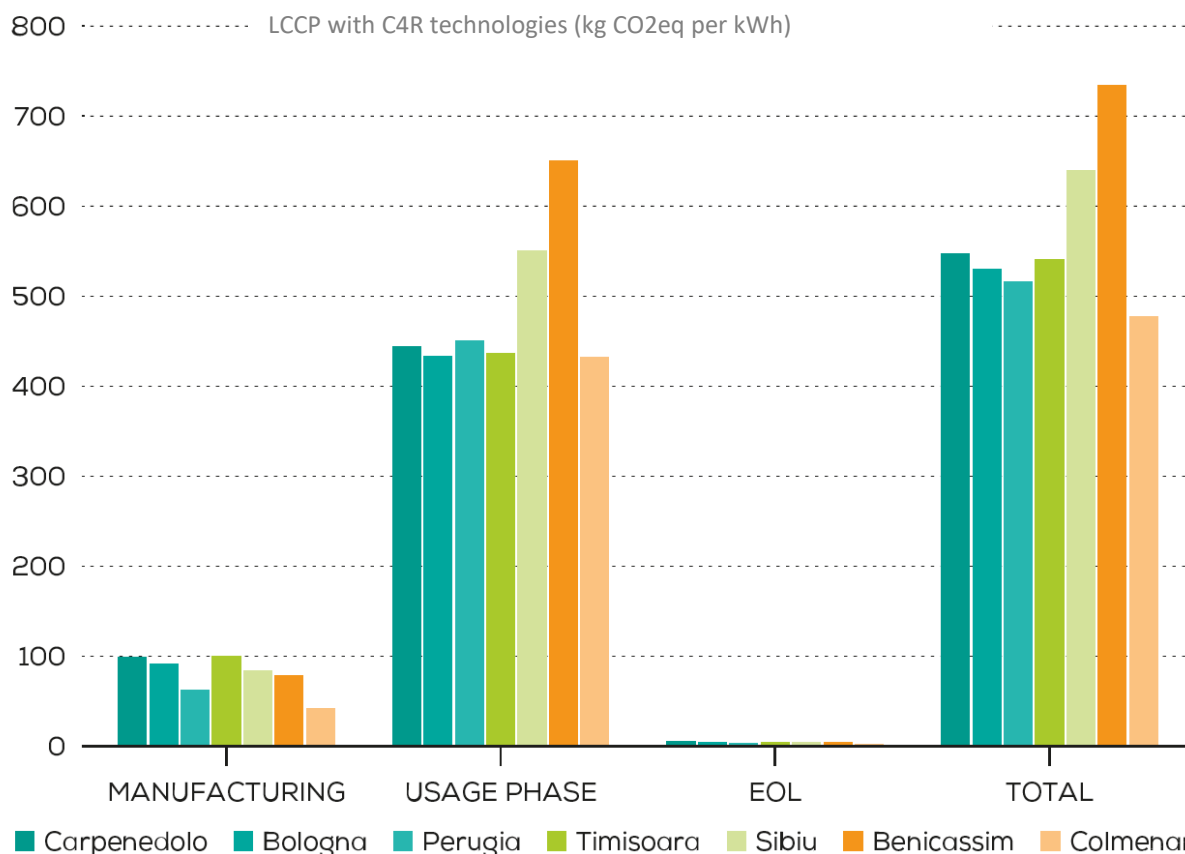


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## 4.6 LCA and Environmental Impact Assessment

A full analysis of the greenhouse gas emissions of the C4R technologies has been performed according to the standards of Life Cycle Climate Performance (LCCP) assessing all the stages of its life cycle, from “cradle” (refrigerant and product manufacturing), through use (energy usage), to “grave” (recycling and disposal).



*CO<sub>2</sub>eq emissions with C4R technologies, calculated in the different stages of the technology lifetime: Manufacturing, usage phase, end of life (EOL) and total impact assessment (kg CO<sub>2</sub>eq per kWh), by means of life cycle climate performance (LCCP).*



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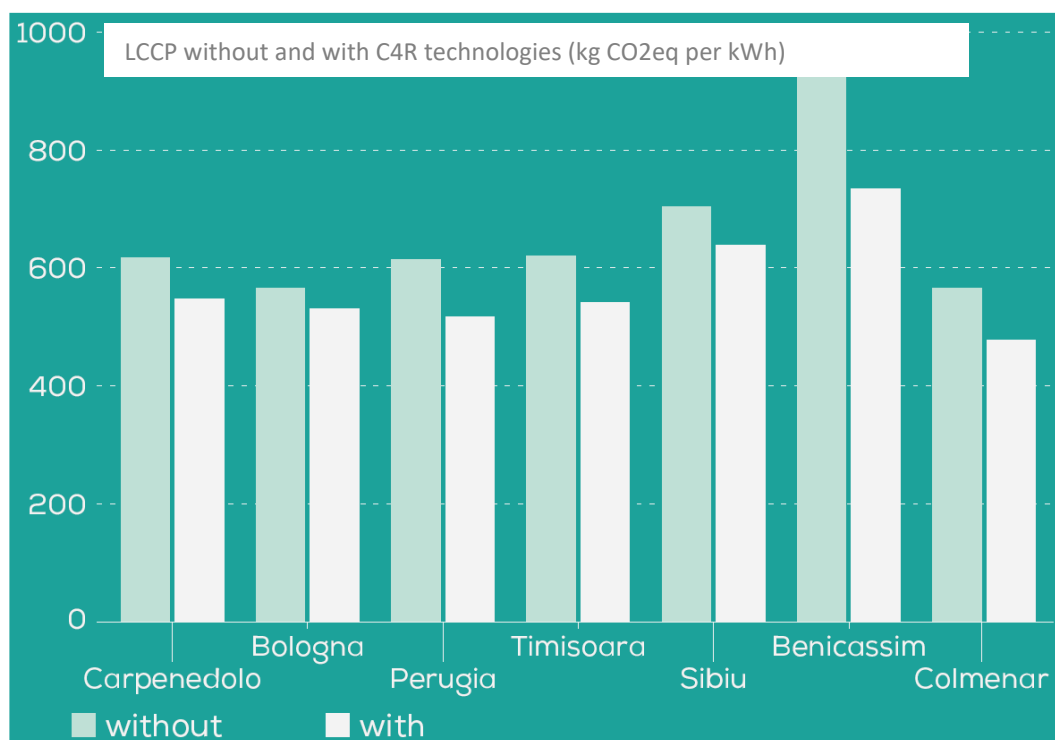


Figure 10 – CO<sub>2</sub>eq emissions in the different pilot stores by means of LCCP without (light colours) and with (dark colours) C4R technologies - Total impact assessment (kg CO<sub>2</sub>eq per kWh)

All the C4R pilots show that using the C4R technologies ensure a reduction of CO<sub>2</sub> emissions from a minimum of 6% to a maximum of 21%.

Most of the emissions are linked to the use phase (85%), particularly given by electricity consumption, whereas manufacturing accounts for 14%, the EOL being only 1%.

The expected benefits of LIFE C4R technologies have been confirmed, and the LCA has demonstrated that the proposed innovation enables the reduction of electricity consumption, and therefore a reduction of the impact on the environment in terms of CO<sub>2</sub>eq emissions of up to about 20%.

Additionally, since the EU's power generation sector is gradually decarbonising switching from coal to renewable fuels, natural gas and renewable energy sources, and therefore the greenhouse gas (GHG) emission intensity of power generation, namely the CO<sub>2</sub> emissions to



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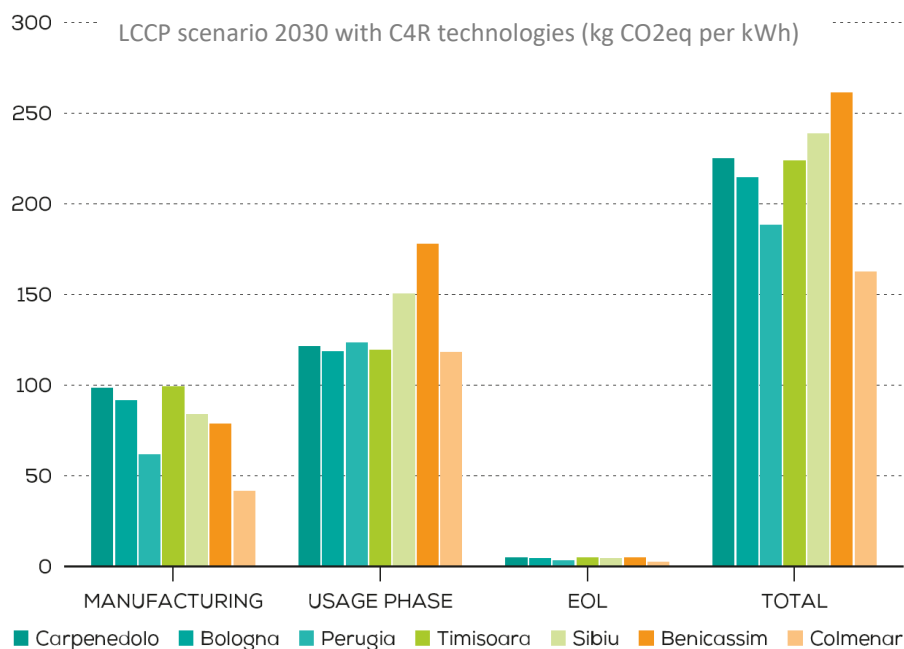
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produce one kWh of electricity, is continuously falling across the EU, we have decided to replicate the LCCP analysis also based on the 2030 energy mix scenario, i.e. considering a lower CO<sub>2</sub>eq vs kWh conversion factor.

The CO<sub>2</sub> emissions from the electricity usage (CO<sub>2</sub>eq/kWh) have been accounted based on the 2030 forecasted energy production mix provided by the EEA European Environment Agency.



