Efficient heating and cooling without refrigerants and fossil fuels

Magneto

RISING USE OF ELECTRICITY FOR HEATING & COOLING IS A PROBLEM

Migration to highly energy efficient cooling and heating systems is critical for meeting energy transition targets and enforced by regulators

SITUATION

Heating and Cooling account for 50% of the global energy consumption*

01

02

TRENDS

- **ELECTRIFICATION OF HEATING**
  - Installed heat pumps to rise with 800% by 2030 compared to 2020 level*
- **GROWING DEMAND FOR COOLING,**
  - 40% of future growth in global electricity consumption goes to cooling*
- **ELECTRIC GRID CAPACITY CONSTRAINTS**
  - Inadequate capacity is a key barrier to scaling electric heating and cooling

RESULT

New regulations enforce migration to systems with higher efficiency**

03

Do current refrigerant-based systems offer an energy efficient solution?

* IRENA Research, ** Energy Efficiency Directive (EU/2023/1791 + IEA's 8th Global Conference on Energy Efficiency

REFRIGERANT BASED SYSTEMS ARE NOT THE SOLUTION

The most efficient refrigerants were banned because of their environmental impact and safety hazards, forcing the industry to turn to less efficient refrigerants

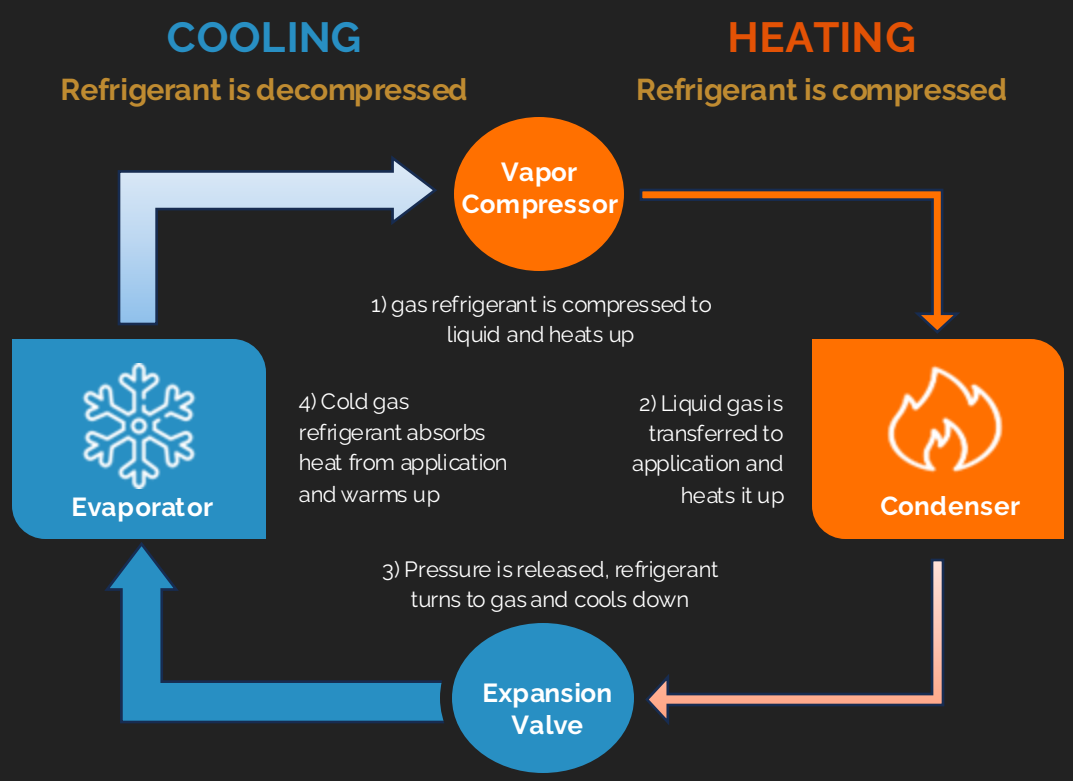
BANNED for environmental impact

- **Group of CFCs and HCFCs** ↦ Ozone layer depletion ↦ Montreal protocols banning them globally
- **Group of HFCs** ↦ Global Warming Contribution ↦ Kigali amendments to Montreal protocols dictating their phase out in EU by 2030

