

EPEE and JBCE feedback on Öko-Recherche's briefing paper: HFCs and HFC alternatives in split air conditioning systems

20 April 2020

Executive Summary

EPEE and JBCE, representing the refrigeration, air-conditioning and heat pump industry in Europe, welcome the opportunity to comment on the European Commission's briefing papers on "HFC availability on the EU market" and "HFCs and HFC alternatives in split air-conditioning systems". EPEE and JBCE's comments in the following paper will refer to the latter only.

Key messages:

- Currently there are no "cost-effective, technically feasible, energy-efficient and reliable alternatives" available to replace fluorinated greenhouse gases safely in small single split air-conditioning systems as defined in Annex III.
- HFC R-32 is the dominant refrigerant for single split a/c equipment < 3kg in Europe, but full market penetration is still being prevented by a lack of adaptation and harmonisation of building and fire safety codes to flammable refrigerants in some EU Member States:
As long as these issues will not be resolved, refrigerants with a GWP > 750 will still be required for all types of split a/c equipment, including small split a/c as defined in Annex III;
- There is no solid justification to support the claim made by Öko-Recherche that the criteria of cost-effectiveness, technical feasibility, energy efficiency and reliability would currently be fulfilled by R-290 in small split a/c below 7kW capacity;
- The F-Gas Regulation works and emissions have been decreasing since 2014. Further strengthening of Annex III provisions is not necessary. Rather, the focus now needs to be on addressing still existing barriers to the uptake of lower GWP solutions including safety standards, building and fire safety codes and training.
- Imposing additional constraints on refrigerants could jeopardize the uptake of heat pumps which are essential to decarbonise Europe's heating sector.

1. Introduction

EPEE and JBCE have supported the EU F-Gas Regulation from the start and has continuously worked to ensure its success. For instance, EPEE has developed a range of tools including the "Gapometer" and various communication materials to support its harmonised implementation and application throughout Europe. More recently, EPEE has engaged with OLAF to support better customs controls and cooperation in order to prevent illegal imports.

The review process as set out under article 21 of the EU F-Gas Regulation provides a useful framework to take stock and evaluate whether the current provisions work or require adaptation to market developments. Representing the majority of manufacturers active on the European market, EPEE and JBCE welcome the opportunity to provide feedback and share their experience from the market. In this

context, EPEE and JBCE would like to recall the scope of Article 21 §4 which refers to “**assessing whether cost-effective, technically feasible, energy-efficient and reliable alternatives exist**, which make the replacement of fluorinated greenhouse gases possible in [...] new small single split air-conditioning systems” as defined in Annex III.

2. The current market situation and outlook for single split a/c < 3kg

- HFC R-32 is the dominant refrigerant for single split a/c equipment < 3kg in Europe
- Market penetration of R-32 in small split a/c today is estimated to be approx. 80%
- Full market penetration is still being prevented by a lack of harmonisation and adaptation of building and fire safety codes for the use of flammable refrigerants in some EU Member States
- R-32 has contributed significantly to achieving the HFC phase-down due to reduced charge sizes and a lower GWP than the previously dominant HFC R-410A

EPEE and JBCE concur with Öko-Recherche that HFC R-32 “is currently the dominant A2L refrigerant for single-split sales in the EU” and “has now been adopted by all major manufacturers of a/c equipment in their product portfolio in the EU market”. Results of an EPEE survey carried out by Gluckman Consulting among manufacturers of split a/c equipment < 3kg charge confirm these findings with a market penetration of R-32 of approx. 80% in 2019 in such type of equipment.

EPEE’s survey data slightly differ from that of Öko-Recherche regarding the time when full market penetration of R-32 in small split a/c < 3kg can be expected. Whereas the report sees this potential already in 2020, the EPEE survey expects full market penetration of R-32 filled, small split a/c only in 2025, i.e. 5 years later. This delay is not technically motivated but results from a lack of harmonisation and adaptation of building and fire safety codes to the use of flammable refrigerants in some European countries, which to date still prohibit or restrict the use of flammable refrigerants in certain types of buildings. One example for such restrictions is France, where national legislation still restricts and/or prohibits the use of flammable refrigerants in certain public and high-rise buildings.