*Figure 13 - LCCP scenario 2030 with C4R technologies – Manufacturing, usage phase, EOL and total impact assessment (kg CO<sub>2</sub>eq per kWh)*

It is particularly interesting to observe that again most of the impacts, both for the baseline scenario and for the new C4R plants, are linked to the use phase, given particularly by the energy consumption, but in this case a “greener” energy mix in 2030 reduces the impact of the use phase compared to the manufacturing and EOL phases.



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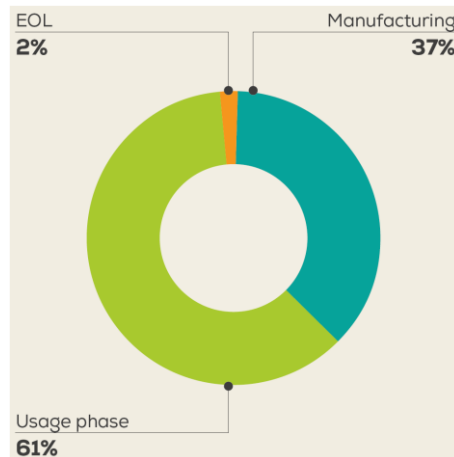


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In the new scenario it will therefore become essential, in addition to reducing electricity consumption, to pay particular attention to the choice of materials used to realise the plant, choosing sustainable materials throughout their life cycle.



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## **4.7 Socio-economic impact assessment**

The Social-Economic Impact Analysis has assessed the potential of the LIFE C4R technology to change the lives of current and future residents of the European Community based on quantitative parameters.

We have engaged the key stakeholders representing the commercial refrigeration industry and spanning geographically across all of Europe (retail stores, EU and national associations of categories and networks, policy makers) by means of dedicated online questionnaires and interviews on:

1. the EU commercial refrigeration equipment market: the migration path to natural refrigerants, the competitors arena, the Epta market positioning, the C4R unique selling points, the advantages compared to other natural refrigerant-based solutions, the C4R economic impact
2. the social impacts: job creation, positive health effects, decrease of illegal trade of HFCs
3. the policy impacts: Regulation (EU) 517/2014 on fluorinated GHG (F-gas regulation), Directive (EU) 2018/2002 amending Directive 2012/27/EU on energy efficiency and European Green Deal,

The socio-economic analysis performed highlighted LIFE C4R socio-economic impacts: reduction of the energy and GHG emissions of the commercial refrigerator sector; economic growth and competitiveness of the EU commercial refrigerator equipment sector; job creation; safety increase in retails; impact on policy regulations at EU and national level. LIFE C4R partners will use these results to foster the adoption of the technologies in EU in the future.



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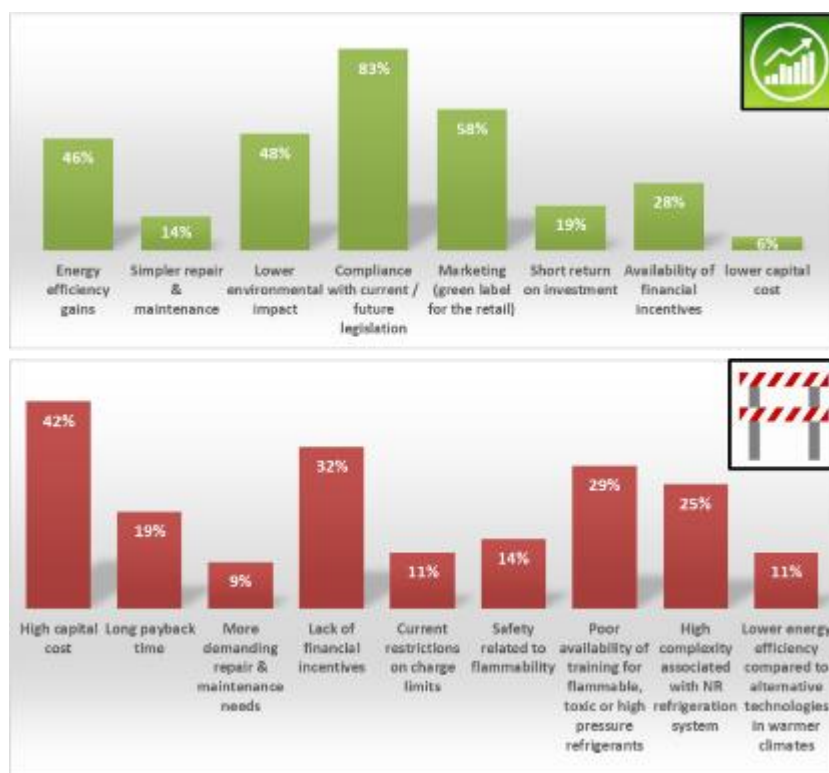


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*Main drivers and barriers for the adoption of natural refrigerators in commercial refrigeration sector according to questionnaires collected from LIFE C4R stakeholders.*



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*Results from the LIFE C4R questionnaire to the question: "Life-C4R project has a range of economic, social and environmental impacts. For each impact, please rate how much you value it (5 more valuable, 1 less valuable)". Scores are averages among all types of stakeholders.*

At national Italian level, LIFE C4R actively worked to support the approval of specific measures (tax incentives) in the context of the Italian recovery plan to promote the retrofitting of old refrigeration systems using highly climate-impacting HFCs (GWP> 1500) with new commercial refrigeration systems that use natural refrigerants (CO<sub>2</sub> and propane) and better energy efficiency.

F-Gases accounted for 4.4% of total greenhouse emissions in Italy in 2019 (16.8Mt CO<sub>2</sub>eq ). To obtain a significant reduction in HFC consumption it is not enough to regulate only new systems, as done by the F-gas regulation. It is necessary to reduce the consumption of high-GWP HFCs for the maintenance of the existing old supermarkets and hypermarkets which, on average, disperse 15% per year in the environment due to operating losses (>2500t/yr). EPTA estimated that the number of stores that still use HFC gases with high GWP (around 4000) in Italy is currently 7,700.

EPTA invited the Italian policy makers to promptly act in this direction, by introducing in the Italian Recovery Plan incentives for the reconversion of older commercial refrigeration systems by replacing them with modern natural refrigerant systems and low consumption. Considering a period of 7 years, time estimated as reasonable considering the characteristics of the market, the predisposition to investments and the climate targets, the result is an average annual cost of about € 120 million, with a saving in emissions of 3 MCO<sub>2</sub>eqT/year.



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The tax incentives proposal has been presented to several members of the Italian Parliament and of the Government and a law has been drafted (already co-signed by 40 senators) and is currently being discussed in the frame of the Italian Recovery Plan and/or 2022 budget law.



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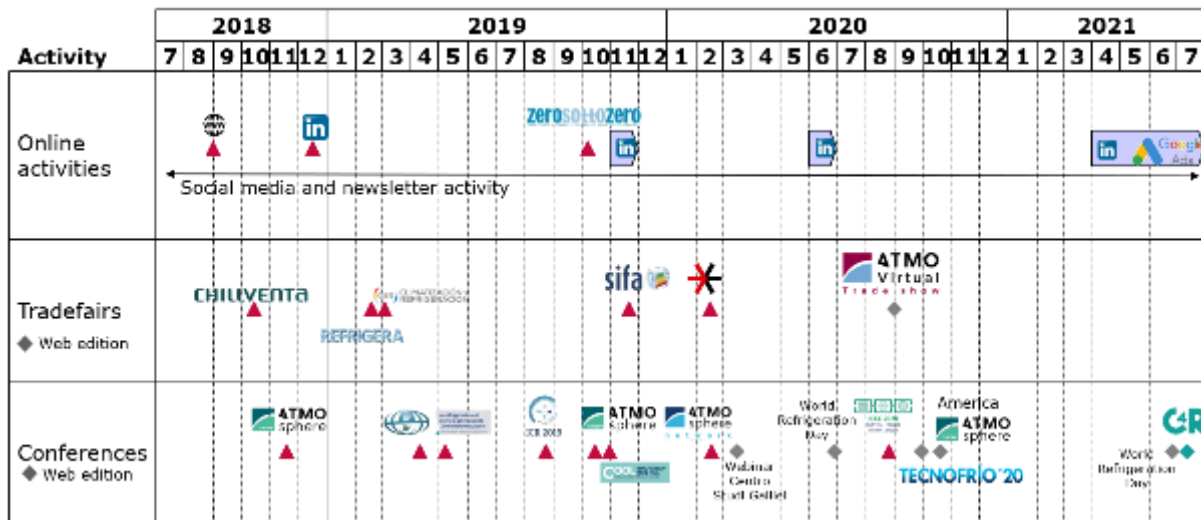
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## 4.8 Dissemination Activities

### Activity GANTT



### Notice boards



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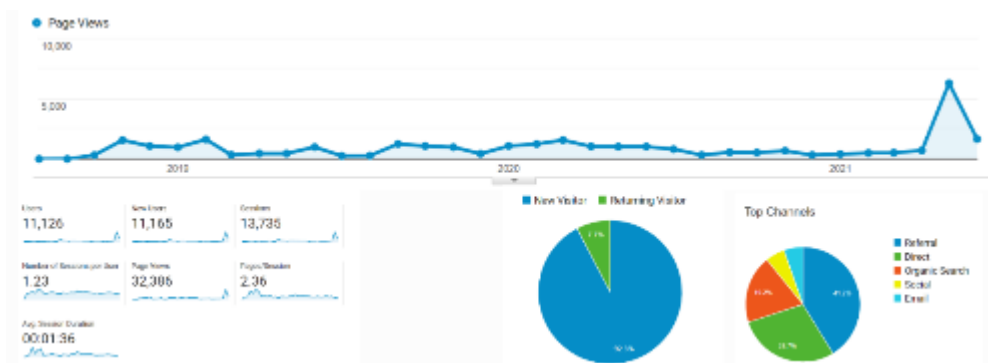
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### Website and online activities



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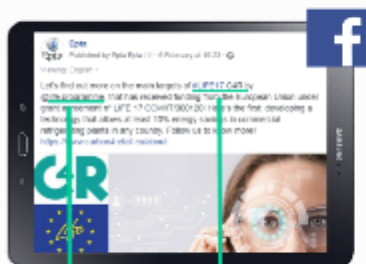


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## Online and social activities

Dedicated social activity from **Epta social networks** starting from October 2018 for a total of more than 100 posts.



