Note on changes between the attached draft proposal and the Working Document presented to the Consultation Forum on 22 June 2009 on air-conditioning appliances

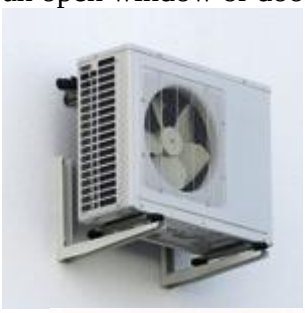
During the impact assessment phase, additional stakeholder input has allowed identifying specific issues that can have an impact on the foreseen legislative proposals on air-conditioning appliances. This note aims at explaining these issues, including the changes on main items considered in comparison to the approach taken in the Consultation Forum. No changes in the approach on comfort fans are foreseen.

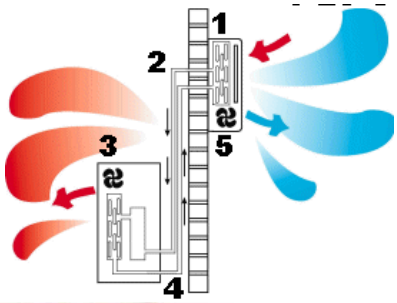
1. **Subject matter:** No changes.

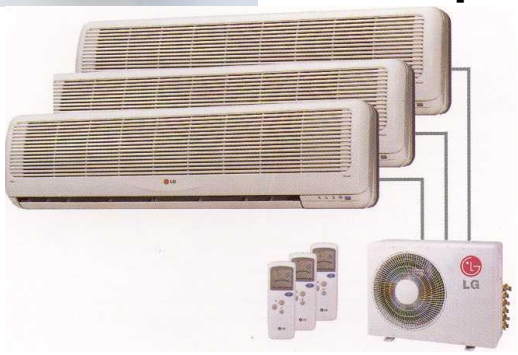
2. **Product definition (scope):** there are no changes in product scope. The scope includes split and single package air-conditioning appliances below 12 kW output power. The definitions have been rewritten to allow a better alignment with requirements. To facilitate the understanding of the document, the appliances in scope are illustrated below.

2.1 Ducted and non-ducted, split and multi-split package

A split package has a heat exchanger unit (evaporator when cooling) located inside the building shell and the other heat exchanger unit (often with compressor) located outside the building shell (condensor when cooling). The inside and outside units are connected by refrigerant lines, which often are assembled on site. When multiple indoor units are connected to a single outdoor unit, the appliance is "multi-split". When the indoor unit is delivering the cold air through air ducts the adjective "ducted" is applied (ducted split or multi-split package). Split package units can also be made portable, with handles and/or castors, in which case a flexible refrigerant line is led through an open window or door.







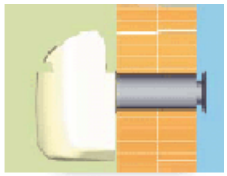
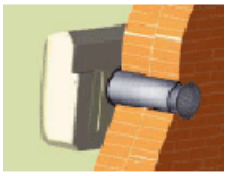
2.2 **Single package: window and wall units, double and single ducts**

A single package (‘unitary’ design) combine the condensor and the evaporator in one single housing (share a common frame). The unit is hermetically sealed; no evaporator and condensor installation is necessary on site. Single package is available in various variants as follows:

Window and wall units are rare in the EU but common in other major air-conditioning markets. The unit is positioned on the window sill or in a recess in the wall. For optimal performance in- and outdoor air should remain separated (by closing gaps in window, etc.).



