Walk-in cold rooms

Jonathan Bain

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

A study being conducted for DG ENTR by BIO Intelligence Service

Bio Intelligence Service - Scaling sustainable development
Industrial Ecology - Nutritional Health

Bio Intelligence Service S.A.S - bio@biois.com
20-22 Villa Deshayes - 75014 Paris - France
Tél. +33 (0)1 53 90 11 80 - Fax. +33 (0)1 56 53 99 90

Agenda

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

- A walk-in cold room is a refrigerated space, large enough to walk into, maintained at a temperature lower than ambient by a refrigerating system temperature.
- Walk-in cold provide refrigerated storage for a variety of items (foodstuff).
- The rooms are constructed from self supporting, pre-fabricated panels.
- They may exist solely as refrigerators or freezers, or a refrigerator-freezer combination.

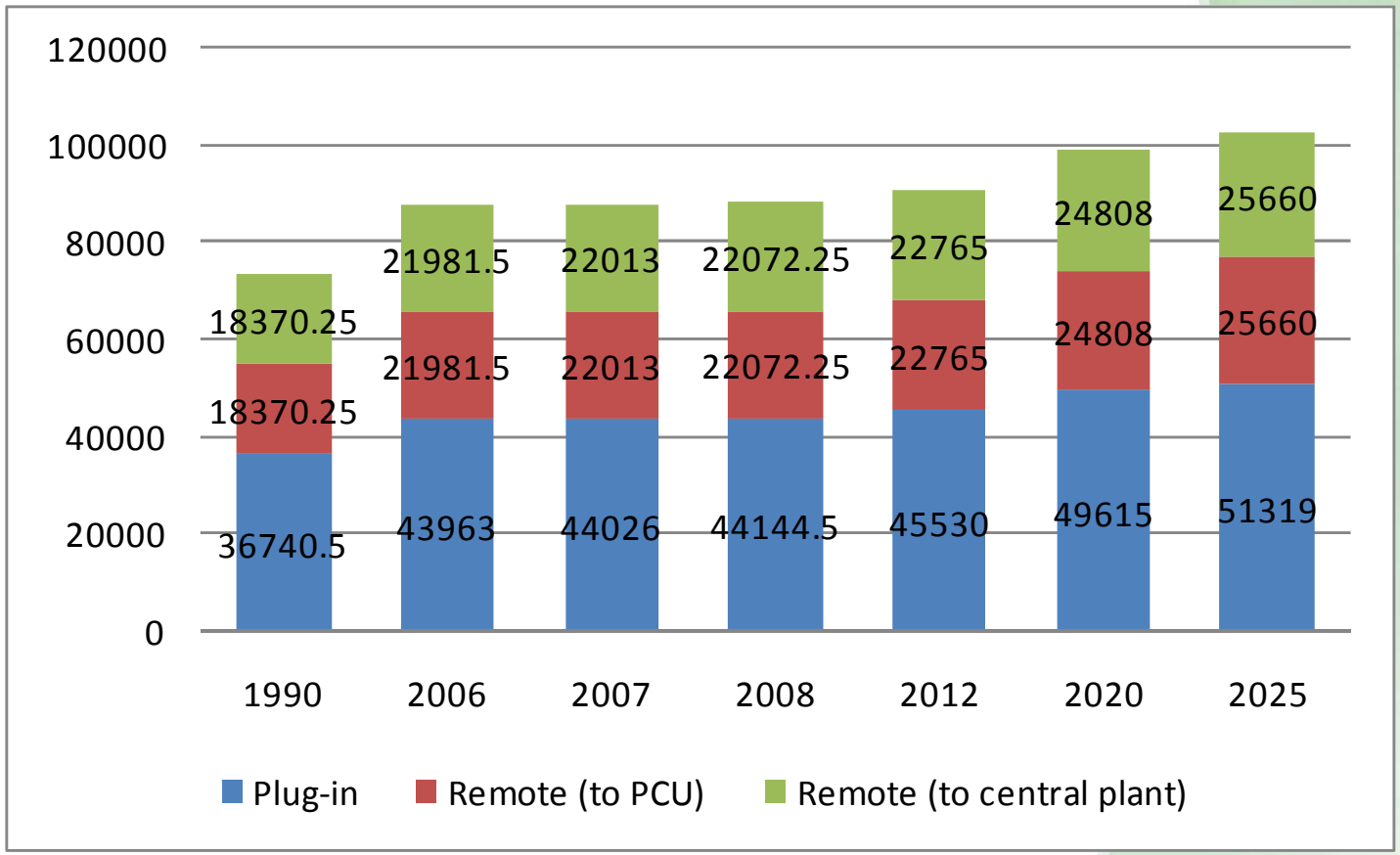
Functional Unit

➢One cubic metre of net storage volume at +2°C

Market - Sales

Estimated sales forecast of walk-in cold rooms until 2025 in EU (units)

