

Remote condensing units

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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

Product description

- Not a complete refrigeration unit: Only condenser, compressor, receiving tanks and auxiliaries
- Connected to remote cooling appliances (evaporator and expansion valves)
- RCUs can be packaged (PCUs) or used with separate compressor packs (or racks)
- They are used to provide refrigeration to large spaces (walk-in cold rooms). Compressor racks are normally used for supermarket systems

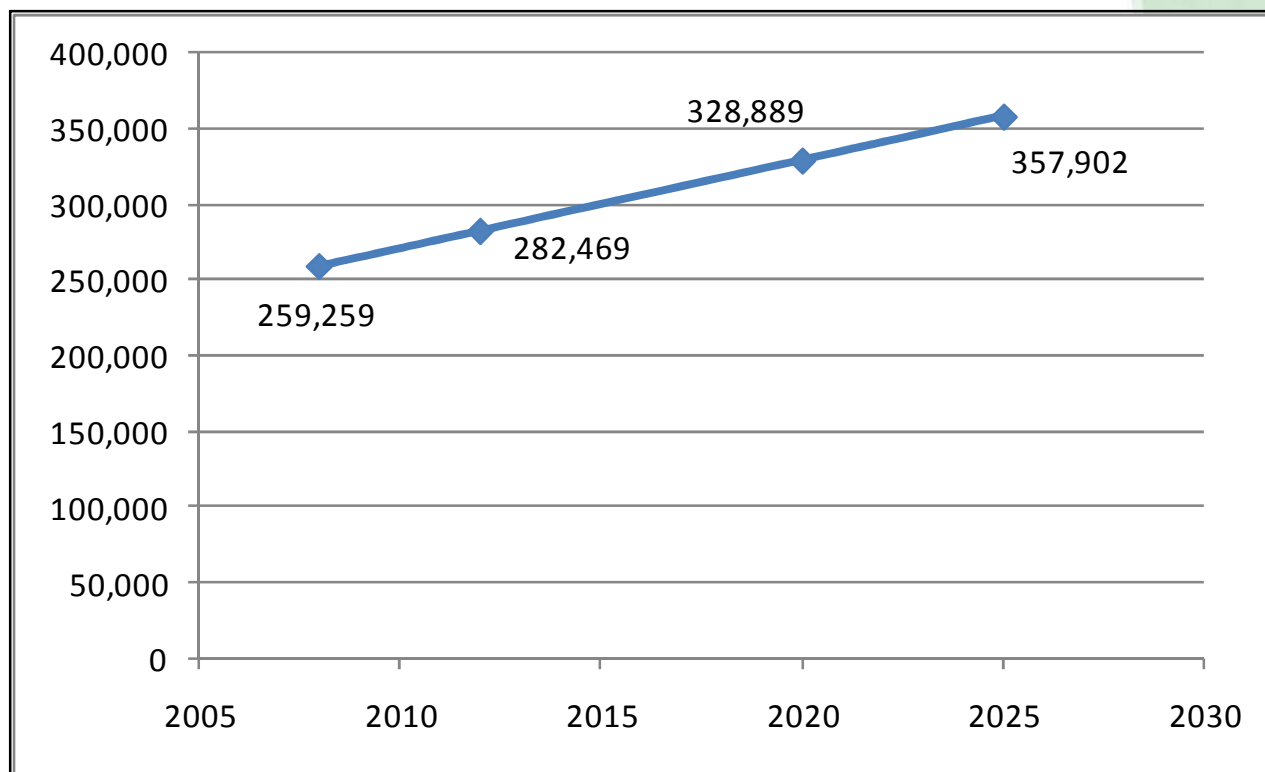


Functional Unit

- kW cooling capacity

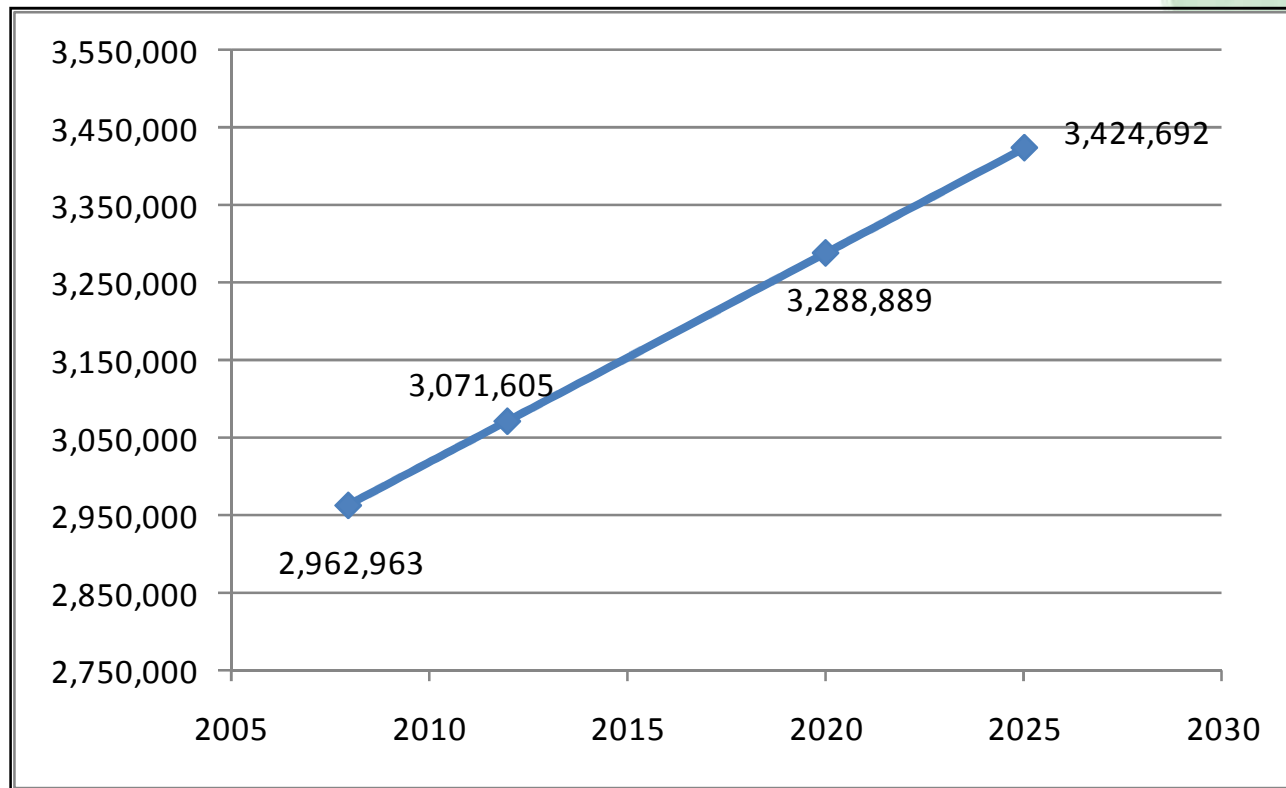
Estimated sales forecast of remote condensing units cabinets until 2025 in EU (units)

*Extrapolation of Defra MTP figure



Estimated stock forecast of remote condensing units until 2025 in EU (units)

*Extrapolation of Defra MTP figure





Classification

1. System: packaged condensing units, independent compressor/compressor rack and condensing unit, or split systems (PCU sold with a non-integral evaporator)
2. Compressor and operation mode: VSD compressor (continuous load matching), parallel sequential (multiple on-off compressors combined to approximate load matching), single compressor (on off operation)
3. Cooling capacity (3 – 20kW / 20 – 420kW)
4. Operating temperature range (5°C, -10°C, -35°C)*

Location (indoors, outdoors) and type of coolant can be considered among the parameters for classification as well

Do you agree with these categories for classification?

Suitable classification from manufacturing or purchasing scope?

Are split systems applicable for refrigeration, or are they more oriented to A/C systems only?

* Update from task documents

Source: UK ECA Scheme, Standard Specifications from U of Washington and stakeholder feedback



Test standards

- EN 13771:2007 (European level)
Establishes the refrigerant capacity of condensing units and separate compressor and condensers and testing methods.
- EN 13215:2000 (European level)
Provides rating conditions and labeling requirements for comparison of different units.
Tests done according to ISO 917.
- ASHRAE Standard 23-2005 (USA)
Applies to packaged condensing units evaluation

Need for new standards development ?

Condensing units are in the scope of several evaluation standards. EN 13215 is useful to compare different products from an efficiency point of view

- No mandatory requirements are identified at EU level/MS

- MEPS
 - EU: UK ECA Scheme. Air-cooled condensing units

What should a performance evaluation standard or MEPS consider for Remote Condensing Units?



User Behaviour

- The use pattern corresponds to 8760 hours/year (365 days/year, 24hrs/day).
- Consumption over the course of a year is the sum of the consumption of the components within the unit.

Do you agree with this use pattern?

What is the average consumption/use-time per component?