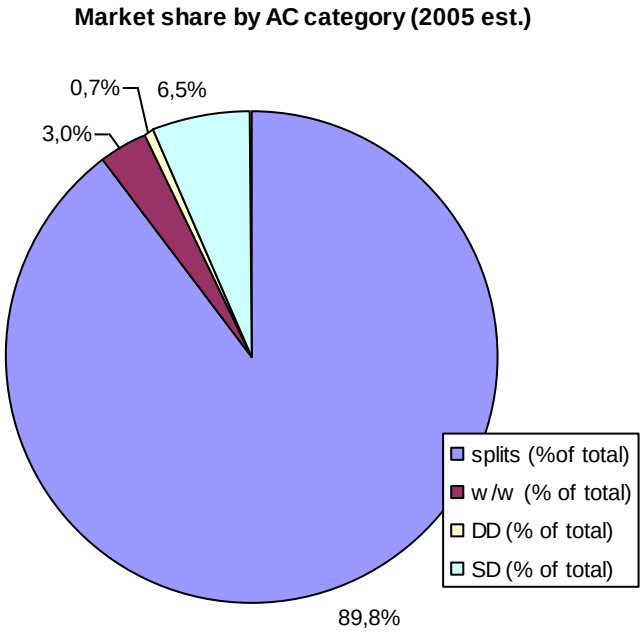
Double duct unit is placed completely indoors but remains connected to the outside air through dedicated intake and exhaust ducts. The unit does not require important modifications on the outer building shell and can be placed on the inside wall or be portable (with flexible ducts).

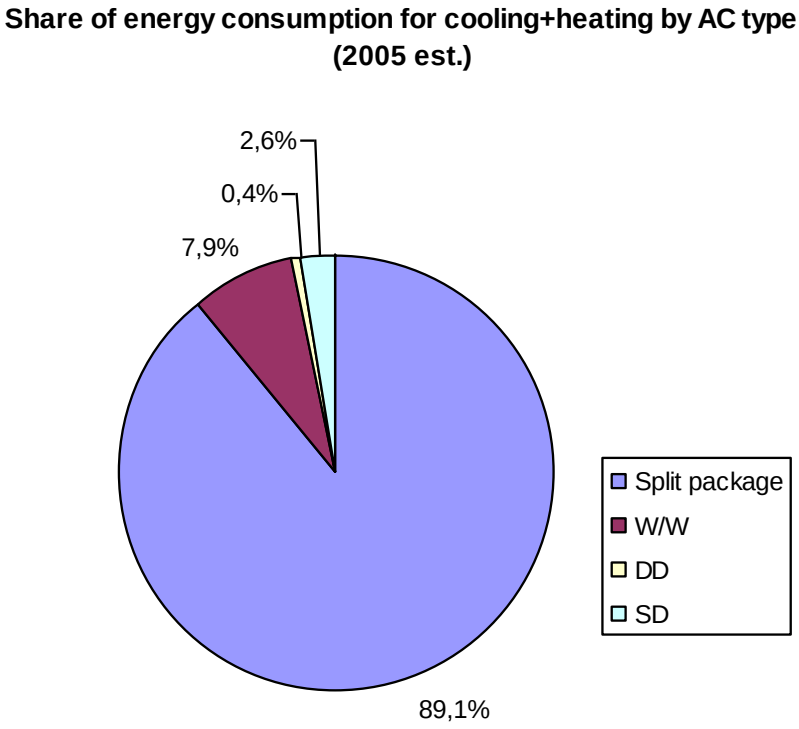




Single duct has a substantial difference compared with other single package units in the sense that the condensor (rejecting the heat from the vapour compression cycle) is cooled by the air taken from the room in which the unit is placed. The hot air is expelled outdoors by a dedicated duct, often placed through an opened window or door. The open window means that warm air from outside is drawn into the room, often through the same opening through which the exhaust duct is led, or else from other parts of the building. Under these conditions, a single duct cannot really cool a room but only the area within the reach of the fan power.

In principle, the above appliances can function either cooling-only, heating-only or reversibly (heat pump function) and can have additional functions for air treatment such as an extra heating function (electric resistance heating), dehumidification, air ionisation / purification, etc. They can be either on-off-type of appliances or be equipped with an inverter to run at variable capacity.

The market share and the share of energy consumption of the above appliances is shown in the below pictures. Annual the total sales of air-conditioning appliances were about 4.9 million units and the total energy consumption approximately 26 TWh in 2005.





3. **Ecodesign requirements**: No changes are proposed on noise requirements. No changes are proposed on the energy efficiency requirements for split, window, wall or single duct units. Information requirements are introduced on the basis of the discussion in the Consultation Forum.

