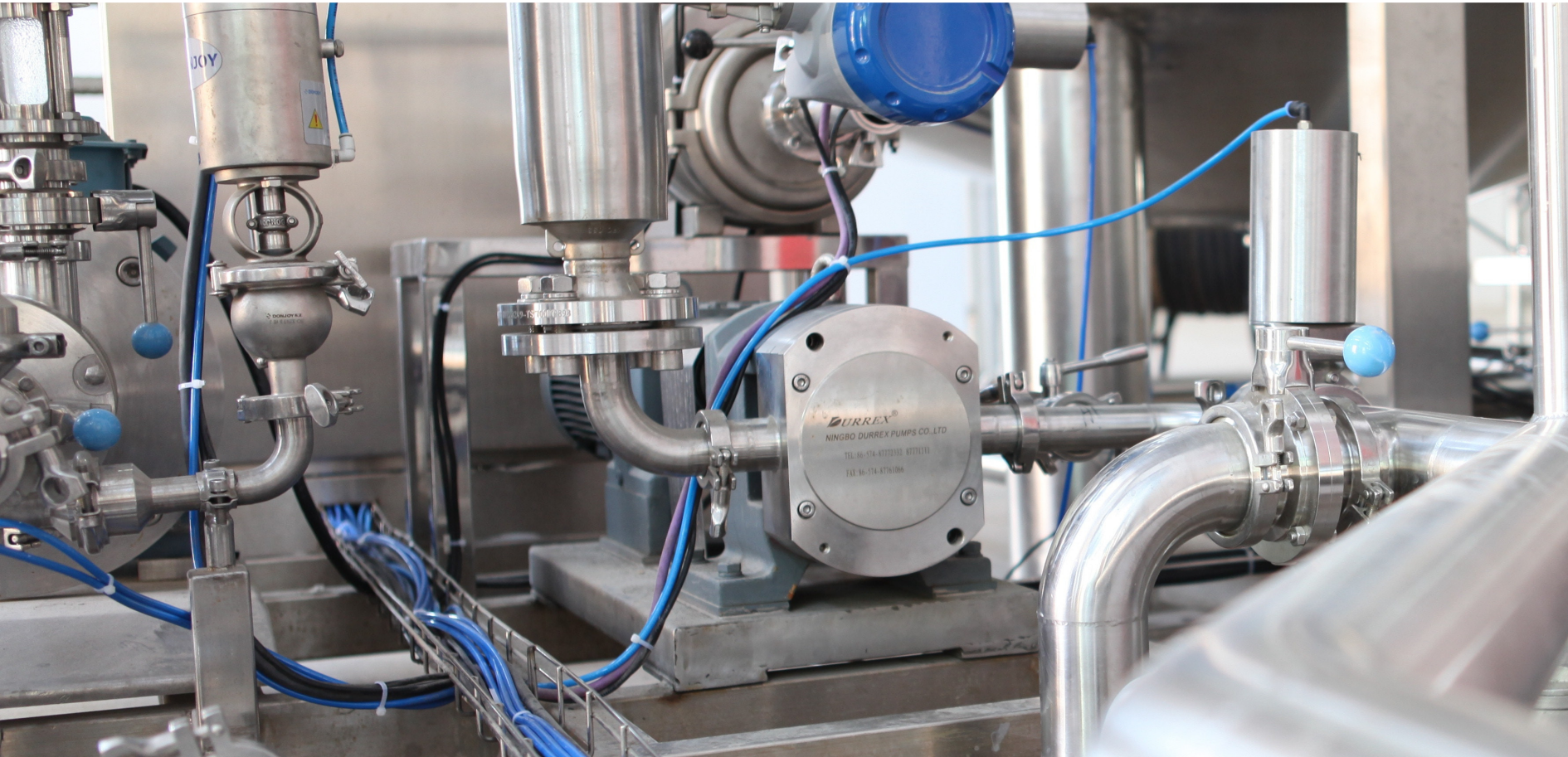


COOLBA



**CENTRALIZED SYSTEM
REFRIGERATION AND CLIMATIZATION**

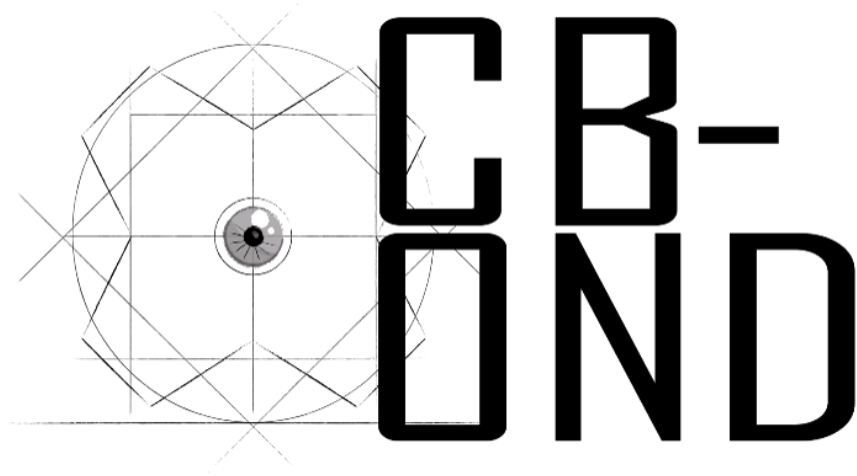
CO-PARTNERS



**PORTO
DESIGN
FACTORY**



TEAM





João studies Industrial Design at ESMAD. Likes to learn about everything, getting lost in new topics and finding new interests by accident. To be multidisciplinary is of the greatest value to him.



Luís wakes up in the morning... and wants to learn more. Passionate about management and communication since he was a child. For him, this is an opportunity to grow, to meet new people and to work and improve multidisciplinary skills. Luís really likes to know new companies. Learn with people from other countries and other areas is good. Working in Porto Design Factory with them is amazing.