As illustrated by the data of the European Environmental Agency (EEA), the use of R-32 in such equipment has already resulted in significant reductions in CO₂-equivalent due to reduced charge sizes and a lower GWP value than R-410A. As such it has played an important role in achieving the phase-down requirements according to the EU F-Gas Regulation and will continue to do so in the coming years.

3. Availability of cost-effective, technically feasible, energy efficient and reliable alternatives in single split a/c < 3kg

- Currently there are no “cost-effective, technically feasible, energy-efficient and reliable alternatives” available to safely replace fluorinated greenhouse gases in small single split air-conditioning systems as defined in Annex III.
- So far, no other alternatives than HFC R-32 have been adopted by the market for small split a/c equipment < 3kg charge size

- There is no solid justification to support the claim made by Öko-Recherche that the criteria of cost-effectiveness, technical feasibility, energy efficiency and reliability would currently be fulfilled by R-290 in small split a/c below 7kW capacity.

Öko-Recherche found that the market has been moving from R-410A to R-32 for single split sales in the EU because it “was found to be comparable or better than R-410A” from a product cost/performance and efficiency perspective.

EPEE and JBCE agree with this assessment and would like to add that this transition has been very swift.

It did not happen because of the upcoming GWP limit of 750 since this will only enter into force in 2025. Rather, it happened because of the pressure of the HFC phase-down and the fact that R-32 is considered by the relevant OEMs as a safe, cost-effective and technically feasible alternative to R-410A. **In other words: the EU HFC phase-down has proven to be a powerful driver for the industry to transition towards lower GWP solutions, while allowing for the development of energy efficient, safe and affordable solutions.**

Apart from R-32, there are, according to Öko-Recherche, a number of other alternatives either theoretically available or in the pipeline, including hydrocarbon R-290, different HFC blends and others. With the exception of R-290 and R-1270 – which are both categorised as higher flammability refrigerants (A3) – all of these alternatives belong to the F-Gas family. Up to now, none of the alternatives, whether F-Gases or other refrigerants, have been broadly adopted by the European market, as stated by Öko-Recherche and confirmed by the EPEE survey.

Even R-290, which is currently the only alternative besides R-32 listed by Öko-Recherche as being “ready for the market”, has not been introduced yet in Europe in small split a/c equipment. EPEE and JBCE are aware of the Chinese brand that was awarded with the German label “Blue Angel”, however, to EPEE and JBCE’s knowledge these models have not been commercialised so far at a broader scale in Europe.

As regards the introduction of R-290 in China, quoted as an example by Öko-Recherche, a recent report by the United Nations Environment Programme (UNEP) under the Montreal Protocol found that market introduction in China has been very slow and represents a negligible share (less than 3%) of total sales. It states that “notwithstanding continued efforts by the Government of China, CHEAA, industry and UNIDO, the production of R-290 equipment on the converted [production] lines remains very low. [...] Among the challenges that contribute to the low production, are the longer installation time for an R-290-based unit; domestic and international standards; and the higher cost relative to other products that are already mass-produced and benefit from economies of scale.”¹

A brief comment on energy efficiency in this context:

It is necessary to evaluate an alternative on its potential to further increase the energy efficiency, and not on a benchmark of products that are already on the market today. For example, the revision of Ecodesign Regulation 206/2012 (split a/c < 12kW) will most likely increase the required minimum SEER efficiencies for split a/c by up to 30%. In addition, the energy labelling directive aims to stimulate the

¹ Executive Committee of the Multilateral Fund for the implementation of the Montreal Protocol, 83rd Meeting, Montreal, 27. – 31. May 2019

demand for products that perform much better than the minimum level. However, due to safety constraints, highly flammable refrigerants such as R-290 are sensitive to charge in terms of energy efficiency. For example, in order to assure the max potential capacity range of a product, the charge amount of the equipment needs to be reduced, which typically leads to lower energy efficiency levels.²

All these findings beg the conclusion that **currently there are no “cost-effective, technically feasible, energy-efficient and reliable³ alternatives” available to replace fluorinated refrigerants in small single split air-conditioning systems as defined in Annex III** – otherwise, the market would have adopted them already as it did with R-32 or would have shown at least some first signs pointing in that direction. Furthermore, EPEE and JBCE would like to highlight the importance of circular economy aspects such as reusability and efficient use of resources which will play an increasingly important role in light of the European Green Deal and Circular Economy Action Plan.