Tag of EU  
Channels

Dedicated hashtag:  
#Life17C4R

## FOLLOWERS



5 093

1140

789

38 463

1 906

Average of **1,000 people reached** for each post on Life-C4R\*

**CR**

**PTR Systems, the technology at the heart of Life-CAR project**

The level of the project is the PTR systems technology used in 12 water, 12 air and 12 soil water treatment systems. The system is designed to remove all organic matter, including microplastics, from water. It is a simple, efficient and reliable system, which can be installed anywhere in the world.

In the PTR system, the water is treated by a series of filters made of polypropylene fibers. These fibers are designed to capture all particles larger than 0.1 micrometers. This means that even the smallest bacteria and viruses are removed from the water.

Click here to see the system works without fail. The latest PTR system is now available in the market.

Do you want to know more about the PTR technology? We invite you to visit our website, where you will find all the information you need.

**Click here**

The Life-CAR project is a European Union initiative, supported by the European Commission. The project aims to develop a new generation of water treatment technologies, which can be used to treat wastewater and other types of water pollution.

The Life-CAR project is a joint effort between several research institutions and companies. The project has received funding from the European Union's Horizon 2020 research and innovation programme.

The Life-CAR project is a testament to the power of collaboration and innovation. We hope that the results of the project will inspire others to work towards a better future for our planet.

## LinkedIn Sponsored Campaign to sponsor Life-C4R website

45k Impressions  
95 website visits  
0,21% engagement\*

\* The average of the sector is 0,2%

The screenshot shows a LinkedIn sponsored post for the Life-C4R project. The post includes a video player with a play button and a title 'PILOT PROJECTS'. Below the video, there is a list of pilot projects with details such as location, dates, and status. The LinkedIn logo is visible in the top right corner.

## Google Adwords campaign to sponsor Life-C4R website

250k impressions  
3.690 clicks

The screenshot shows a Google Adwords campaign for the Life-C4R project. The ad text includes 'Carbon & Retail Refrigeration / Life-C4R', 'European programme / National refrigeration', and 'National refrigeration and innovative technological solutions to reduce F-Gas emissions. Development systems to achieve zero-WCO and zero-WCO with zero CO2 emissions'. The Google logo and 'Ads' text are visible at the bottom.



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### Advertising, media and leaflets (examples)



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### Store and concept videos

We have realized several videos that explain very clearly the C4R project, the function and benefits of the FTE2.0 and ETE technical solutions and the environmental advantages of the C4R efficient and sustainable technologies, that we have widely used in exhibitions, conferences and events.

The stakeholders and even the laymen that see the video have a very easy and direct way to quickly become familiar with C4R even if they do not have any technical background.

The advantages for the C4R project are evident as the clients, retailer and technical stakeholders immediately after watching the advertising/training videos are in the position to discuss further and appreciate our commercial propositions. This way the videos have been a very powerful sales tool throughout the duration of the project and will help us a lot to realize new sales even after the project end.

Main videos realized and permanently available on the web:

- [Video of the Carpenedolo pilot store](#)
- [First pilot project in Italy \(Carpenedolo\)](#)
- [LIFE C4R at Climatization y Refrigeration in Spain](#)
- [New Epta Iberia #Life17C4R project](#) (Aldi Colmenar)
- [Life-C4R Project - Benicassim Pilot](#)
- [Epta FTE System is part of Life-C4R Project](#)
- [Francesco Mastrapasqua on Life C4R project](#)
- [The most important moments of #LIFE17C4R project](#)
- [Epta – Reportage from the LIFE17 C4R project](#)
- [Life-C4R: Natural technology for Sustainability](#)
- [Life-C4R at #EuroShop 2020](#)
- [#Euroshop 2020: Life-C4R](#)
- [LIFE C4R digital conference project introduction](#)
- [Life C4R digital conference - pt.1](#)
- [Life C4R digital conference - pt.2](#)
- [EPTA and ESGs](#)

Technical videos used with the professional stakeholders to present the advantages of the technologies related to the C4R project:

- [C4R FTE scheme and advantages technical video for Chillventa 2018](#)
- ETE pt 1 <https://www.youtube.com/watch?v=vjEQW4UCflo>



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- ETE pt 2 <https://www.youtube.com/watch?v=mUMsgDQP3ug>
- FTE pt 1 [https://youtu.be/8jiGK\\_TsfKU](https://youtu.be/8jiGK_TsfKU)
- FTE pt 2 [https://youtu.be/IWETJ\\_ijVcE](https://youtu.be/IWETJ_ijVcE)
- FTE pt 3 <https://youtu.be/jvkETHw1IMY>
- [Predictive maintenance diagnostic technologies applied to C4R](#)

And several more can be found visiting Youtube and EPTA LIFE C4R....

### Exhibitions and Conferences

|                                                                           |                                                                      |
|---------------------------------------------------------------------------|----------------------------------------------------------------------|
| Chillventa 2018                                                           | Nuremberg, 16 <sup>th</sup> – 18 <sup>th</sup> October 2018          |
| ATMOsphere Europe 2018                                                    | Riva del Garda, 19 <sup>th</sup> – 21 <sup>st</sup> November 2018    |
| Refrigera Show 2019                                                       | Piacenza, 20 <sup>th</sup> -22 <sup>nd</sup> February 2019           |
| Climatizacion y Refrigeration 2019                                        | 26 <sup>th</sup> February – 1 <sup>st</sup> march                    |
| International conference about Ammonia and CO2 Refrigeration Technologies | Ohrid, 11 <sup>th</sup> – 13 <sup>th</sup> April 2019                |
| 25th International Congress of Refrigeration IIR                          | Montreal, 24-30 August 2019                                          |
| ATMOsphere Europe 2019                                                    | Warsaw, 16-17 October 2019                                           |
| Sifa                                                                      | Paris, 19 <sup>th</sup> – 21 <sup>st</sup> November 2019             |
| EuroShop                                                                  | Dusseldorf, 16-21 February 2020                                      |
| Webinar Centro Studi Galilei                                              | 17 <sup>th</sup> March 2020 (ONLINE)                                 |
| World Refrigeration Day                                                   | 26 <sup>th</sup> June 2020 (ONLINE)                                  |
| 6th IIR Cold Chain conference                                             | 26 <sup>th</sup> - 28 <sup>th</sup> August, Nantes 2019 (France) and |
| Virtual Trade Show                                                        | 1 <sup>st</sup> - 2 <sup>nd</sup> September 2020 (ONLINE)            |
| Tecnofrio                                                                 | 30 <sup>th</sup> September – 1 <sup>st</sup> October 2020 (ONLINE)   |
| ATMOsphere America                                                        | 20 <sup>th</sup> – 22 <sup>nd</sup> October 2020 (ONLINE)            |



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## **FOCUS on Euroshop – 26th February – 2<sup>nd</sup> March 2020, Düsseldorf, Germany**

- More than 6.000 people on the stand over 5 days
- More than 3.000 registered visitors over 5 days
- 2.000 entry tickets redeemed and used (-20% vs. 2017)
- >4.000 snacks and meals served (same as 2017)
- 1.400 Epta information kits distributed
- Life-C4R information kits distributed
- 20 Journalists met during the show (Italy, France, Germany, Uk, Spain, Japan)
- 30 magazines have already published at least one article  
for a total of more than 60 clippings until the end of April 2020



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### AREA 4 – FTE AND ETE SYSTEMS TECHNOLOGY ADOPTED

Interactive projection mapping  
→ Used to explain and compare the functioning  
of FTE and ETE systems in a very simple and  
clear way to a vast audience



Online web app  
→ Used to explain the functioning of FTE system  
and show its main installations all over the world



### LIFE-C4R ARENA



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**Virtual Trade show – 1st – 2nd September 2020 – digital**

**Virtual** **TRADE SHOW**  
1-2 September 2020 - GLOBAL

**World's First Global & Virtual  
Natural Refrigerants Trade Show!**

**Free to Attend!  
REGISTER NOW**

→ [atmo-marketplace.com](https://atmo-marketplace.com)

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**Virtual booth** dedicated to  
Life-C4R promotion

Presentations on **FTE system**,  
**ETE Systems** and **ECO2Small**  
pack displayed on the booth

**550** visits on the virtual booth  
**200** downloads of FTE contents  
**80** downloads of ETE contents



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#### **IIR International Institute of Refrigeration - 26th – 28th august 2020, Nantes, France**



#### **The LIFE C4R Digital Conference – Closing event**

Event organized by Epta for the presentation of the results of the project. Extensive information has been presented regarding FTE and ETE technologies, as well as data and lessons learnt from the 7 pilot projects installed in Italy, Spain and Romania, with feedbacks from our Clients.

- Live recording from TV studios (Italy)
- Remote connections from Spain and Romania with external speakers
- Online streaming with live translation in Italian, Romanian and Spanish language
- Registered participants: 304 – Attendees (complete duration) : 140



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**Life-C4R Project digital conference**  
Thursday, July 1<sup>st</sup>, 2021  
h. 15.00 CET

Life-C4R is the international marketing project co-financed by the EU and part of the European LIFE Programme created to promote natural refrigeration replacing HCFC and HFC refrigerants with transcritical CO<sub>2</sub>.

