The Energy Efficiency Transformation in the European Heating and Cooling Market

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This article assesses the effects of the Ecodesign and energy labelling regulations with respect to space heating and cooling technologies. A detailed study of performance rating data over three years period (2014 - 2016) from an independent database of heating and cooling products on the European market is made. This enables to evaluate the energy efficiency evolution of these type of products and to identify how policies can further boost energy efficiency development and ensure its success. Results demonstrate the positive effects of the introduction of energy labels in the European market and the importance of reliable data. However, the facts presented suggest that adjustments on the requirements of minimum energy efficiency should be considered in the future revision of the ecodesign regulations and highlight the importance of reliable data to avoid jeopardizing the energy saving potential of these mechanisms.

Energy labelling enables customers to make informed choices based on the energy consumption of energy-related products. This entails several benefits: reduces energy demand and saves customers money on energy bills, contributes to innovation and investment in energy efficiency, and supports industries which develop and produce the most energy efficient products.

However, a lack of ambitious requirements and standardised/reliable data for heating and cooling technologies will lead to a risk that the cost effective and energy saving potential will not be fully utilized and that the consumers will lose their confidence in the energy labelling and other product information provided by suppliers.

The technologies considered in this study are: air conditioners, liquid chilling packages and hydronic heat pumps, rooftop and variable refrigerant flow units.

Comfort air conditioners (ACs) consist of a reversible heat pump that can be used for both heating and cooling the air in a room. This type of heating and cooling technology has gained increasing market penetration in recent years and thus, it has been included in the ecodesign (2009/125/EC) and energy labelling (2010/30/EU) European directives (implemented through regulations No 206/2012 and No 626/2011) to contribute with a large amount of energy savings in the European Union within the next 10 to 20 years. The products evaluated in this work have a capacity that varies between 2 kW and 15 kW [1].

Liquid chilling packages and hydronic heat pumps (LCP-HP) consist in electrically driven reversible heat pumps used for heating and refrigeration. Like air conditioners, LCP- HP units may be air-cooled or liquid cooled, but instead of heating and/or cooling air, they transfer heat to liquid water. The units considered in this work have a capacity up to 1500 kW (water-cooled) and 600 kW (air-cooled) [2].

Rooftop (RT) units consist of a blower, heating or cooling elements, filter racks or chambers, sound attenuators and dampers. They are used to condition and circulate air as part of a heating, ventilation and air condition (HVAC) system. Rooftops are designed for outdoor use, as it names indicates, typically the roof. The units considered in this work have a rated capacity up to 200 kW [3]. They can be air-to-air or water-to-air rooftop units.

Finally, variable flow refrigerant (VFR) units is a more recent HVAC technology (1982). A typical unit consist of one or several outdoor units – with the compressor and condenser, several indoor units –evaporator, refrigerant piping running between the outdoor and indoor units. These types of systems modulate the flow of refrigerant according to exact demands of one or several areas and are especially suited for large buildings with several rooms – commercial buildings, offices, schools, etc. In this study, only single module outdoor units used for cooling-only, heating-only and reversible units are considered. They can be air- or water- sourced. The units considered in this work have a rated capacity between 7.2 and 61.6 kW [4].

Methods

To assess the energy efficiency progress in heating and cooling European market, statistical analyses were made on reliable performance rating data of an independent database over a period of three years. The data studied is third-party certified, i.e. it proceeds from tests run at independent laboratories. The rating data studied includes:

- Coefficient of Performance (COP) and Energy Efficiency Ratio (EER): For all systems considered in this study the COP – energy efficiency in heating mode – and EER – energy efficiency in cooling mode – are defined as the ratio between the thermal energy delivered and electrical power absorbed by the unit at reference design conditions [1; 2; 3; 4].
- Seasonal Coefficient of Performance (SCOP) and Seasonal Energy Efficiency Ratio (SEER): The calculation of SCOP and SEER is in accordance with EN14511:2013, EN14825:2013 and the [6].
- Energy classes:
- AC: The energy classification for air conditioners is defined in the European Commision Regulation (EU) No 626/2011 supplementing the Directive 2010/30/EU [5]. See Annexes **Table** 7.
- LCP-HP: The energy classification for LCP-HP is defined in the Eurovent Certita Certification Rating Standard [2].
- RT: The energy classification for RT systems is defined in the Eurovent Certita Certification Rating Standard [3].

Results and discussion

Air Conditioners

Figure 1 and **Figure 2** reflect the effects of the entry into force of the ecodesign regulation requirements illustrated by the evolution of energy classes (introduced in Jan.2013 for AC units). Non-ducted AC units are classified with 10 different energy classes, from the best, A+++, to the worse, G. This sample includes more than 6500 AC units between the years 2014 and 2016. The share of non-ducted AC units with high energy efficiencies (classes A+, A++ and A+++) is larger than 50% and has smoothly increased along the years in both heating (**Figure 1**) and cooling mode (**Figure 2**). There are no units in the market labelled with classes lower than D.

The progress illustrated in **Figure 1** and **Figure 2** mirrors the positive effects of the regulations. However, in the recent revision of the European Commission of the Energy Labelling directive (2010/30/EU) [7] it was identified the need to update the energy labelling framework to improve its effectiveness. Customers compare labels across different product groups (for example, between ACs and dishwashers), and not all have the same number of classes,

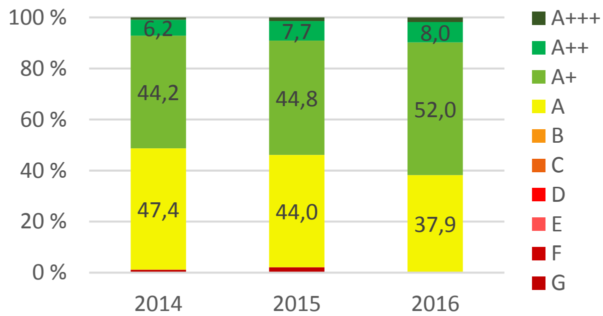

Figure 1. Seasonal Cooling Energy Efficiency – seasonal energy efficiency ratio (SEER) transformation of non-ducted AC units between 2014 and 2016.