This conclusion applies to all single split a/c with charge sizes below 3kg, independent of their cooling capacity. The claim made by Öko-Recherche that it seems “technically possible to avoid F-Gases today in new single split a/c with a cooling capacity below 7kW by using R-290” has not been substantiated by any solid justification in the report itself, nor is there any experience from Europe or other regions in the world, including China, that would support such conclusion in the short and medium term. Likewise, it will not be possible to renounce F-Gases with a GWP >750 as long as barriers related to building and fire safety codes, safety standards and training (see next chapter) will not be overcome.

4. Barriers to be overcome in view of the transition towards lower GWP refrigerants in single split a/c < 3kg and larger equipment

- Main barriers that still need to be overcome include the adaptation of safety standards, building and fire safety codes and training to the use of flammable refrigerants.

EPEE and JBCE agree with Öko-Recherche’s assessment that there are still barriers for the use of refrigerants classified as flammable (2L, 2, 3) and/or toxic (B). These barriers relate to three main areas: Standards, buildings and fire safety codes and training.

Standards:

Safety standards are important references and are often used as practical guidance, a code of good practice or, if it is a harmonized standard, as a possible method to demonstrate compliance with legislation. Even if standards are not mandatory, a harmonised standard can facilitate fulfilment of requirements. For example, a faster harmonization process of standard EN60335-2-40 could facilitate the placing on the market for larger split equipment.

Building and fire safety codes:

Building and fire safety codes are enshrined in national, regional and sometimes even local rules, often related to fire safety but also to other issues such as access to buildings, health, etc. If a building or fire safety code prohibits the use of flammable refrigerants, then it is simply not allowed to use those. This

² UNIDO presentation: 31st Meeting of the Parties to the Montreal Protocol, Rome, 2019

³ “Reliable”, in this context, has to include the concept of safety as a key feature as any equipment that is not safe would also not be reliable for use in buildings.

is for example the case in France, where the national building code for public buildings, although it was recently revised, still poses barriers for split air-conditioners with flammable refrigerants, and where the latter are not yet allowed in public and non-public high-rise buildings.

Training:

EPEE and JBCE agree with Öko-Recherche that there is a further need for training on flammable refrigerant use for installers and service companies.

However, it's not only about training, but also about a formalised qualification, certification and registration structure scheme (QCR)⁴. The EU F-Gas Regulation already includes a mandatory certification scheme for handling of HFC refrigerants including training on possible alternatives, but there is no EU mandatory certification scheme for using non HFC refrigerants such as propane/ R-290.

This poses a particular safety and liability risk for split air-conditioners: although safety standards require equipment manufacturers to provide installation and operation instructions, in many cases manufacturers have no direct access to the companies that are installing or servicing the equipment (for example due to sales via importers, distributors, wholesalers)⁵. As an example, in India, the manufacturer Godrej offers both R-32 Split a/c and R-290 Split a/c on the Indian market, but restricts the sales of the R-290 a/c to a limited network of own trained and certified a/c technicians⁶.

5. Conclusions and recommendations

- The F-Gas Regulation works: emissions have been decreasing since 2014
- Focus now needs to be on aligning and adapting buildings and fire safety codes, safety standards and training to the increased use of flammable refrigerants rather than on changing Annex III provisions
- Imposing additional constraints on refrigerants could jeopardize the uptake of heat pumps which are essential to decarbonise Europe's heating sector
- Further strengthening of Annex III provisions is not necessary to achieve the goals of the F-Gas Regulation
- To date, F-Gases cannot be avoided in new single split a/c units < 7kW capacity

There is no doubt that the transition towards refrigerants with a lower GWP in small split air-conditioning equipment below 3kg filling charge is making excellent progress. The main driver for this transition is the HFC phase-down as stipulated by the F-Gas Regulation. The market development and the broad adoption of HFC R-32 for all capacities of split a/c equipment below 3kg show that OEMs are ready and keen to adopt lower GWP refrigerants as soon as this is possible from a regulatory, technical, safety and economic perspective.

