



solutions for europe
natural refrigerants

16-17 March 2015 in Brussels

Magnetic Refrigeration

A Natural refrigerant technology
Integration into EU Regulations



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www.iifiir.org



- RESEARCH PROJECTS:

FRISBEE (ended August 2014)
COOL-SAVE
ELICIT



Objective of Presentation

Industrial 'Oversight' of process for integration of Magnetic Refrigeration
into EU energy & Refrigeration Regulations

Magnetic Refrigeration

Potted History - 1

W Giauque

Magneto Caloric Effect

1927

achieves temperatures below 1 Kelvin

Demonstrated 1933~35

Nobel prize 1949 – Chemistry

Industrial example

CERN's in particle accelerators

Pr K Gschneidner

Giant Magneto Caloric Effect

1997

Strong Academic Interest growing in terms of Materials & Systems

→ Start-ups ~ Multinationals take interest 2000~2005

→ Start-ups & PME working systems in Public 2010~2014

Industry / Academic : Magnetocaloric Heat-pump systems



P152037-3



Magnetic Refrigeration

Recent History - 2

K Gschneidner

Giant Magneto Caloric Effect

1997

MR 'Metallic Refrigerant' - becomes a *Realistic* possibility

Academics, Start-ups & Advanced R&D

Thermag & DELFT Conferences

2004 IIR Magneto Caloric working party – Organise co-operation globally

2012 Thermag V Grenoble - Industrialisation Keynote 200

2014 Thermag VI Victoria - 3 Start-up/PME's 400
Serious Academic ↔ Industrial co-operations evident

14/15 Q1 Consumer Fridge - B2B Plug-in - Cave-a-Vin Public Demonstrations

ELICiT – Magneto-caloric Heat-pump Validation & integration into existing EU Regulations with 'Industry Oversight'



Magnetic Refrigeration

Basic Principles

State change caused by

Electric Field

1 ~10~100 KV/cm

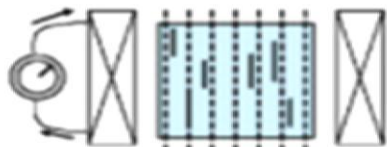
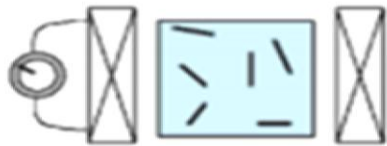
Magnetic Field

MAGNETS 0.5T to 1.25 T

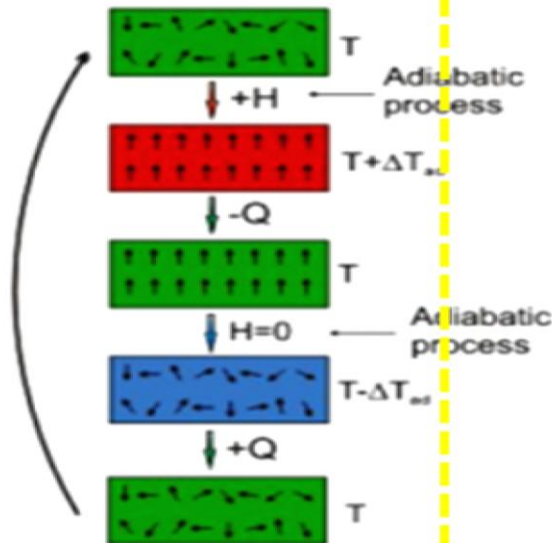
Pressure

FGas Evolution

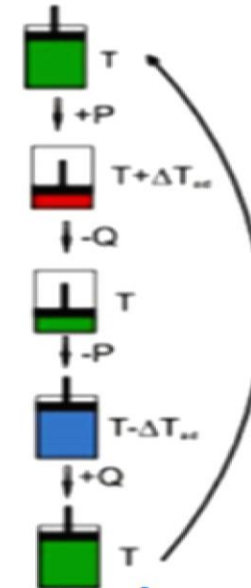
Challenge



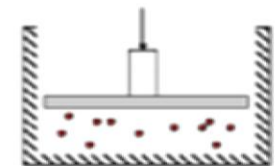
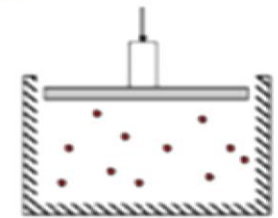
Electro Caloric
(EC System)



