Brussels, 18 September 2008

Technical briefing on "Room Air-Conditioners" under EuP
Extracts from Lot 10 preparatory study & comments from ECOS expert

1. Background

In the international benchmark, it appears **some countries have much more demanding legislation** and consequently more efficient markets:

- minimum performance thresholds,
- shift to seasonal performance index to foster competition on efficient technologies at part load (USA more than 20 years ago, Japan and Korea in 2004),
- reduce tolerances (USA has 0 % tolerance and only uncertainty of measurement is considered for market surveillance),
- include auxiliary power modes in legislation (standby, off mode, crankcase heater),
- ban products or set high financial penalties to manufacturers that do not respect performance requirements (Australia and USA).

Around 90 % of the models sold in Europe in 2006 did not comply with the Japanese legislation on full load performance, despite main brands on the EU and on the Japanese market are the same.

Eurovent was the only industry association to have proposed voluntary agreements at EU level for products in the scope, but **the second stage of this agreement (i.e. removing classes E and F) has not been respected**.

2. Problem of assessing the energy performance

The standard rating conditions of the EN14511 standard (measurement of energy efficiency at full load under fixed testing conditions) **cannot translate properly the energy efficiency of the products**. Inverter driven units are becoming the common product.

With the fast penetration of inverter driven air conditioners and heat pumps, **seasonal energy efficiency ratios, seasonal coefficient of performance in heating mode and annual performance factor for reversible heat pumps** have been developed in close collaboration with the CEN TC113/WG7, in charge of the revision of the part load CEN TS 14825 technical standard. This work is in progress and coordination with the CEN TC113 WG7 has been ensured. **The draft standard is to be released for enquiry in 2008, and revised with comments received at the end of year 2008**.

The Lot 10 preparatory study has been led using seasonal performance indicators: SEER is the seasonal performance index for air conditioners and reversible heat pumps, SCOP is the Seasonal Coefficient of Performance for heat pumps and APF the annual performance factor for reversible heat pumps. These indices include standby power modes (whose energy consumption cannot be neglected).

It should be noted that energy consumption gain does not lead to similar gains in terms of CO2 emissions. The two reasons are: with lower energy consumption, **the share of direct emissions linked to refrigerant leakage becomes more important** in relative terms; in addition, increasing the energy efficiency above LLCC levels means more heat exchanger surface and consequently more refrigerant fluid.

Regarding the link with the EPB Directive, **the application of the directive is made very difficult for reversible heat pumps and air conditioners,** since their performances at other than standard rating conditions are not published. Member States, in order to evaluate the energy consumption of these products for a given project, adopt default factors to correct the performances of the units with outside and inside temperature and with load ratio; **these corrections are different for each Member States**.

3. Standby consumption

Available data indicate that **there has been little effort made to decrease the electric power consumption of auxiliary power modes** that were presently not considered in testing standards. Australia now requires manufacturers to declare auxiliary power mode values (standby and off-modes).

The approach chosen in the preparatory study was to include those power modes in the evaluation of the global performances of the units, **but not to ask for specific requirements on standby**.

4. On-mode consumption

BAT levels are as follows:
- air conditioners: SEER between 5.9 and 6.4,
- reversible heat pumps: SEER between 6.5 and 7.7, SCOP of 4.9 and APF between 5.3 and 5.5.

For air conditioners:
- LLCC levels enable to cut energy consumption by 40 to 60 % as compared to the base case,
- BAT levels enable to cut energy consumption by 60 to 70 % as compared to the base case.

For reversible heat pumps:
- LLCC levels enable to cut energy consumption by 40 to 45 % as compared to the base case,
- BAT levels enable to cut energy consumption by 55 % as compared to the base case.

5. Issue of refrigerants

There is presently **no specific incitation to foster the development of low GWP refrigerants**. Due to the difficulty to make measurements, very few data are available on leak rates and more generally very few data about refrigerant emissions at installation and end of life of the product. Hopefully, the entry into force of the WEEE directive will enable to recover data at the products' end-of-life.

The share of direct CO2 equivalent emissions linked to the refrigerant fluid has been estimated to lie between 20 and 50 % for split air conditioners and between 10 and 20 % for reversible split, depending on the energy efficiency of the unit. Once best available technology has been used to improve energy efficiency and without specific measure on refrigerant charge or leaks, the share of direct emissions in the total CO2 equivalent emissions of the heat pumps is likely to rise to more than 40 %.

