

Working document
on
ecodesign and labelling implementing measures
for
REFRIGERATING APPLIANCES: main elements

Meeting of the EuP Consultation Forum 05/11/2008

Scope

- Enlarged and clarified compared to Directives 96/57/EC and 94/2/EC-2003/66/EC
- Electric mains operated household refrigerating appliances also where these are sold for non-household uses and/or for the refrigeration of items different from foodstuffs
- Exclusions:
 - » RAs that can use fuels (LPG, kerosene, bio-diesel,.....);
 - » RAs that are only battery operated;
 - » RAs designed to be primarily operated by batteries, but than can be connected to the electric mains through an AC/DC converter, for primary use in non-household applications;
 - » RAs manufactured on a one-off basis (i.e. *'unique pieces'*);
 - » RAs for medical applications under the World Health Organisation vaccine refrigerators and freezers specifications;
 - » RAs in which the removal of refrigerated items is electronically sensed and can be automatically transmitted through a network connection to a remote control system for accounting (i.e. *vending machines*);
 - » Equipment where the foodstuffs refrigeration is not the primary function (i.e. standalone ice makers, chilled water dispensers,)
 - » RAs with a storage volume < 10 litre (*only from Energy labelling*)

Scope: rationale (I)

- Revise minimum efficiency requirements (Directive 96/57/EC)
- Revise the energy labelling scheme (Directives 94/2/EC and 2003/66/EC)
- Create a “package” of measures which will phase out less efficient models, and support the technological innovation and market transformation through the labelling scheme
- Include refrigerating appliances which are not covered by the current EU policy measures either because of non-compression-type (no minimum requirements) or due to an “ambiguity” in the definition of «refrigerator» in EN 153/EN ISO 15502:2005

As consequence the so called ‘wine coolers’ and ‘mini drink chillers’ are included in the new legislation.

Scope: rationale (II)

- Include «wine storage appliances». But due to lack of an appropriate measurement method addressing their specific characteristics they will - for the moment - fulfil the obligation of information to consumers about 'intended use' when advertised and in the booklet of instructions, but not specific requirements and the display of label or technical fiche
- Cover all the refrigerating technologies on the market:
 - » “compression-type refrigerating appliance
 - » “absorption-type refrigerating appliance
 - » “other-type refrigerating appliances”, essentially thermoelectric (Peltier) cooling

Examples: included products



Definitions (I)

- Present definitions of RAs have been improved and new definitions have been added from international experiences
- “Refrigerating Appliance” means a factory-assembled insulated cabinet with one or more compartments and of suitable volume and equipment for household use, cooled by natural convection or a frost-free system whereby the cooling is obtained by one or more energy-consuming means;
- “Foodstuffs” mean food, ingredients, beverages and/or other items primarily intended for consumption, and that require refrigeration at specified temperature conditions;
- “Refrigerator” means a refrigerating appliance intended for the preservation of foodstuffs, one of whose compartments - or the unique compartment in case of a single compartment appliance - is suitable for the storage of fresh food and/or beverages including wine.

Definitions (II)

- “Wine storage appliance” means a refrigerating appliance having only one or more wine storage compartment(s)
- “Wine storage compartment” means a compartment exclusively designed for long term storage of wine. It has to be designed with:
 - » (i) the capability of maintaining continuously a nominal temperature in the range from +9 °C to +15 °C with cooling as well as heating;
 - » (ii) the capability of maintaining the storage temperature within a variation over time of less than 0,5 K
 - » (iii) the capability to actively or passively control of the compartment humidity in the range 50-80%
 - » (iv) a construction to reduce the transmission of vibration to the compartment, whether from the refrigerator compressor or from external source.

Definitions (III)

- multi-use appliance” mean a refrigerating appliance having only one or more multi-use compartment(s);
 - » “multi-use compartment” means a compartment intended for use at two or more of the temperatures of the compartment types and capable of being set by a user to maintain continuously the operating temperature range applicable to each compartment type according to the manufacturer instructions;
- “equivalent refrigerating appliance” means a model placed on the market with the same gross and storage volumes, same technical, efficiency and performance characteristics and same compartment types of another refrigerating appliance model placed on the market under a different commercial code number by the same manufacturer.

Refrigerating Appliances market in the EU (I)

- Compression-type RAs: about 18 million units produced in the EU in 2006, divided into:
 - » Refrigerators ~ 17%
 - » Refrigerator-freezers ~ 61,5%
 - » Upright freezers ~ 13,5%
 - » Chest freezers ~ 8,5%
- Absorption-type: about 250.000-350.000 units, divided into:
 - » hotels and business (called mini-bars), 250.000 units/year
 - » household applications (called mini-coolers), for compact living spaces, offices and rooms outside the kitchen, ~ 10-20.000 units/year
 - » professional applications (such as medical) ~125.000 u/y
- Other-type RA (thermoelectric): mini-drinks chillers, wine coolers, mini-refrigerators,, estimated lower than the absorption type (< 100.000 u/y)

Refrigerating Appliances market in the EU (II)

Energy efficiency of compressor type RAs on the market in 2005
(reference year for the preparatory study)

Energy Efficiency class	All models		Refrigerators		Freezers	
	(n)	(%)	(n)	(%)	(n)	(%)
A++	288	1,84	131	1,1	157	4,7
A+	3 108	19,9	2 269	18,4	839	25,3
A	8 635	55,2	7 547	61,3	1 088	32,8
B	3 133	20,0	2 308	18,7	825	24,8
C	466	2,98	64	0,5	402	12,1
D	7	0,04			7	0,2
E	2	0,01			2	0,1
F						
G						
Total	15 639	100	12 319	100	3 320	100

