Annex III

to Task 7 ENTR Lot 6 Ventilation Final Report

Stakeholder Input

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Summary stakeholder final comments and reaction study team (before meeting)

Before the final stakeholder meeting 16 April 2012, several stakeholder groups presented their initial position on policy options to the study team. The following is a summary of the most important stakeholder inputs, notably the ones that played a role in proposing scenario 1, and the first reaction of the study team. The industry positions and reactions are compiled per product category: Categorisation in general, CEXHs, CHRVs and AHUs.

Categorisation

In general, the industry experts[1] are in favour of different sets of requirements for domestic[2] and non-domestic ducted ventilation units, whereby the manufacturer can choose –on the basis of the self-declared intended use—to which set of requirements the unit should comply. Rooftop and boxed ventilation exhaust units should be treated as yet another category, according to industry.

Although the industry does not excluded the long-term possibilities of harmonising metrics and test standards it clearly states that, if a speedy implementation of measures is desired it is not possible to unite all domestic and non-domestic ventilation units on the short term. Both the domestic ventilation unit manufacturers, represented by EVIA, and the non-domestic ventilation unit manufacturers, represented by Eurovent, state that for both there industries there are now up-to-date but different sets of EN standards, which have been validated, proven and suitable for application in category-specific legislation. Developing joint standards could be a long term option, but not seen as realistic within the time scope of measures under development today.

The option for a manufacturer to choose between domestic and non-domestic measures and metrics is mainly induced by manufacturers of units in a 'grey area' where 'domestic' and 'non-domestic', albeit perhaps not in the same configuration, could be competing. As an alibi for the admissibility of self-declared 'intended use' the Machine Directive was mentioned. These manufacturers, in part represented by EPEE, feel that their units should be judged by the holistic approach proposed for ENER Lot 10.

Reaction study team:

The industry position is a reaction to the Commission proposal at the stakeholder meeting 30 Sept. 2011, stating the desirability of treating domestic and non-domestic ventilation in one regulation and preferably with one set of metrics and requirements. The industry is strongly opposed to use the same set of requirements and their concern that the development of joint standards would take can be confirmed from experience with other products. On the other hand, there is still the option to treat different sets of metrics and requirements in one piece of legislation (or two, where labelling is required). Especially if the policy makers would allow, probably within restrictions (see hereafter), a choice between domestic or non-domestic requirements such an approach would make sense.

[1] Joint expert group of Eurovent, EVIA and EPEE.

[2] Refers to the measures and metrics as proposed in the Commission working document on Domestic Ventilation Units and Kitchen Hoods (ENER Lot 10), send out for written consultation by the European Commission d.d. 21 Dec. 2010.

The industry position as regards the self-declared intended use could solve some problems in the so-called 'grey area', but in the interest of the credibility of the Ecodesign measures and a 'level playing field' this possible solution should be limited. The Commission proposal for domestic ventilation units is based on the SPI (Specific Power Input) at a default external pressure drop of 100 Pa. This pressure drop could still be credible under certain circumstances for units with design flow rates up to e.g. 1 000 -1 500 m3/h, but for larger units the design pressure drops –and thereby the largest part of the power consumption-- could be more than 10 times higher.

The notion of 'rooftop' and 'boxed' ventilation units as a separate category is a legacy from the discussion on the Commissions' Fan Regulation 327/11 where eventually they were excluded from the scope, although certain parties preferred them to be in the scope. In principle, this is plausible because from the very beginning of the project exhaust units ('CEXH') where identified as a specific Base Case category based on their characteristics. However, how exactly this category will be handled depends on specific proposals.

Rooftop and boxed 'fans' ('CEXH')

As regards rooftop and boxed ventilator units with fan power >125 the industry association EVIA has issued a position paper in February 2012. EVIA proposes, different from Ecodesign Regulation 327/11, the following definition *'box fans' and 'roof fans' are to include products in which any fan or motorised impeller is built in without any thermodynamic air treatment or additional physical (for example filtration) air treatment and is not a component of a ventilation unit.*

EVIA proposes minimum efficiency requirements, using the same methods as proposed in Ecodesign Regulation 327/11, for rooftop and boxed ventilator units as set out in Tables 1 and 2.

Table 1.. **First tier minimum energy efficiency requirements for fans**

Fan types	**Measurement category** (A-D)	**Efficiency category** (static or total)	**Target energy efficiency (see also Annex II.4 for applicable power ranges)**	**Efficiency grade**
Box fan with backward curved or mixed flow fan	B, D	total	$\eta_{target} = 4.56 \cdot \ln(P) - 10.5 + N$	35
			$\eta_{target} = 1.1 \cdot \ln(P) - 2.6 + N$	
Box fan with forward curved or axial fan	B,D	total	$\eta_{target} = 2.74 \cdot \ln(P) - 6.33 + N$	25
			$\eta_{target} = 0.78 \cdot \ln(P) - 1.88 + N$	
Roof fan (axial fan within)	A, C	static	$\eta_{target} = 2.74 \cdot \ln(P) - 6.33 + N$	27
			$\eta_{target} = 0.78 \cdot \ln(P) - 1.88 + N$	
Roof fan (centrifugal or mixed flow fan within)	A, C	static	$\eta_{target} = 4.56 \cdot \ln(P) - 10.5 + N$	38
			$\eta_{target} = 1.1 \cdot \ln(P) - 2.6 + N$	

Table 2. Second tier minimum energy efficiency requirements for fans

Fan types	Measurement category (A-D)	Efficiency category (static or total)	Target energy efficiency (see also Annex II.4 for applicable power ranges)	Efficiency grade
Box fan with backward curved or mixed flow fan	B, D	total	$\eta_{target} = 4.56 \cdot \ln(P) - 10.5 + N$	39
			$\eta_{target} = 1.1 \cdot \ln(P) - 2.6 + N$	
Box fan with forward curved or axial fan	B,D	total	$\eta_{target} = 2.74 \cdot \ln(P) - 6.33 + N$	28
			$\eta_{target} = 0.78 \cdot \ln(P) - 1.88 + N$	
Roof fan (axial fan within)	A, C	static	$\eta_{target} = 2.74 \cdot \ln(P) - 6.33 + N$	31
			$\eta_{target} = 0.78 \cdot \ln(P) - 1.88 + N$	
Roof fan (centrifugal or mixed flow fan within)	A, C	static	$\eta_{target} = 4.56 \cdot \ln(P) - 10.5 + N$	42
			$\eta_{target} = 1.1 \cdot \ln(P) - 2.6 + N$	

Reaction study team:

The industry proposes minimum values that are almost half of those proposed in the Fan Regulation (see table).

Table 3. Comparison EVIA industry position rooftop/boxed ventilation units versus Fan Regulation 327/2011: Minimum efficiency values in %

Power P in kW-->	0.5		1		1.5		2		12	
	EVIA	Fan Reg.	EVIA	Fan Reg.	EVIA	Fan Reg.	EVIA	Fan Reg.	EVIA	Fan Reg.
Box fan with backward curved or mixed flow fan	21	50	25	54	26	55	28	57	35	64
Box fan with forward curved or axial fan	13	37	15	39	16	40	16	40	25	49
Roof fan (axial fan within)	15	28	17	30	18	31	18	31	27	40
Roof fan (centrifugal or mixed flow fan within)	24	48	28	52	29	53	31	55	38	62

The proposal would result in negative savings, i.e. an increase in electricity consumption of around 30- 35% versus the CEXH BaseCase (fan efficiency 23%) assuming that in a competitive market clients and thus manufacturers will move towards the solution with the lowest acquisition costs .

As a side-effect the industry proposal would a serious loophole in Commission Fan Regulation 327/11 in as much as it would allow fans that are forbidden under the Fan Regulation to be placed on the EU market because they are incorporated in 'rooftop' or 'boxed' ventilation units. This would have a very detrimental effect on resources efficiency and environmental impacts up to a degree that far extends the direct CEXH increase of energy use.

The proposal is detrimental to the competitiveness of the EU fan industry vis-à-vis low-cost imports.

The proposal would have a negative impact on the end-users of these fans, having to face a 30-35% higher energy bill.

The proposal is not in line with coherent and consistent EU policy and would not create a level playing field between market actors, i.e. fan industry on one hand and suppliers of rooftop and boxed ventilation units on the other hand.

Central Heat Recovery Ventilation units ('CHRV')

Floor-standing and wall-hung CHRVs, i.e. the integrated (non-modular) central heat recovery ventilation units, are generally speaking amongst the most energy-efficient ventilation solutions in the field (see also Task 6) and the saving potential comes from some evolutionary steps in all aspects but as a whole it is limited.

An exception are ceiling mounted CHRV where the height restrictions and the noise restrictions have prompted the manufacturers of low-cost units to use still forward curved fans. Also 3-speed AC motors are still quite common, reportedly because they take up less space than the variable drive EC or DC motors and according to the manufacturers this extra space goes at the expense of the heat recovery efficiency.

As a solution, especially these manufacturers are seeking to have a self-declared 'intended use' that would allow them to rate the efficiency in accordance with the metrics for domestic ventilation.

Reaction study team:

As has been argued before, the option of self-declared 'intended use' could be a solution when limited to maximum of 100 Pa external pressure drop at design flow rate. On the other hand, the seriousness of the situation should not be overstated. The standard height of these units is 40 cm but there are units on the market with heights up to 70 cm. Also there are possibilities of increasing width and length und thus lowering face velocity and internal pressure drop. As regards the noise, most units are made with a simple folded metal housing, which offer untapped potential for optimisation on noise.

Allowing manufacturers the choice between two calculation methods also carries a risk that eventually all CHRV-manufacturers, also the ones that have no problem in achieving targets, are forced to choose the most advantageous calculation methods for reasons of a fair competition (c.p.). In the final design of the measures great care should be given to the details in order to avoid an undesirable situation in this respect.

AHUs

For all ducted balanced ventilation units, the joint industry experts think that heat recovery should be made mandatory. This is an important statement, because it implies that in all circumstances, even those where cross-contamination between air streams possibly may play a role, they say that there is a technical solution, e.g. through run-around coils, that would allow heat recovery.

Furthermore, the AHU manufacturers indicate a preference to use the parameters and methods in the EN 13053 as a basis for minimum requirements. This is a standard that at least large part of the sector is currently using while at the same time they state that the Specific Fan Power (SFP) according to EN 13799 should be included in the product information requirements.

Heat recovery ('H' classes in EN 13053), fan system efficiency ('P' classes in EN 13053) and face velocity ('V' classes in EN 13053) are possible regulatory parameters that are discussed, but where industry experts have not made a statement on the ambition level. Maximum pressure drop values for individual components like heat recovery modules could also be an option. Setting requirements on controls –apart from a possible requirement on variable speed drives-- is excluded by manufacturer experts, because it is not part of the air handling unit packages that are placed on the market.

The filter industry would like to a) make the use of EU7 (F7) filters mandatory and b) set minimum requirements, e.g. according to an imminent Eurovent labelling system that was explained in Task 6.

Reaction study team:

The industry experts' suggestion to make heat recovery mandatory for ducted balanced units is an important statement, because it implies that in all circumstances, even those where cross-contamination between air streams possibly may play a role, they say that there is a technical solution, e.g. through run-around coils, that would allow heat recovery.

It is unclear to what extend also unducted balanced ventilation units, e.g. in injection ventilation units for industrial halls and warehouses, should use heat recovery. Unducted balanced ventilation units with heat recovery exist, but the question is if they would be universally applicable. In any case, these units have a small market share and any decision will not have a large impact on savings potential.

As regards the ambition level of parameters there was no formal statement but the AHU-industry experts appeared to be in favour of measures that are at least as ambitious as the ones currently in place in Member States. In Germany, for instance, this implies a minimum heat recovery efficiency at the level of H2 for units larger than 4400 m3/h design flow.

The position of industry experts as regards controls for AHUs seems reasonable, as long as products are optimally designed to add the most sophisticated controls on the market. At least as far as variable speed drives the measures should be stringent and probably mandatory.

As regards the filters, EN 13053 recommends the use of F7 filters, both in the interest of health and the protection of the heat exchanger, but making them a mandatory part of each air handling unit is not in line with current practice. For several applications the addition of F7 filters is not necessary or instead of F7 also a G5 filter would do. It would necessitate the legislator to make a long list of exceptions to such a rule. On the other hand, measures could include that –if a filter module is required—the AHU-manufacturer could be required to offer an F7 filter with low pressure drop (e.g. 'A' according to Eurovent filter classification).

Summary stakeholder final comments and reaction study team (after stakeholder meeting)

Overview

After the final stakeholder meeting 16 April 2012 the stakeholders had one month for written comments regarding the draft Task 6 and 7 reports on the Ventilation part of Lot 6 which were presented at the meeting.

Written comments were received –in order of entry-- from

- Nordic manufacturer's associations ("Nordic Proposal");
- Danish manufacturer Exhausto;
- Danish Technological Institute DTI;
- Swedish manufacturer SWEGON;
- The Japanese manufacturer's association JRAIA (mainly ceiling-mounted CHRV manufacturers);
- The chair of the Technology and Research Committee TRC of the association of HVAC professionals REHVA;
- German Umweltbundesamt UBA;
- German manufacturer AL-KO.

These comments will be summarized hereafter. A full version can be found in Annex I.

European manufacturer's associations EVIA, Eurovent and EPEE did not react, i.e. their position was already, as much as possible, incorporated in the Task 6 and 7 reports. There were no written comments from Member States or NGOs.

Summary of comments

The main focus of the first three comments was on promoting the Specific Fan Power (SFP) in EN 13799 as the right metric for electric efficiency of air handling units, instead of the metrics from EN 13053. The **Scandinavian industry**, supported by DTI, points out that SFP is a successful in Scandinavia and is now also adopted in regulations in more and more Central and Western European countries (UK, Belgium, Germany). Instead of addressing individual parameters for internal pressure and other losses like in the proposal, i.e. face velocity V , fan drive efficiency P and energy (not thermal) efficiency of heat exchangers H, the SFP gives designers more degrees of freedom in reaching the result.