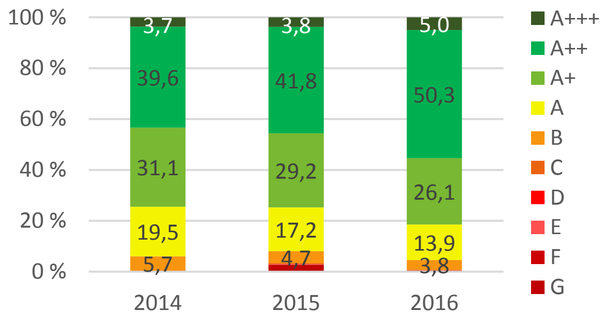

Figure 2. Seasonal Heating Energy Efficiency – seasonal coefficient of performance (SCOP) transformation of non-ducted AC units between 2014 and 2016.

i.e. some vary from A to G (7 classes) while others vary from class A+++ to class G (10 classes, case of AC units). This leads to some confusion making some customers believe that more efficient products could exist or, in the opposite case, that a class A product in a product group where classes vary, from A+++ to G, is very efficient. In the new revision, the Commission considers that the classification using letters from A to G has shown to be more effective for customers and intends to uniform this across products groups (except space and water heaters). For all other products, all class A+++ will be assigned class A, class A++ will be class B and so forth from Jan. 2019 [8].

Today, the energy class of AC units is determined through the calculation of the seasonal energy efficiency ratio (SEER) and seasonal coefficient of performance (SCOP) of the unit. Compared to the previous requirements, before 2013, based on the energy efficiency ratio (EER) and the coefficient of performance (COP) a single standard operation condition, the SCOP and SEER are calculated based on measurements at six different ambient conditions (known as points A, B, C, D, E and F). They represent the fluctuating demand in residential buildings. Additionally, the new method takes into account the residual electric energy demand during standby and off-mode periods. Altogether, this gives a more realistic picture of the phase of use of AC for consumers.

The regulations demand the manufacturers to self-declare the performance data. These new requirements and its complexity stimulate manufacturers to be more knowledgeable about their products and discourages free-riders. Yet, empirical data from the last three years show that not all manufacturers are able to declare accurate performances (**Figure 3**). When compared to its performance data tested in independent labs, the share of non-conform declared ratings was above 30% and has significantly increased. This mismatch between declared and tested values will over and above have a negative impact on the confidence of end-use consumers and investors in this technology and certainly, jeopardize its potential to reduce energy demand and increase the energy efficiency in buildings. This emphasizes the importance of third party independent testing performed by market surveillance authorities and independent certification organisations. These organisations and their activity ensure the reliability of values declared and thus, promote energy efficiency and end-user confidence.

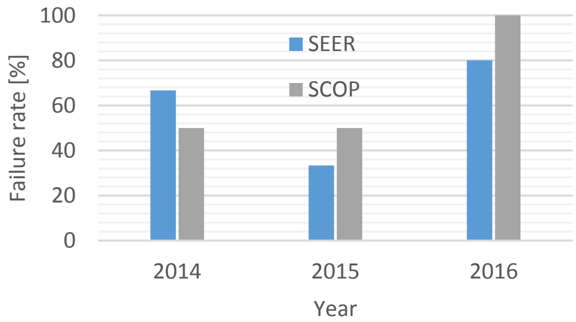

Figure 3. Failure rate of tested non-ducted AC units in the period 2014-2016 according to Eurovent Certita Certification testing campaigns.

Since January 2013, the EU regulation No 206/2012 requires minimum levels of energy efficiency and sound power for all electric AC units with a rated capacity up to 12 kW for cooling or heating (if the unit has no cooling function). The minimum requirements depend on the rated capacity (<6 kW and 6-12 kW) and, since January 2014, also on the global warming potential (GWP) of the refrigerant (GWP > 150 or GWP ≤ 150), the working fluid of the unit.

Figure 4 shows the SCOP values of the products analysed in this study. All units seem to comply with the ecodesign minimum (SCOP ≥ 3.8) [5]. The units with larger capacity (>12 kW) have SCOP values less

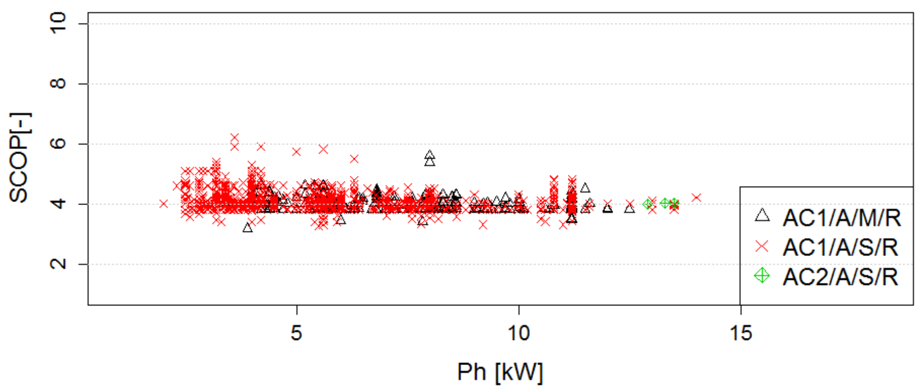

Figure 4. SCOP values dispersion for each of the non-ducted AC unit type according to its rated heating capacity (Ph). See Table 6 in Annexes for unit type.

spread than smaller capacities units. Together with this, it is evident that smaller capacity units can reach SCOP values much higher (max. = 6.2) than the minimum requirements imposed today.