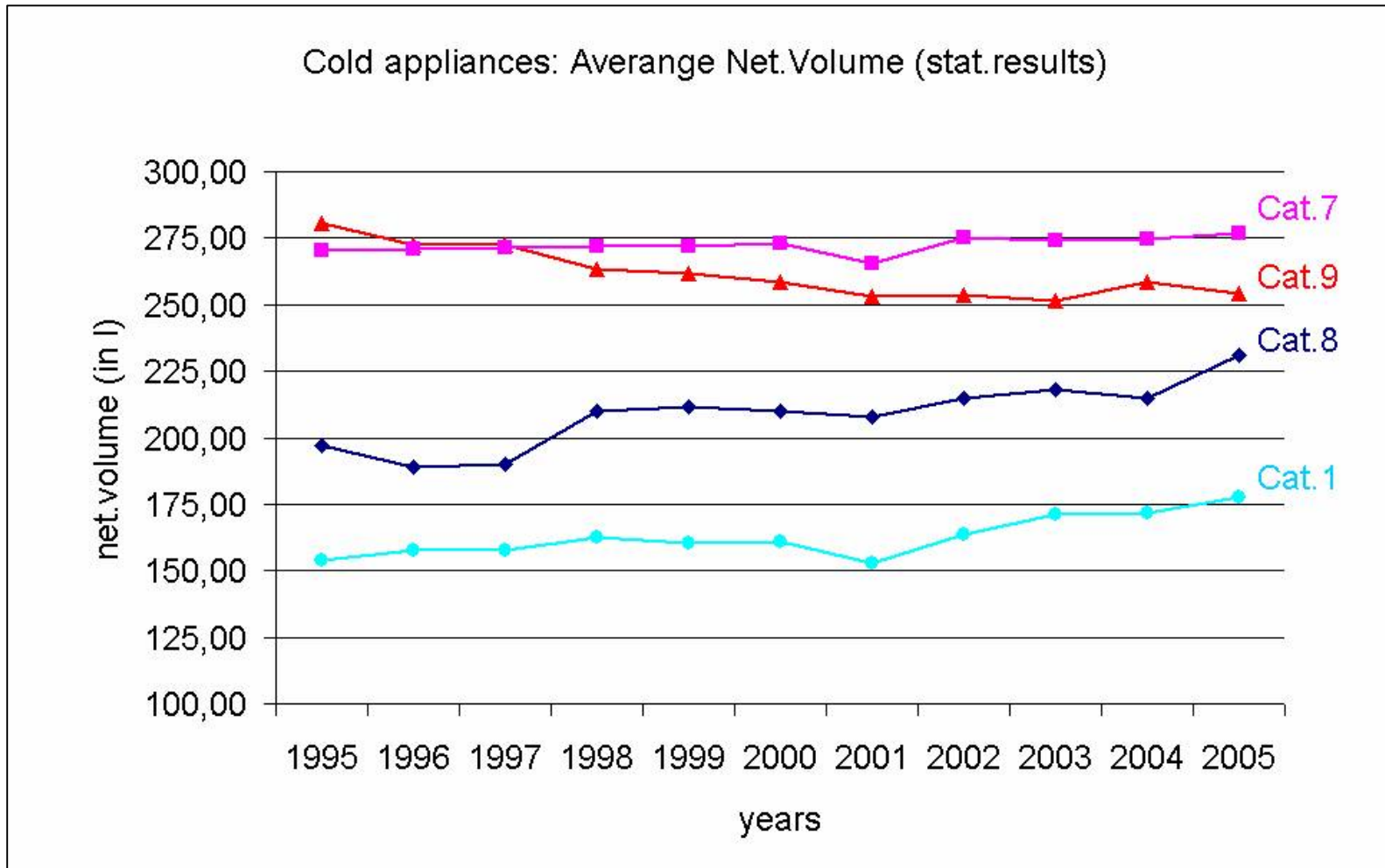


Refrigerating Appliances market in the EU (III)

Energy efficiency of compressor type RAs on the market in 2006
(preliminary results)

EE classes	Refrigerators	Freezers
	(%)	(%)
A++	0,52	3,06
A+	14,45	19,98
A	63,27	37,83
B	16,05	21,42
C	2,06	13,34
D	0,09	1,06
E	0,01	0,69
F	0,00	0,08
G	0,06	0,39
Unknown	3,48	2,16
Total	100	100

RAs evolution of the models' storage volume in 1995-2005



source: technical databases 1995-2005

Ecodesign requirements: approach

- Generic and specific requirements
- IM revision after 7 years of entry into force
- Generic Requirements, two stages with a 3 year interval for:
 - » refrigerator-freezers with one compressor/thermostat
 - » fast-freeze facility (in freezers and freezer compartments)
 - » RAs with a storage volume < 10 litre
 - » wine storage appliances
 - » drawers, baskets and shelves combination in RAs
- Specific Requirements, three Steps with a 2 year interval for:
 - » 1st Step: maximum EEI for all RAs
 - » 2nd Step: maximum EEI for Absorption and Other type RAs
 - » 3rd Step: further reduction of the allowable EEI for all RAs

Energy Labelling: approach (I)

- Directive revision after 7 years of entry into force
- Efficiency rating: two scales for all RAs:
 - » Energy efficiency ranking: absolute, remains fixed
 - » Energy efficiency class: relative, upgrades
- Time horizon: two Steps with a 5 year interval for all RAs:
 - » 1st Step, one year after enforcement
 - » 2nd Step, six years after enforcement
- The two labelling Steps should be co-ordinated with the parallel ecodesign specific requirements

Energy Labelling: approach (II)

- The labelling bandwidth is ~20%, providing sizeable differentiation in terms of absolute energy consumption/ money savings, also for the «higher efficiency» part of the scale
- An overlapping of 3 months will be allowed for the transition between Step 1 and Step 2. i.e. the circulation of models with the old label (common background) will be allowed for 3 months after the end of the validity of the previous label
- Setting medium-term targets provides clear and predictable legal framework for investments and product development
- **Final label layout depends on the outcome of the discussions withing the EELEP (labelling formation) and is not an issue for this Consultation Forum**

Other environmental aspects

- HCFC and HFC used as refrigerating and foaming agents have been replaced by hydrocarbons
- Almost all models in the 2005 database use hydrocarbons as foaming agent and only a residual ~5-8% of models still exists with HFC as refrigerant
- Noise is addressed within energy labelling declarations
- Hazardous materials in production are dealt within the RoHs Directive
- End-of-life wastes are addressed in the WEEE Directive
- Other aspects such as recyclability/durability/etc. are difficult to define and verify

