

DDMC 2011

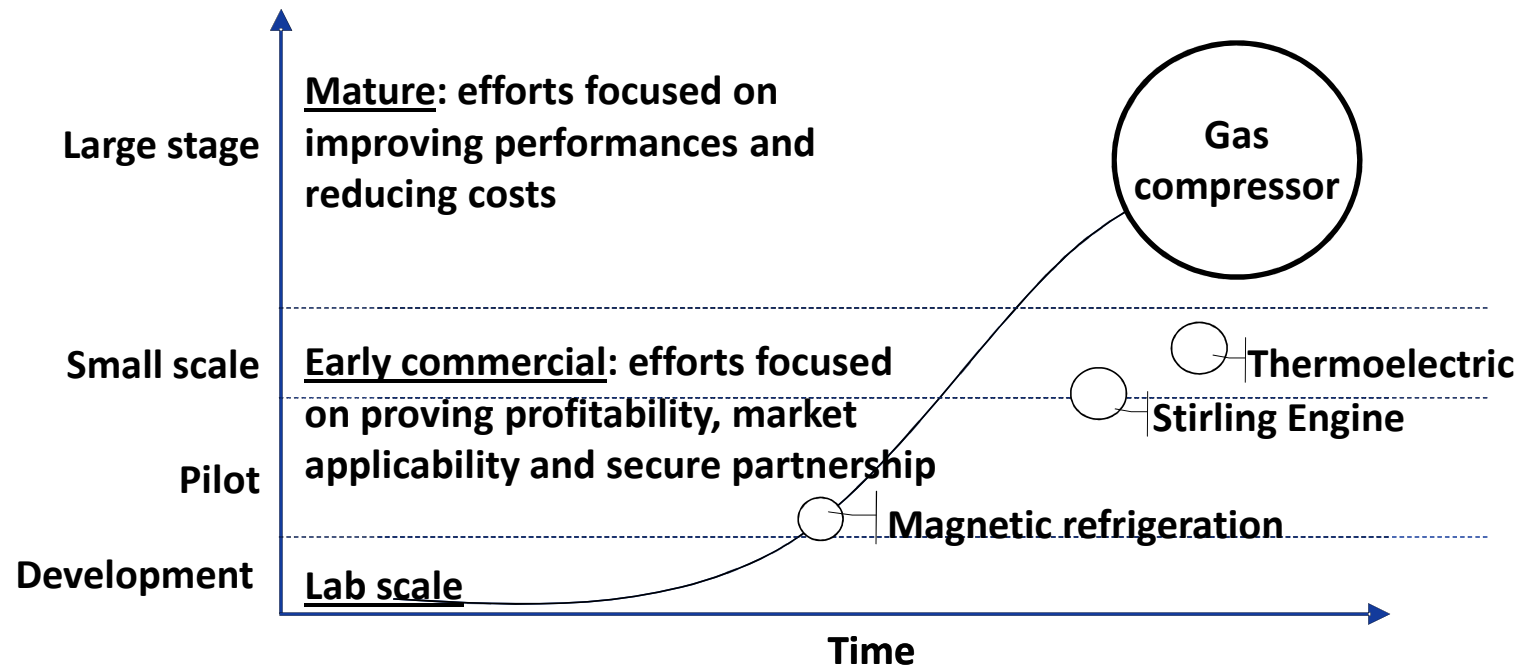
Commercializing Magnetic Refrigeration

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Magnetic refrigeration commercialization: where are we?



- Magnetic cooling technology is sufficiently well understood
- Evaluation basis of future performances extrapolated by current performance and benchmarked with current specs
- R&D roadmaps of 3-5 year timeframe can be drafted

Early commercial: market applicability

Domestic Refrigeration

Commercial Refrigeration

Air Exchanger/Heat Pump

Vehicle Air Conditioning

Early commercial: Domestic Refrigeration

Reference specs (for temperate class)

T span: 34K (fridge)/ 54 K (freezer)

Tcold: 274 K (fridge) / 254 K (freezer)