However, EPEE and JBCE do not agree with Öko-Recherche's conclusion that F-Gases can be avoided today in new single split a/c with a cooling capacity below 7 kW. Indeed, there is no thorough assessment in the report nor any experience from the market or from EPEE's survey, which would

⁴ GIZ: R-290 Split Air Conditioners Resource Guide Version 1.0, page 50

⁵ UNIDO presentation, Slide 12: Meeting of the Parties to the Montreal Protocol, Rome 2019

⁶ GIZ: R-290 Split Air Conditioners Resource Guide Version 1.0, page 52

support Öko-Recherche's claims that F-Gases can be replaced by alternatives such as hydrocarbons in split a/c equipment below 7kW and that it would be possible to renounce on F-Gases with a GWP >750 in split a/c equipment > 7 kW.

While it may be technically possible to make R-290 a/c for a limited capacity range, the report did not sufficiently assess the potential for additional energy efficiency savings, which are required due to EU Ecodesign, Energy efficiency and Energy Performance of Building directives. This aspect also influences the capacity range. Therefore, 7 kW is not a valid conclusion. In addition, what is considered a "good energy efficiency" today may not be good enough to meet the future EU energy saving targets. In addition, the study did not look into the wide variety of indoor units required for the EU market, the heating function, the maximum piping lengths required, and the SEER/SCOP EU methodology (the situation of R-290 models in China and India cannot be simply extrapolated to the EU market conditions).

Furthermore, the report seems to underestimate the need for a mandatory qualification and certification programme for R-290 installers, although recommended by GIZ as the experience in India has shown that this is necessary.

Given that the transition is happening and that the broad introduction of R-32 has already been making a significant contribution to achieving the phase-down steps – as confirmed by the EEA data – EPEE and JBCE strongly recommend **to focus on adapting building and fire safety codes, safety standards and training and certification measures to the increased use of flammable refrigerants** rather than introducing artificial, additional thresholds such as 7kW which would likely lead to confusion in the market without any tangible environmental benefits.

In this context, EPEE and JBCE would like to draw attention to the huge potential of heat pumps to reduce emissions from the heating and cooling sector, which, today, represents almost 50% of the total final energy consumption in the EU. Decarbonising the heating sector will only be possible by radically moving away from fossil fuels and heat pumps have an important role to play in that respect. However, currently they represent less than 5% of the total heating energy consumption in Europe, among others due to higher investment cost and lack of awareness in the market.

Small split a/c may fall in the category of air to air heat pumps as many of them can provide both, heating and cooling, and operate as heat pumps⁷. Adding yet another layer of difficulty in the form of de facto imposing higher flammability refrigerants would almost certainly impact cost and slow down the crucial deployment of heat pumps (see also barriers under point 4). Considering that almost 80% of the total greenhouse gas emissions in Europe are related to CO₂, mainly due to energy use and production, whereas only approx. 2% are related to F-Gases, **it would be disproportionate and counter-productive to jeopardize the uptake of heat pumps for the sake of forcing the market to adopt F-Gas alternatives when the market is moving to lower GWP refrigerants anyway.**

⁷ The Ecodesign Lot 10 studies (Tasks 2&5) show that the EU market of these units is nearly 100% consisting of reversible a/c types, also called air-to-air heat pumps. The heating function is becoming more and more important and equipment designs are increasingly optimized for it, because heat pumps are one of the key solutions to decarbonize the heating needs of the EU's building stock. See also: Delta EE, 17 Dec 2019: "Has the time come for air/air heat pumps in Europe?"



EPEE and JBCE would therefore like to re-iterate their strong support to the F-Gas Regulation and its current provisions, emphasizing that HFC emissions have been decreasing since 2014 and that the phase-down has proven to drive the transition to lower GWP refrigerants. Further strengthening the provisions under Annex III is therefore not necessary in order to achieve the goals of the F-Gas Regulation.

