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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Commission Regulation implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to Ecodesign requirements for ventilation units

and

Commission Delegated Regulation implementing Directive 2010/30/EU of the European Parliament and of the Council with regard to energy labelling of ventilation units

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EXECUTIVE SUMMARY

The majority of building stock in the EU could benefit from optimised mechanical ventilation, with demand side control, heat recovery ventilation or both. Ventilation units are energy-using but also energy-related products with a significant untapped potential to reduce their own electricity consumption, but also in terms of savings on space heating. However, the market has so far failed to achieve a larger penetration of energy efficient ventilation units and an increased use of mechanical ventilation units instead of natural ventilation. So far, no product-level legislation addressing the electrical efficiency and the thermal efficacy of ventilation units exists in the EU or in third countries.

This ecodesign and energy labelling initiative shall correct market and regulatory failures, contributing to exploit the large cost-effective potential of ventilation units for reducing electricity consumption and increasing the space heating energy saving. This policy will contribute to the EU 2020 goal to reach a 20% energy and carbon saving.

The proposed regulations, together with relevant standards, will help consolidate the internal market for ventilation units. In the absence of an EU Regulation, manufacturers and utilities may be confronted with a proliferation of national regulations establishing disparate minimum performance requirements and increasing compliance costs.

The following options have been considered:

Option 1: No EU action (included as a baseline reference in the analysis).

Option 2: Self-regulation

Option 3: Energy labelling

Option 4: Ecodesign implementing regulation

Option 5: Labelling and Ecodesign combined

Three policy scenarios differentiating in their ambition level were designed for the maintained options. In conclusion, this Impact Assessment found for 'small' residential ventilation units (RVUs) option 5 as most adequate solution, combining the advantages of the two options, the 'market push' of Ecodesign, and the 'market pull' of labelling, as such small units can be considered 'consumer products'. For 'big' non-residential ventilation units (NRVUs) 'Ecodesign only' is considered an optimal choice, as these products are chosen by planners and architects and largely independent from consumer and market behaviour.

The Member States, Environmental NGO's and consumer associations support in general the design of the energy label measures for residential units and the ecodesign minimum requirements measures both for residential and non-residential. Industry associations also largely supported the ecodesign and energy labelling measures. However, initially there was opposition to the ambition level and to the inclusion of some unidirectional units as proposed by the Commission. Also there was opposition against measuring several aspects and components instead of a more holistic measurement approach. . The Commission has tried to accommodate the various concerns in its proposals and tried to reach compromise solutions.

It is estimated that cost efficient savings in the order of over 30% are feasible. By 2025 around 1300 PJ per year primary energy extra savings can be attributed to the preferred option (2030: 1460 PJ). The accumulative energy and CO_2 savings amount to almost 16 000 PJ and 760 Mt CO_2 equivalent respectively over the 2011-2030 period. The total saving in end-user spending is projected to be over € 26 billion in the year 2025. For the environment, by 2025 around 70 Mt CO_2 equivalent less will be emitted due to this initiative (by 2030 81 Mt). No significant negative impacts are expected from the preferred option. It is expected that manufacturer's revenues, in 2010 estimated at around € 2.9 billion, will triple over the 2010-2030 period, creating around 85 000 new industry jobs in this primarily EU-based industry. Installers, consisting of over 80% small- and medium sized enterprises taking most of their income from labour, are expected to benefit with an extra increase of revenue from unit sales and extra installation work. As a benchmark, if all the ventilation units would be replaced by the Best Available Technology, savings of more than 60-70% are possible.

The measures will remove and replace less efficient ventilation units at an adequate pace. As meeting the target levels does not require exotic or highly advanced technology, the costs of R&D and tooling are not expected to rise above the normal level. The same goes for testing costs, which will constitute less than 0.1% of the product price. For the vast majority of companies, strong measures on the energy and the performance side will have a positive impact on their competitiveness and their innovation capacity. It will deter inefficient low-cost imports which have negative impact on profitability. Costs for more efficient products are passed on to consumers in a higher purchase price, but which is more than compensated by lower running costs. Payback times for the preferred option are in the order of 4-6 years for users living in the average climate.

There is a small threat of low-cost imports of components and whole ventilation units to EU manufacturing and SMEs. Given the quality-levels and energy efficiency of these products, the advantages of these low-cost appliances for consumers, if any, are at best limited. This initiative supports maintaining the growth in EU manufacturing of ventilation units. This will help SME producers of components, with no negative impact on consumers as regards the total Life Cycle monetary costs. Testing costs for the proposed measures are, also for SMEs, not significantly different from current practice. As the measures contribute significantly to push the ventilation sector, the increase of employment in the ventilation industry is estimated at 85 000 jobs and in the related system industry and installer business, which is predominated by SMEs, at 300 000 jobs. Thus the overall impacts on SMEs will be positive.

No significant impact on national budgets and administration is expected. Efficient ventilation products will save space heating also in buildings of the public sector and thus reduce public spending.

No other significant impacts are expected. The regulation is establishing minimum energy efficiency requirements for new ventilation units. The requirements consider the needs for replacement and retrofitting.

The regulation is expected to be reviewed in 2019. Some of the issues that will be considered in the review, inclusion of small units the need to tighten ecodesign requirements, the need to add a further tier, and the possibility of establishing a single set of requirements for both RVUs and NRVUs or harmonising their requirements..

1. PROCEDURAL ISSUES AND CONSULTATION

1.1. Organisation and Timing

Implementing measures on residential and non-residential ventilation units (hereafter 'RVUs' and 'NRVUs' respectively) are priorities of the *Action Plan for Energy Efficiency* [1] and the *Energy Efficiency Plan 2011*[2] .

The legal basis for these implementing measures are Article 114 TFEU[3] (internal market) for Ecodesign requirements and Article 194 TFEU (energy policy) for Labelling measures.

Ecodesign and energy labelling requirements for products constitute an important instrument for meeting the policy objectives under the *Resource-efficient Europe - Flagship Initiative*[4], the *Energy 2020* [5] strategy paper and the Commission's *Energy Efficiency Plan 2011*.

At an operational level, the *'20-20-20'* target is relevant, which aims amongst others at a 20% reduction of energy consumption and carbon emissions in 2020 with respect of the reference year 1990.[6]

These measures on ventilation units are part of the holistic energy accounting in the Energy Efficiency Directive (EED) [7], in the Energy Performance of Building Directive (EPBD) [8] and in the EU Emission Trading Scheme Directive (ETS)[9].

The implementing measures are based on the Directive 2009/125/EC[10] (from here onwards "the Directive") of the European Parliament and of the Council establishing a framework for the Commission, assisted by a regulatory committee to set ecodesign requirements for energy-related products, in combination with energy labelling under Directive 2010/30/EU[11]. The Ecodesign Directive 2009/125/EC references the objectives of the *EAP6* [12] and *ECCP*[13].

Article 16 of the Ecodesign Directive provides the legal basis for the Commission to adopt implementing measures on this product category.

According to the Ecodesign Directive, an energy-related product or a group of energy-related products shall be covered by ecodesign implementing measures, or by self-regulation (cf. criteria in Article 17), if the products represent significant sales volumes, while having a significant environmental impact and significant improvement potential (Article 15). The

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1 COM(2006)545 final. *Action Plan for Energy Efficiency: Realising the Potential*, Brussels, 19.10.2006.

2 COM(2011)109 final. *Energy Efficiency Plan 2011,* Brussels, 8.3.2011.

3 Treaty on the European Communities (TEC) was replaced by the Treaty on the functioning of the European Union (TFEU) which entered into force on 1st December 2009 (content of Article 95 TEC was moved to Article 114 TFEU).

4 COM (2011)21 final. *A resource-efficient Europe – Flagship initiative under the Europe 2020 strategy*, Brussels, 26.1.2011.

5 COM(2010)639 final. *Energy 2020 – A strategy for competitive, sustainable and secure energy*, Brussels, 10.11.2010.

6 European Council, Presidency Conclusions, March 2007.

7 OJ L 315, 14.11.2012, p. 1-56.

8 OJ L 153, 18.6.2010, p. 13-35.

9 OJ L 275, 25.10.2003, p. 32-46.

10 Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (recast), OJ L 285, 31.10.2009.

11 Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products (recast), OJ L 153, 18.6.2010.

12 Decision No 1600/2002/EC of the European Parliament and of the Council of 22 July laying down the Sixth Community Environment Action Programme OJ L 242, 10.9.2002, p. 1.

13 European Climate Change Programme. http://ec.europa.eu/clima/policies/eccp/index_en.htm

structure and content of an ecodesign implementing measure shall follow the provisions of Annex VII of the Directive.

Consultation of stakeholders is based on the Ecodesign Consultation Forum as foreseen in Article 18 of the Ecodesign Directive (see next chapter for details), including the consultation of stakeholders during the preparation of preparatory technical studies from 2006 to 2011 in order to assist the Commission in analysing the likely impacts of the planned measures.

Article 19 of the Directive 2009/125/EC foresees a regulatory procedure with scrutiny for the adoption of implementing measures. Subject to qualified majority support in the regulatory committee and after scrutiny of the European Parliament, the adoption of the measures by the Commission is planned by early 2014.

For labelling measures, the consultation of stakeholders and the adoption procedure are carried out in a delegated act procedure according to Articles 10 to 13 of the Labelling Directive 2010/30/EU, to the extent possible in parallel and linked to the ecodesign implementing measures. The preparation of labelling measures is based on the consultation of experts, followed by a proposal for Delegated Regulation to be adopted by the Commission before going for approval by the Council and the EP.

Ventilation units have neither been previously subject to EU-wide minimum energy efficiency performance standards ('MEPS'), nor to mandatory energy labelling.

1.2. Impact Assessment Board

The draft Impact Assessment (IA) received a positive opinion of the Commission's Impact Assessment Board (IAB) in their meeting of 29 May 2013.[14] However, the IAB stated that the report should be improved in a number of respects.

First, it should clarify the nature of the problem and provide more evidence of the need for EU-level product legislation as opposed to ventilation system-level legislation at the EU and national level. In addition, the report should widen the set of options under consideration, including for instance system-level regulations, and provide a stronger justification for the need to adopt both labelling and minimum energy requirements for residential products. More specifically, the IAB insists that the 'energy labelling only' option and the 'ecodesign only' options for RVUs should not be discarded upfront but should be analysed in full. Finally, the report should strengthen the analysis of impacts, particularly as regards costs for producers and consumers and different climate zones. In the absence of robust evidence, the very large increases in employment expected should be reconsidered. Against this background, the comparison of the options should be reviewed and the preferred option better justified.

In response, the underlying report explains more clearly in Chapter 2 how the product-level legislation and system-level legislation are complementary. The ecodesign product-level measures procure the more efficient products and the system-level measures on e.g. energy performance of buildings (EPB) promote the use of these more efficient products in buildings. The former address the manufacturers and their design engineers; the latter address builders and their architects/planners. Regarding the use of system-level legislation, the report now explains more clearly in Chapter 4 that system-level measures at the level of building design are a) not in the scope of the Ecodesign Directive and b) are not a substitute for product-level measures but should be complementary. As regards the impacts, Chapter 4 and 5 are expanded with a better explanation and include a quantitative analysis of 'energy labelling only' and the ecodesign only' options for RVUs. The report addresses the issue of economics

[14] IAB scrutiny process, reference number 2014/ENTR/003.

in different climate zones, see paragraph 4.4.1, and it puts the expected employment effects into perspective in paragraph 5.2.8.

1.3. Transparency of the consultation process

This Impact Assessment is supported by preparatory studies for eco-design requirements (hereafter called 'preparatory studies') carried out by external consultants on behalf of the Commission's Directorate General for Energy (DG ENER, for RVUs) and Enterprise (DG ENTR, for NRVUs).

For RVUs, the preparatory study –ENER Lot 10, 'Residential ventilation' part– was carried out by Armines, between Nov. 2007 and Feb. 2009.[15]

For NRVUs, VHK carried out the preparatory study –ENTR Lot 6, 'Ventilation' part– during the period Jan. 2010-June 2012.[16]

The preparatory studies followed the structure of the 'Methodology for the Ecodesign of Energy Using Products (MEEuP)'[17] developed for the Commission's Directorate General for Enterprise and Industry (DG ENTR). MEEuP has been endorsed by stakeholders and is used by all ecodesign preparatory studies until 2012[18].

The purpose of the preparatory studies was to perform a technical, environmental and economic analysis for ventilation units in order to improve their environmental performance, within the framework of the Ecodesign Directive.

The preparatory studies were developed in an open process, taking into account input from relevant stakeholders including manufacturers and their associations, environmental NGOs, consumer organisations, and EU Member State experts. During each of the preparatory studies 3 stakeholder meetings and several bilateral encounters with stakeholders took place in Paris (for RVUs) and Brussels (for NRVUs) to discuss and validate the preliminary results of the studies.

In 2010, an update of the main findings of the RVU-study was undertaken in the context of technical assistance contract for the Commission DG ENER, which resulted in a draft Working Document and written stakeholder consultation by the Commission DG ENER issued 21 Dec. 2010. The results of this consultation, which yielded reactions from Member States, industry and NGOs, were published on the Commission's CIRCA website in the first half of 2011.

In July 2011, during the second stakeholder meeting, the Commission announced to stakeholders that it intended to combine the design of measures for RVUs and NRVUs as the

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15 ARMINES et al., Preparatory study on the environmental performance of residential room conditioning appliances (airco and ventilation)—Study on residential ventilation, Final report, February 2009. [Contract TREN/D1/40-2005/LOT10/S07.56606]. Available at http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/product-groups/airco-vent/files/residential_ventilation_en.pdf

16 VHK, Preparatory Study on Lot 6: Air Conditioning and ventilation systems, Ventilation part, project with Armines (FR), VHK (NL) and BRE (UK) for the European Commission, Report 14 June 2012.

17 Kemna, R. et al., *Methodology for the Ecodesign of Energy-using Products (MEEuP)*, VHK for EC DG ENTR, Final Report 28 Nov. 2005, available at http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm

18 From beginning of 2012, following the recast of the Ecodesign directive, updated: Kemna, R. et al., Methodology for the Ecodesign of Energy-related Products (MEEuP), Final Report 28 Nov. 2011, available at http://www.meerp.eu/documents.htm .

products were found similar in functionality and the combination in one package of measures expected to alleviate the administrative burden.

The European Commission consulted SMEs, companies working in the ventilation sector, and other interested parties about possible future EU requirements for ventilation products. A specific information and consultation document was prepared in 6 languages (EN FR DE IT ES PL). It was widely distributed via the ENTERPRISE EUROPE NETWORK, trade associations, public webpages, and CIRCA. The consultation was launched in October 2012 and open for more than 12 weeks. Replies were received from a couple of SMEs from different Member States until end of February 2013, and their comments taken into account.

Further to Article 18 of the 2009/125/EC Directive, formal consultation of stakeholders was carried out for residential and non-residential ventilation units through the Ecodesign Consultation Forum consisting of a 'balanced participation of Member States' representatives and all interested parties concerned with the product group in question'.

The meeting of the Ecodesign Consultation Forum took place on 6 Nov. 2012. Building on the results of the preparatory studies, the Commission services presented a Working Document suggesting ecodesign requirements based on scenarios developed under the preparatory studies. The working documents were circulated duly before the meetings to the members of the Ecodesign Consultation Forum and to the secretariats of the ENVI (Environment, Public Health and Food Safety) and ITRE (Industry, Research and Energy) Committees of the European Parliament for information. The working documents were published on DG ENTR's ecodesign website, and they were included in the Commission's CIRCA system alongside the stakeholder comments received in writing before and after the Consultation Forum meeting. Minutes of the Consultation Forum meetings can be found in **Annex A.**

Internal consultation: All relevant Commission services (ENER, ENTR, ENV, CNECT, SANCO, CLIMA, COMP, SG, and TRADE) were consulted on drafts and relevant documents. Impact Assessment Steering Group Meetings concerning this product group took place on 7 November 2012, 22 February 2013, and 15 April 2013. At the last meeting, the Impact Assessment Steering Group was consulted on a final draft of this IA.

1.4. Results of stakeholder consultation

The **Member States** support in general the design of the energy label measures for RVUs. They also support in general the setting up of ecodesign minimum requirements measures both for RVUs and NRVUs. However, as regards RVUs various Member States advocated that the ecodesign requirements would be restricted to the subsequent elimination of labelling classes and would not venture to regulate the other aspects, such as SPI (Specific Power Input), thermal efficiency of heat recovery because they were already integral part of the holistic calculation method for the label. As regards the NRVUs, especially the Scandinavian countries advocated the use of the SFP (Specific Fan Power) to regulate the electrical efficiency of the units instead of the power reference taken from the EN standard that was proposed by the Commission in its Working Document (WD). As the proposed ambition level of tier 2 of the proposed measures was already very ambitious, Member States indicated not to insist on the definition of a 3rd tier requirement. Having said that, Sweden asked the Commission to consider whether the 'A' class limit could not be raised, as their research showed that already several models could meet that requirement. Italy stressed that smaller unidirectional ventilation units, which are used in a large variety of applications and typically operated intermittently, should not be included in the scope.

Environmental NGO's and consumer associations supported the requirements in the Commission proposal, but they also favour the use of SFP to regulate the electrical efficiency of NRVUs.

Industry associations[19] largely supported the ecodesign and energy labelling measures proposed by the Commission, especially for balanced units. Regarding unidirectional units, there was initially strong opposition to the ambition level proposed by the Commission. Also there was strong opposition of the European associations to the SFP-approach, advocated by Nordic Member States, because in the perspective of the European industry associations the SFP-parameter would regulate several aspects (external pressure, pressure drop from non-ventilation components) over which they have no control.

Note that the results of the stakeholder consultation reflect the situation during and immediately after the Consultation Forum (CF). In the period following the CF, the Commission Services have studied the comments and has tried to accommodate the various concerns in its proposals or, through bilateral meetings and additional analysis, and tried to reach compromise solutions. Consumer associations have been consulted and agreed to the proposed requirements.

1.5. Terminology

This product is both an energy-using product (EuP) consuming electricity, and an energy-related product (ErP) indirectly saving on space heating energy. In this context, the terminology of the word 'saving' may be confusing. With an ErP the saving is not a result of a measure but an inherent characteristic of the product, like with insulation materials or double glazing which may save less or more, but they always save. In order to avoid confusion, this report will use the term 'avoided' instead of 'saved' space heating energy.

2. POLICY CONTEXT, PROBLEM DEFINITION, AND SUBSIDIARITY

2.1. Policy context

Article 15(2) of the Ecodesign Directive formulates the main criteria that make a product group eligible for Ecodesign measures, i.e. *significant sales volume*, a *significant environmental impact* and a *significant improvement potential without excessive costs*. The latter is to take into account the absence of other relevant Community legislation or *failure of market forces* to address the issue properly and a *wide disparity* of environmental performance for functionally comparable products.

The following paragraphs will subsequently address the product scope, and the three main eligibility criteria. Where possible, not only historical and actual data are given, but –as detailed background information to the impact analysis in Chapter 5, also the baseline ('BAU', 'Business-As-Usual') projections.

It should be taken into account that data availability for the product group is particularly poor and much information is based on anecdotal data and expert estimates rather than EU-wide accurate estimates. Different from many other products subject to an impact assessment for ecodesign measures, ventilation units have not been subject to product-specific policy measures before. Furthermore, mechanical ventilation products, especially for residential applications, are a relative newcomer in the building installation market and the various

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[19] EVIA, Eurovent, EPEE. See section on Industrial market actors and stakeholder associations Annex D for more details.

representative associations, nor any commercial research institute, have much experience in gathering market and energy data.

