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19 & 20 April, 2016 – Barcelona







**MAGFREEG**

A PROJECT MANAGED BY COOLTECH APPLICATIONS



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*MagFreeG- Accelerating the deployment of refrigerant gas alternatives thanks to European Union initiatives*

A project led by Cooltech Applications – Magnetic Refrigeration



- An European Union initiative **supporting eco-friendly innovations**. The objective is to help bridge the gap between research and market.
- A comprehensive project proposal had to be submitted – **Very selective (~20%)**
- **€200 M fundings from 2008 to 2013**

⇒ *Cooltech's project MagFreeG was selected in 2014*

**Other organizations or projects are supporting green innovations**



**Creation of a network boosting Eco-friendly innovations in the HVACR sector**



## The Project

- **Title:** MagFreeG (Gas Free Magnetic Cooling System for Commercial Refrigeration)
- **A European Project:** CIP Eco-innovation
- **Calendar:** 30 months (July 2014 – December 2016)
- **Budget:** €1,7 million (financed at 50% by the European Commission)



## Project Objectives

- Start the commercialization of the **Magnetic Cooling** technology in Europe
- Overcome the barriers when introducing a **disruptive innovation**
- Develop partnerships in **complementary markets** (domestic refrigeration, AC, transport...)
- Improve and optimize the system performances

