

Refrigeration Systems

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ENTR Lot 1 Second Stakeholder Meeting
Brussels, Belgium, June 4th 2010

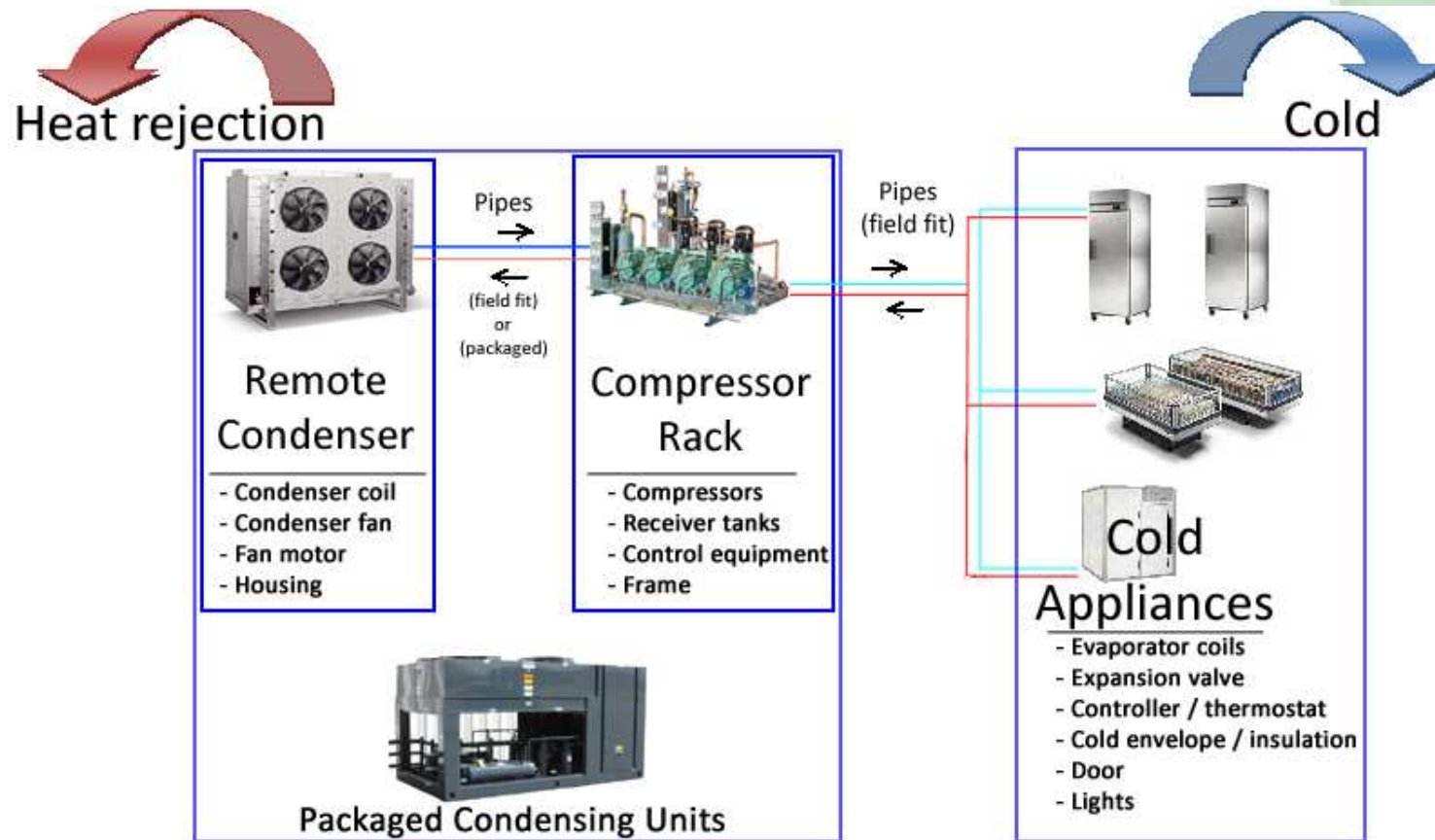
A study being conducted for DG ENTR by BIO Intelligence Service