A change is proposed on minimum energy performance requirements for double duct units below 1kW input power and for single duct units, COP values are proposed for single and double duct units and a 'bonus' is introduced to promote appliances using refrigerants with low-GWP (Global Warming Potential).

It is proposed to modify the energy efficiency requirements for double duct units compared with what was presented in the Consultation Forum. The CSWD[1] proposed EER- and COP-based requirements for cooling-only single package appliances[2] below 1 kW input power[3]. For reminder, the '1 kW input power limit' was set in order to:

- ensure that appliances will be available on the market for buildings with building restrictions (buildings on which no impact on the outer building shell are allowed) capable of cooling of a normal-sized room;
- provide an incentive for manufacturers to increase efficiency of the appliance (reduce input power to reach the same output power);

[1] Commission Staff Working Document.
[2] Includes double duct, window and wall units.
[3] Expressed as '2.2kW output power' in the CSWD.

- set a power limit at a level after which an appliance becomes heavy for the purpose (e.g. double duct units of 0.75kW and 1,3kW input power weight about 35kg vs. 50kg respectively). This is particularly important for movable units.

Further evidence shows that:

- The first argument (above) only holds for double duct units, not for window and wall units;
- The technical limitations of double duct appliances make them inherently less efficient than split, window and wall units. This fact was taken into account in the Directive 2002/31/EC but not in the preparatory study. For example, the heat exchanger area of a double duct unit is smaller than in a split (1/5 of an equal split) and the airflow is 1/3 of a split. The above limitations also apply on inverter-units reducing the possibility of increasing the efficiency by using inverters. For these reasons, the second tier requirement levels presented in the CSWD would result in a ban on most or all currently available double duct models in the EU market. The highest EER value recorded for double ducts is 2.7 for a new model to be introduced this year, while for splits an EER of 2.9 is a basecase level.
- Double ducts can seldom replace other heating appliances in the way split appliances can (e.g. national bonus programmes only include split systems and replacement of split appliances often leads to the purchase of another split due to the installation arrangements already made on the building shell. Also, double ducts are more expensive than other types of appliances with similar performance because the small production series do not allow benefits by economy of scale; sales of double ducts are relatively constant at around 50.000 units a year whereas split package sales are estimated to increase from more than 4 million units in 2005 to over 6 million units in 2010;
- some manufacturers have introduced reversible double ducts, which requires the identification of minimum efficiency levels for heating. Models with inverters are, up to now, not available, but a first introduction is foreseen for this year. While there is no immediate need to include requirements with part load performance, this issue need to be addressed at the revision of the foreseen measure.

Consequently, for all double duct units below 1 kW input power:

- Lower minimum energy efficiency requirements are proposed than initially suggested in the preparatory study in order to ensure that these appliances are available for cases where national and local building regulations do not allow using more efficient technologies;
- For reversible (and possibly heating-only) appliances, COP values are introduced;
- Energy efficiency requirements for reversible appliances are set on the basis of EER and COP values (no inverter appliances exist on the market yet).

The proposed changes are summarised in the below table.

Appliance type		Requirements			
		Consultation Forum		Updated draft WD	
		cooling	heating	cooling	heating
split package		**SEER 3.6 / 4.3**	**SCOP 3.2 / 3.5**	**SEER 3.60 / 4.30**	**SCOP 3.20 / 3.50**
single package	window/wall	**SEER 3.6 / 4.3** >1 kW input **EER 2.3 / 3.6** ≤ 1 kW input	**SCOP 3.2 / 3.5**	**SEER 3.60 / 4.30**	**SCOP 3.20 / 3.50**
	double duct	**SEER 3.6 / 4.3** >1 kW input **EER 2.3 / 3.6** ≤ 1 kW input	**SCOP 3.2 / 3.5**	**SEER 3.60 / 4.30** **>**1 kW input **EER 2.10 / 2.45** <1 kW input	**SEER 3.60 / 4.30** **>**1 kW input **COP 2.36 / 2.60** <1 kW input:
	single duct	**EER 2.3 / 3.6**	(no requirement)	**EER 2.3 / 2.6**	**COP 1.80 / 2.04**

In the Consultation Forum, no requirements were proposed on refrigerants. The preparatory study showed that 10-20% of the total greenhouse gas emissions during the product life of air-conditioning appliances can be attributed to direct emissions in form of refrigerant leakage. In practice, the rest of the emissions are due to indirect emissions from the use of energy in the use phase. Therefore a bonus system is proposed to steer the market towards the use of refrigerants with reduced harmful impact on the environment.