2.1.1. Product scope

The scope of the product categories addressed by the future implementing measures is in line with the scope of the preparatory studies and the result of the stakeholder consultations.

The product scope entails (mechanical) ventilation units (VUs), defined as an appliance equipped with at least a fan, motor and casing intended to replace utilised air by fresh air in a building or part of a building. A distinction can be made between

Residential ventilation units (RVUs) and

Non-residential ventilation units (NRVUs).

The distinction was made on the basis of the electric input power per individual fan, i.e. if the power is ≤125 W then the VU is residential (the scope of the ENER Lot 10 preparatory study) and if the power is >125W then the VU is non-residential (the scope of the ENTR Lot 10 preparatory study). Unless explicitly mentioned otherwise, the data in this IA report refer to the above definition for RVU and NRVU used in the preparatory studies.

Illustrations of the products in the scope, as well as a further product categorisation and exclusions are given in **Annex B.**

Note that ventilation systems, i.e. including not only the ventilation units but also ductwork, grills, etc., are subject of the Energy Performance of Building Directive EPBD 2010/31/EU which Member States are supposed to implement through national EPB building regulations. Building regulations are not only a powerful market driver, but also a very helpful complement to Ecodesign measures (or v.v.). Directly or indirectly they determine the required ventilation performance (air change rate, minimum outlet pressure to conquer over/under-pressure on the façade), the external pressure drop (i.e. outside the ventilation unit) of ductwork and air terminals, pressure drop of additional non-ventilation elements (heating coils, mixing valves) that influence the energy use of the ventilation unit, the performance of natural ventilation in/outlet openings in case of unidirectional mechanical systems, noise, etc..

The Ecodesign legislation operates at product level and cannot regulate these ventilation aspects of the EPBD, which still are a vital part of the overall performance. But it should be mentioned that well-designed Ecodesign measures facilitate such lateral EPB measures. (see also paragraphs. 2.2.2, 4.3 and . 4.4)

2.2. Problem definition

The main market and regulatory barriers, hampering a larger market penetration of energy efficient ventilation units and an increased use of mechanical ventilation units instead of natural ventilation, were identified in the preparatory studies as follows

2.2.1. Market failures

<u>Lack of consumer information</u>

Most people associate low-energy/passive housing and Near Zero Energy buildings with better insulation, double glazing, solar panels and possibly a better boiler. Outside the colder climate zones, very few people know that insulation and double glazing tackle only 60-65% of the heating load and that the ventilation losses take up the rest (35-40% and in well insulated houses even more). As a result, they don’t see an energy efficient ventilation system

–that could save up to 80% of these 35-40%-- as an important potential energy saver. Whenever ventilation is seen as part of the solution, many people think about fighting the drafts and closing the infiltration gaps to get an airtight building shell. To remedy the stuffy indoor-atmosphere that is the result from closing these infiltration gaps it is perceived that it is enough to open the windows more often and longer, by installing the cheapest possible mechanical ventilation (extraction fans) or simply –because of lack of knowledge on the detrimental effects of insufficient ventilation--accept it.

It is obvious that with this general mind-set of the end-user, which is changing only very slowly due to the lack of effective information, the end-user is not a strong driver of demand to implement effective and efficient mechanical ventilation systems. For the non-residential market the same problem exists, i.e. that there is lack of information with the final buyer (businesses, real estate project managers). Such knowledge exists –to a degree—with the builders, planners and engineers but this is no guarantee that it is necessarily transferred to the final buyer of a building with a ventilation system (see also 'split incentives' paragraph).

<u>Lack of installer training and information</u>

In most parts of Europe, again with the exception of Northern and mountainous areas, effective and efficient mechanical ventilation systems are new not only to consumers but also for installers, especially in the residential sector. Unless they are actually forced by building regulations, most of them just put in the cheapest solution or replace a broken unit one-on-one. Most often they don't have the knowledge nor the motivation, to suggest the best possible ventilation solution. Instead, there are numerous anecdotal cases where installers are seen to dissuade builders or end-users from trying something new[20]. Furthermore, when installing new systems, there are incidences where grave installation errors were made.[21]

Reasons are deficiencies in proper schooling, vocational training and information (e.g. books, standards, etc.), but above all lack of motivation. The latter is caused by habit (most training is 'on the job', which doesn't work when no-one 'on the job' is familiar with the subject), a lack of competition (installers are in short supply), no mandatory certification (no tangible commercial gain from training) and economics (training costs time and time is money, especially with SMEs).

In the non-residential sector architects, planners, engineers and installers work together in the realization of the ventilation systems. Here the situation is better, but still far from ideal. In the non-residential sector, it takes several years before the best-practice of the 'early adopters' trickles down to the traditional, most conservative professionals.

<u>Split incentives</u>

There is a split incentive between builders and building owners or landlords and tenants as regards the costs and efficiency of ventilation systems. The building-owners, i.e. the ones paying the energy bill, have an interest in energy-efficient ventilation systems. The builders are working on a strict budget, where ventilation systems are one of the last items in the building process where a cost saving is possible. Given the low awareness of the building owners of the relevance of the ventilation system for energy consumption (see above) it is also a very common item for builders to realize monetary savings. Likewise, in a situation

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[20] VHK, Lot 6: Air-conditioning and ventilation systems – Ventilation part, Final report 14 June 2012, Consortium ARMINES (main contractor)/VHK/BRE for EC DG ENTR. [Contract ENTR/2009/035/LOT6/SI2.549494]. Available at www.ecohvac.eu .

[21] Ibid. 42.

between landlords, who would have to invest, and tenants, who pay the energy bill, very often there is a similar case of split incentive.

Negative image

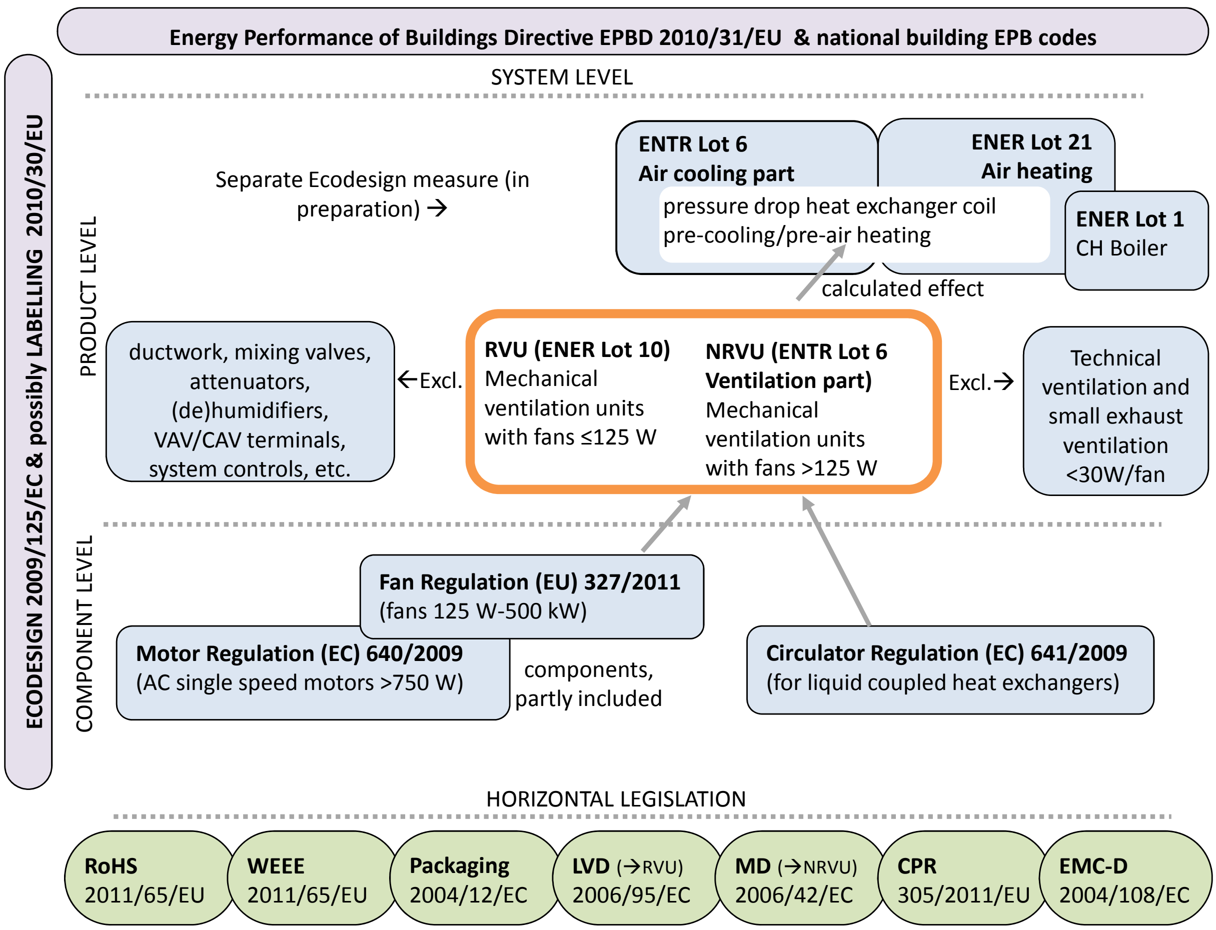
With some parts of the population, mechanical ventilation through ductworks does not have a positive association. Polluted ductworks and the 'sick building' syndrome still have a bad reputation, even though they were typical of legacy solutions. On the other side, the negative image is with a small and shrinking group. Sufferers from respiratory health problems, the elderly and (school) children are strong advocates of the health benefits from mechanical ventilation.[22]

2.2.2. Regulatory failures

Lack of specific policy measures

There is a myriad of ventilation related legislation, but at the level of the *products* there have been no mandatory legislative measures either in the EU or in third countries addressing the electrical efficiency and the thermal efficacy of ventilation units.

Figure 1: EU legislation related to ventilation units (orange border delimits the scope of the underlying IA report)



[22] Ibid 42.

The Energy Performance of Buildings Directive EPBD (2010/31/EC) explicitly stresses the importance of ventilation systems for energy efficiency of buildings, i.e. that it should be handled in national building legislation. The EBPD also stresses their importance for health and sound building constructions, though leaves much room to Member States what to do and how. But it addresses the subject at *system* level and not at the level of the *products*. This applies not only to the ventilation units that are in the current scope, but also to other products in the system, such as ductwork, attenuators, (de)humidifiers, etc. that could perhaps be subject to other ecodesign measures in the future.

Although the national building codes and EPB-regulations in most Northern EU Member States have been identified in the preparatory studies as the main market drivers for mechanical ventilation, several Southern and Eastern Member States are lagging behind in implementing requirements for optimal and energy efficient building ventilation *systems*.

Efficient heat recovery ventilation (HRV) is currently the accepted standard in Scandinavia, after 20 years of technology procurement, building R&D capacity with industry, education of installers, promotion, tax incentives and –finally-- building regulation. In Western- and Central Europe HRV is presented as only one of the options in a holistic EPB approach. Only in 'passive' or 'near-zero' buildings it is seen as unavoidable, but inefficient low-cost ventilation solutions still hold a large market share, mainly because market failures persist (see paragraph 2.2.1) persist [23]. In Southern- and Eastern Europe, most building codes for the residential sector are still at a level of natural ventilation with some local, intermittently operated exhaust fans. For non-residential buildings the central mechanical ventilation is often seen, although the current practice is different, as a part of air heating/ cooling solutions. Demand Control Ventilation is not part of residential building legislation and is still very rare also in regulation of the non-residential sector. Without external incentive from e.g. EU legislation this will change only slowly.[24]

The effect of system-level legislation on efficient ventilation was analysed in the preparatory study and is incorporated in the IA baseline ('BAU') projections (see paragraph 2.3 and Chapter 5). The success of HRV in Nordic Member State is exemplary, but the saving potential of efficient ventilation for the other 95% of EU citizens is still huge and improvement is slow. Hence, from this viewpoint, the current practise of realising policy goals only through system-level legislation cannot be termed successful.

The Energy Performance of Buildings Directive (EPBD, 2010/31/EU) suggests that product-level legislation and system-level building regulations should be complementary. In recital 12 of the EPBD it says: 'When setting energy performance requirements for technical building systems, Member states should use, where available and appropriate, harmonised instruments, in particular testing and calculation methods and energy efficiency classes developed under measures implementing Directive 2009/125/ECon ecodesign requirements for energy-related products, and Directive 2010/30/EU on labelling, with a view to ensuring coherence with related initiatives and to minimise, to the extent possible, potential fragmentation of the market.'

23 E.g. exhaust ventilation without heat recovery and without demand control
24 Ibid 42.

While appropriate product-level ecodesign and labelling measures are in place or imminent for e.g. various space heating, space cooling and lighting products, for ventilation products this is not the case.

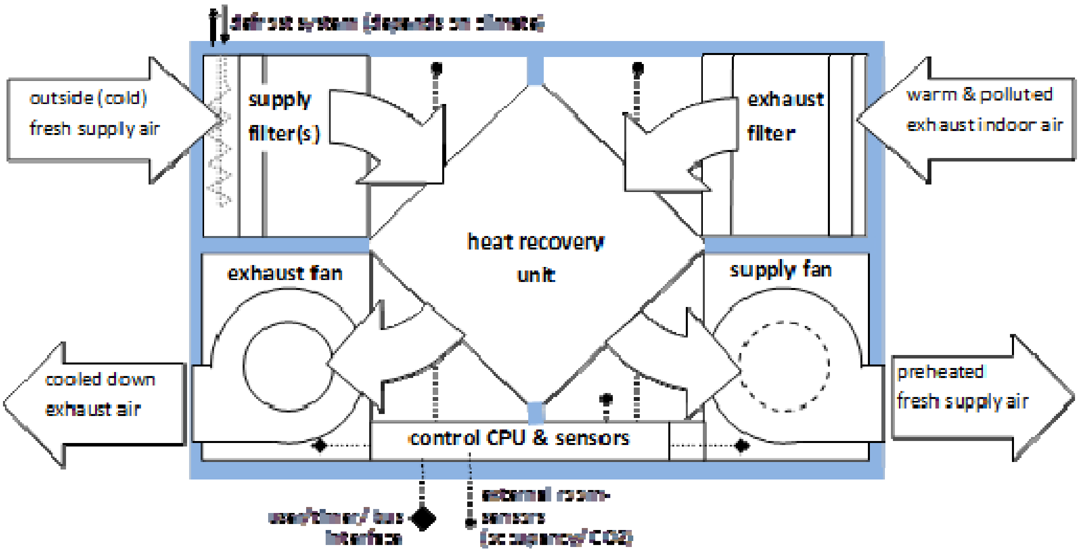
At a *component* level, the Ecodesign Commission Regulation (EU) 327/2011 on Fans >125 W will have an impact on the electric efficiency of the non-residential ventilation units with fans >125W. This regulation is very recent and its stipulations still have to enter into force, i.e. tier 1 in 2013 and the more ambitious tier 2 in 2015.

The introduction of the Fan Regulation will be an important step forward, but it needs to be considered that the ambition level, assessed at Least Life Cycle Costs (LLCC), was tuned to a general application and could not assume the high operating hours and the specific requirements of ventilation units. Using the same LLCC criterion for ventilation units more ambitious targets in terms of minimum fan efficiency are likely to be achieved. Also the Fan Regulation covers 'just' the electrical efficiency of fans without casing and not the effectiveness of the ventilation unit in reducing ventilation heat loss or the possibilities for heat recovery.

The influence of the Motor Regulation (EC) 640/2009 will be limited to those applications that use a single speed AC motors >750 W. In practice, these will be rare, used only for larger ventilation units that supply a base-load extraction ventilation. Most units use either a variable speed drive or multi-speed drive and will not be regulated by this regulation.

The Circulator Regulation (EC) 641/2011 has an effect on the energy use of the circulator pump of liquid-coupled ('run-around') heat recovery heat exchangers that may occur in non-residential applications.

Figure. 2: Balanced heat recovery unit (both RVU and NRVU), technical principle and components



Apart from the specific legislation mentioned above, there is also more generic ('horizontal') legislation that covers a much wider scope, but which again for the ventilation units misses out on the main impact, i.e. the electric efficiency and thermal efficacy. See Annex K, Section K.5 for more details.

The possible use of brominated or chlorinated flame-retardants is tackled in the RoHS.

<u>Lack of (consensus on) robust measurement standards</u>

As mechanical ventilation is a relatively new sector, the sector is investing a considerable amount of effort in creating standards. Most standards either relate to RVUs or NRVUs and very little standards are intended for both sectors.

So far, the standardisation bodies have made little effort –even though they are similar products—to harmonize test and calculation methods between RVUs and NRVUs.

The standards apply to

the system performance and relate to air quality, performance requirements, calculation methods for air flows and ventilation rates;

product performance and rating level and relate to capacity assessment (air flow, pressure difference), heat recovery, face velocity, electrical efficiency, air leakage rates, acoustics, etc..

component performance and rating and relate to efficiency and performance of fans, heat exchanger and filters.

For an overview of the relevant standards see **Annexes F** (standards applied in proposed regulations) **and K** (references).[25]

2.2.3. Discrepancy between fundamental EU goals and the existing situation

As mentioned in sections 1 and 3, the EU pursues policy goals in terms of energy efficiency and carbon emission reduction as well as a single internal market. The existing situation with ventilation units where the potential in contributing to these goals is not explored poses a discrepancy. And the described market failures and regulatory gaps are expected to persist. Furthermore, the legal tools to change this situation exist (Ecodesign, energy labelling) and the boundary conditions set by the legislator for using these tools are fulfilled.

2.3. Baseline (criteria for eligibility)

According to Article 15.2 of the Directive products are eligible for measures is if they are economically significant (see par. 2.2.1 hereafter), have a significant environmental impact (see par. 2.2.2) and there is a significant saving potential (see par. 2.2.3)

2.3.1. Economic significance

2.3.1.1. Unit sales and stock

In 2010 the market of the products in the scope is estimated at around 3.2 million units, according to the preparatory studies. This number does not include the local exhaust fans < 30 W mainly operating intermittently, which are not in the product scope (see section 2.1).

Figures 1 and 2 show actual sales and stock 1990-2010 and 'Business-as-Usual' projections for the period 2010-2025.

The sales and stock figures combine the data from the preparatory studies, including updates. Despite the economic crisis and the structural downturn of the construction sector, a growth rate of 2-3% per year is projected for 2010-2025, taking into account that the market is far from saturated, i.e. naturally ventilation (infiltration and window opening) is still the most frequent practice in the EU building stock.

[25] For the purpose of the product-specific measures for the residential units, the EN 13141 series and EN 13142 seems most appropriate as a basis. For non-residential units the most important standard is EN 13053. However, in the discussions with the stakeholders also the system-standard EN 13799 played an important role.

The RVU-sales represent 2.64 million unit-sales and 35.4 million of the stock in 2010 (82-84% of the total). The NRVU-sales represent 0.54 million unit-sales and 6.7 million of the stock (18% of total) in the same year.

Figure 3: Sales of ventilation units in the EU 1990-2010 and projections 2010-2025 (BAU, source: preparatory studies).