Regarding split products, it appears CO2 could be used as an alternative refrigerant. But in the absence of products on the market, there are large differences in the estimate of the energy efficiency the products could reach. Other alternative refrigerant blends, based on propane or propylene, are being investigated but with no concrete outcome at the moment for market application.

For R410A products, **there are technologies that could be implemented to cut refrigerant charge by 20 to 50 %** according to manufacturers. Manufacturers also report technologies to reduce leak levels down to 1 % for split products but there is no test standard to check these values.

For air conditioners:
- At LLCC levels for split air conditioners, a 40 % energy consumption gain translates into a 25 % CO2 emissions cut without refrigerant charge reduction and with a 45 % charge reduction, a 40 % gain can be reached,
- At LLCC levels for single duct air conditioners, the unit is supposed to use propane so that a 57 % energy gain gives a 61 % CO2 emissions cut.
- At BAT levels for split air conditioners, 60 to 65 % energy consumption gain translates into a 17 to 22 % CO2 emissions cut without refrigerant charge reduction and with charge reduction, a 40 % to 45 % gain can be reached,
- At BAT levels for single duct air conditioners, the unit is supposed to use propane so that a 69 % energy gain gives a 72 % CO2 emissions cut.

For reversible heat pumps:
- At LLCC levels for split air conditioners, a 42 to 45 % energy consumption gain translates into a 36 to 37 % CO2 emissions cut without refrigerant charge reduction and with charge reduction, a 42 to 43 % gain can be reached,
- At BAT levels for split air conditioners, a 56 % energy consumption gain translates into a 40 % CO2 emissions cut without refrigerant charge reduction and with charge reduction, about 50 % gain can be reached.

It is suggested in the preparatory study to **add a standardized global CO2 equivalent emission value over the whole life cycle of the product, on a kWh basis (gCO2/kWh), tailored on the label for cars in gCO2/km**. This is supposed, in a first stage, to foster the competition on reducing the refrigerant charge of the products even if default leak rates are to be used and to highlight products using refrigerant fluids with low GWP.

6. Information requirements

According to the preparatory study, the only way to enable a true comparison between air conditioners or reversible heat pumps and also with other heating and cooling products / systems, is to **require manufacturers to publish a standardized map of the performances of their products** (at given outside temperature, inside temperature and load ratio). This performance map is to be standardized and energy efficiency declared by manufacturers in those conditions should be superior to the declared value minus the uncertainty of measurement as specified in the technical annex in section 8.4.1. This work should be mandated to CEN with a specific mention that coordination between TC228 and TC113 is required within the frame of the application of the EPB directive.

It is suggested that **every product in the scope of the study shall bear on its plate and in all document describing the performances of the unit the following values**:
- **SEER** value for both cooling only and reversible air conditioners,
- **SCOP** value for both reversible heat pumps and heating only heat pumps,
- **APF** value for reversible units.

Dehumidification being an important function of the products in the scope for the end-user, manufacturers should **indicate the dehumidification capability and efficiency** of air conditioners and reversible heat pumps.

7. Improving the Energy labelling & market surveillance

The energy classes of the energy labelling for room air-conditioners would be as follows:

	APF	**SCOP**	**SEER**
A	>5,1	>4,7	>6,5
B	4,6	4,1	5,5
C	4,0	3,7	4,7
D	3,5	3,3	4,0
E	3,1	3,0	3,5
F	2,7	2,6	3,0
G	<2,7	<2,6	<3,0

In the existing energy labelling scheme, tolerance level of 15 % makes that the EU labelling classes (that are between 6 and 14 % depending on the product categories and classes) are shorter than the tolerances, **enabling manufacturers to declare EER and COP values up to 2 classes above the real EER values**. An enquiry led in the UK by the Market Transformation Program shows that consumers are very concerned by such a situation.

In the few countries (Italy, Spain, UK) where market control was led, tests have shown that **low price products with false declarations was a common situation,** with some units declared in class A or B and rated in class E or F. In these countries where units were tested, **no measure was taken towards the manufacturers or importers responsible of the infringement**.

It is both necessary to increase the size of the intervals between classes and to **reduce the tolerance levels to solve the issue**. In Japan, 10 % tolerance is granted while in the USA, energy efficiency target include a 0 % tolerance and only measurement uncertainties are considered in the declared data.