It is proposed that the minimum energy efficiency requirements presented in the Consultation Forum are set at appliances using refrigerants with GWP>150.

The most common refrigerants in this group are R410A and R407C with a GWP around 1500-1700, that is, about 10 times higher than for HFOs and 1500 times higher than for CO2. These refrigerants are used in almost all appliances today although HFOs and natural refrigerants start appearing more and more. For example, there are today four companies using natural refrigerants in split air-conditioning appliances while during the preparatory study this was still not the case.

It is proposed that the minimum energy efficiency requirements are reduced by 5% for appliances using refrigerants with GWP≤150.

The refrigerants in this group are HFOs (GWP≤150, close to 4-6) and propane (GWP=3). The preparatory study shows that propane is some 7% more efficient than R410A or R407C, while HFOs are equally efficient. However, for the positive environmental benefits from the use of HFOs to occur, manufacturers must invest on product design and research. To apply propane as refrigerant manufacturers must make additional investments in production line quality and address the 300g/per appliance refrigerant charge limit due to propane's flammability. The 5% 'bonus' could help manufacturers in this initial phase of research and innovation on the use of HFOs and propane.

From the point of view of safety, HFOs can be used in all appliances, while propane can only be applied in smaller models (less than 5% of available single ducts). Thus far, HFOs are only registered for the use in mobile air-conditioning appliances but application in stationary air-conditioning appliances is expected. As such, this proposal is in line with European legislation in banning refrigerants with GWP>150 in cars by 1 January 2011[4].

It is proposed that the minimum energy efficiency requirements are reduced by 15% for appliances using refrigerants with GWP=1.

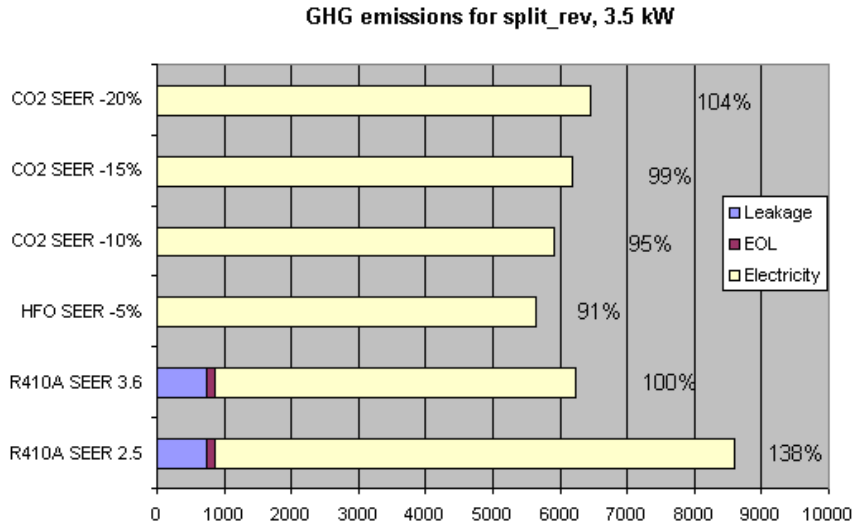
This group of refrigerants include CO2 and can be used in all appliances in the scope of the Regulation. The preparatory study shows that CO2 is less efficient than conventional refrigerants when cooling and more efficient when heating[5] having a particular important potential in colder climates.

The proposed bonus factors will support the placing on the market of appliances with low GWP refrigerants with a view to reduce the total environmental impacts. For illustration, the table[6] below shows some scenarios on the impact of total emissions in the case of split package 3.5 kW appliances, if today's refrigerants were replaced by HFOs/propane or CO2, taking into account the lost savings in indirect emissions due to lower energy efficiency requirements and the compensation effect due to possibly lower direct emissions from refrigerant leakages.