ANNEX I
Detailed comments on the report

Öko-Recherche Report on Split AC	Comments																		
<p>2 Scope</p> <p>This paper addresses the feasibility of using alternatives in new¹ split air conditioning (A/C) equipment. To this purpose, it is useful to distinguish between different types of A/Cs and their sizes²:</p> <ul style="list-style-type: none"> • Single-split systems³ consisting of (only) one indoor unit and one outdoor unit connected by a refrigerant-carrying pipe that require installation <ul style="list-style-type: none"> o Small single-splits: below 3 kg charge size⁴ for a one-room solution; o Larger single splits: above 3 kg charge size, for larger rooms. • Multi-split systems consisting of one outdoor unit connected by refrigerant-carrying pipes to two or more indoor units of choice; suitable to create different room climate zones and/or for multiple rooms or large rooms. 	<p>Although there is no clear definition of “small single split A/C systems” in the main F-Gas Regulation, it is our understanding that the scope of the study is related to the following category in the F-Gas reporting implementing act , namely category “11A5 Stationary equipment for comfort cooling/heating, direct design: single split units charged with less than 3 kilograms of refrigerant”.</p> <p>An analysis of this market should include an assessment of the full range of products, including heating function, all indoor types and piping lengths, and not be narrowed down to an average wall mounted cooling only type unit.</p> <p>Example: There are many different types of indoor units connected to outdoor units: wall mounted, floor standing, ceiling mounted, concealed. Also, the piping distance between indoor and outdoor units varies, up to 30 meters or 50 meters, which has an influence on the amount of refrigerant used.</p>																		
<p>3 Relevance of Alternatives</p> <p>Equipment with alternatives must also comply with the efficiency standards of the Eco-design Directive, safeguarding that the <u>positive climate impact of indirect emissions</u> is also guaranteed.⁶</p> <table border="1" data-bbox="215 1234 810 1413"> <thead> <tr> <th></th> <th colspan="2">Toxicity</th> </tr> <tr> <th>Flammability</th> <th>A: lower toxicity</th> <th>B: higher toxicity</th> </tr> </thead> <tbody> <tr> <td>1: non flammable</td> <td>R744 (CO2), R410A, R466A</td> <td></td> </tr> <tr> <td>2L: lower flammability</td> <td>R32, R452B, R454C</td> <td>R717 (NH3)</td> </tr> <tr> <td>2: flammable</td> <td></td> <td></td> </tr> <tr> <td>3: higher flammability</td> <td>R290 (propane), R1270 (propylene)</td> <td>R1270</td> </tr> </tbody> </table> <p><i>N.b: Only the refrigerants in bold are alternatives that are not F-gases</i></p> <p>Work is being undertaken on the product standard IEC 60335-2-40, that is relevant for split A/C systems, <u>to establish a maximum charge size of 1 kg for A3 refrigerants</u>. Different precautionary measures will be required depending on charge and room size.</p>		Toxicity		Flammability	A: lower toxicity	B: higher toxicity	1: non flammable	R744 (CO2) , R410A, R466A		2L: lower flammability	R32, R452B, R454C	R717 (NH3)	2: flammable			3: higher flammability	R290 (propane) , R1270 (propylene)	R1270	<p>Comment on indirect emissions: this is indeed very important, but it should not be forgotten that energy efficiency is also a target on its own (EU energy efficiency directive, Energy Performance of Buildings directive, etc.). Even when low carbon electricity is used (e.g. from renewable energy sources), that energy must be used efficiently.</p> <p>Editorial comment: R-466A is not listed in EN378 and ISO817 yet. It is classified A1 in ASHRAE34.</p> <p>The statement is not correct : the current version of IEC60335-2-40 already has a maximum charge size of 1 kg for R-290 (not for all A3, it depends on the LFL).The revision will provide options for safety modifications that would allow a potentially wider scope of applications within the 1 kg upper limit.</p> <p>Note that for the EU, the revised IEC standard will require to be converted in an EN version, which typically includes harmonization with the Low Voltage Directive and Machinery Directive.</p>
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Flammability	A: lower toxicity	B: higher toxicity																	
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<p>Significant research on the risks related to the use of flammable refrigerants in air conditioners has already been undertaken worldwide (e.g. Tang et al., 2018; Colbourne & Suen, 2015).</p>	<p>Research on the use of flammable refrigerants has also been undertaken in the USA and Japan, and is further continued. Examples: the Japanese JSRAE risk assessments, and US AHRTI studies could also be mentioned here.</p>																		

4 Technical feasibility

As regards the feasibility of using refrigerants, charge size is an important parameter. The most commonly used refrigerant in split A/Cs so far has been the HFC blend R410A. The average charge (kg) with this refrigerant depends on the typical average cooling capacity (kW) and would range between 0.25 kg/kW for single and multi-split systems with a cooling capacity < 7 kW and 0,34 kg/kW for multi-split systems with a cooling capacity < 17.5 kW (Uniclimate, 2019). We can consider therefore that single-split equipment containing charges of HFC refrigerant < 3 kg as specified by the existing prohibition Nr. 15 (Annex III) thus relates to cooling capacities of <12 kW.¹²

The assumption that the range of products relates to cooling capacities below 12 kW, based on “average” values, is mathematically not correct.