**REGISTER TO THE DIGITAL CONFERENCE**

The digital conference will be held on July 1<sup>st</sup> at 15.00 CET

Extensive information will be presented regarding FTE and ETE technologies, as well as data and lessons learnt from the 7 pilot projects installed in Italy, Spain and Romania, with feedbacks from our Clients.

The participation is **free of charge** and live translation in English, Italian, Spanish and Romanian will be available.

[www.carbon4retail.eu](http://www.carbon4retail.eu)

The LIFE C4R project has received funding from the European Union under grant agreement n° LIFE 17 CCM/IT/000120

**Life-C4R Project digital conference**  
Thursday, July 1<sup>st</sup>, 2021  
h. 15.00 CET

Epta  
Life-C4R digital conference  
Event by EPTA GROUP

1st July 2021, 15:00 PM - 16:00 PM (your local time) - Add to calendar

Registration fee: <https://www.epta.it/registration>

Speakers: Alessandro Pappalardo, Romano Sanna, Massimo and Tullio, other attendees

[View](#) [Details](#) [Attendees](#) [Analytics](#)

**Life-C4R Project digital conference**  
Thursday, July 1<sup>st</sup>, 2021  
h. 15.00 CET

**Life-C4R Project digital conference**  
Thursday, July 1<sup>st</sup>, 2021  
h. 15.00 CET

Save the date:  
**Life-C4R Project digital conference**

Life-C4R is the international marketing project co-financed by the EU and part of the European LIFE Programme created to promote natural refrigeration and help replacing HCFC and HFC refrigerants with transcritical CO<sub>2</sub>.

The digital conference will be held on 1<sup>st</sup> July at 15.00 CET, and it is an exclusive event dedicated to illustrating the results of the project. Extensive information will be presented regarding FTE and ETE technologies, as well as data and lessons learnt from the 7 pilot projects installed in Italy, Spain and Romania, with feedbacks from our Clients.

[Click here to register](#)

The participation is **free of charge** and live translation in English, Italian, Spanish and Romanian will be available.

The LIFE C4R project is a 5-year (2018-2023) international marketing project that, thanks to Epta FTE and ETE technologies, will promote natural refrigeration replacing HCFC and HFC refrigerants with transcritical CO<sub>2</sub>, with any related temperature, allowing 100% energy and 100% reduction in maintenance costs.

The LIFE C4R project has received funding from the European Union under grant agreement n° LIFE 17 CCM/IT/000120

The information and content set out in this notice is based on the information of the author(s) and does not necessarily reflect the views of the European Union. The official website of the project is: [www.carbon4retail.eu](http://www.carbon4retail.eu). No other website may be held responsible for the content which may be made of the information contained therein.

Stakeholders identified as relevant for LIFE C4R represent the refrigeration industry in Europe:

- **Retail stores:** being LIFE C4R potential customers, retail stores represent a crucial category to be approached. Retail stores are ultimately the ones that will decide if to adopt LIFE C4R technology or not, hence leading to the actuation of the positive socio-economic impacts of the project or not. It is hence extremely important to understand how they perceive the LIFE C4R impacts and what matters for them.
- **EU and national associations of categories and networks:** LIFE C4R approached stakeholders covering the rest of the value chain besides retails (e.g. manufacturers, servicing and repair companies, operators, refrigeration consultants) through associations. Discussion with associations involved in the development process of standards at EU and international level was also crucial for the LIFE C4R definition of a novel standard fostering the adoption of CO<sub>2</sub> instead of HFCs for refrigeration and air conditioning.
- **Policy Makers:** LIFE C4R aimed to engage policy makers, responsible for the national and common EU policies, regulations and medium to long-term strategies, to use LIFE C4R results obtained in the specific sector of Cold Appliances both to further improve the eco-design features of cold appliances and to target specific legislation updates in other manufacturing sectors. For such a reason not only we made them aware



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of the importance of LIFE C4R to reduce GHG emissions and HFCs-HCFCs refrigerants, but also we focused on the socio-economic impacts that they deem more important.

## **NETWORKING WITH OTHER EU PROJECTS AND INITIATIVES**

Among the measures for networking we have regularly invited the CREG to meetings and seminars including of course the final C4R Digital Event.

Besides, in order to enhance the transfer of knowledge and experience among the network partners and promote further innovation in the overall project lifecycle and beyond, we have stimulated the interaction with other relevant LIFE projects and European technology platforms, including (but not limited to):

1. **NXTHPG (Next Generation of Heat Pumps working with Natural fluids.)**  
<https://cordis.europa.eu/project/id/307169/it>
2. **H2020-FTIPilot-2016-1 (Industrialization and path to commercialization of a patented innovative industrial kit to modify COLD cycle in order to drastically reduce ENERGY consumption)**  
<https://cordis.europa.eu/project/id/737929/it>
3. **H2020 723137 (Demonstration of the next generation standardised integrated cooling and heating packages for commercial and public buildings based on environment-friendly carbon dioxide vapour compression cycles.)** <https://cordis.europa.eu/project/id/723137/it>
4. **LIFE18 GIC/DE/001104 Ref, Nat! for LIFE**  
<https://webgate.ec.europa.eu/life/publicWebsite/project/details/5063>
5. **LIFE16 CCM/BE/000054 LIFE FRONT**  
<https://webgate.ec.europa.eu/life/publicWebsite/project/details/4666>
6. **LIFE16 GIC/UK/000007 REAL Alternatives 4 LIFE**  
<https://webgate.ec.europa.eu/life/publicWebsite/project/details/4680>
7. **H2020-EU.3.3.7. Expertise hub for a market uptake of energy-efficient supermarkets by awareness raising, knowledge transfer and pre-preparation of an EU Ecolabel**  
<https://cordis.europa.eu/project/id/696076/it>
8. **LIFE05 ENV/DK/000156 CO2REF Development and demonstration of a prototype transcritical CO2 refrigeration system** <https://webgate.ec.europa.eu/life/publicWebsite/project/details/2479>
9. **LIFE FRONT Quantitative Risk Assessment for flammable refrigerants**  
[www.lifefront.eu](http://www.lifefront.eu)
10. **GRUPPO CANNON** <https://www.cannon.com/>



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From the successful contact and interaction with the above projects some additional synergies have been explored, to which C4R has given a substantial contribution.

In particular 2 new projects started:

- LIFE20 CCM/IT/001644 LIFE VICORPAN, that will demonstrate energy efficient and recyclable VACUUM improved INSULATION by CORE shaped PANELS for commercial and household refrigerators, with potential extension to walk-in coolers and thermal insulated trucks
- H2020 ENOUGH, that will demonstrate improvement of security, reliability, efficiency, sustainability of the food cold chain.



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## 4.9 Stakeholders involvement and Business generation

Relevant stakeholders approached were:

- Tenants and managers who have the power to decide and make the buying decision;
- Store managers as users of refrigeration plant interested in performance and easiness of technical management and maintenance during the life of the plant that can influence the buying decision;
- Responsible for technical department of customers or refrigeration engineering firms interested in the installation feature as well as in reliability and feasibility.

To build a stable relation with them and develop the CREG we organized the following conferences:

|                                                                         |                                                   |
|-------------------------------------------------------------------------|---------------------------------------------------|
| <b>La refrigerazione si mette a servizio della grande distribuzione</b> | <b>8th May 2019 - Milan</b>                       |
| <b>Cool Innovation in Retail</b>                                        | <b>3th October 2019 - Bucharest</b>               |
| <b>ATMOsphere networking event</b>                                      | <b>18<sup>TH</sup> February 2020 – Dusseldorf</b> |
| <b>Life-C4R digital conference</b>                                      | <b>1<sup>st</sup> July 2021 - Broadcast</b>       |

Stakeholders identified above were contacted individually both personally or digitally and informed/updated of the LIFE C4R projects and its main outcomes. We have been able to make store visits to the pilots with 20 particularly important stakeholders, thus generating a specific outcome of 18 commercial propositions.

Depending on their availability and interest level in many cases they have been involved in personal one-to-one meetings or included in mailing lists that have been used to broadcast the proceedings and the results and to keep the stakeholders continuously involved on the project. The final CREG list included 139 key contacts.



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## 4.10 After Life Plan

We have developed a solid and intense After Life action plan to transfer and deploy the results of the LIFE C4R project at European level after the project end, in order to make the best practices developed during the project the reference solution for the future for the commercial refrigeration systems.

The environmental benefits of the LIFE C4R project have been demonstrated and will be used to further support the technical, commercial and political roll out and massification of the technologies as they are key to reach a higher degree of decarbonization of the commercial refrigeration sector and other cooling industry.

In the coming years we plan the following activity guidelines.

### Technical:

- Further optimization of the components, hardware and software to improve the industrialization and increase the market penetration
- Further optimization of the system controls to achieve even better energy efficiency performances
- Adoption of recyclable and/or natural components in reduce the CO2 impact of manufacturing and end-of-life treatment
- Evaluate the possible adoption of the C4R technology in other sectors such as as industrial refrigeration, air conditioning, process cooling, transport refrigeration, etc.
- Specific replicability and transferability actions at R&D level, which aim to ensure that the project results will be continued, transferred in other contexts and multiplied, increasing the use of sustainable materials throughout their life cycle

### Commercial:

The C4R technologies have been appreciated as leading environmental technologies and are nowadays very well accepted in all the European markets. The European Union is recovering from the pandemic, our economies are growing and we see the opportunities for many new C4R installations scaling up during the course of 2022 and after.