A new element is that the Nordic industry now gives several proposals to tie in SFP with the external pressure loss, e.g. through a mathematical relationship. Although reportedly the exact ambition level is yet to be determined at a later stage, this means that an SFP requirement can now be translated into the Scenario 2 or 3 requirements in the Task 7 report. In Annex II VHK has made a first attempt how this could look like. The outcome is a single SFP formula (plus 75% thermal efficiency of heat recovery), which for common units comes down to SFP3 class at static pressure difference <200 Pa and SFP4 class for the rest. As mentioned, it will be up to the Commission, with again a new round of stakeholder consultations, how to choose the final metric(s) for the Working Documents.

The **Exhausto** and **DTI** comment support the Nordic proposal, but also suggest limitations in using the EN 13053 metrics. For starters, Exhausto points out that especially for the lower air-flows (e.g. below

1 m3/s) the fan-drive requirements in EN 13053 (the P-class) are considerably more lenient than the ones in the EC 327/2011 regulation. Furthermore the definition of face velocity –and its relationship with the other parameters—should be refined. As regards the Scenario 1 in the Task 7 report, where the electric efficiency requirements for CEXH are set at a much lower level than in EC 327/2011, DTI and Exhausto state that this is not the right way forward, i.e. would induce unfair competition and creates loopholes in legislation. But Exhaust would like to see an ambition level at backward curved fan level that is slightly (5%; N=57 instead of N=62) more lenient than EC 327/2011

Exhausto illustrates the problems above graphically with company data and graphs that compare EN 13053 (P-class), EN 13799 (SFP) and EC 327/2011 requirements to show the imbalance at lower airflows.

Exhausto also presents a proposal that would depict the electric efficiency requirement not as a single value at one working point, but as relating to a working range of the unit in terms of air flow and pressure. Exhausto does not elaborate on how such a proposal could be implemented in Ecodesign measures, which have to set a single parameter against legal limits.

Swedish manufacturer **SWEGON** points out the different concepts of fan efficiency in EN 13053 and EC 327/2011, whereby the former does take into account the effects of the fan, although there are no filters or heat recovery units, suffers some losses from being built-in. Furthermore, SWEGON gives additional technical remarks on Task 6, which could be incorporated in text or footnotes of the report. Similarly on Task 7 SWEGON points out that there are AHUs (like SWEGON's) where the AHU is delivered with controls as a self-standing package. They are reportedly common in Scandinavia and used all over Europe. "Bypass for free-cooling" may not actually a physical by-pass, but could be realized by stopping the rotor of the heat exchanger or the pump in a run-around heat exchanger. As seemingly opposed to Exhausto –but they may be talking about a different working range—SWEGON believes that the P1 requirement in EN 13053 is more severe than EC 327/2011. Another issue is the correct treatment of variable speed drive, a device that uses extra energy but also saves energy (more energy) in part-load.

As regards Face velocity and heat recovery energy efficiency SWEGON proposes to use lower ambition levels: V2 instead of V1 when there are space limitations; H2 instead of H1 where 0% cross-contamination is required (e.g. H1 difficult with run-around coils for hospitals, laboratories, etc.) .

JRAIA welcomes the option of choosing an alternative (domestic) test and calculation for units below 100 Pa external pressure, but would like to know more details of such a method.[3] Amongst others JRAIA proposes a thermal efficiency of at least 75% and firm measures to reduce recirculation and leakage. JRAIA is concerned over the cost increase and thus competitiveness of CHRV against CEXH with measures aiming at fan efficiency and proposes to exclude CHRV completely from Tier 2 targets. JRAIA feels that EC 327/2011 is stringent enough. JRAIA would like to stress that backward curved fan impellers take more space than forward curved fans (this is not due to the motor, where JRAIA states that DC motors can be smaller than AC). Ceiling mounted CHRVs with 70 cm height are the exception; especially for renovation or retrofit 40 cm height is seen as a maximum. As regards the filters, JRAIA indicates that filters are not always necessary and agrees with what is said in paragraph 1.4.2 of the Task 7. VHK has asked for further clarification of the efficiency numbers mentioned by JRAIA for one specific product.

The **TRC** chair of **REHVA** mainly reacts to the 'Regulatory options' paragraph 3.2 of the Task 6 report (page 33) and points out that for "un-occupied" space the section B4 of EN 15251 applies, i.e. which mentions that in un-occupied periods for commercial buildings –as one of the solutions-- a rate of 0.1 to 0.2 l/s/m2 applies, i.e. considerably lower than the 0.4 l/s/m2 'for the building' rate from the Table B2 in the same EN 15251 standard. VHK has asked for further clarification regarding this discrepancy.

[3] Note, as is mentioned in the meeting, that this alternative method is the one proposed for domestic ventilation units, with proposal as communicated by the Commission in December 2010.

The TRC chair has further asked for some reformulation of requirements, i.e. not making components mandatory but minimum performances, and stresses that –although he supports efficient and effective filters—he does not want to see them made mandatory.

The **ECOS** comments relate largely to generic procedural matters. See Annex II for full text and see the VHK reaction below.

The German **UBA** has a large number of questions. They are summarized with the VHK reaction in the next paragraph. Full text of the questions can be found in Annex II.

According to **AL-KO** the study is too optimistic regarding the merit of heat recovery for space cooling and –as a result—too optimistic regarding the savings of ventilation heat recovery in a Warmer Climate.

Having said that, AL-KO believes that the general conclusion from the preparatory study, i.e. that heat recovery at levels of around 70% thermal efficiency can be economical (payback period < product life) in all EU climates, is still valid.

Higher thermal efficiency levels than 70% for air flows of approximately 5000 m^3/h or higher would require a step-change in technology, i.e. only leave rotary heat exchangers, and therefore in pricing.

Illustrates the first point regarding heat recovery in the various climate zones with calculations showing amongst others that in Warmer Climates the calculated cooling+heating energy is 30% less than in the average Climate and the share of cooling+heating energy that can be recovered is up to 60% less in the Warmer Climate versus the Average Climate.

For the case where benefits of the thermal efficiency gains are weighed against the electricity AL-KO has made calculations whereby the optimum for the Warmer Climate, compared to the average climate zones, would be more towards lower thermal efficiency (e.g. 47% versus 67%) at lower electricity use (125 Pa pressure drop versus 230 Pa).

VHK reaction

One of the most discussed items is the choice between SFP and EN 13053 metrics in tackling the electric efficiency of AHUs. Here, the **Nordic Proposal** for the first time opens the option that the SFP limit could be coupled to the external pressure drop through a mathematical expression. This means that it should be possible to make a conversion between SFP and EN 13053 demands (P1, V1, H1) at the same ambition level. The Nordic proposal does not propose this, but VHK has prepared a simple example of how this could look like.

Another issue is the exact definition of the fan-drive efficiency limits, especially in the lower air flow range (below 0,5 – 1 m3/s). **Exhausto** and **SWEGON** appear to have opposite views, i.e. Exhausto feels that the P1 requirement is too lenient with respect of EC 327/2011 or a widely accepted minimum building regulation requirement of SFP4-class, whereas SWEGON points out that the definition of P1 is different from EC 327/2011 fan definitions and thinks the P1-requirement is more severe. However this may be, for certain it means that the current EN 13053 is not clear enough and should be expanded regarding exact testing conditions, working point and possibly an adjustment of requirements for the lower airflows.

SWEGON is making a valid point regarding the possibility of lowering heat recovery requirements in case of 0% cross-examination. Also in Task 5 it was found that –although run-around arrangements can achieve high heat recovery with thermal efficiencies of around 70%—a limit at H1 may be a little too ambitious. As regards lowering the face velocity limits because of the space limitations this needs to be further investigated by the Commission and stakeholders in a legal context: Can 'space limitations' be defined in a legally robust manner? Is it a problem to realize face velocity V1 (≤ 1.6 m/s) in the smaller capacity units that are typically used in situations with space limitations? Or can situations be found where also large capacity units (e.g. > 10 m3/s) would have a problem with space limitations? In other words, VHK suspects that there is a link between the ease of realizing a low face velocity and the capacity.

The suggestion of SWEGON to include climate zones in Ecodesign requirements is legally close to impossible under the provisions of the Ecodesign directive, simply because 'climate zone' is not a product feature and there is no possibility to check compliance of the product 'placed on the market'. A theoretical option would be to forbid installers to 'put into service' certain types of units that are not allowed for a certain climate zone. This assumes that the installers will be sufficiently informed as to what these climate zones are and that the inspectors of competent bodies will have to check on installers of all non-domestic ventilation units when the units are 'put into service'. Note that, compared to e.g. building regulations where the main driver for compliance is the acquisition of a building permit, this adds considerable burden on building inspectors or special on-site inspection teams of the competent bodies. But most importantly, as has been argued in the Task 6 report, the current proposal in scenarios 2 and 3 is based on what is economically advantageous in terms of LLCC also for the warmer climate zones and therefore there is no reason for this differentiation.

As regards the comments of **JRAIA**, allowing the choice between the test and calculation methods ('domestic' and 'non-domestic') for units <100 Pa external pressure in scenario 3 was done to accommodate the wishes of the Japanese manufacturers of ceiling-mounted CHRVs and to make sure that –although this demand for this particular product was understandable—these products that constitute less than 1% of the energy impact would deteriorate the ambition level for all the other non-domestic AHU products, i.e. products that constitute >99% of the energy impact. The underlying principle is that the measures should be proportionate to the relative impact. Also in the domestic ventilation sector the share of ceiling mounted CHRV units is very small.

As regards the filters several stakeholders have mentioned that the filters should remain optional. In other words there is support for scenarios 2 and 3 where it is proposed that –if the unit offers the option of filter placement (filter module or otherwise)—the unit should be prepared for the possibility of placing at least an F7 filter of the Eurovent-defined "A" class. This does not mean that it is mandatory to deliver the unit with that filter (or any filter for that matter).

The contribution of the **REHVA TRC**-chair is very valuable because it shows that indeed the saving levels for controls depicted in the various Task reports are realistic. VHK has requested REHVA to support a review of EN 15251 on this important point.

The **ECOS** comments relate largely to generic procedural matters, as would apply to all candidate products for Ecodesign. Tier 3 requirements, as discussed in the most recent Consultation Forum 19.4.2012, were considered but the P1, V1, H1 requirements already constitute the highest defined efficiency levels for AHUs and the fan efficiency requirements are much more ambitious than what is allowed under EC 327/2011. These items are fully explained in Task 1, but in this Task 7 report the Annex III shows again in detail what the requirements are. Product information requirements are now also included in Task 7 report, Annex IV

The high ambition levels for this particular product group mean that an EU energy labelling scheme – if it would be appropriate at all for these non-domestic products that are bought by professional buyers and where already appropriate industry labels exist—would bring little in terms of further differentiation. As regards timing-issues, a very important consideration is that the proposed measures for ventilation units are to be synchronised with the implementation dates in EC 327/2011 (Fan Regulation). Regarding integrated controls, although this has not been described explicitly, the allowance for CHRV manufacturers to choose also the 'domestic method', which incorporates the value of controls, does offer the possibility to incorporate controls. For units (CHRV & AHU) for an external pressure >100 Pa the stakeholders were adamant during the preparatory meetings for Task

6 and 7 that these were exceptions and could thus be treated at the level of building regulations (EPBD).

The **UBA** comments relate to compact HVACs, the need for energy labels, the scope of the measures and the requirements. Hereafter the UBA questions are summarized *(italic font)* and VHK answers are given immediately after each question.

Compact HVAC units

UBA expects an increasing market share for compact HVAC units that combine ventilation heat recovery with utilisation of exhaust air for water- and space heating.

Compact HVAC-units assume that, after heat recovery of exhaust versus supply air, there is still enough energy left in the exhaust air to give a significant contribution to domestic water heating and/or space heating in a passive house. However, in our experience the energy that is left in exhaust air after heat recovery at ≥75% and proper ventilation control (not overventilating) is not enough to significantly make a contribution. In practice, either there is a choice for heat recovery ventilation that is covered here OR the choice is for an exhaust-air (or most likely a mixed exhaust-outdoor air) heat pump which can be used for domestic hot water (covered in Lot 2) or for space heating (covered in Lot 1, when 'to-water').

Energy label

UBA sees the need of an energy label also for professional equipment.

As mentioned by UBA there are labelling/certification schemes with A-G scale or similar already in use, like the Eurovent A-E scale, the RLT B-A-A+ scale and in Northern EU countries the SFP1-SFP7 classification (also see Task 1 report). Especially if, as is exemplified in Annex III, the SFP-scale is linked to the external pressure loss the differences between all these classifications is very small and they would all be helpful –also for procurement officers-- in the transition towards the Tier 2 Ecodesign requirements proposed. For comparison: the Tier 2 requirements are comparable or better than "A" (Eurovent), "A+"(RLT) and "SFP3"(≤200 Pa external static pressure) or "SFP4"(>200 Pa external static pressure). The former two are based implicitly or explicitly on EN 13053 (H, V, P classes or derivatives) and the latter uses similar test methods but is slightly more flexible. As mandatory information, the classification according to all these three methods should be provided.

In such a situation, although the differences are small, the professionals in the field are used to work with mostly one of them and, as was shown in the stakeholder meeting which also UBA attended, it would cost the Commission a very considerable effort with very little gain (if any) in trying to harmonise them all into one single EU energy label at this time. However, the study team would recommend the Commission to issue a mandate to the standardisation bodies to develop a common methodology that could be implemented at the first review of the measures.

A full proposal for information requirements, for technical fiche and manufacturer's websites, will be added to the Task 7 report (see Annex IV).