**WP1:**  
Management

**WP2:** 400W  
demonstrator and  
market  
implementation

**WP3:** 700W  
demonstrator and  
market  
implementation

**WP4:**  
New markets,  
optimizations

**WP5:**  
Business plan and  
exploitation

**WP6:**  
Dissemination



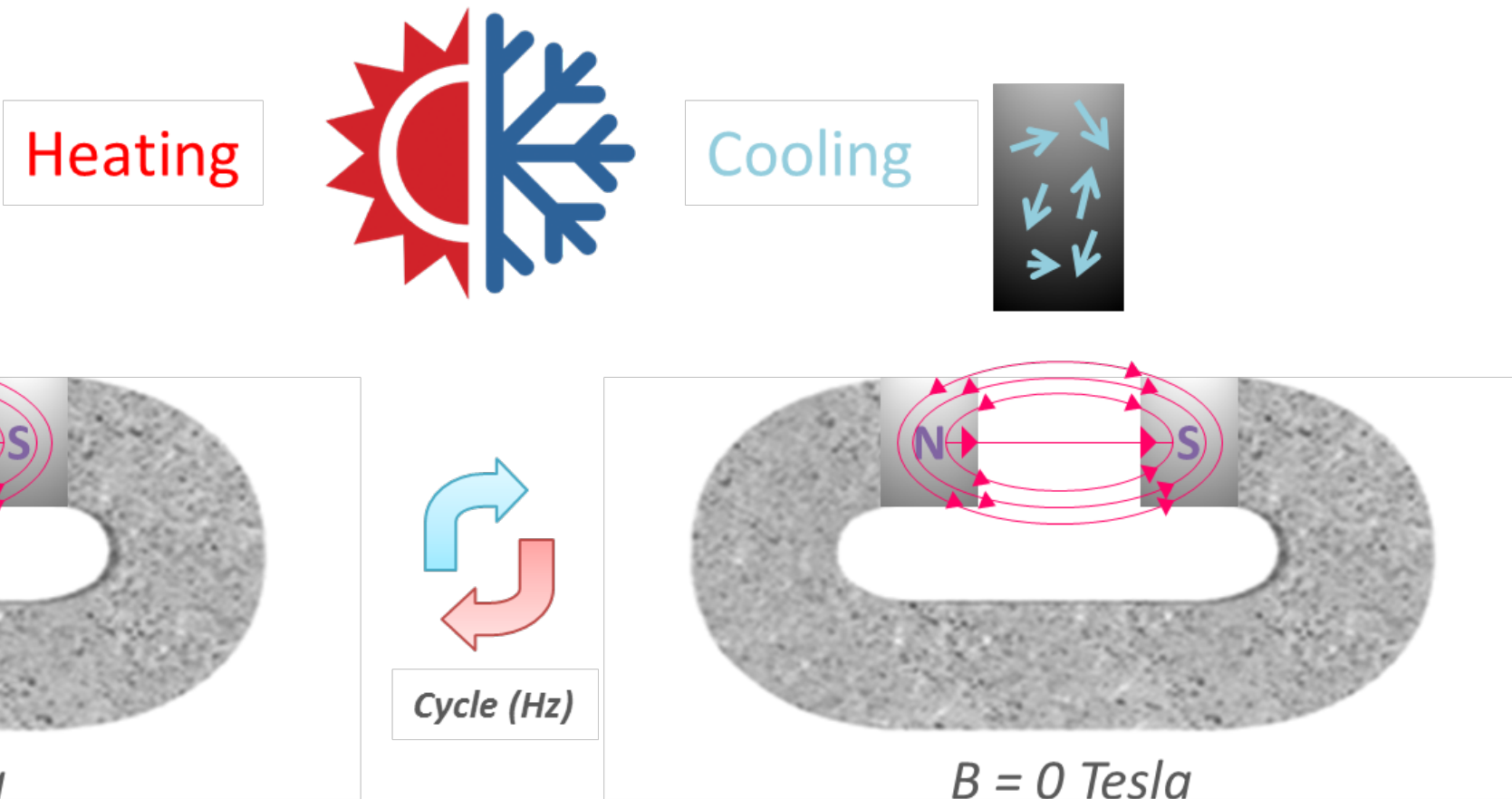


# What is Magnetic Cooling ?



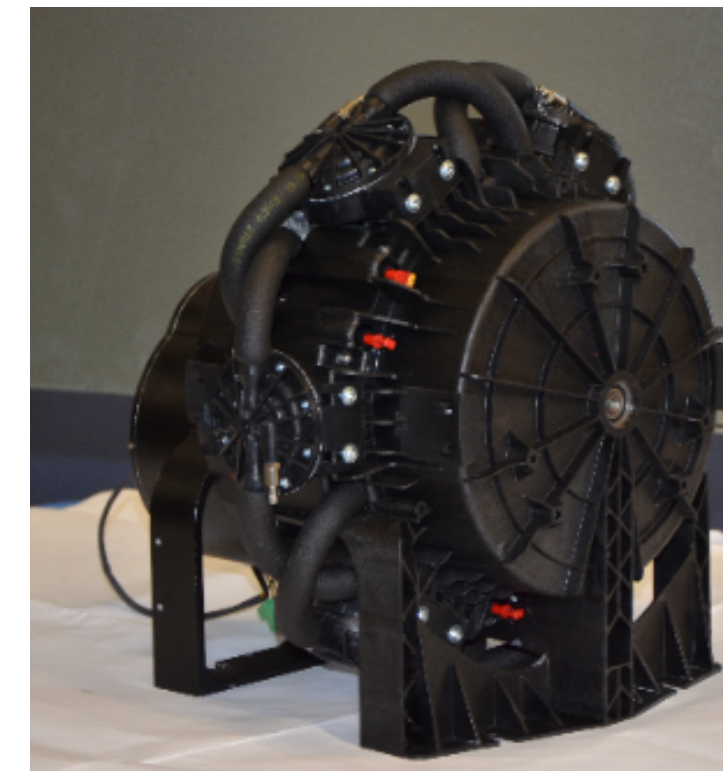
## Magnetic cooling: the physical principle