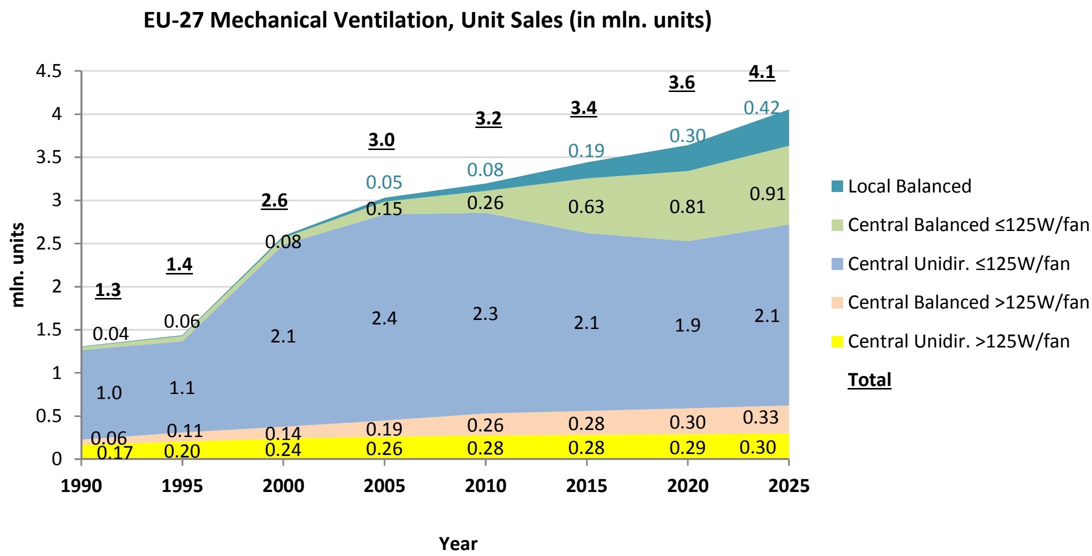
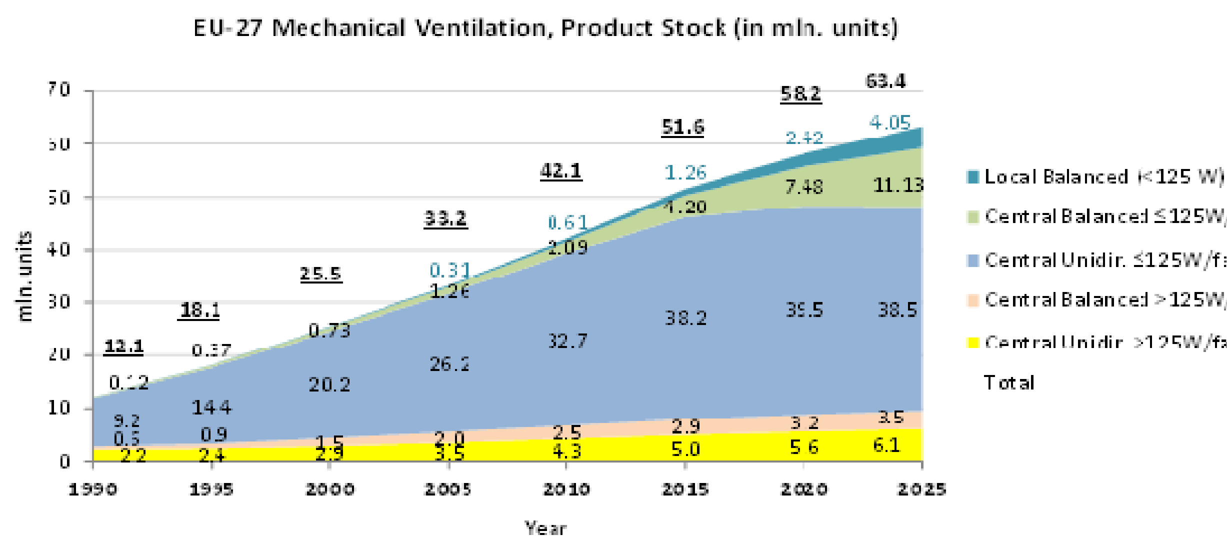


Figure 4: Stock of ventilation units in the EU 1990-2010 and projections 2010-2025 (BAU, source preparatory studies).

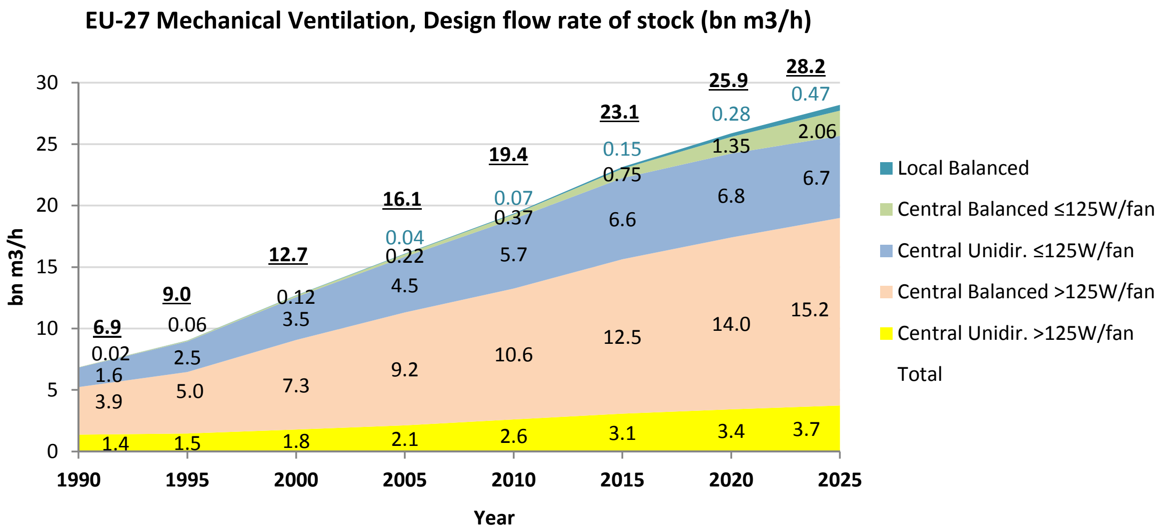


The graphs shows that for 2010 both in the RVU and NRVU section the central unidirectional units (mostly exhaust units) represent the largest unit sales of in total 2.6 million unit-sales (81% of unit sales of all products in the scope) and 37 million (88%) of the stock. The balanced units represent 0.6 million unit-sales (19%) and 5.3 million units (12%) of the 2010 stock in the EU-27.

Note that, while all balanced RVU-units feature heat recovery ventilation (HRV), only one-third of the installed NRVU balanced units in the stock (around 0.8 million of the 2.5 million units installed) is equipped with heat recovery. In total, this means that only 3.6 million units in stock (8.5%) are equipped with heat recovery ventilation.

Almost 55% (10.6 bn m³/h) of the ventilation performance comes from non-residential balanced ventilation units (>125 W/fan). Within that group, most of that ventilation performance, 7.8 bn m³/h, comes from the large air handling units (AHU-L), which represent less than 2% of the installed stock (0.72 m units).

Figure 5: EU-2008 sales distribution of balanced NRVUs, unit market share by design flow rate class of the products (m³/h)



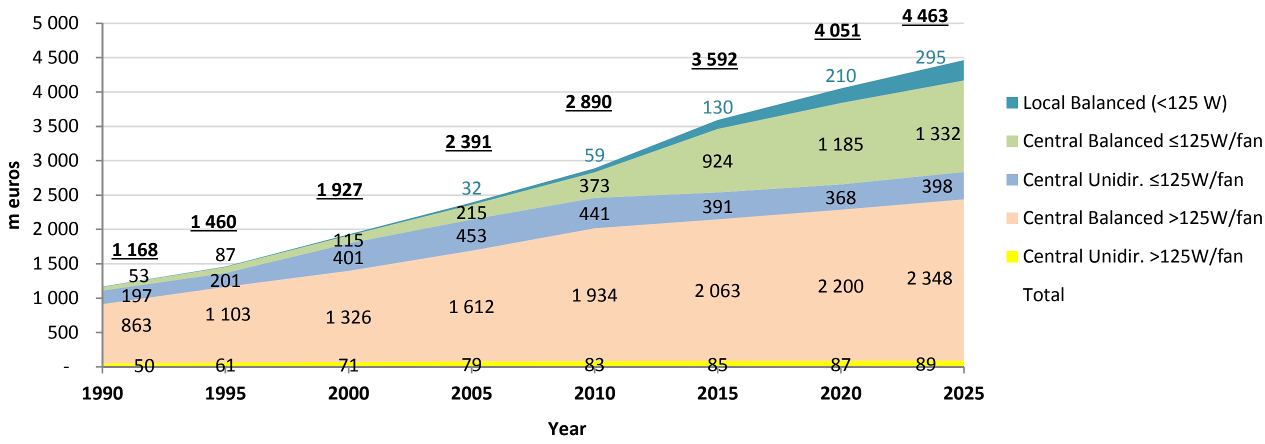
2.3.1.2. Sales revenue

Figure 6 below gives the industry revenue of strictly the sales of ventilation units, in manufacturer selling prices (msp), amounting to 2.9 billion in the EU 2010.[26] Of this, 520 million euros relate to unidirectional units in the scope (18%) and 2 370 million euros (82%) relate to balanced units.

Figure 6: Industry revenue from sales of ventilation units EU 2010

[26] The preparatory study gives prices for RVUs 2003. These have been updated to 2010, to make them comparable to the NRVUs, using an inflation rate of 2% per year.

EU-27 Mechanical Ventilation, Industry revenue (in m euros, msp)



The manufacturer selling price excludes non-ventilation modules in the unit (heating coils, mixing valves, etc.), system components (ducts, terminal units, external attenuators, etc.), any installation labour costs, spare parts, replacement filters[27] and VAT. These costs, especially but not only the installation costs, make up the larger part of the cost of the whole ventilation system[28].

In **Annex C** more details are given regarding the total cost built-up.

The ventilation unit and especially the whole ventilation system generate much more than just revenue for the manufacturers of the strict units, and their suppliers. Other hardware includes ductwork, grilles, air terminal units, system controllers, filters, spare parts, etc.. There are the trade margins for wholesalers and installers, the labour costs for installers, engineers and planners as well as the VAT for consumers that do not have the possibility to recuperate the Value Added Tax. During the running phase, the energy costs play a dominant role.

A complete overview of the costs, and thereby the revenue for the various market actors, can be found in the section on Consumer Expenditure.

2.3.1.3. Production and trade

The preparatory studies show that, although a substantial part of the unidirectional units may be imported from Asia, most balanced residential and non-residential ventilation units sold in the EU-market are also produced in the EU-27. Ventilation units are products that are very much linked to local building habits/regulations and, due to their dimensions, the transportation costs are relatively high. These two factors make that Extra-EU trade (imports and exports) of the whole product --at component scale this may be different-- is limited. More details are given in Annex K, section K.1.

[27] Meaning that the cost of one filter delivered with the unit but not any possible revenues that a manufacturer may have from also supplying replacement filters during the unit lifetime.

[28] For instance, in the case of the largest non-residential systems (AHU-L), with a strict msp of € 20 000 for a typical 35 000 m³/h unit, the strict unit price may only be as little as 3-4% of the total costs for realizing the ventilation system that has a total cost of well over 0.5 million euros for the end-user in a new building or 0.6-0.7 million for a retrofit building. On the other hand, in case of a simple unit-replacement, the extra installation costs and trade margin take up only 40% of the total (and the msp of the unit takes up 60%). For residential ventilation systems, the msp of the unit takes up on average between 10% (for exhaust units) and 25% (for balanced units) of the total ventilation system costs including VAT

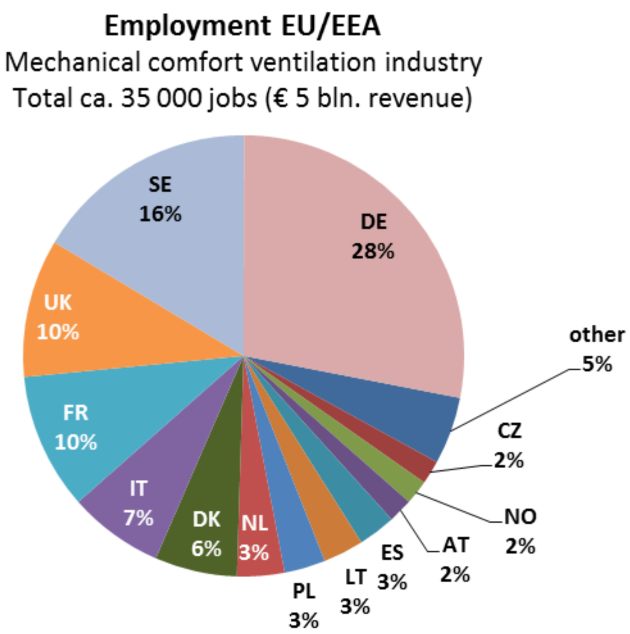
2.3.1.4. Employment

Through additional analysis of the individual companies the Commission services with its technical assistants have tried to assess the employment in the ventilation unit sector. Details can be found in the **Annex D**.

In a policy context it is relevant that the sector provides employment to around 35 000 people in Europe, 20 000 directly and 15 000 indirectly, for the manufacturing of the ventilation unit. A country split-up is given in figure 7. The jobs relate to all ventilation related activities, i.e. not only the strict manufacturing of the unit, but also its spare parts and some components (e.g. heating coils) that do not strictly pertain to the ventilation function.

The employment figures do not include OEM component manufacturers that have not ventured into the production of ventilation units. These include large companies such as for fans, filters and controls. Also the jobs that relate to component manufacturing for third-party AHUs within companies that also have their own ventilation unit production are not taken into account. Also here only a rough estimate can be made, but it may amount to an extra 10-15 000 jobs related to ventilation units at the level of EU suppliers.

Figure 7: Ventilation unit industry employment 2012



In the wholesale sectors, average revenue/employee is typically in the range of 300 000 euros per employee and thus employment in wholesale is estimated at around 2000 jobs (related to the 0.6 billion euros mentioned in the business revenue section).

The employment effect from the ventilation unit that should be partitioned for installers and engineers is difficult to estimate. Assuming 120 000 euros revenue per employee and the total business revenue of 14.5 billion euros, it can be estimated that the installation of mechanical ventilation systems provides around 120 000 EU jobs. Adding also the installer revenue from maintenance and repairs, the total would arrive perhaps at 135-140 000 EU jobs.

However, this would include to a large extent work, like the installation of ductwork, air terminals, etc., that is not strictly linked only to the ventilation unit. Especially if these 'other components', representing 7 billion euros in costs, will become subject to future Ecodesign measures –which is not impossible– it seems logical to partition the employment on a material's and maintenance cost basis. This would result in around 50 000 EU installer jobs partitioned to the strict ventilation units.

In total, the number of EU jobs depending on producing, distributing, installing and maintaining ventilation units is estimated at around 100 000 [29]. Employment related to the total ventilation systems, also including ventilation components (ductwork, grills, air terminal units) and related installation work that is not in the strict scope of the measure[30], is roughly double that amount (around 200 000 jobs).

2.3.1.5. Consumer expenditure

Consumer expenditure for residential ventilation units consists of acquisition and running costs. Levies for end-of-life disposal, where they exist, are assumed to be incorporated in the acquisition costs.[31] The acquisition costs can be incorporated in the price of the house (new sales), in the total costs of a renovation project (retrofit sales) or charged as a replacement cost for a broken-down unit. The manufacturer selling price of € 2.9 bn has been discussed in the section on business revenues.

The table below gives a complete split-up of the costs of a ventilation system, excluding the costs of non-ventilation (heating/cooling humidification) components.

Table 2. Split up of 2010 EU expenditure on mechanical ventilation systems

	Total
Acquisition costs	
Ventilation unit (VU), ex factory (msp), incl. EoL*	2.9
Wholesale margin	0.6
Installation materials (incl. trade margins)	7.0
Installation labour	7.0
VAT (RVU only)	0.8
subtotal acquisition costs	***18.3***
Running costs	
Filters, maintenance and repairs	2.2
Electricity costs (RVU € 0.172/kWh; NRVU € 0.12/kWh)	10.55
subtotal running costs	12.75
Gross total expenditure 2010	***31.05***
Heating fuel saved (RVU € 0.6/GJ; NRVU € 0.37/GJ)**	28.05
Net total expenditure 2010	***3.0***

[29] 35 000 in production, 10-15 000 in additional OEMs, 2000 in wholesale, 50 000 installers. Total 97 000 to 102 000.

[30] But excluding possible non-ventilation components, such as heating coils, mixing valves, (de)humidifiers, attenuators, air heating and cooling equipment and their related installation.

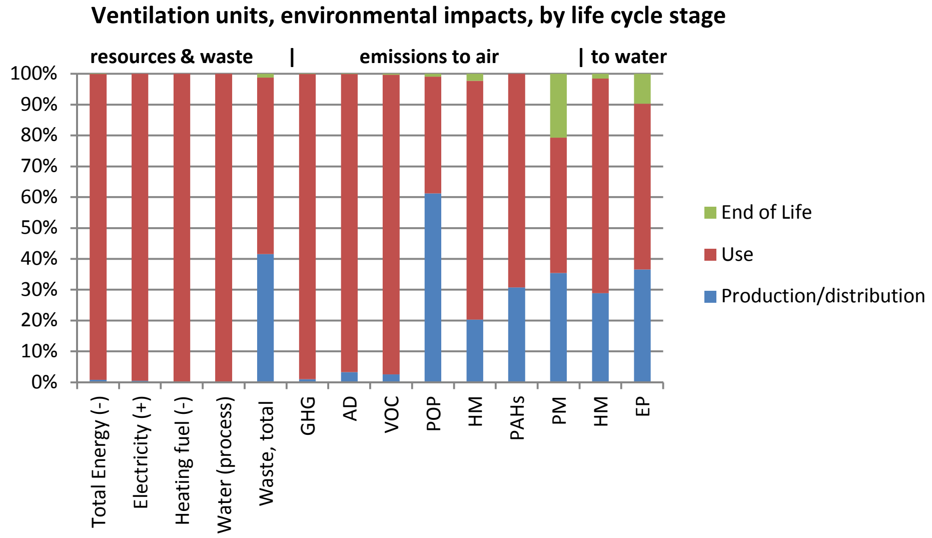
[31] Ventilation units have a high metal content (>80%, of which a substantial part non-ferro), which represents a value that is usually more than enough to cover disposal costs by the installer at no charge. Nevertheless, in some cases, government levies (e.g. 'recupel' in Belgium) may be part of the purchase price.

2.3.2. Environmental significance

2.3.2.1. Resources and emissions overview

The environmental impact[32] included in the preparatory studies shows that the use phase is by far the most impacting stage of the life cycle of the life cycle in terms of energy consumption and greenhouse gases emissions. The production phase has relatively a significant impact on some aspects as generation of non-hazardous waste, persistent organic pollutants (POP), heavy metals emissions (HM) and eutrophication (EP), but the absolute impacts for these impact categories is low. See Figure 8 below.

Figure 8: Distribution of environmental impacts of ventilation units.



2.3.2.2. Energy in the use phase and related carbon emissions

As mentioned previously, mechanical ventilation units consume electricity, but also avoid space heating energy because they do a more efficient and effective job than the alternative without mechanical ventilation.

The electricity is consumed mainly through the fans[33] that have to produce the required air flow q (in m³/s) at a minimum internal, additional and external pressure drop Δp (in Pa)[34], a given fan efficiency η_f (roughly the ratio of electric power input P in W and aerodynamic work output in Pa·m³/s=W)[35] and a certain number of operating hours per year. Possible timer-controls (on-off, parameter $\underline{CTRL_{on}}$) influence the number of operating hours; possible variable or multiple speed drives in combination with demand-side sensors[36] and controls

[32] Calculated with EcoReport version 5, Eco-design of energy-using products, VHK for European Commission, Nov 2005

[33] Other auxiliary electricity may include electricity for controls, motor of rotary heat exchangers, pump in run-around (' liquid coupled') heat exchangers or defrosting-provisions.

