

Roll out and Experience of Natural Refrigerants based technology at Carrefour



Agenda

- Executive Overview
- Carrefour mapping NR
- Reasons and choice for using NR
- Results from our test hybrid stores
- Barrier and solutions
- Future plans
- Action plan

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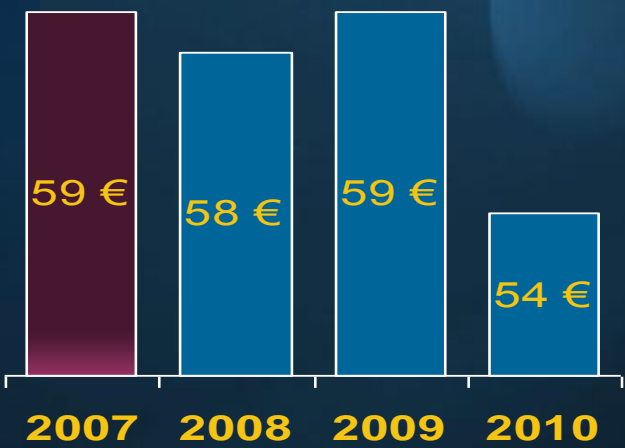
Executive Summary

- Among other sustainable development in action pursued by Carrefour, refrigeration is a major concern subject, indeed is significant and growing source of greenhouse gases. This is because is dominant technology hydrofluorocarbons (HFC) is 1400 times more potent than carbon dioxide as a greenhouse gas. HFCs represents 1.5% of total warming potential today and are expected to increase 69% of total GHG by 2050 unless we take action
- Executive Committee of Carrefour recognizes the major and increasing contribution to total greenhouse gas emissions from hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) and derivative chemical refrigerants. Carrefour is taking action to mobilize resources within their respective businesses to begin phasing out these refrigerants by 2015 and replace them with non HFC refrigerants (natural refrigerant alternatives) where these are legally allowed and available for new purchases of point of sale units and existing installations



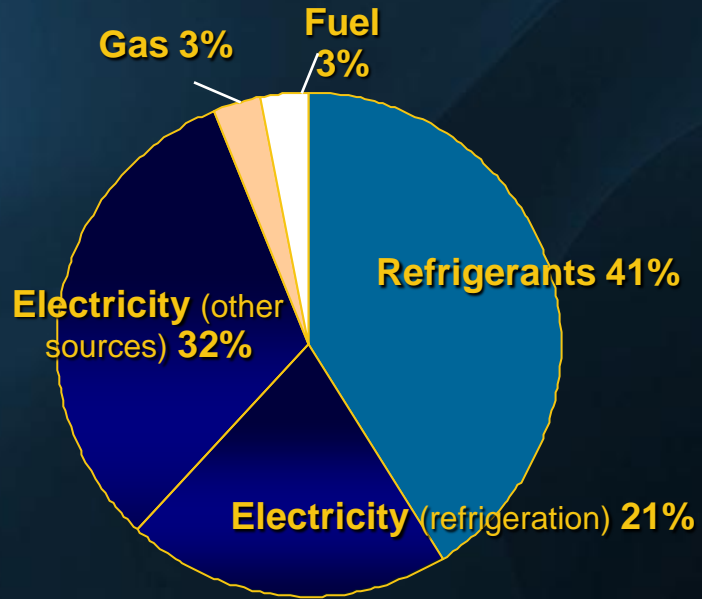
Refrigeration pose 3 important issues to every one of our countries

Operationnal issue
Gas refrigerants volume used in the group



Quantity of gas refrigerant used (kg) per 1000m2 of sales area

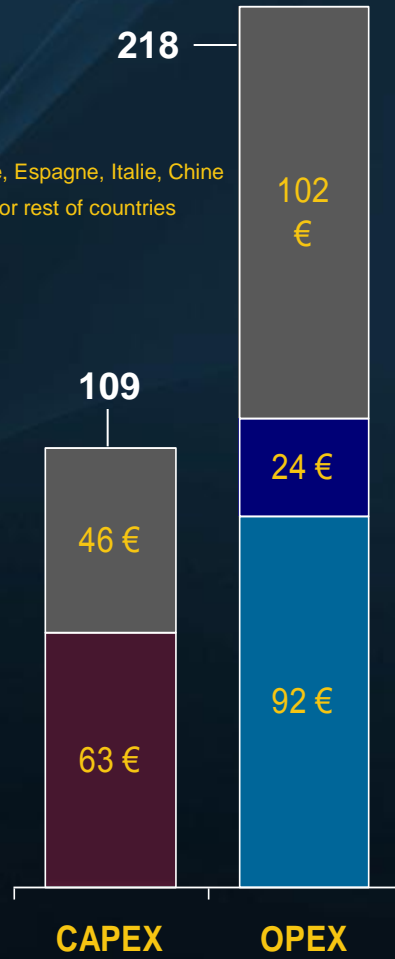
Environmental issue
Emission of CO2 equivalent 2010 = 4M tons