Values versatility and efficiency. Owner of an academic background in Music and Singing Pedagogy but never felt fully accomplished. Had a couple of other occupations and lately started a degree in Industrial Engineering and Management. Besides that, Sara was always a big sucker for project-based learning and multidisciplinary, that's why Porto Design Factory and Challenge Based Innovation Program caught her eye and now here she is!

ABSTRACT

CHALLENGE BASED INNOVATION (CBI)

Three Polytechnic Institute of Porto students met and teamed up under the guidance of Porto Design Factory for the Challenge Based Innovation Program, powered by Swinburne University, Design Factory Melbourne and Ideasquare at CERN.

This white paper showcases what they achieved by the end of the six-month long project.

The United Nations set seventeen Sustainable Development Goals that mobilize efforts to end all forms of poverty, fight inequalities and tackle climate change while ensuring that no one is left behind until 2030.

Challenge Based Innovation (CBI) program relates the 12th goal - Responsible Production & Consumption - with the existing technology developed at CERN, addressing it to a local problem.

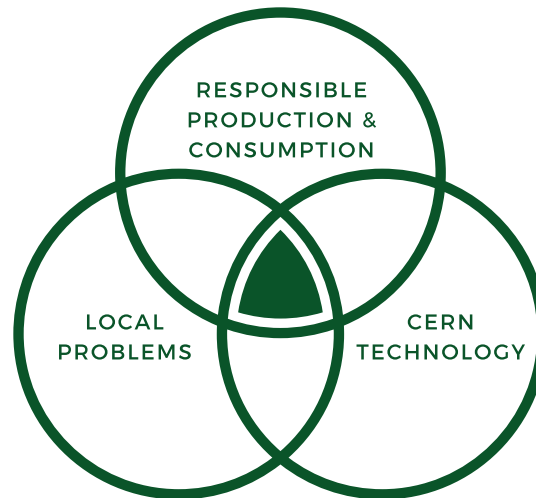
We will show you three ideas for different time scenarios: 2020, 2025 and 2030.

Key Words: CO2, Refrigeration, Climatization, Centralized System

INDEX

Vision	9 - 11
Thinking The Future	11
Technology	12 - 13
CO2 Cooling System	12 - 13
Problem	14 - 15
Refrigeration	14 - 15
Concept	17 - 26
Centralized System. How Coolba is born.	18 - 19
Centralized System. How it works.	20
Centralized System. Design Detail	21 - 22
Door Design	23
Door Design - Design Detail	24 - 25
Modular System	26 - 27
Stages - 2020, 2025, 2030	28
Business Model	29 - 32
User	30
Customer	31
Value Chain	32
Colba's Purpose	33
Hero Images	34 - 35
References	36 - 37

HOW MIGHT WE REDUCE THE HOUSEHOLD ENVIRONMENTAL IMPACT IN OPORTO BY 2030?



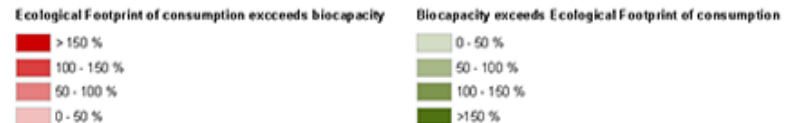
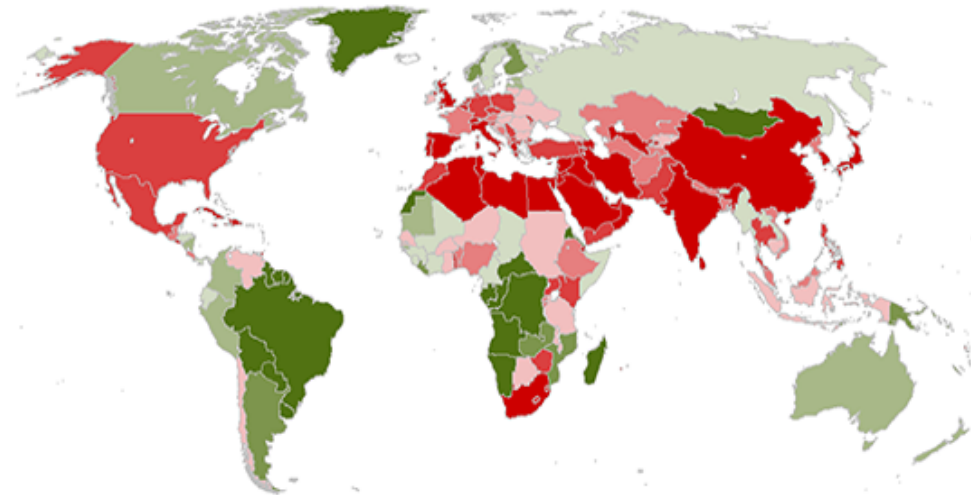
VISION

THINKING THE FUTURE

Our planet resources are paying the biggest price for our growth.

We must reduce the ecological footprint and change the way we produce and consume goods and resources. Studying Oporto and considering CERN technology, we understood that:

Working on the **Refrigeration** and **Climatization** subjects would be the best way to address e-waste and energy efficiency.



INTEGRATED CO2 COOLING SYSTEM

The Integrated 2-Phase Accumulator Controlled Loop (2PACL) is the new model of the existing 2 PACL system developed for the AMS-Tracker and LHCb-VELO CO2 cooling systems.