10:00 – 10:20	Welcome, “Tour de table”
10:20 – 10:30	Introduction to the Ecodesign Directive
10:30 – 10:40	Horizontal session: Progress update and selection of Base Cases
10:40 – 11:30	Product focus: Walk-in cold rooms
11:30 – 11:50	COFFEE BREAK
11:50 – 12:40	Product focus: Service cabinets
12:40 – 13:30	Product focus: Blast cabinets
13:30 – 14:20	LUNCH BREAK
14:20 – 15:10	Product focus: Remote condensing units
15:10 – 15:40	Horizontal session: Refrigeration systems
15:40 – 16:00	COFFEE BREAK
16:00 – 16:30	Horizontal session: Refrigerants
16:30 – 17:20	Product focus: Chillers
17:20 – 17:30	Conclusions, next actions and AOB

Definition

One or several remote refrigerating appliances connected together with one or several condensing units



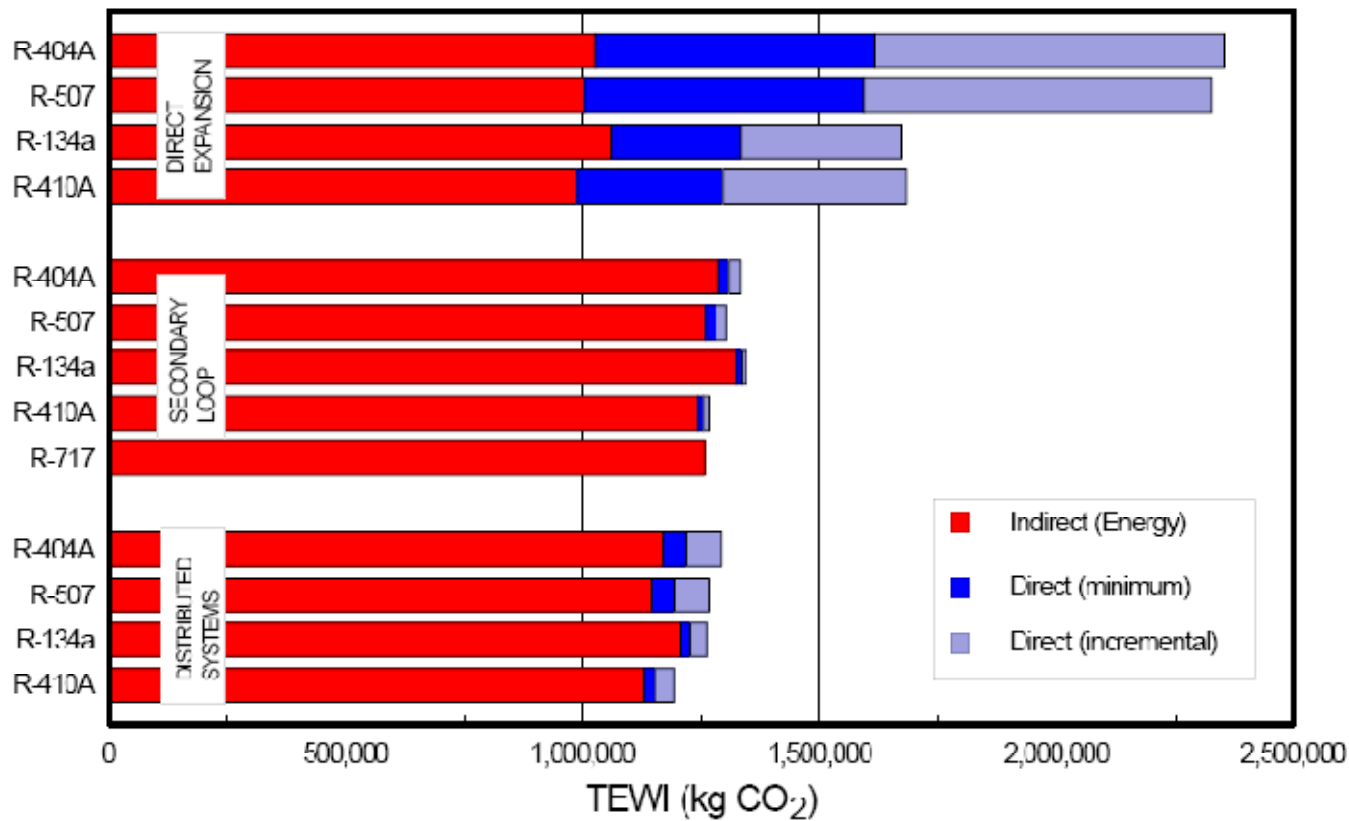


Main Environmental Issues

- Configuration of the system
- Refrigerant choice
 - Trade off between performance limitations and impact of leaks
- Variable ambient conditions
- Construction and maintenance