Source: Sustainable Development 2010

Economic issue
Capex and Opex 2010 related to refrigeration

Source: France, Espagne, Italie, Chine
* Extrapolated for rest of countries



Carrefour Group

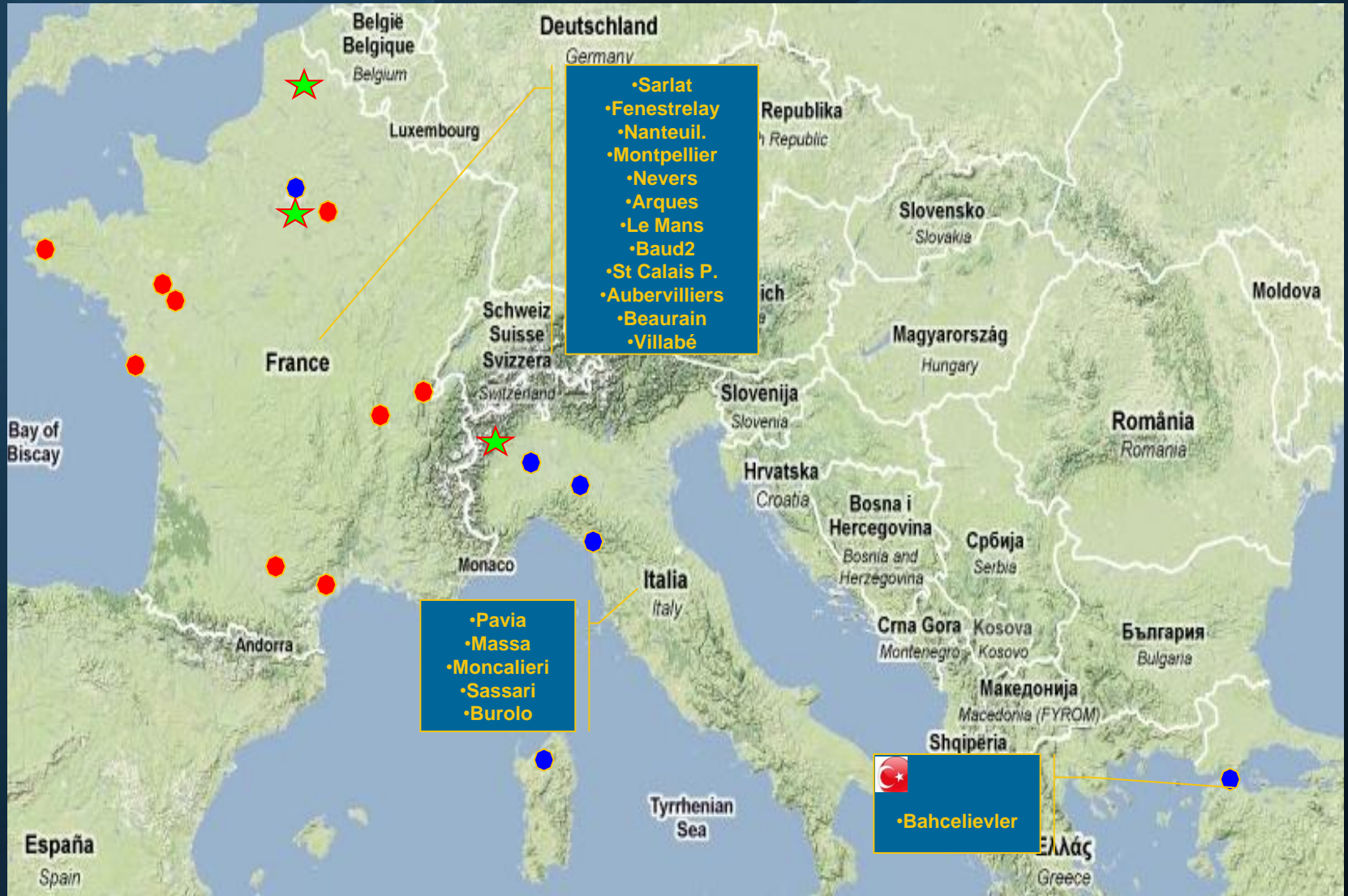


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Carrefour is testing 18 sites* using Natural Refrigerants