Verification procedure for market surveillance checks (I)

- European standard EN 153 describes a two-stage verification procedure which is currently used for the EU labelling scheme and the minimum requirements.
- This staged procedure is in line with international practice
- This staged procedure is acceptable for the verification of the ecodesign IM and the new labelling Directive:
 - » Stage I: one unit is tested, if non-compliant then
 - » Stage II: three additional units of the same model are tested, if non-compliant then
 - » the model **and all other equivalent refrigerating appliance models** are considered not to comply

Verification procedure for market surveillance checks (II)

- The values of the measurement uncertainty has been reduced (from 15% to 10% for energy consumption), since the production variability is today considered as being part of the overall appliance quality and therefore under manufacturers' responsibility
- Within the mandate to be issued to ESOs for the preparation of the EN harmonised standard, a specific request about the identification of the measurement variability sources and their evaluation through a Round Robin Test will be included.

RAs classification (I)

Category	Description
1	Refrigerator without other compartments
2	Refrigerator-cellar and Cellar (including wine storage appl.)
3	Refrigerator-chiller and Refrigerator with a 0 star compartment
4	Refrigerator with a 1 star compartment
5	Refrigerator with a 2 star compartment
6	Refrigerator with a 3 star compartment
7	Refrigerator-freezer
8	Upright freezer
9	Chest freezer
10	Multi-use cabinet and other appliances



RAs classification (II)

Storage temperature range (°C)	> +14	± 0,5K ^a	+14 / +8	+8 / +3	+3 / -2 °C	< 0 / > -6	< -6	< -12	< -18	< -18	Category (number)	
Nominal temperature (for the EEL) (°C)	design T	design T (+15 /+9)	+12	+5	0	0	-6	-12	-18	-18		
Compartments types	Other ^c	Wine storage	Cellar	Refrigerator	Chill	0star/ Ice making	1 star	2 star	3 star	4 star		
Appliance Category	Compartments composition											
REFRIGERATOR WITHOUT OTHER COMPARTMENTS	N	N	N	Y	N	N	N	N	N	N	N	1
REFRIGERATOR-CELLAR and CELLAR	O	O	Y	Y	N	N	N	N	N	N	N	2
	O	O	Y	N	N	N	N	N	N	N	N	
	O	Y	N	(Y) ^d	N	N	N	N	N	N	N	
REFRIGERATOR-CHILLER and REFRIGERATOR WITH A 0 STAR COMPARTMENT	O	O	O	Y	Y	O	N	N	N	N	N	3
	O	O	O	Y	O	Y	N	N	N	N	N	
REFRIGERATOR WITH A 1 STAR COMPARTMENT	O	O	O	Y	O	O	Y	N	N	N	4	
REFRIGERATOR WITH A 2 STAR COMPARTMENT	O	O	O	Y	O	O	O	Y	N	N	5	
REFRIGERATOR WITH A 3 STAR COMPARTMENT	O	O	O	Y	O	O	O	O	Y	N	6	
REFRIGERATOR-FREEZER	O	O	O	Y	O	O	O	O	O	Y	7	
UPRIGHT FREEZER	N	N	N	N	N	N	N	O	(Y) ^b	Y	8	
CHEST FREEZER	N	N	N	N	N	N	N	O	N	Y	9	
MULTI-USE AND OTHER APPLIANCES	O	O	O	O	O	O	O	O	O	O	10	

Notes:

Y = the compartment shall be present;

N = the compartment shall not be present;

O = the compartment presence is optional;

a) the range of the storage temperature for wine storage compartments is ± 0,5K of the nominal temperature, to be included in the range +15/+9;

b) includes also the three-star frozen food cabinets;

c) "Other compartment" includes any compartment, other than a wine storage one, with a storage temperature higher than +14°C

d) refrigerator compartment is not present in wine storage appliances



Ecodesign generic requirements (I)

One year after the measure has come into force:

- wine storage appliances: indication in the booklet of instructions that the appliance is “*intended to be used exclusively for the long term storage and/or maturation of wine*” [same indication in the labelling scheme when these appliances are advertised]
- for all RAs: indications about the combination of drawers, baskets and shelves giving the best appliance energy efficiency in the booklet of instructions [same indication in the labelling scheme, in the fiche]

Ecodesign generic requirements (II)

Three years after the measure has come into force:

- refrigerator-freezers with one compressor and one thermostat: automatic control according to the ambient temperature of the heating function (the so called “winter setting switch”, or a similar device or function) for the models with also the fast freezing facility
- Fast freeze facility (in freezers and freezer compartments) and similar function: automatic reversion within 72 h to avoid extra energy consumption when users forget to switch it off
- RAs with a storage volume < 10 litre: automatic switching to an operating conditions with a power consumption of 0,00 Watt, when left empty for more than 1 hour [if volume ≥ 10 litres, IM specific requirements and labelling apply]

Ecodesign generic requirements (III)

Practical consequences:

- electromechanical refrigerator-freezers, with 1 compressor/1 thermostat, with winter switch but no fast freezing: NO ACTION
- electromechanical refrigerator-freezers, with 1 compressor/1 thermostat, with winter switch + fast freezing: ELECTRONIC CONTROL
- electromechanical freezers with fast freezing: use of an IMPROVED ELECTROMECHANICAL CONTROL
- electromechanical refrigerator-freezers, with fast freezing only: use of IMPROVED ELECTROMECHANICAL CONTROL
- RAs with electronic control: requirements easy to fulfill
- Note: if the elapsed time before fast freezing reversion is reduced from 3 days (72 h) to 2 days (48h) there is a benefit of an additional saving of ~ 1-2 kWh/year but the risk to lower the quality of the frozen food

Ecodesign specific requirements (I)

- 1st Step, one year after enforcing, requirements on maximum annual energy consumption:
 - » $EEI < 150$ for absorption/other type of RAs
 - » $EEI < 55$ for compression-type RAs
- 2nd Step, three years after enforcing, requirements on maximum annual energy consumption:
 - » $EEI < 125$ for absorption/other type of RAs
- 3rd Step, six years after enforcing, requirements on maximum annual energy consumption:
 - » $EEI < 110$ for absorption/other type of RAs
 - » $EEI < 44$ for compression-type RAs