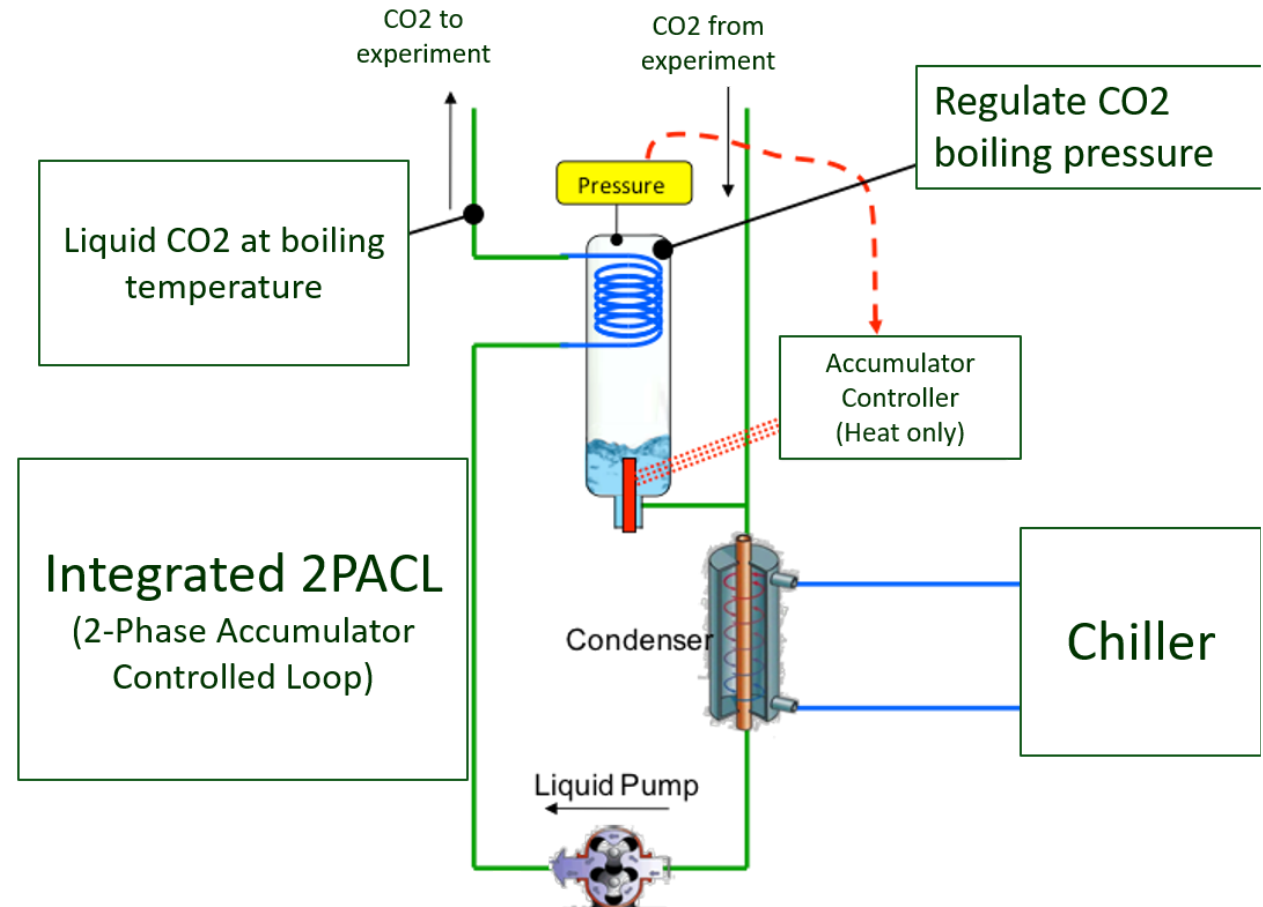
This system, through its compressor, applies an atmospheric level of 5, turning the gaseous CO2 into liquid CO2. This liquid CO2 is then sent to the experiment, evaporates and returns to the compressor.

CO2 cooling has very good physical properties which allow small diameter tubing. Regarding traditional Fluorocarbon systems, the cooling system mass can be reduced by about 80% (Verlaat et al., 2012)

ADVANTAGES

- Clean and green technology
- Small cooling tubes
- Accurate (isothermal) and direct temperature control on distant experiments
- Higher energy efficiency rate while working for longer periods

INTEGRATED CO2 COOLING SYSTEM



PROBLEM

REFRIGERATION SYSTEMS

The world's population is growing.

Actually, it is estimated that population grows almost 3 billion in the next 30 years, which means that cities will continue to grow, we will have more buildings, more consumed energy and produced e-waste.

Considering the households refrigeration in Oporto, this is an alarming situation.

We need to do more and better with less.



*Every time we talk about «fridges», we mean «fridges and freezers».



**WHAT IF WE USED A CENTRALIZED SYSTEM TO
REFRIGERATION AND CLIMATIZATION?**

CONCEPT

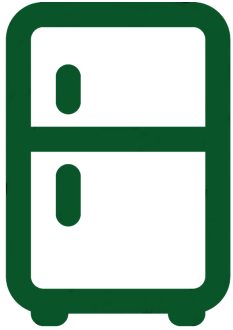
CENTRALIZED SYSTEM

Centralized facility systems, such as water and gas, became a common aspect of our modern lives.

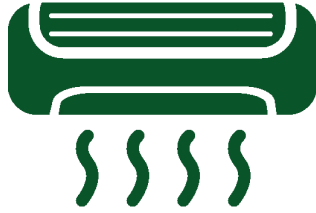
Taking a closer look at modern household refrigeration and climatization, everyone has a fridge and its compressor at home and may even have air conditioning systems.

So, why not have a centralized system in the building for refrigeration and climatization? We envision this solution for the fridge, the air conditioning, and the radiant floor.

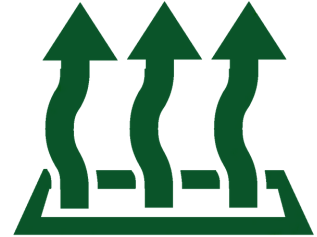
That's how **Coolba** is born.



+



+



CONCEPT

CENTRALIZED SYSTEM

We collected some data about fridges in Oporto. This type of equipment represents 6 000 000 kg of e-waste every 10 to 15 years.