$$E = m C_p \Delta t$$



*Magnetic refrigeration, getting energy from temperature changes in a material*

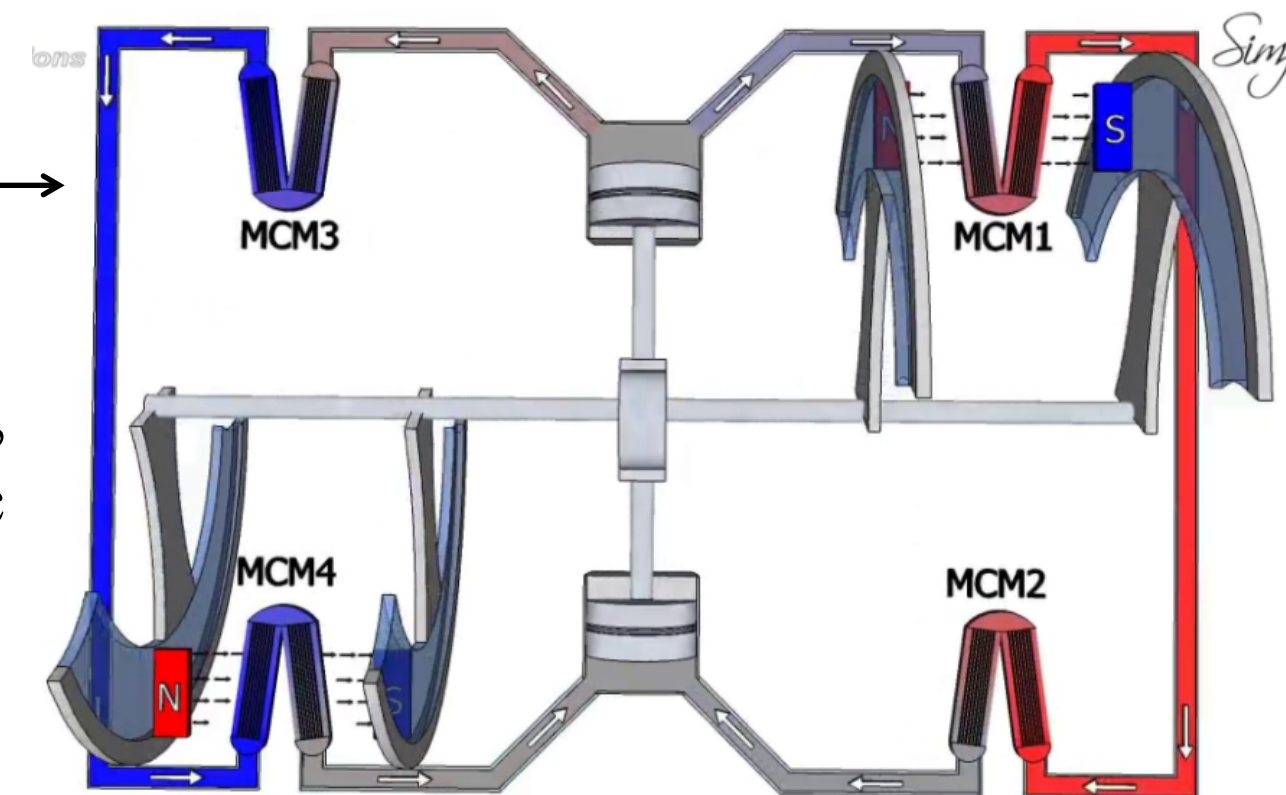
## The Magnetic Refrigeration System



First generation of machines  
 (200-700W)

### Inside the machine

(rotating magnetic Systems, Magneto caloric alloys, Hydraulic distribution)






## Environmental challenge

- Increasing **restrictive regulations** on refrigerant gases (*F-gas, EPA...*)
- Impact of refrigeration on **Climate Change** (already 10% of GHG emissions)




- A **gas-free** solution
- **Eliminating** the HFCs emissions
- Reducing **carbon footprint** through energy savings (high COP).  
 ***A differentiator for OEMs / Image for end-users***

## Economic Challenge

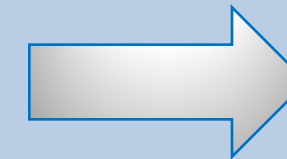
- **Refrigeration: 17%** of the world's electric consumption
- A huge part of energy costs for Supermarkets
- Limited efficiency provided by gas compressors




- **High energy efficiency** up to 40% energy savings
- **Global cost reduction** Maintenance reduced, extended life time  
 ***An economic benefit for end-users***

## Technical Challenge

- High pressure systems
- Maintenance costs
- Noise and vibrations



- **Safer system**, low pressure and low rotational speed
- Less **noise** and **vibrations**  
 ***Comfort for users and contractors***





# Development status and potential



## Prototype performances (02/2016)

- Temperature ~ +1.8°C (equipment)
- Pressure ~ 1,5 bar to 2 bars
- Cooling power ~ 450W
- Electric consumption ~ 85W

## Commercial demonstration (World Premiere at Medica -11/2015)





**Cooling Power : 200 W (Medica-11/2015)**

(*) Magnetic Refrigerator (F = 1,1 Hz)		
	Absorbed Power	
	W	
<b>Hydraulic mode</b>	Indirect mode	
<b>Pumps</b>	8	
<b>MRS * (motor efficiency 90%)</b>	35	<b>COP 5,7</b>
<b>Fans (heat ex. hot)</b>	3	
<b>Fans (heat ex. Cold)</b>	3	
<b>Total</b>	<b>49</b>	
<b>Total COP</b>	<b>4,08</b>	

(**) Standard Butane Refrigerator		
	Absorbed Power	
	W	
<b>Pumps</b>	-	
<b>Compressor</b>	79	<b>COP 2,5</b>
<b>Fans condensor</b>	12	
<b>Fans evaporator</b>	13	
<b>Total</b>	<b>104</b>	
<b>Total COP</b>	<b>1,92</b>	