Thot: 308 K

Cooling power: 30W – 180W

Cooling engine weight : max 10 Kg

Efficiency appliance: EEI < 22

Life cycle: 10-15 years

Noise appliance: <40 dB

Gas compressor nominal cost benchmark: 300 – 600 €/kW



Early commercial: Commercial Refrigeration

Reference specs

T span: 34 K

T product temperature: 276 K

T_{hot}: 308 K

Gas compressor cooling capacity: 180W

Gas compressor weight: 8kg

Electricity bill with gas compressor: about 100 euro/year

Life cycle: 10 years

Noise appliance: < 40dB

Gas compressor nominal cost benchmark: 160 €/kW



Early commercial: Vehicle Air Conditioning

Reference specs

T span: 50 K

Tcold: 278 K

Thot: 328 K

Cooling power (cars): 3 - 6 kW

Cooling system weight: max 20 Kg

Efficiency target: COP > 2

Life cycle: about 300000 Km

Noise: lower than 45 dB

Cost benchmark: *industry proprietary*



Early commercial: Air Exchanger/Heat Pump

Reference specs (Air-to-Air, Water-to-Air)

Typical Cooling Mode span: +/- 100%	Air-Air Exchanger	8K
	Air-Air Heat Pump	16K
	Water-Air Heat Pump	10K
Typical Heating Mode span: +/- 100%	Air-Air Exchanger	8K
	Air-Air Heat Pump	25K
	Water-Air Heat Pump	10K