[34] 'Internal' pressure drop Δp_{int} is given by the pressure drop from ventilation components inside the unit (casing +possibly filter and heat recovery heat exchanger). 'Additional' pressure drop Δp_{add} comes from possible additional non-ventilation components inside the unit (e.g. heating coils, mixing valves). 'External' pressure drop Δp_{ext} comes from resistance of components outside the unit, i.e. ductwork, grilles, etc., and a minimum pressure needed to expel or take in the ventilation air even at a certain wind-force (over/under-pressure) on the facade of rooftop.

[35] Exact definition is given in Fan Regulation 327/2011.

[36] E.g. gas sensors (CO2, VOC) or occupancy sensors in combination with relative humidity (RH) sensors

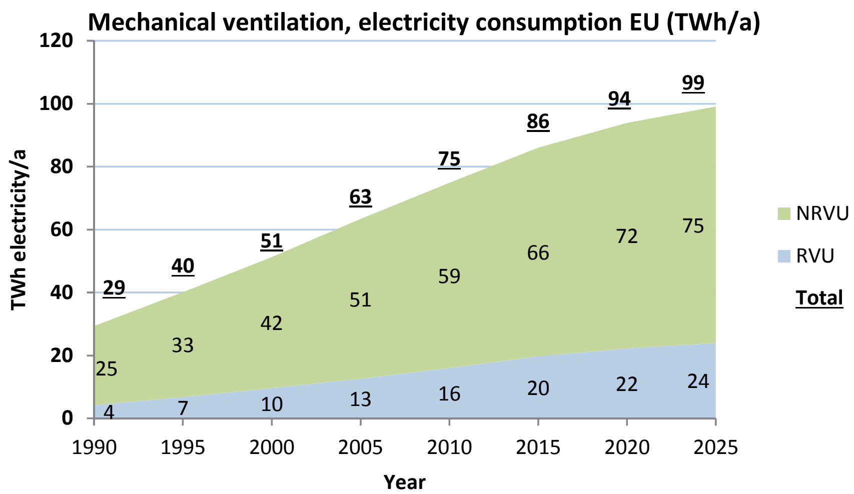
(Demand Control Ventilation DCV, parameter *<u>CTRL</u>*$_{var}$) influence the required performance (air flow and pressure drop) and thus the required power input *P*. Because a reduction in air flow also reduces the pressure drop, the electricity saving from proper DCV is not linear but exponential (power 1.7-1.8 for most configurations).

The avoided space heating energy is derived from the fact that –at equal performance for the user—the mechanical ventilation units --in combination with minimizing infiltration losses—avoid more ventilation heat losses than the 'natural' ventilation of infiltration and opening windows, which is still the most common practice in most buildings. Even without DCV or timers, there is a larger control over the air change rate in the room(s). With proper DCV[37] they change the air in the room(s) as needed and otherwise reduce air change to a trickle. An option that avoids even more space heating energy is heat recovery ventilation ('HRV'), which applies to balanced units whereby the heat from the outgoing stale air is transferred to the cold fresh incoming air in a heat exchanger at efficiencies that may be over 80%.

The energy formula for residential ventilation units in section 4 gives a mathematical illustration of all the elements mentioned above.

The figures below show the historical data 1990-2010 and the projections 2010-2025 'Business-as-Usual' of electricity consumption (in TWh/a electricity), the space heating fuel avoided (in PJ primary/a) and the net primary energy consumption (in PJ primary/a, with conversion 1 TWh electric = 9 PJ primary). The EU electricity consumption in 2010 is around 75 TWh, the avoided space heating fuel consumption is almost 2400 PJ and the net balance is around 1700 PJ/a of primary energy avoided. This net balance constitutes the equivalent of around 188 TWh electricity consumption. The avoided GHG emissions amount to 108 Mt CO_2 equivalent in 2010.

Figure 9: Mechanical ventilation, EU electricity consumption 1990-2010 and projections 2010-2025 (BaU) in TWh electricity per year.



[37] 'proper' meaning for instance that in a unidirectional system with an exhaust ventilation unit and 'natural' air supply, the action of the grills in the facade that provide the natural air supply should be synchronised with the action of the mechanical ventilation unit. This is certainly not always the case, but the regulation of the grills is outside the scope of the measures, i.e. could be dealt with in EPB (Energy Performance of Buildings) regulations or national building codes. Furthermore, it needs to be considered that the best DCV should work with local sensors and local actuators (VAV-box or local ventilation units).

Figure 10: Mechanical ventilation, EU avoided space heating energy 1990-2010 and projections 2010-2025 (BaU) in PJ primary energy per year.

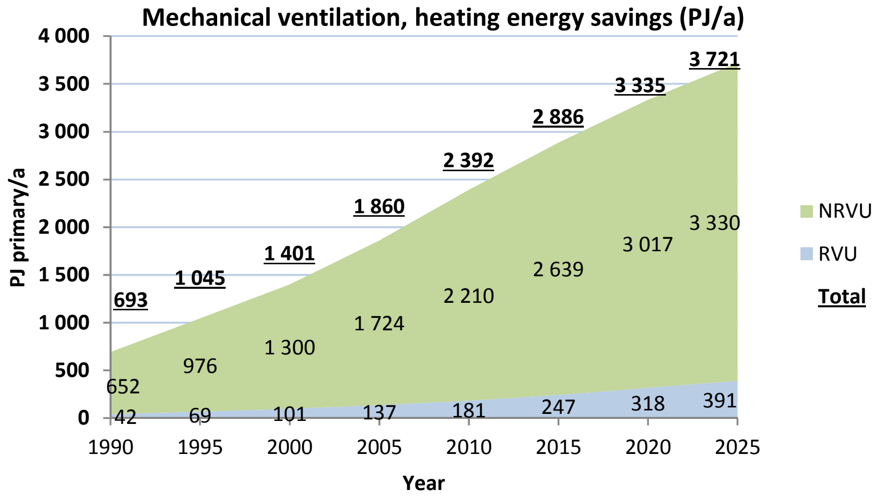
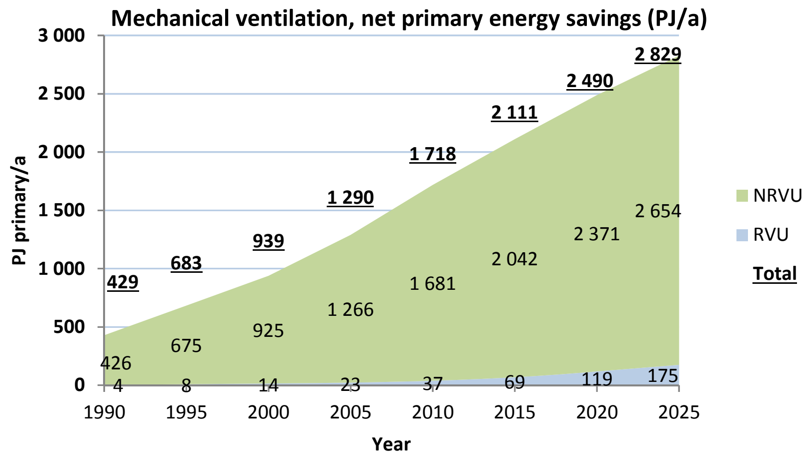


Figure 11: Mechanical ventilation, EU net primary energy balance 1990-2010 and projections 2010-2025 (BaU) in PJ primary energy per year.



2.3.2.3. Other environmental impacts

The materials in non-residential ventilation units produced for the EU-market in 2008, amounted to 535 kt. Of this, it is estimated that at end-of-life in 2025 around 488 kt (91%) will be recycled and 47 kt will be disposed (landfill or incinerated with heat recovery). The high recycling percentage is due to the high share of metals (see Annex K, section K.2)

Noise is identified as an environmental impact of residential ventilation units, influencing the user satisfaction (and indirectly health) and is therefore considered a potentially relevant impact.

For non-residential units, usually mounted in a technical room, the noise emitted by the unit is of relatively low interest. For building regulation the noise emitted in occupied rooms (in this case coming through the ductwork) is what counts and technically the noise from the unit can be attenuated outside the unit.

Note that both in the residential and non-residential buildings many Member States have issued minimum noise requirements in their building codes.

Also there is a negative relationship between noise production and energy use, i.e. there is an extra pressure drop from attenuators and/or the relatively silent fans (e.g. forward curved fans) consume more than the more energy efficient ones (backwards curved).

2.3.3. Saving potential

The preparatory studies concluded that the saving potential is significant enough to be eligible for measures.

The technical design options that could bring about saving were identified in the preparatory studies as follows:

- More efficient fans, drives and motors.
- Lower pressure drop of ventilation-components of the unit.
- Increase heat recovery.
- Better controls.

At the moment there is no technical database of ventilation unit models and their features to help quantify the EU saving potential for this product, which has so far never been subject to product-specific energy saving measures. The (updated) preparatory studies relied on technical-economic modelling of a number of 'base-case' products, in consultation with the stakeholders. The modelling took into account not only the electrical and thermal energy related to the individual units, but also took into account how an increase of mechanical ventilation, instead of the less efficient natural ventilation, would have an impact on societal energy savings.

Details of the modelling and calculations of the saving potential can be found in **Annex E**.

The bottom line is, that cost efficient savings in the order of over 30% are feasible, both in the reduction of the energy consumption and the increase of the savings on space heating energy.

If all the ventilation units would be replaced by the Best Available Technology, savings of more than 60-70% are possible.

This clearly demonstrates that the ventilation units qualify as a product group with a significant saving potential.

2.4. Sensitivity analysis of baseline

The data availability for this relatively new sector is particularly poor and projections are difficult. This section takes a critical look at the assumptions underlying the baseline projections after 2010 presented earlier.

Economic Crisis

While investment in efficient ventilation units makes a lot of business sense for building owners and developers of new real estate property, the crisis in the construction sector is structural and it is uncertain if –even if payback times are attractive—there are enough potential investors around with money to invest.

Timing and speed of savings

In the projections a growth rate for the ventilation unit market of 2% per year is assumed. But due to the crisis, sales may be slower.

Energy prices

The baseline scenario has been adapted to the latest findings in the MEErP study[38], which signals that the energy rates were subject to an escalation rate (real growth, i.e. above inflation) of 3-4% over the last 5 years. It is assumed that this will persist, but energy price developments for the period up to 2030 is difficult to predict and is an inherent uncertainty in the projections

Technology trends

The projections assume that unit sales of unidirectional (exhaust) units will slightly decline, while the market volume for balanced units with heat recovery will continue to grow. However, within these two larger segments there may be technology shifts that are more tuned to retrofit situations than today. This may affect the unit efficiency in unpredictable ways.

Rebound effect

Ventilation units bring not only energy efficiency but also improved indoor air quality (IAQ). In some cases, where the indoor quality was poor due to insufficient ventilation, the savings effect may therefore be diminished with respect of projections.

More details can be found in Annex K, section K.4.

Conclusion

It is believed that the underlying IA represents the currently best possible assessment of market and energy use related to ventilation, but as a result poor data availability and the factors above the accuracy of the assessments is, as is the case with most products that have not been subject to measures previously, limited.

2.5. Legal basis and subsidiarity

The Ecodesign Directive and, more specifically, its Article 16 provides the **legal basis** for the adoption of implementing measures. The Ecodesign Directive uses 'CE marking' of products brought on the market by manufacturers as the legal tool.

Subsidiarity in this context is not applicable, because the problem is trans-national and actions by Member States alone would restrict free circulation of goods. Furthermore at the scale of Community level any action would be far more effective than at Member State level.

2.6. Affected Stakeholders

2.6.1. Industry

The ventilation unit industry, i.e. companies manufacturing products in the scope of the proposed measures, is dynamic and very heterogeneous. The production of residential ventilation units, beyond simple extraction fans, is a relatively young industry, where EU representation (EVIA) has started only recently and commercial market research institutes came into this specific field a few years ago. Policy makers are more and more addressing ventilation units at the systems-level through building regulations, but there are no measures – neither at EU or national level—addressing the products.

[38] Methodology for the Ecodesign of Energy-related Products (MEErP), VHK for European Commission, 2011.(see www.meerp.eu)

For non-residential units, the so called ‘air handling units’ (AHUs) were traditionally not a self-standing product but linked to air-conditioning (central air-cooling). This started to change only in the 1990s when local, hydronic fan coil units and refrigerant-based systems became dominant over central air-cooling/heating. Thus the necessity to decouple non-residential ventilation from the air-cooling/heating function became more evident.

As a result of the above, robust data on revenues and employment in this sector are lacking and making an estimate is a difficult task, aggravated by the fact that ‘ventilation units’ are very rarely the only, or even the most important products of the companies involved.

For residential ventilation units manufacturers and brand-owners can be grouped as follows:

Traditional manufacturers of fans and small extraction ventilation units (<30 W and out of scope), with the hardware mainly produced in S.E. Asia, who venture into larger unidirectional, more and more demand controlled ventilation units that are in the scope of the measures. These can mainly be found in Southern Europe and the UK. Examples are Soler & Palau, Nicotra-Gebhardt, Aldes, Xpelair, Vortice, etc. and many wholesellers/importers with their own brand.

Manufacturers of other products that have diversified into ventilation 10-20 years ago and where residential ventilation units are now a significant part of the business. The background of these companies, and still the largest part of turnover, is in hydronic radiators & convectors (Zehnder, Jaga), air heating (Centrotec Brink, Robatherm, Kampmann), window frames (VKR, Schüco, Siegenia-Aubi), heat pumps (NIBE through Schulthess), etc..

Large ‘*me-too’* companies that have only recently entered the EU market, mostly with ventilation trade products or very limited assembly activities. These include large boiler and water heater manufacturers (Bosch Thermotechnik, Vaillant, Viessmann, Stiebel-Eltron), Japanese companies of residential air conditioners (e.g. Daikin JP, Mitsubishi JP), large control manufacturers (Danfoss). The share of ventilation in total company-turnover is estimated at less than 1% of company revenue and employment.

Manufacturers of non-residential balanced ventilation units (a.k.a. ‘air handling units’ or ‘AHUs’) that have migrated also into residential heat recovery ventilation, following trends Scandinavian building regulations since the beginning of the 1980s. This is the case for many larger Scandinavian conglomerates like Fläkt Woods, Swegon, Flexit and (although also with a strong position in unidirectional ventilation) Systemair.

For non-residential ventilation units manufacturers and brand-owners can be grouped as follows:

Traditional central air conditioning manufacturers, where AHUs are a part of a broad range of other components of air conditioning systems such as process ventilation, chillers, ductwork (‘air distribution’), terminal units and fan coil units (‘air diffusion’). This applies to the Scandinavian conglomerates mentioned above, European multinationals like GEA, Dantherm, Airwell and US multinationals with a (modest) EU manufacturing presence like Carrier, Trane and Lennox. Furthermore, this is the domain of many medium-sized companies (100-300 employees) in Germany and Scandinavia. The share of ventilation units (AHUs) in the company turnover and EU employment is typically in the range of 10-20%.

Specialist component manufacturers that have added AHUs to their product range. Trox DE (specialist for air diffusion, filters), Munters SE (specialist for (de) humidifiers), Östberg (heat recovery units) and Danfoss (controls). The share of AHUs in company turnover is also in the range of 10-20%.

Manufacturers of residential ventilation units that have added small non-residential units to their catalogue (up to 10 kW/ 10 000 m³/h). This applies now to most of the larger manufacturers of residential units (Zehnder, Centrotec, etc.).

2.6.2. SMEs

The share of independent medium-sized companies in ventilation unit manufacturing, in the range of 50-500 employees, is still significant and may represent some 30% of the total. This is also the typical size of a manufacturing unit within the larger multinationals which have expanded though acquisitions and mergers. As the market becomes more mature, however, more acquisitions and mergers can be expected and the share of these independent SMEs can be expected to diminish.

Small and micro-size companies with less than 50 employees, often do not have in-house manufacturing. They are either traders (with or without their own brand) or small, innovative start-ups with their own unique energy-saving product where manufacturing is wholly or partially outsourced to jobbers inside or outside the EU.

Annex D presents an indicative (incomplete) list of production facilities in the EU.

2.6.3. Stakeholder associations

The ventilation industry associations are EVIA[39], Eurovent[40] and EPEE[41]. Professional organisations in the ventilation sector are REHVA[42], INIVE[43], AIVC[44], EHVA[45]. Consumer associations are represented at EU level by ANEC/ BEUC[46]. Green non-governmental organisations collaborate in the consultation process e.g. through ECOS[47]. Eurelectric[48] represents EU electric utilities. Heating energy suppliers are represented amonst others by Marcogaz (natural gas), Eurofuel (heating oil) and AEGPL (LPG).

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[39] The European Ventilation Industry Association EVIA 'represents the ventilation industry both in Brussels with the EU institutions and in the national capitals. EVIA aims to serve as platform and point of contact between all the relevant European stakeholders involved in ventilation industry including European decision-makers, scientists, and other relevant organizations.' EVIA has 34 prominent EU industry members in residential and non-residential ventilation unit manufacturing..

[40] EUROVENT is the spokesman for the European refrigeration, air conditioning, air handling, heating and ventilation industry, representing trade associations from European and non-European countries. Brochure text: 'Eurovent represents over 1,000 companies in 13 European countries, employing 150,000 peoply who generate more than €25 to 30 billion of annual output.' Website: www.eurovent-association.eu

[41] European Partnership for Energy and Environment EPEE . Mission: 'To promote a better understanding of the HVACR sector in the EU and to contribute to the development of effective European policies in order to achieve a long-term sustainability agenda. Members include many prominent HVAC-firms and associations from Japan (Daikin, Mitsubishi, Hitachi, Fujitsu, JRAIA) and the US (Carrier, Trane, Lennox, Johnson Controls, Honeywell, etc.).

[42] REHVA: Federation of European heating, ventilation and air-conditioning associations. 100 000 professional members, mostly in non-residential HVAC. www.rehva.eu

[43] INIVE: International Network for Information on Ventilation and Energy performance (www.inive.org). INIVE is the IEA (International Energy Agency) operating agent for the AIVC

[44] AIVC: Air Infiltration and Ventilation Centre. Supplies information for (construction) industry.

[45] EHVA European Ventilation Hygiene Association.

[46] BEUC is the European Consumer's Association. ANEC represents the European consumer interest in the creation of technical standards developed to support the implementation of European laws and public policies.

[47] The European Environmental Citizen's Organisation for Standardisation ECOS is an umbrella organisation of European environmental NGOs created to enhance the voice of environmental protection in the definition of ecological standards and specifications for products and services in the European Union.

[48] Eurelectric: The association of the electricity industry in Europe: electricity producers, suppliers, traders and distributors from the EU and other European and Mediterranean countries. www.eurelectric.org

As shown in the Annex A of the Consultation Forum, no critique was brought forward that would indicate a disagreement on the problem analysis in this section, nor were any written comments received to this effect.

3. OBJECTIVES

As laid out in Chapter 2, the preparatory study has confirmed that ventilation units represent a large cost-effective potential for reducing electricity consumption and increasing the space heating energy saving. This potential is not fully captured.

The **general objective** is to develop a policy which corrects the market and regulatory failures, and which

reduces energy consumption and related CO_2 and pollutant emissions due to ventilation units following Community environmental priorities, such as those set out in Decision 1600/2002/EC or in the Commissions European Climate Change Programme (ECCP);

promotes energy efficiency hence contributes to security of supply in the framework of the Community objective of saving 20% of the EU's energy consumption by 2020.

These should be achieved while maintaining a functioning internal market with a level playing field for producers and importers.

The **specific objectives** are:

- to facilitate removal of the poorest performing products from the market, where their life cycle cost disadvantages have proven insufficient to drive this, thereby reducing the problem of split incentives;

to help residential buyers to make an informed/rational choice based on performance information that reflects real life usage, thereby moving the market to adopt improved technology solutions.

to set incentives for producers to further develop and market energy efficient and climate-friendly technology and products.

to generate cost savings for end-users.