There is a wide variety of capacity ranges for units with a charge below 3 kg. Taking into account the charges needed for a maximum piping length (precharged amount + on site top up), our analysis shows that the range of models in EU varies between 0,22 kg/kW and 0,63 kg/kW with an average of 0,35 kg/kW, which means a range span of 4,8 kW up to 13,6 kW with an average of 8,6 kW. Again, as noted earlier, these units do not only have cooling but also heating functions, which typically require more refrigerant per kW.

When assessing technical feasibilities, a more detailed analysis is needed, taking into account :

- Cooling & heating capacities (instead of cooling only)
- Maximum piping lengths (instead of average)
- All types of indoor units (not only wall mounted)
- Equipment energy efficiencies (not theoretical COP of a refrigerant)
- SEER/SCOP methodologies using EU Ecodesign methods (including stand by and off mode losses)

Refrigerant	GWP (4AR)	Relevant use restrictions	Feasibility for different types of split A/C	Market readiness	Current production capacity of split A/C	Energy efficiency
R410A	2088	A1 <i>No restrictions</i>	All	Yes	High	Baseline
R32	675	A2L Charge size limited by product standards/building codes.	All	Yes	High	Better than R410A ^{13, 14}
R290	3	A3 Charge size limited by product standards/building codes. Some prohibitions (for instance in high-rise buildings in France).	Single split currently up to 7 kW. Potential also for larger single & multi-splits if increase of charge limits in standards.	Yes	ca. 7millions of R290 split units per year in China (UNEP, 2019)	Similar to R32; especially under high ambient temperature ^{15, 16}
R1270	2	A3 Manufacturers have concerns about stability of the refrigerant. Charge size limited by product standards/building codes.	Yes, but mainly used in chillers today.	No		Similar to R290 ¹⁷
R161	12	A3 Use may be prohibited locally. Toxicity testing incomplete.	Principally feasible	No Ongoing research	None	High ¹⁸
R452B	698	A2L	All	No. Possibly conversion of R22 production lines in Egypt from 2020 (UNEP, 2019a)		Similar, slightly better at elevated temperature (>35°) ¹⁹
R454B	466	A2L				Similar, slightly better at elevated temperature (>35°) ¹⁹

Comment on column GWP :

Refrigerants should be compared based on their required CO₂eq charge (GWP x quantity) needed for the same equipment capacity and efficiency, and not on GWP only, because GWP is not a sufficient parameter to assess the potential contribution to the HFC phase down targets.

Comment on “market readiness” : equipment is market ready when all the market conditions are fulfilled, including the availability of qualified installers & service technicians, and the compliance with EU legislation (Energy, safety, end of life legislation). There is no evidence shown in the report that the market readiness is already achieved for R -290 Split A/C on the EU market. For example, there is no EU certification scheme for R -290 installers. This box should be changed to “No”.

Comment on production capacity :

Actual production amounts are more relevant to compare than theoretical production capacities. For example: UNIDO presentation (MOP Rome 2019, slide 8) mentions that production capacities in China for R-290 Split A/C are 6 mio units/year currently, with a future additional capacity of 6 mio units/year. However actual production does not yet take place in the same magnitude. Total Sales in China with subsidy of FECCO is 180,000 units (UNIDO, slide 8). Global Sales of R290A/C is 1 mio units and of R-32 Split A/C 80 mio units (UNIDO, slide 6)

R466A	733	A1		No	No	Similar ²⁰
Other mixtures containing R1123 (trifluoroethylene), R1132a (1,1-difluoroethane) and CF3I (trifluoroiodomethane)	Ca. 300	No safety classification yet for the blends but R-1132a is A2, CF2I is A1 and R-1123 is A2L (expected)	unknown	No	No	Ongoing research

N.b: Only the refrigerants in bold are alternatives that are not F-gases

In theory, if production capacity is available for R-290, it means it is also available for R-161. But production capacity is not the real issue.

Comment on mentioning of “High ambient regions” : This is relevant for the Middle East but not for a report that covers the needs of the EU market.

Comment on Energy efficiency

As the report itself mentions, the theoretical COP of a refrigerant is only one side of the coin. The comparison should be based on equipment energy efficiency, and on a proper comparison on a same capacity benchmark, taking into account the equipment materials needed to achieve a certain energy efficiency. This report did not do such an analysis, and therefore this column is misleading.