Magneto Caloric
(MR System)



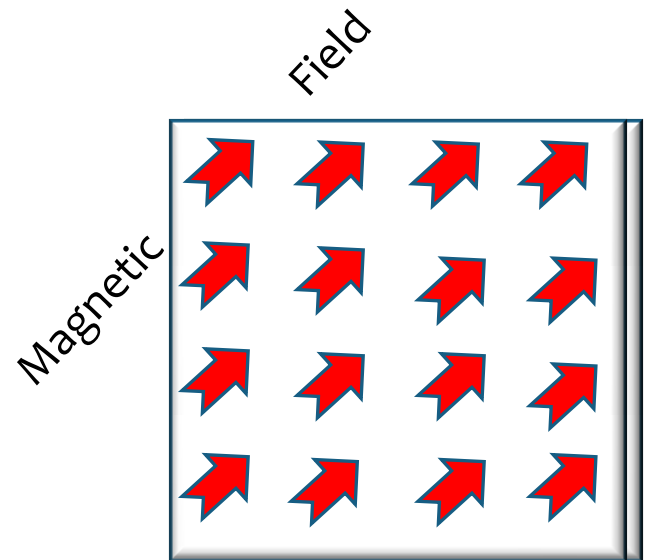
Vapour Cycle
(Compressor)



Piezo or Baric
Information

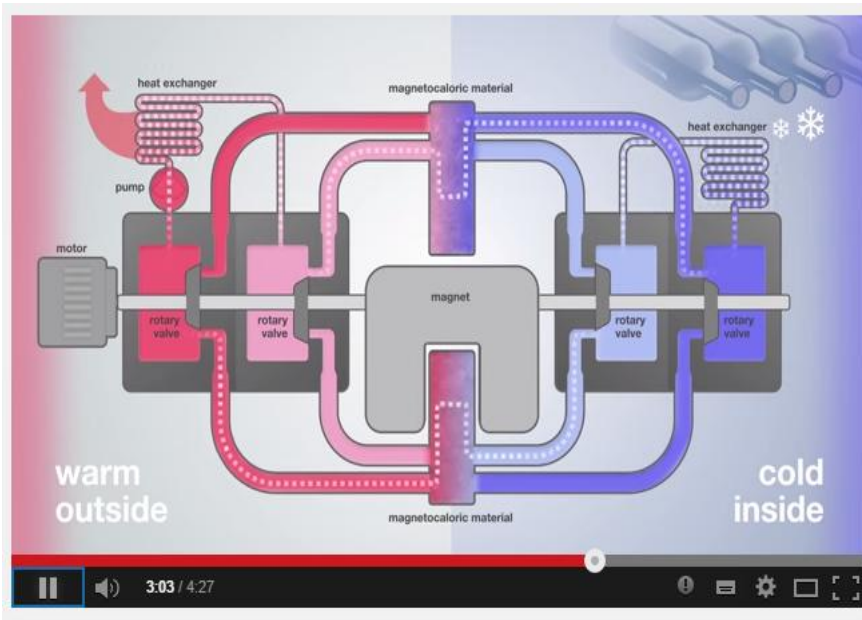
Refrigeration systems

Magnetic Refrigeration Heat Pump & Magneto-Caloric Principle



Magnetic Refrigeration

How it works



Ambient temperature MRS Public Explanations on Youtube

- Haier / Astronautic / BASF (example cited)
- OCF / Cooltech
- General Electric
-

Attention Wikipedia oriented to historic 'Low temperature' or -250°C hybrid systems used at CERN etc

EU Regulations ‘Oversight’ Industry participation

Formal IIR Sub-Working Group

Industry (I-SWG) → 'Industry oversight' (one of three objectives)