- Intensify the commercial activity with the participation of multi-annual tenders
- Increase in capillarity and acceptance in new markets where the solution has not been commercialized yet



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- Evolve the case study and benchmark information to keep it always updated and effective to stand the competition and increase the customer perception
- Increase the standing of the solution by the most important European end-users and contractors to become their standard reference solution

### Dissemination

- Attend to the most important exhibitions in our industry and business sector
- Perform a robust communication plan with seminars and public presentations, especially involving stakeholders not yet informed about the environmental impacts of the cooling products (ordinary people, students, journalists, etc.)
- Pursue the optimal presence in the press (magazines, videos, articles, etc.)
- Develop a debate and exchange with other European projects connected to C4R and modern commercial refrigeration to substantially contribute to the reindustrialization of the commercial retail sector into a more sustainable and efficient way

### Lobbying

- Continue and further enhance the contact with European and national policy makers to obtain acts and incentives that can drive the market towards natural refrigerant based equipment with the best energy saving technologies
- Advocate the uptake of natural refrigerants in the frame of the Reviewed F-Gas Regulation
- Political and lobbying actions to seize a solid base of laws, acts, incentives, etc. to support the massification of natural refrigerant based efficient technologies and in particular the C4R solutions (European Climate Law, F-Gas Regulation Review, implementation of the ecological transition in the Italian Recovery Plan).



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## 5 Evaluation of Project Implementation

LIFE C4R demonstrates a breakthrough process that dramatically reduces CO<sub>2</sub> emissions impact of supermarkets across Europe by introducing an innovative CO<sub>2</sub> commercial refrigeration system solution. LIFE C4R offers a practical “show-case” of energy efficiency improvement and carbon footprint reduction in the commercial refrigeration in retail sector while providing a good practice and real-life example of how the private and public sectors can share common policy objectives to promote eco-efficiency both in the industrial and civil sectors.

The project has confirmed the suitability and validity of the proposed equipment, processes and final product through the realisation and installation of the innovative prototypes of a refrigerating storage plant at 7 different end-users' premises (in 3 countries: Italy, Romania and Spain) and in different conditions of store size, from 1000 to 6000 sqm, climate, from moderate to very hot and tropical, and different markets, which means habits, knowledge, skills, etc.

The Life Cycle Assessment (LCA) analysis finally has demonstrated the achievement of the expected environmental benefits in respect with the state of the art, evaluating and taking in consideration the carbon foot print and environmental impact of the C4R solution from “cradle-to-grave”, including the prototypes realisation and their EOL dismissal.

In parallel a complete business case, transferability and After Life plan have been done and an intense dissemination activity has been performed in the spirit of the LIFE programme to spread this approach to the wider public as well as to policy makers and refrigeration industry stakeholders in order to stimulate the market uptake of the C4R technical solutions.

### Technical Objectives:

|                                                    |                                                                                   |           |
|----------------------------------------------------|-----------------------------------------------------------------------------------|-----------|
| High efficiency at all temperatures with no limits | C4R proved reliable from -25°C up to 44°C                                         | EXCELLENT |
| Improved efficiency, minimum of 10% energy savings | The combined use of FTE2.0 and ETE proved savings of 15-18% (only FTE2.0 min 12%) | VERY GOOD |



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|                                                            |                                                                          |                        |
|------------------------------------------------------------|--------------------------------------------------------------------------|------------------------|
| Limited costs of equipment and controls, savings up to 30% | Savings vs competing technologies targeting hot climates are substantial | INVESTIGATE<br>FURTHER |
|------------------------------------------------------------|--------------------------------------------------------------------------|------------------------|

### Environment Objectives:

|                                                                                                               |                                                                                                             |           |
|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|-----------|
| Reduce refrigerant GWP to 1                                                                                   | CO2 refrigerant was used (GWP 1)                                                                            | EXCELLENT |
| Reduce carbon footprint over the entire value chain based on a Life-Cycle climate performance (LCCP) approach | All C4R pilots show a reduction of CO2 emissions from 6% to 21%.                                            | EXCELLENT |
| Reduce EU GHG emissions by at least 1.5%                                                                      | This is a long term target, it needs further monitoring in the future – the C4R pilots are very encouraging | VERY GOOD |

### Policy Objectives:

|                                                                                |                                                                                                                                                                                                                                                     |           |
|--------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| To create an industrial standard that supports policy makers                   | The C4R technologies have been appreciated as leading environmental technologies and are nowadays very well accepted in all the European markets                                                                                                    | VERY GOOD |
| To stimulate the further uptake of this technology across Europe               | Political lobbying actions have been extensively performed at national and European level to seize a solid base of laws, acts, incentives, etc. to support the uptake of natural refrigerant based technologies and in particular the C4R solutions | EXCELLENT |
| To promote the conversion to new SIMPLE, GLOBAL and RELIABLE natural solutions | Intense and high-level profile dissemination and stakeholders involvement has been at the core of the C4R action plan                                                                                                                               | EXCELLENT |



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The market uptake of the LIFE C4R technologies, with the use of natural refrigerant CO<sub>2</sub> instead of climate altering HFCs and the increase in energy efficiency, can effectively support the transition towards the climate neutrality in the commercial refrigeration sector in Europe and worldwide.

We have carried out continuous and permanent actions to advocate the F-Gas increased ambition and in particular a review to foster the use of natural refrigerants towards the European Commission.

The European Regulation on Fluorinated Gases (F-Gas Regulation) of 2014 introduced a series of measures to gradually reduce the consumption of HFC by 80% (expressed in percentage terms of CO<sub>2</sub> equivalent) by 2030.

As part of the European Green Deal, the EU has raised its climate ambition, and committed to net greenhouse gas emission reductions of at least 55% by 2030, and climate neutrality by 2050. To achieve this, the European Commission is in the process of reviewing all climate relevant rules, including those on F-gases.

The first Fit for 55 package is due to be adopted in summer 2021, and a review of the EU F-gas Regulation (EU) No 517/2014 with raised ambition will follow by the end of 2022. The Regulation is the main instrument for reducing emissions from fluorinated greenhouse gases in the EU.

Refrigerants R-404A and R-507a (market standard since 2009) have a very high GWP, approx. 4000, so their use has been banned in all new commercial refrigeration equipment from January 1st, 2020, but they can still be used for the maintenance of existing plants to regularly compensate for the leakages.

Therefore it is crucial and urgent to put in place a structural program to retrofit the old highly climate-impacting commercial refrigeration systems with new systems equipped with modern natural refrigerant technologies and improved energy efficiency.

The EPTA proposal for a fiscal incentive for the retrofit of existing high-GWP refrigeration systems has been presented to several members of the Italian Parliament and of the Government and a law has been drafted (already co-signed by 40 senators) and is currently being discussed in the frame of the Italian Recovery Plan and/or 2022 budget law.

## **6 Analysis of benefits**

### **6.1 Environmental benefits**

Consumers are becoming more and more conscious about the environmental burden of food retail stores and look for labels that guarantee the environmentally friendly character of products/ stores. In this regard,



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Super Smart EU funded project prepared and submitted to the European Commission two documents to support the proposal for an EU Ecolabel for food retail stores. Supermarket stakeholders hence actively look to implement environmentally friendly and eco-efficient technologies (including natural refrigerants) (67% of respondents of LIFE C4R questionnaires) and thus reduce the environmental impact of their food retail stores in line with customers environmental consciousness (59% of respondents of LIFE C4R questionnaires stated that marketing was a driver for them and that LIFE C4R well addresses their “green label” marketing needs, giving a score of 4.9).

LCCP analysis from the 7 pilots demonstrated that LIFE C4R has multiple environmental impacts: a reduced energy consumption between 8% and 23% and reduced GHG emissions between 6% and 21% compared to competitor CO<sub>2</sub> based solutions. LIFE C4R can hence provide the right solution to these stakeholders, as confirmed by the retailers that scored 4.4 LIFE C4R energy use reduction and 4.8 LIFE C4R use of a refrigerant with GWP equal to 1. They also gave a score of 4.9 to how well LIFE C4R addresses environmental impact.

The climate impact of the cooling equipment, including fridges and air-conditioners, is two-fold: they use huge amounts of electricity and often rely on super greenhouse gases.

Rapidly reducing emissions from the cooling sector is more and more nowadays perceived as a major challenge yet it also offers vast opportunities to sustainable technologies like C4R that act with the ambition needed to meet the climate emergency.

The environmental advantages of refrigerant CO<sub>2</sub> are fundamental in this respect:

- absolutely safe, non toxic in normal concentrations and non flammable
- ODP (Ozone depletion potential) is 0
- GWP (Global Warming Potential) is 1 (nearly 4000 times lower than the most used refrigerant in the commercial refrigeration sector R404A)
- has excellent thermodynamic properties both for medium and low temperature applications
- very abundant in the environment (waste of many technological processes). its cost is extremely low and it is easily available anywhere
- as refrigerant it is often produced as recovery from industrial waste, hence the added greenhouse impact is to be considered nil
- it is an inert product, compatible with all common materials encountered in a refrigerating circuit, both metals and plastics or elastomers



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Even though hydrofluorocarbons (HFCs) and other fluorinated GHG do not attack the ozone layer (ozone depleting substances are banned in Europe since 2012), they are strong climate warming gases with a high GWP, the use of which needs to be drastically reduced. For this reason, the Regulation (EU) 517/2014) on fluorinated GHG includes a so-called HFC phase-down that will have reduced HFCs by 80% by 2030. In 2016 an agreement was also reached under the Montreal Protocol (the "Kigali Amendment") to phase down HFCs at global level. The project proves that a natural refrigerant solution even in hot climate latitude can have efficiencies comparable or superior than the current HFC solution removing the "Equator of CO<sub>2</sub>" that actually strongly limit the use of CO<sub>2</sub> as a refrigerant in southern country of Europe.