The **operational objectives** are:

to develop by 2015 an appropriate metric for energy performance that reflects real life usage, is cost-effective, accurate and repeatable/reliable.

to make sure by 2015 that buyers receive appropriate and understandable performance information and so foster an effective competitive market driven by competition on energy performance.

to create a framework for gathering information about energy performance that can allow for possible subsequent (self-) regulation at a review four years after entry into force.

to achieve the objectives listed above without having a significant negative impact on functionality, safety, affordability of the product, nor on the industry's competitiveness and the administrative burden imposed on it as provided in Art. 15 of the Directive.

4. POLICY OPTIONS

4.1. Option 1: No EU action

This option implies that the current practice of national building regulations addressing efficient ventilation at system-(building) level would continue to be the only regulatory way to promote the use and the further development of efficient ventilation. No new ecodesign or energy labelling legislation would be implemented, because regulation at the level of building systems is outside the legal scope of Directives 2009/125/EC and 2010/30/EU.

This option would have the following implications:

- The market failures would persist, and only very slowly the consumers would become aware of the advantages and disadvantages of the different types.
- It is not unlikely that Member States (e.g. in Scandinavia), that already are imposing strict mandatory rules for energy-efficiency of ventilation systems through building codes, may also want to impose minimum demands at the ventilation product level. This would hamper the functioning of the internal market and lead to high administrative burdens and costs for manufacturers, in contradiction to the objectives of the Ecodesign Directive.[49]
- The specific mandate of the Legislator would not be respected: As has been demonstrated in paragraphs 2.1 to 2.3, the product group is fully eligible for ecodesign measures under the stipulations of Article 15.2. It is economically and environmentally significant and there is a large saving potential that is not sufficiently addressed because of existing market and regulatory failures.

Adopting this option would imply that it is impossible, within the boundary conditions set by the directives, to improve on the existing situation through ecodesign or energy labelling measures. This option is included as a baseline (Business-as-Usual, BAU) and a reference in the analysis of possible other options.

4.2. Option 2: Self-regulation

The option of self-regulation was explored with stakeholders, but no initiative for self-regulation on ventilation units was brought forward by any industrial sector during consultation.

Therefore this option is discarded from further analysis.

4.3. Option 3: Energy labelling

This option would include the labelling of ventilation unit efficiency in seven efficiency classes as under the Energy Labelling Directive.

This option would imply the following:

- In general, the two main objectives of labelling schemes are to increase the market penetration of, in this case, energy efficient products by providing incentives for

[49] Sweden, Denmark, Norway, at the CF (see Annex A) and in several written position papers insisted strongly on the use of their SFP system metrics also for product measures. There is no way to predict the future but if the SFP is not in some way accepted it is likely that they would go their separate way on this issue.

innovation and technology development, and to help consumers to make cost effective purchasing decision by addressing running costs.

- Furthermore, the energy label would be an appropriate vehicle to inform the consumers on the performance characteristics of the new(er) technologies.

Option 3 would result in some savings for the residential market where there is a lack of know-how with installers, consumers, institutional buyers (e.g. building corporations) and, especially in certain parts of the EU, the regulatory authorities. However, it would miss out on the substantial reduction in energy consumption, especially in case of split incentives between builders and real estate property buyers or landlord and habitants of rented apartments.

These split incentives cannot be overcome by an energy label: 35% of the EU housing, to a large extent social housing, is rented [50]and the owner is not the one paying the energy bill. Thus the economic incentives for the owner, often a building corporation, to invest in efficient ventilation are limited. In most Member States there is a legal maximum to the raise in rent that is allowed. Recuperating extra investments in energy efficiency, including more efficient ventilation is possible only in a few situations. There could be commercial reasons to invest, e.g. to attract tenants more easily, but in social housing this is hardly a problem. Energy efficiency is not a motive for change in this particular situation, so there will be no significant impact of an energy label. From other residential product groups it is also known that a strategy of only energy labelling without minimum requirements will miss out on at least one-third of the saving potential. For refrigerators and freezers, one of the first products that was subject to both mandatory energy labelling and minimum energy efficiency standards (MEPS), the manufacturer's association CECED could assess in hindsight that labelling was responsible for two-thirds of the saving and MEPS for one-third.

As mentioned in paragraph 2.3, the estimated cost-efficient saving potential is estimated at 30% versus the baseline, following the preparatory studies. The option of 'energy labelling only' would thus miss out on 8-10% of savings in the residential sector. This will be further quantified in the impact analysis of various scenarios in Chapter 5, where the 'energy labelling only' impact is calculated as a variation ('variation A') on the three sub-option scenarios.

The non-residential market is very heterogeneous, with specific features that could have a detrimental effect on efficiency but are required due to the specific wishes and boundary conditions from clients and sites. In those circumstances, it is very difficult to develop a labelling scheme that is fair and does not mislead the potential buyers. Furthermore, as with all professional products, the level of knowledge with the buyers, supported by certification schemes[51], is much higher than in the residential sector.

The preliminary conclusion is that 'energy labelling' is not appropriate for non-residential units and 'energy labelling only' is a sub-optimal solution for residential units. Nevertheless, following the IAB, this option is not discarded upfront and will be included in the quantitative analysis in Chapter 5.

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[50] VHK, MEErP 2011 – Part 2, for the European Commission, 2011.

[51] E.g. Eurovent certification scheme or the German RLT certification scheme. These schemes aim to increase the reliability of certain product information by using amongst others a label-like classification (e.g. B, A, A+).

4.4. Option 4: Ecodesign implementing regulation (MEPS[52])

4.4.1. Introduction

This option aims at improving the environmental impact by setting Minimum Energy Performance Standards (MEPS) for their electrical efficiency and thermal efficacy.

This measure is largely independent on consumer and market behaviour and would take the worst performing products from the market. Chapter 5, Table 7 gives an overview of 3 sub-options that have been considered in this respect.

See **Annex G** for a summary of more considerations when fine-tuning the regulation for NRVUs.

In addition, it must be mentioned that the issue of different economics in different climate zones has been investigated and discussed with stakeholders in the preparatory study, in the context of energy labelling but particularly in relationship to minimum efficiency requirements.

In this context it is relevant that it is not possible or even desirable, for practical and legal reasons to formulate a minimum ecodesign requirement per climate zone. The products are regulated when they leave the factory gate and it is impossible for the manufacturer and certainly for surveillance authorities to be certain in which climate zone the product will be installed. Also, the Ecodesign directive has been introduced to help create a single internal market and to avoid the barriers to trade that a forced division of the EU in climate zones would create.

It can be expected that life cycle costs and payback periods for investing in energy efficient ventilation will of course vary between climates, buildings, technical building installations and the behaviour of individual consumers. For instance, the preparatory study finds payback times for a certain type of efficient mechanical ventilation that vary from 3-4 in a cold climate (reference Helsinki, FI) up to 8-9 years in a warm climate (reference Athens, Greece), with the average climate (reference Strasbourg, France) somewhere in between at around 6 years. This is in a building with only space heating. If the building also has space cooling in the summer, which is common in the non-residential sector and also is a trend in the residential sector in warm climates through room air-conditioners, the payback time in the warm climate becomes similar to the payback time in an average climate, i.e. also around 6 years.

These variations are normal, i.e. they are anticipated and not a barrier to formulate a single minimum efficiency target for the whole of Europe, as long as the targets are still in the range of what is economical. In that sense there is an absolute limit if the life cycle costs (acquisition costs and discounted running costs) of the regulated products exceed the life cycle costs of the baseline product (a.k.a. the 'base case') or if the payback period exceeds the service life of the product. In those cases, following Article 15 (5) of the Ecodesign Directive, there is an inadmissible 'significant negative impact'. However, for the average mechanical ventilation unit this service life is around 17 years, so a payback period of 8-9 years in a warm climate for a building without space cooling is well within that range.

Within those absolute limits, and the other boundary conditions in the legislation, the Ecodesign Directive looks for a target that is as close as possible to the Least Life Cycle Costs for representative ('average') products. This is formulated in Annex II ('Method for setting specific ecodesign requirements'), referred to in Article 15 (6) of the Ecodesign Directive. And this is exactly what the target level that is discussed hereafter tries to do.

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[52] Minimum Energy Performance Standards

4.4.2. *Outline of measure for NRVUs*

The table below summarizes the Ecodesign limit values for the most recent proposal and includes also some of the requirements that were not disputed..

The main definition of the new parameter SFP_{int} [53]would be given in the Commission Regulation, with further details in a transitional method to be published as a Commission Communication. For incorporation and detailing in the standards, the Commission will issue a mandate to the European Standardisation Organisations (ESOs).

Table 3. NRVU Ecodesign requirements

Parameter	**Tier 1, 1.1.2016**	**Tier 2, 1.1.2018**
drive	multi-speed or variable speed mandatory	
min. thermal efficiency HRS, ηt	**67%** (run-around coil 63%)	**73%** (run around coil 68%)
min. fan efficiency (with P is nominal electric power input)	56.1% for P>30kW else 6.2%* ln(P) + 35.0%	63.1% for P>30kW else 6.2%* ln(P) + 42.0%
max. SFPint, BVU with runaround HRS in W/(m³.s)*	1 700 + E – 300*q_{nom}/2 – F if q_{nom} < 2 m³/s and 1 400 + E – F if q_{nom} ≥ 2 m³/s;	1 600 + E – 300*q_{nom}/2 – F if q_{nom} < 2 m³/s and 1 300 + E – F if q_{nom} ≥ 2 m³/s;
max. SFPint, BVU with other HRS in W/(m³.s)*	1 200 + E – 300*q_{nom}/2 – F if q_{nom} < 2 m³/s and 900 + E – F if q_{nom} ≥ 2 m³/s;	1 100 + E – 300*q_{nom}/2 – F if q_{nom} < 2 m³/s and 800 + E – F if q_{nom} ≥ 2 m³/s;
max. SFPint, UVU with filter-module in in W/(m³.s)**	250	230
	250	
Filter performance room-inlet/ outlet	F7/M5 (acc. EN 779:2012)	

**= standard test configuration for Balanced Ventilation Unit (BVU) with F7 filter on room-inlet and M5 filter on room outlet (F=0). Testing without F7 and/or M5 filters is only allowed in case no filter module(s) are foreseen, i.e. it is physically impossible to do the test. **=standard test configuration for Unidirectional Ventilation Unit (UVU) with filter module, typical for a positive pressure system, is with F7 filter. For UVUs without filter module there are no SFPint requirements.*

4.4.3. *Timing*

The table 7 (Chapter 5) gives three scenarios of sub-options, in increasing level of ambition. Each scenario uses a 2-tier approach, whereby typically the 1st tier is mainly intended to make market actors and surveillance authorities familiar with the nature of the measure and gives time to the industry (with low efficiency appliances) to invest and adapt. The 2nd tier sets stricter requirements to boost savings. As mentioned in Chapter 1, a long-term 3rd tier, which is customary in new Ecodesign measures, was not specified, because already the ambition level of the 2nd tier is high. However, this does not mean that the legislator may introduce, e.g. at the review of the measure foreseen for 2019, new tiers.

The mechanics of the tiered implementation follows the principles on which wide consensus has been reached with stakeholders, including Member States and environmental NGOs, in the Ecodesign Consultation Forum and Regulatory Committee.

[53] Internal specific fan power [W/(m3.s)] i.e. the ratio of pressure drop over internal ventilation components of the unit and the fan efficiency.

The scenarios are all based on the tiers being introduced 2 years (tier 1) and 4 years (tier 2) after entry into force of the legislation[54]. For instance, assuming that the measures will be published in the Official Journal in early 2014, tier 1 would be implemented 1.1.2016 and tier 2 per 1.1.2018. This timing was discussed in the Consultation Forum and found consensus with both industrial and the other stakeholders.

4.4.4. Monitoring and market surveillance

As is the practice with other Ecodesign measures for large domestic appliances (refrigerators, washing machines, dishwashers, laundry driers) the responsibility for market surveillance lies with the Member States and their surveillance authorities.

As regards the monitoring of progress, this is an issue that the Commission, in consultation with the Member States, has tackled through external consultants, which usually employ several sources for monitoring progress, for instance:

Reports from surveillance authorities on compliance rates found from their investigations;

Industry databases that are updated continuously or ad-hoc. They are usually not sales-weighted, but progress is measured from the number of models in each energy class in the database.

Commercial market research institutes that could monitor –now that the energy label classes of ventilation unit sales can be identified—unit sales at point-of-sales. Data from commercial market research institutes are sales-weighted and provide a more accurate picture, but – depending if the latest figures are required or figures from 1 or 2 years before—are available only at a very substantial cost.

4.5. Option 5: Labelling and Ecodesign MEPS combined

For residential units RVUs a combination of options 3 and 4, i.e. labelling and MEPS is considered. Its rationale is to combine the advantages of the two options, i.e. the 'market pull' of labelling and the 'market push' of MEPS as discussed earlier.

4.5.1. Introduction

In its Working Document of 10.10.2012 the Commission proposed an approach whereby the MEPS were introduced for individual technical parameters, such as making variable/multi-speed drive mandatory, maximum specific (electric) power input (SPI), minimum thermal efficiency (%) and maximum control factor with the values as given in the table below.

Table 4. Alternative Ecodesign requirements RVUs

Technical parameter to be regulated	1.1.2016 Ecodesign Tier 1 Limits		1.1.2018 Ecodesign Tier 2 Limits	
	Unidirectional	Balanced	Unidirectional	Balanced
Variable speed or Multi-speed	mandatory		mandatory	
SPI, in W/(m³/h) <	0.23	0.35	0.18	0.28
Thermal efficiency heat recovery >	not applicable	75%	not applicable	80%/85%[55]
Heat recovery with bypass	not applicable	mandatory	not applicable	mandatory
Control factor <			0.9	

[54] Entry into force is usually 20 days after publication in the Official Journal.

[55] The first value of 80% applies for local balanced units; the second value of 85% to central balanced units

The proposed Energy Labelling relates to a holistic, single Specific Energy Consumption (SEC) for ventilation per m^2 heated floor area of a dwelling or building [$kWh/m^2.a$] that was calculated with a formula comprising the parameters. Details of the formula can be found in **Annex H**.

During the Consultation Forum most stakeholders were in favour of a combined approach, based on the energy label formula and whereby subsequently energy classes were eliminated (see also Chapter 1).

This approach is also used with white goods (domestic refrigerators, washing machines, dishwashers, etc.) where it has the advantage of larger consistency, transparency for consumers and easier market surveillance of both MEPS and labelling. These advantages also apply to the balanced RVUs (2 fans per unit), but for the unidirectional RVUs (one fan) the market situation and the test methods is different and such a single holistic approach might prove either too easy for those unidirectional units (not best savings) or too difficult (eliminating a too large share of the market).

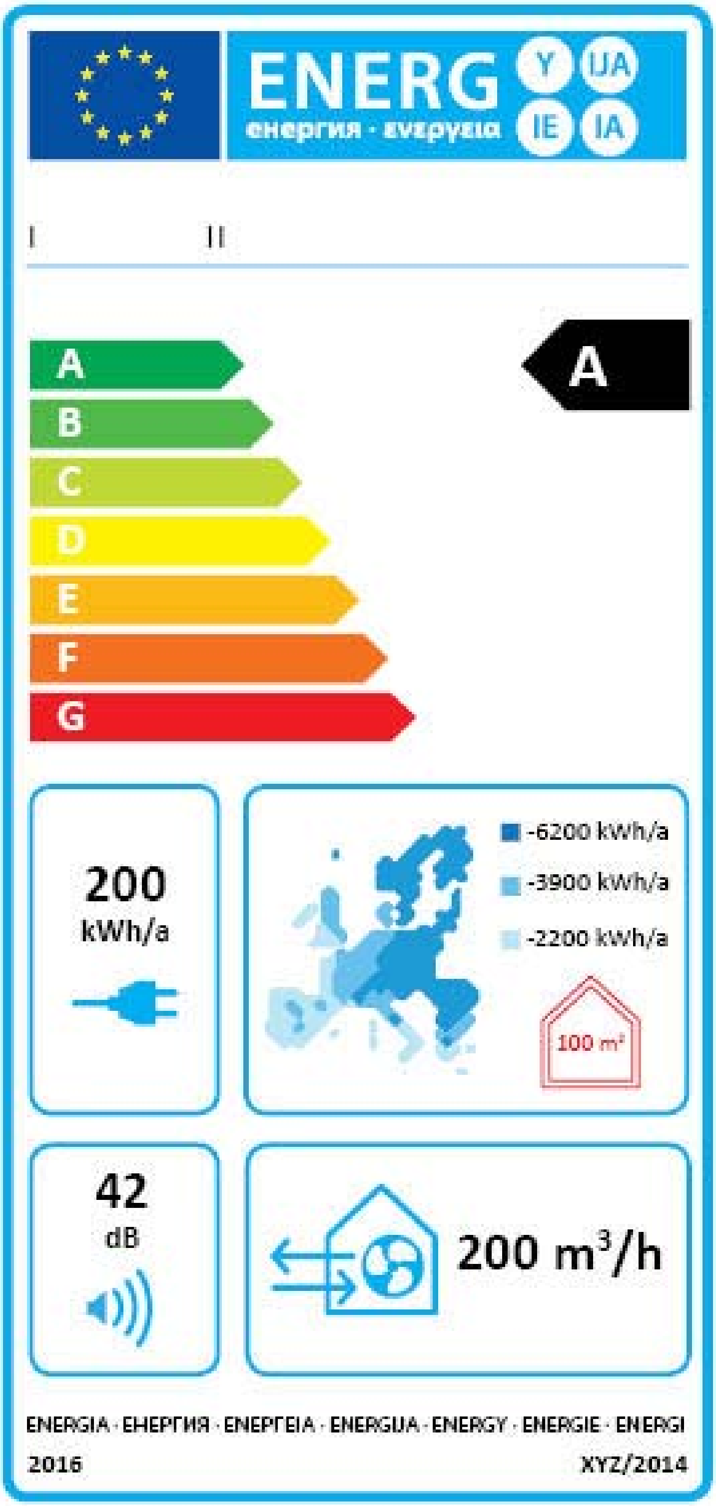
Option 5 is designed to be adequately challenging for both the balanced and unidirectional ventilation units.

In designing an energy label scheme along these lines, there are some written and unwritten rules pertaining to energy labelling and its relationship with minimum ecodesign requirements. These are discussed in **Annex I**.

4.5.2. Outline of the measures for RVUs

The following shows the preliminary label design (Figure 13), the proposed SEC energy label classification (Table 5), including timing and nature of the ecodesign and labelling measures.

Figure 12. Draft design of Energy Label for residential ventilation units (RVUs)



I, II

III

IV, V

VI, VII

The label shall provide the following information:

I supplier’s name or trade mark;

II supplier’s model identifier;

III energy efficiency; the head of the arrow containing the energy efficiency class of the appliance shall be placed at the same height as the head of the arrow of the relevant energy efficiency class. Energy efficiency is indicated for an ‘average’ climate;

IV annual electricity consumption (AEC) in kWh/a rounded to the nearest integer, as defined in Annex VIII;

V annual heating saved (AHS) in kWh/a rounded to the nearest integer, as defined in Annex VIII, with a map of Europe displaying three indicative heating seasons and corresponding colour squares, accompanied by a ‘house’ symbol with the text ‘100 m²’;

VI sound power level (L_{WA}) in dB rounded to the nearest integer;

VII maximum flow rate in m³/h rounded to the nearest integer, accompanied by a ‘fan in a house’ symbol with with one arrow representing UVUs, or with two arrows in opposite directions representing BVUs (as in the label above);

Table 5. Available energy classes by upper class limits in SEC (at entry into force 1.1.2014).