[4] Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC.

[5] In hot climates, CO2 is 17% less efficient in cooling and 7% more efficient in heating than traditional refrigerants with GWP<150. In colder climates, CO2 is equal in efficiency in cooling and 4% more efficient in heating: Reversible Residential Air-Conditioners and Heat Pumps Using Carbon Dioxide (CO2, R744) as Working Fluid, A. HAFNER, P. NEKSÅ, J. STENE, SINTEF Energy Research, 7465 Trondheim, Norway, 2009.

[6] The values indicated in the table relate to greenhouse gas emissions over the product life of a 3.5 kW reversible split package unit (most popular model in the EU). The options relate to different energy efficiency performance factors (from basecase SEER 2.5 to 1st stage SEER 3.6 and subsequent SEERs, if the alternative refrigerants were used) and changes in the GWP values of refrigerants. No corrections were applied for changes in refrigerant charge. The calculation assumed an emission profile of 0.43 kgCO2/kWh electricity.



The table shows that HFOs as an alternative could save 9% on total emissions even if SEER efficiency goes down by 5%. For CO2, total emissions go down with both 10 and 15% lower efficiency, while a bonus of 20% causes higher total emissions (lower direct emissions do not compensate the higher emissions from electricity consumption). Consequently, an option would be to grant 5% and 15% bonuses as presented above.

4. **Energy labelling requirements**: In line with stakeholder requests in the Consultation Forum, one single energy labelling scale (A+++-G) is proposed for all air-conditioning appliances in order to rank the comparative efficiency levels of all appliances irrespective of the technology. All labelling classes would be populated, going down to E, F and G classes for single and double duct units and up to A+++ for the best air-conditioning appliances.

It is proposed that resistance heating be labelled as 'G' in the label for appliances measured in steady state (EER/COP). For reversible units, as the impact of resistance ('backup') heating is included in the SCOP efficiency calculation, it is proposed not to label resistance heating separately.

The bonus factors (5% vs. 15%) used in ecodesign requirements in relation to appliances using certain refrigerants are not implemented in the energy label in order to ensure that the label provides as unbiased information as possible on the comparative energy efficiency performance (and on actual energy consumption running costs) of air-conditioning appliances.

Due to the inherently lower efficiency performance of double and single ducts, they would not be able to reach the A class. Single and double duct units would in practice populate classes E-F-G until the second implementation date. The use of evaporative cooling would allow reaching the D class.

It is proposed that the annual electricity consumption is not indicated on the label, as the actual consumption is much too dependent on the indoor and outdoor weather conditions, usage

patterns, level of thermal insulation of the building in which the appliance is used, structure and position of the house etc.

The proposed energy label would only include air-to-air appliances in line with the preparatory study. This would leave water-to-air appliances currently covered by the existing energy labelling Directive 2002/31/EC without a label. This is proposed as the efficiency measurement method completely changes and water-to-air appliances are often not an alternative to air-to-air appliances but included in a larger 'water loop heat pump' system. Also, water-to-air appliances are currently studied under another Ecodesign study (ENTR Lot 6). If the current requirements on water-to-air appliances from 2002/31/EC would be included into this delegated Regulation, it would have to be amended very soon on the basis of the results of the LOT 6 study. Consequently, it is proposed to leave water-to-air appliances out of this delegated Labelling Regulation and to regulate them in the forthcoming air-conditioning measure on commercial and other air-conditioning appliances under the Lot 6.

5. **As an alternative to one energy labelling scale**, three labelling scales could be introduced; one for room air-conditioning appliances in A+++-G scale (split, wall and window units), as presented above, and another one for double ducts and a third one for single duct units. However, double duct and single duct units would only be able to achieve 'A'.

Single ducts can be considered as serving a different function than room air-conditioning appliances cooling only an 'area' of the room instead of a whole room/dwelling. Single ducts are also movable (can serve cooling needs in several rooms) and may be used less intensively (less often) than room air-conditioning appliances.