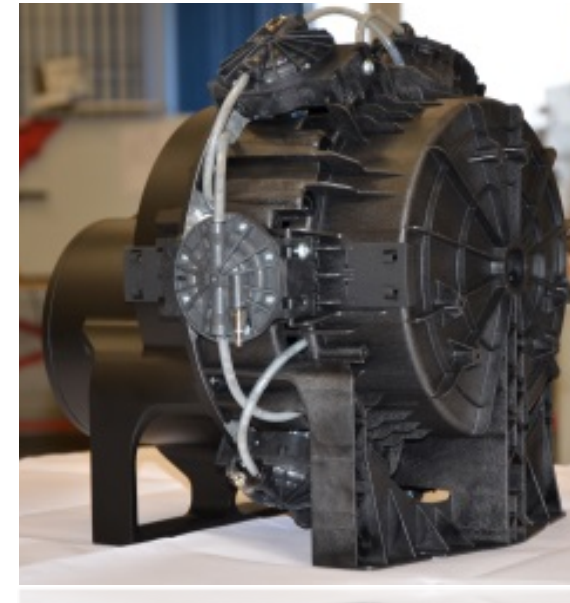
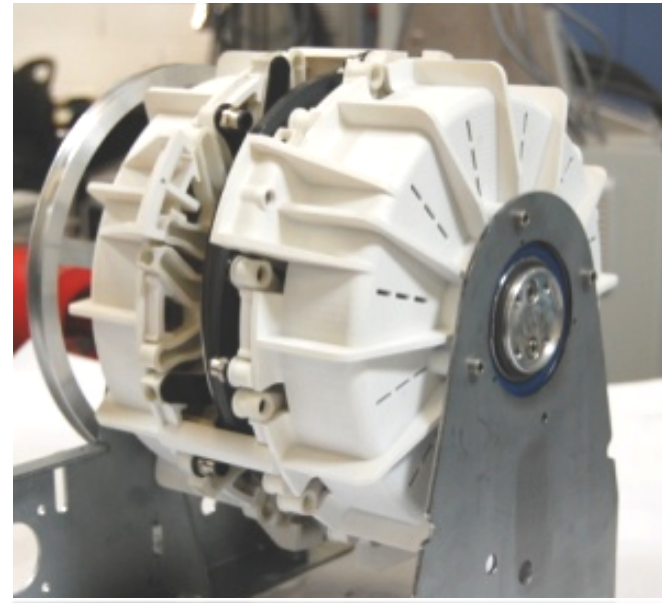
COP Comparison between a magnetic refrigerator and a standard bottle cooler