Cooling power: 2 - 5 kW

Exergy Efficiency for magnetic cooling engine: +50%

Whole unit weight: 13- 28 Kg/kW

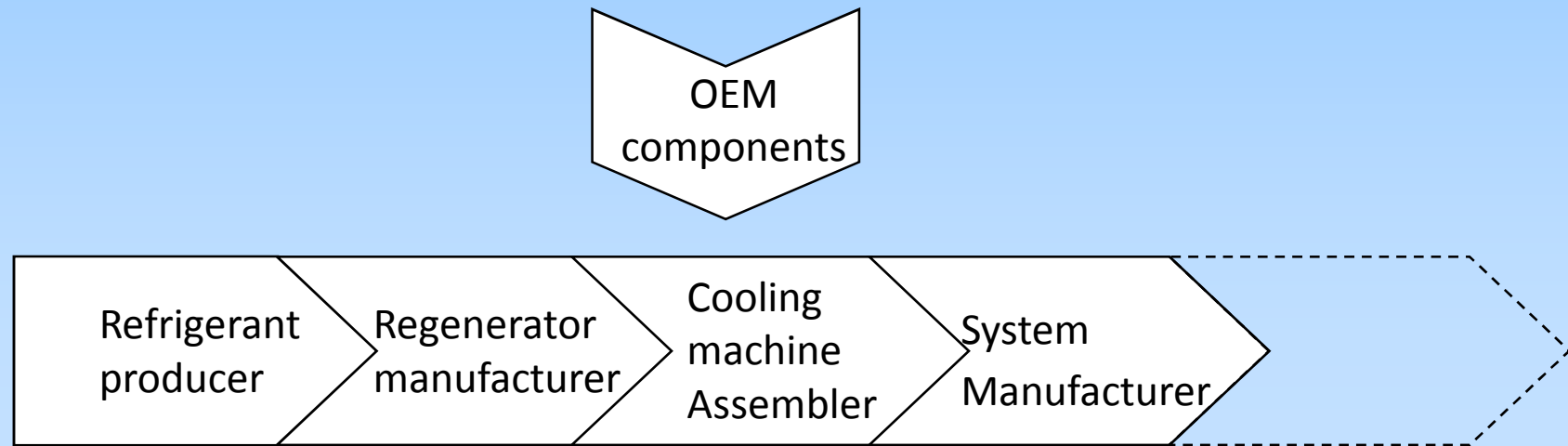
Life cycle: 10 -15 years

Noise: < 40 dB

Gas compressor nominal cost benchmark: 12-20 €/kW



Reference magnetic refrigeration industry value chain

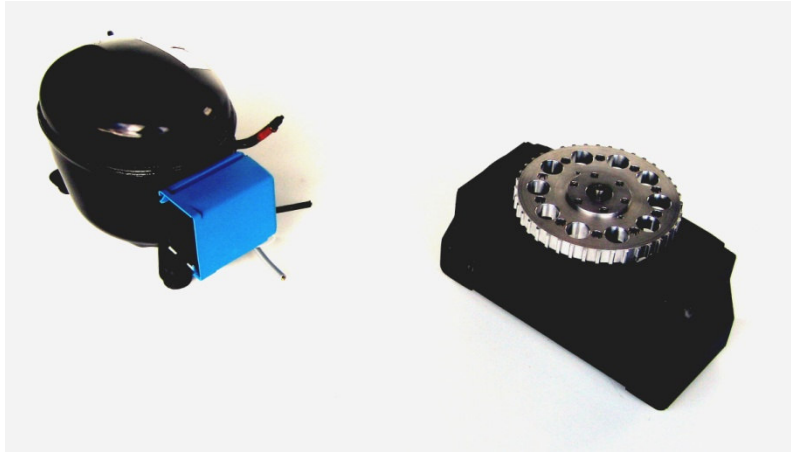


- **Construction holistic approach is required**
- **Collaboration and partnering are essential to making magnetic refrigeration successful**
- **Camfridge** already works with Whirlpool, Arcelik, Clivet, VAC, + others under confidentiality terms

Magnetic System Development

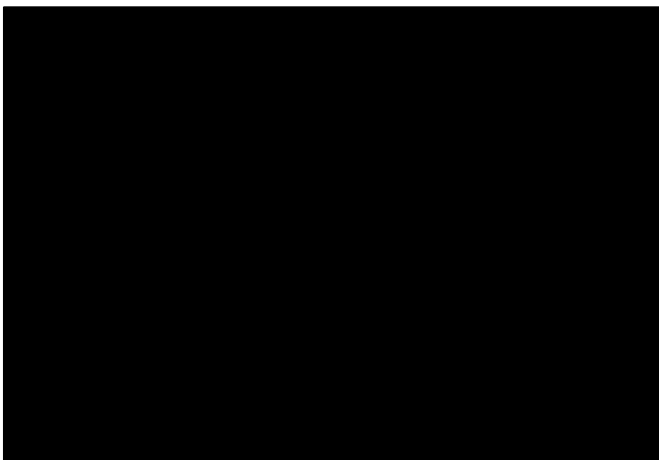
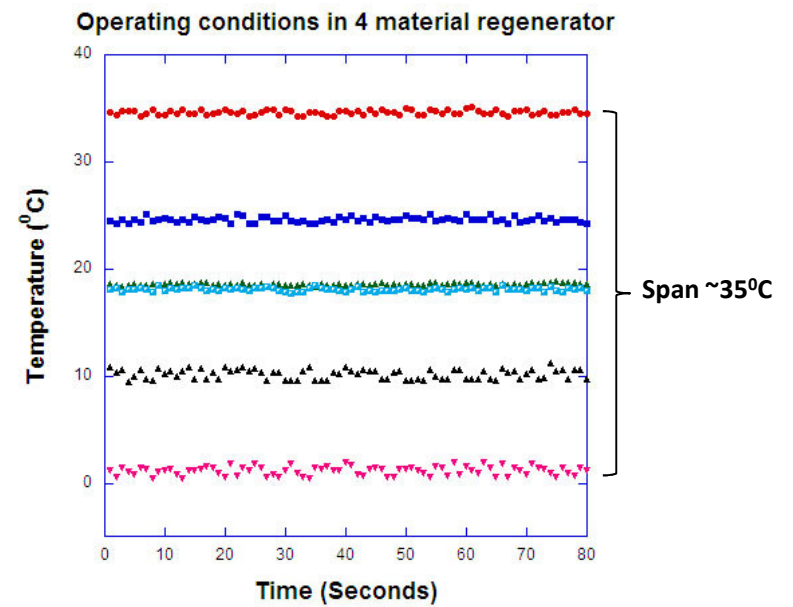
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Magnetic solution now same size and similar weight to gas compressor !

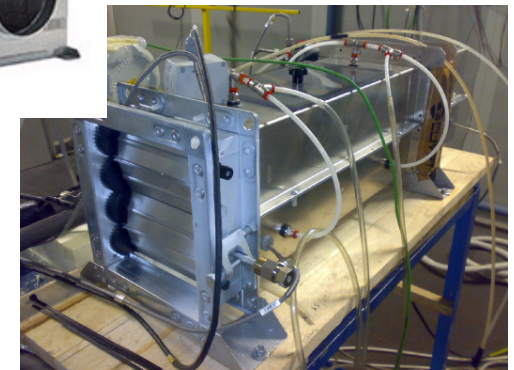


Typical gas compressor

1.15T field 5 Hz rotary magnetic system



Designed to integrate with domestic fridge (left) and air-air exchangers (right).



Thanks for listening



Acknowledgements

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See: <http://www.sseec.eu/>

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See: <http://www.frisbee-project.eu/>