Energy label class	**1.1.2016 Ecodesign Tier 1 (T1) Class limits**	**1.1.2018 Ecodesign Tier 2 (T2) Class limits**
A^+ (most efficient)	-	-44 (new)
A	-40	-40
B	-30	-30
C	-20	-20
D	-10	Phased out (Ecodesign T2)
E	0	Phased out (Ecodesign T2)
F	Phased out (Ecodesign T1)	
G (least efficient)	Phased out (Ecodesign T1)	

Implementation of the energy label is mandatory two year after entry into force of the delegated regulation, at the same time when the Ecodesign requirements enter into application.

Apart from ecodesign requirements relating to electrical efficiency, heat recovery and controls, there are also supplementary requirements relating to sound power level as well as a visual filter change warning signal. See table below.

Table 6. Other Ecodesign requirements

Technical parameter to be regulated	1.1.2016 Ecodesign Tier 1 Max. limits	1.1.2018 Ecodesign Tier 2 Class limits
RVU: Sound power level (L_{WA})	45 dBA	40 dBA
Visual filter change warning signal	-	mandatory

The ecodesign requirements are supplemented by information requirements i.e. on leakage rates or mixing rates, which support the aim to increase energy efficiency (less leakage, lower pressure drop of filters when in use, more ventilation effectiveness through limits on mixing of cold incoming and warm outgoing air). Due to a lack of data, measurement methods and technology-neutral approaches, the possibility to set ecodesign requirements on leakage and mixing can be addressed at a later stage only.

4.5.3. Date for evaluation and possible revision

Revision of the Ecodesign measures is foreseen 5 years after entry into force (1.1.2019). The main issues for a possible revision of the Regulation are

- the inclusion of units with a nominal power input smaller than 30 W,
- labelling for non-residential units and of units with a nominal power input smaller than 30 W,
- the appropriateness of the specific energy consumption calculation and classes for demand controlled unidirectional and bidirectional ventilation units
- the verification tolerances
- the need to set requirements on air leakage rates,
- the need to tighten ecodesign requirements and the need to add a further tier,
- the possibility of establishing a single set of requirements for both RVUs and NRVUs or harmonising their requirements, following a mandate to European standardisation organisations (ESOs) for full revision of the relevant test standards in the coming years.

4.5.4. Interrelation with other ecodesign implementing measures, scope implications

The possibility of including also installation requirements, theoretically possible through the mentioning of 'putting into service' (rather than only 'placing on the market'), has been considered but discarded, because it is virtually impossible to implement and control effectively in practice[56] and –unless it completely takes over the role of the EPBD—not helpful in achieving more energy saving.[57]

The (limited) influence of the large number of horizontal legislative instruments has been discussed in Chapter 2, paragraph 2.3.

Stakeholders agreed with the above.

5. IMPACT ANALYSIS

5.1. Introduction

Given that options 1 to 3 have been discarded in Chapter 4, this Chapter looks into the impacts of option 4 'MEPS only' for NRVUs, and option 5 'combined MEPS and labelling' for RVUs.

The impact assessment builds on the impacts in the (updated) impact analyses in the preparatory studies, where sets of low- , medium- and high ambition measures were formulated and their future impacts were calculated. These sets of draft measures and their impacts were discussed with stakeholders. For RVUs these (written) consultations took place in the first half of 2011, following the draft Commission WD of 21.12.2010, and for NRVUs

[56] Basically it would require continuous surveillance of the specific installation site and there are no Member States have the required resources to realize that.

[57] Effective measures relating to the installation practice in this field require a profound understanding of the specific site and its requirements. Generic requirements are not enough and might even be counter-productive, i.e. increase the energy consumption.

the various scenarios were discussed during a final technical stakeholder meeting in July 2012. [58]

The impact analysis shows, apart from the Business-As-Usual scenario ('BAU') the impacts for this set of requirements for NRVUs and RVUs ('Scenario 3'). However, it also looks at the impact of a less ambitious sets of sub-options, that also has been brought forward by certain parts of the industry in the past ('Scenario 1') and a more ambitious set of sub-options ('Scenario 2') that disregards the physical limitations of retrofit situations, e.g. regarding the size of the units, and the variations in economics due to the climate. In other words, it only looks at the Least Life Cycle Cost (LLCC) strictly for new buildings and for the Average EU climate.

[58] The Consultation Forum in November 2012 discussed the options for both RVUs and NRVUs, giving a clear 'mandate' to the Commission to go ahead with the most ambitious scenario but also with instructions on certain issues as discussed in Chapter 4 and Annex F. In the following period November 2012- March 2013 the Commission and its technical assistant had several consultations with technical stakeholder experts to solve the technical details of appropriate set of measures. With this product, the effectiveness of the measures very much depends on the technical details ('the devil is in the detail') and the drafting and consulting process yielded several alternative solutions at micro-level in order to arrive at a robust set of measures.

Table 7. Main requirements Tier 2 in scenarios 1 (least ambitious), 2 (most ambitious) and 3 (intermediate)

	Scenario 1	Scenario 2	Scenario 3
NRVU (Option 4, Ecodesign requirements, 3 sub-options → scenarios 1, 2, 3)			
fan efficiency	as in Reg. 327/2011	4.56%LN(1)-51.5% if P≤10kW (51.5% at 1 kW); 1.1%LN(P)+59.4% if P>10kW (63% eff at 30 kW)	63.1% for P>30kW else 6.2%* ln(P) + 42.0%
electric efficiency*	UVU, N= 39-42% BVU, N= 64%	UVU, N=54% BVU, Pmref=0.85 *(approx. comparable to N=68%)*	SFPint UVU with filter max. 230 W/(m³/s); SFPint BVU with runaround HRS: 1 600 + E – 300*qnom/2 – F if qnom < 2 m³/s and 1 300 + E – F if qnom ≥ 2 m³/s; SFPint BVU with other HRS: 1 100 + E – 300*qnom/2 – F if qnom < 2 m³/s and 800 + E – F if qnom ≥ 2 m³/s;
HRS efficiency (BVU)	64%	energy eff. η_e=71%	thermal eff. η_{t_nrvu}=73% (68% for runaround)
drives	-	vsd or multi-speed	vsd or multi-speed
face velocity	-	1.6 m/s	*(in aggregate with SFPint above)*
filter	-	BVU: max 106 Pa @ 2.7m/s and F7 performance	F7 and M5 performance *(in aggregate with SFPint above)*
controls	-	clock or central DCV or local DCV	-
bypass	-	mandatory	-
RVU (Option 5, Ecodesign & Energy Label, 3 sub-options → scenarios 1, 2, 3)			
SPI max.	UVU: 0.23 W/(m³/h)	UVU: 0.18 W/(m³/h)	*(in aggregate with SEC max below, comparable to mid-value scenarios 1 & 2)*
	BVU: 0.33 W/(m³/h)	BVU: 0.28 W/(m³/h)	
HRS efficiency (BVU) min.	η_{t_rvu} =75%	local BVU: η_{t_rvu}=80% central BVU: η_{t_rvu}=85%	*(in aggregate with SEC max below, comparable to mid-value scenarios 1 & 2)*
SEC max.	-	-	-20 kWh/(m²/year)
energy labelling A-G	Yes	Yes	Yes
label class width	SEC 10 kWh/(m²/yr)	SEC 10 kWh/(m²/yr)	SEC 10 or 4 kWh/(m²/yr)
highest label class	'A' (at SEC=-40)	'A' (at SEC=-40)	'A+' (at SEC=-44)

*= N is parameter in 4.56%LN(P)-10.5%+N for P≤10kW and 1.1LN(P)-2.6%+N

Note that each of the policy scenarios represents a package of measures, which mainly differs in the ambition levels and the metrics employed.

The assessment is done with a view to the criteria set out in Article 15(5) of the Ecodesign Directive (see Chapter 3), and the impacts on manufacturers including SMEs, following the Commission's Impact Assessment Guidelines. **Annex E** explains the methodology, main inputs and detailed outputs of the quantitative analysis.

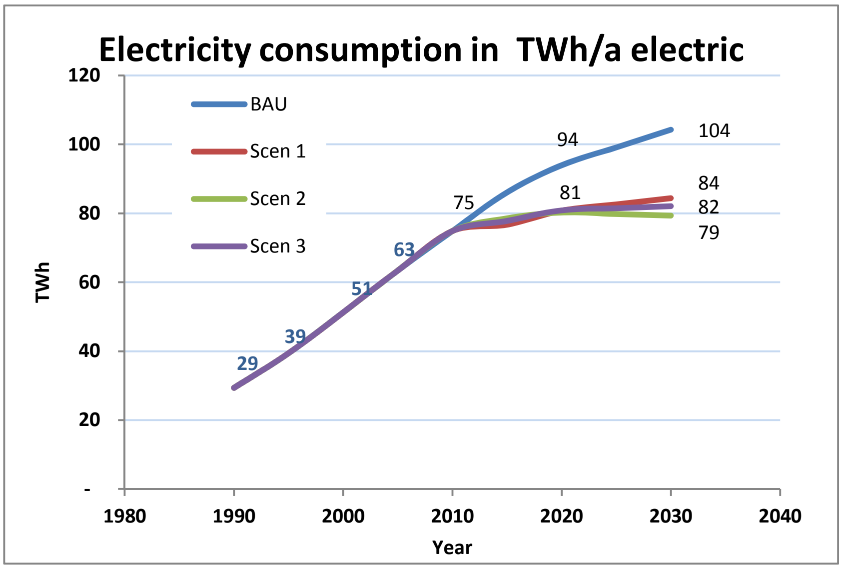
The IAB has requested the calculation of impacts for an option (hereafter 'Variation A') whereby in all scenarios the residential ventilation units (RVUs) are regulated not through ecodesign measures, but only through energy labelling under Directive 2010/30/EU (see par. 4.3). The IAB also requested the calculation of impacts for an option (hereafter 'Variation B') where in all scenarios the residential ventilation units (RVUs) are regulated only through ecodesign measures under Directive 2010/30/EU and not through energy labelling (see par. 4.4).These options are calculated and presented in separate tables for each impact category.

5.2. Impacts

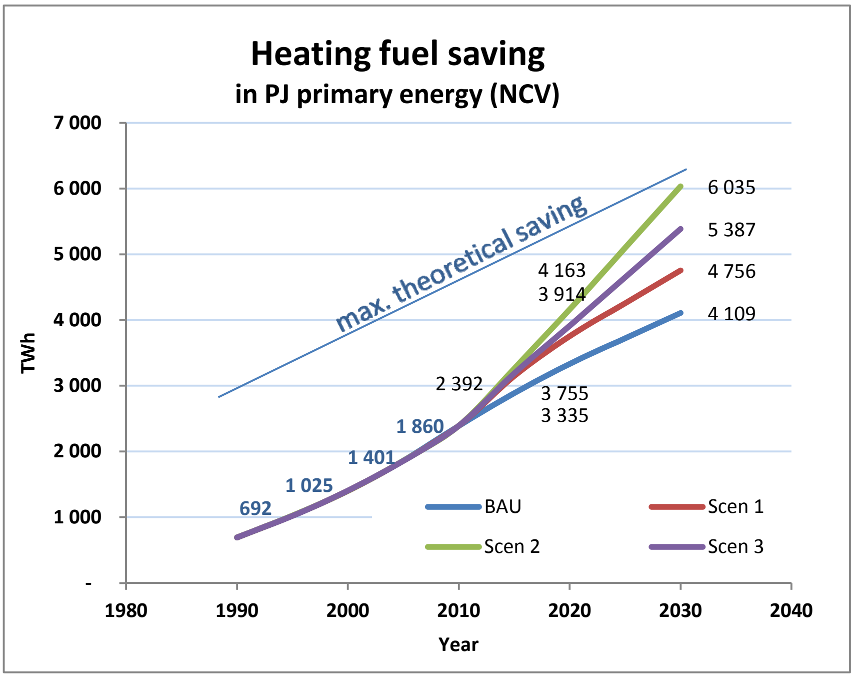
5.2.1. Energy

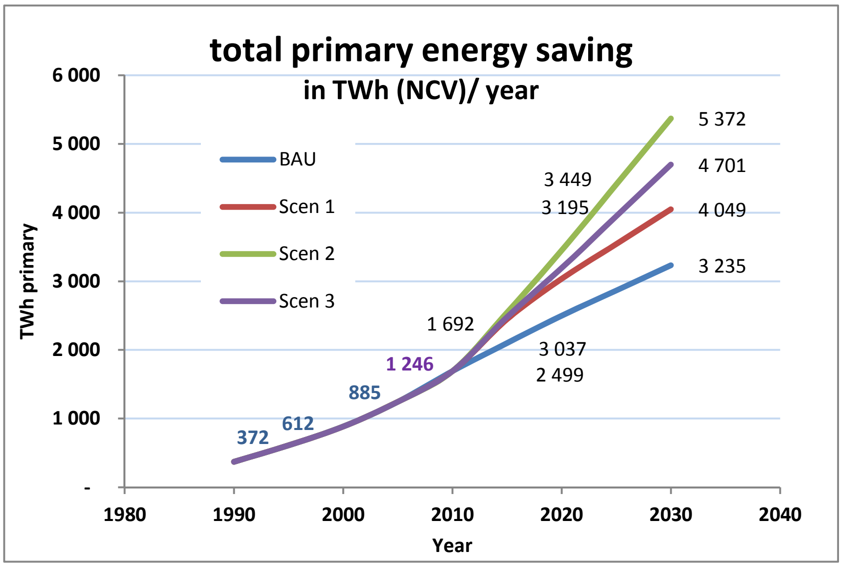
The graph below gives the results for the baseline and the Ecodesign scenario

Figure 13: Energy consumption scenarios 1990 – 2030, split between electricity consumption, space heating fuel avoided[59] and the net primary energy saving



59 The maximum theoretical saving line relates to the fact that the savings on space heating fuel can never be more than the space heating, at the assumed boiler efficiency (see Annex E), for the ventilation heat losses.





The graph shows that in the next decade the total primary energy saving of ventilation units is expected to grow in a BAU scenario with 48%, from 1692 PJ in 2010 to 2499 PJ in 2020. With the intermediate scenario 3, the saving in 2020 will be 3195 PJ, i.e. almost 700 PJ more.

In 2030, when the BAU arrives at 3235 PJ saving, the most ambitious scenario (3) arrives at 4701 PJ, i.e. over 1450 PJ extra saving. This 1450 PJ (34 Mtoe) equals roughly the final energy consumption of a country like Belgium or Sweden in 2010.[60]

The table below shows the primary energy savings of variations A and B.

60 Eurostat, Energy in Figures, 2012.

Table 8. Primary energy saving (in PJ) according to scenarios 1,2,3 and variations A & B, for 2020 and 2030.

in PJ	year 2020			year 2030		
Scenario	Original: RVU label + MEPS	Variation A: no RVU MEPS	Variation B: No RVU label	Original: RVU label + MEPS	Variation A: no RVU MEPS	Variation B: No RVU label
Scenario 1	3037	2788	2539	4049	3717	3385
Scenario 2	3449	3166	2883	5372	4931	4491
Scenario 3	3195	2933	2671	4701	4316	3930
BAU	2499	2499	2499	3235	3235	3235

Variation A entails, as indicated in par. 4.3, that the EU misses out on one third (33%) of the RVU savings. The RVUs are around 25% of the total energy in the baseline (see par. 2.2) and thus the overall saving in all three scenarios is 8.2% less.

Variation B entails, as indicated in par. 4.4, that the EU misses out on two thirds (66%) of the RVU savings. The RVUs are around 25% of the total energy in the baseline (see par. 2.2) and thus the overall saving in all three scenarios is 16.4% less.

The table shows that for scenario 3 in 2030 the savings will be 387 PJ lower than in the original proposal. For scenarios 1 and 2, the savings in 2030 are respectively 267 PJ and 334 PJ lower than in the original proposal. For comparison: the total final energy demand in the Belgian region of Brussels (1 m inhabitants) is currently around 100 PJ (2200 ktoe)[61].

5.2.2. Emissions: Greenhouse gas

The situation for greenhouse gas emissions is similar to that of the energy consumption, which is the main contributor to the carbon emissions with ventilation units. In 2020 the proposed measures in scenario 3 save up to 29 Mt CO_2 equivalent versus BAU. In 2030 this number grows to 80 Mt CO_2 equivalent.

The calculation of the impacts of variations A and B, given in the table below, is similar to those for energy above.

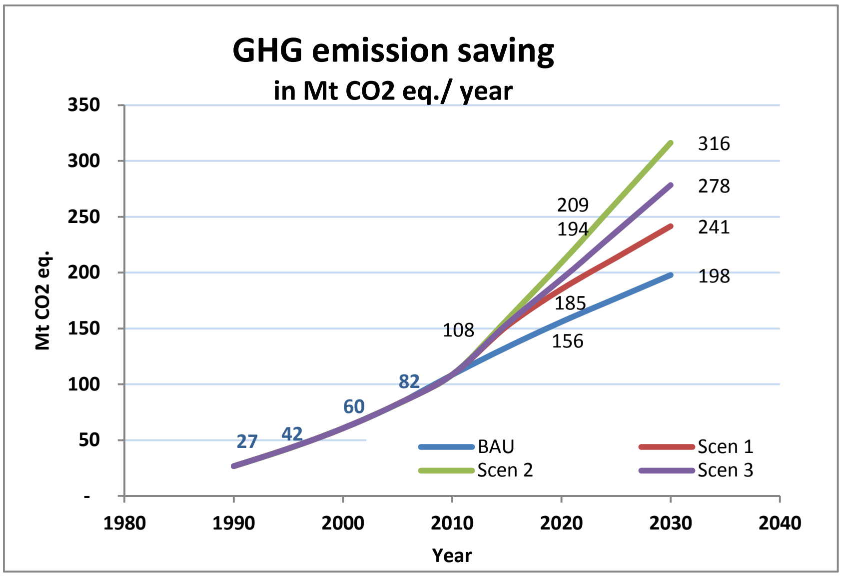
Table 9. Carbon emission savings (in Mt CO2) according to scenarios 1,2,3 and variations A & B, for 2020 and 2030.

in Mt CO2 eq.	year 2020			year 2030		
Scenario	RVU label + MEPS	Variation A: no RVU MEPS	Variation B: No RVU label	RVU lbl+ MEPS	Variation A: no RVU MEPS	Variation B: No RVU label
Scenario 1	185	170	155	241	221	201
Scenario 2	209	192	175	316	290	264
Scenario 3	185	170	155	278	255	232
BAU	156	156	156	198	198	198

61 Devogelaer,D. et al., Regionalisatie van de energievooruitzichten voor België tegen 2030: resultaten voor het Brussels Hoofdstedelijk Gewest, Federaal Planbureau, publisher Henri Bogaert, Brussels, April 2007. Calculation 1000 ktoe = 1 Mtoe = 44.54 PJ

For instance, in 2030 and in the intermediate scenario 3, the variation A gives 23 Mt CO2 less savings and variation B gives 46 Mt CO2 eq. less saving than the original proposal with both MEPS and an energy label for RVUs.