Each fridge has a compressor. What if we decrease the number of needed compressors?

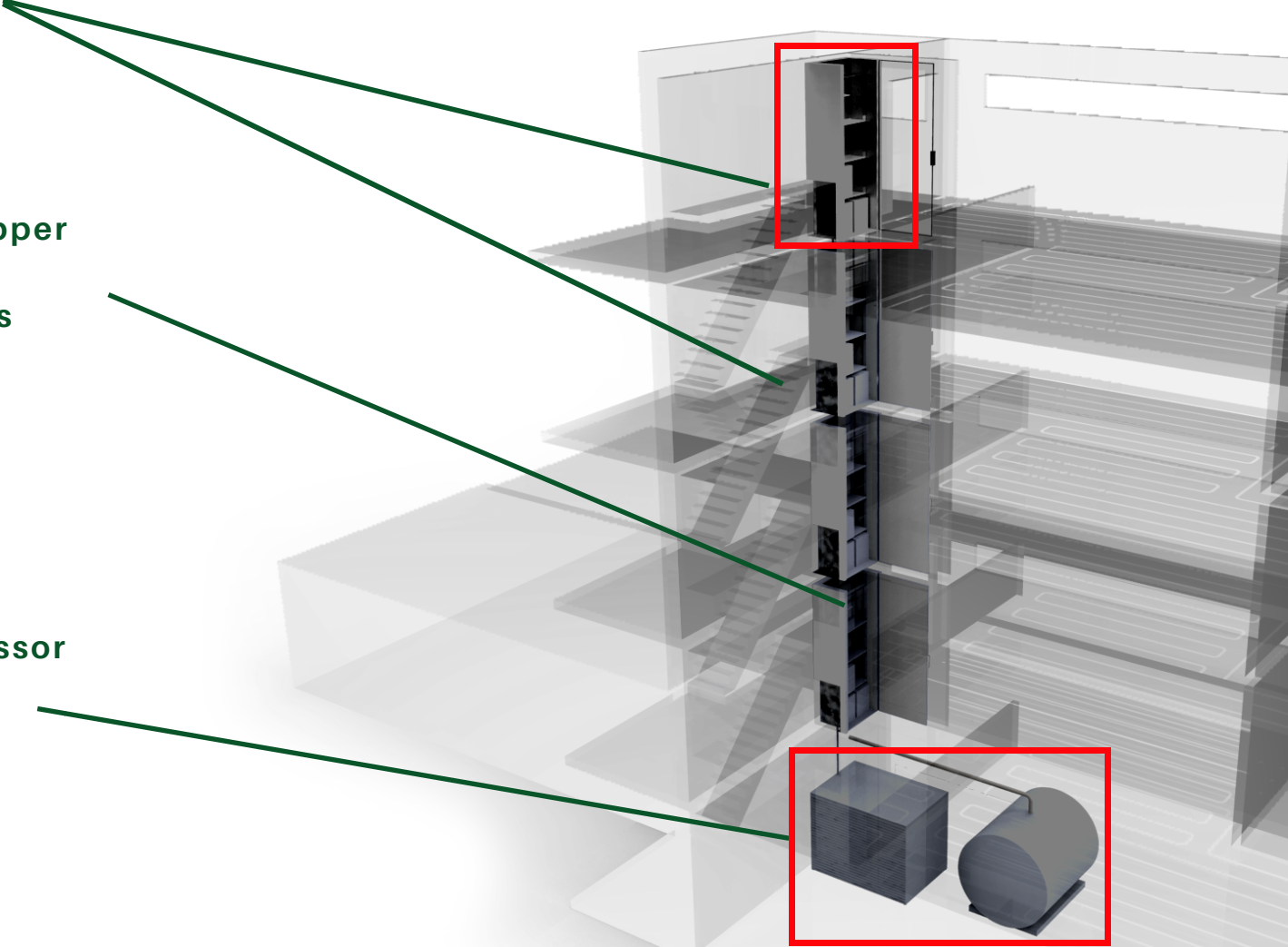
We thought about a centralized refrigeration and acclimatization system using the Integrated 2PACL: one compressor would be placed in the building basement, connected by pipes to all the apartments, bypassing the need of having one compressor per apartment.

According to Danfoss research, which has a similar refrigeration technology, our solution could **increase the system efficiency by 20%**.