*our partners and franchises franchises are testing 9



★ CO2 trans. or NH3

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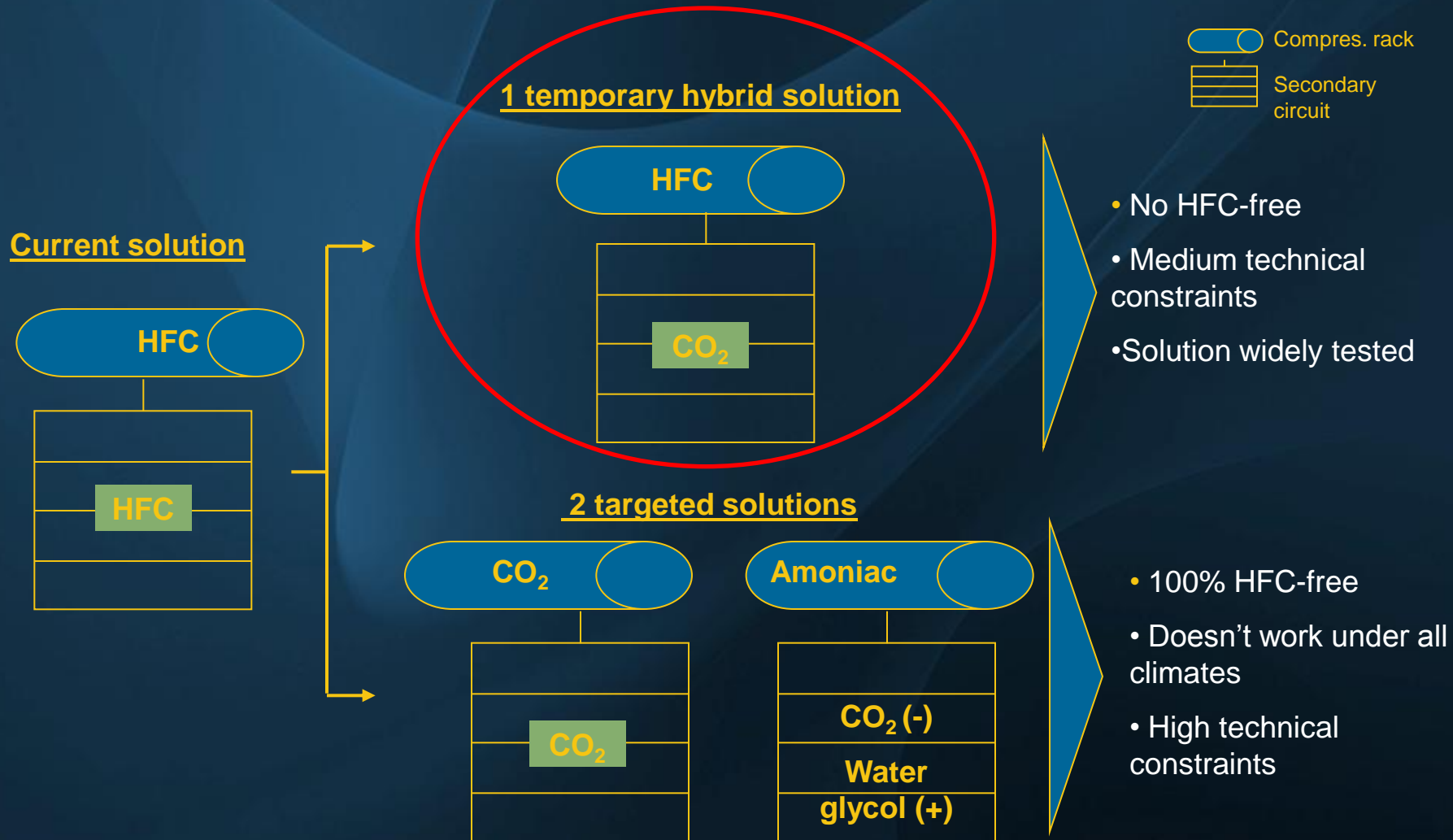
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3 natures of subjects are driven our decision going to NR: environmental, economic, and legal

- Executive committee of Carrefour took commitment to reduce energy consumption – 30% in 2020 vs 2004 and emissions of CO2 -40% in 2015 vs 2009 (France, Belgium, Italy, Spain) and 2020 vs 2004 for remaining countries
- Switchover refrigeration installations to 100% natural refrigerants is going to contribute to reach this challenge. The current solutions 100% NR run with conditions like climates or/and comprise some legal constraints f-gas regulation, government policies, change CE regulations, consequently we have to envisage a temporary solution using CO2 and HFC