Nonetheless, it is should be highlighted that the average SCOP has evolved in a very conservative way during the last three years. **Table 1** outlines the SCOP transformation of non-ducted AC units between 2014 and 2016. The Split Reversible units (…/S/R) represent the greatest progress with maximum of 0.96% SCOP increase between 2015 and 2016. Together with the high SCOP values, the facts suggest that a readjustment of the minimum requirements of the current regulation is recommended in the future. Rated capacities of AC units with a cooling capacity larger than 12 kW (AC2 in **Figure 4**) are plotted to exemplify what can be expected from larger units. It seems that their seasonal energy efficiency in heating mode is analogous to AC1 units.

Figure 5 shows the SEER values of the products analysed in this study. As it happens for SCOP, the larger capacity (>12 kW) units have SCOP values less spread than units with smaller capacities.

Table 2 outlines the SEER transformation of non-ducted AC units between 2014 and 2016. The SEER has evolved in an indisputable way for both split (…/S/R) and multisplit reversible (…/M/R) units. Given the existence of high SEER values, the question of the suitableness of the minimum requirements pops-up once more. In distinction to reversible units (…/R), the only cooling mode (…/C) units exhibit a deterioration of the seasonal energy efficiency ratio. Some of only cooling units have tested rated capacities below the EU minimum requirements (SEER≥4.3) [5].

This might be caused by the decreasing interest in units that only deliver cooling in buildings applications and therefore, manufacturers abandon their development.

Finally, under the ecodesign requirements a bonus is proposed to guide the market in the direction of the use of refrigerants with low global warming potential (GWP) falls short of expectation. The bonus consists in imposing lower minimum energy efficiency for AC units using low-GWP refrigerants (GWP < 150). The introduction of low GWP refrigerants represents certain technological challenges with respect to energy efficiency of AC units due to thermodynamic characteristics of new refrigerants but great benefits in terms

Table 1. Summary of average and std. deviation SCOP values for each non-ducted AC unit type.

Unit Type	SCOP Mean ($\bar{x}$)			SCOP Std. deviation (s)			Δ 14/15	Δ 15/16
Year	2014	2015	2016	2014	2015	2016	[%]	[%]
AC1/A/M/R	3.96	3.97	4.00	0.24	0.22	0.23	+0.25	+0.76
AC1/A/S/R	4.04	4.06	4.10	0.30	0.32	0.32	+0.46	+0.96
AC2/A/S/R	–	–	4.01	–	–	0.01	–	–

Table 2. Summary of average and std. deviation SEER values for each non-ducted AC unit type.

Unit Type	SCOP Mean ($\bar{x}$)			SCOP Std. deviation (s)			Δ 14/15	Δ 15/16
Year	2014	2015	2016	2014	2015	2016	[%]	[%]
AC1/A/M/C	–	6.36	6.27	–	0.66	0.41	–	-1.42
AC1/A/M/R	5.85	5.88	6.18	0.51	0.51	0.86	+0.51	+5.10
AC1/A/S/C	5.43	5.19	5.10	0.95	1.20	1.35	-4.42	-1.73
AC1/A/S/R	6.08	6.12	6.24	0.87	0.90	0.91	+0.66	+1.96
AC2/A/S/R	–	–	5.92	–	–	0.24	–	–

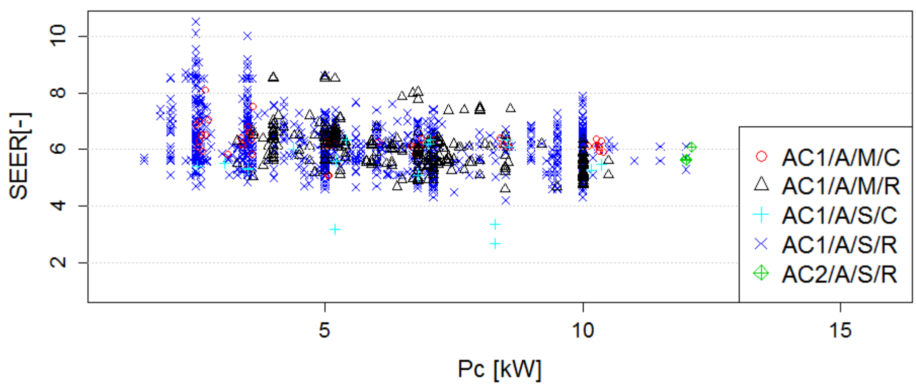

Figure 5. SEER values dispersion for each of the non-ducted AC unit type according to its rated cooling capacity (Pc). See Table 6 in Annexes for unit type.

of reduction of global warming gas emissions, in the case of leakage. According to this study (**Figure 6**) among over 6500 non-ducted AC products, low-GWP are not present in the market. The R410A refrigerant (GWP = 2088) is by far the dominating refrigerant used in the market of AC units in Europe while R32 (GWP = 675) has been gaining moderate importance. Perhaps, more stringent ecodesign minimum requirements for AC units using conventional refrigerants could also steer the market for the use of low GWP refrigerants.