Built-in fridges

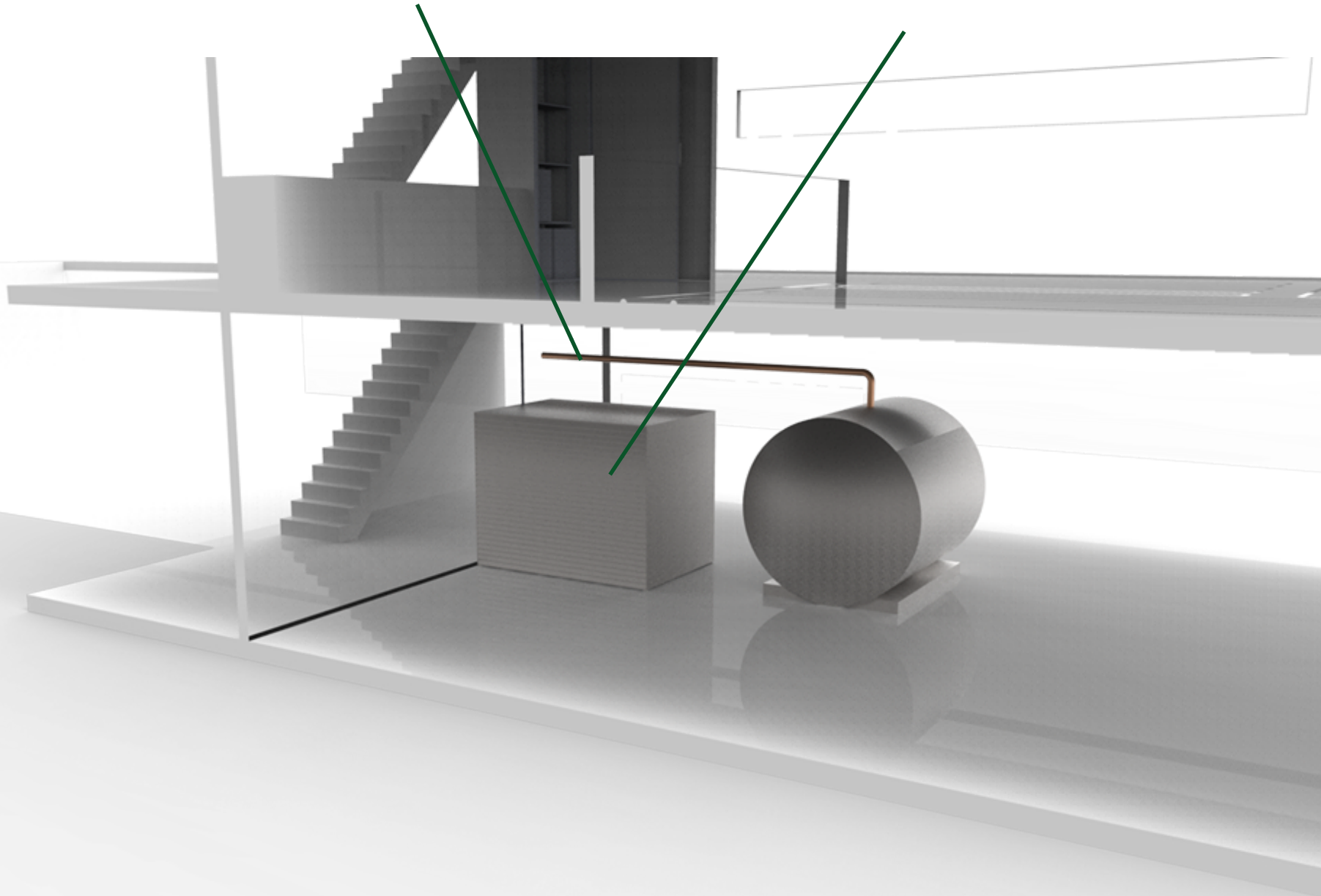
**Stainless steel or copper
3.175mm pipes with
0.2mm wall thickness**

CO2 System Compressor



**Pipes carrying
CO2**

**CO2 System
Compressor**



CONCEPT

CENTRALIZED SYSTEM - DOOR DESIGN

We also want to change how we look at fridges, and maybe we can introduce you to some interesting concepts on that subject. The average fridge weight is 100 kg. Having a **built-in fridge**, we can reduce the quantity of materials used.

We can also have a glass door. In this way, we would mitigate those energy losses that happen when we open the door just to check what is inside the fridge. Using an **electro-transparent glass** door, we can toggle it transparent or opaque (Yes, we know, sometimes the fridge is a mess and we don't want our visits to take a peek!).

Each apartment would have a counter to monitor the share of Coolba usage.

MODULAR PLUG-IN FREEZER UNITS



**Adjustable shelves and
walls of sheet metal
with polyurethane rigid
foam filling**



**Plug and play freezer
mobile boxes inside**



Fridge with electro-transparent glass door off



Fridge with electro-transparent glass door on

CENTRALIZED SYSTEM -MODULAR SYSTEM

ATTENTION, FUTURISTIC SCENARIO!