5 Market overview and trends

Figure 1. Refrigerants in imported stationary refrigeration and A/C equipment (metric tonnes).

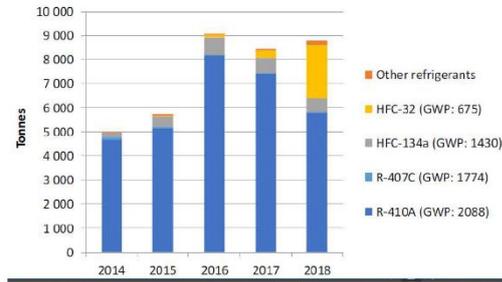


Figure 2. Total CO2 equivalents in different types of imported F-gas equipment



R32 was introduced to the market in Japan in the 2010s. It has been now been adopted by all major manufacturers of A/C equipment in their product portfolio for the EU market since 2013. The use of R32 in single-split systems also allows to reduce the refrigerant charge by about 20% to achieve the same cooling capacity. However, the current reduction of charge is only about 10% compared to R410A because of relevant ecodesign requirements²².

In France, national legislation about the use of flammable refrigerants in public access building (legislation CH35) has evolved in 2019, but still contains certain constraints depending on whether the refrigerant is A2L or A3. In the case of high-rise buildings, the use of A2L and A3 refrigerants is prohibited but some work on related legislation is still ongoing. About 60% of split systems put on the French market in 2019 were using R32. A roadmap has been established by the national association and all the manufacturers are committed to using a refrigerant with GWP < 750 in split systems with a refrigerant charge < 3 kg before 2022.

Nevertheless, several technical experts as well as service technicians believe that R32 represents only an interim solution because they consider its GWP is too high to allow meeting the 2030 HFC phase-down reduction target.

R290 has been used in moveable A/Cs²⁶ by Asian and European equipment producers for a number of years. From 2020 onwards, R290 is expected to be the refrigerant of choice for this type of application due to the placing on the market prohibition set out by the EU F-gas Regulation (Annex III (point 14)). Major Asian equipment manufacturers perceived this policy measure as the main driver for the market uptake of hydrocarbon-based products. Since 2012, R290 has also been used by some major Chinese and Indian manufacturers in

Figures 1 and 2 show stationary “refrigeration and A/C” equipment, which is a wider scope than the scope of this report.

Since importers of equipment have to report in detail about the type of equipment imported, it could be useful to ask the EEA for specific data on the category “11A5 Stationary equipment for comfort cooling/heating, direct design: single split units charged with less than 3 kilograms of refrigerant”. Since data have recently been uploaded on the F-Gas portal about 2019 results, maybe the graph could also include 2019 data.

Depending on equipment designs, up to 30% charge reduction has already been achieved for some R-32 units, with a higher energy efficiency compared to R-410A.

It should be noted that the French association’s commitment is based on the condition that French building codes have been modified to allow the use of flammable refrigerants, but this is not the case yet.

Moreover, these commitments would be achievable if, and only if, accompanying and monitoring measures are taken by the French authorities from 2019 onwards. To date, this is still not the case.

There is a misunderstanding in the market that the GWP of R-32 would be too high to meet the 2030 phase down reduction target. The EPEE HFC outlook model (2012) estimates that the average GWP of HFCs used in 2030 will be around 1300. With a GWP of 675, R-32 is far below that average. The misunderstanding probably occurred because the average GWP of ALL refrigerants in 2030 is estimated to be 400, as several parts of the market are expected to transition to non-HFC refrigerants. (Source: JARN September 2019, Ray Gluckman). EEA data indicate that transition to non-HFC solutions is indeed starting to happen.

R-290 Split AC : according to UNIDO (MOP November, Rome, slide 8), Global Sales of R-290A/C is 1 mio units. The sales in China with subsidy of FECCO is 180,000 units, but there is no commercial regular sales in China. The remaining 800,000 units were sold in India.