LIMITED IN APPLICATION for safety hazards*

- **Propane, Isobutane** ↦ Flammable
- **CO2** ↦ High Pressure
- **Ammonia, HFOs** ↦ Toxic

How gas refrigerants work



The cooling & heating industry is searching for a sustainable and efficient alternative

* EN 378, ASHRAE 15, ASHRAE 34, EU Pressure Equipment Directive, PFAS regulation, etc.

TRILLION DOLLAR OPPORTUNITY TO REPLACE REFRIGERANTS

Refrigerant based heating & cooling systems will never be sustainable and energy efficient at the same time

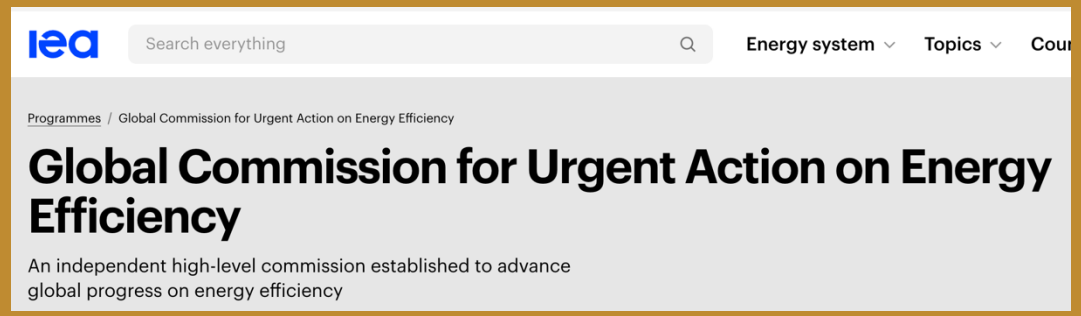
Energy efficiency is a top global priority*

+

The most efficient refrigerants are banned by global regulation**

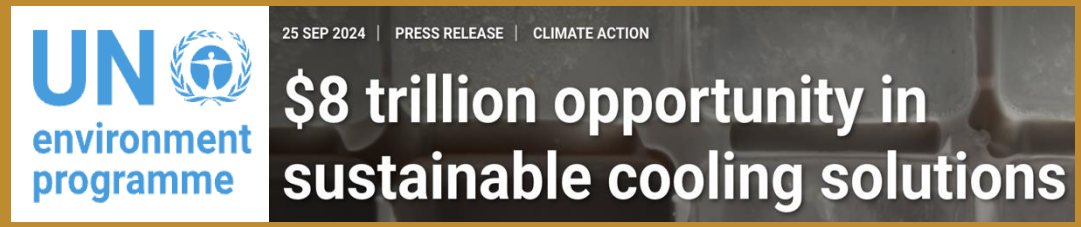
=

Trillion-dollar opportunity to replace refrigerants in cooling and heating!



Posted on October, 23 2016

More than 170 countries today agreed to amend the Montreal Protocol to allow the phase out of hydroflurocarbons (HFCs).



Magneto is leading the R&D race to replace refrigerants and capture the market

* Energy Efficiency Directive (EU/2023/1791), + IEA's 8th Global Conference on Energy Efficiency **Regulation: Montreal protocols + Kigali amendments + PFAS

MAGNETOCALORIC SYSTEMS ARE LEADING THE R&D RACE

Magnetocaloric heat pump systems stand out for high efficiency, wide applicability and longevity

COMPETING TECHNOLOGIES

Technology Temperature Effect	Efficiency	Longevity	Applicability
MAGNETOCALORIC Exposure material to magnetism			
Elastocaloric Stress on shape memory material			
Thermoacoustic Exposure gas to sound waves			
Barocaloric Compression of solid material			
Thermoelectric Voltage in semi-conductor			
Electrocaloric Exposure material to electric current			