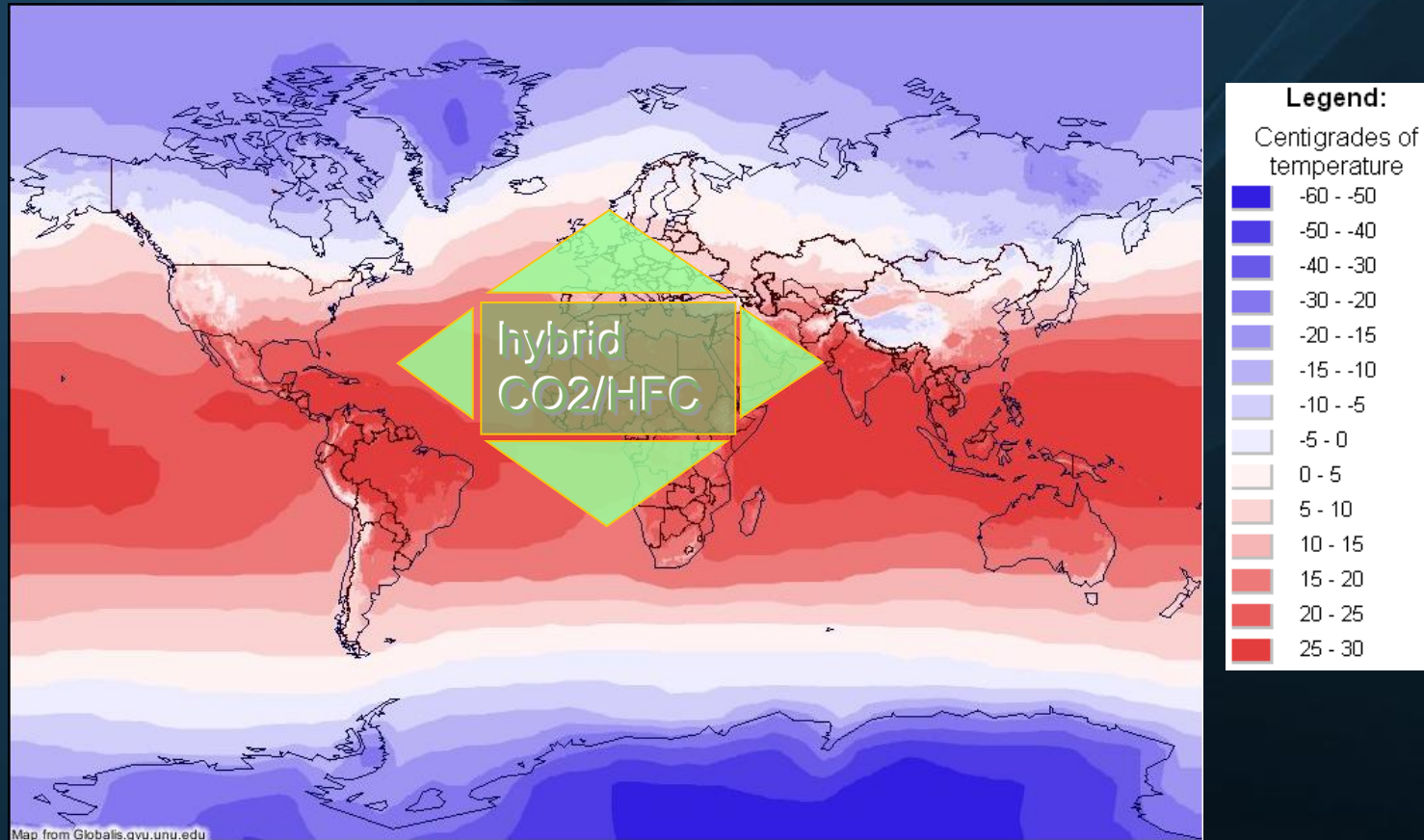


Targeted solutions don't still work under all climates, consequently we envisage a temporary hybrid solution meanwhile we are testing HFC free solution



100% of Carrefour countries can roll-out hybrid technology now

The projects and remodelings can be planed whatever the latitude, without climate constraint



Gas chosen among HFC: R134a is the least noxious

Natural Refrigerants

Ammoniac

- CO₂
- Hydrocarbon (propane)

Natural Carrier fluid

- Glycol water (MEG – MPG)
- Brine
- CO₂

Hydrochlorofluorocarbure (HCFC)

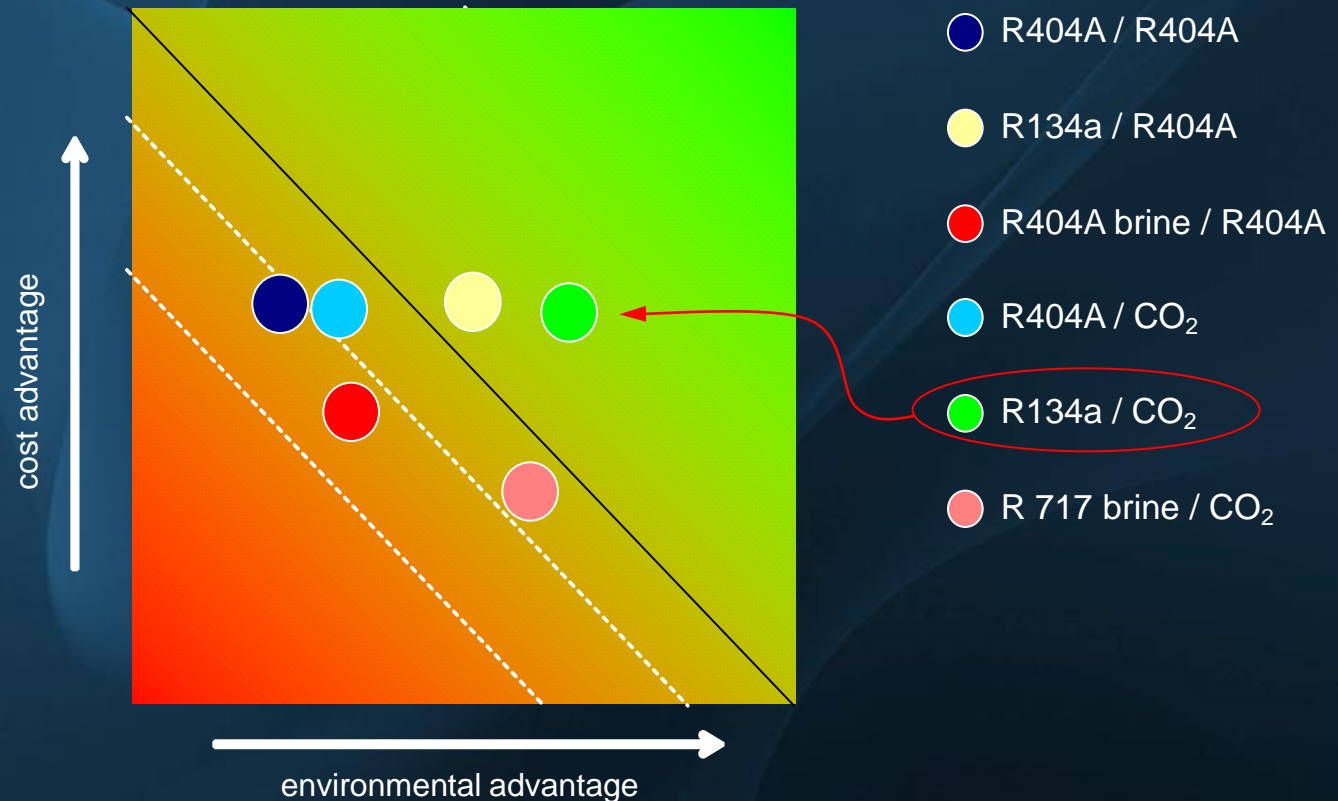
- R22-R (only the gas recycled is allowed)