Ventilation

Scope

UBA supports that domestic and non-domestic ventilation may be dealt with in one regulation. However, distinction should be made due to different sets of existing standards. If typical operating conditions like external pressure drop(?) for making this distinction cannot be defined, manufacturers may declare the type of application of their products.

External pressure drop can be defined and is the underlying condition for using the 'domestic ventilation' method. External pressure difference and airflow are the two output parameters (input is electricity consumption) that determine electric efficiency; leaving one of them out could create unfair competition and would certainly confuse purchasers.

Requirements

UBA thinks Scenario 2 to be very reasonable but would appreciate more explanation of the scenarios, pros and cons, etc..

As regards Scenario 1 the disadvantages were clearly shown and confirmed by some of the stakeholders. Scenario 2 is the strict Least Life Cycle Cost scenario and it was anticipated that the stakeholder meeting and the following written comments would be helpful in identifying the pros and cons. Especially the 'cons' in terms of practical limitations, e.g. like the limitations on face velocity mentioned by the Swedish manufacturer (V2 instead of V1 for installations with 0% cross-contamination requirement), would then lead to a solution that tends more towards Scenario 3. A more exact scenario would then have to be worked out in the Working Documents.

UBA mentions that requirements on component level bear the risk that some aspects of the products are not entirely covered and would like to see a deeper investigation on this aspect, i.e. if a more holistic approach would not be better.

As mentioned by UBA, it may be more difficult to apply a holistic approach when the product is built from modules, i.e. fan-modules, heat recovery module, filter module, controls, etc.. For larger ventilation units this is the case and therefore, also in order to indirectly give guidance to the OEM manufacturers of these modules, it is recommended in this particular case to address the requirements at the proposed lower aggregation level. Within that level –e.g. for the heat recovery system—there is the possibility for a trade-off, e.g. of pressure drop versus thermal efficiency. As regards the VSD: The number of equidistant steps is a part of the definition of "VSD", e.g. it is not intended that a conventional 2-speed motor qualifies as a "VSD". But we are open for suggestions as regards alternative definitions of "VSD".

UBA states that heat recovery requirements may be extended with requirements ion ternal and external leakage and balancing.

As mentioned in the stakeholder meeting, requirements on internal and external leakage as well as maximum recirculation will be added in Task 7. Automatic balancing requires implicitly a more sophisticated VSD than was defined, but this requirement can be added. Alternatively, if balancing cannot be achieved for whatever reason, the EN 13053 standard offers a correction formula.

UBA asks whether for the assessment of heat recovery classes in EN 13053 a definition of operating hours is required.

In EN 13053 A1: 2010 the formula for H-classes is fully defined and does not require an estimate of operating hours.

UBA asks to check if it may be possible to circumvent the heat recovery requirement by simply using two separate products, one for supply air, one for exhaust air.

Yes, it will still be possible to sell and install exhaust fans and supply fans and therefore they can both be installed in the same building. Under the Ecodesign directive this cannot be excluded and should be addressed under EPB measures.

The proposal was not intended to ban single fans or avoid installation of (combinations of) single fans on a building site; it was intended to avoid the situation where obviously the buyer thought it appropriate to install a balanced unit and did not order the heat recovery unit as well.

UBA wonders if part load operation is considered properly? Do the correction factors (for VSD) of the fan regulation match the situation in ventilation units as there may be deviations in the share of operation hours in part load and full load?

The proposal is to determine efficiency at a single self-declared working point (>65% design airflow + > 65% external pressure; usually best efficiency point) and add the VSD requirement. This is in line with the fan regulation and should make surveillance easier. Requiring 3 or 4 part load tests and work out a universal weighting pattern would be more exact and appropriate if a) the weighting pattern is more or less known, and b) if such a more exact determination would be used in a holistic calculation approach. E.g. for domestic ventilation this could therefore be considered. For the larger non-domestic ventilation units these conditions do not apply.

UBA: How can electricity consumption through auxiliary equipment (rotary heat exchangers, auxiliary equipment like condensate pumps) and in stand-by mode (for example of variable speed drives) be considered?

In EN 13053 the auxiliary electricity consumption for rotary heat exchangers, pumps ,etc. is part of the determination of the heat recovery class (H class). Stand-by electricity consumption of VSDs is, consistent with the fan regulation, considered negligible compared to the benefits of having VSD. The Commission could consider to issue a mandate to the standardisation bodies that looks into the possibility of differentiating between the overall energy performance (including stand-by) of varies types of VSDs.

UBA: The impact of controls to the overall energy consumption is significant. Why are CEXH units required to have clock speed control or air quality sensors, but for AHUs and CHRV no specifications are made? As controls may be added to the final installation, it may be checked if generic requirements on the compatibility of the ventilation unit with certain open control protocols are useful (for example, OpenTherm has been discussed in lot 1 for boilers). If it is not possible to include energy savings through controls into the energy efficiency requirements , at least mandatory information should be given. This could include the compatibility with controls (interface) and the effect on the energy consumption when using different types of controls. Alternatively, an "extended product approach" as for boilers may be appropriate.

According to most stakeholders (exceptions, see comment SWEGON) AHUs are generally placed on the market without a control unit, i.e. it is added afterwards on site. Setting control requirements for these products would thus alter the market not only for AHU-suppliers, but also the market for suppliers of controls, building automation systems, etc.. Furthermore, even if such a measure would be introduced the variety of AHU applications would make it very difficult to formulate controls configurations that are generally applicable and appropriate. Also the variety of bus-controls is such that prescribing e.g. OpenTherm would not necessarily help in promoting more sophisticated controls.

For CHRVs the situation is different: A considerable part of CHRVs is placed on the market with integrated controls and in fairly predictable situations. For that reason, an also because there is a 'grey area' where the technical characteristics of CHRVs and small AHUs overlap, it is recommended to offer manufacturers (for units <100 Pa external pressure) a choice to follow the 'domestic ventilation' calculation method which does take into account the controls and follows a holistic approach.

Publishing the technical data regarding the interface is already common practice, but could be made mandatory. The benefits of using best practice sensors is common knowledge with specifiers and planners, but could also be made a mandatory piece of information for e.g. the procurement officers and other non-expert decision makers.

The ‘extended product approach’ is intended for boilers <70 kW, which is typically the domestic range and is comparable with the draft Commission proposal for domestic ventilation of December 2010.. For non-domestic ventilation units, as for non-domestic boilers, it seems less appropriate.

UBA wonders whether it makes sense to define a minimum exhaust air filter, too, as exhaust air filters will be used to protect the heat exchanger from contamination.

The filter-requirement could apply also the exhaust side, but in that case –also to be in line with practice—a minimum requirement could be that a possible filter-module for the exhaust side should be prepared for a G5 “A”class filter.

UBA mentiones that there should be proposals for product information which is currently missing completely (supporting proper dimensioning of the product etc., even going beyond the product itself like air tightness of the building and of the ducts).

As mentioned in the Task 6 report (paragraph on “regulatory options”) and as can be seen from the comments of the TRC-chair of REHVA, the subject of proper dimensioning (the right flow-rate per application and as a function of occupancy) is extremely important. If EN 15251 cannot be adjusted/clarified in time for the introduction of the measures, or even when it is changed in time, it could be useful if every manufacturer in his technical documentation and on his/her website would be required to show the recommended flow rates. Likewise the importance of air tightness of the building and ducts could be stressed but it would be difficult to quantify generically.

UBA: Benchmarks are missing. Please add.

As mentioned before, the Tier 2 requirements are comparable or better than the highest energy efficiency classes according to RLT and Eurovent. Hence they are close to BAT benchmarks. In individual cases/ applications it must be possible to find more efficient examples, but they would not necessarily be universally applicable. Only if, in the next phase, the current Tier 2 requirements will not be deemed feasible for the 2nd tier in terms of timing, the current Tier 2 requirements could be used for a Tier 3 and/or can be used as benchmarks.

UBA: Editorial task 7 p. 18: There is no G5 filter defined in EN 779. Will be changed to F5.

According to **AL-KO** the study is too optimistic regarding the merit of heat recovery for space cooling and –as a result—too optimistic regarding the savings of ventilation heat recovery in a Warmer Climate.

Having said that, AL-KO believes that the general conclusion from the preparatory study, i.e. that heat recovery at levels of around 70% thermal efficiency can be economical (payback period < product life) in all EU climates, is still valid.

Higher thermal efficiency levels than 70% for air flows of approximately 5000 m^3/h or higher would require a step-change in technology, i.e. only leave rotary heat exchangers, and therefore in pricing.

Illustrates the first point regarding heat recovery in the various climate zones with calculations showing amongst others that in Warmer Climates the calculated cooling+heating energy is 30% less than in the average Climate and the share of cooling+heating energy that can be recovered is up to 60% less in the Warmer Climate versus the Average Climate.

For the case where benefits of the thermal efficiency gains are weighed against the electricity AL-KO has made calculations whereby the optimum for the Warmer Climate, compared to the average climate zones, would be more towards lower thermal efficiency (e.g. 47% versus 67%) at lower electricity use (125 Pa pressure drop versus 230 Pa).

Full Stakeholder's comments

NORDIC PROPOSAL **(Dansk Ventilation, FAMBSI Finland, Svensk Ventilation, VKE Norway)**

Ecodesign requirements on air handling units
Common Nordic proposal based on specific fan power

General

Air handling units (AHU) can be declared against a requirement on specific fan power (SFP) for a standardized model configuration, which not necessarily conforms to the exact configuration of the real supplied unit. According to this model, SFP is calculated at a reference airflow applied for different calculated external static pressures. In this SFP calculation, only those components are included that are necessary for the ventilation function of the AHU.

The method is expected to promote AHU with low internal pressure drops. By applying SFP, we connect directly to the energy use of the ventilation system, and we obtain a motivated requirement. For manufacturers of ventilation products, SFP is a well-known concept, and it is used for energy requirements on ventilation components in a plurality of European countries. A similar method can be used also for fan units.

Components included in the SFP calculation (including modules necessary for their functions)

- Supply air filter class F7
- Extract air filter class G5
- Heat recovery unit*
- Fans for supply and extract air

*) In the complete requirement on AHU, requirements should be included on the dry temperature efficiency of the heat recovery unit. Heat recovery implies/gives a considerable decrease in energy use, but the SFP value increases with increased
temperature efficiency. A requirement on temperature efficiency is necessary for optimization of the energy use.

Reference airflow

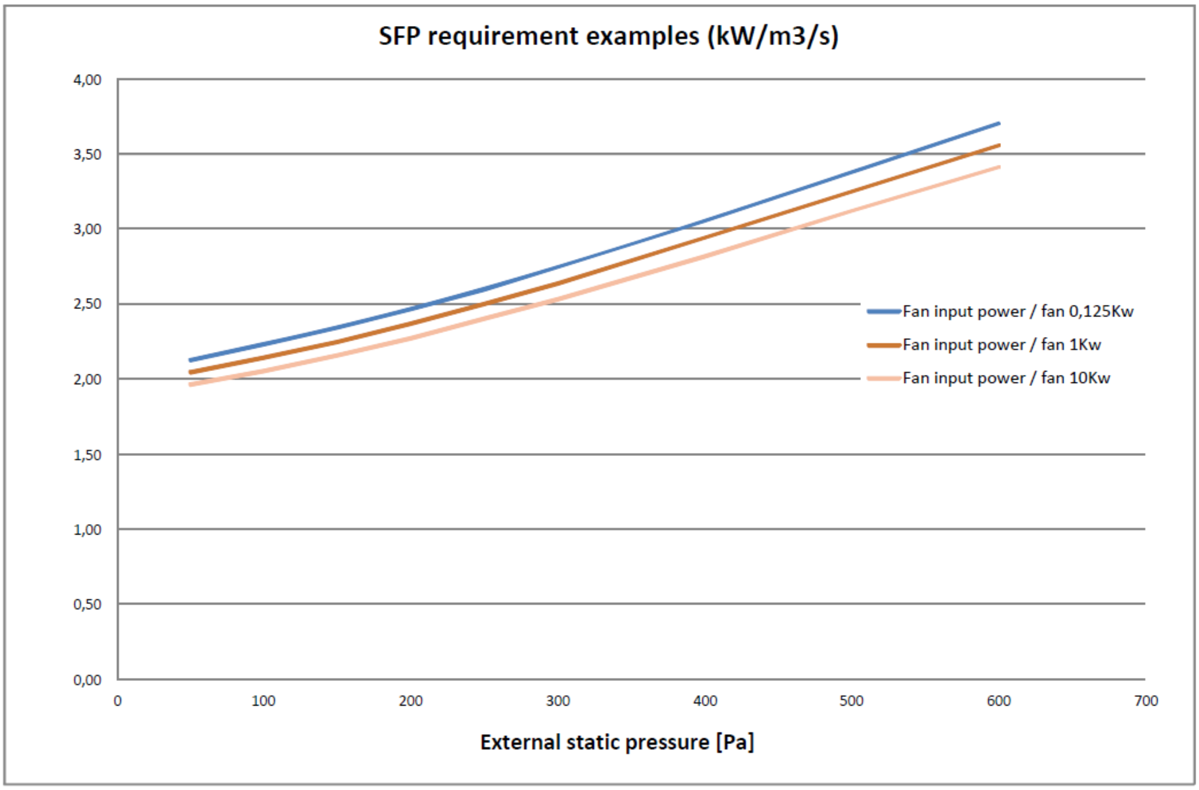
Depending on the AHU design provisions, the reference working point is defined in one of the following ways.

1. General reference working point
For AHU not designed for a specific working point, the reference working point is calculated at 70 % of the maximum airflow. If not stated, the maximum airflow is defined as the airflow at maximum AHU speed and 100 Pa** external pressure drop. SFP is calculated in the operating pressure at the reference working point recommended by the manufacturer.
**) If the AHU is not designed for pressures ≥100 Pa, its maximum design pressure applies.