MAGNETOCALORIC EFFECT

The response of certain solid-state materials to a magnetic field

They heat up when magnetized and cool down when the magnetic field is removed

The leading position of magnetocaloric systems is confirmed by our corporate customers

MAGNETO UNLOCKS THE BENEFITS OF MAGNETOCALORIC SYSTEMS

Magnetocaloric (MC) heat pumps offer unbeatable efficiency and environmental benefits … when powered with our unique heat exchangers

BENEFITS OF MAGNETOCALORIC HEATPUMPS VERSUS HEAT PUMPS WITH REFRIGERANTS

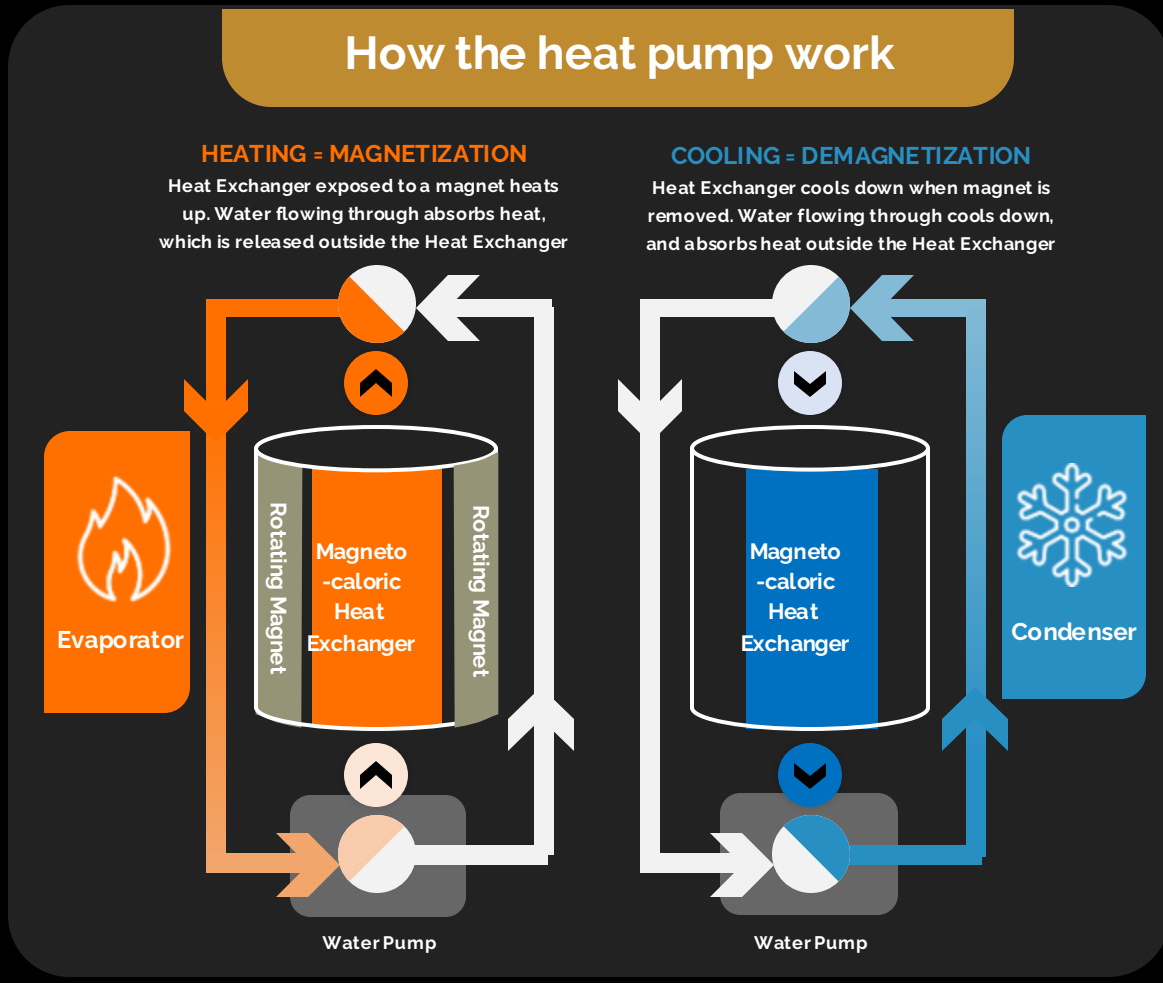
Lower total cost of ownership

- Up to **30% higher energy efficiency**
- Lower maintenance cost
- Much longer lifespan