Configuration	Strengths	Weaknesses
Direct system	<ul style="list-style-type: none"> ✓ Good efficiency ✓ Less components than indirect system ✓ Lower investment cost than indirect system 	<ul style="list-style-type: none"> ✓ Large refrigerant charges ✓ Refrigerant leakages
Indirect system	<ul style="list-style-type: none"> ✓ Lower refrigerant charges ✓ Simple and cheaper service ✓ Use of natural refrigerants possible 	<ul style="list-style-type: none"> ✓ Risk for low energy efficiency ✓ Pump work ✓ Risk of corrosion ✓ Pipes need to be insulated
Distributed system	<ul style="list-style-type: none"> ✓ Good efficiency ✓ Reduction of refrigerant circuit length => lower refrigerant charges ✓ Less refrigerant leakages 	<ul style="list-style-type: none"> ✓ No possibility to use natural refrigerants such as ammonia or HC ✓ Noise
Cascade system	<ul style="list-style-type: none"> ✓ Lower refrigerant charges, less leakages ✓ Simple and cheaper service ✓ Natural refrigerants possible 	<ul style="list-style-type: none"> ✓ Both medium and low temperature interact ✓ Pump work ✓ Risk of corrosion ✓ Pipes need to be insulated

- Indirect = electricity consumption
- Direct = refrigerant leaks



Source: Oak Ridge, Laboratory Energy and Global Warming Impacts of HFC and Emerging Technologies, 1997

- Direct: refrigerant leaks

Country	Year(s)	Annual refrigerant loss (%)
Netherlands	1999	3.2
Germany	2000-2002	5-10
Denmark	2003	10
Norway	2002-2003	14
Sweden	1993	14
	1998	12.5
	2001	10.4
United-Kingdom	1998	14.4

- Ecoreport assumption for all base cases is 10%

Agree with these numbers?

Average leakage in EU-27?

- Indirect: energy consumption
- 40 % energy savings is possible with:
 - 10% : Efficient control, operation and design directive for refrigeration system
 - 12% : Reduction of effective temperature differences on heat exchangers
 - 3%: Use of highly efficient motors
 - 7% : Saving in the refrigeration need
 - 8% : System improvement, design in compliance with the annual temperature profile, heat recovery and further improvements

Source:VDMA 24247 – Energy efficiency of refrigeration systems – Part 1

- There are no relevant EU performance test standards for refrigeration systems

Reference	Title
EN 378	Refrigerating systems and heat pumps – safety and environmental requirements
EN 12178:2003	Refrigerating systems and heat pumps - Liquid level indicating devices - Requirements, testing and marking
EN 13136:2001	Refrigerating systems and heat pumps - Pressure relief devices and their associated piping - Methods for calculation
EN 1861:1998	Refrigerating systems and heat pumps - System flow diagrams and piping and instrument diagrams - Layout and symbols
EN 12284:2003	Refrigerating systems and heat pumps - Valves - Requirements, testing and marking
EN 12900:2005	Refrigerant compressors - Rating conditions, tolerances and presentation of manufacturer's performance data

VDMA-Einheitsblatt – 24247(Requirements for refrigeration systems)

Specifies measures for implementing the recommendations laid down in the position paper of the ‘Forschungsrat Kältetechnik e.V.’ and proposes solutions for meeting 40% energy savings.