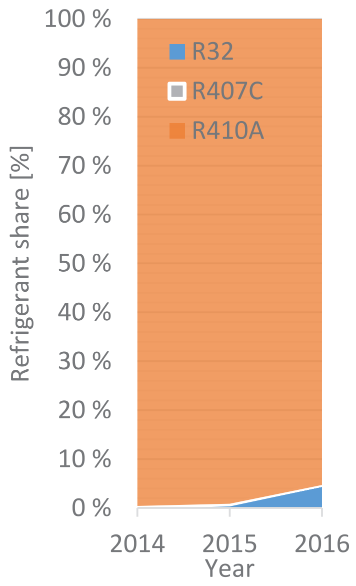

Figure 6. Evolution of refrigerants used in non-ducted AC units.

Liquid chilling packages and hydronic heat pumps

The COP of LCP-HP units in low temperature heating mode sorted by unit type are plotted against its capacity in **Figure 7**. Air source packaged reversible units (LCP35/A/P/R) tend to perform worse than any type of unit. Otherwise, the COP values of LCP-HP units seem to exhibit no significant statistical dependence between energy efficiency (COP) and its capacity.

The maximum average COP among LCP-HP units in low temperature (35°C) heating mode was 5.59 – in water based packaged (LCP-HP35/W/P/C) units, while the minimum was 3.89 in air based packaged reversible units (LCP-HP35/A/P/R). See **Table 3**.

Table 3. Summary of average and std. deviation COP and EER values for each LCP-HP unit type.

Unit Type	COP Mean ($\bar{x}$)	COP Std. deviation (s)	EER Mean ($\bar{x}$)	EER Std. Deviation (s)
LCP35/A/P/R	3.89	0.28	3.43	0.42
LCP35/A/S/R	4.34	0.31	3.38	0.33
LCP35/W/P/C	5.43	0.11	3.58	0.47
LCP35/W/P/R	5.32	0.35	6.80	0.80
LCP-HP35/A/P/H	4.21	0.16	5.64	0.48
LCP-HP35/W/P/H	5.59	0.43	-	-
LCP55/A/P/R	2.51	0.20	-	-
LCP55/A/S/R	2.83	0.21	-	-
LCP55/W/P/C	3.41	0	-	-
LCP55/W/P/R	3.33	0.18	-	-
LCP-HP55/A/P/H	3.2	0.37	-	-
LCP-HP55/W/P/H	3.69	0.15	-	-

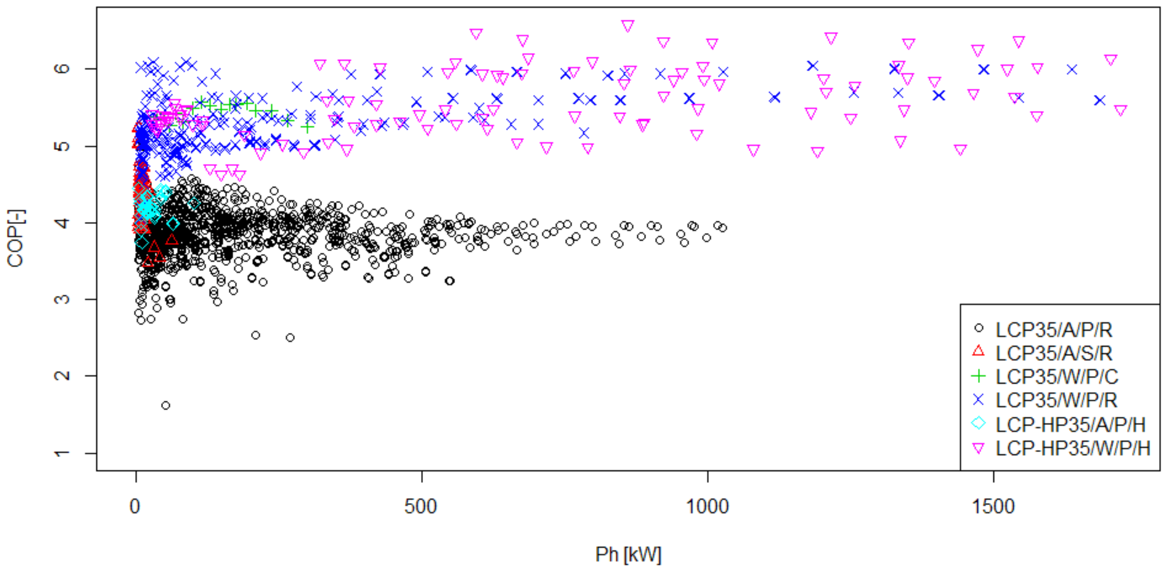

Figure 7. COP values dispersion of the LCP-HP type low heating mode (35°C) units according to its rated heating capacity (Ph). See Table 8 in Annexes for unit type.

In high temperature (55°C), as shown in **Figure 8**, the maximum average COP was reached water based packaged LCP-HP units (LCP-HP55/W/P/H), 3.69 and the minimum average 2.51 with air based packaged reversible units (LCP55/A/P/R). The different types of LCP-HP units show to be clustered in different COP value levels. This indicates that, particularly in high temperature heating mode, the different types of units should be considered independently with regards to minimum energy performance requirements.

Figure 9 shows the EER values of LCP-HP units during the period 2014–2016. The maximum average EER among LCP-HP units in low temperature heating mode was 6.80 – in the case of water based packaged reversible units (LCP35/W/P/R), while the minimum was 3.38 in air based split reversible units (LCP-HP35/A/S/R). See **Table 3**.