2. Specific reference working point
For AHU designed for one or more specific working points, the reference working point is the working point at which the AHU will be mainly used.

SFP requirement

We propose an SFP requirement looking as the attached example diagram. The requirement could be based on the same principle as the requirement on fans in Lot 11, but with compensation for expected pressure losses in the AHU (one can easily prove that SFP is the ratio between the sum of pressure drops and the overall efficiency of the fan). The exact mathematic function forming the limits should be defined at a later stage. In order to generally promote energy efficiency, it is reasonable that the calculation model includes mitigation for working points at lower pressure.



2012-05-14

Christen Galsgaard
Dansk Ventilation, Denmark

Ilkka Salo
FAMBSI, Finland

Mats Eriksson
VKE, Norway

Britta Permats
Svensk Ventilation, Sweden

EXHAUSTO A/S

LOT 6 – Comments to the draft of task 6 & 7 for ventilation.

Enclosed please find our comments to the draft report 6 & 7 for ventilation.

Generally we are supporting the idea of energy requirement for ventilation components to increase the possible energy saving potentials from this kind of components.

Therefore we do not see any reason to reduce the energy efficiency for CEXH as mentioned in Task 7, as these fans are already covered by the Ecodesign regulation 327/2011, even though the energy saving from primary energy is low compared with the thermal energy transported by these fans.

AHU/CHRV

The large saving is coming from converting extract system into some kind of heat recovery system, where the thermal energy can be reduced for heating/cooling. The benefits are depending on the situation as the saving on heat recovery is larger than the cooling recovery due to the primary energy used in the process and the thermal difference is typically larger by heating than by cooling recovery and the number of hours where for recovery is in use.

EN13053 is probably the best standard given at the moment, but it has a number of limitations, which is not covered in a prober way, which makes it difficult to use in all situations to optimization of an AHU for best energy performance.

Velocity class grouping do not correspond to the heat recovery class, temperature efficiency and corresponding pressure drop.

EN13053		Measured at EXHAUSTO product
V-Class	H-Class	Heat exchanger type used by EXHAUSTO, causes the following avg. result based on face velocity of 1.6 m/s
Class V1 (v <=1,6 m/s)	Class H1 η_e=71% (η_t = 75% @ 2 x 280 Pa) Class H2 η_e=64% (η_t = 67% @ 2 x 230 Pa) Class H3 η_e=55% (η_t = 57% @ 2 x 170 Pa)	Cross : η_t = 63% @ 2 x 28 Pa Rotor : η_t = 80% @ 2 x 80 Pa Counter flow : η_t = 80% @ 2 x 125 Pa

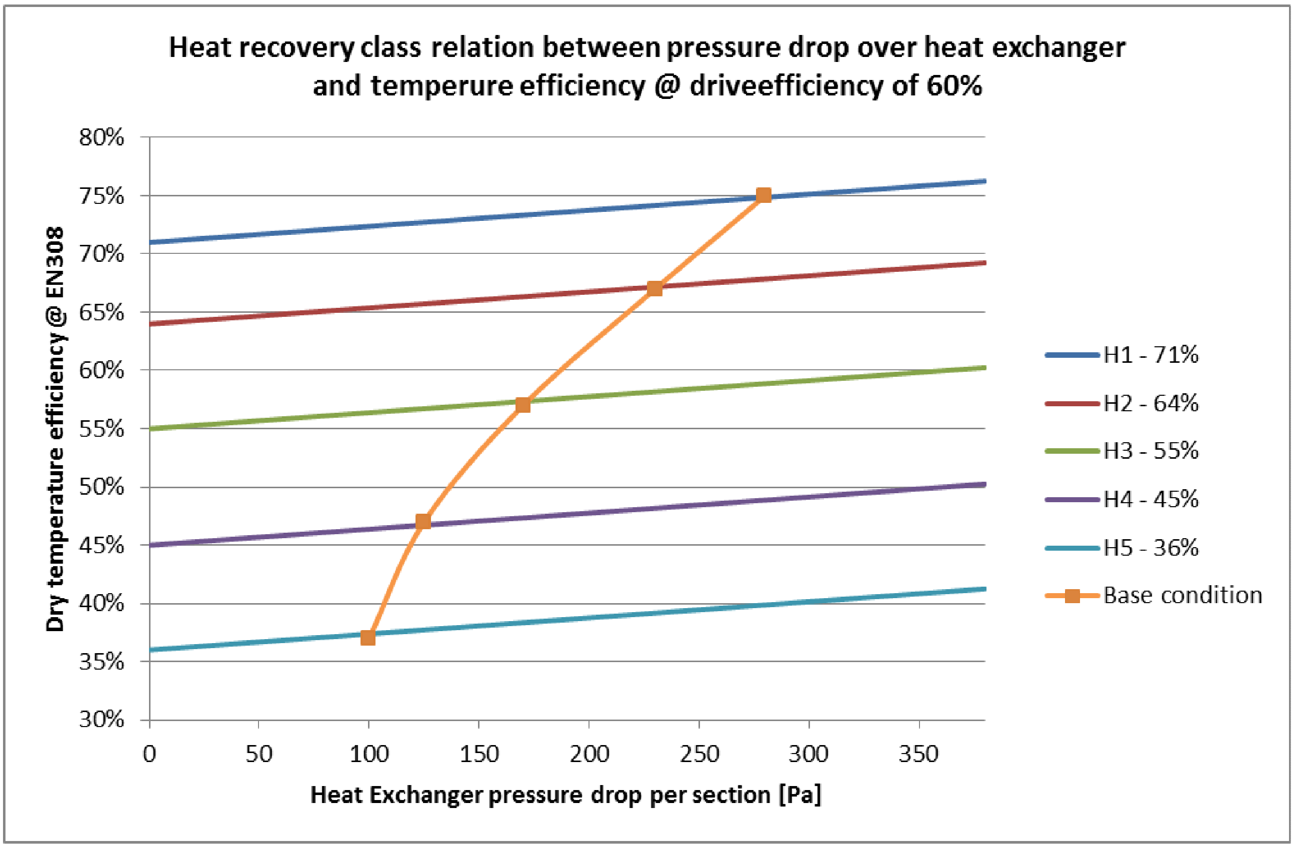
As the table shows there is no relation between the velocity over the heat recovery system and the heat recovery class's, temperature efficiency and the corresponding pressure drop from the real world, this is not a final proof, but just an indication of the problem with using the velocity a the main figure.

The velocity class idea is good as long as this is covering all components from ducts, filters, heat recovery, coils etc. as the change in velocity from one component to another is energy consuming which is not taken into account in EN13053.

Even with same velocity in the filter section it will not bring the same pressure drop over the filter even for same filtration class on the filter construction ex. filters exist in more lengths short and long where the long filters have smaller pressure drop than the short filters, which therefore is more energy efficient.

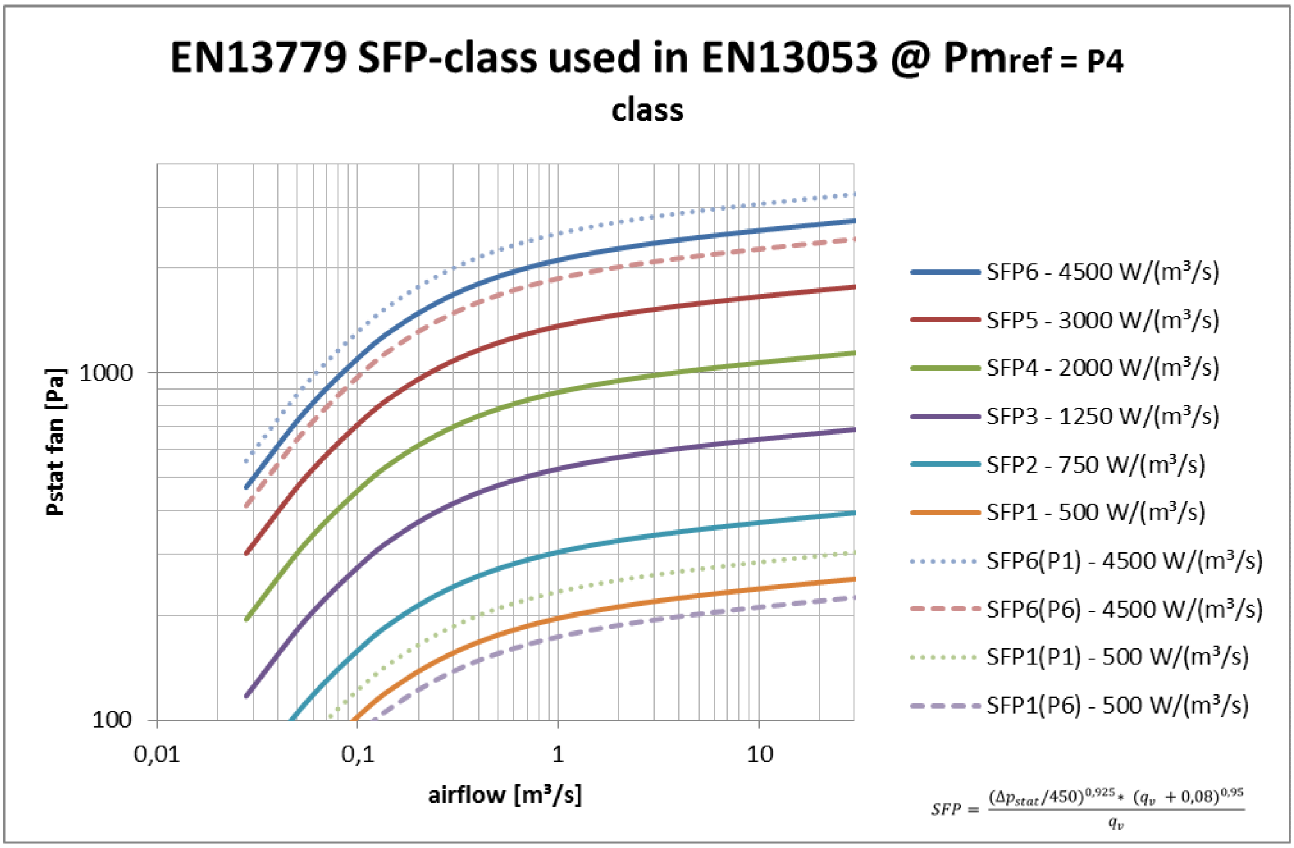
Last and most important we are already today struggling with space requirement for the equipment on the market for refurbishment as these units have to fit the already existing rooms and the energy saving potential on this renovation market is high.

Below is how EN13053 converting of the pressure drop and temperature efficiency is directly linked to the fan system efficiency, there the design condition is based on a drive efficiency of 60% which is a high figure for system running on low pressure, which can be seen in the following.



Fan power consumption

EN13053 do not care why the unit has to use a high pressure, if this is caused by the function of the unit or the external requirement for ductwork etc. EN13053 is purely focusing on efficiency in balance between pressure and airflow.



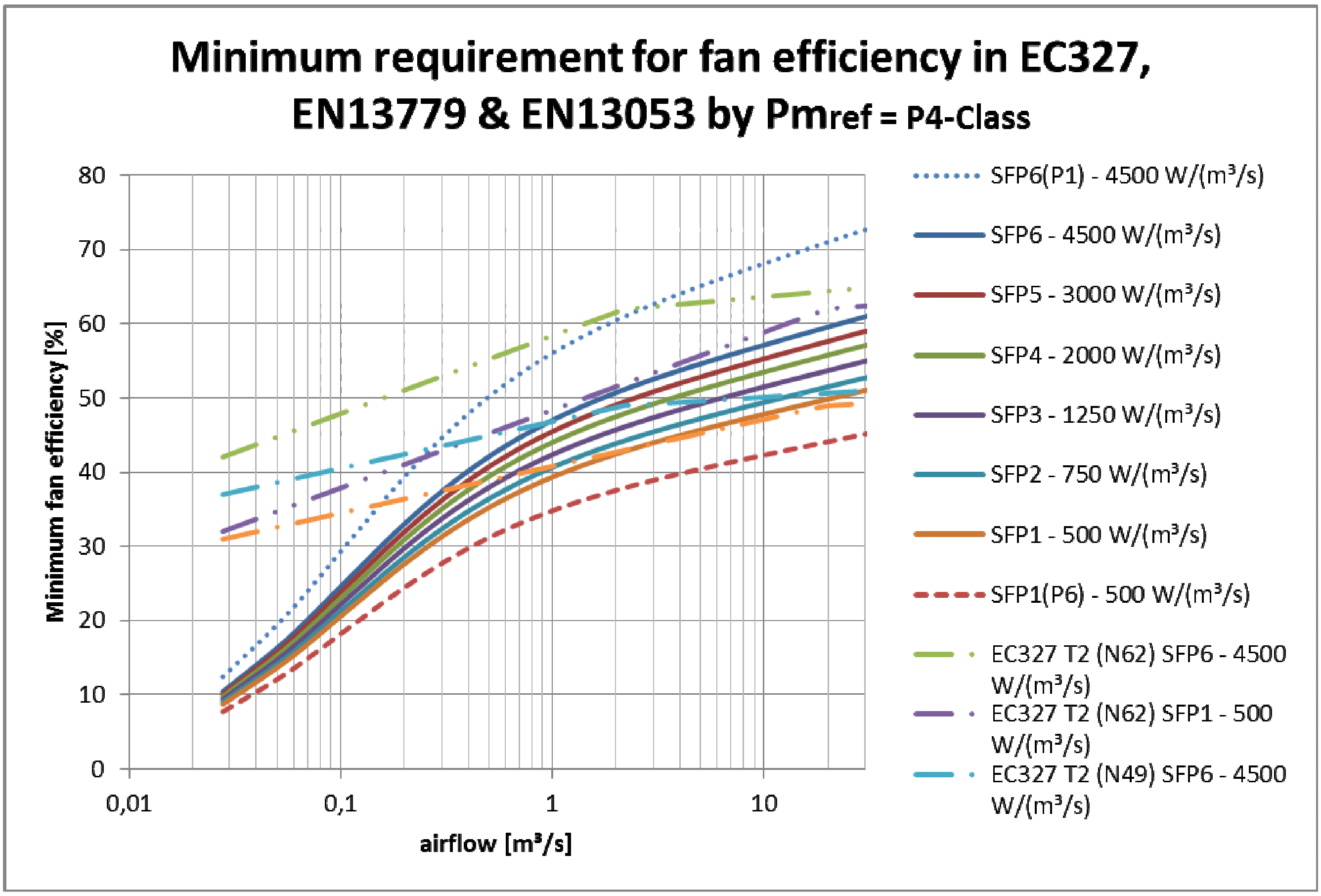
If we take a look on the SFP-class from EN13779, where SFP6 is using 9 times more energy than SFP1 and use these values to calculate pressure requirement by using the formula for P-class in EN13053, which is equation power class P4 in the EN13053.