Sustainable and compliant to new regulations

- **Water instead of regulated refrigerants**
- Low pressure systems
- Simple installation and maintenance
- Silent operations

How the heat pump work



Magneto's magnetocaloric heat exchangers are the key to successful market entry!

INNOVATIVE MAGNETOCALORIC HEAT EXCHANGER TECHNOLOGY

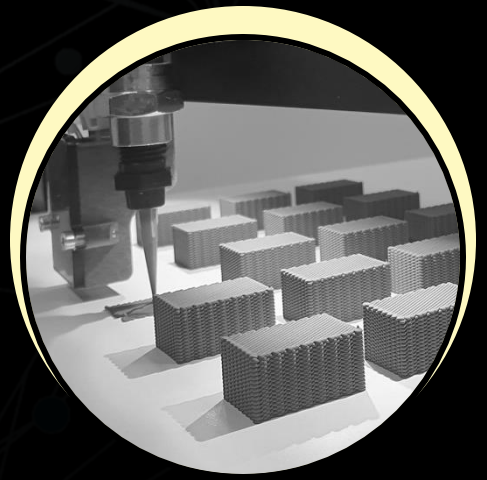
Removing the last market entry barriers:

(1) expensive rare metals, (2) low efficiency and (3) insufficient temperature span

Magnetocaloric (MC) material

- Patented material composition
- The only composition with no rare earth metals
- Cost of raw materials only €3/kg

Solution for (1)



MC heat exchangers

- Patented 3-D Printed shape
- 50% higher thermal transfer efficiency **Solution for (2)**
- Applicable in (-80°C to +200°C) temperature span **Solution for (3)**

Our product: the AMR

- The **Active Magnetic Regenerator (AMR)** is a critical MC heat pump component with customizable temperature span & heating/cooling power
- Sold on €/Kg basis

Our patented innovation: Low cost and highly efficient AMRs with a wide temperature span

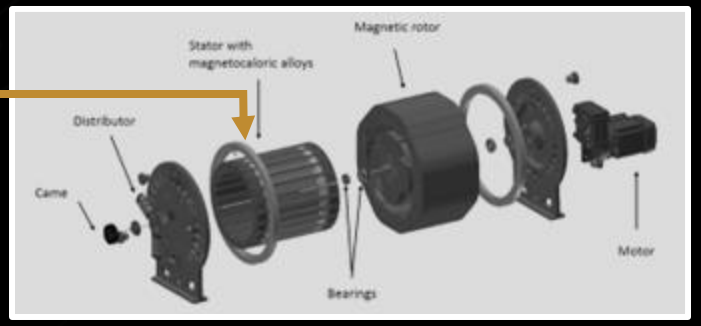
OUR BUSINESS MODEL

Empowering market leading OEMs to add MC heat pumps to their product portfolio

Functional material
Magnetocaloric (MC) materials shaped into heat exchangers

Functional component
Active magnetic regenerator (AMR) for parallel cooling and heating with customizable power and temperature span

Device
Magnetocaloric heat pump powered by Magneto's AMRs with customized cooling power and temperature span to meet our client's specifications



Applications
Any existing heat pump application and beyond, thanks to our wide temperature span