Chair : Timothy Lorkin

MoveOnn Inside &
Representative of IIR-IIF & WP to ELICiT project

Co-Chair : David Beers

GE Appliances, Director of Technology

Dr. John Barclay

Emerald Energy, Director

PierLuigi Schisario

ARNEG, Director R&D

Dr. Ekkes Brück

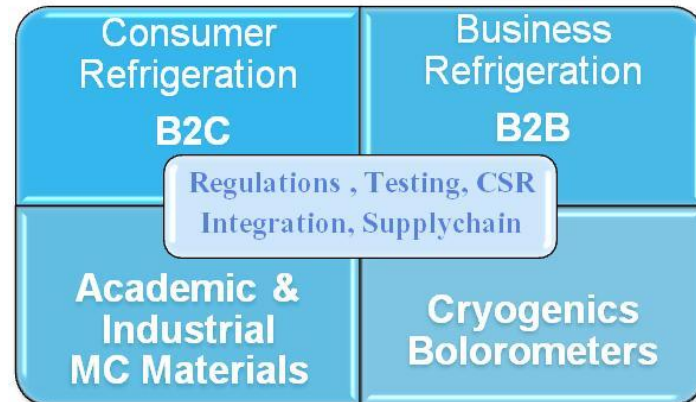
Technical University
of Delft

MC Materials

Chair : Dr. V Pecharsky
Ames Laboratory – USA

MR Systems

Chair : Dr. A Rowe
University of Victoria - Canada



EU Regulations ‘Oversight’ Industry participation

Complete System level

ELICiT 1st Integration of Magnetic Refrigeration into existing regulations

EU project → Pilot : Consumer Fridges 3 year Project (2014 ~2017)
Testing & Validation to be completed

Industrial participation in Oversight

How Expert topic groups eg Linked-in (open & transparent)
Industry ‘Oversight’ – of regulations & developments
Transfer &/or share Industry & Academic experience

IIR-IIF To provide industry ‘Oversight’ for new EU level proposals
Leading to an IIR-IIF recommendation to EU



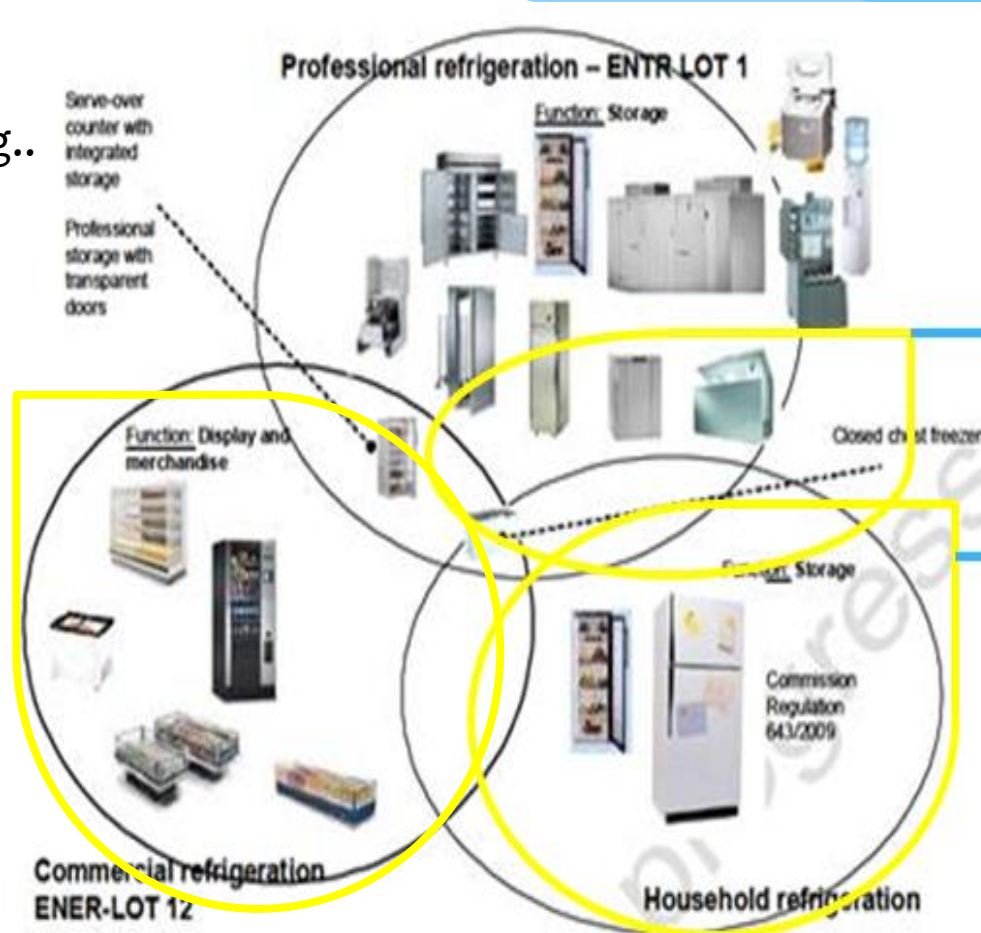
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Magnetic Refrigeration Eco-design Regulations – Energy