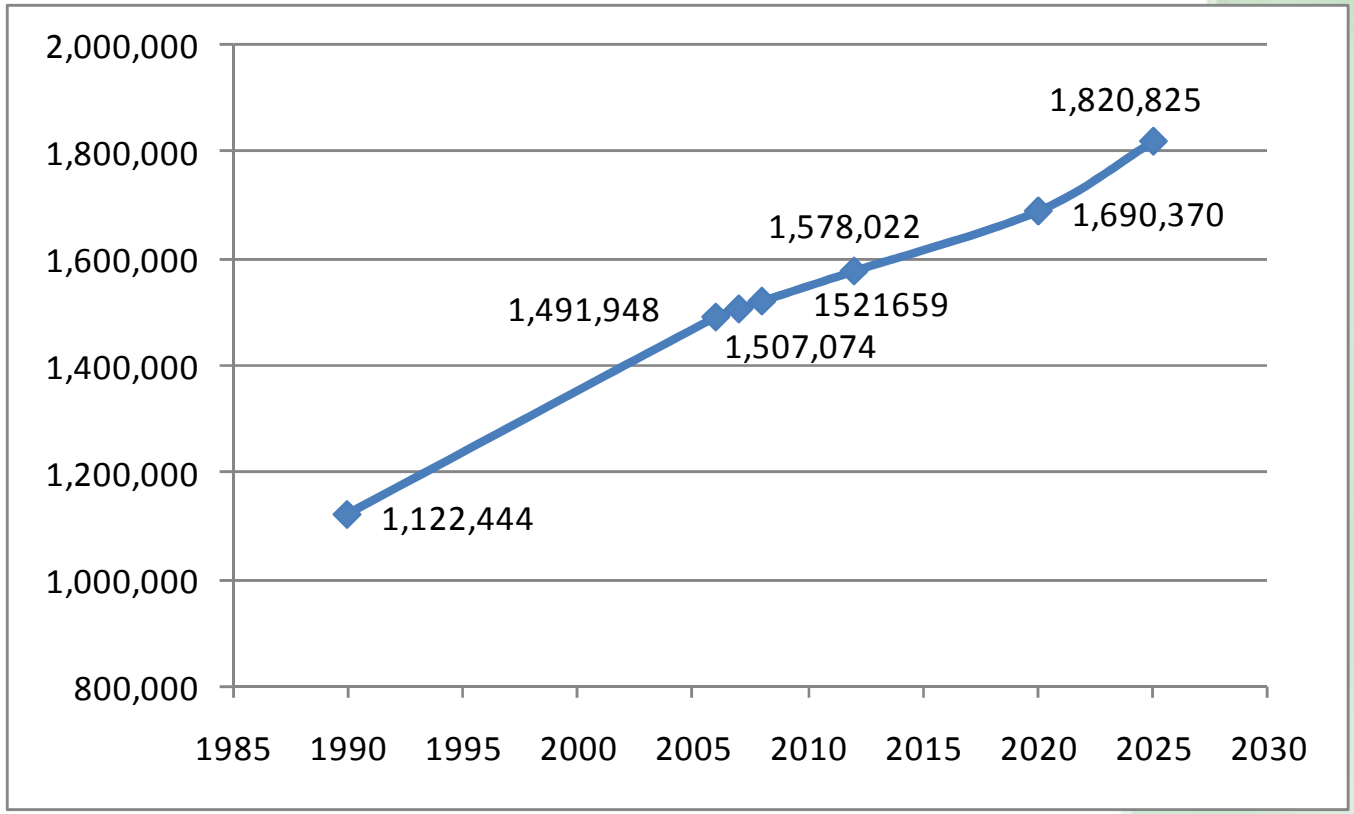
*Extrapolation of Defra MTP figures



Market – Stock

Estimated stock forecast of walk-in cold rooms until 2025 in EU (units)