-80°C to +200°C

HVAC

Data Center cooling

Refrigeration

Cold Chain

Industrial heating and cooling

Magneto → Client

Magneto will be THE key supplier to all magnetocaloric heat pump manufacturers

THERE ARE NO COMPETING MAGNETOCALORIC MATERIALS

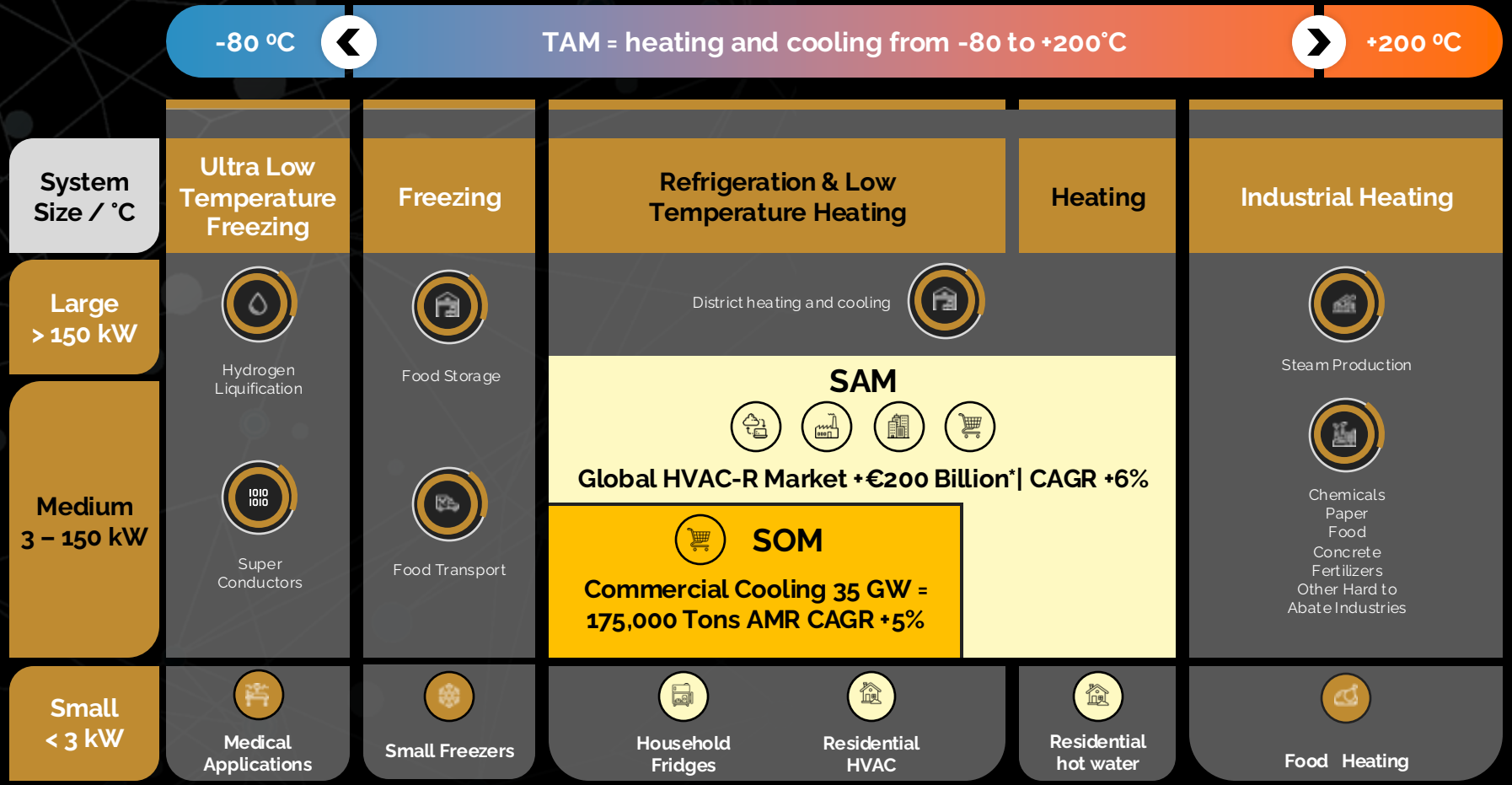
All competitors failed on mechanical stability, price, or applicability, leaving Magneto uniquely positioned to capture the market