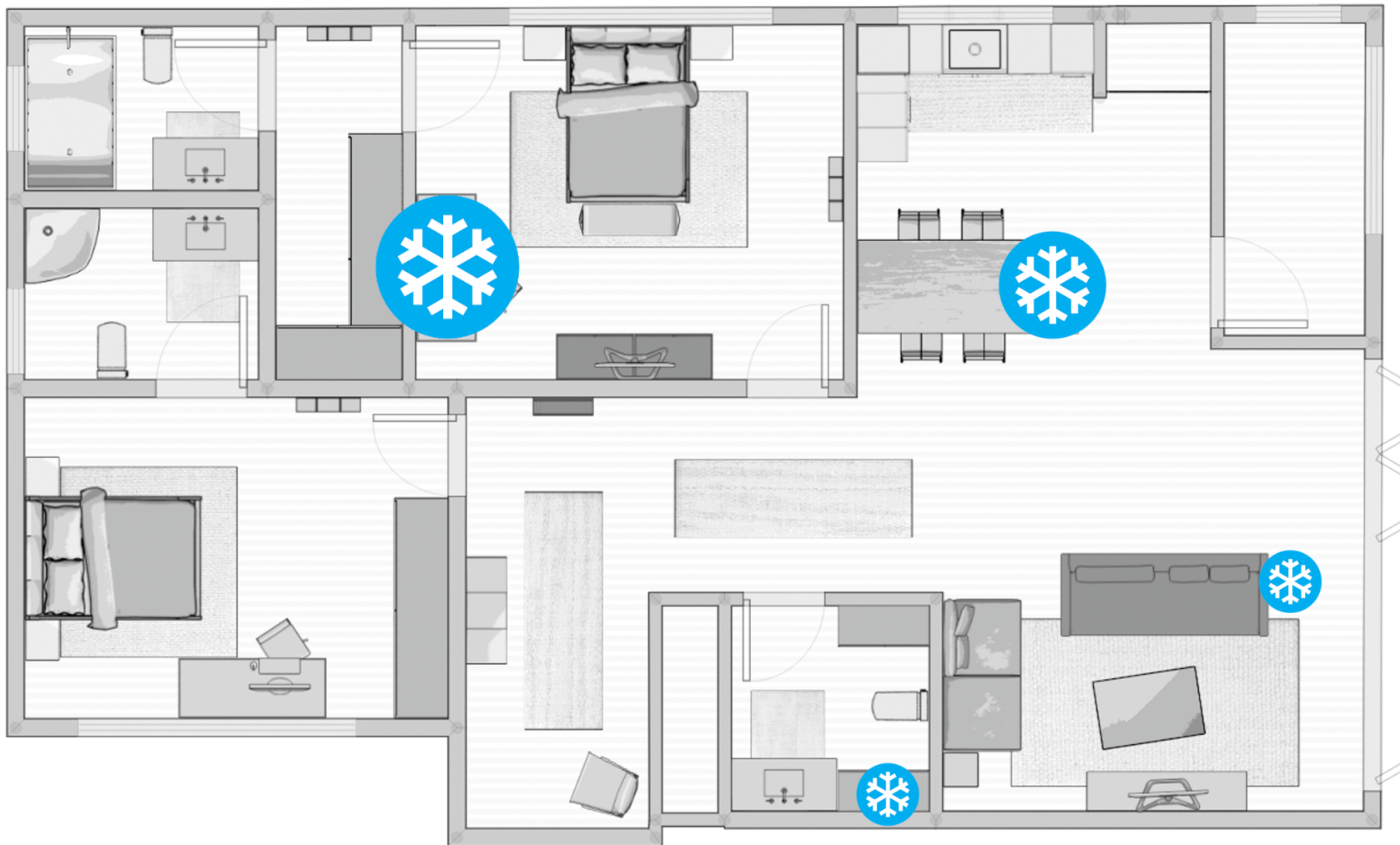


Regarding the growth of population and the growing interest of people to live in the center of cities, we expect an increase in having more shared houses.

We thought about creating a modular system to complement household refrigeration. So, our centralized system takes refrigeration not only for each cooled pantry but also for each module. With the modular system, the refrigeration pipes circuit begins in the basement's compressor and merge with the energy tubes until the Coolba outlet, next to each power outlet. We could also have Coolba outlets in other places, such as light or shutter switches.

Even in shared houses, each person can have its own small/modular fridge and connect it to the Coolba outlet. This modular fridge can even be a drawer!

We also think this can be useful in hospitals to preserve medicines or analysis laboratories to preserve samples.



2020



Centralized System.
Continue developing the concept. Start looking for partnerships and customers.

2025



Make it real. Start installation
in new buildings and reconstructed buildings.

2030



Shared houses. Use
modular system as a plus
for the centralized system.

WHO IS COOLBA FOR?

WHO WILL USE COOLBA?

We will install a centralized system that includes the fridge, the air conditioning, and the radiant floor. For the business model, we won't consider the modular system because it is a really futuristic project.

We think the user will be a man or woman, interested in living in the center of Oporto, looking for a new or reconstructed building. Another possible user is the growing family with environmental concerns.

Both types of users want to reduce the energy consumption and e-waste production.



Age: 25-45

Wants: To live in downtown in a new building or in a reconstructed building

Needs: Comfortable house

Desires: To help the planet's survival

WHO WILL BUY COOLBA?

Between 2020 and 2025, we want to find partners/clients. But who are they?

We studied many ways about how to sell the idea and how to make money.

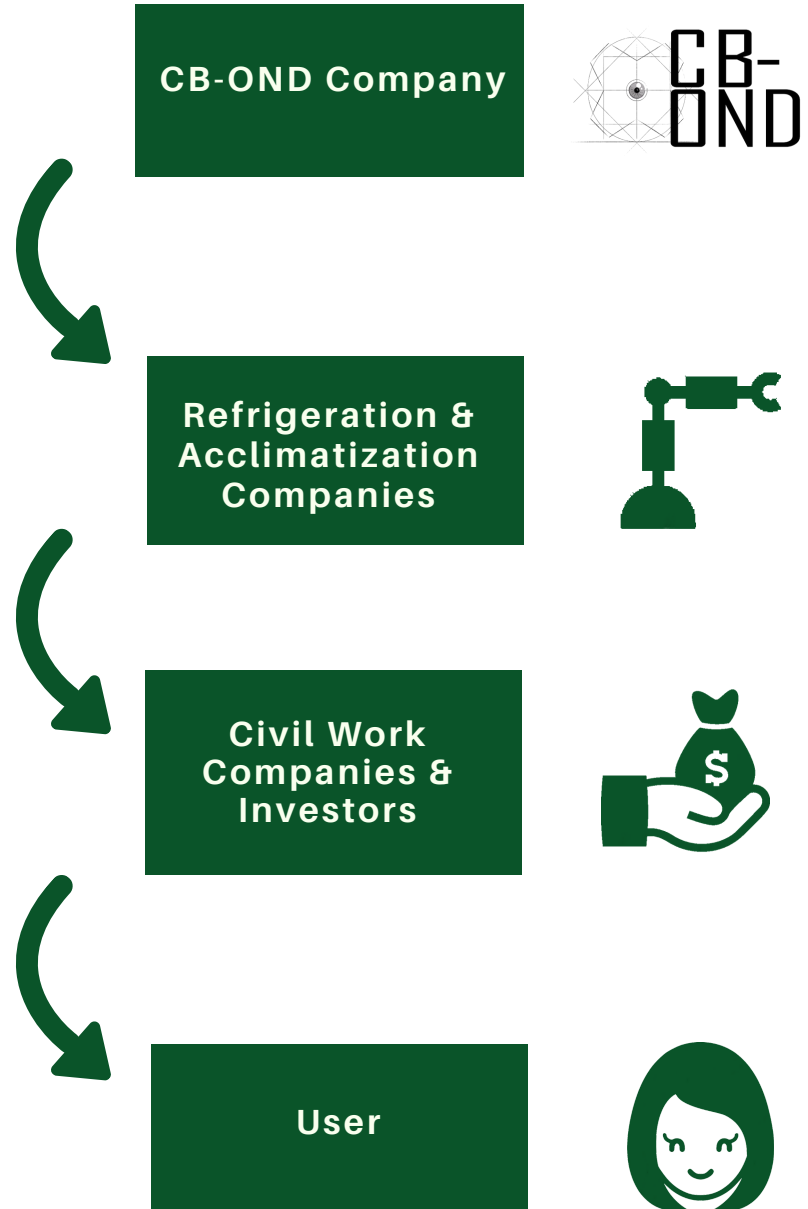
We think our target for Coolba are companies that work on refrigeration and acclimatization and companies that work only with one of these sectors but want to work on the other, through partnerships.