All C4R pilots show a reduction of CO<sub>2</sub> emissions compared with the baseline scenario, from a minimum of 6% to a maximum of 21%.

It has to be noted that, since the direct emissions caused by the use of the refrigerant are dramatically reduced with the use of natural refrigerant CO<sub>2</sub>, most of the impacts are linked to the energy consumption of the system in operation.

This is a very interesting and positive result, because the EU's power generation sector is progressively decarbonising. The greenhouse gas (GHG) emission intensity of power generation, namely the CO<sub>2</sub> emissions to produce one kWh of electricity, is continuously falling across the EU. Supported by the different recent EU policies there has been a gradual switch from coal to renewable fuels, natural gas and renewable energy sources, and the efficiency of transformation processes has improved across the sector. By 2019, the GHG emission intensity of electricity generation nearly halved compared with 1990. While the declining trend of the past decade continues linearly, the EU electricity generation will fully decarbonise by 2050. Following this, since C4R has reduced the CO<sub>2</sub> emissions of the overall cooling process to those coming from the energy use, the future expected energy mix scenario, with the lower CO<sub>2</sub>eq vs kWh conversion factor, will be key to cut the climate impact of commercial refrigeration reaching the Nearly Zero Emission (Climate Neutral) definitive long-term solution.

## 6.2 Economic benefits

### [EU migration path to natural refrigerants](#)

Nowadays there are still many devices that operate with synthetic fluorinated refrigerants (HCFCs and HFCs). In particular, HFCs refrigerants (R-404A and R-507a) with high GWP (around 4000) are still used for the maintenance of old supermarkets and hypermarkets which lose these highly climate-impacting refrigerants



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in the environment at a yearly rate of averagely 15% due to the operating leakages.

Natural refrigerants are exempted from the obligations of the F-Gas Regulation, i.e. regular leakage checks (CO<sub>2</sub>eq based), record keeping (5 years), labelling of products and equipment, certification of personnel performing the maintenance, annual reports, etc. The cost of these obligations depends on the quantity of HFC refrigerant, the number of refrigerators and freezers in the system, etc. and easily accounts for several hundreds of €/year for a medium sized store.

Besides, the prices of natural refrigerants are low and stable (CO<sub>2</sub> is currently 2,3€/kg), whereas HFCs' price has increased enormously depending on their GWP value (especially R404A, + 700% compared to 2017, at more than 50€/kg).

For instance, a medium sized store of 2000 sqm with a R404A refrigerant charge of 1000 kgs, needs refilling averagely 150 kgs of refrigerant lost every year, and spends approximately 7.500€/year.

LIFE C4R unique selling points: In terms of competitiveness of the solution, LIFE C4R has several unique selling points that can foster the adoption of the technology by overcoming the current existing market barriers and leveraging on current drivers, as explained in the following.

Low investment, installation and maintenance costs: customers see investment costs as a barrier (22% of respondents accordingly to 21, 58% accordingly to the questionnaire collected from retails). LIFE C4R solves this limitation by achieving a 30% cost reduction (equipment, installation and maintenance) compared to costs of competing natural refrigerant solutions using CO<sub>2</sub> for retail. LIFE C4R low costs are seen as a key unique selling point by the majority of stakeholders: 92% of the retails stated that the minimum yearly operating cost saving (energy costs, maintenance cost) to adopt a new refrigeration technology should be between 10% and 20% (the remaining 8% stated between 20% and 30%) and responders gave a score of 3.5 to the 30% saving of LIFE C4R equipment, and a score of 3.8 to the 30% LIFE C4R savings in installation and maintenance costs.

Low energy demand: Supermarkets are estimated to be responsible for around 3-4% of the total energy consumption in an EU country. Refrigeration systems represents the biggest share (35-50%) of the supermarkets' total energy demand and contribute to more than 1.1TWh/year of energy consumption/production, at global level, equal to 303MTCO<sub>2</sub>eq. With EU buildings getting closer to n-ZEB (nearly - Zero Energy Building), refrigeration is becoming one of the most important, and one of the few, thermal loads of the shopping mall buildings characterised by the presence of a big food retail shop. Energy costs for the sector were estimated at 5.1B€ by EC in 2020. Retail owners are hence driven towards low



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energy cost solutions (67% acknowledged it as a driver, accordingly to the questionnaires collected from retails). LIFE C4R demonstrated a reduction of energy consumption of commercial refrigeration between 8% and 23% compared to other state of the art refrigerant solutions using CO<sub>2</sub> in its 7 pilots. EPTA expects to sell LIFE C4R product to 40% of the market by 2026 thus contributing to a total saving between 61 and 175 TWh/yr, equal to between 18 to 52 MTCO<sub>2</sub>eq (almost equal to the total GHG emission of entire Portugal). LIFE C4R low energy demand is seen as a key unique selling point by the majority of stakeholders: 92% of the retails stated that the minimum yearly operating cost saving (energy costs, maintenance cost) to adopt a new refrigeration technology should be between 10% and 20% (the remaining 8% stated between 20% and 30%) and the retails gave a score of 4.4 to the LIFE C4R energy savings. It is worth to mention that in the questionnaire LIFE C4R advantage in terms of energy saving was inserted, in a conservative scenario, as 10-14%, well below the final maximum savings achieved by the pilot (up to 23%).

In particular, customers consider energy efficiency in warm regions as a limitation of NRs technologies (21% of respondents) and are resilient to adopt these technologies without proof of reliability. LIFE C4R overcomes this limitation by providing a solution that is efficient also at temperatures as high as 40°C, as demonstrated in the pilots. Retails confirmed that this is a key unique selling point.

### 6.3 Social benefits

LIFE C4R estimated job creation impact: The commercial refrigeration has a huge socio-economic impact in EU: 30,400 people were employed in EU in the commercial refrigeration sector in 2020, which means that almost 2 workers out of 10,000 had a job linked to the manufacturing, installation, maintenance and servicing of commercial refrigeration equipment.

Since the manufacturing phase of LIFE C4R device subsystem is similar to the one of conventional commercial refrigeration equipment, LIFE C4R will not create additional jobs in this step. LIFE C4R will instead have an impact in terms of employment on the number and level of experience of HVAC technicians. The installation and maintenance of new cabinets (1.6million expected to be sold by EPTA by 2026) will result in the creation of 20,000 qualified technicians in Europe 5 years after the end of the project , i.e. a 9% increase in the number of technicians. Trainings of these technicians will also represent a relevant job creation opportunity. In fact, even if not compulsory by EU regulation, training programmes for NRs are seen as a need by stakeholders and its number is increasing over the years. Courses on CO<sub>2</sub> service and maintenance are longer compared to courses on HCs and A2L service & maintenance (three-days courses compared to two-days ones) and typically more expensive (up to 3 times more, with typical prices for HCs courses around 500€). Trainings of



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the new 20,000 qualified technicians will hence result in a volume of 10M€ and an increase of number of trainers by 14%.

Some additional work forces (60 blue collars) have been added to the EPTA personnel to cope with the increasing demand of C4R systems.

Positive health effects: Refrigerants contribute to the global warming potential (GWP). Total emissions (direct+ indirect) of commercial refrigeration in Europe accounts to 90.5MT CO<sub>2</sub>eq (474MT CO<sub>2</sub>eq in the world).

Since CO<sub>2</sub>eq emissions are related to premature deaths and respiratory hospitalisations (estimated at 30.414 and 41.313 per year, respectively, over the period 2020-2050), decreasing CO<sub>2</sub>eq emissions has a positive health effect.

LIFE C4R saves around 35 TCO<sub>2</sub>eq per store with respect to a system operating with HFC refrigerants. By considering that EPTA expects to gain 40% market share in the near future, then ~10 premature deaths and ~14 respiratory hospitalisations can be saved each year thanks to LIFE C4R.

Moreover, the adoption of CO<sub>2</sub> instead of HFCs or other NFs will also remove the negative health effects of these refrigerants. Exposure to high concentrations of some HFCs may affect the heart and HCs are flammable, and hence they may pose fire and explosion hazards to humans.

Decrease of illegal trade: As the cap and phase-down of F-gas Regulation in EU gradually reduces the supply of HFCs in CO<sub>2</sub>eq (total weight of gas multiplied by its GWP), there is pressure on the industry to either lower the quantity of HFCs in kilograms or reduce the average GWP. This dramatically affected the cost and availability of synthetic refrigerants in EU and resulted in the flourishing of illegal HFC trade from China directly and via EU-border countries, in particular via Russia, Ukraine, Turkey and Albania, as documented by a 2019 EIA report. 5,527 tonnes of HFCs were imported illegally on the EU market only in 2017, with severe economic losses from EU countries (e.g. >20 M€ in lost VAT and taxes in the case of the Greek state in 2018). LIFE C4R thanks to the introduction on the market of technologies that use NRs and that, at the same time, lower the operating costs for stores by 30% will foster their adoption and reduce the illegal trade. This, in turn, will lower EU countries economic losses.

## 6.4 Replicability, transferability, cooperation

LIFE C4R addresses the commercial refrigeration equipment market, which accounts for refrigerators installed in food retail outlets such as supermarkets, discount stores, butcher's and bakeries, cafés and



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restaurants and catering facilities to keep perishable goods fresh or frozen. This market amounted to 43.3 B\$ in 2019, up 4.8% versus 2017, accordingly to International Institute of Refrigeration. In EU the commercial refrigeration appliances market was estimated at 1.123B€ in 2020. The number of commercial refrigeration systems in operation in EU in 2019 were 14M3 (90M at worldwide level).