	Composition	Temperature span	Mechanical stability	MC strength	Price of raw materials
MAGNETO	**Main: Mn, Fe, P, Si Patented: V, C, N, B**	**-80 to +200°C**	**Good**	**Very strong**	**3 €/kg**
Vacuumschmelze + Magnotherm	Lanthanum, Iron, Silicon, Cobalt	-20 to +46°C	**Failed Unusable**	Very strong	100s of €/kg
Merck	Gadolinium, Silicon, Germanium	- 30 to **+25°C Limited applicability**	Very good	Strong	**1000s of €/kg Unscalable**
GE&R & Others	Gadolinium alloys	-30 to **+50C Limited applicability**	Very good	Strong	**1000s of €/kg Unscalable**

Our customers confirm that Magneto offers the only scalable solution available

OUR PRODUCT ADDRESSES A VAST GLOBAL MARKET

Magneto will be a key component supplier to the € 1 trillion global market for cooling and heating systems



Targeting the €200 billion Heating, Air Conditioning & Refrigeration market (HVAC-R)

Reference: IEA (2023), IRENA, GM Insights, FMI, Fortune, Spherical Insights, PHCP Pros, Fortune, McKinsey, Magnoric Estimates.

* Assumes AMR price of €150,000 per Ton

GO-TO-MARKET AND TRACTION

Building partnerships with innovative HVAC-R manufacturers: From joint heat pump development to offtake contracts

HVAC-Refrigeration OEMs

Feasibility

- **Best market fit**
- **Target specs:**
  - Temperature span
  - Cooling power
  - Efficiency
  - Cost
- **Validation with modeling**

Joint heat pump development

- **Heat pump design**
- **Heat exchanger design**
- **Joint testing & Optimization towards target specs**

Pilot

- **Integration of heat pump into cooling/heating system**
  - COP
  - Cooling/
  - heating power
  - Durability

Offtake contract

- **Supply or Offtake contract**
  - Volumes
  - Price
  - Timelines
  - Quality
  - Warranties

TRACTION

magnoric	✓	Q3/2025	2026	2026
SAMSUNG	✓	Q4/2025 | Contract under negotiation		
magnoric + TRANE		Q2/2025		
DAIKIN		Q2/2025		

MARKET VALIDATION & SCALE UP FEASIBILITY

We investigated how to reach profitability in commercial cooling (supermarkets) considering current regulation, competition (CO_2 systems), and our production process

Price?	Unit profitability?	Market penetration?
What is the market acceptable price?	At what scale this price is unit profitable?	What market penetration we need to sell this capacity?

Clear framework for successful route to profitability based on achieved efficiency

MARKET ACCEPTABLE PRICE OF €150 PER KILOGRAM

Our feasibility study validated the market acceptable price for supermarkets of Magneto's AMRs and magnetocaloric heat pumps powered by our AMRs

Market validation consortium

Magneto	Magnetocaloric Heat Exchangers
magnoric	Heat pump manufacturer
frimex	Large Dutch installation company