With good quality laboratories (accredited according to standard ISO 17025) and taking into account the revised standard for part-load measurement (CEN/TS/14825), the total uncertainty of measurement of SEER and SCOP should in fact lie **between 5.1 % and 10.1 %**.

It is advised in the preparatory study to require that APF, SCOP and SEER be published without tolerances and only with uncertainties of measurement resulting from the ones of the individual tests.

8. Setting minimum requirements on energy efficiency

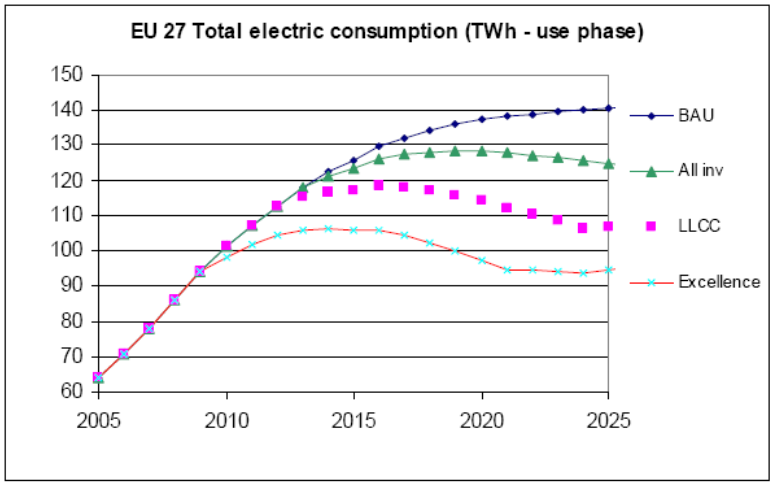
Several scenarios have been considered in the Lot 10 preparatory study:

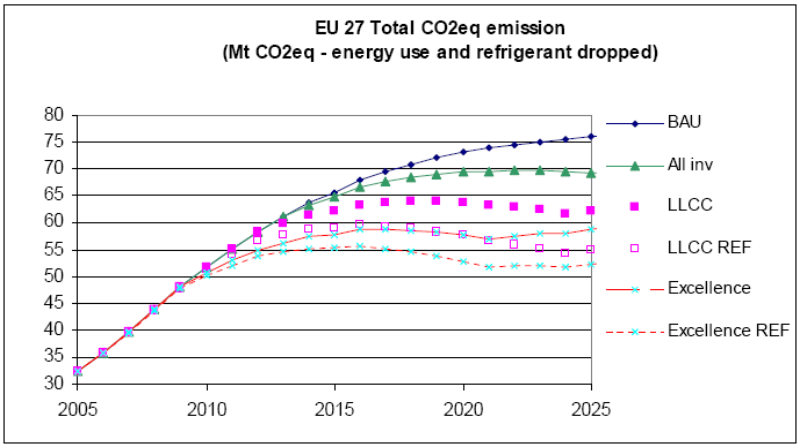
- the **BAU scenario** includes some energy efficient improvement traducing long time trends, energy efficiency increase in standard rating conditions and continuous penetration of inverter driven air conditioners with 100 % penetration ratio in 2012. Refrigerant charge of the units increases. Propane unit's market share grows linearly up to 25 % in 2025.
- In the "**all inverter**" scenario, the MEPS levels are set to ensure the complete transition of the sales towards inverter driven units; this scenario is seen as an accompanying measure of an already observed trend. Energy efficiency classes E-G for reversible heat pumps and F-G for air conditioners are banned 2014.

➢ In the "**LLCC**" scenario, the MEPS levels are set to LLCC levels. Classes D-G reversible heat pumps and classes E-G air conditioners are banned from the market in 2013.

➢ The "**Excellence**" scenario is made of two steps: D-G reversible heat pumps and E-G air conditioners are banned from the market in 2010; additionally, C reversible heat pumps and D air conditioners are banned from the market in 2013.

The LCC curves are very flat around the LLCC optimum: it means that the LLCC energy efficiency levels are likely to move upward rapidly if adequate public procurement and other incentive schemes are put in place at Member State level. That is the reason to build a scenario with higher targets than the LLCC level.





It is to be noted that energy consumption and CO2 emissions are mainly the consequence of energy consumed for heating (104 TWh over 137 TWh).