Energy Labelling (I)

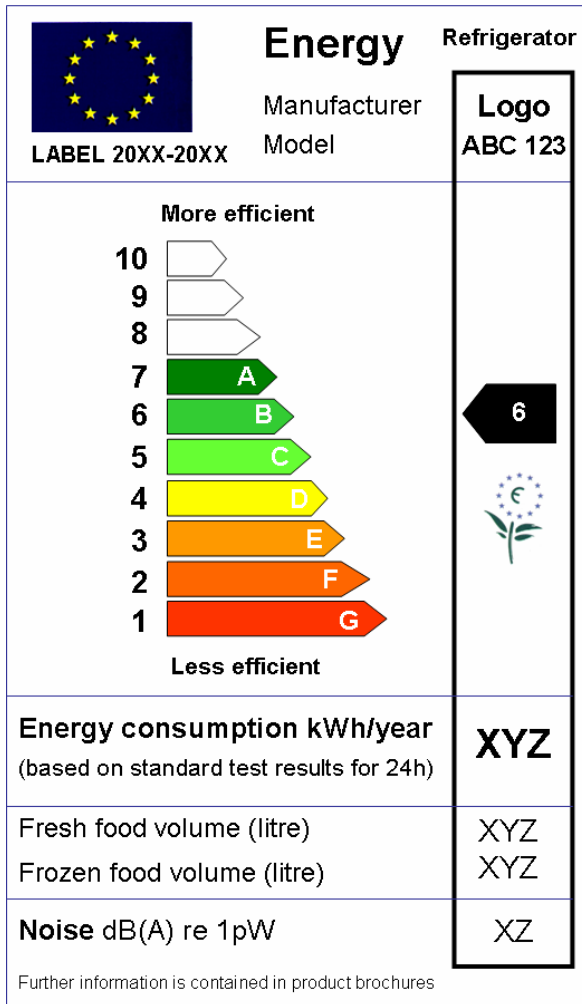
Start of label: EEI=100 is the threshold between ranking 1 and 2

Energy Efficiency Ranking	Energy Efficiency Index	Energy Efficiency Cass	
		Step 1	Step 2
10	$EEI < 15$	--	--
9	$15 \leq EEI < 18$	--	--
8	$18 \leq EEI < 22$	--	A
7	$22 \leq EEI < 28$	A	B
6	$28 \leq EEI < 35$	B	C
5	$35 \leq EEI < 44$	C	D
4	$44 \leq EEI < 55$	D	E
3	$55 \leq EEI < 75$	E	F
2	$75 \leq EEI < 100$	F	G
1	$EEI \geq 100$	G	--

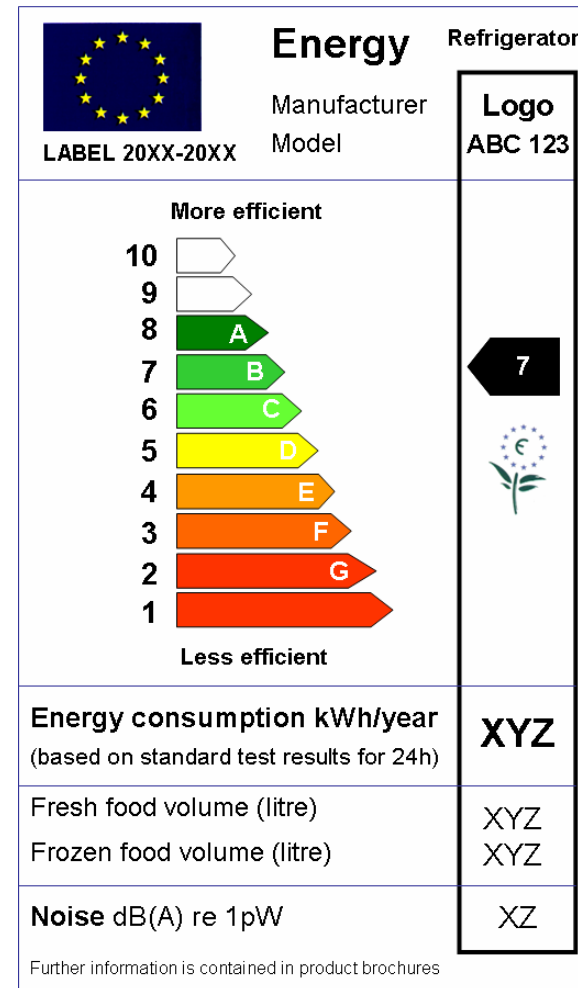
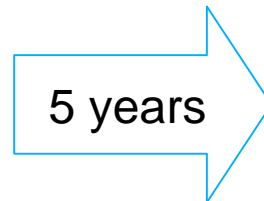
Energy Labelling (II)

- The Label is not language neutral
- The Label contains easy-to-understand parameters which are the most relevant for the RAs ecoprofile:
 - » annual energy consumption (kWh/year)
 - » fresh and frozen food (storage) volume (litre)
 - » airborne acoustical noise (dBA)
- The Label (in the presented layout) will be delivered by the manufacturer in two pieces:
 - » the common background, including the validity period
 - » the "Strip" with the declared values of the parameters, being a sort of «passport» of the model

Energy Labelling (IV)