Hydrofluorocarbures (HFC)

- Gas HFC : R134a / R507 / R404a / R410a
- Gas Dupont type ISCEON: R417A R422D
- Gas FX 100 : R427A
- Performax LT

	ODP	GWP
CO ₂	0	1
H ₂ O	0	< 1
NH ₃	0	0
R 134a	0	1300
R 404A	0	3800
R 507	0	3300
R 22	0.05	1500

Solution CO2/R134 is the best choice among hybrid solutions



* Basis for study

This solution allows to get the best economic performances and contribute to a better sustainable development

Reasons to choice hybrid technology using CO2-R134a

1

100% natural technologies are not enough mature

2

Gas chosen among HFCs, R134a is the least noxious for environment

3

Solution CO2/R134a gets the best combination environment/costs

4

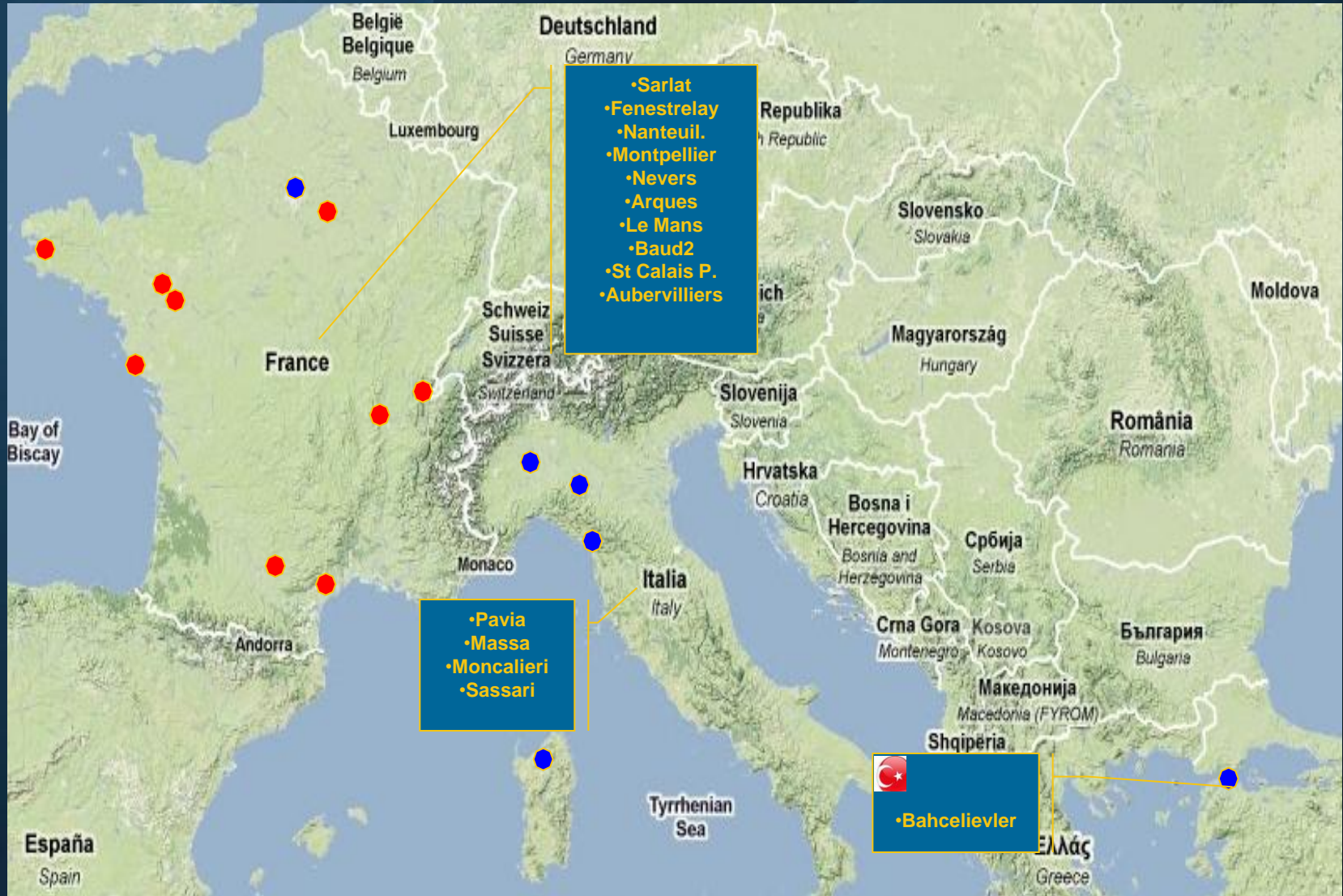
Medium pressure can be spread more easily outside Europe