*Extrapolation of Defra MTP figures



Classification

1. Temperature: cellar rooms (10 to 12°C), general purposes (1 to 4°C), meat rooms (-2 to 2°C) and deep freeze (-22 to -18°C)
2. Size (volume): mini (27 m^3), small (72 m^3), medium (144 m^3) and large (400 m^3)
3. Cooling capacity at 5°C: mini (2,250 W), small (4,100 W), medium (9,000 W), large (20,400 W)
4. System: Plug-in, remote packaged (+PCU) or remote (+ central plant)
   - Plug-in products integrate the condensing unit within the product
   - Remote products are connected to a remotely-located packaged condensing unit.
   - Packaged models are assumed to include the condensing unit, either integrated or through a remotely packaged unit.
5. Location can be considered among the parameters for classification as well, but no data has been identified at this stage, stakeholders are invited to provide feedback, e.g. indoors or outdoors.

Do you agree with these categories for classification?

Sizes too large? Upper limit on size for walk-in cold rooms?

Classification

Are the categories of walk-in cold room models predominantly:

- factory-assembled (mini models only?);
- provided as a complete in-situ construction kits;
- customised from sets of components specifically designed to be used together for walk-in cold rooms and constructed on-site;
- a mixture of construction kit (e.g. the outer shell) and customised element (e.g. refrigeration system); or
- other combination.

  - Proportions of products that are packaged or remote?
  - Of those that are remote, the proportions of products connected to RCUs compared to centralised refrigeration plants?

Sales data indicates that walk-in cold rooms primarily plug-in (50%), with equal distribution of remote + packaged condensing unit and remote + central plant types (25% each).

Trend toward packaged?

Testing standards

- US DoE developing a method for calculation of walk-in cold room efficiency, with calculation of heat load into the shell (envelope) and COP of refrigeration system; integration and adapting the ANSI/AHRI 1250:2008 or the ASHRAE 72:2005 standard
- AHRI 1251 could be used to evaluate the performance of the technical equipment (i.e. refrigeration system), with development of a more comprehensive test standard, in parallel to the US DoE proposal
- Possibililty of computer modeling method
- Food safety an issue to consider (CWA 15596:2006 and NSF/ANSI 7:2009)

Identified need for a testing standard. It should consider effectiveness and accuracy in context of complexity/expense/burden of enforcement

Could US approach be a starting point ?

Legislation and voluntary initiatives

- No MEPS or voluntary agreements
- Legislation relates to components
- ETAG 021 – only refers to prefabricated equipments:
  - Thermal performance
  - Air permeability
  - Water vapour permeability
- US California Energy Commission requires:
  - automatic doors closers, strip doors, spring hinged doors, or other method to minimize infiltration;
  - walls, ceiling and door insulation;
  - electronically commutated and 3-phased motors; and
  - light sources efficacy.

MEPS for walk-in cold rooms (components and/or energy performance)?

User Behaviour

- 8760 hours per year
- Energy consumption can be found either through testing methodology or calculating 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 compressor used assumed to be hermetic and reciprocating, capacity of 560W, total weight 20kg
- Condenser weight is 3.5kg with the fan wattage of 20.4W
- Evaporator weight is 2.4kg with the fan wattage of 12W
- 200W lighting

Base Case Characteristics

(1 partial BOM received from Industry)

Parameter	Base Case
Design:	Plug-in
Internal cold storage temperature [°C]:	+2°C (Range: +1°C to +4°C)
Net volume [m^3]:	6.7
Cooling capacity [kW]:	TO BE COMPLETED
Power input [kW]:	0.58
Weight of product [kg]:	365
Price [€]:	10,000
Lifetime [years]:	14
Refrigerant:	R134a
Type of compressor:	Hermetic reciprocating
Capacity of compressor [W]:	560
Condenser cooling:	Air-cooling
Annual electricity consumption [kWh/year]:	4,500
Performance [kWh/m^3 at 2°C/year]:	671.6