LCP-HP units are not yet considered under the energy labelling regulation. Thus, no study on the seasonal energy efficiency (SCOP and SEER). However, the Eurovent Certita Certification program [2], defines energy classes on the basis of the COP and EER values [2]. Results of the market transformation between 2014 and 2016 can be found in the following couple of figures (**Figure 10** and **Figure 11**). These results echo the stagnation of the LCP-HP market. In the last three years, there are no signs of significant positive evolution with respect to COP and EER values.

Rooftops

Figure 12 shows that RT present no clear dependence between COP and unit rated capacity. In addition, the latter figure reveals two clear clusters corresponding to water-based units with higher COP values than air-based units.

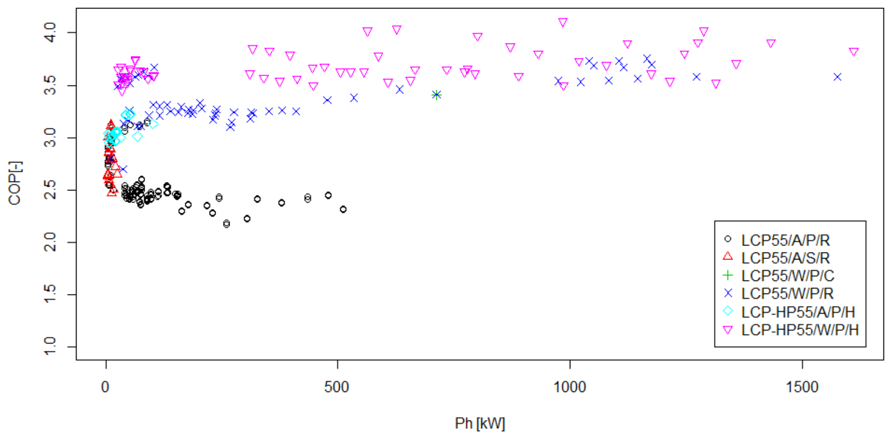

Figure 8. COP values dispersion of LCP-HP unit in high heating mode (55°C) units according to its rated heating capacity (Ph). See Table 8 in Annexes for unit type.

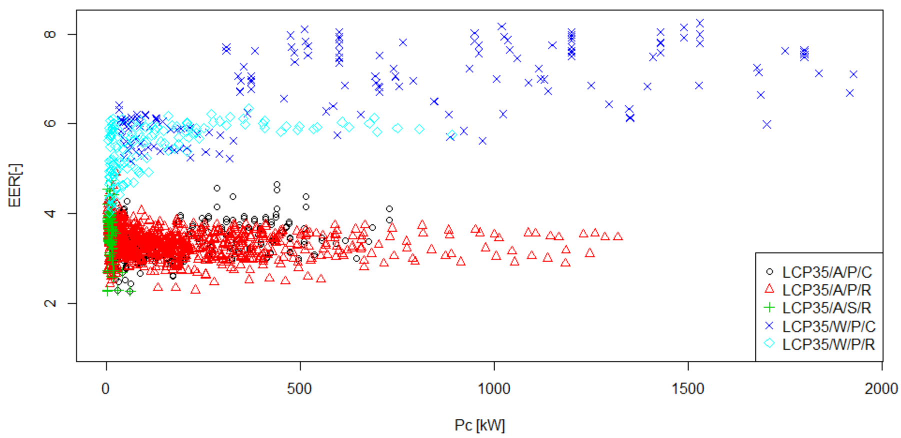

Figure 9. EER values dispersion LCP-HP units according to its rated cooling capacity (Pc). See Table 8 in Annexes for unit type.

Figure 13 shows that RT present no clear dependence between COP and the rated capacity of the unit in cooling mode, either. In addition, the latter figure reveals two clear clusters corresponding to water-based units with higher EER values than air-based units, both cooling only mode and reversible type.

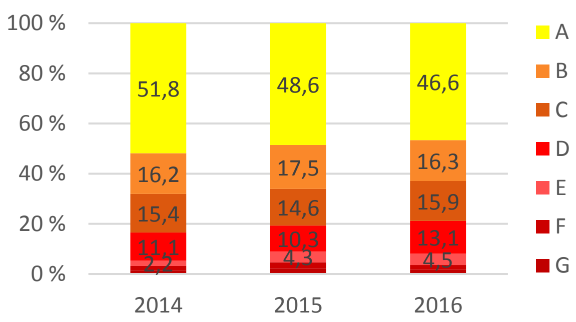

Figure 10. Coefficient of performance (COP) – transformation of LCP-HP between 2014 and 2016.

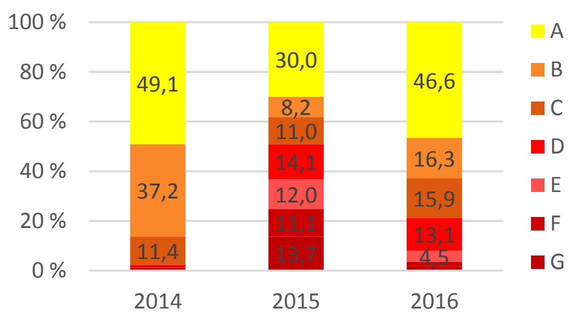

Figure 11. Energy Efficiency Ratio (EER) – transformation of LCP-HP between 2014 and 2016.