**Energy Savings >50% , a key factor for future value proposition**

(\*) Machine with first generation magneto caloric alloys

(\*\*) Measures done by an OEM, partner of Cooltech





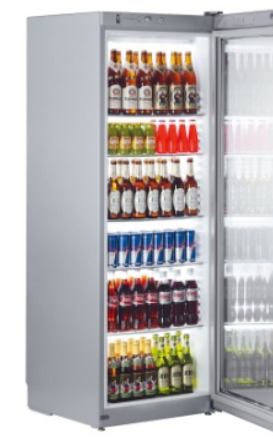
**Prototyping**

**Industrialization**

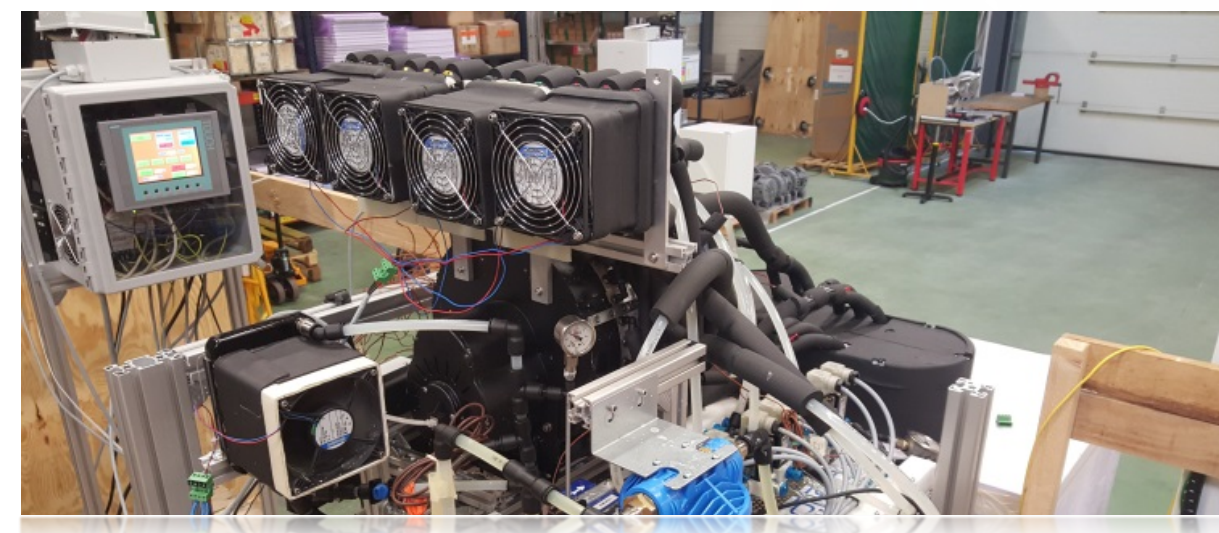
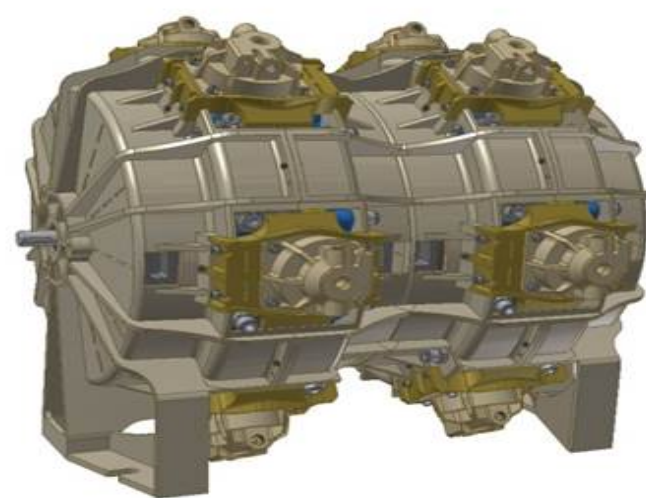
**MRS**

*Commercial Refrigeration*

*Medical*



**MRS commercialization in entry markets  
 (Europe / USA)**

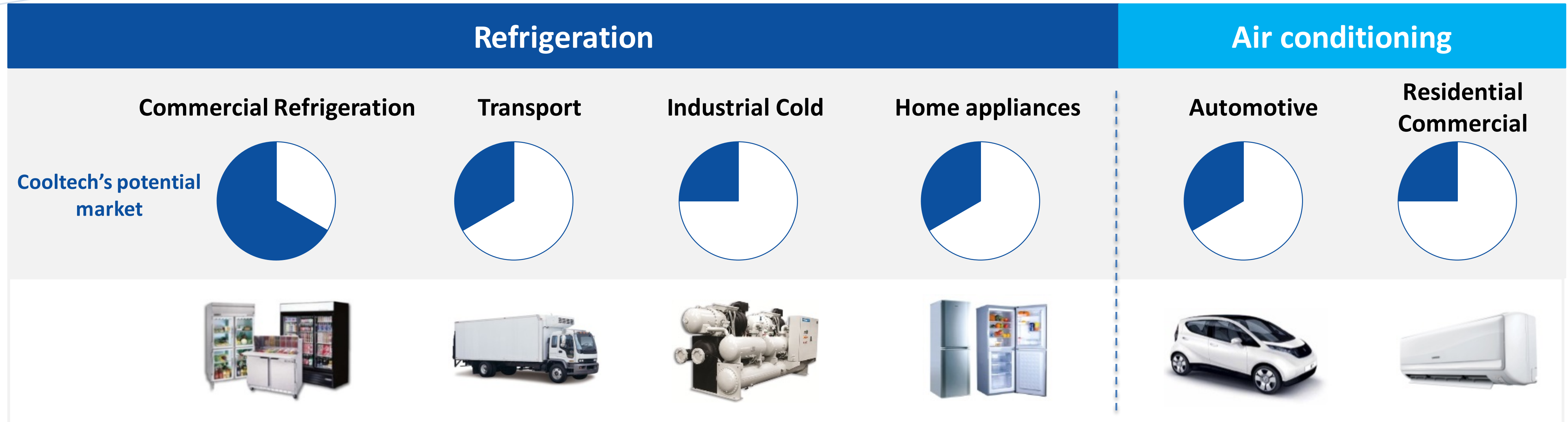


**Development and improvement of new designs  
 (power, size...)**



**For complementary markets**





The Magnetic Cooling market is expected to reach **\$315 million by 2022\***

**Road map (2016-2017)**

- **Demonstrations/tests** at end users sites (e.g Supermarkets /Pharma market– 1/ Europe 2/North America)
- **New Partnerships** for further applications (manufacturers)





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Thank you very much!