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Carrefour is testing 15 sites* with Hybrid solutions

*our partners and franchises franchises are testing 9



Gas leaks are unstable and possibly a serious issue and have pushed us to go to NR too

Context

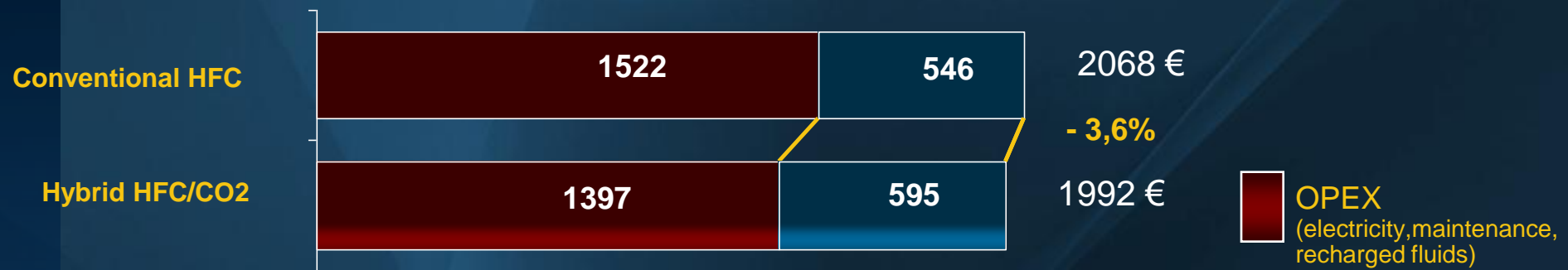
- Our installations run with a majority of HFC refrigerants
- Regularly the volume of leaks is recorded they are unstable country to country, hypothesis average a full year corresponds to 21% of leaks, it corresponds to 9 millions euros
- HFCs will become rare and expensive
- CO2 refrigerant is cheaper, and price would be stable or down

About CO2 stores testing

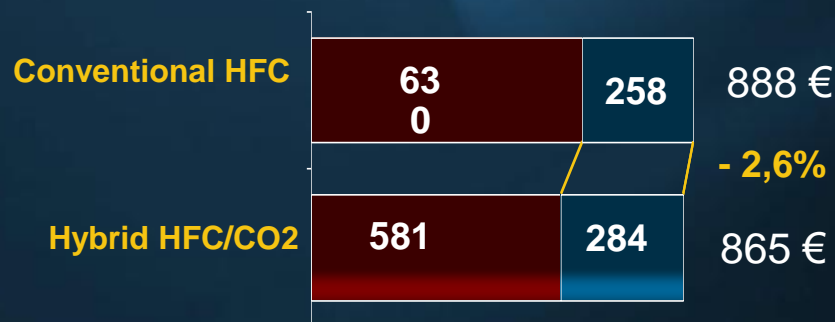
- Leaks were decreased 75% compare with conventional systems, average down from 10.6% to 2.3% (Fr,It,Tu)
- Using CO2 obliges a provision of piping well airtight

Our test stores demonstrate total cost ownership decreases and complying with other experiences in retail sector

Hypermarkets



Supermarkets



In case that we retrofit the whole stores, it represents a decreasing of 52 863 ton eqCO₂, or yearly CO₂ emission* of 13 838 cars



Test CO2 stores delivered encouraging result in TCO

	Non natural technologies	Hybrid single	
	<i>Classic DX</i>	Exist.	Open.
CapEx	100	0	104.3
OpEx *	100	0	93
Energy	100	0	90.7
Maintenance	100	0	114
TCO	100	0	97.4

Capital Expenditure/
Cost to purchase and install CO2 hybrid is high* by comparison against HFCs, but according with market demand increasing, we expect light savings
**because single purchase*

Operation Expenditure/
Throughout our CO2 stores working, and following similar experiences in retail sector, we believe that at least 10% improvement of OPEX compared to HFC system is possible, choice of refrigerants is not enough, adapted a right technical design is essential

Conclusion/
Carrefour had successfully tested hybrid systems in 15 stores, and a wide spread use of CO2 and other conventional energy savings measures related with refrigeration will bring Carrefour closer to our commitment to reduce energy consumption and carbon emissions.

* based on TCO 10 years - medium life cycle: compressors rack 15 years, showcases 10 years

The most of Carrefour stores are located in warm latitudes where only hybrid CO2 systems can be set up

1

Tests stores Hybrid CO2 are convincing

2

Roll out Hybrid CO2 should start now!