Average product characteristics

- The most commonly used PCUs are air cooled and consist of a compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.
- The two-speed compressor used within the equipment is a scroll type, hermetically sealed, with rubber vibration isolators.
- The motor is a two speed and includes thermal and current sensitive overload devices, start capacitor, relay, and contactor.
- The condenser coil is made of a seamless copper tube and aluminum fin coil.
- The condenser fan is made of aluminum.
- Various technical specifications unknown.
- Lifetime estimated to be 10 years.

Are scroll or reciprocating compressors more common?

BOM of components such as compressor and condenser provided by stakeholders

Parameter	Base Case
Design	Packaged
Target output temperature[°C]:	(+2°C/+4°C)
Annual electricity consumption *[kWh/year]:	18,034
Cooling capacity [kW]:	7.1
Power input [kW]:	6.4
Performance [COP]:	1.11
Weight of product [kg]:	141
Lifetime [years]:	10
Price [€]:	6,000
Refrigerant:	R404a
Type of compressor:	Scroll (reciprocating?)
Condenser cooling:	Air-cooling

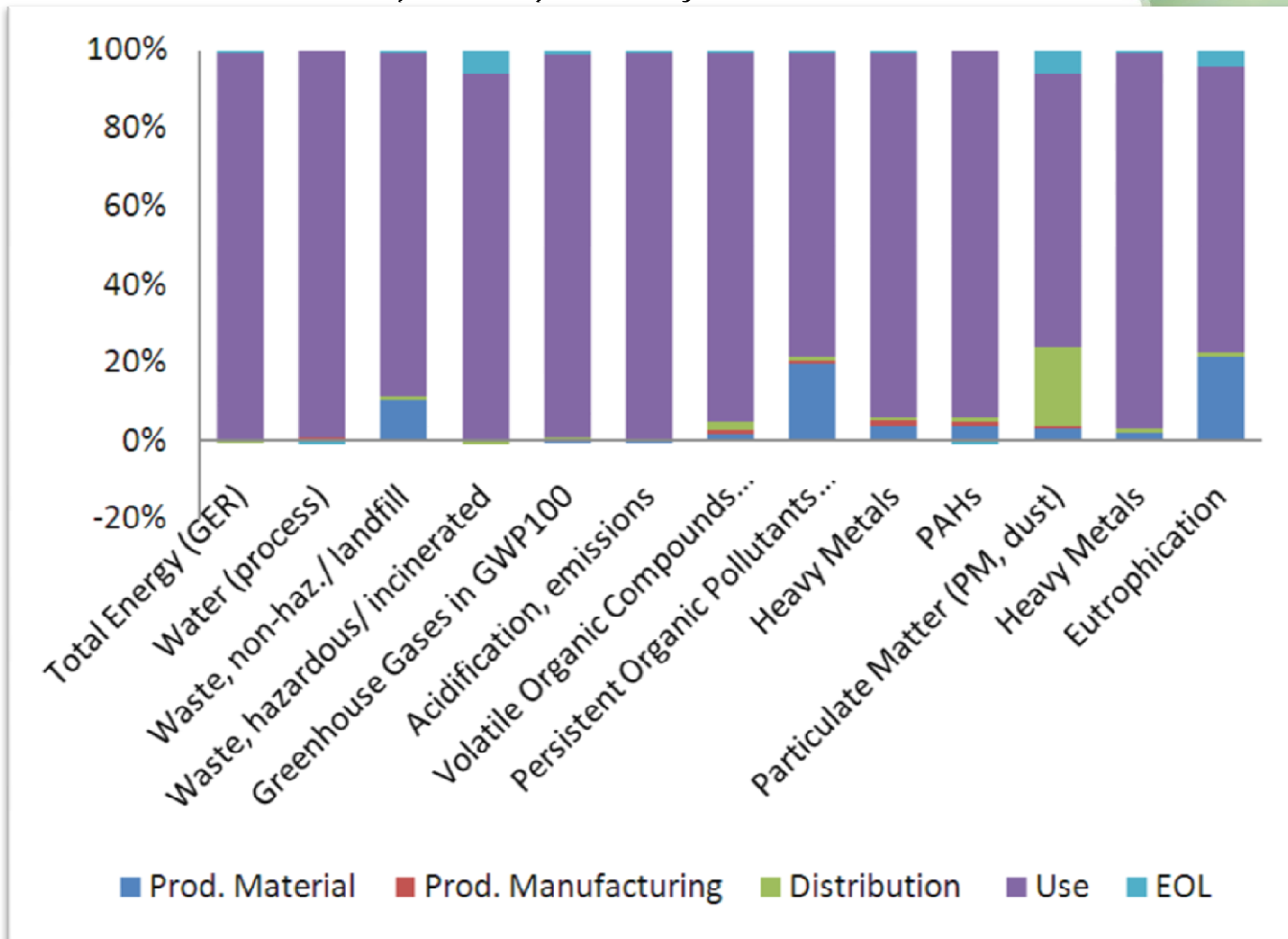
* Information provided by the manufacturer, calculated according to the EN 13215

What is a more representative target temperature?