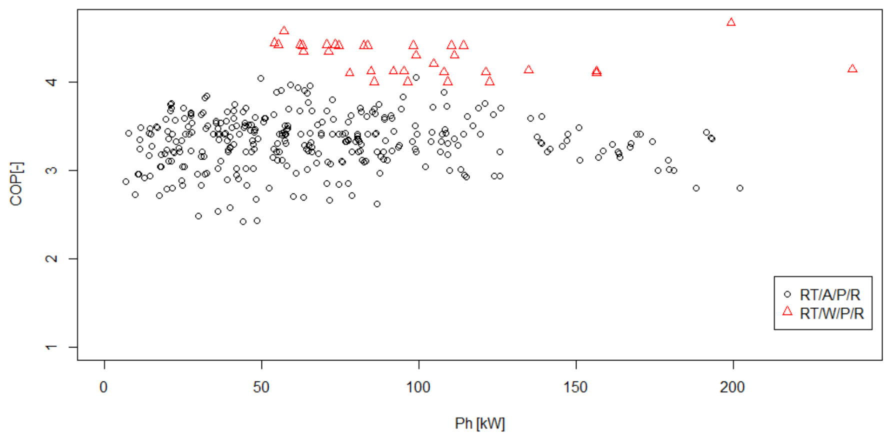

Figure 12. COP values dispersion for each of the RT unit type in heating mode according to its rated heating capacity. See Table 9 in Annexes for unit type.

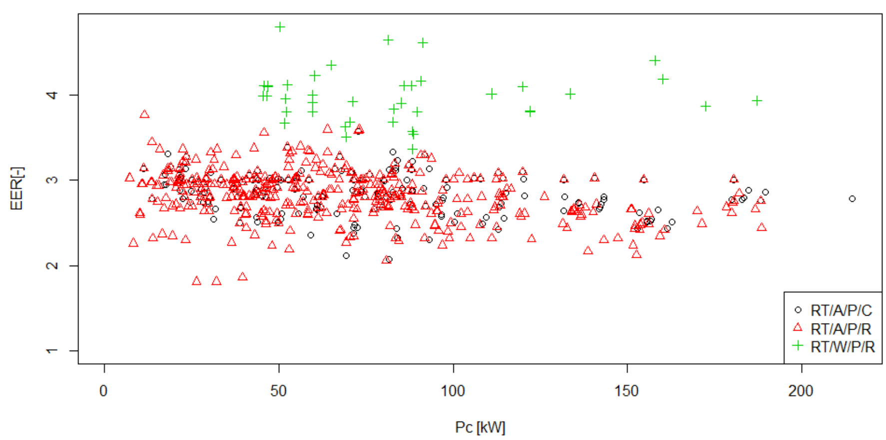

Figure 13. EER values dispersion for each of the RT unit type in cooling mode according to its rated cooling capacity (Pc). See Table 9 in Annexes for unit type.

Table 4 sums up average COP and EER values found for three different types of RT units (see types in **Table 9**). The water based packaged reversible systems (RT/W/P/R) present COP values 1.3 times higher than air heated units (RT/A/P/C and RT/A/P/R) in heating mode. The standard deviation values indicate a slight potential for positive effects to incite for energy performance improvement for heating applications.

The performance of water cooled RT units in cooling mode is also up to 1.4 times higher than air cooled packaged reversible units (RT/A/P/R). The standard deviation values indicate a slight potential for positive effects to incite for energy performance improvement in cooling mode.

Table 4. Summary of average and std. deviation COP and EER values for each RT unit type.

Unit Type	COP Mean ($\bar{x}$)	COP Std. deviation (s)	EER Mean ($\bar{x}$)	EER Std. deviation (s)
RT/A/P/C	–	–	2.87	0.23
RT/A/P/R	3.24	0.28	2.80	0.28
RT/W/P/R	4.31	0.19	3.94	0.30

As LCP-HP units, RT are not considered under the energy labelling regulation. Thus, no study on the seasonal energy efficiency (SCOP and SEER). However, the Eurovent Certita Certification program [3], defines energy classes on the basis of the COP and EER values. Results of the market transformation between 2014 and 2016 can be found in the following couple of figures (**Figure 14** and **Figure 15**) for air and water based RT systems. These results echo the stagnation of the RT market. Except with respect to water-based systems, in the last three years, there are signs of positive evolution on EER values. From 2014 to 2016, 19% passed from lower energy classes to class A.

Variable Flow Refrigerant

Figure 16 shows the COP values of VRF units in heating mode sorted by unit type against its capacity. It is shown that water- and air-sourced systems seem to have comparable performances. The evident vertical lines corresponding to different heating capacities are defined by the market.

Figure 17 shows the EER values of VRF units in cooling mode sorted by unit type against its capacity. Water-sourced units present higher energy efficiency that air-sourced in cooling mode, contrasting with what

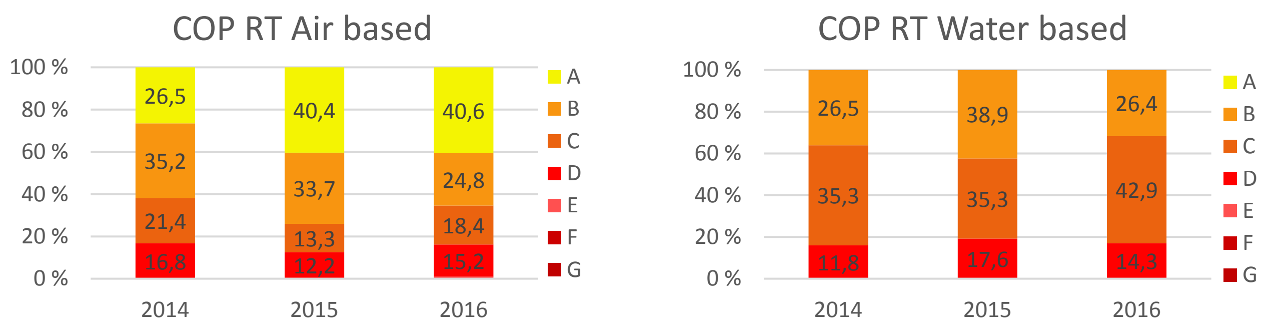

Figure 14. Coefficient of performance (COP) –transformation of RT for air and water based units between 2014 and 2016.