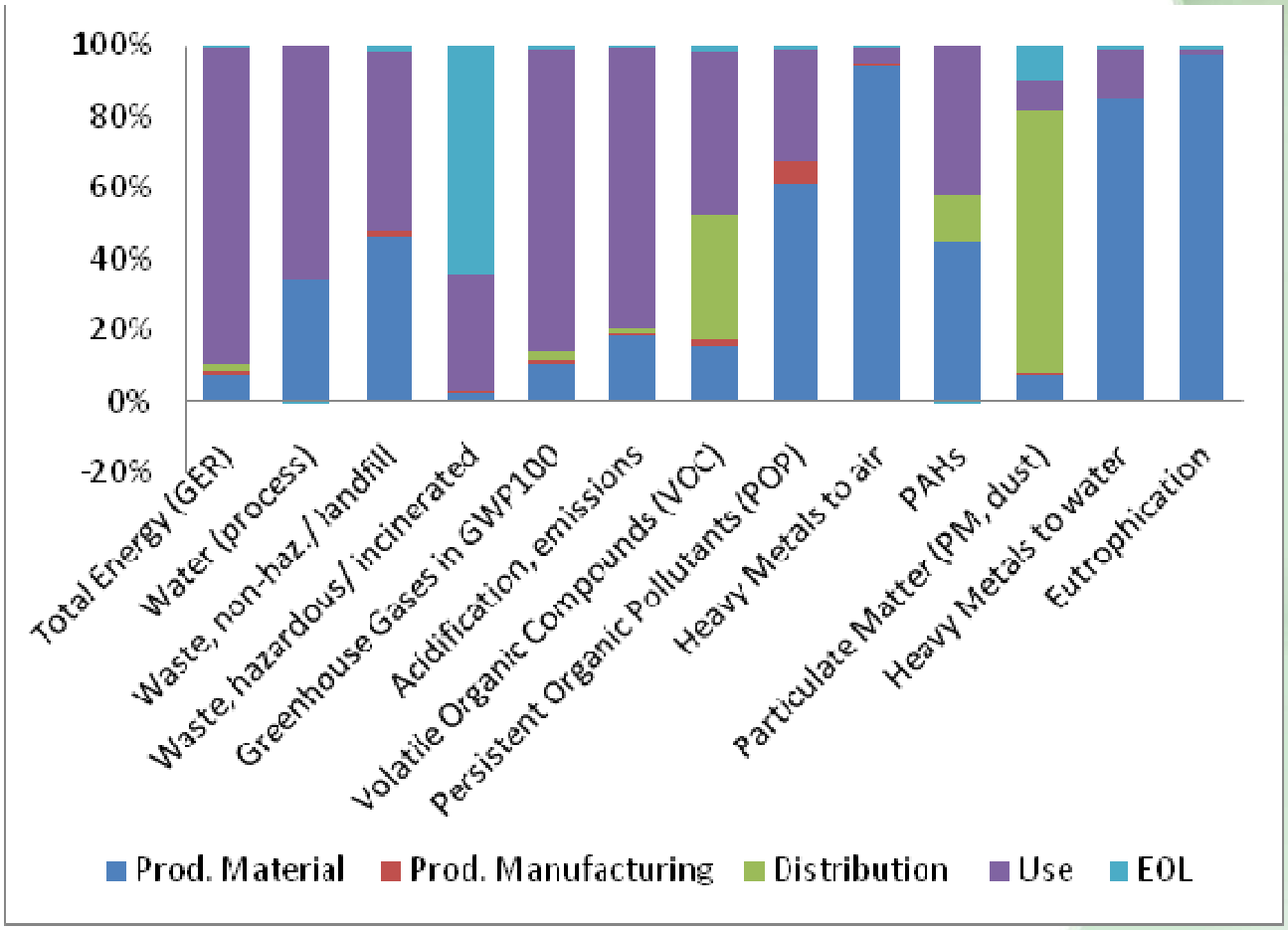
Price too high?

Lifetime too long (for this product/for average)?

Refrigerant – majority using R404a?