Step 1



Step 2

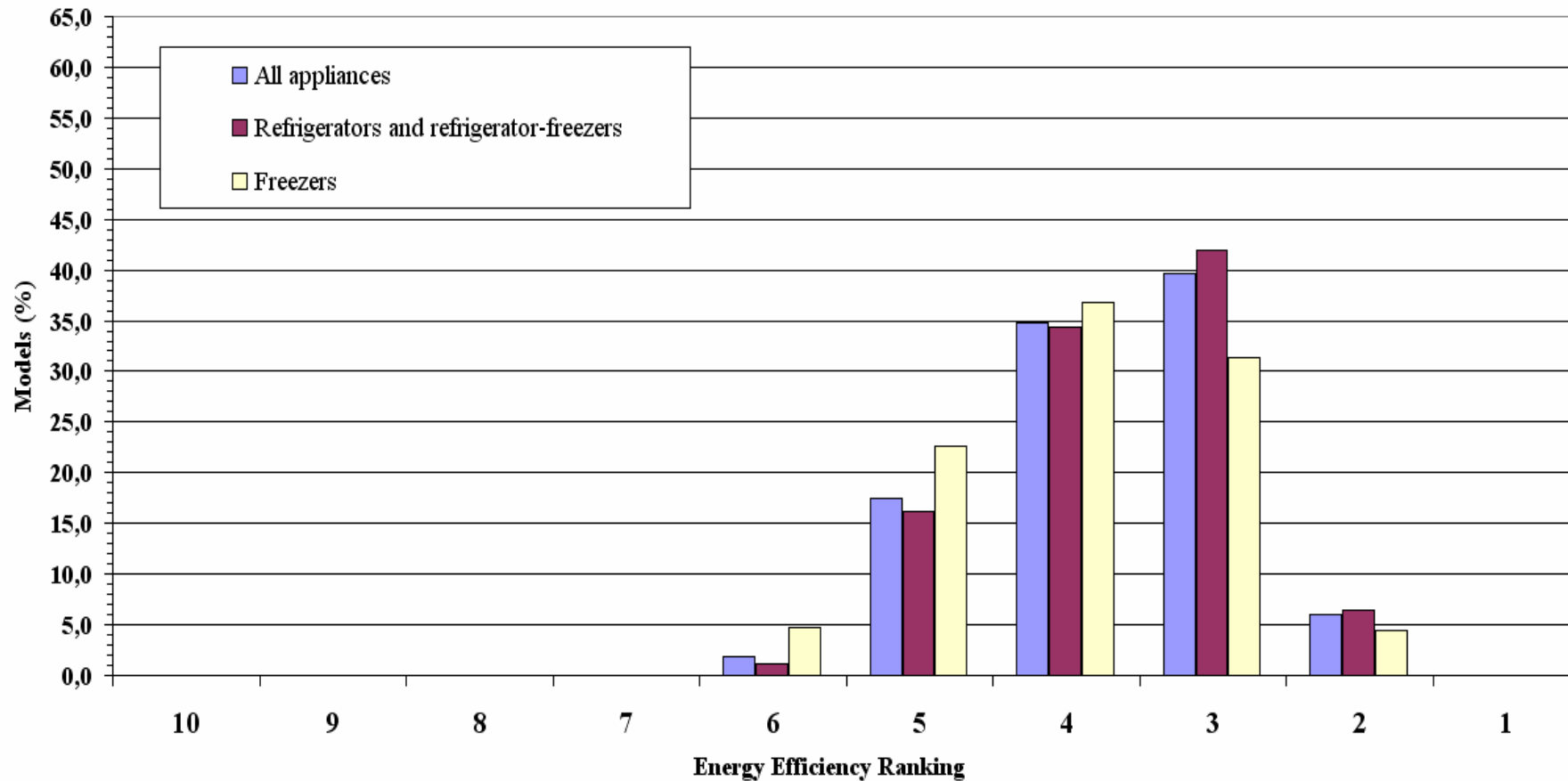


Ecodesign and Energy labelling impact

For compressor-type RAs:

- Source: technical database about models put on the market in 2005 and including more than 15.000 refrigerators, refrigerator-freezers and freezers
- Impact of Ecodesign specific requirements, depending on the hypothesis,
 - » Step 1: phase out of about 46% of the models
 - » Step 2: phase out of about 80% of the models
- Impact of Energy labelling: depending on the hypothesis in Step1 most of the models in ranking 4 (or 3 and 4) and almost no models in ranking beyond 6

Energy labelling impact (compressor-type RAs)



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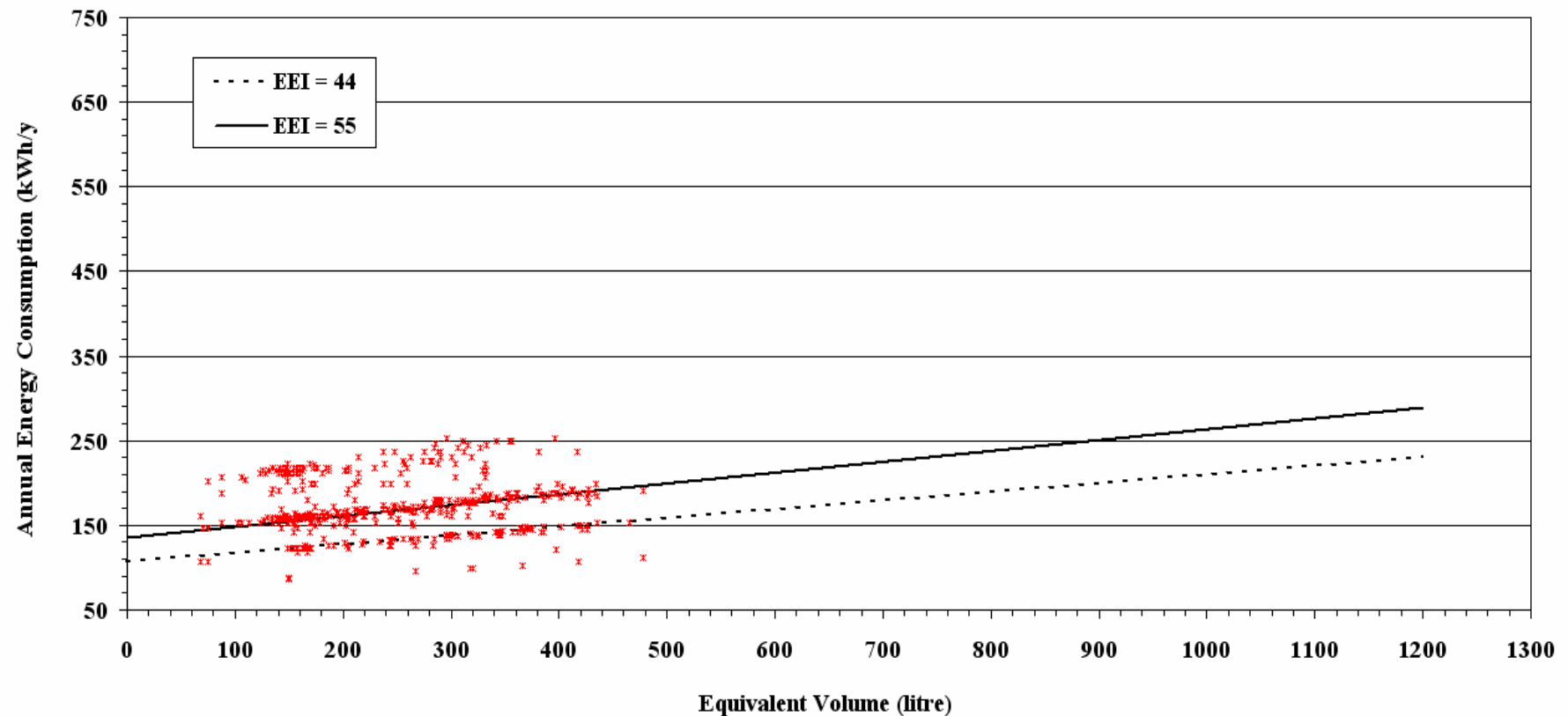
Ecodesign impact (Ia)