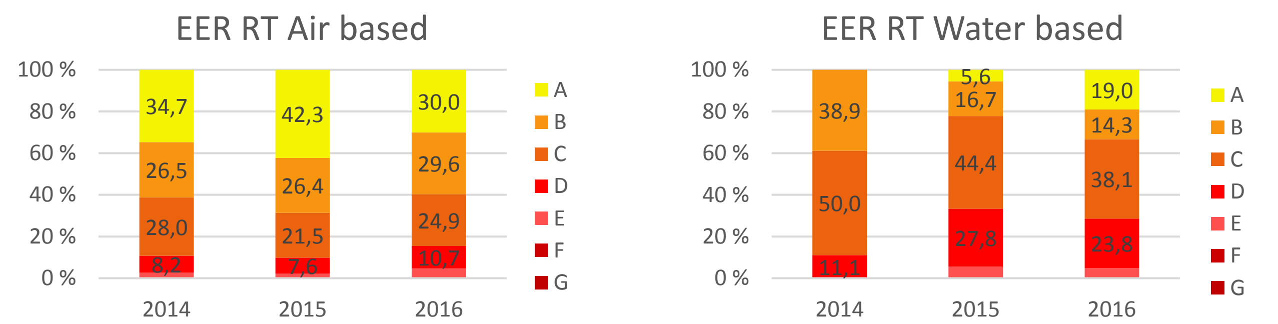

Figure 15. Energy Efficiency Ratio (EER) –transformation of RT for air and water based units between 2014 and 2016.

could be seen in heating mode, where these two types of units seem to show comparable performances (**Figure 16**). This could be a result of free-cooling. However, it is ambitious to conclude that this is a trend as there are only three samples of water-sourced units available in this dataset.

The maximum average COP among VRF units in heating mode was 4.53 –water based units (VRF/W/R), while the minimum was 4.22 in air based units (VRF/A/R). **Table 5** summarizes the mean and standard deviation of COP and EER for each unit type in the last three years period (2014-2016).

Air based types present a larger standard deviation than water based. Yet, this might be due to the smaller numbers of water based samples. Thus, the potential for policy effect should be the same for air- and water-sources VRF units.

VRF units are not considered under the energy labelling regulation or any certification program. Thus, no study on the seasonal energy efficiency (SCOP and SEER) or nominal conditions efficiency (COP and EER) were performed.

Table 5. Summary of average and std. deviation COP and EER values for each VRF unit type.

Unit Type	COP Mean ($\bar{x}$)	COP Std. deviation (s)	EER Mean ($\bar{x}$)	EER Std. deviation (s)
VRF/A/R	4.22	0.48	3.77	0.47
VRF/W/R	4.53	0.10	5.52	0.28

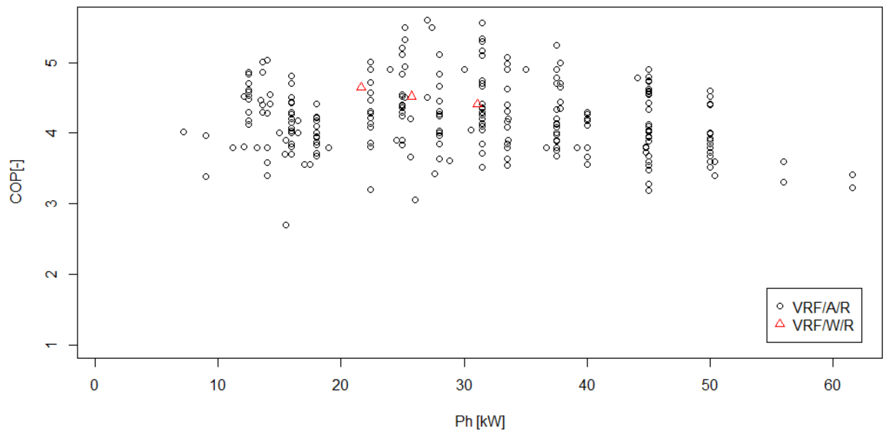

Figure 16. COP values dispersion for each of the VRF unit type in heating mode according to its rated heating capacity (Ph) See Table 10 in Annexes for unit type.

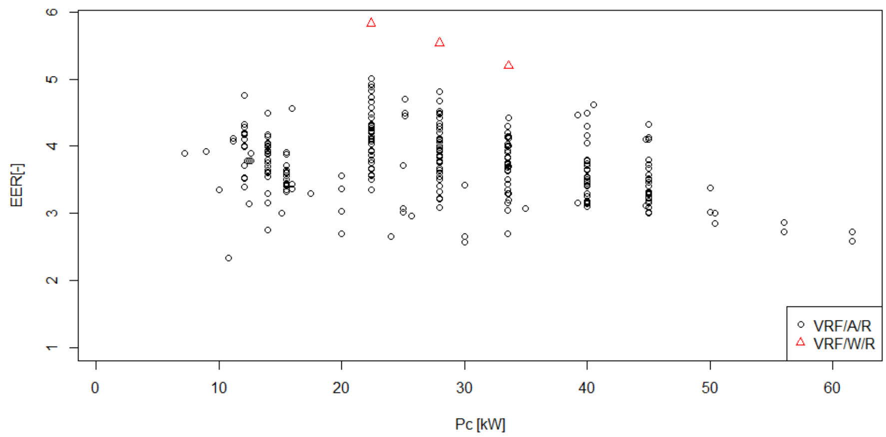

Figure 17. EER values dispersion for each of the VRF unit type in heating mode according to its rated heating capacity (Pc). See Table 10 in Annexes for unit type.