As it can be seen from the curves above the pressure increase from SFP1 to SFP6 is more than 10 times, which means that the efficiency of the fan system has to increase with the pressure load as the cost was only 9 times.

Two extra lines are drawn for P1 and P6-class for comparing, which represent a 15% improvement and 12% reduction compared with P4.

As the Ecodesign requirement for ventilators EC327/2011 is already in place, it will be reasonable to compare the requirement for ventilators with the P-class from EN13053, which are focusing on using P1-class as requirement. The following curves are using 2015 requirements for F-impeller and chamber fans which both are used generally in the market.

From the curves below will a generally requirement for P1 be easy met by small units but very difficult for large systems, as the requirement for the small system is below the requirement in EC327, but it extents the requirement for large systems with several percentages. Second the requirement for P1 has to be met at the working point, which not always is the optimal working point for the fan system, as the impeller and motor are produced in fixed sizes.



The use of F-impeller system will be limited to small systems.

Proposals

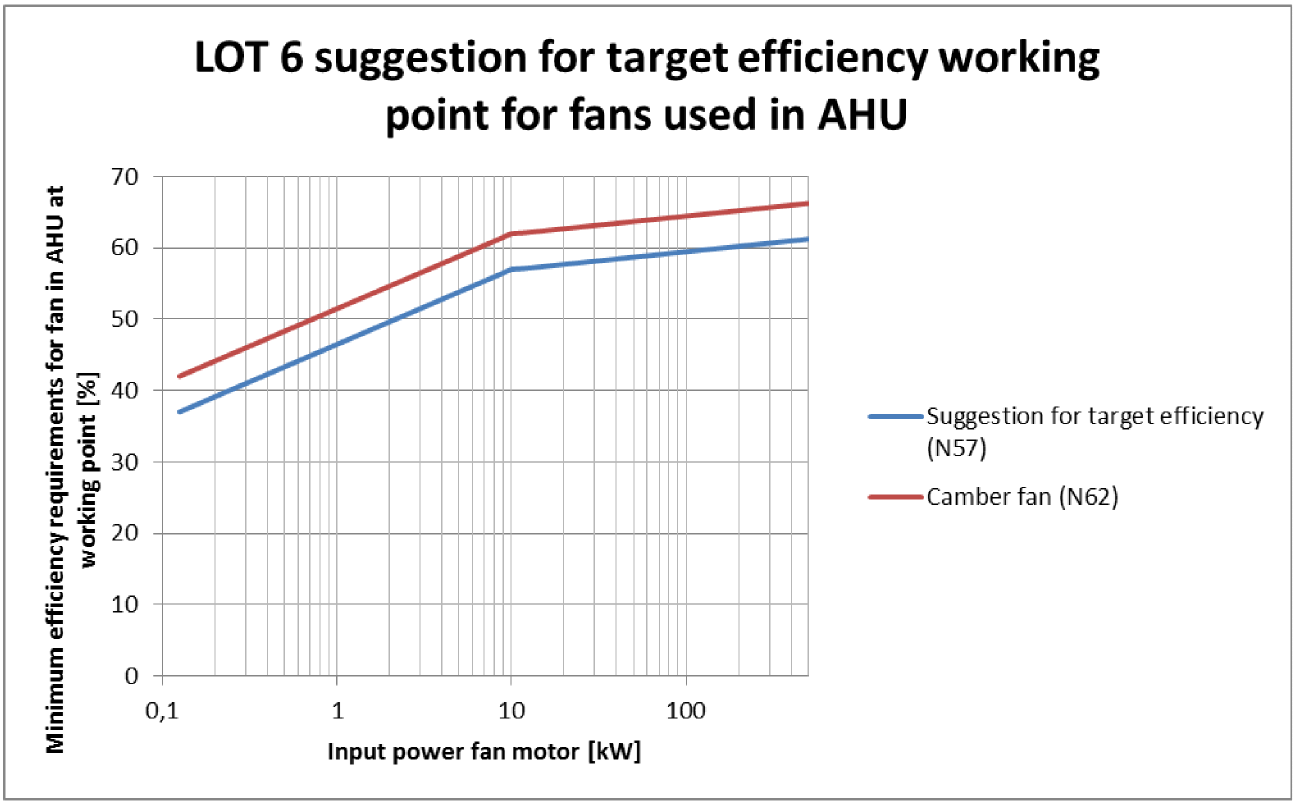
A general comment: It will be difficult to handle all systems in the same setup in all respects as the requirement for the unit is very much depending on the application and the prime function of the AHU. Many systems are just venting the building with normal requirement for filtering, heating and cooling. Other systems are specially designed to deliver very clean air or controlled humidity because the air is a part of a process, where the main focus is the quality of the process, this type of AHU will of cause have higher energy consumption compared with normal ventilation of buildings, some figures for this extra cost are describe in EN13779.

The degrade of heat recovery efficiency do have to consider the climate zone as the cooling recovery part is overestimated in the report as the fan power to overcome the heat exchange pressure drop reduces the benefits.

No. 1

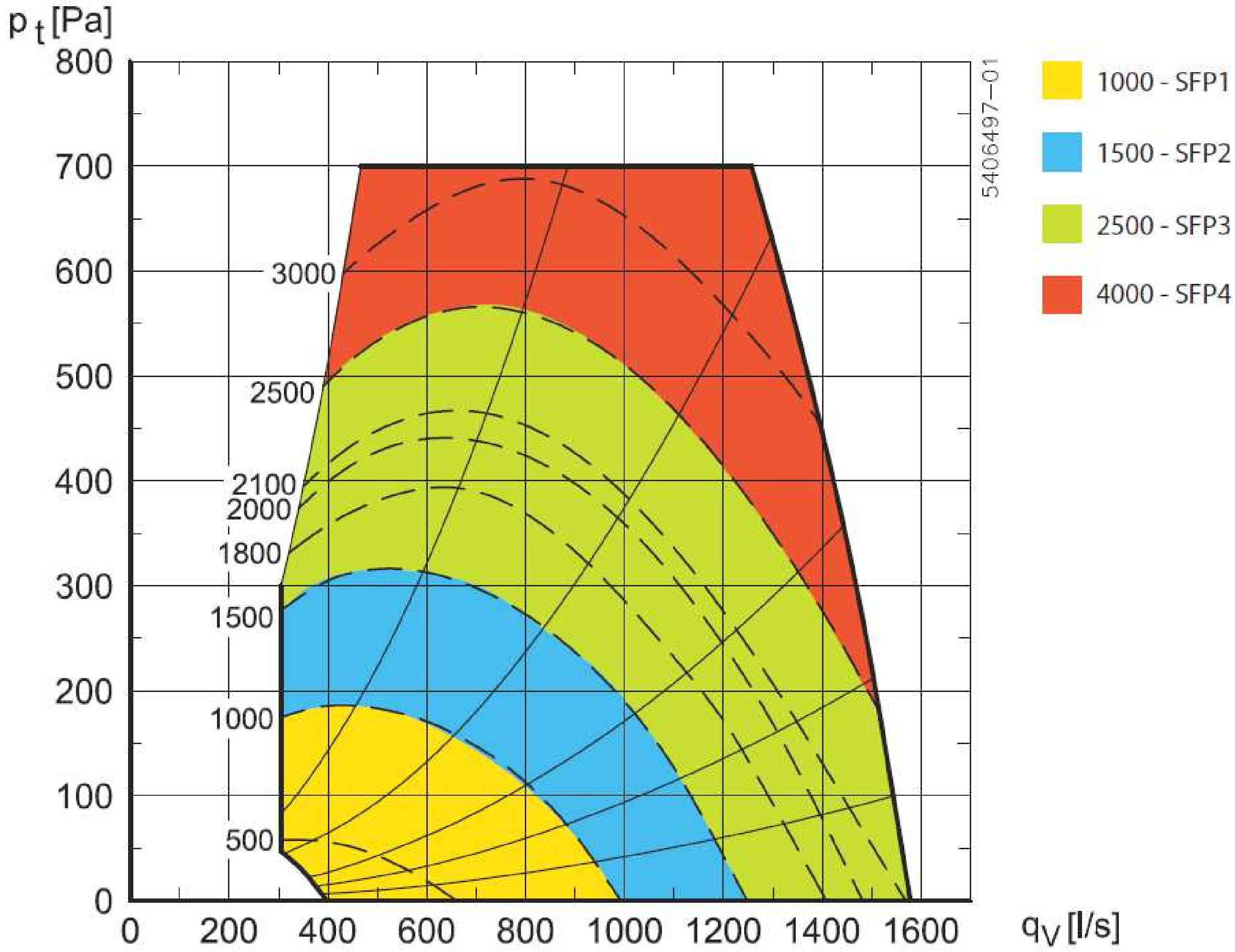
As shown earlier the requirement for P1-class in some cases will extend the requirement for fans as described in EC327/2011, the proposals to use a 5 % reduced fan efficiency as in EC327/2011 to handle the problem with the working points. This does not give the best efficiency, but gives some work space around the best energy efficiency point. This will make it possible to describe a working range of the unit for standard produced AHU's.

Power range P in kW	Target energy efficiency	Efficiency grade (N)
$0{,}125 \leq P \leq 10$	$\eta_{target} = 4{,}56 \times \ln(P) - 10{,}5 + N$	57
$10 < P \leq 500$	$\eta_{target} = 1{,}1 \times \ln(P) - 2{,}6 + N$	



No. 2

One main problem with EN13053 is that it is only focusing on one working point, which must be known to do the calculation, but there are also many standard products sold on the market, where we as manufacturer do not known the working point of the unit and therefore describing the performance data on the base of SFP-values, which makes it possible for the client to select the most economic unit for his use. This model is integrated into all Scandinavian countries' legislations and the Passivhaus standard.



Above figure is showing such diagram, which then make it possible to describe that this unit in the area below the red area will fulfill a requirement of maximum SFP3 = 2500 J/m³ = 2.5 kW/(m³/s).

Danish Technological Institute DTI (Christian Drivsholm)

Comments to the draft AC-reports, task 6 and 7 (Lot 6): "Air – conditioning and ventilation systems"

In general we think you have done a good work in the study. We have however some important issues to comments:

Comments 1

There is still considerable disagreement over the use of the SFP number[J/m^3] for the entire ventilation system, particularly in which the Nordic building regulations are bound upon. On the other hand there are also other countries interests. It is very important that further work is done under a basis that an agrregate energy label is taken from its' SFP number. Regardless of the variation of air demand, it will always be necessary, logically speaking, for the unit manufacturer to know the air volume and pressure available for the duct system. Thus the SFP number is also known.

Comments 2

With respect to EN13053, there are some comments abouts this standard as it has certain computational limits and therefore cannot be used as a general standard for all AHU without causing an imbalance (especially the lower capacity range of 0.5 - 1[m^3/s]). The limitation is also highly dependant on the system pressure where the ventilator operates. The next problem with the standard is that there is no flexibility for individual design solutions that could promote energy efficiency across components. For example, the velocity inside in the filter is not fixed upon the pressure drop across the filter or the velocity through the filter material, which is a typical method of adjusting the pressure drop eg. Short/long bags.

comments 3

About the EVIA proposal which is based on by-passing the existing directive 327/2011, which established a framework for minimum peak efficiencies for ventilators, including box and roof ventilators.

This obviously means that because of Directive 327/2011 that some products will become unusable because they cannot meet the requirements for ventilators. However there are alternatives that meet the requirements. Unfortunately this means more expensive products, as frequency regulation is far more expensive than voltage regulation for small engines. The main idea behind the the directive 327/2011 is to create more energy-efficient products, which would not be the case if the proposal for EVIA is implemented. The problem with the option to by-pass is to others who meet the requirements for 327/2011, all the others will have to be faced with expensive products which could be hard to compete at in price alone.

Senior Consultant, MSc
Christian Drivsholm
Center for Ventilation
Danish Technological Institute, DK-2630 Taastrup

DTI Minutes of the meeting (extract)

Only units (aggregates) with a effect larger than 125 W per ventilator are covered in this work.

The breakdown is as follows:

- Central exhaust units (CEXH)
- Central Heat Recovery Ventilation (CHRV)
- Air Handling Units (AHU) {AHU-S, AHU-M, AHU-L}

There have been several cost-benefiting analyses for many different ’design options’. LCC versus’ Energy savings’. There is an assumed product serivce lifetime of 17 years.

The work carried out is all done in a proffesional manner.

Duct systems are not included in this work. It is suggested that duct systems could rather be included in ”Energy Performance of Buildings, Green Public Procedurement, MS building codes etc.”.

There is much emphasis on this primarily, because of the building work around the two EN standards and regulations listed below.[EN 13799, EN 13053 and EC 327/2011)

It was my clear impression in the meeting, that the process is too far down the track (also in relation to the deadline in summer 2012) leaving no room to make major changes! Although, there are minumum requirements for work in the future on relevent subjects.