3

However we are preparing a second phase with 100% NR

4

Improvement of refrigeration technology should helps us to choice in near future solutions 100% NR

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Some obstacles should be overcome, to succeed in NR

- Technical maturity working with NR solutions is unequally available around the world
- Non standardization of components and heterogeneity of products don't lower the financial access to solutions using 100% natural refrigerants
- Legal constraints like high pressure 120 bars, toxicity, or flammability, of some gas have various consequences on:
 - Perception (firefighting bureau, technical design, trade association, consumers,...)
 - Local regulations (nat. local gov., cities)
therefore we have to envisage a temporary solution using CO₂ and HFC, meanwhile the national or local laws are going to be favourable to NR, and mentality could change rapidly



The technology is advanced compare with installation network

	Belgium-France-Italy Spain-Poland	Greece-Turkey-Romania- China	India-Indonesia-Malaisia-Singapore- Taiwan-Argentina-Brazil-Colombia
Production	<ul style="list-style-type: none"> ■ Components of new technologies are located in West Europe, Europe countries get benefit of this proximity 	<ul style="list-style-type: none"> ■ A stock of CO2 components will be required locally, currently doesn't exist 	<ul style="list-style-type: none"> ■ A stock of CO2 components will be required locally, currently doesn't exist
Installers	<ul style="list-style-type: none"> ■ Some installers have knowledge on hybrid CO2, they can make in same time up to 7 installations, probably no more 	<ul style="list-style-type: none"> ■ The local installers don't handle yet technology CO2, except some of them located in Turkey, Romania and China, this last country has several projects in hybrid CO2 	<ul style="list-style-type: none"> ■ The local installers don't handle yet technology CO2, they will have to deal a partnership and a complete training plan with manufacturers (compressors rack, showcases, components)
Manufacturers showcases	<ul style="list-style-type: none"> ■ The manufacturers of CO2 showcases are located in Europe, they will be ready to deliver a wide demand of specific CO2 showcases, however it depends other retailers demand in same time 	<ul style="list-style-type: none"> ■ The manufacturers of showcases, most of them located in China and Turkey would be ready to produce locally, and would deliver a great quantity of CO2 showcases, however it depends other retailers demand in same time 	<ul style="list-style-type: none"> ■ In Asia, manufacturers of showcases, most of them located in China, would be ready to produce locally, and would deliver a great quantity of CO2 showcases. Investigation for american countries is in progress... however it depends other retailers demand in same time

Condition for successful of roll-out goes through expert ability of local technical teams

The suppliers/ partners

Technical support

- Control ability of local installers on each project Hybrid CO2/HFC (training, certification, sub-contractors,...)
- Delegation of senior engineer come from country with CO2 knowledge, he will intervene on each 1st Hybrid CO2/HFC site
- Specific clauses in the commercial contract which guarantee a quality maintenance, and availability of specific spare parts

Internal Carrefour

Training

- Draw up a training CO2 programme for our engineers and maintenance people, this programme will be made between Carrefour and lead supplier in CO2
- Negotiate with the lead supplier in CO2, the responsibility of training CO2 programme following the speed of roll-out
or/and
- Search a training institute with capacity to train our technicians to manage CO2 systems following the speed of roll-out
- Appointment of national manager of refrigeration having a degree in refrigeration/AC
- Training CO2 programme hand out to 1 technician per store planed



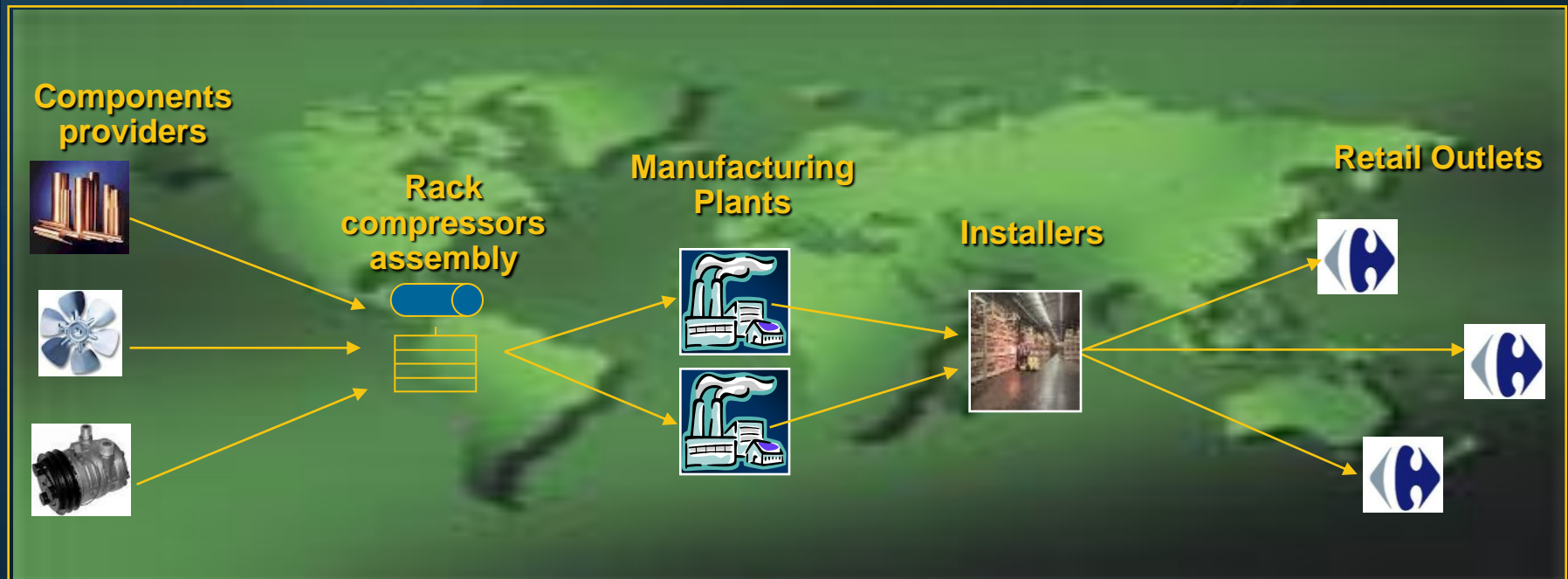
Set up a national CO2 mapping, begin to end supply chain with third party providers