Double ducts are inherently less efficient than split or other single package appliances. They also show lower efficiency than single duct appliances, though partly due to a different temperatures[7] used in measurement methods[8].

Three labelling scales would be less transparent for the consumer in leaving the lower efficiency of double and single ducts less obvious. On the other hand, it would have the advantage of promoting the most efficient units as A-labelled appliances within each category of appliances. To avoid misguiding consumers in terms of relative energy efficiency of these appliances, the classes A+, A++ and A+++ for single and double duct units could be kept empty, while these superior classes would be populated in the label for room air-conditioning appliances (split, window and wall units).

As discussed in the Consultation Forum, single duct units, could be called 'local air coolers' in order to more clearly inform consumers on their specificity compared to "room air-conditioning" appliances.

[7] Single ducts are measured at 35ºC at both condensor and evaporator, while other units at 27ºC evaporator and 35ºC condensor.

[8] In 2002/31/EC, a lower EER value (-0.4) was used to allow double duct appliances reaching the labelling classes design for single package appliances.

The table below shows a three-labelling scale approach (bolded values in the table indicate the values for the first and second tier Ecodesign requirements. COP values are proposed on the basis of the efficiency values indicated for single and double duct appliances.

Labelling classes	**Limit values for labelling classes**					
	Room air-conditioning appliances				**Local air coolers**	
	Split, wall and window below 12 kW output power and double duct above 1kW input power up to 12 kW output		Double duct below 1kW input power		Single duct below 12 kW output power	
	SEER	**SCOP**	**EER**	**COP**	**EER**	**COP**
A+++	7,00	5.10	3.95	4.10	4.10	3.45
A++	6,40	4.60	3.60	3.75	3.75	3.15
A+	5,80	4.20	3.30	3.45	3.45	2.85
A	5,30	3.80	3.00	3,15	3,15	2,60
B	4,80	**3.50**	2.70	2,86	2,86	2,30
C	**4,30**	**3.20**	**2.45**	**2,60**	**2,60**	**2,04**
D	4,00	2.90	**2.10**	**2,36**	**2,30**	**1,80**
E	**3,60**	2.60	1.90	2,09	2,09	1,59
F	3.30	2.40	1.71	1,90	1,90	1,41
G	< 3.30	< 2.40	<1.54	< 1,90	< 1,90	< 1,41

In the above scales, the efficiency levels are not equal to those established in 2002/31/EC due to the very low efficiency levels identified for A-level[9]. This will require downgrading currently labelled A-appliances. In order to reduce the possible negative impacts on manufacturers and confusion for consumers, it is proposed to stop requiring the provision by suppliers and the display by dealers, of labels under Directive 2002/31/EC six (6) months prior to the coming into force of the mandatory requirements of this delegated Regulation. During this six months period, the delegated Regulation could be voluntarily applied. The mandatory labelling requirements would come into force simultaneously with the introduction of the first tier Ecodesign requirements on 1 January 2013.

6. **Measurement and calculation method**: No changes.

7. **Information requirements for components and sub-assemblies**: No changes.

8. **Conformity assessment:** No changes.

9. **Market surveillance**: No changes.

10. **Benchmarks**: The below table shows the benchmarks proposed in the Consultation Forum (CF) and the updated and newly added values (UD) based on the draft impact assessment and comments from industry.

[9] The lower limit for A-class split is EER>3.2, window and wall units EER>3.00, double ducts and single duct EER>2.6. For COP of double and single duct units, the benchmark is proven to be below the current A-class levels. The new labelling scales are proposed accordingly.

Benchmarks											
Room air-conditioning appliances								**Local air coolers**			
Split, wall and window below 12 kW output power and double duct above 1kW input power up to 12 kW output				Double duct below 1kW input power				Single duct below 12 kW output power			
SEER		**SCOP**		**EER**		**COP**		**EER**		**COP**	
CF	UD	CF	UD	CF	UD	CF	UD	CF	UD	CF	UD
7,00	7,00	5.10	5.10	3.4	3.00[10]		3,15	3.4	3,15		2,60

11. **Review:** No changes.

[10] Possible with evaporative cooler, but will require an essential change in design.