Environmental Impact Results

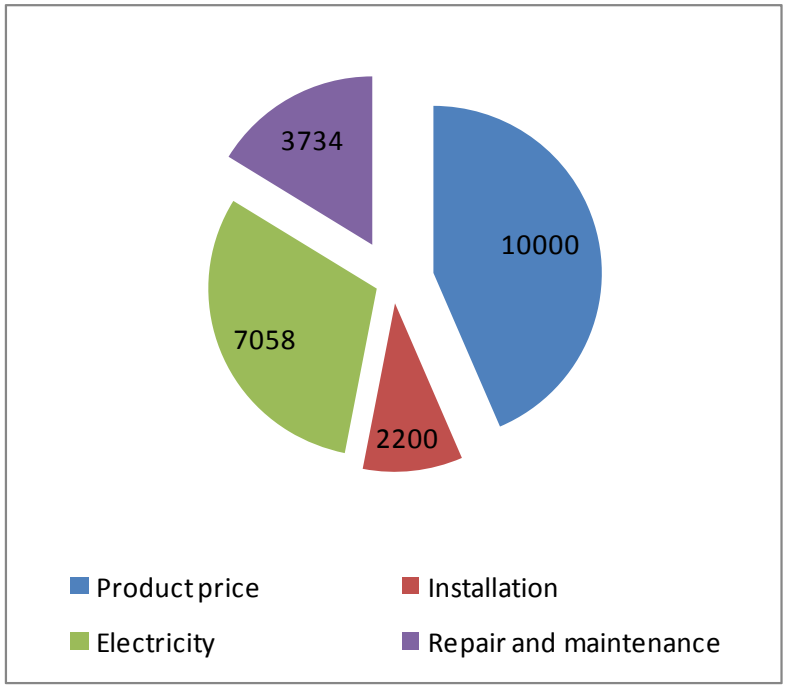
Total Energy (GER) = **7907.77** MJ/per m^3 of net volume at 2°C per year, of which the use phase represents **89%**



*** Impacts in the graph are given by Life Cycle**

Economic Impact Results

Life cycle costs of walk-in cold room: **22,991** EUR



Walk-in cold room *Item*	total annual consumer expenditure in EU25	
Product price	**441**	**mln.€**
Installation/ acquisition costs (if any)	**97**	**mln.€**
Fuel (gas, oil, wood)	**0**	**mln.€**
Electricity	**423**	**mln.€**
Water	**0**	**mln.€**
Aux. 1: None	**0**	**mln.€**
Aux. 2 :None	**0**	**mln.€**
Aux. 3: None	**0**	**mln.€**
Repair & maintenance costs	**217**	**mln.€**
Total	**1179**	**mln.€**

Best Available Technology

Parameter	Base Case	BAT
Design:	Plug-in	Plug-in
Internal cold storage temperature [°C]:	+2°C (Range: +1°C to +4°C)	+2°C (Range: -2°C to +2°C)
Net volume [m^3]:	6.7	14
Cooling capacity [kW]:	TO BE COMPLETED	TO BE COMPLETED
Power input [kW]:	0.58	1.2
Weight of product [kg]:	365	602
Price [€]:	10,000	TO BE COMPLETED
Lifetime [years]:	14	14
Refrigerant:	R134a	R134a
Type of compressor:	Hermetic reciprocating	TO BE COMPLETED
Capacity of compressor [W]:	560	TO BE COMPLETED
Condenser cooling:	Air-cooling	Air-cooling
Annual electricity consumption [kWh/year]:	4,500	6,500
Performance [kWh/m^3 at 2°C/year]:	671.6	464

Improvement options

Technology	Walk-in cold rooms		
	Application and market penetration (%)	Energy savings (% of TEC)[1]	Increase in price (€)
High efficiency compressor		5	10
ECM compressor motor		4	
Variable-speed-drive (VSD) compressor		15	
Increase of the heat exchanger surfaces		3	10
Electronic Expansion Valve (EEV) *when integrated with FHP		5-10	
ECM Fan Motor		5-10	260
Fan motor controllers		3	
High Efficiency Fan Blades		3	90
Insulation Material/Thicker insulation		10-20	
Defrost Control		5-10	
Anti-condensation control		2	370
Ecube		30	120
Floating head pressure (FHP) *when integrated to EEV	1	18	130
Zeolite Filter Cassettes		25	175
Ambient subcooling		7	380
Mechanical subcooling			
High efficiency light bulbs (e.g. LED)		3-5	30
Strip door curtains		1-15	100
Applicable			
Applicable, but not yet included in the product (might be common feature in 2-3 years)			

BNAT

The best available walk-in cold rooms within next 5 years could achieve energy savings of up to approximately 80% using the following:

- improved insulation material and thickness;
- application of floating head pressure integrated with electronic expansion valve;
- ECM motor and VSD compressor;
- ECM motor for fans;
- increase of the heat exchanger surfaces;
- use of strip door curtains;
- ambient subcooling;
- anti-condensation control; and
- defrost control.