Conclusions

This study is based on accurate data of the performance of heating and cooling technologies tested in independent laboratories. The technologies considered in this study are: air conditioners, liquid chilling packages and hydronic heat pumps, rooftop and variable refrigerant flow units.

The statistical analyses performed and its results give an outlook of the technological progress in European heating and cooling market during the period of 2014 and 2016. The facts presented prove the positive effect of energy labelling implementation on energy efficiency improvement and confirm the importance of standardised/legit data for heating and cooling technologies. Furthermore, the facts strongly recommend the revision of the ecodesign requirements on the minimum energy efficiency in the future revision of the regulation in the matter of AC units. A review of the regulation No 206/2012 supplementing the Directive 2010/30/EU with regard to ecodesign requirements of AC products is planned. The Commission shall review the regulation No 206/2012 no later than 5 years from the date of entry into force.

With respect to the other technologies (liquid chilling packages and hydronic heat pumps, rooftops and variable flow refrigerant) studied in this work and its future application with regards to energy efficiency improvement, it is suggested that these systems should be discriminated by water and air-based units when defining minimum requirements. In addition, packaged and split systems also present distinguished performances.

Annexes

In this study, the AC units are classified according to their capacity:

- AC1: Comfort Air Conditioners and Heat Pumps rated up to 12 kW;
- AC2: Comfort Air Conditioners rated from over 12 kW up to but not including 45 kW cooling capacity.

Furthermore, they are also classified according to its heat source, system and mounting types. AC units reject heat from the room to water (water cooled unit) or air (air/air units) in cooling mode and, if reversible, they can also absorb heat from the water or air to the room in heating mode. **Table 6** condenses the AC units classification used in this study.

Table 6. Non-ducted air conditioners (AC) classification.

<table>
<tr><th>Programme</th><th>Code</th><th>Heat rejection</th><th>Code</th><th>System</th><th>Code</th><th>Operation</th><th>Code</th><th>Mounting</th><th>Code</th></tr>
<tr><td rowspan="3">Comfort Air Conditioners up to 12 kW</td><td rowspan="3">AC1</td><td rowspan="3">Air cooled</td><td rowspan="3">A</td><td rowspan="2">Split</td><td rowspan="2">S</td><td rowspan="3">Cooling only</td><td rowspan="3">C</td><td>High wall</td><td>W</td></tr>
<tr><td>Floor mounted</td><td>L</td></tr>
<tr><td rowspan="2">Multisplit</td><td rowspan="2">M</td><td>Cassette</td><td>C</td></tr>
<tr><td rowspan="4">Comfort Air Conditioners from 12 up to 45 kW</td><td rowspan="4">AC2</td><td rowspan="4">Water cooled</td><td rowspan="4">W</td><td rowspan="4">Reverse cycle</td><td rowspan="4">R</td><td>Ceiling suspended</td><td>S</td></tr>
<tr><td rowspan="3">Packaged</td><td rowspan="3">P</td><td>Built-in horizontal</td><td>B</td></tr>
<tr><td>Built-in vertical</td><td>V</td></tr>
<tr><td>Window</td><td>Wi</td></tr>
</table>

Table 7. Energy Classification for Air Conditioners except double ducts and single ducts.

Energy Efficiency Class	SEER	SCOP
A+++	SEER ≥ 8.50	SCOP ≥ 5.10
A++	6.10 ≤ SEER ≤ 8.50	4.60 ≤ SCOP ≤ 5.10
A+	5.60 ≤ SEER ≤ 6.10	4.00 ≤ SCOP ≤ 4.60
A	5.10 ≤ SEER ≤ 5.60	3.40 ≤ SCOP ≤ 4.00
B	4.60 ≤ SEER ≤ 5.10	3.10 ≤ SCOP ≤ 3.40
C	4.10 ≤ SEER ≤ 4.60	2.80 ≤ SCOP ≤ 3.10
D	3.60 ≤ SEER ≤ 4.10	2.50 ≤ SCOP ≤ 2.80
E	3.10 ≤ SEER ≤ 3.60	2.20 ≤ SCOP ≤ 2.50
F	2.60 ≤ SEER ≤ 3.10	1.90 ≤ SCOP ≤ 2.20
G	SEER < 2.60	SCOP < 1.90

Table 8 sums all the classes of LCP-HP units studied as classified by ECC [2].

Table 9 sums all the classes of RT units studied as classified by ECC [3] and **Table 10** sums all the classes of VRF units studied as classified by ECC [4]. ■

Table 8. Classes of LCP-HP units.

Programme	Code	Heat rejection	Code	System	Code	Operation	Code	Duct	Code	Compressor	Code
Liquid Chilling Packages	LCP	Air cooled	A	Packaged	P	Cooling only	C	Ducted	D	Centrifucal	C
		Water cooled	W	Split	S	Reverse cycle	R	Non Ducted	N	Other	O

Table 9. Classes of RT units.

Programme	Code	Heat rejection	Code	System	Code	Operation	Code
Rooftop	RT	Air	A	Packaged	P	Cooling only	C
		Water	W			Reversible cycle	R

Table 10. Classes of VRF units.

Programme	Code	Heat rejection	Code	Operation	Code
Variable Refrigerant Flow	VRF	Air	A	Cooling only	C
		Water	W	Reversible cycle	R

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