{The Swedish representatives will however send a report regarding the use of the SFP number}

There is still considerable disagreement over the use of the SFP number[J/m^3] for the entire ventilation system, particularly in which the Nordic building regulations are bound. On the other hand there are also intersts in other countries, see for example comments from Mats Eriksson.

Ventilation unit manufacturers will only be held responsible for the unit and not be held responsible for the entire ventilation system performance. See extract from Lot6 and 7.

The industry position as regards the self-declared intended use could solve some problems in the so-called ‘grey area’, but in the interest of the credibility of the Ecodesign measures and a ‘level playing field’ this possible solution should be limited. The Commission proposal for domestic ventilation units is based on the SPI (Specific Power Input) at a default external pressure drop of 100 Pa. This pressure drop could still be credible under certain circumstances for units with design flow rates up to e.g. 1000 -1500 m3/h, but for larger units the design pressure drops –and thereby the largest part of the power consumption-- could be more than 10 times higher.

There is reasonable consensus in cases involving small ventilation systems(eg for houses), where the design pressure for a duct system is fairly constant at about 100 Pa. Here it is possible to work with the required SFP values (classes).

That said, using the proposed requirements (classes) for efficiency for ventilators, air velocity (face velocity) in the unit, and the efficiency for heat exchangers is a sensible step. The lowest classes specified in EN 13053 is however very low.

If the pressure loss in the unit is reduced and the total efficiency of the unit increases. The electrical needs and everything else can all be reduced. See the formula below:

$$SFP \approx \frac{\Delta p_{total}}{\eta_{total}}$$

This is ensured despite everything in Lot 6.

The problem is the design of the duct system! How to ensure that this work will be performed in the correct, design-wise manner?

In Denmarks ventilation regime, many measurements have been made with the correct correlation between in-duct pressure and air flow.

There are still areas where further work is needed. The further work should ultimately lead to the development of classification for maximum in-duct pressure at required air flow rates. This may therefore also set demands for air handling units expressed by an SFP number. There is great support for this work by all Nordic countries.

It should be clearly maintained (manditory) that a balanced ventilation system must be equipped with:

- Heat recovery
- EU7 (F7) filter

This would therefore ensure that first and foremost the whole of northen europe (read ”Helsinki climate zone”) has heat recovery from the cold air outside, which contributes to a large amount of energy recovery. For example, in Denmark heat recovery saves 130kWh/year per l/s at 8760 hours of operation.

See the comments from Exhausto A/S and Mats Eriksson(Norway), listed below.

Follows: Comments from Exhausto which are also expressed in the Exhausto A/S paper and the position of Mats Eriksson who is one of the authors of the Nordic proposal.

SWEGON (SWEGON is member of Eurovent, author Gunnar Berg)

General

The remarks in this document apply mainly to Air Handling Units (AHU) and in some extent Central Heat Recovery Ventilation (CHRV).

Task 6

Page 18 and 19, subchapter "Design option 1 improved fan system":
There is a comparison between fan efficiency in EN 13053 and in Fan Regulation No. 327/2010. They are, however, derived out of different aspects. The efficiency in EN 13053 is derived as a mean curve out of measured fans in AHU on sold AHU in Germany and as such there are system pressure losses due to the build in of the fan. Minimum fan efficiency (for the optimal duty point at optimal conditions) is used in the Fan Regulation. The Fan Regulation gives also reward for use of variable speed drives. It is thereby harder to reach certain efficiency according to EN 13053 compared to the Fan Regulation. The differences should be commented and further explained.

In the **second last paragraph** I believe, but I have not the background information, that there must be a mix in the comparison of efficiencies. Fan efficiency can be calculated out of the static pressure rise or the total pressure rise. The BAT figures 83 – 84 % is most probably out of total pressure rise. Fan efficiency is also depending on mechanical power supplied to the impeller of the fan, shaft power or electrical power to motor or the speed control. The BAT values are most probably out of mechanical power. The system efficiencies, according to EN 13053, are out of static pressure rise over the fan (no regard to recovery and filters) and electrical power.

In the **last paragraph** seem the efficiencies too high to be a design option of system efficiencies (static pressure rise and electrical power). They are in the level of peak performance but there is limited number of fans sizes (limited in overlapping) so one has to use a certain fan in different duty points with lower efficiencies.

Page 20, second paragraph:
A reduction in face velocity will reduce the power demand by less than the square of the velocity reduction due partially laminar flow in filters, heat recovery sections and coils. The power demand can be estimated to face velocity raised to 1.4 instead of 2 (compare treatment of pressure correction due to velocity in Eurovent energy labelling system).

Task 7

Page 10 last sentence in the second paragraph, about controls and page 17 subchapter "AHUs" last sentence in third paragraph, about controls:
There are Air Handling Units delivered with controls as a self-standing package. They are common in Scandinavia and they are used all over Europe. Swegon have, as an example, a range from 0.2 up to 14 m^3/s where a control system always is included.

Top of page 19:
First bullet point: "Heat recovery, including bypass for free cooling, mandatory":
Bypass is necessary in the combination free cooling and cross flow or counter flow heat exchanger. Bypass is not used together with a rotary heat exchanger, just stop the rotor (no heat exchange)

when free cooling is possible. Runaround heat recovery works in similar way, just stop the pump to get free cooling possible.

Third bullet point: "AHU: Minimum fan system efficiency EN 13053 level P1 in Tier 2":
See above remark about comparison between EN 13053 and Fan Regulation. Level P1 in EN 13053 require higher efficiencies than the Fan Regulation although there will be pressure losses when placing a fan inside an AHU and the Fan Regulation only check the best efficiency duty point. This will raise to strong demands on AHU fans and last but not least the EN 13053 is calculated case by case for each AHU offer, manufactures can't have a system where they don't, in advance, know if an AHU fulfils the CE mark requirements or not. In my opinion it will be better to apply the same figures for AHU as for CHRV and stick to the Fan Regulation methodology but the fan placed in the AHU. One other thing is the efficiency of a motor together with a Variable Speed Drive, VSD, were the VSD have impact on the motor in such way that the drive system efficiency will decrease with decreasing speed. A most common fan in Air Handling Units is the centrifugal backward curved fan without housing, it is most common direct driven and equipped with a VSD. The fan has benefits in high overall static efficiency (the highest requirement in the Fan Regulation, second tier). The VSD gives the benefit that the speed can be adjusted so correct air flow is reached (minimum power consumption at fulfilled requirement on air flow), supports variable air flow systems and use in low pressure systems (systems with low SFP values). The drawback with the efficiency of the drive system at low speed must be handled in a proper way similar as the Fan Regulation which only considers the optimal duty point.

Fourth bullet point: "Maximum face velocity EN 13053 level V1 in Tier 2":
For AHU this will, in many cases, lead to too large units especially when old AHU shall be replaced. Present buildings have normally strong limitations in space for the AHU. Use class V2 (up to 1.8 m/s). Class V1 is not considered as a common class, see note 2 in chapter 6.3.1 in EN 13053:2006+A1:2011.

Fifth bullet point: "Heat recovery energy efficiency EN 13053 level H1 in Tier 2":
Rotary heat exchanger is used wherever it is possible; H1 is okay for normal circumstances. In cases where separated air sides is required (e.g. when smells can be transferred between different zones) one have to use other heat exchangers (e.g. cross flow heat exchanger). H1 will lead to sub optimisation in Nordic countries due to risk of freezing. A heat recovery device with higher temperature efficiency will spent more time in an anti-frost mode which will lead to less recovered energy than expected and have higher pressure, use more electrical energy. I consider H2 as sufficient for the case where higher values of separation between air sides are required by the client. A rotary heat exchanger is less sensitive to freezing due to the rotation and the transfer of humidity.

JRAIA (Japanese Refrigeration and Air Conditioning Industry Association, author Mr. Kataoka)

Comments on EuP(ErP) ENTR Lot 6 Ventilation Task 6 and 7

JRAIA respects the intention of EU to improve energy efficiency of ventilation products and recognizes importance of the studies made for this lot. We would like to support reasonable and fair regulation for this purpose. Although it is still at study stage, we would like to comment on several part of the reports to improve the quality and accuracy of the reports. JRAIA appreciate that some of the comments we made so far are reflected to the reports, however we believe others are not well recognized or misunderstood.

1. Task 7 Scenarios

The reports of the ventilation study so far have been indicating the significant potential of CHRV to contribute energy conservation, although current market penetration of them is still limited. So, use of CHRV should be promoted. However, current proposal includes equivalent fan efficiency requirement for CHRV and CEXH in policy scenario 2. If this becomes regulation, cost difference between CHRV and CEXH stays the same or becomes larger that may results in decrease of CHRV sales. This does not meet the purpose of the Ecodesign directive. LLCC is theoretically correct if all user has sufficient money. However, reality is different. If initial price is high, it may not be affordable for many people.

JRAIA believes CHRV should be excluded from the Tier 2 targets and make the next targets at the next revision of ventilation implementation measures.

2. Test method

Self declaration of use or test category is indicated in scenario 3. This allows cost optimum design of the CHRV units more than 125W fan power input but mass produced complete units. JRAIA believes such low cost mass produced units increase the potential of market penetration and energy saving. Larger units require customization of ventilation system for each installation, but in boundary area many installation more than 125W fan input does not require such customization.
We appreciate this point is taken up to the report. However, more practical or elaborated method should be indicated in that part of the report. JRAIA would be delighted to help developing such requirements. For instance, heat exchanger pressure losses and air passage losses should be appropriately reflected to the implementation measures of such whole unit requirements.

Scenario 2 proposes level H1 of EN13053 in tier 2. However, it is not applicable when unit is tested as entire unit. In such case equivalent sensible heat recovery efficiency should be required. JRAIA recommends the efficiency of at least 75%.

The concept of "net supply airflow" is taken up in ISO and other ventilation standards, but EN standard does not includes such concept and require very high tightness. Supply air will be mixed with indoor air in the room that is same as the exhaust air. So, requiring high tightness to ventilation unit has little meaning except critical application such as hospital and nursing home.

Certain gap is necessary between element and body of CHRV for maintenance purpose. Installation of such compact CHRV is above suspended ceiling, so complicated and rigid structure is possible but not preferred from maintenance view point.

3. Fan efficiency requirement

Basically, lot 11 fan implementation measure already includes fan efficiency requirement at peak condition, so there is no reason to excludes fans of CHRV from lot 11 and to make higher requirement with lot 6 ventilation implementation measures.

Efficiency formula indicated in the policy scenario 2 of task 7 report appears to indicate optimum efficiency of backward curved fan. However, actual efficiency is quite different. A sample that appears one of the best products in the EU is shown in attachment. The total efficiency of this fan is 14.2% while the formula of scenario 2 gives 45.9% efficiency.

So, requirement of sole fan efficiency at optimum condition has little meaning. JRAIA strongly recommends to evaluate such units as whole units as indicated in the scenario 3.

4. Fan type choice

In the bottom part of page 16, there is misunderstanding about fan type selection. Backward curved fan has to has angle to radial direction, so choke area is smaller than forward curved fan with the same diameter and thickness. That means larger diameter or thickness is necessary with backward curved fan than forward curved fan to get the same air flow volume. In order to minimize the fan size and maximize heat exchanger size to achieve higher entire efficiency, sirocco fan is preferred in compact CHRV.

AC motor for compact CHRV is chosen to compete against low cost CEXH not the size issue. Many DC fan motors are much smaller than AC ones.

The first clause of discussion part indicates also misunderstanding. It explains that there is 70 cm height ceiling mount CHRV units, so all CHRV can be large. However, many installations of such units are for retrofit of existing buildings where height beyond suspended ceiling is quite limited. If 40 cm height unit is not available, installation of CHRV has to be given up. This should be minimized.

Clause 1.2 of Task 6 report includes design options with backward curved fan. However, as it is indicated above, total efficiency is higher with sirocco fan than backward curved fan in limited size.

5. Filter requirement

Although the filter requirement is suggested optional at the last paragraph of clause 1.4.2, the scenario 2 appears requiring filter mandatory. JRAIA agree the discussion in 1.4.2. Filter is not always necessary. So, it should be clearly indicated that filter requirement is optional and is applied in cases where filter is supplied with AHU or CHRV.

TRC-Chair REHVA (Jorma Railio comments, Federation of European Heating, Ventilation and Air Conditioning Associations, Technology and Research Committee, **16-5-2012)**

….

So far I have noted in the REHVA discussion one major comment on Task 6 / p33, "3.2 Regulatory options" - ventilation during non-occupancy periods.

According to my understanding, there is one conclusion based on a misunderstanding of EN 15251 - Actually, EN 15251 / Annex B, item B.4 gives "Recommended ventilation during un-occupied hours", as follows

"Non-Residential buildings

Outdoor air flow equivalent to 2 air volumes of the ventilated space shall be delivered to the space before occupancy (e.g. if the ventilation rate is 2 ach the ventilation is started one hour before the occupancy). Infiltration can be calculated as a part of this ventilation (leakage assumptions should be described).

Instead of pre-start of the ventilation system, buildings to be ventilated during the unoccupied periods, with lower ventilation rate than during the occupied period. The minimum ventilation rate shall be defined based on building type and pollution load of the spaces. A minimum value of 0,1 to 0,2 l/s,m^2 is recommended if national requirements are not available.

Residential buildings

In residential building, "unoccupied periods" means mainly periods when there is no demand.

A minimum ventilation rate between 0,05 to 0,1 l/sm^2 during un-occupied hours is recommended if no value is given at national level"

I also noted in the texts (Task 6 report) some statements that like to suggest e.g. "mandatory heat recovery" and "mandatory minimum filter class". Even though I'm in favour of promoting good heat recovery and high-class filtration, making some technical solutions mandatory may have a negative impact, so only minimum **performance** should be mandatory. The end result can be the same, but requirement on "recovered heat" instead of "heat recovery" might give a much more positive impression.