<p><u>commercially available split A/Cs (cooling capacity up to 7 kW)</u>. The use of R290 in single split systems allows for a reduction of the charges to about 40% compared to R410A (UNEP, 2014). Material costs for R290 units can thus be lower than for units running on R410A or R32. However, production costs are still somewhat higher than for HFC units (+6-10%) due to additional safety measures²⁷. <u>Energy efficiency levels of R290 split units are very similar compared to R32 units²⁸</u> and perform well under high ambient temperature conditions²⁹.</p> <p>The conversion of production capacities for split A/C units in China from R22 to R290 of approximately 4 million units per year has been completed in 2014 (Zhou, 2014). The current production capacity for R290 split A/C units ranged at about 7 million units per year in 2019 (UNEP, 2019).</p> <p><u>Manufacturers have published a schedule for increased production numbers from 2018³⁰, aiming at the European market</u>. For 2020, a production target of 330,000 R290 split units has been set³¹. The globally installed base is about 1 million units today, mainly in India and China.</p> <p>Certain models of the range of split A/Cs offered by a Chinese manufacturer (2.6/3.5 kW cooling capacity) were granted the German ecolabel “Blue Angel” in 2018.</p> <p>For 2020, a large Chinese manufacturer is planning to start commercialization of a new single-split R290 split A/C system on the EU market.</p>	<p>The statement on material cost for R-290 is not correct. The refrigerant itself is cheaper, but the material cost for R-290 is higher than R-410A or R-32 : because of the refrigerant characteristics (e.g. heat exchange capacity, liquid density), R-290 models require more copper and aluminium for the same capacity as R-410A or R-32. Material cost for R-290 is similar compared to R-22 equipment designs.</p> <p>On energy efficiency : same comment as above. This should be assessed based on equipment energy efficiency, not on theoretical COPs. This assessment should take into account that R-290 products are sensitive to charge in terms of energy efficiency. (UNIDO, Rome 2019). High ambient conditions are not relevant for the EU market.</p> <p>This is a wrong quote : The quoted article from hydrocarbons.org mentions that eight companies — Gree, Midea, Haier, Hisense, Changhong, TCL, Aux and Yair — pledged to produce no less than 220,000 split-type R-290 RAC units <u>in the domestic Chinese market</u> by the end of the 2019 "cooling year," which ended on July 31. The article does not mention the publication of a schedule to increase numbers aiming at the European market. In addition, the UNIDO report of (MOP , Rome) mentions that 180,000 was the number achieved in China until November.</p> <p>The Blue Angel website (date : 7th April 2020) mentions that the product is not available on the EU market. https://www.blauer-engel.de/de/produktwelt/elektrogeraete/klimageraete/midea-split-type-room-air-conditioner-all-easy-ser</p> 
<p>The EU funded research project LIFE ZEROGWP (2018-2021) intends to demonstrate the technical feasibility, full safety and commercial viability of an innovative residential A/C system based on Double Duct (DD) technology³².</p>	<p>A double duct system is a monobloc system. It has the advantage of a refrigerant circuit being built in the factory and not on site. Compared to split type A/C there are however limitations on the installation location (unit should always be located on an outer wall) and indoor sound levels are higher (compressor unit is located indoors). Also the energy efficiency is lower compared to Split type A/C : the Ecodesign lot 10 study (table 19, task 5) for example mentions an average SEER of 6.0 for Split A/C compared to an SEER of 2.09 for portable and double duct units.</p>



ANNEX II

About EPEE

The European Partnership for Energy and the Environment (EPEE) represents the refrigeration, air-conditioning and heat pump industry in Europe. Founded in the year 2000, EPEE's membership is composed of over 50 member companies as well as national and international associations from three continents (Europe, North America, Asia). With manufacturing sites and research and development facilities across the EU, which innovate for the global market, EPEE member companies realize a turnover of over 30 billion Euros, employ more than 200,000 people in Europe and also create indirect employment through a vast network of small and medium-sized enterprises such as contractors who install, service and maintain equipment. Please see our website (<http://www.epeeglobal.org>) for further information.

About JBCE

Created in 1999, the Japan Business Council in Europe (JBCE) is a leading European organisation representing the interests of 88 multinational companies of Japanese parentage active in Europe. Our members operate across a wide range of sectors including information and communication technology, electronics, chemicals, automotive, machinery, wholesale trade, precision instruments, pharmaceutical, railway, textiles and glass products. Building a new era of cooperation between the European Union (EU) and Japan is at the core of our activities, organised under several committees focusing on: Corporate Policy, Corporate Social Responsibility, Digital Innovation, Environment & Energy, Standards and Conformity, and Trade.