BAT potential energy savings

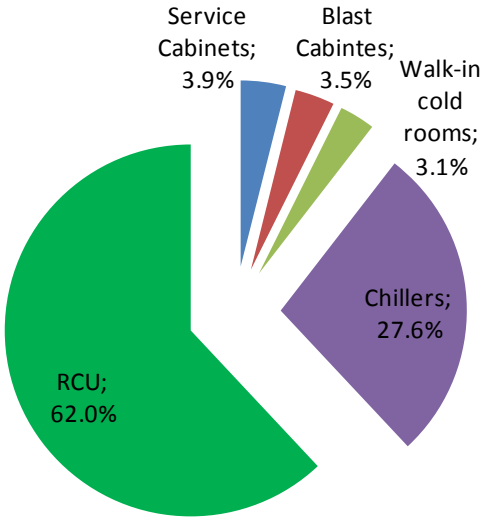
	Annual electricity consumption (kWh/year)	Capacity (m^3)
Base Case model	4,500	6.7
Current available BAT model	6,500	14
Theoretical BNAT product model (possibly available within 5 years)	900	6.7

	Performance [kWh/m^3 at 2°C/year]	Energy saving potential
Base Case model	672.3	-
Current available BAT model	464	31%
Theoretical BNAT product model (possibly available within 5 years)	134.32	80%

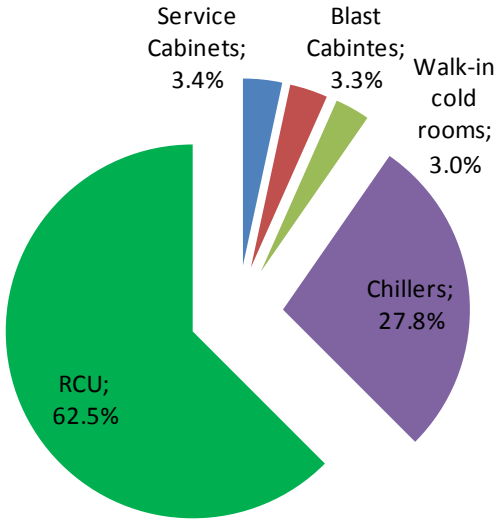
Base Case relative impact

Impact calculation for the total stock per year

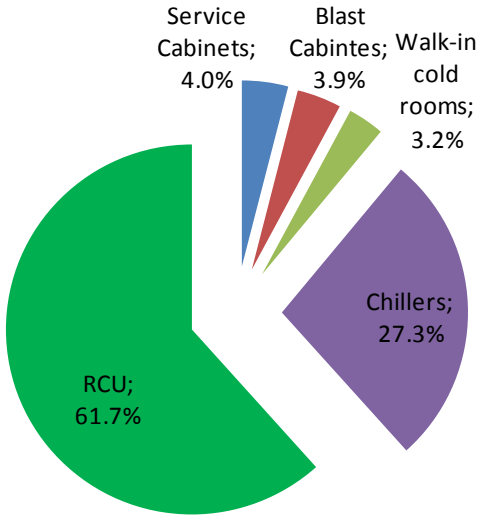
	Service cabinets	Blast cabinets	Walk-in cold rooms	Chillers	Remote condensing units	Total
Total Energy (GER) (PJ)	3.66	3.24	**2.90**	25.80	58.02	**93.62**
Electric. Consump (TWh)	0.30	0.29	**0.26**	2.45	5.51	**8.81**
GWP (mt CO2 eq.)	0.17	0.16	**0.13**	1.13	2.56	**4.15**



Total Energy (PJ)



Electricity Consumption (TWh)



GWP (mt CO2 eq.)

Gaps

- Consensus in categories for classification and market data break-down by these
- Relation between categorisations of the equipment and energy efficiency
- Testing standards for performance evaluation and possible approaches for MEPS
- New BOMs and technical data to improve representivity of the Base Case
- Current BAT models and BNAT potential