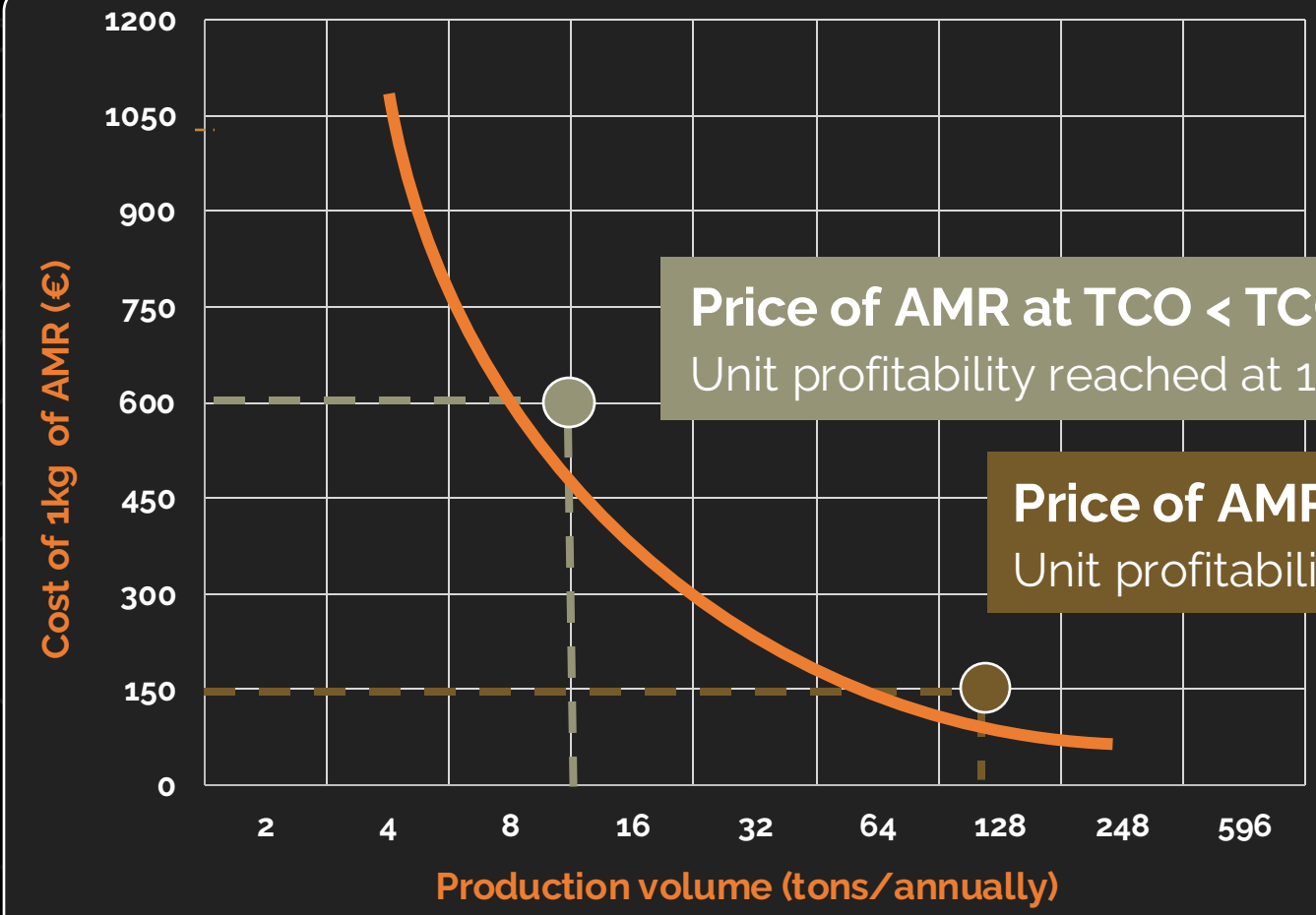
Business case for supermarkets

- **CAPEX** by x% higher than current solution
- **Payback Period** < 5 years
  - Investment into higher efficiency system with payback period <5 years enforced by current regulations
  - New EU regulation requires comparison on Total Costs of Ownership (TCO) not only payback period
- **TCO 12 years:** €600k savings
  - lifespan of CO_2 compressors
- **TCO 28 years:** €2m savings
  - lifespan of MC heat pump

At €150 per kilogram our AMRs and the technology is pushed to market by regulation!

UNIT PROFITABILITY REACHED AT A SCALE OF 120 TONS/YEAR

At a price which secures regulatory "push to the market" for higher efficiency systems



Price of AMR at TCO < TCO competition ≈ €600 / Kg

Unit profitability reached at 12 ton / annum

Price of AMR at Payback Period < 5 years ≈ €150 / Kg

Unit profitability reached at 120 ton / annum

Scale easily achievable by only focusing on supermarkets in Western Europe

PROFITABILITY REACHED AT REALISTIC MARKET PENETRATION

A market share of 10% in new supermarket installations across 4 EU countries is sufficient for unit profitability