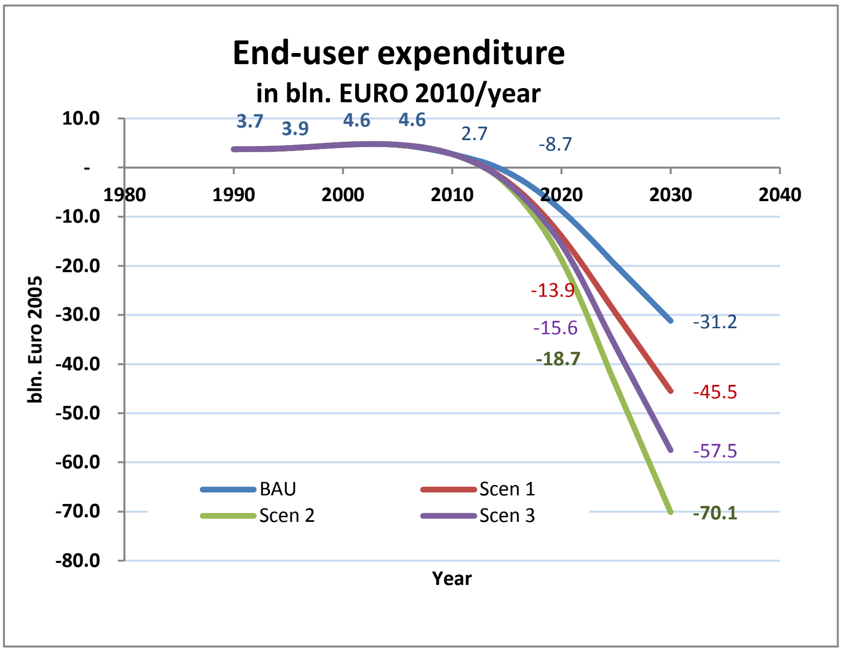
Figure 14: Greenhouse gas emission savings scenarios 1990 – 2030



5.2.2. Consumer impact

The graph below shows the total annual consumer expenditure on ventilation <u>systems</u> (purchase of system and running costs).

Figure 15. Consumer expenditure scenarios 1990 - 2030



The graph shows that until around 2015 the scenarios represent an actual monetary cost to the consumers in residential and non-residential sector. The reasons are that the installed stock is dominated by exhaust systems without demand control and that balanced systems with heat recovery are relatively rare. Only when DCV and HRS systems are growing there will be a substantial monetary saving from mechanical ventilation versus natural ventilation. In 2030, which is still 5 years before a complete stock change in 2035 (17 years after tier 2), the savings of scenario 3 versus BAU already amount to 26 bn euros.

In the Variation A around one-third of the RVU market will stay at the BAU level, whereas two-thirds of the RVU-market will follow the scenarios 1, 2 or 3. In monetary terms the share of the RVU-market in the total savings is larger than in energy terms, because the electricity tariffs for residential consumers are 50% higher than for NRVU users[62] . The acquisition costs of the RVUs are 43% of the total and thus, if one-third of the consumers does not invest in the more expensive efficient units they will recuperate some of the savings lost. Overall, in monetary terms it is estimated that RVUs generate around 35% of the total savings in the scenarios and thus one-third of these savings constitute around 12% of monetary savings missed.

In Variation B around two-thirds of the RVU market will stay at BAU level and only one-third follows the scenarios. Subsequently, the savings per scenario will be 24% less.

The table below shows the monetary savings in the original proposal as well as in variations A and B for the years 2020 and 2030.

Table 10. Annual consumer expenditure (in bn euros) according to scenarios 1,2,3 and variations A & B, for 2020 and 2030. (negative numbers mean savings)

in bn euros	year 2020			year 2030		
Scenario	RVU label + MEPS	Variation A: no RVU MEPS	Variation B: No RVU label	RVU lbl+ MEPS	Variation A: no RVU MEPS	Variation B: No RVU label

62 € 0.12/kWh for non-residential versus € 0.18/kWh for residential users, per 1.1.2011 (see also Annex E).

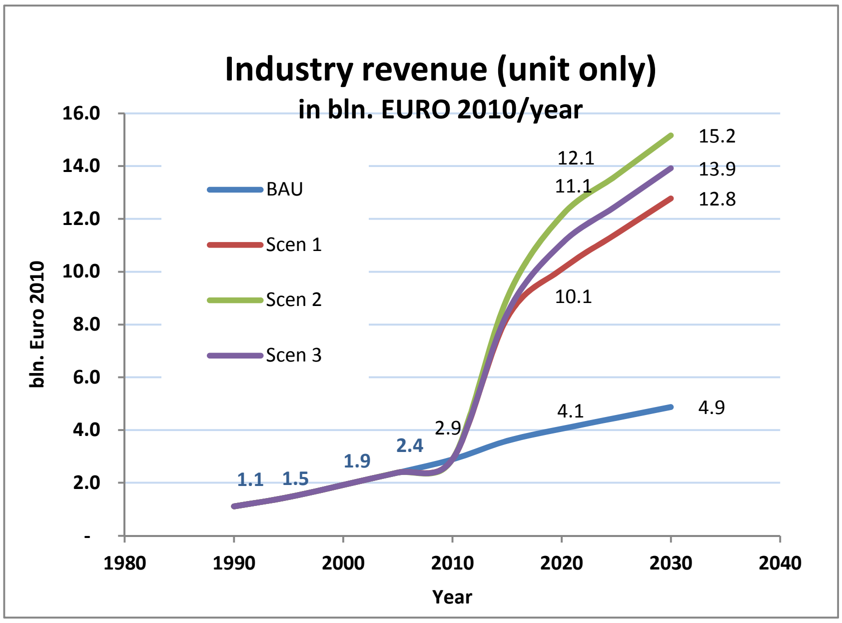
Scenario 1	-13.9	-13.3	-12.6	-45.5	-43.8	-42.0
Scenario 2	-18.7	-17.5	-16.3	-70.1	-65.4	-60.6
Scenario 3	-15.6	-14.8	-13.9	-57.5	-54.3	-51.1
BAU	-8.7	-8.7	-8.7	-31.2	-31.2	-31.2

For instance, in 2030 and in the intermediate scenario 3, the variation A gives 3.2 bn euros less savings and variation B gives 6.4 bn euros less saving in consumer expenditure than the original proposal with both MEPS and an energy label for RVUs.

5.2.3. Business economics

The graph below gives the projected industry sales value of only the product in billion euros per year over the 2010-2030 period. This is the result of an increase in unit sales of 40% over the period for all 4 scenarios and a real (inflation-corrected) price increase that varies between 10% for the BAU scenario and a factor 3 for scenario 3. The latter is due to the improvements on components and overall design, but also for RVUs a shift towards more BVUs. The industry revenue in scenario 3 is 7 billion euros higher in 2020 and 9 billion euros higher in 2030 with respect of the BAU scenario.
The cost built-up of the system is given in Annex C. Costs are passed on to consumers in a higher purchase price, which is then more than compensated by lower running costs. Payback periods vary per scenario. E.g. for scenario 3 it is in the order of 4-6 years for users living in the average climate.

Figure 16. Industry revenue scenarios 1990 – 2030



As is shown in figure 6 of paragraph 2.2.1, the RVUs are responsible for 43% of the revenues of the VU industry. In variation A, one-third of that revenue stays at BAU-level, which means that the total increase in revenue versus the BAU will drop by 14% (one third of 43%). If two-thirds of the revenue stays at BAU-level (variation B), then the total increase in revenue versus the BAU will drop by 28% (one third of 43%).

Table 11. Annual industry revenue (in bn euros) according to scenarios 1,2,3 and variations A & B, for 2020 and 2030.

in bn euros	year 2020			year 2030		
Scenario	RVU label + MEPS	Variation A: no RVU MEPS	Variation B: No RVU label	RVU lbl+ MEPS	Variation A: no RVU MEPS	Variation B: No RVU label
Scenario 1	10.1	9.3	8.4	13.9	12.6	11.3
Scenario 2	12.1	11.0	9.8	15.2	13.8	12.3
Scenario 3	11.1	10.1	9.1	12.8	11.7	10.6
BAU	4.1	4.1	4.1	4.9	4.9	4.9

For instance, in 2030 and in the intermediate scenario 3, the variation A gives 1.1 bn euros less industry revenue and variation B gives 2.2 bn euros less industry revenue than the original proposal with both MEPS and an energy label for RVUs.

5.2.4. Impacts on competitiveness

Competitiveness Proofing is described in Commission Staff Working document SEC (2012) 0091[63] as a complementary instrument to reinforce the overall assessment of economic impacts of a new proposal with a better account of impacts on enterprise competitiveness at sector and aggregate level by identifying, and – where proportionate – by quantifying the likely impacts of the new proposal in three dimensions of enterprise competitiveness, i.e. costs, capacity to innovate and international competitiveness [of the European industries].
Unfortunately for the ventilation-sector not enough data are available for quantification and thus the following describes the three dimensions only qualitatively.

The mentioned measures will remove a significant percentage of 2012-models from the market in 2018, but the pace of removal/replacement by more efficient units is not faster than that of the normal replacement of models in a manufacturer's catalogue for strictly commercial reasons. Hence, also given the fact that meeting the target levels does not require exotic or highly advanced technology, the costs of R&D and tooling are not expected to rise above the normal level. The same goes for testing costs, which –as with other large domestic appliances—will constitute less than 0.1% of the product price. [64]

For the most part, i.e. the vast majority that believes that good energy efficiency is vital for their future business, EU-industry is firmly convinced as evidenced during the consultation that strong measures both on the energy and the performance side will have a positive impact on their competitiveness and their innovation capacity. It will deter inefficient low-cost imports which have negative impact on profitability.

Table 12. Competitiveness proofing screening table

Cost and price competitiveness	Positive	Negative
Cost of inputs		Likely to increase
Cost of capital	No significant change expected	

[63] Commission Staff Working Document SEC(2012)91 final, *Operational Guidance for Assessing Impacts on Sectoral Competitiveness within the Commission Impact Assessment System, A "Competitiveness Proofing" Toolkit for use in Impact Assessments*, Brussels, 27.1.2012. Available at http://ec.europa.eu/governance/impact/key_docs/docs/sec_2012_0091_en.pdf

[64] Ibid 42.

Cost of labour	No significant change expected	
Other compliance costs (e.g. reporting obligations)		Minor compliance cost to prepare self-declarations (see also par. 5.2.9)
Cost of production, distribution, after-sales services		Distribution costs could rise because of larger products
Price of outputs (directly not through the cost, e.g. price controls)	Initial price increase expected, but Life-cyle cost (LLC) should go down (see also par. 5.2.3)	
Capacity to innovate		
Capacity to produce and bring R&D to the market	Should be stimulated in order to meet Tier 2 MEPS requirements	
Capacity for product innovation	Should be stimulated in order to meet Tier 2 MEPS requirements	
Capacity for process innovation (including distribution, marketing and after-sales services)	Cannot say	
Access to risk capital	Cannot say	
International competitiveness		
Market shares (single market)	Likely to increase	
Market shares (external markets)	Likely to increase	
Revealed comparative advantages	Products with higher added value	

5.2.5. Impacts on SMEs (manufacturing)

Not as much as with e.g. smaller domestic appliances, but also with the smaller unidirectional ventilation units there is a threat of low-cost imports of components and whole products to EU manufacturing and EU industry jobs especially with small and medium-sized companies (SMEs). Given the quality-levels and energy efficiency of these products, the advantages of these low-cost appliances for consumers, if any, are at best limited.

Maintaining the moderate growth in EU manufacturing of ventilation units, this will no doubt also help (SME) producers of components, with no negative impact on consumers as regards the total Life Cycle monetary costs. Testing costs for the proposed measures are, also for SMEs, not significantly different from current practice.

5.2.6. Impacts on distribution channels

Between 1990 and 2010 the gross total consumer expenditure for ventilation units, both acquisition and running costs, has raised considerably (see section on consumer expenditure).

It is expected that this trend will continue up to 2030 without measures (BAU) and will further increase with Ecodesign measures. This means an increase in the value of sales, so benefiting distribution channels. As there is a relatively large proportion of SMEs in these channels it should also benefit them.

5.2.7. Impacts in third countries

The process for establishing ecodesign requirements has been fully transparent, and after endorsement of the regulation by the Regulatory Committee a notification under WTO-TBT will be issued.

There are no regulations at product level on ventilation units in third countries. No competitive disadvantages for EU manufacturers exporting affected products to third countries are expected.

The EU has often been leading in standardisation and energy labelling and it is thus likely that many countries would follow the EU example especially in the field of labelling. This will strengthen the global effort of fighting low-efficiency appliances.

5.2.8. Social impacts: Employment

The increase of employment in the ventilation industry is estimated by this Impact Assessment at 85 000 jobs, and in the related system industry and installer business, which is predominated by SMEs, at 300 000 jobs.

Although exact data on employment in the ventilation is not available, the best estimate of current employment, based on information in annual reports and anecdotal data in the public domain, is described comprehensively in Annex D. Following the Ecodesign Methodology MEErP 2011[65], Part 1, paragraph 7.6), the average revenue per employee for the various market actors is used as a parameter to calculate the employment effects. According to the Ecodesign preparatory study (VHK 2012) this amounts to around 160-170 000 euros per employee in the VU industry and 100 000 euros in per employee for installers. The determination of the revenues is described extensively in Annex E. The number of jobs then follows from the division of a specific revenue by the average revenue per employee. For example, if the industry revenue doubles then also the employment doubles (compare figure 16, industry revenue scenarios).

As is also indicated in MEErP 2011, indirect employment effects outside the sector are not taken into account. This means that no Input/Output analysis or other type of analysis was employed to estimate e.g. the indirect jobs (greengrocers, bakers, etc.) in the local economy where the workers spend their income. Also the indirect employment effect of the tax income generated by the sector is not taken into account. The employment analysis is strictly limited to the VU industry (the ventilation unit), their OEMS (fans, filters, heat exchangers, controls), the VU system industry (air ducts, terminal units, installation materials), wholesalers and retailers/installers (installing and maintaining not only the VU, but also the duct, terminal and control systems that go with it).

Furthermore in this context, not all ventilation-related jobs are new jobs, but a part is due to job migration/redefinition in the installation practice whereby installers that previously would be classified as working in ‘air-conditioning’ sector are now working in the ‘ventilation’ sector. This is due to an on-going trend in non-residential air-conditioning whereby the space cooling/heating function on one hand and the ventilation function on the other hand are no longer combined using a central duct system. The central duct system still exists but is now (mainly) used for ventilation, and thus the installer jobs for making the duct work are now classified as ‘ventilation’ jobs. The space cooling/heating is realised through hydronic systems with fan coils or through local refrigerant based units, both using local air recirculation to distribute the cold or hot air.

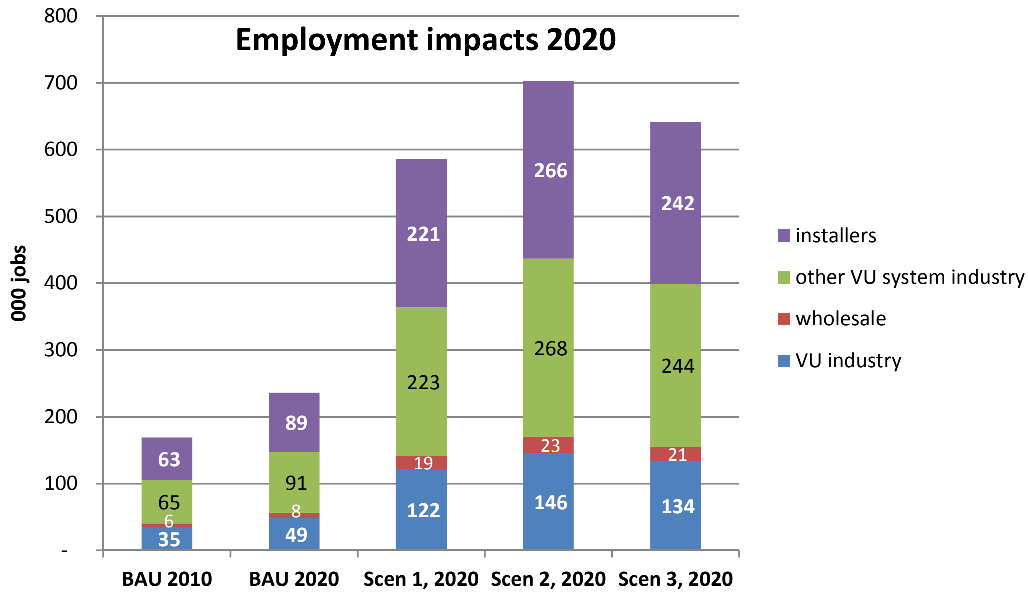
It should be noted that there are large uncertainties in future projections. Nobody knows exactly how long the current crisis in the construction industry is going to last. The ventilation industry has suffered much less than others from the crisis, because it also has revenue from the renovation market and because it is one of the most economical investments in energy

65 http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/methodology/index_en.htm

efficiency that builders and consumers can make, but it most certainly has slowed down the strong growth-trend before the crisis. Also it is not certain if Member States will be willing to invest substantially in promoting, through subsidies and regulations, energy efficiency in buildings, in general. If they do --as is planned-- efficient mechanical ventilation (combined with making the building shell air-tight) will be on the top of their priority list as one of the most economical options. But if they don't, and all initiatives have to come from consumers and builders, growth projections will suffer.

Figure 17 gives the outcome of the employment analysis. The increase in the jobs, e.g. for installers, in the various policy scenarios may seem very optimistic, but it should be taken that the total number of jobs in the EU27 building installation sector is around 3.4 million (Eurostat 2010). In that light 266 000 installer jobs are only 8% of the total. Furthermore, it should be considered that installing most parts of ventilation systems and ductwork does not require highly specialist skills, but is currently performed by all types of installers. In other words, it is not anticipated that a lack of skills or finding suitable personnel will be a major barrier in realizing job-growth.

Figure 17. Employment scenarios 2020



5.2.9. Administrative burden

The form of the legislation is a regulation which is directly applicable in all Member States. This ensures no costs for national administrations for transposition of the implementing legislation into national legislation.

The Impact Assessment on the recast of the Energy Labelling Directive SEC(2008) 2862 calculates the administrative burden of introducing a new implementing Directive similar to the proposed ecodesign implementing measure, in accordance with the EU Standard Cost Model. See **Annex J**.

It estimates the administrative cost of implementing measures in the form of a Directive at 4.7 million euros of which 720 000 euros for administrative work on the amendment/development of the new Directive and 4 million euros for transposition by Member States. It follows that the administrative cost of an implementing Regulation, as currently mentioned, would save 4 million euros in avoided transposition cost. In the proposal with both RVU energy label and

MEPS there are two regulations and thus the administrative work would be around 1.44 m euros. The same goes for variation A. In the case of variation B, only one regulation (on ecodesign) is needed and this would require, in theory, only half of the administrative burden, i.e. the 720 000 euros mentioned above.

Administrative costs of enforcing the Regulation are difficult to estimate. Enforcement could involve random spot-checks by the authorities, but from experience with other regulations of this type most spot-checks are not random but follow indications of competitors or third parties (e.g. industry or consumer associations). In those cases, the probability of not only recuperating testing costs and legal costs, but also of collecting fines is high. Therefore, no extra enforcement costs for Member States are anticipated from the measure.

For business, extra administrative costs, if any, will be modest. In current practice, ventilation units are subject to efficacy and performance tests for a number of reasons (CE-marking, client specification, etc.). The considered Regulation will not change this situation. There is no difference in this respect between various sub-options. The printing and handling costs of the label, for other products like white goods assessed at less than € 0.10 per unit, will not significantly impact the administrative burden for the industry nor the purchase price for the consumer that will of course ultimately pay for it.

5.3. Summary economic, social and environmental impacts

The impact analysis was performed for the baseline (BAU) and three policy scenarios. The latter entail setting only Ecodesign minimum requirements (Option 4) for NRVUs) and setting Ecodesign minimum requirements in combination with energy labelling (Option 5) for RVUs) but differentiate mainly in their ambition level.