Equivalents for
other sectors,
Air-conditioning..

EU Q1 - 2014



USA Q1 - 2015

EU Q1 – 2014
ELICiT Project

Market segments shown are based upon public declarations

Source EN Refrigeration standards (J Evans - RD&T)



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Magnetic Refrigeration

EU Regulation Context

REGULATORY CONTEXT : SUBSIDIARITY PRINCIPLE



CE Certification → 3rd party test facility



Magnetic Refrigeration

EU Regulation Context

EU REGULATORY CONTEXT

Global approach

14 conformity assessment modules

Product evaluation

Approved quality system

Free circulation of products / CE Marking

New approach (1985)

Essential requirements

Harmonized standard

Essential requirements



Safety



Security



Environmental issues

Magnetic Refrigeration EU Regulation Context

MAIN EU REGULATIONS APPLICABLE TO MAGNETIC REFRIGERATOR

Type of requirement	EU Directive							EU & USA Regulation			
	Energy Labeling	Eco-Design	Machinery	Low Voltage	EMC	WEEE	RoHS	REACH	The Food Law	Delegated act for Energy labelling	Delegated act for Eco Design
/	2010/30/EU	2009/125/EC	2006/42/EC	2014/35/EU	2014/30/EU	2012/19/EU	2011/65/EU	1907/2006	178/2002 - 852/2004 - 853/2004	1060/2010	643/2009
Safety			+	+							
Health									+		
Performance		++	+	+	+				+		+
Environment	+					++	++	++		+	

Eco-Design : Energy Efficiency

WEEE : Recyclability 80% / 85%

EMC : 'Electro Magnetic Compatibility'

REACH : Chemical Hazard evaluation

Magnetic Refrigeration

EU Regulation Context

MAIN STANDARDS APPLICABLE TO MAGNETIC REFRIGERATOR

<u>Type of requirement</u>	<u>Main Standards</u>					<i>National</i>
	<i>International</i>	<i>Regional</i>				
/	<u>Characteristics & test methods</u> ISO - EN 15502	<u>Environmental testing</u> EN 60068	<u>EMC of Household Appliance</u> EN 55014	<u>Airbourne Acoustical Noise</u> EN 60704-2-14	<u>Measurement methods for electromagnetic fields of household appliances</u> EN 62233	Nothing to report
Safety	+	+	+		+	
Health	+					
Performance	+		+	+		
Environment						

N.B.: For W.P 4.2 : EN 60730-2-9, EN 60335 will be also developed...

EU Regulations ‘Oversight’ Process

Oversight

FGas & 2020~2030 defines time line

1. Review of applicable regulations Industry feedback
Regulation review → Comments from interested parties
2. Feedback on application tested Industry feedback
Consumer Fridge → Applicability to B2B Plug-in units / Cave-a-Vin
3. Finalised test Procedure & validation Energy measurement
New Procedures → Feedback from Industry
Validated by I-SWP & MC experts ¹
Recommendation to IIR-IIF → EU

EU Regulations ‘Oversight’ Industry participation

Request Industrial participation in Oversight
FGas & 2020~2030 : defines time line

MR Status End user EU regulations - Required

If your company is interested in participating -

Contact Elicit <http://elicit-project.eu/>

Or Email Lorkin.MOI@gmail.com

Subject line MRS Oversight