The use of hydrocarbons (isobutane, propane and propylene) and CO<sub>2</sub> is instead common today in new appliances. The migration path of refrigeration to natural refrigerants (i.e. hydrocarbons and CO<sub>2</sub>) in commercial areas is currently driven by the 2014 EU F-Gas Regulation. A survey of north EU supermarkets found that the 65% of them started implementing NR (natural refrigerant) technology by 2017/18. According to market analyst shecco, 40,000+ supermarkets in EU are using transcritical CO<sub>2</sub> systems in September 2021, or 35% of the total number of outlets (about 115,000) – a growth of >275% from 2018 to 2021 - and predicts an additional 6,000 new systems each year as the EU F-Gas phase-down gets well under way, up to reach >50% market share for new installations using transcritical CO<sub>2</sub> in commercial refrigeration by 2025 and between 73,000 and 92,000 stores using transcritical CO<sub>2</sub> by 2030.

EPTA is a leading company in the commercial refrigeration equipment market, already detaining about 28% of EU commercial refrigerating cabinet markets and 5% of the refrigerating plants market.

EPTA current main customers include some of Europe's biggest retailers (e.g. Sainsbury's, Carrefour S.A., METRO AG, Ahold Delhaize, Lidl, ALDI Sud, Tesco, Marks & Spencer), all committed to keep implementing the transition to NR in their stores in EU and in other parts of the world in the next years. EPTA positions itself as the most innovative company with respect to competitors: it is the only one to have participated in EU projects and it is the most active in filling patents.

Thanks to LIFE C4R, stores will have 30% savings in equipment, installation and maintenance cost (equal to 18,000€/yr for a store having a load refrigerant of 110KW) and up to 23% energy cost reduction (up to 9,693 €/yr per single store having a load refrigerant of 110KW, corresponding to a maximum energy saving of 77MWh/yr). Since these energy savings are higher than the threshold set for reinvestment by the majority of the stakeholders (<10% for the 8% of the stakeholders, 10-20% for the 75%, 20-30% for the 8% and >30% for the remaining 8%), almost all retailers (92%) stated that they will reinvest LIFE C4R savings for opening new stores (82%) or expanding existing ones (17%), hence creating new jobs. Conad retailers involved in the LIFE C4R demonstration activities stated that they have already reinvested the saved money. Auchan Romania stated that the number of customers increased by 20% thanks to the LIFE C4R project.

The potential for application of the C4R technologies is enormous since they can be widely used in the commercial refrigeration sector, for replacing HFCs with natural



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refrigerants as requested by the European F-Gas Regulation. Since some competitor HFC technologies exist since many years, they attract retailers promising more consolidated and well known profile, and continue to have a share in the market in the area of small stores, convenience stores and city stores. To acquire this market share with sustainable natural solutions a strong policy and European Regulation is required, thus pushing the market to evolve similarly to what is already happening for medium and large supermarkets.

Without the stimulus of the F-Gas Regulation the European market would never have evolved this way, so the new policies and regulations should raise their ambition and introduce sustainability targets also for the small store surfaces.

Similarly a strong push is required from the regulatory and the financial bodies to encourage the replacement of the existing stores, which are in most of the cases consuming an excess of electricity and leaking considerable amounts of R404A/R507A and in some cases even R22 or its replacements.

Important consideration was given to the the possible adoption of the C4R technology in other sectors such as industrial refrigeration, air conditioning, process cooling. The FTE2.0 and ETE technologies can be applied in any cooling system based on 2 levels of operating temperatures, so besides the commercial refrigeration where we have medium temperature appliances (fresh food products) and low temperature appliances (frozen food products), industrial refrigeration, with areas where the food is prepared and others where it is stocked at different temperatures, A/C applications, where for instance we find the cooling of technical rooms (telecom shelters, etc.) and living offices, and in the process cooling (food production and packaging, pharmaceutical industry, etc.).

## 7 Innovation and demonstration value

LIFE C4R innovative aspects consist in:

- **High efficiency at all temperatures**, and not only at temperatures lower than 30°C like in state of the art solutions. This advantage will allow to substitute HCFCs and HFCs with CO<sub>2</sub> all over Europe and not only in the north of Europe;
- **Improved energy consumption efficiency**, by ~9-14%/yr, of commercial refrigeration systems to all latitudes of application. **Evaporation temperature increases 365day/year**, hence dramatically lowering energy consumption (2,5-3% each K) and all year round, including winter, differently from ejectors contributing to energy saving only in the TSC mode. This will push the adaption of the LIFE C4R technology even in the north of Europe, where CO<sub>2</sub> trans-critical plants are already gaining acceptance;



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- **Contained costs of equipment and controls**, savings up to 30% for maintenance and monitoring compared to current and competing solutions;
- **Partial reuse of flash gas**: efficiency and reliability of the compressors due to perfect liquid refrigerant separation;
- **Extended life of the compressor**: thanks to the substantial 10 °K reduction of discharge temperature of compressor return of the oil into compressors is not an issue, perfect lubrication is maintained as the oil circuit is uninterrupted.

## 8 Policy implications

In this age, rapidly reducing emissions from the cooling sector is more and more nowadays seen as a major challenge and the climate emergency is widely acknowledged as being a matter of survival for the next generations.

In the air conditioning and refrigeration environmental debate, the available technologies divide in 2 main categories: “Clean Cooling”, referring to natural refrigerant based solutions, and “Dirty Cooling”, based on chemical substances HFCs that are polluting the air and warming up the planet.

The C4R technology is definitely and univocally perceived as one of the most sustainable, beneficial and economical proposals from the industry

LIFE C4R may positively impact on several policy regulations, by introducing in the market a solution that can reduce the HFCs use, reduce energy use and GHG emissions of the commercial refrigeration sector:

### [Regulation \(EU\) 517/2014 on fluorinated GHG \(F-Gas Regulation\)](#)

The current F-Gas Regulation (EU 517/2014) introduces the following specific measures:

- Limits the total amount of the most important F-gases that can be sold in the EU from 2015 onwards and phasing them down in steps to one-fifth of 2014 sales in 2030
- Bans the use of F-gases in many new types of equipment where less harmful alternatives are widely available, such as fridges in homes or supermarkets, air conditioning and foams and aerosols
- Prevents emissions of F-gases from existing equipment by requiring checks, proper servicing and recovery of the gases at the end of the equipment's life.

Following the implementation of the 2014 F-Gas Regulation, the commercial refrigeration industry has fully adapted its technologies and product portfolio favoring natural-based refrigerants, carbon dioxide (R744,



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CO<sub>2</sub>) and propane (R290), which are currently used in the market in new refrigeration systems and which do not cause direct greenhouse effect.

As part of the European Green Deal, the EU has raised its climate ambition, and committed to net greenhouse gas emission reductions of at least 55% by 2030, and climate neutrality by 2050. To achieve this, the European Commission is in the process of reviewing all climate relevant rules, including those on F-gases.

The first Fit for 55 package is due to be adopted in summer 2021, and a review of the EU F-gas Regulation (EU) No 517/2014 will follow by the end of 2021. The Regulation is the main instrument for reducing emissions from fluorinated greenhouse gases in the EU. Besides its contribution to the EU targets and the goals of the Paris Agreement, the EU F-gas Regulation must also ensure compliance with the EU's obligation to reduce consumption and production of hydrofluorocarbons (HFCs) under the Montreal Protocol on substances that deplete the ozone layer.

The Commission is currently reviewing Regulation (EU) No 517/2014 (the 'F-gas Regulation'). This review evaluates how well the Regulation has functioned, following the standard framework for evaluation of EU policies by examining its relevance, effectiveness, efficiency, coherence and EU added value.

Preliminary findings and insights were reported in a briefing paper published last 6th of May 2021. The new Regulation is expected by end of 2022.

EPTA has carried out continuous and permanent actions to advocate the F-Gas increased ambition and in particular a review to completely phase out HFCs in new equipment and in maintenance and foster the use of natural refrigerants towards the European Commission.

During the open consultation (29 June – 7 September 2020) and in all direct and indirect (via the Italian Association Assocold and Eurovent - European HVAC&R Industry Association) subsequent consultations EPTA has advocated a position in total favor of an increase of ambition and an acceleration of the HFCs total phase out in Europe.

Thanks to its advantages, LIFE C4R can have an effect on the new 'F-gas Regulation', because it has proved that it is technically, economically and socially beneficial to replace all HFCs with natural refrigerant CO<sub>2</sub> and confirmed that the technology is ready and no barriers are posed by any of the current standards.

[Directive 2018/2002/EU amending Directive 2012/27/EU on energy efficiency + European Green Deal](#)



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The new amending Directive on Energy Efficiency (2018/2002) sets a headline energy efficiency target for EU energy consumption for 2030 of at least 32.5%. As part of the EU Green Deal, the European Commission proposed in September 2020 to raise the 2030 greenhouse gas emission reduction target, including emissions and removals, to at least 55% compared to 1990. LIFE C4R impacted on both these directives, by introducing in a sector highly impacting on EU energy consume and GHG emissions (1.1 TWh/year of energy consumption/production, and 90.5MT CO<sub>2</sub>eq), a solution that cut energy consumption by 8%-23% and total GHG emissions by 6%-21% compared to competitor CO<sub>2</sub> based technologies.

#### Italian recovery plan

At national Italian level, EPTA is actively working to support the approval of specific measures (tax incentives) in the context of the Italian recovery plan to promote the retrofitting of old refrigeration systems using highly climate impacting HFCs (GWP> 1500) with new commercial refrigeration systems that use natural refrigerants (CO<sub>2</sub> and propane) and better energy efficiency.

In Italy, fluorinated gases represent 4.4% of the total greenhouse gas emissions in terms of CO<sub>2</sub> equivalent in 2018. In particular, HFCs show a significant increase between 1990 and 2019, from 0, 4 to 16.8 million of CO<sub>2</sub> equivalent tons (MCO<sub>2</sub>eqT).