We believe that companies like Race, Friar, Frostline or Danfoss could be interested in installing the centralized system.

Our main added value as a team would be to sell our consultancy and expertise to companies like the above, teach them how the system works for one year and then have them paying a royalty for each installation. This model allows companies to start working and make money since early and bypass expenses on research and development.

This model needs further developments considering we are using CERN technology.

BUSINESS





**Improve
Energy Efficiency**



**Reduce
E-Waste**

REDUCE THE E-WASTE



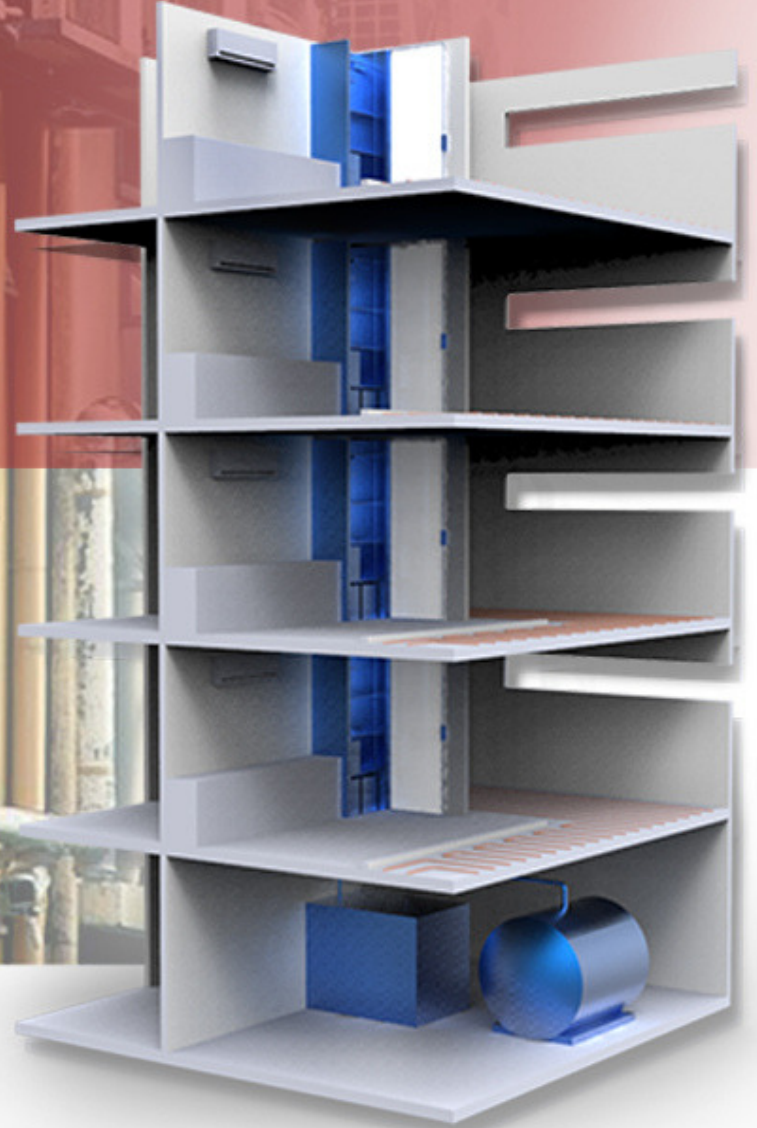
FRIDGE



HVAC



**RADIANT
FLOOR**

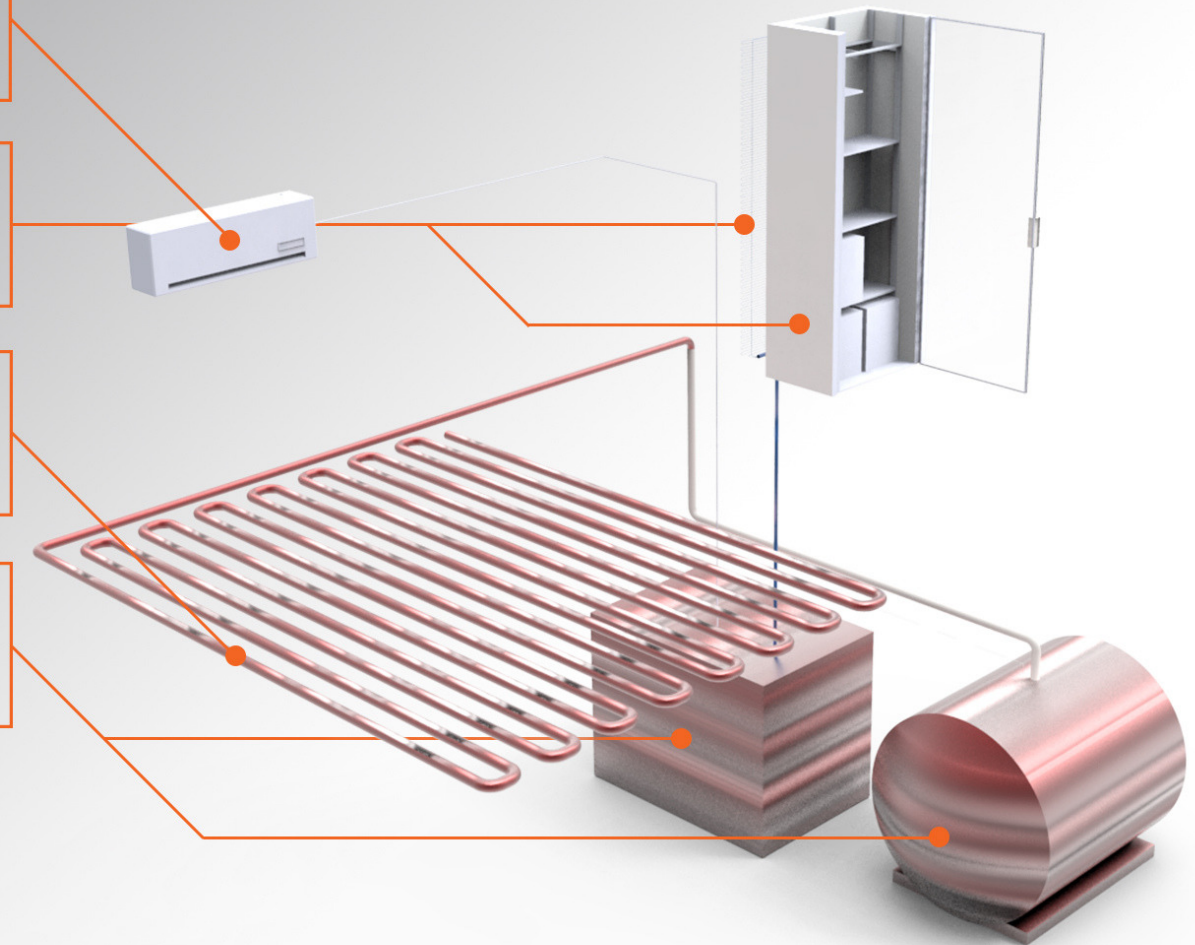


Air-Conditioning Unit

Fridge & Cooling Pipes

Radiant Heating

CO2 Compressor & CO2 Hot Pump



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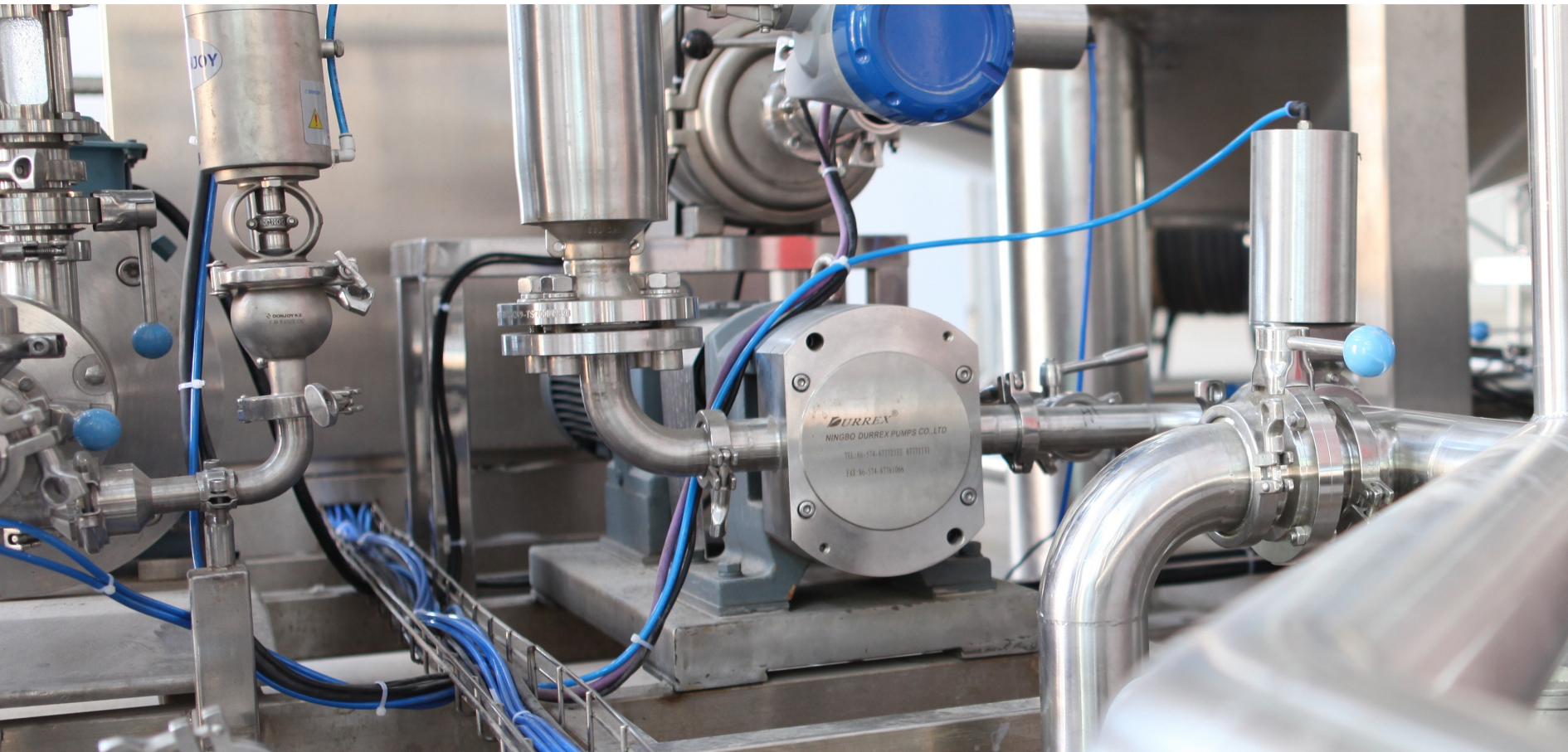
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**PORTO
DESIGN
FACTORY**