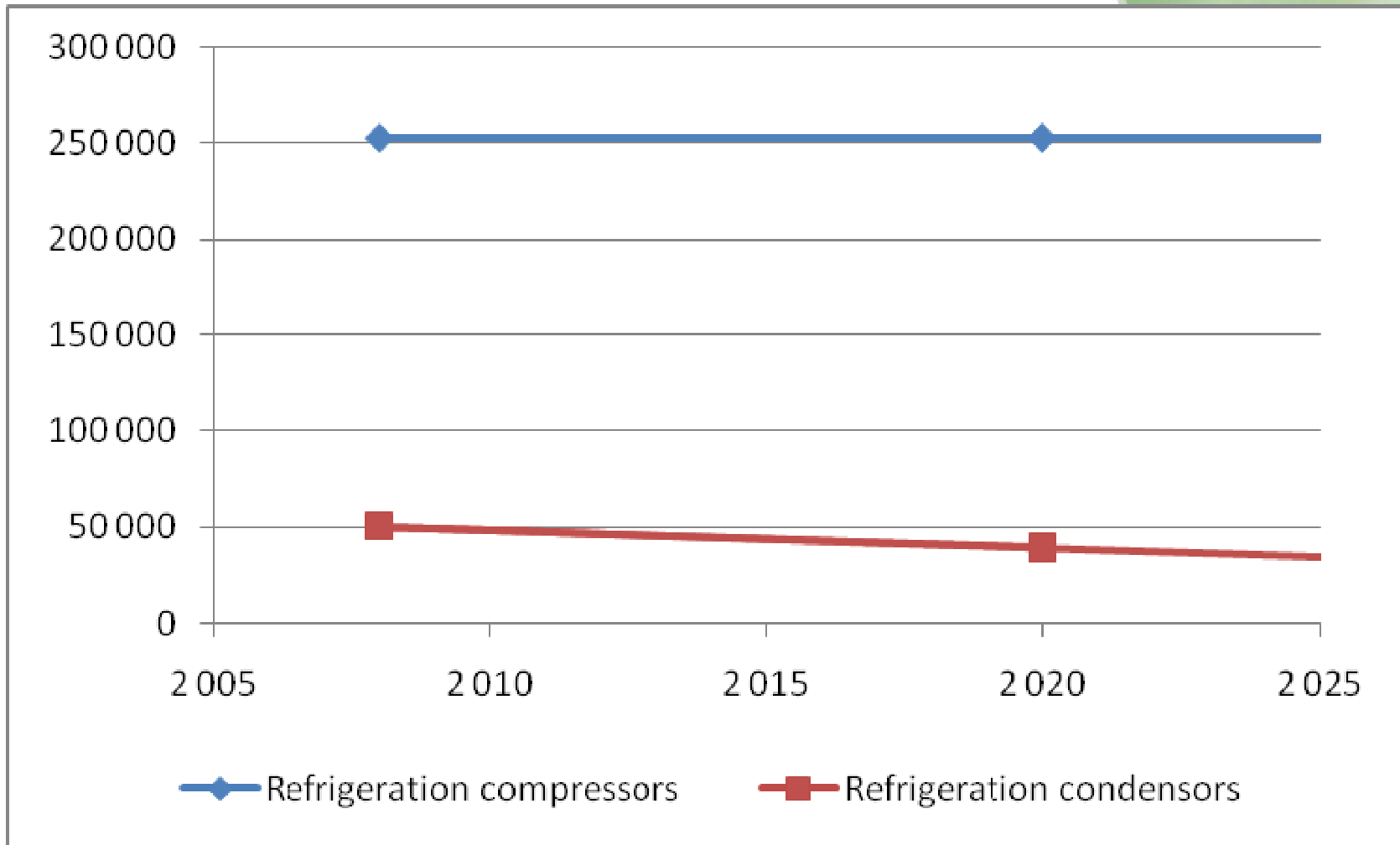
- **Recommendations:**

- Optimisation of system concepts (choice of refrig. choice of temp level)
- Definition of design directive (annual temp profile, full / partial load)
- Optimisation of operational concepts of already existing systems
- Application of energy management systems
- Reduction of refrigerant load (better insulation)
- Energy recovery
- Introduction of maintenance regulations
- Introduction of energy efficiency criteria
- Minimum requirements and certification of components
- Optimisation of drives