Price per kW of cooling capacity is high, is this representative?

Cost: 850€ / kW

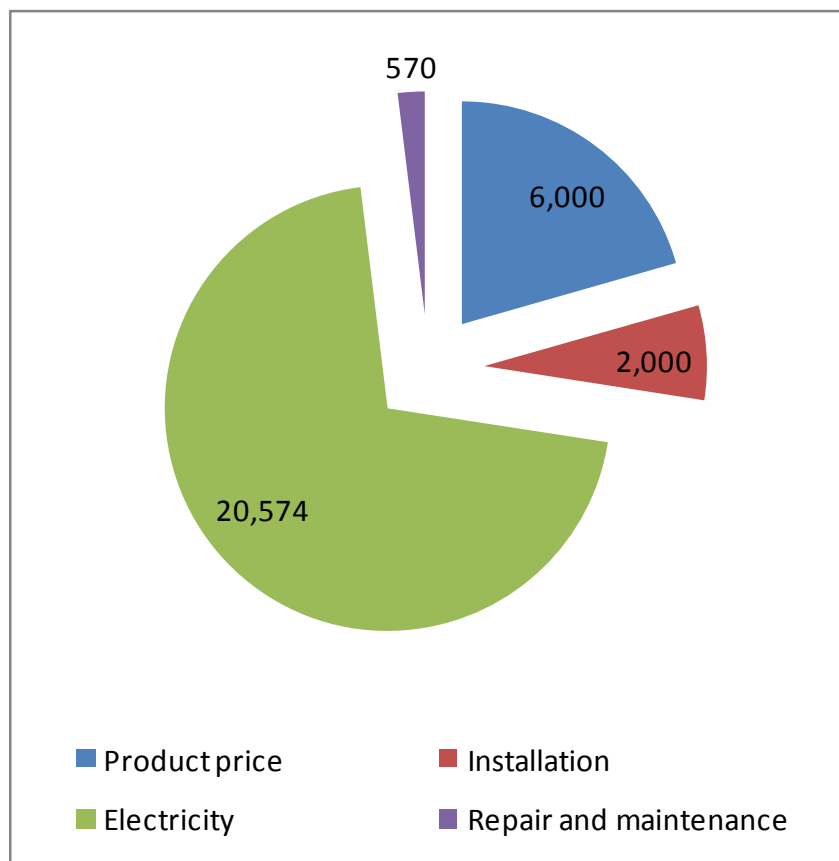
Total Energy (GER) = **26,817.28** MJ/kW cooling capacity per year, of which the use phase represents just under **100%**



* Impacts in the graph are given by Life Cycle

Economic Impact Results

Life cycle costs of RCUs: **29,144 EUR**



Packaged condensing unit <i>Item</i>	total annual consumer expenditure in EU25
Product price	1556 mln.€
Installation/ acquisition costs (if any)	519 mln.€
Fuel (gas, oil, wood)	0 mln.€
Electricity	6604 mln.€
Water	0 mln.€
Aux. 1: None	0 mln.€
Aux. 2 :None	0 mln.€
Aux. 3: None	0 mln.€
Repair & maintenance costs	178 mln.€
Total	8856 mln.€

Parameter	Base Case	BAT
Design	Packaged	Packaged
Target output temperature[°C]:	(+2°C/+4°C)	(+2°C/+4°C)
Annual electricity consumption *[kWh/year]:	18,034	19,068
Cooling capacity [kW]:	7.1	7.2
Power input [kW]:	6.4	4.89
Performance [COP]:	1.11	1.46
Weight of product [kg]:	141	117
Price [€]:	6,000	5,000
Lifetime [years]:	10	10
Refrigerant:	R404a	R404a
Type of compressor:	Scroll (reciprocating?)	Scroll (reciprocating?)
Condenser cooling:	Air-cooling	Air-cooling