Then there are also points that I found very positive in the reports, including that the importance of ductwork airtightness and good filtration are properly addressed there.

ECOS (comments environmental NGOs)

ECOS Comments on the draft tasks 6 and 7 of the ErP preparatory study on Air Conditioning and Ventilation Systems (Lot ENTR 6)

May 2012

Ventilation

The study suggests two tiers (T7, p. 13); it should furthermore suggest a third one, based on the current benchmark. We propose this on the basis of the Commission proposals to potentially include a long-term (3rd) tier in future implementing measures, as presented by the Commission at the horizontal CF meeting on horizontal issues (19.4.2012). This would send a long term signal to industry, providing sufficient time for manufacturers to prepare accordingly. If this is not possible at this stage, the absence of this information should be clearly documented in the preparatory study.

The timing of the suggested tiers is 1 year/ 3 years or 2 years / 4 years after entry into force. The purpose of Tier 1 is – among others – for market actors to become acquainted with the regulation. Tier I should therefore become mandatory already after 1 year.

Policy scenario 1 includes a request that F7 filter with low pressure drop should be offered. Why is this request limited to F7 filters only?

Policy scenario 2 (T7 p. 18) and policy scenario 3 (T7 p. 19) should be described in more detail. It should be clarified which requirements could become mandatory in tier 1 and which in tier 2 (and probably tier 3). Pros and cons should be elaborated as well as the relevant issues highlighted that need further refinement (e.g. relative level of ambition for the different fan types; consideration of part load etc.). If this is not possible at this stage, the lack of this should be clearly stated in the preparatory study.

In scenario 2 for AHUs, integrated controls are mentioned as an improvement option (T7, p. 18). Why are they not included in the list of requirements under AHUs & CHRV (p. 19)?

We also encourage the study team to illustrate the potential impact of the various scenarios on the current market regarding the products in question. i.e. what percentage of the market would be cut off if the suggested tiers were implemented?

Noise generated by ventilation equipment is not considered for a future measure in Task 7 under ventilation, unlike how it is dealt with under the air conditioning part. Further clarification on why this is the case is needed.

We strongly suggest the elaboration of information requirements, as in the air conditioning part. These should not only cover the basic information directly related to the specific requirements (e.g. energy consumption) but they should moreover also help the customer to better plan/model theirsystem (based on various parameter of their building, like dimensions and use patterns). The study team should indicate the information needed and suggest harmonised requirements (probably in alignment with the air conditioning part).

Benchmarks based on current BAT should be given.

The study team should discuss the option of introducing an energy label for this product group and elaborate the necessary details, since this will allow for innovation and differentiation in this product group. If this is not possible at this stage, the lack of reference to such a label should be clearly documented in the preparatory study.

UBA Comments by Umweltbundesamt (Federal Environment Agency, Germany)

21.5.2012

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General

Compact HVAC units for passive houses

In the stakeholder meetings, there has been a discussion on compact HVAC units being used in passive houses; we got the impression that there was no common understanding on those units. These units provide ventilation including heat recovery through heat exchanger, air heating through exhaust-air-to-air heat pump, water heating through heat pump. Some information can be found at http://passipedia.passiv.de/passipedia_en/planning/building_services/compact_hvac_systems, an example can be found at http://www.nilan.dk/en-GB/Frontpage/Solutions/Domestic-solutions/Total-solutions/Compact-P.aspx. It is still not clear how to handle those multi-functional products. We expect an increasing market share in the future.

Energy Label

We see the need of an energy label also for professional equipment for the following reasons:

- Professionals can use an energy label as tool for the communication with consumers (as manufacturers for professional ventilation equipment explained to us).
- In this product group, consumers/purchasers may be professionals, but in many cases they are not professionals in air conditioning or ventilation technology. Especially (green) public procurement needs simple support tools.
- Voluntary labels like Eurovent classification or German RLT-Geräte (http://www.rlt-geraete.de) show that also for professional equipment of high complexity an energy label can be successful and make sense.
- An energy label can support market transformation during the transition period until the more ambitious tiers become mandatory of proposed ecodesign requirements apply; the longer the transition period, the more important this support is.
- For boilers up to 70 kW heat output, there is a need of an energy label that is used by and for semi-professionals and non-professionals. There is no reason why for air conditioners above 12 kW (where a label is applied) there should be professional users only. It should be evaluated how the current label of air conditioners (regulation (EU) 626/2011) may be extended to a broader scope to meet the needs of semi- and non-professional users.
- We do not understand why there are differences among (reversible) air conditioners below 12 kW providing space for an energy label, but not above 12 kW.
- In the preparatory study it is noted, that only limited differentiation would be feasible. We do not agree with this perception. Energy efficiency classes usually reach from the average base case to BAT level. For example, for air conditioners, there could be in steps of 0.5 points of SEER or SCOP:
    - 5 classes for air-to-air air-conditioners (cooling),
    - [ok, only 3 classes for air-to-air air-conditioners (heating),]

  - o 11 classes for water-cooled air conditioning chillers > 400 kW,
  - o 5 classes for water-cooled air conditioning chillers > 400 kW

providing much space for additional product information in an energy label. (Note: the number of classes here is only for illustration of the space for an energy label. Categorisation and classes would need to be defined.)

- Mandatory Information on the properties and on the energy efficiency (classes) or TEWI (classes) of the product may be requested in the ecodesign requirements, too, similar to efficiency classes IE 3 etc. for electric motors. Then it needs to be ensured that decision makers have easy access to such information before the purchase decision, not only in the technical product documentation being provided after installation when it's too late.

Ventilation

<u>Scope</u>

- Domestic and non-domestic ventilation may be dealt with in one regulation. However, distinction should be made due to different sets of existing standards. If typical operating conditions like external pressure drop(?) for making this distinction cannot be defined, manufacturers may declare the type of application of their products.
- For heat recovery, also (exhaust)air-to-(supply)air-heat pumps combined with passive heat exchanger may be used. How can those products be handled?

<u>Requirements</u>

- Recommendations shall be based on outcomes of the assessments of this study, not on other considerations. Hence Policy 2 scenario seems very reasonable to us. However, we would appreciate more details and explanation of the scenario. An assessment of the pros and cons would furthermore be helpful.
- It is usually more convenient both for manufacturers and legislators to define the overall energy efficiency of a whole product considering all energy consumption for a certain purpose, than having a set of requirements on component level as it is proposed in the study. This allows manufacturers to find solutions for individual problems: they can do compromises in certain matters, but then need to be better in other elements. It may be more difficult to apply such an overall approach to products which are designed in a large number of variants. Requirements on component level bear the risk that some aspects of the products are not entirely covered. You don't know in advance how many steps a VSD actually needs. Nevertheless it seems important to have a more extensive investigation in the study,
  - o if using an overall energy efficiency parameter gives manufacturers more freedom in designing ventilation units by describing an overall target, opening a level playing field, or
  - o if the proposed set of requirements is precise enough, is useful for a large number products being modularly designed, and does cover all important aspects of ventilation.
- The criterion on heat recovery may be extended through the following criteria:
  - o Heat may be recovered through internal leakage in the heat exchanger, too. This is, of course, not intended, but is accounted in the measurements. A maximum *internal leakage rate* may be defined.
  - o Heat recovery rate is influenced by heat losses or heat gains through a poorly insulated casing, dependent on the measurement method and on installation location: An indoor

placed unit would benefit from poor insulation and high external leakage if the temperature increase of supply air would be used for measurements as currently proposed; actually the installation location would be cooled, and not heated from exhaust air recovered. In the current proposal, indoor and outdoor placed units are not rated unbiased. A maximum *external leakage rate* may be defined and an *appropriate measurement method* may be chosen. See also our comments by November 2011 for detailed proposals.

  - o Heat recovery units are tested with balanced air flows. For proper real life operation, there should be (*automatic) balancing*. Otherwise measured heat recovery figures would not be reached in practise.

- In EN 13053:2007 the heat recovery classes H1...H6 depend on operating hours which can hardly be estimated when placing a product on the market; more precise boundary conditions may be given. Please check if this definition still applies.
- Please check if it may be possible to circumvent the heat recovery requirement by simply using two separate products, one for supply air, one for exhaust air.
- Is part load operation considered properly? Do the correction factors (for VSD) of the fan regulation match the situation in ventilation units as there may be deviations in the share of operation hours in part load and full load?
- How can electricity consumption through auxiliary equipment (rotary heat exchangers, auxiliary equipment like condensate pumps) and in stand-by mode (for example of variable speed drives) be considered?
- The impact of controls to the overall energy consumption is significant.
  - o Why are CEXH units required to have clock speed control or air quality sensors, but for AHUs and CHRV no specifications are made?
  - o As controls may be added to the final installation, it may be checked if generic requirements on the compatibility of the ventilation unit with certain open control protocols are useful (for example, OpenTherm has been discussed in lot 1 for boilers).
  - o If it is not possible to include energy savings through controls into the energy efficiency requirements , at least mandatory information should be given. This could include the compatibility with controls (interface) and the effect on the energy consumption when using different types of controls. Alternatively, an “extended product approach” as for boilers may be appropriate.
- Please check if it makes sense to define a minimum exhaust air filter, too, as exhaust air filters will be used to protect the heat exchanger from contamination.
- There should be proposals for product information which is currently missing completely (supporting proper dimensioning of the product etc., even going beyond the product itself like air tightness of the building and of the ducts).

<u>Benchmarks, </u>…are missing. Please add.

<u>Editorial </u> task 7 p. 18: There is no G5 filter defined in EN 779.

AL-KO comments German manufacturer (Martin Törpe)

In our opinion the study is too optimistic regarding the merit of heat recovery for space cooling and – as a result—too optimistic regarding the savings of ventilation heat recovery in a Warmer Climate.

Having said that, we still believe that the general conclusion from the preparatory study, i.e. that heat recovery at levels of around 70% thermal efficiency can be economical (payback period < product life) in all EU climates, is still valid.

Higher thermal efficiency levels than 70% for air flows of approximately 5000 m³/h or higher would require a step-change in technology, i.e. only leave rotary heat exchangers, and therefore in pricing.

In the following we would like to illustrate our first point regarding heat recovery in the various climate zones.

As you already know, we had a similar problem when we established the energy labelling system for air handling unit in the Eurovent certification scheme. One of the main points, which affect the energy efficiency of air handling unit, is the use of a heat recovery system. The Eurovent Energy Label has to work through whole Europe. This was the reason why we did a lot of calculations with different climate data's in Europe to calculate the benefit of a HRS and to evaluate this in the label system.

As an example for a typical situation we found that for a more or less average climate (Wurzburg, Germany) the sum of heating and cooling energy is 160 MWh/a, whereas for cities in warmer climates like Madrid (inland, higher altitude) the value was 120 MWh/a and for a typical Mediterranean city like Barcelona 100 MWh/a was calculated. In other words, the theoretically maximum achievable heating/ cooling energy recovery in Spain was some 30% (25-37%) less than in the average climate.

These values were based on a pure mass- and thermal flow basis, i.e. independent of building characteristics, for 10 000 m³/h (12 h/d; 7d/wk).

We made new calculations for Athens, Strassbourg and Helsinki, based on the same airflow but with extract temperatures of 21 °C in winter and 25 °C in summer.

The benefit of a heat recovery system is very different. For example with a HRS efficiency with 65% you can save in Strassbourg 118 MWh/a but in Athens only 43 MWh/a, i.e. 60% lower. This includes also the saved cooling energy. Remember that we have a supply air temperature which increases up to 35°C ODA to 16°C, which is not only ventilation. The calculated cooling energy includes a part of room cooling as well.

All the calculations are done under the following basic conditions:

- supply temperature summer and winter fixed at 19°C
- extract temperature winter 19°C
- extract temperature summer 25°C
- total efficiency fan motor assembly 60%
- Equivalence factor thermal heating/electrical energy is 2
- (1 kWh electric energy = 2 kWh thermal energy)
- Standard air density =1,2 kg/m3
- Operating hours 24h
- Air flow 1m3/s = 3600 m3/h
- Pressure drop HRS acc. EN 13053

For the relationship between thermal efficiency and pressure drop the values from EN 13053 were used.

Latent heat was taken into account but not found very significant.

The problem with heat recovery for the Warmer Climate is in the fact that the temperature difference is often too small for effective heat transfer. For instance, 1.5 K has to be added to the extract air temperature of 25-26 °C for the motor heat and then still 2K is the minimum temperature difference needed to get some form of effective heat transfer. This means in practice, that below an outdoor temperature of 29 °C no heat recovery will take place.

At the same time, the heat recovery system's pressure drop does consume extra electricity. In order to find a way where in each climate zone the benefit of a HRS is nearly the same we calculated not only the benefit of the HRS but also the involved electrical energy for the pressure drop only for the HRS. The aim was to find the theoretical optimum for the total benefit (thermal energy – electrical energy).
The outcome for the three climates, at a 75% of the total theoretical benefit of an HRS was:

- Helsinki will reach it with an HRS temperature efficiency of 71% / 250Pa
- Strasbourg will reach it with an HRS temperature efficiency of 67% / 230Pa
- Athens will reach it with an HRS temperature efficiency of 47% / 125Pa

At the 80% of the totals theoretical benefit of a HRS:

- Helsinki will reach it with an HRS temperature efficiency of 76% / 280Pa
- Strasbourg will reach it with an HRS temperature efficiency of 73% / 270Pa
- Athens will reach it with an HRS temperature efficiency of 48% / 130pa

Martin Törpe, AL-KO Therm GmbH

Comparison EN 13053 to SFP

Comparison EN 13053 requirements to SFP (example)

The Nordic proposal gives the option that minimum requirements could be formulated where SFP limits are linked to static external pressure (Δp_{stat}) through a –to be defined—mathematical expression. This opens the possibility that the EN 13053 requirements in e.g. scenario 2 can be converted to SFP values with the same ambition level. Below an example is given how this could function in practice.