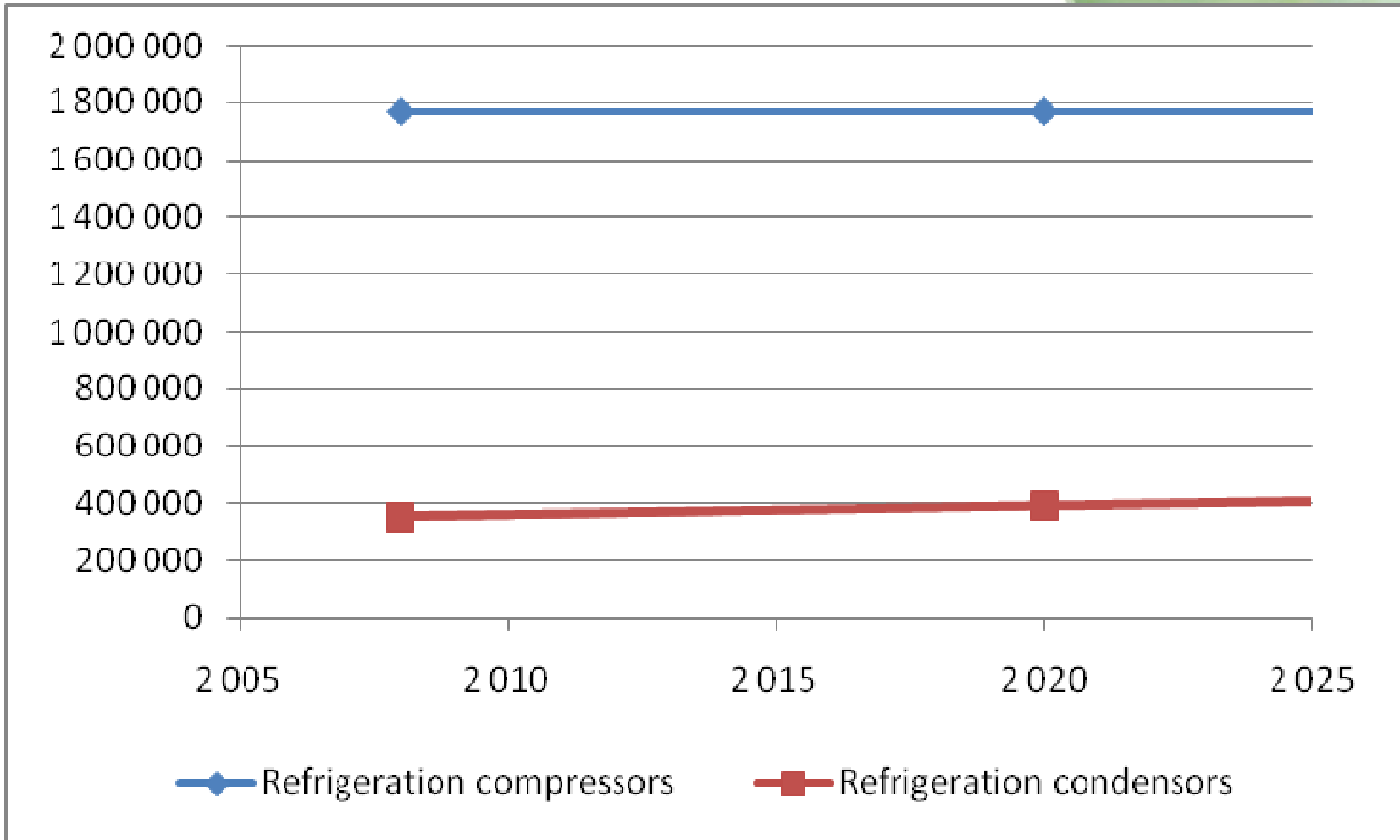
Is an EU test standard necessary for refrigerant systems?

Are there relevant similar standards which could be adopted?

Market size - sales



Market size - Stock





Improvement options

Technology	Energy savings (%)	Application
Trigeneration	20	Supermarket system
Liquid pressure amplification	Up to 20	All remote refrigeration systems
ECM/Variable speed compressor	15	All integral and remote systems
High-efficiency compressors	12	All integral and remote systems
Defrost optimisation	10	Freezers (should be operated on off-cycle)
Multi-evaporator systems	10	Freezers (indirect through removal of defrost heat load)

Non-quantified improvement options for refrigeration systems suggested by stakeholders include:

- Reducing pipe lengths to a minimum.
- Using electronic expansion valves.
- Using efficient compressors.
- Reducing joints and potential leak points.
- Monitoring refrigerant levels to ensure efficient operation.
- Electronically commutated fans (additionally estimated to last 7 times longer than standard fans).
- Heat exchangers to collect waste heat produced by the central plants.

Proposed initial MEPS benchmarks to be met by 2013 for categories of large, medium and small sized stores

Category	Size of trading floor size (m ²)		MEPS Energy intensity (kWh/m ² p.a.)
	Range	Average	
Large	≥ 2,750	3,800	820
Medium	≥1,500 and < 2,750	2,500	850
Small	< 1,500	650	980



Potential Impacts

	Estimated average energy consumption (MWh/year)	Estimated average energy savings per product by 2020	Estimated total savings per year (TWh / year)
Compressors	22.9	5%	1.52
Condensers	19.1	3%	0.15