Phased out of compressor-type RA models (2005)

EEI	All RAs		Refrigerators		Freezers	
	(n)	(%)	(n)	(%)	(n)	(%)
< 44	3.040	19,4	2.128	17,3	912	27,5
55 ≤ 44	5.447	34,8	4.226	34,3	1.221	36,8
> 55	7.152	45,7	5.965	48,4	1.187	35,8
Total	15.639	100,0	12.319	100,0	3.320	100,0

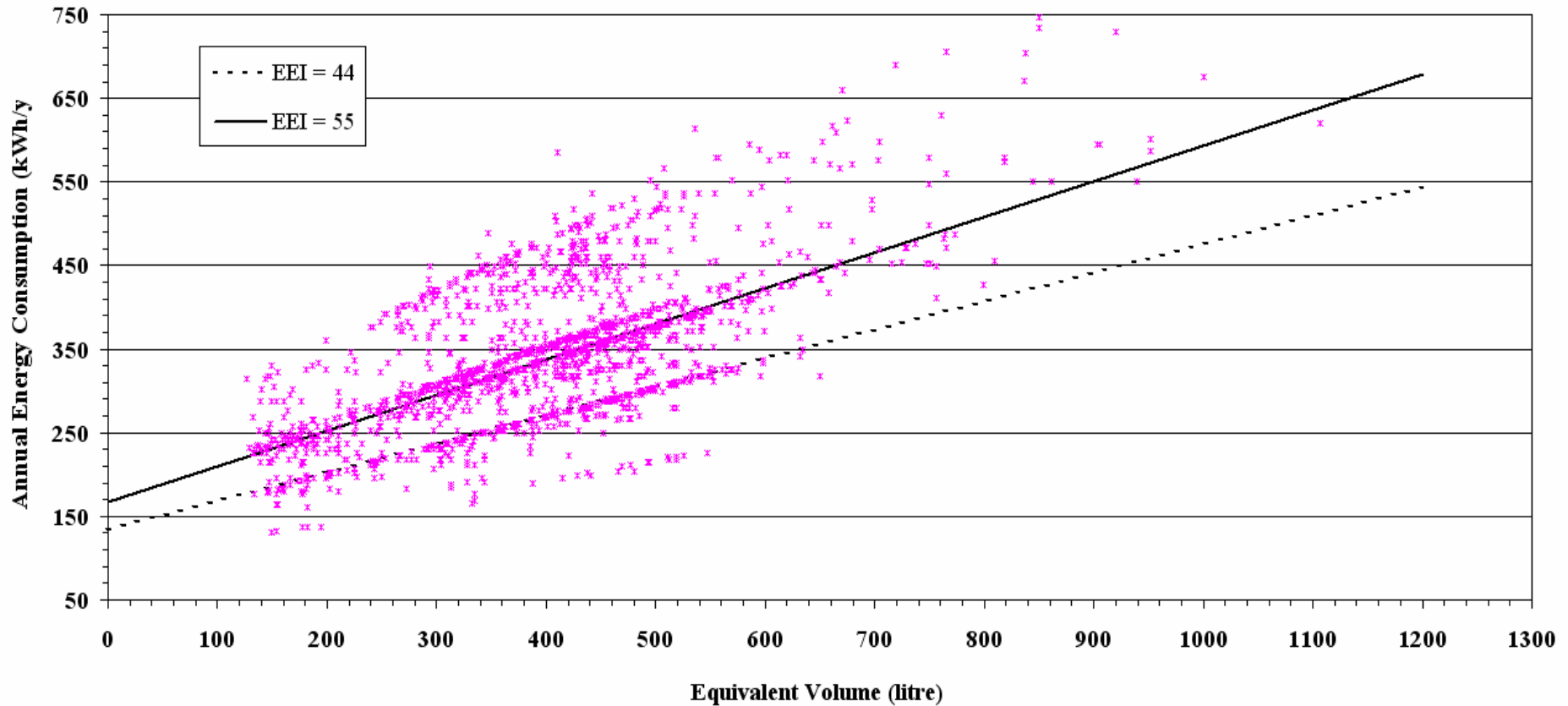
Ecodesign impact (IIa)

Phased out compressor-type RA models (Cat.1)