Specifications

Training programme

Specific support

After Service 24/7



Reliable design, safety guarantees, training engineers, knowledge of installers, maintenance efficiency, whole these topics should be permanent objectives to deal with upstream suppliers

All contributors will benefit

	Consumer	Gov't	Retailer	Upstream suppliers*
Friendly environment				
Energy savings				
Corporate image				

Everyone Wins to progress in hybrid before going to 100% NR

* installers, manufacturers, providers of components, maintenance suppliers

To fix CO2 hybrid technology safety in its stores Carrefour requires collective action by the industry of refrigeration

1

Select the best installer(s) in every country

2

Specific training programme hand out to installers & end users

3

Develop high quality international supply chain to provide components and guarantee working flow

4

Raise after service delivering spare parts, quality technicians in good timing

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Roll-out refrigeration systems hybrid CO2 takes into account of maturity of upstream refrigeration supply chain

How :

Following the limited capacity of suppliers and installers, the number of sites selected is 64 or 112 sites in year 2012 (2 scenarios have been developed).

In order to accelerate, the principle is to get confirmation then deal with suppliers capable to run, having CO2 knowledge, the achievement of all sites is subjected to successful of the 1st hybrid CO2 store per country (non mature country)

Range of sites :

Taking into account relative simplicity to put in practice « in situ », the chronology is:

1. New projects,
2. Sites technical « end life » or accounting write off (value 0)
3. Sites in remodeling and/or commercial or technical enlargement
4. Old sites where current TCO excess theoretical hybrid TCO

Speed of roll-out :

According with the maturity of duo « internal / suppliers-installers», **the country can decide to accelerate the number of sites** selected and get wider the range of sites

Meanwhile a solution 100% natural, we don't envisage to launch hybrid refrigeration systems for sites type 4.



Schedule following the technology choice

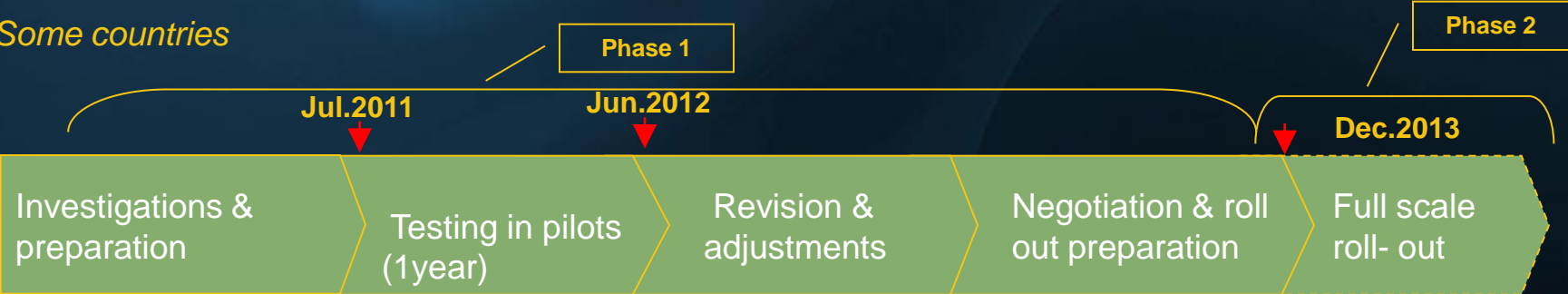
Hybrid technology

All countries



HFC-free technology

Some countries



Reminder that 100% NR is our final target

1

Get profit of new generations of technologies as compact NH₃/CO₂ systems, CO₂-Transcritical, Hydrocarbon,...

2

Incitations of regulations could be favourable to develop speed up solutions using natural refrigerants

3

Stage set up hybrid solutions prepare and train technical people to welcome in better conditions 100% NR

4

Several Carrefour countries are targeted to be leader testing 100% refrigerants by end of 2012 (France, Spain, China,...)

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Going refrigeration **Green** faster through ATMO 2011

1. Our actions:

- Carrefour managers involved in this project strive to exchange points of view and search fruitful contacts with refrigeration industry and retailers to embrace common point of view (especially to standardize technology)

(Already information exchange with Tesco, Auchan, Sobeys,...and a plenty of refrigeration companies)

2. Needed actions:

- Set up and share common CO2 and NH3 training programmes, spreaded in various designs
- Get a directory of all actors of NR per country (operational presence through NR solutions)
- Get geographical mapping per main NR solutions, at least for Europe, and for emerging countries



Conclusion

- The challenge for Carrefour is to ensure reliable systems are set up to recover fluorocarbon gas from all types of applications and equipment existing and launch a range of NR system covering all formats of new projects then existing stores using FC in all countries where Carrefour has a presence.
- **This challenge needs to be based on economic viability for wider adoption of decision makers internally.**
- Finally get the benefits of our action to be recognized by our customers and NGO organizations as an lead actor eco-friendly which participate to delight shopping in Carrefour.



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Thanks for your attention