9. Impact assessment

➢ Given the respective sales of reversible heat pumps and air conditioners, 4 to 1 in 2005 and 5 to 1 in 2020, **even the "Excellence" scenario is beneficial to the end-user** in average of both product categories.

➢ the impact on the industry of setting minimum requirements at LLCC level or just above for air conditioners and heat pumps **is estimated to be very low**.

➢ **Comfort of the end-users should not be negatively affected** by the energy efficiency increase and consequent lower dehumidification capability. For the end-user, the purchase price increase due to the measures is planned to be of +30 % for air conditioners and +60 % for heat pumps in the "LLCC" scenario. The 60 % increase in purchase price for reversible heat pumps would only translate in **a 25 % total cost increase** (installation + purchase price).

➢ There should **not be affordability issue** with the measures proposed. So the implementing measures may not be as costly as computed and will most probably become very profitable already from its application date.

➢ **All scenarios are largely beneficial to utilities**. Yearly gains amount to 20 billion euros in 2020 and still increase in 2025.

10. General comments from ECOS technical expert on the Lot 10 study

According to the study, only half of the European market for cooled space is served by the products within the scope and the reminder half is served by centralised systems, larger than 12 kW split, VRF, rooftops and chiller based systems.

The impact of the installed products is increasing rapidly; electricity consumption is estimated to grow approximately from 32 TWh to more than 200 TWh. The cooling part is about 30% of these figures.

Regarding the brands, if we exclude the moveable units, the dominant brands for other products within the scope are Asian with 60% for the Japanese one and 13% for Korean ones. As it can be expected climate, population and economic structure have an important impact on number of products sold: Italy is the largest market (33%), followed by Spain (21%) and Greece (13%).

Three base cases have been considered in the study: Moveable units, reversible split units and cooling only split units. The European market is dominated by the reversible split units. Air-conditioners using solar panels are considered as non-available technologies in the study. The product life considered in the study is 12 years. There is no real correlation between the price of the products and their energy efficiency.

Reversible units are sold as units able to heat air at -7℃ but in reality most of them are facing def rosting problems and the end users need to have a supplementary heating system.

Only one weather data file (generally the one of the capital city) has been considered in the study to see the influence of the climate on the use of the RAC. The study showed that by temperature and humidity effect, EER is increased by about 15% while average part load decreases performance by 20% for single duct units.

The present energy label classes need to be revised and include the annual energy consumption, the APF, the CO2 emissions indicator, the cooling output and SEER, the heating output and SCOP and the noise level.

Going to seasonal efficiency will help to increase energy efficiency in cooling mode but not in heating mode.

11. Main strong and weak points of the Lot 10 study according to ECOS expert

- According to the study, the energy consumption of air conditioners should decrease after 2020 because of the introduction of new buildings with lower heating demand. In reality, the heating demand will decrease while the cooling demand will increase due the insulation of buildings to reach low heating targets. In addition, if we consider the climate change and its effect on hot period particularly in south of Europe, **we can rather expect an increase of total demand of energy consumption of air conditioners**.
- Proposals regarding the revision of the energy label, introduction of SEER, SCOP, APF, CO2 emissions indicator, sound noise level on the label, coverage of standby consumption and the performance map **should be supported by ECOS**.
- **The scenario which ECOS should support is the "excellence" scenario**.
- **Efficiency requirements could be set earlier.** The argument that going too fast would create monopoly for one efficient manufacturer is not solid enough. According to the consultant, a lot of energy savings can be made if competition is introduced between manufacturers. One way will be the declaration of the indexes at part load.
- The introduction of energy efficiency indexes for room air conditioners is not enough. **There is a need to introduce a more regular checking of the data declared by manufacturers**, with strong penalties in case the tests performed in independent accredited laboratories show non-compliance.
- It is welcomed that the consultant suggests limiting the tolerance for seasonal indexes to the measurement uncertainty, but it is a pity that the same has not been proposed for COP and EER. For the CO2 indicator, it is proposed not to consider any tolerance for declaration of refrigerant mass contained. **The study proposal for the revision of EN14511 should be supported, except for the tolerances proposed for EER and COP; ECOS should ask to consider only uncertainty of measurement** (as proposed for SEER, SCOP and APF).
- **Considering only one weather sheet per country (i.e. same for Lille and Nice) is a problem**, especially for LLCC calculations and impact assessment. The choice of one weather data (the one of the capital city) of each European country underestimates the cooling loads of the buildings.