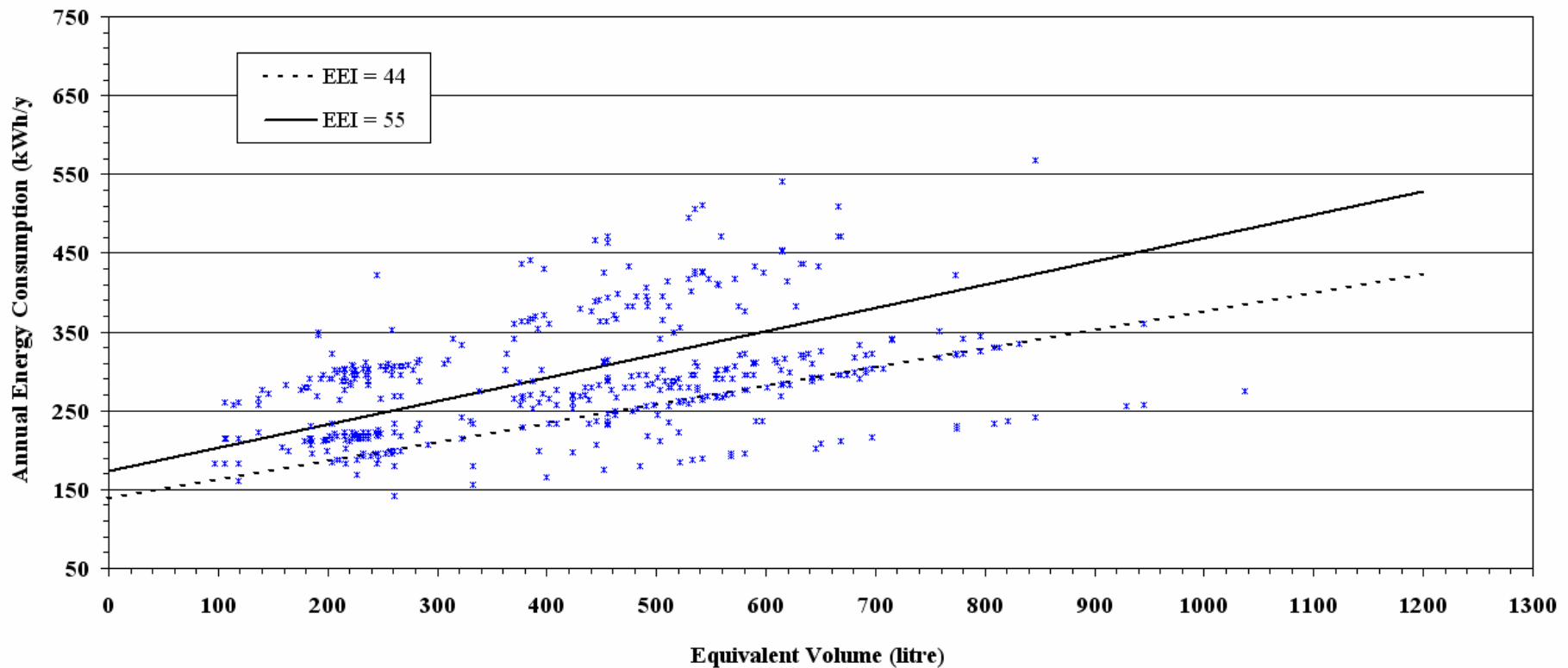
Ecodesign impact (IIb)

Phased out compressor-type RA models (Cat.7)



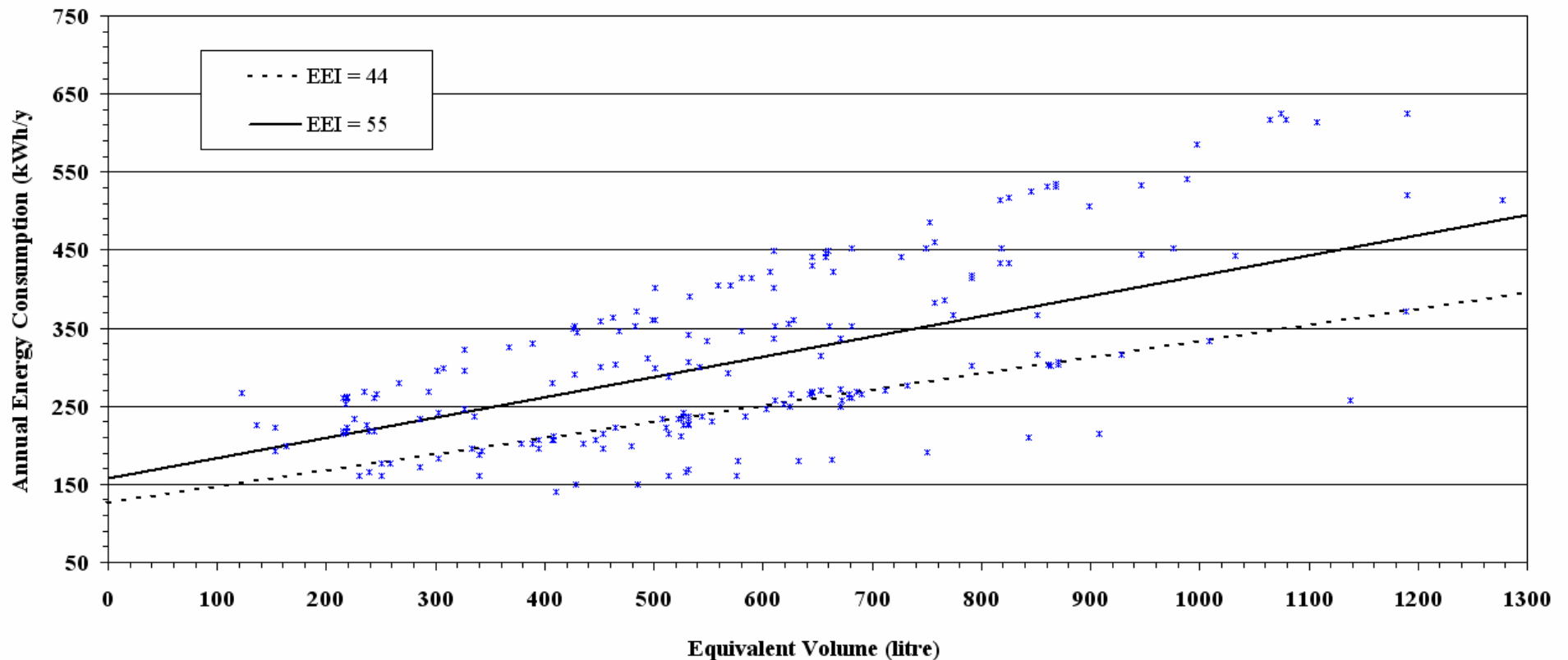
Ecodesign impact (I1c)