* Information provided by the manufacturer, calculated according to the EN 13215



Improvement options

Technology	Remote condensing units		
	Applicable Market penetration (%)	Energy savings (% of TEC)	Increase in price (€)
High efficiency compressor	10	12	300
ECM compressor motor		4	
Variable-speed-drive (VSD) compressor		10	
Increase of the heat exchanger surfaces	10	5	400
ECM Fan Motor	20	5	500
Fan motor controllers	3	5	300
High Efficiency Fan Blades	5	4	300
Ambient subcooling		5	
Brazed plate heat exchangers			
<i>Applicable</i>			
<i>Applicable, but not yet included in the product (might be common feature in 2-3 years)</i>			

For the coming 5 years a 50% energy savings could be achieved by combining the following technologies:

- high efficiency compressor with the ECM motor and VSD
- ECM motor for fans
- high efficiency fan blades
- surface of heat exchanger increased
- fan motor controllers



BAT potential energy savings

	Annual electricity consumption (kWh/year)	Cooling capacity (kW)
Base Case model	18,034	7.1
<u>Current</u> available BAT model	19,068	7.2
<u>Theoretical</u> BNAT product model (available within 5 years)	9,017	7.1

	Performance (COP)	Energy saving potential
Base Case model	1.11	-
<u>Current</u> available BAT model	1.46	23%
<u>Theoretical</u> BNAT product model (available within 5 years)	2.21* r1	50%

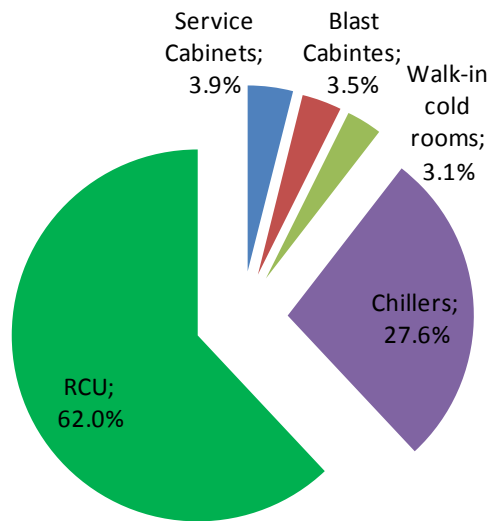
* COP calculated using assumption of 50% decrease of the required power input producing the same cooling capacity as per the Base Case

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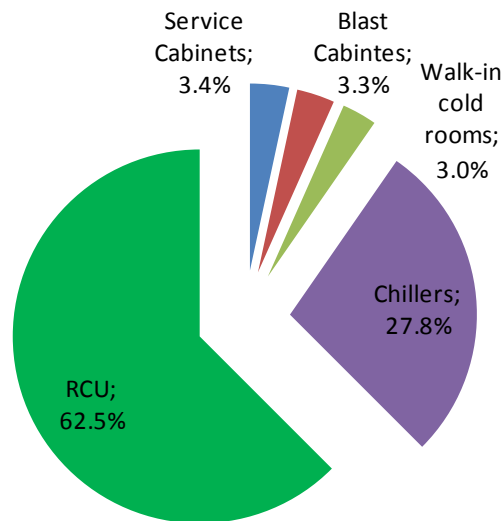
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Impact calculation for the total stock per year

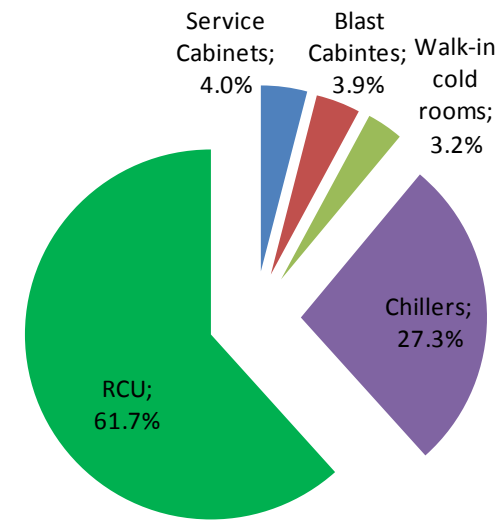
	Service cabinets	Blast cabinets	Walk-in cold rooms	Chillers	Remote condensing units	Total
Total Energy (GER) (PJ)	3.66	3.24	2.90	25.80	58.02	93.62
Electric. Consump (TWh)	0.30	0.29	0.26	2.45	5.51	8.81
GWP (mt CO2 eq.)	0.17	0.16	0.13	1.13	2.56	4.15



Total Energy (PJ)



Electricity Consumption (TWh)



GWP (mt CO2 eq.)



Gaps

- Consensus on classification
- Market data related to the agreed classification
- Average component specifications used in current stock
- Reliable BOM to assess properly the environmental impacts related to the production phase of the Base Case
- Current BAT or BNAT models