SUPERMARKETS
Netherlands, Germany, Denmark & Belgium

- 40,000 locations
- 12 companies
- 250 MW Cooling Power / annum
- 1300 ton / annum of our AMRs
- €200 million revenue / annum*

Global €25 Billion Commercial Cooling Sector

- 35 GW / annum of Cooling Power
- 175,000 ton / annum of AMRs
- 10-Year CAGR +5%

CONSORTIUM PROJECT FOR TECHNOLOGY INTRODUCTION IN SUPERMARKETS

2023 - MoU + Market Acceptance Study

Magneto + magnoric + frimex

Q3 2025 – TRL 7 - Demonstration in Customer Heat Pump

Q4 2025 – TRL 8 - Technology Demo for Supermarkets

2026 – TRL9 - First Contracts for Supermarket Pilots

- 100 kW of cooling power / supermarket / 500 kg of AMRs

2026 – Offtake Contract with Magnoric

2028 - Commercial Production Magneto-Powered Heat Pumps

Clear performance goals for demo and pilot to secure offtake contract

* Assumes AMR price of €150,000 per Ton

INTRODUCING OUR CORE TEAM

Dutch university spin-off with strong IP and international team focused on replacement of refrigerants with efficient magnetocaloric technology

Ivo Dusek (Czech)

Managing Director | Co-Founder

- 20 years of experience running businesses in Europe, Africa and Asia
- Built provider of pay as you go solar systems from scratch to 250 employees

Bowei Huang, PhD (Chinese)

Director Product | Co-Founder

- PhD in Mechatronics
- Focus on magnetocaloric heat pump design
- Built 2 generations of magnetocaloric heat pump prototypes
- 13 research papers, 230 citations

Michael Maschek, PhD (Austrian)

Director Materials | Co-Founder

- PhD in Material Science
- 10 years in research of magnetocaloric material
- Leading expert in production of magnetocaloric material
- 10 research papers, 21 publications,
- 266 citations

Jasper Pierik (Dutch)

Finance Director

- 25 years in financial services and corporate development
- Ex PwC director with focus on mergers & acquisitions, leveraged buy-outs, and strategic business modeling

PAST ACHIEVEMENTS AND FUTURE FUNDING ROADMAP

We validated a first prototype and secured €3.5 million in grants for technology demonstration

Research	Prototype	Demonstrator	Pilot	FOAK	Repeat
TRL 1-3 grams	TRL 4-5 decagrams, Watts	TRL 6-7 kilograms, kW	TRL 8 tons/a, kW	TRL 9 100t/a, megawatts	kilotons, megawatts

€1.15m Pre Seed CLAs for Technology validation

- 3 institutional investors
  - SHIFT Invest
  - Graduate Entrepreneur
  - UNIIQ
- €1.15m CLAs with €15m cap
- + Grants of €1.5m

€5.0m Seed Capital for Market validation

EIC Accelerator €2.5m grant

+

Investment consortium

- New Lead investor

+

- Current Investor

+

- Strategic investors? + EIC?

Series A for FOAK

Blended funding

- 10% VCs + Strategic investors

+

- 10% EIC or Invest NL

+

- 20% European Investment bank loan

+

- 60% Innovation Fund (grant)

European Innovation Council

WE SEEK A LEAD INVESTOR IN €5m SEED ROUND

€1.0 to 2.5m ticket to join current investors and potentially strategic investors and EIC

SEED round for Demonstrator

€5m
Equity

Up to €5m
Subsidies

2 years

SERIES A

ACHIEVED MILESTONES

- TRL 6
- 2x Joint heat pump development agreements
- 16 FTEs
- Production up to 20kg/month
- EIC accelerator awardee

TARGET MILESTONES

- TRL 7 – Demonstration
  - for Supermarkets
  - for HVAC and Data Centers
  - for Fridges
- First pilot contracts (TRL8)
- 26 FTEs
- Industrial facility, capacity 0.5 t/quarter
- Secured grants for pilots

We will derisk the investment with up to €5m in grants

Get in touch!

Ivo Dusek
Managing Director

+31 6 1184 4002

ivo@magneto.systems

Magneto