EN 13053

The EN 13053 requirements are class P1 for fan-drive efficiency, class V1 for face velocity and class H1 for energy efficiency of heat recovery.

P1 class limit = 0.85 * Pmref = $0.85 * \left(\frac{\Delta p_{stat}}{450}\right)^{0,925} * (q_v + 0,08)^{0,95}$

where

— *Pmref* is the reference power consumption [kW];

— Δp_{stat} is external static pressure [Pa];

— q_v is airflow [m³/s].

Δp_{stat} and q_v are determined at the reference working point, which is assumed to be at b.e.p. (best efficiency point) or at 65-70% of the design (declared maximum) air flow.

V1 class limit = 1.6 m/s

H1 class limit : $\eta_e = \eta_t * (1 - 1/\varepsilon) = 71\%$

where

— η_e is the energy efficiency of the heat recovery system HRS [-],

— η_t is the thermal efficiency of the HRS [-], where

$\eta_t = (t_2'' - t_2')/(t_1' - t_2')$, with

— t_2'' is temperature of the supply air leaving the HRS and entering the room [°C]

— t_2' is temperature of the outside air [°C]

— t_1' is temperature of the exhaust air, leaving the room and entering the HRS [°C]

— ε is the coefficient of performance [-], where

$\varepsilon = Q_{HRS} / P_{el}$, with

— Q_{HRS} is the capacity of the heat recovery system [W], where

$$\boldsymbol{Q_{HRS} = q_m \bullet c_{pA} \bullet (t_2'' - t_2')}$$, with

- q_m is the mass flow of the air [kg/s] (air density, by convention: 1.2 kg/m³);
- c_{pA} is specific thermal capacity [kJ/kg K] (dry air ca. 1 kJ/kg K);
- $(t_2'' - t_2')$ is the difference between supply and outdoor air temperature [K]

- P_{el} is the electric power consumption attributed to the pressure loss of the heat recovery system [W], where

$$\boldsymbol{P_{el} = q_v \bullet \Delta p_{HRS} / \eta_D + P_{el\,aux}}$$, with

- Δp_{HRS} is the sum of pressure loss [Pa] at supply side and exhaust side of the heat recovery system with $\Delta p_{HRS} = \Delta_{supply} + \Delta_{exhaust}$
- η_D is 0.6 is the efficiency [-] of electric power generation (EN 13053)
- $P_{el\,aux}$ is the auxiliary electric power consumption [W], e.g. of circulation pump in a run-around system.

Note that the formula for $\boldsymbol{\eta_e}$ promotes both a high thermal efficiency $\boldsymbol{\eta_t}$ and a low pressure loss $\boldsymbol{\Delta p_{HRS}}$ (determining part of $\boldsymbol{\varepsilon}$) of the heat recovery system.

Thermal efficiency $\boldsymbol{\eta_t}$ is determined according to EN 308:1997, i.e. with reference testing conditions entailing dry exhaust 'indoor' air $\boldsymbol{t_1'}$ at 25 °C dry bulb temperature (wet bulb temperature 18 °C for regenerative hygroscopic recovery devices, <14 °C for other types) and dry 'outdoor' air $\boldsymbol{t_2'}$ supplied to the heat recovery system on the supply side at 5 °C dry bulb temperature (for regenerative hygroscopic recovery devices 3 °C wet bulb temperature) , with no influence of fan motor waste heat during the test. The test procedure consists of 7 tests at the following combinations of supply (q_{m2}) and exhaust(q_{m1}) air flows:

qm2	qmn	0,67 qmn	1,5 qmn	0,67 qmn	qmn	qmn	1,5 qmn
qml	qmn	qmn	qmn	0,67 *qmn*	0,67 qmn	1,5 qmn	1,5 qmn

Wher q_{mn} is the nominal air flow. Thermal efficiency is the non-weighted average of the test results.

The pressure drop of the heat recovery system $\boldsymbol{\Delta p_{HRS}}$ is the sum of supply side and exhaust side pressure drops Δp_2 and Δp_1, determined according to EN 308:1997. Static pressure drops shall be measured, and dynamic pressure calculated, both sides of the recovery device for the 7 different air flow rate combinations mentioned above. The pressure drops Δp_2 and Δp_1 are the non-weighted averages of the individual 7 test results.

Further stipulations regarding test conditions, allowed leakages, tolerances, etc. can be found in EN 308:1997.

Filter class (Eurovent classification): "A", e.g. maximum 105 Pa average pressure drop at F7 filter class.

Units equipped for filters should be prepared to accommodate filters with these specifications; delivery of filters is not required. Filters are tested according to Eurovent recommendation 4/11: at EN 779 conditions, i.e. at air flow of 0.944 m3/s, filter face 0.592 x 0.592 m (face velocity 2,7 m/s), and while –for fine filters-- loading 100 g of appropriate ASHRAE test dust the filter's pressure drop is measured at least at 5 different points in time until 100 g of test dust is loaded or a maximum pressure drop of 450 Pa is reached. Through 4tht order polynomial curve fitting the average pressure drop $\overline{\Delta p}$ is assessed. Using 50% fan efficiency, 6000 operating hours and an airflow of 0.944 m3/s the annual electricity consumption W= 11.32 * $\overline{\Delta p}$ in kWh/a is determined. The class limit for the "A" class with F7 filters in this scheme is set at 1200 kWh/a, which means at around an average pressure drop of 105 Pa.

SFP equivalent

The Nordic proposal entails that the AHUs and CHRV should be tested with filters (F7 supply, G5 exhaust) and heat recovery unit.

The AHU Basecases show a range of 260 (AHU-S) to 390 (AHU-L) Pa internal pressure drops per side. For CHRV the pressure drop is around 320 Pa. It is assumed, as an illustration and also based on Exhausto data, that it must be possible at a face velocity V1 (1,6 m/s) instead of the customary 2.5 – 3 m/s to realize an average internal pressure drop of 200 Pa per side (400 Pa total).[4]

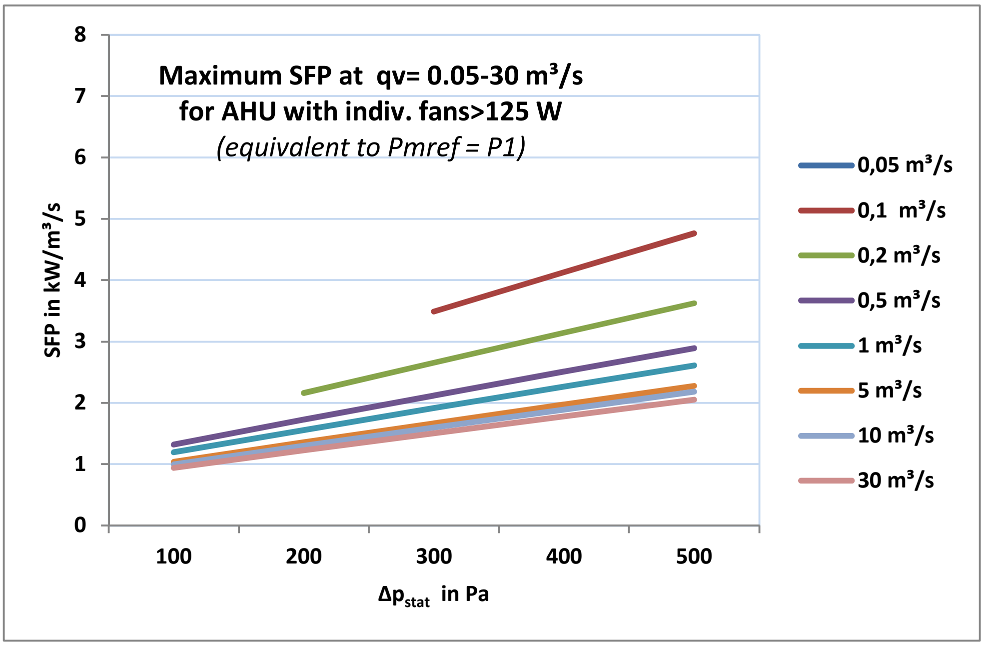
Hence, considering that the unit contains 2 fans that have to meet P1 class, the equivalent formula for the SFP limit should be

$$SFP = 2 * 0{,}85 * \frac{\left(\frac{\Delta p_{stat} + 200}{450}\right)^{0{,}925} * (q_v + 0{,}08)^{0{,}95}}{q_v}$$

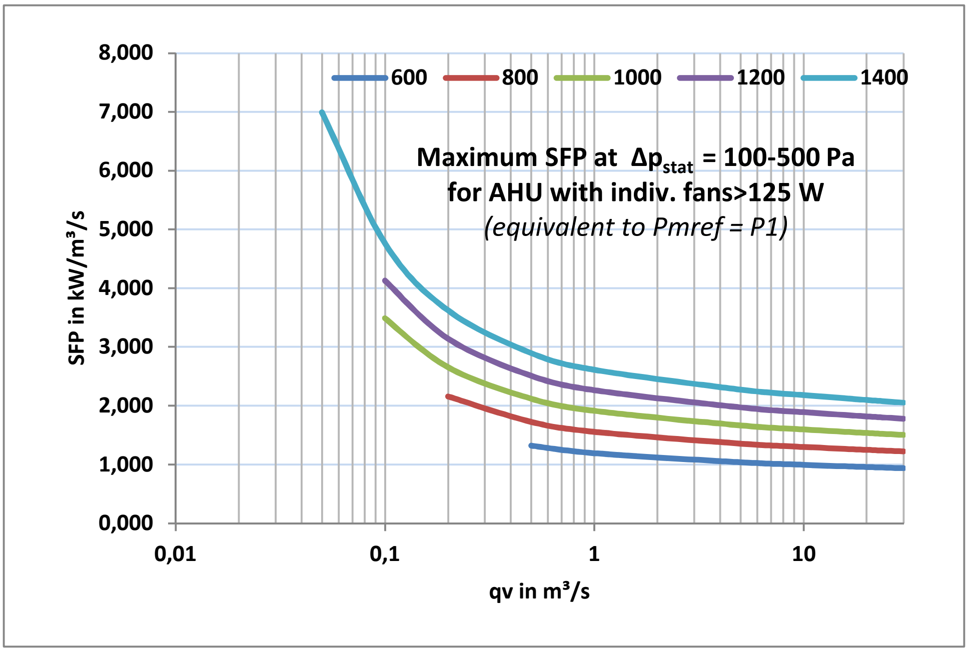
Note that the fixed number of 200 Pa could be adaptable e.g. for cases where there are no filters, i.e. to avoid unfair competition. Furthermore, to avoid loopholes as regards the reference working point, which should be chosen not below 65% of the (maximum) design air flow and 65% of the design pressure, the manufacturer should clearly state in the product documentation that no liability is assumed if the unit is operated at flow rates above the design air flow.

Graph with SFP on y-axis and external static pressure on x-axis, with curves for 100-200-300-400-500 Pa external pressure drop (600-800-1000-1200-1400 Pa internal+external)

[4] Based on an "A" class F7 filter: nominally 100 Pa, but at lower-than-test pressure drop with V1 class face velocity (<1,6 m/s) estimated at around 60-80 Pa. For a G5 filter, also "A" class this should be less than 60 Pa. For an 80% thermal efficiency heat exchanger Danish manufacturer Exhausto mentions pressure drops of 80 Pa (rotor) and 125 Pa (counterflow) at V1 face velocity. Casing pressure drop is estimated in literature around 10-20 Pa. Thus 200 Pa per side (400 Pa in total) internal pressure drop should be possible.



Graph with SFP on y-axis and airflow on the x-axis, with curves for 100-200-300-400-500 Pa external pressure drop (600-800-1000-1200-1400 Pa internal+external)



SFP values and classes for 100-200-300-400-500 external static pressure difference

		Max. SPF$_{ahu}$ (in kW/m3/s)								
External + internal p	**External pstat**	**0,05**	**0,1**	**0,2**	**0,5**	**1**	**5**	**10**	**20**	**30 m^3/s**
600 Pa [2*(100+200)]	**100 Pa**				1,322	1,193	1,039	0,996	0,958	0,938
800 Pa [2*(200+200)]	**200 Pa**			2,159	1,725	1,557	1,356	1,300	1,251	1,224
1000	**300 Pa**		3,489	2,654	2,121	1,914	1,666	1,598	1,537	1,505
1200	**400 Pa**		4,130	3,142	2,510	2,266	1,973	1,891	1,820	1,781
1400	**500 Pa**	6,993	4,763	3,624	2,895	2,613	2,275	2,181	2,099	2,054

Maximum SFP classes		**0,05**	**0,1**	**0,2**	**0,5**	**1**	**5**	**10**	**20**	**30 m^3/s**
600 Pa [2*(100+200)]	**100 Pa**	Pmref P1 is <125 W			3	2	2	2	2	2
800 Pa [2*(200+200)]	**200 Pa**			5	4	4	4	4	4	3
1000	**300 Pa**		6	5	5	4	4	4	4	4
1200	**400 Pa**		6	6	5	5	4	4	4	4
1400	**500 Pa**	7	7	6	5	5	5	5	5	5

In W/m3/s: SFP1=<500; SFP2=<750; SFP3=<1250; SFP4=<2000; SFP5=<3000; SFP6=<4500

For the most common pressure-airflow combinations one could say that units with static pressure difference <200 Pa fall into the SFP3 class and the rest falls into the SFP4 class, at overall a thermal efficiency of 75%.

Note that the above is a first estimate to arrive at an equivalent ambition level as sketched in Scenario 2. Should the Commission decide to use the SFP-metric instead of, or alongside, the EN 13053 requirements the determination of the exact values will be topic of discussion with the stakeholders.

For comparison it can be mentioned that building regulations in Scandinavian countries, Germany and the UK require SFP-classes around SFP4. More details can be found in the Task 1 report.