The main sources of emissions are the consumption of HFC-134a, HFC-125, HFC-32 and HFC-143, which are highly climate-impacting and polluting refrigerants that are the main components of the blend mixtures used in refrigeration and air conditioning systems.

ISPRA (Italian Official Institute for environmental research and protection, operating for the Italian Ministry of Ecological Transition) in its Italian Greenhouse Gas Inventory 1990-2019 (April 2021) quantifies the contribution required from the industrial processes and F-gas sector to be 6 MCO<sub>2</sub>eqT to align with the net zero emissions targets by 2050.

Meanwhile in the rest of Europe greenhouse emissions from HFCs have been progressively decreasing for years, **in Italy they are increasing exponentially due to the consumption of very high-GWP refrigerants (over 2500 tons per year) used mainly for the maintenance** of old supermarkets and hypermarkets which lose these highly climate-impacting refrigerants in the environment at a yearly rate of averagely 15% due to the operating leakages.



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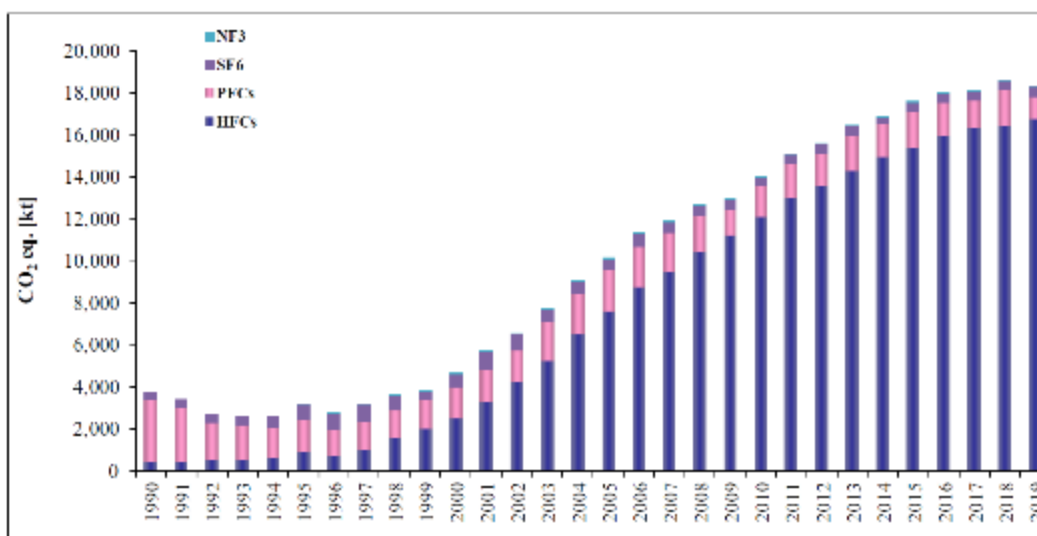


Figure 2.7 National emissions of fluorinated gases by sector from 1990 to 2019 (kt CO<sub>2</sub> eq.)

Although in some European countries it is possible to observe a positive trend of HFC phase down, the amount of F-Gases used in commercial refrigeration is anyway consistent and we are still everywhere in Europe far from meeting the goals of the Climate Law.

**The market uptake of the LIFE C4R technologies, with the use of natural refrigerant CO<sub>2</sub> instead of climate altering HFCs and the increase in energy efficiency, can effectively support the transition towards the climate neutrality in the commercial refrigeration sector in Europe and worldwide.**

To obtain a significant reduction in HFC consumption it is not enough to regulate only new systems, as done by the F-gas regulation. It is necessary to reduce the consumption of HFC with very high greenhouse potential (more than 2500 tons/year) tied to the maintenance of old supermarkets and existing hypermarkets which still use highly climate-impacting refrigerants and which, on average, disperse 15% per year in the environment due to operating losses (>2500t/yr).

Therefore it is crucial and urgent to put in place a **structural program to retrofit** the old highly climate-impacting commercial refrigeration systems with new systems equipped with modern natural refrigerant technologies and improved energy efficiency.

The expected benefits of this action are:



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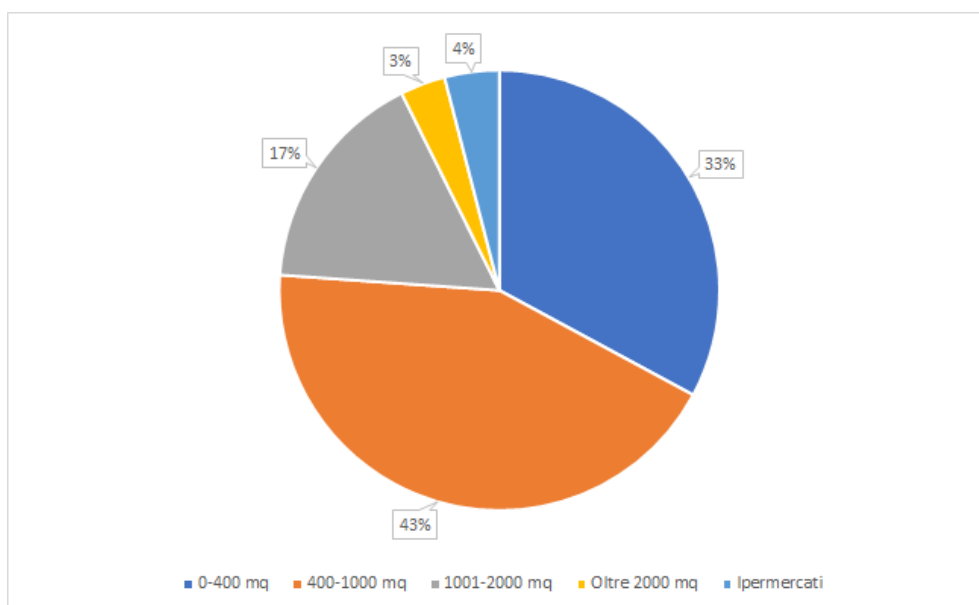


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- Environmental, a dramatic reduction of the polluting CO2 emissions, as retrofitting a store from R404A to CO2 means cutting its direct greenhouse emissions by 4000 times;
- Modernization of the food distribution network;
- Reduction of operating costs and bureaucratic burdens;
- The prices of natural refrigerants are low and stable, whereas HFCs' price has increased enormously (especially R404A, + 700% compared to 2018)<sup>29</sup>;
- Stop the big business in the illegal HFC market;
- Preserve jobs in the manufacturing and service companies, that account for more than 8000 employees and over 2 bn€ turnover in Italy.

EPTA invited the Italian policy makers to promptly act in this direction, by introducing in the Italian Recovery Plan incentives for the reconversion of older commercial refrigeration systems by replacing them with modern natural refrigerant systems and low consumption, technologies in which the Italian companies retain absolute leadership at world level.

We have analyzed the Italian commercial retail sector using the data from the Market Reports of the Ministry of Economical Development.



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| Ripartizioni | 0-400 mq | 400-1000 mq | 1001-2000 mq | Oltre 2000 mq | IPERMERCATI |
|--------------|----------|-------------|--------------|---------------|-------------|
| Nord Ovest   | 1339     | 1817        | 878          | 223           | 278         |
| Nord Est     | 1011     | 1769        | 794          | 175           | 180         |
| Centro       | 848      | 1313        | 544          | 109           | 97          |
| Sud Isole    | 2491     | 2583        | 647          | 67            | 140         |
| ITALIA       | 5689     | 7482        | 2863         | 574           | 695         |

EPTA estimated that the number of stores that still use HFC gases with high GWP (around 4000) in Italy is currently 7,700.

The incentives shall be addressed to all 17.303 food retail stores in Italy except:

- #5689 Stores with surface <400sqm equipped with R290 plug-in cabinets and/or small refrigeration systems with medium GWP refrigerants (R448A GWP1400)
- #2400 Stores realized in the last 5 years with refrigerants GWP<1500
- #1500 Stores that were retrofitted with new refrigerants GWP<1500

(market information by members of the national association of refrigeration manufacturers)

The food retail stores that need to be addressed are **7.700**:

|                      | 400-1000 sqm | 1001-2000 sqm | Oltre 2000 sqm | Hypermarkets | Total |
|----------------------|--------------|---------------|----------------|--------------|-------|
| <b>North West</b>    | 1.027        | 218           | 178            | 248          | 1.671 |
| <b>North East</b>    | 989          | 184           | 130            | 150          | 1.453 |
| <b>Center</b>        | 948          | 294           | 99             | 77           | 1.418 |
| <b>South Islands</b> | 2.368        | 597           | 67             | 140          | 3.172 |
| <b>ITALIA</b>        | 5.332        | 1.293         | 474            | 615          | 7.714 |

In order to encourage the smaller retailers in particular, a decreasing tax rate is proposed in relation to the investment:

- 40% up to 300.000€
- 25% up to 500.000€
- 10% over 500.000€



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Given an estimated budget for the retrofit of the a.m. stores over a period of 7 years, time estimated as reasonable considering the characteristics of the market, the predisposition to investments and the climate targets, the result is an average annual cost of about € 120 million. The saving in emissions for the retrofit of these stores, given both by the savings in HFCs and the increased energy savings is approx. 2,5 MCO<sub>2</sub>eqT/year.

The proposal has been presented to several members of the Italian Parliament and of the Government and a law has been drafted (already co-signed by 40 senators) and is currently being discussed in the frame of the Italian Recovery Plan and/or 2022 budget law.

Ref. DDL “Disposizioni in materia di transizione ecologica, per il contrasto all'aumento dei gas serra fluorurati, provenienti dalla refrigerazione commerciale”

In the meantime, the Italian ministry for the ecological transition (Mite) acknowledged the huge environmental impact that LIFE C4R project could have in Italy, and decided to nominate LIFE C4R project “the LIFE project on the month”, for next January 2022.



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