Phased out compressor-type RA models (Cat.8)



Ecodesign impact (IIC)

Phased out compressor-type RA models (Cat.9)

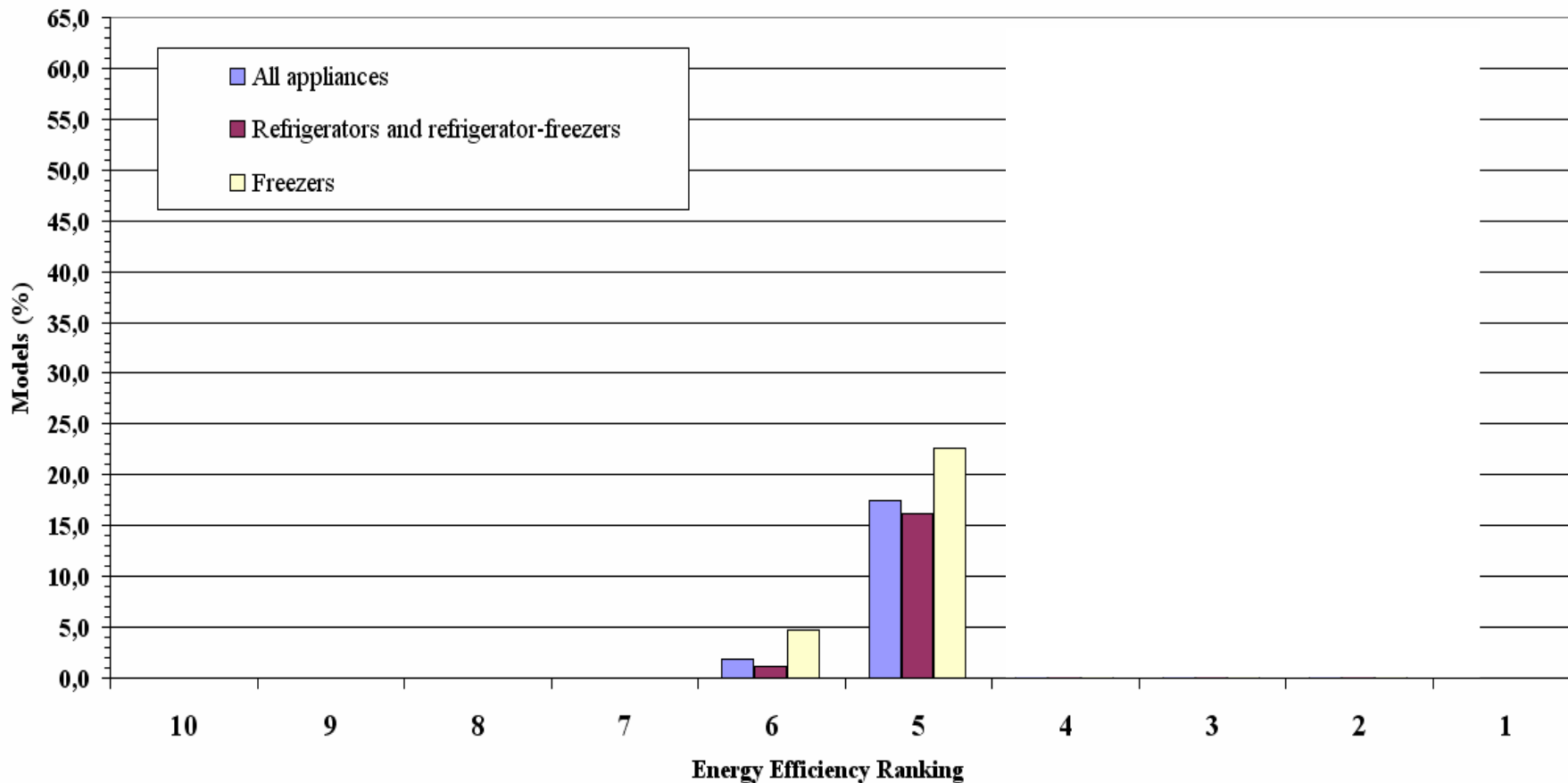


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Ecodesign and Energy labelling combined impact

Models distribution after the 1st Step of the ecodesign specific requirements/Energy labelling



Energy Efficiency Index (I)

- The energy efficiency index is the ratio between the Annual Energy Consumption (measured energy consumption in 24h x 365) and the reference Standard Annual Energy Consumption

$$EEI = \frac{AC}{SC} \times 100$$

- EEI is used to define maximum annual energy consumption thresholds (ecodesign specific requirements) and the energy efficiency ranking (energy labelling)
- A technology-independent function is used to express the standard annual energy consumption

Energy Efficiency Index (II)

- The Standard Annual Energy Consumption is the same of Directive 2003/66/EC:

$$SC = V_{eq} \times M + N + CH$$

- M and N values depend from the appliance category

Category	M	N
1	0,233	245
2	0,233	245
3	0,233	245
4	0,643	191
5	0,450	245
6	0,777	303
7	0,777	303
8	0,539	315
9	0,472	286
10	a	a

^aM and N values depend on the temperature and the star rating of the compartment with the lowest storage temperature

Energy Efficiency Index (III)

The Equivalent Volume is about the same of current Directive 2003/66/EC

$$V_{eq} = \left[\sum_{c=1}^{c=n} V_c \times \frac{(25 - T_c)}{20} \times FF_c \times TD_c \right] \times CC \times BI$$

n is the number of compartments

T_c is the nominal temperature of the compartment

$\frac{(25 - T_c)}{20}$ is the thermodynamic correction factor

FF_c is the no frost correction factor

TD_c is the transparent door correction factor

CC is the climate class correction factor

BI is the built in correction factor