The tables below give an overview of the most important impacts for the 3 sub-options versus the baseline for 2030. Results for 2020 are given in Annex K, section K.7.

Table 13. Annual savings policy scenario 2030 versus BaU 2030

		Scenario 1 (extra) saving	**Scenario 2** (extra) saving	**Scenario 3** (extra) saving
Electricity TWh/a		20	25	22
Space heating fuel saving PJ/a		647	1 926	1 278
Net primary energy primary PJ/a		815	2 137	1 466
GWP $MtCO_2$/a		44	118	81
Acquisition € bn/a		53.2	68.9	60.8
Revenue VU industry € bn/a		7.9	10.3	9.0
Revenue trade, installers & related industry € bn/a		43.2	55.8	49.3
Employment industry '000 jobs		95	124	109
Employment trade, installers & related ind. '000 jobs		393	508	448
Energy costs € bn/a		22	49	35
Consumer expenditure[1] € bn/a		14.3	38.9	26.3

The savings on energy and GWP-related impacts are 8.2% lower, in all scenarios, for variation A and 16.4% lower for variation B. The growth of revenues of industry, trade, installers and related industry, as well as the growth in employment for these market actors are 14% lower, in all scenarios, for variation A and 28% lower for variation B. The savings on energy costs and consumer expenditure are 12% lower, in all scenarios, for variation A and 24% lower in variation B.

The total administrative burden for all operators amounts to 4 million euros (< 0.1% of annual revenue), which is not excessive in view of the savings achieved. In variation B, which does not include energy labelling for RVUs, the administrative burden will be some 20-25% lower.

Costs to producers are all passed on to consumers and thus included in increased consumer acquisition costs. But due to the gains in running costs the consumer expenditure will decrease (see par. 5.2.3).

The territorial impacts are not applicable as the measures are product-oriented and do not differentiate, nor in content nor in effect, between regions.

Table 14. Accumulative savings policy scenarios 2011-2030 versus BaU 2011-2030

Period 2011-2030	**Scenario 1** saving	**Scenario 2** saving	**Scenario 3** saving
Electricity TWh/a	263	274	262
Space heating fuel saving PJ/a	8403	16564	11582
Net primary energy primary PJ/a	10745	19003	13909
GWP $MtCO_2$	583	1056	765
Energy costs € bn	226	361	278
Expenditure € bn	105	200	138

As regards possible negative impacts of the Ecodesign scenario, Table 11 below gives an overview. The differentiation in the first two rows of the table is explained by the differences in energy saving, where scenario 2 scores best.

In rows 4 (affordability) and 5 (competitiveness), however, scenario 2 has a negative impact. The reason is that the demands on NRVU face velocity of 1.6 m/s are very strict and result in units that occupy almost twice the current volume. This means that, although the payback-period on the unit itself is possible, the technical room where many of these units are mounted has to be twice the size, which is especially in a retrofit situation to a very high costs in infrastructure (affordability) or a switch in consumer preference to more compact, cheaper but also less efficient exhaust solutions, with a relative high share of extra-EU imports (industry competitiveness). For residential ventilation units, and especially the unidirectional units, the Specific Power Input-demands in scenario 2, which were incorporated in the first Commission draft Working Document presented in the Consultation Forum of 21.11.2012, are very ambitious compared to the current level of fan efficiency in unidirectional ventilation units and have led to protests from the unidirectional ventilation unit-oriented industry as regards their competitiveness. As regards the other aspects in Table 11 (functionality, health, proprietary technology and excessive administrative burden, there is no significant difference between the sub-options/scenarios and there are no significant negative impacts.

Table 15. Evaluation policy options in terms of their impacts

	base line BAU	**Scenario 1**	**Scenario 2**	**Scenario 3**
reduce energy consumption and related CO2 and pollutant emissions	**0**	**0/-**	++	+

promote energy efficiency hence contribute to security of supply	**0**	**0/-**	++	+
no significant negative impacts on the functionality of the product. from the perspective of the user	**0**	+	+	+
health. safety and the environment shall not be adversely affected	**0**	+	+	+
no significant negative impact on consumers in particular as regards affordability and life-cycle costs	**0**	+	**-**	+
no significant negative impacts on industry's competitiveness	**0**	+	**-**	+
setting of an ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers	**0**	+	+	+
impose no excessive administrative burden on manufacturers	**0**	+	+	+

Table 16. Evaluation policy options in terms of their effectiveness, efficiency and coherence

	base line BAU	**Scenario 1**	**Scenario 2**	**Scenario 3**
Effectiveness (capacity to reach policy goals)	**0**	**0**	+	++
Efficiency (costs versus gain)	**0**	+	++	++
Coherence (within the total of policy measures to reach policy goals)	**0**	+	+	++

Table 12 evaluates the effectiveness, efficiency and coherence of the sets of sub-options in the various scenarios, showing that Scenario 3 is the most effective in reaching the policy goals without negative impacts. In terms of efficiency all scenarios have negative monetary costs for market actors, except –depending on the viewpoint-- for the energy utilities, because the investments are recuperated within a reasonable payback period and overall there is a gain in life-cycle costs. However, between the 3 scenarios –taking into account the negative impacts of scenario 2 in a wider context—Scenario 3 is the preferred option. Finally, in terms of coherence, all three scenarios are tuned to the existing ecodesign regulations for motors and fans in terms of definitions and requirements, but Scenario 3 is also explicitly tuned to EPB-type regulations in the various Member States, especially the Nordic Member States and Germany. The sensitivity analysis of the sub-options can be found in Annex K, section K.8.

The quantitative analysis of variations A and B confirms that leaving out the minimum ecodesign requirements and relying on energy labelling for RVUs (variation A) or, vice versa, leaving out energy labelling and relying only on minimum requirements (variation B) has a considerable negative impact on the projected benefits of scenarios 1, 2 and 3. The only positive impact of variation B that could be identified is in a slightly (25%) lower administrative burden, which is negligible in the light of the considerable positive monetary and environmental impact of keeping energy labelling for RVUs. Variations A and B are thus , in full agreement with the stakeholders, discarded.

6. CONCLUSIONS

Ventilation units are eligible for measures under the Ecodesign 2009/125/EC and the energy labelling directive 2010/30/EC, representing significant sales, a significant environmental impact and saving potential, not already being addressed by existing EU policy measures.

The most important environmental impacts are energy consumption and carbon emissions during the use phase and it is in those areas that ventilation unit-related measures can make the largest contributions to energy policy objectives on energy efficiency, energy security of supply and abatement of greenhouse gas emissions.

In operational terms this means that the ventilation unit-measures contribute to achieving 20% energy saving and greenhouse gas emission reduction in 2020 with respect to 1990. However, given that the market dynamics is coupled to the construction industry, most of the energy saving potential will be realized after 2020.

With respect of the alternative policy options, the following conclusions were reached:

- No action. As ventilation units were found eligible for measures, this would not respect the mandate of the legislator.
- Self-regulation. As the ventilation-industry explicitly rules out this option and demands mandatory measures this option was discarded.
- Energy labelling only. For RVUs this option misses out on roughly one-third of the saving and abatement potential with respect to option 5, because an important market segment –e.g. where the buyer is not the user—would not be reached.
- Minimum Ecodesign requirements only. For NRVUs, where energy labelling is not desirable as mentioned under option 3, this is the best possible option. For RVUs this option misses out on around two-thirds of the saving and abatement potential in option 5.
- Combination of Energy labelling and minimum Ecodesign requirements. For RVUs this constitutes the best option.
- Option 4 for NRVUs and option 5 for RVUs were selected for further quantitative impact assessment.

The Ecodesign and, for RVUs, the energy labelling measures ensure that:

- The least energy efficient ventilation units will be removed from the market, increasing competition on energy efficiency instead of price and additional features;
- on-going energy improvements are fostered by setting a transparent legislative framework that will provide the industry with the long-term security needed to invest in innovative technology;
- information on product differentiation provides residential consumers with an effective and reliable tool to compare energy consumption of products in an economic setting demand for energy efficient appliances;
- cost-effective potentials to reduce the electricity consumption of ventilation units are quickly realized leading to significant increase in average efficiency;
- by 2030 the net primary energy saving from ventilation units will increase by 1460 PJ due only to the measures proposed here and CO_2 emissions will be reduced by 81 Mt CO2 in 2030;
- the accumulative energy and CO_2 savings amount to almost 16 EJ and 0.76 Gt CO_2 equivalent respectively over the 2011-2030 period;
- this can be achieved at no extra consumer expense over product life and also no negative impact on other aspects (health, safety, competitiveness, etc.) is anticipated;

- there is a clear legal framework for product design which leaves flexibility for manufacturers to achieve the efficiency levels; and gives them a level playing field, ensuring fair competition and free circulation of products;
- requirements for ventilation units are harmonized in the Community leading to a minimization of administrative burdens and costs for the economic operators;
- market failures are corrected and the internal market is functioning properly;
- the specific mandate of the Legislator is respected;
- costs for re-design and re-assessment upon introduction of the regulation are limited in absolute terms and not significant in relative terms (per product);
- disproportionate burdens for manufacturers are avoided due to transitional periods which duly take into account redesign cycles;
- there are no significant impacts on the competitiveness of industry, and in particular SMEs;
- there is a positive impact on employment, in particular for SMEs.

Regarding the principle of subsidiarity it can be stated that the problem is trans-national and actions by Member States alone, apart from being less effective than actions at EU-scale, would restrict free circulation of goods. As has been established in Chapter 2, there is a significant EU an international trade in these products and would be opposed to the principle of Article 114 TFEU (internal market), which –amongst others-- is the legal basis for the Ecodesign Directive 2009/125/EC.

The preferred policy option for realizing the improvement potential of ventilation units is a Commission Regulation setting Ecodesign requirements for all products in question, combined with an Energy Labelling delegated Regulation on RVUs, to guide customers towards the most efficient appliances. The Ecodesign requirements would be set in 2 tiers applicable 2 and 4 years after entry into force of the measures respectively. The labelling requirements on RVUs would be set 1 year and updated 2 years after the delegated regulation has entered into force.

7. MONITORING AND EVALUATION

The appropriateness of scope, definitions and limits will be reviewed after maximum 5 years from the adoption of the measure (as required by Annex VII.9 of the Ecodesign Directive and laid down in the implementing measure). The review of this measure is scheduled for 2019. Account will be taken also of the speed of technological development and the input from stakeholders and Member States. Compliance with the legal provisions will follow the usual process of 'New Approach' regulations as expressed by the CE marking.

- The main issues for consideration for the review of the regulation include:
- The appropriateness of the product scope;
- The appropriateness and effectiveness of the levels for the ecodesign requirements, including the possibility of introducing a third tier;
- possibilities of a single set, or at least a more harmonised set of requirements for both RVUs and NRVUs

- Look into the appropriateness of other ecodesign requirements to cover other environmental impacts beyond energy,
- In the forthcoming implementation and standardisation phase, the monitoring will ensure that
- by 2016, when the first labelling tier enters into application, appropriate and understandable performance information is available;
- by 2016, when the first ecodesign tier enters into application, appropriate and reliable metrics for energy performance measurements based on the regulation are available;
- by 2017 a framework for gathering information about energy performance is created that contributes to the subsequent review five years after entry into force;

Key performance indicators for residential ventilation units can be the energy label rating of units sold, collected through market research institutes, and dedicated task-forces from Member States or voluntary databases from industry. For non-residential ventilation, the key indicators are the electricity consumption of the VUs and savings on space heating energy. New industry databases and/or databases from existing certification schemes (Eurovent, RLT), supplemented by spot-checks from Member State surveillance authorities, are the most likely sources for the non-residential sector.

At Member State level, compliance checks are mainly done by market surveillance authorities ensuring that the requirements are met, whereas the appropriateness of scope, definitions and concepts will be monitored by the on-going dialogue with stakeholders and Member States. Further information from the field as e.g. complaints by consumer organisation or competitors could alert on possible deviations from the provisions and/or of the need to take action.

ANNEX A
MINUTES OF CONSULTATION FORUM MEETING 2012

Meeting of the Consultation Forum under Article 18 of Directive 2009/125/EC on energy-related products

Ventilation Units

Brussels, 6 November 2012 (09.00 - 17.30)

Minutes of the Meeting

Subject:	Ecodesign Consultation Forum on Ventilation Units
Place and date:	CCAB, meeting room C3; Brussels, 6 November 2012
Chair:	Kirsi Ekroth-Manssila
List of participants:	See separate Document

1. Welcome and approval of the agenda

The chair opened the Consultation Forum meeting and welcomed the participants.

2) Adoption of the agenda

The chair proposed a more detailed structure to agenda item 3 about the Working Document. A PowerPoint presentation was prepared to guide through the meeting (available on CIRCA). The agenda was approved without amendments.

3) Working Document on possible Commission Regulations laying down Ecodesign and Energy Labelling requirements for Ventilation Units

The chair set off the agenda item and introduced VHK, a consultancy who is providing technical support to the Commission via an impact assessment study contract.

The Commission explained that the ventilation parts of ENER Lot 10 and ENTR Lot 6 have been merged into one working document covering residential and non-residential ventilation units. A short introduction about the importance of the product group was given highlighted that ventilation units are not only energy using, but as well energy related products, which comprise a saving potential of up to 1300 PJ through ecodesign and energy labelling measures (corresponds to 144 TWh in 2025.

VHK gave a presentation about the ventilation demands, products, sales & stock, supplemented by information about environment aspects and energy saving potentials. He highlighted the very high improvement potential through better heat recovery and better controls, and a significant improvement potential through better electric efficiency.

An introductory discussion with contributions from **Agoria Naventa, Inforse, UK, ECOS, EVIA, Eurovent** and **VDMA** took place clarifying the general product scope, the improvement potentials, and interferences with safety or hygiene legislation.

The chair noted that no voluntary agreement or other self-regulatory measures are being prepared by any industry association in this sector.

Draft Ecodesign Regulation

Scope, Exclusions

The Commission introduced the main provisions of the draft legal text of the Ecodesign Regulation. For the scope it proposes a pragmatic exclusion of all fans with a nominal electric power input of less than 30 W.

The UK, assuming a high saving potential, asks if such fans could be covered by a separate regulation, and to introduce information requirements for these small fans. In reply to a question from ECOS, VHK explained that the overall saving potential has been estimated of less than 1% of the whole product group (0.4 TWh, considering other sources max. 1 TWh), and that a regulatory approach for many and very different small fans would be much burden.

EVIA suggested amending the exclusions to units with a heat exchanger and a heat pump for heat recovery, and to products using recirculation air for heating and/or cooling. These are very specific products for passive houses, and should be furthermore covered in Lot 21. VHK offered to cross-check with the Lot 21 scope and agreed in principle to the exclusion representing a very small market share.

EVIA furthermore suggested to exclude fans >30 W with combined functionalities also for safety/emergency use, already being dealt with by existing regulations.

Eurovent raised two issues for the exemptions which exist also under the fan regulation, the cross-contamination and specific hygiene/biological aspects, and announced to come back with written comments. A subsequent discussion between Eurovent, EVIA and VDMA, if it would be better to exclude specific cases like hospitals to keep the overall requirements ambitious, or to cover such cases as far as possible with adapted requirements, was inconclusive.

Residential – Non-Residential

The Commission presented its draft approach how to distinguish between residential (RVU) and non-residential ventilation units (NRVU).

Denmark and **Norway** found that 125 W cut off is not the correct approach; a definition just per single dwelling unit would be preferable. DK added that it should refer to one fire compartment (fire cell/fire area).

EVIA remarked that manufacturers do not know the use of their products, and that therefore the definitions should be product-related rather than use-related to avoid loopholes in the regulation. EVIA expressed preference for an 'intended use' approach instead of fan power. For EVIA the intended use is certain, residential would be a single dwelling, and non-residential blocks of flats, and commercial applications. EVIA fleshed out that the purpose is important. A ventilation unit could also be used for cooling, and units < 125 W could also be adequate for non-residential purposes like for schools.

EVIA suggested a separate category and an extra annex for box and roof fans.

EPEE supported this EVIA suggestion. EPEE demanded beyond the proposed third category for roof top and boxed fans also an exemption for ceiling mounted heat recovery units.

Eurovent supported a simple threshold, being it 125 W, or another power input.

Germany preferred a declaration of use.

The UK expressed concerns about the intended use and that this responsibility is given to the manufacturers. The issue should be treated with caution as it can affect relevant performance standards for products.

The Commission brought forward legal arguments. Scope definitions must be technically clear and tangible, both for legal drafting issues as well for implementation and market surveillance. An intended use would not achieve this.

VHK backed this argument up. If for one product two measurement methods exist, the manufacturer can choose the less stringent, independent from the real intended use, and the regulatory or surveillance authorities can do nothing about the product-related ramifications of this declaration. This approach has led for example to the situation that "tropical fridges" are most popular in Scandinavia. The draft regulation recognises this intermediate category as a grey area, but the regulation should set limits to avoid loopholes. Furthermore, it was highlighted that this is just about calculation methods; it is not about limiting the use.

Following an appeal from the chair to propose a simple solution, **EVIA** on behalf of the Joint Industry Expert Group proposed that the airflow would be better parameter for this distinction than power input and pressure drop.

Austria asked about the criteria to test the two calculation methods.

VHK took up the EVIA proposal to consider the airflow and appraised it as a possible way forward, provided that the flows, tolerances etc. would be well defined and agreed. Legally, this issue could be made more robust if, just as with the nameplate electric power, the product information would explicitly mention that the manufacturer does not assume any liability for damages if the unit is operated above the agreed airflow rate.

Timelines

The Commission presented the proposed timelines, with the first tier entering into application after 2 years, the second tier after 4 years, and a review after 5 years. In its presentation the Commission indicatively translated the timelines as of today into 2015, 2017 and 2018.

Sweden remarked that these dates are overambitious, and asked the Commission to indicate always a more realistic planning. In reply to some further interventions, assuming an entry into force of the regulation at the earliest at the end of 2013, **the Commission** admitted the indicative years as too rash.

Denmark asked for 1 year implementation time for the first tier.

EPEE expressed a clear preference for 2 years as industry would need sufficient time to review and adapt their range of products.

The Environmental NGOs preferred 1 year.

ECOS asked why no third tier has ben proposed as discussed at another consultation Forum of 19 April.

The Commission explained that the proposed timing of the measure with a review after 5 years would guarantee a sufficiently reliable approach. **VHK** added that implementing measures do not concentrate on the current "park" of products, but that they are rather future-oriented, taking into account products to be placed on the market. For these new products in the case at hand, the approach is already ambitious, and a third tier would be highly speculative. Therefore, any future additional tier would be better considered at the time of the review.

Eurovent remarked that they consider the review after 5 years effectively as the third tier, which will implement the progress made.

On a question of the chair if the first tier could be applied already earlier, **Eurovent, EPEE, and VDMA**, speaking particularly on behalf of SMEs, adhered to 2 years as a longer period would be more adequate.

The UK proposed a modification to Article 7 to review the Regulation and to present the result to the Consultation Forum within 5 years. **EPEE** disagreed to this proposal and suggested a pragmatic and realistic approach, i.e. to maintain the review within 5 years, and for example to present the result to the Consultation Forum within 6 years.

The UK suggested to include filters specifically in the review, and possibly to consider filter as a separate ErP lot.

Residential Ventilation Units

For Residential Ventilation Units (Annex I), **the Commission** presented the proposed principles and key requirements. The intention is to have a simple approach towards the most efficient technology. Therefore the proposal does not regulate indoor air quality related issues like filter requirements or types of sensors.

VHK added a technical presentation explaining how the heat recovery and the specific power input will be measured, and highlighting the new 'Effective power input' definition which is not yet implemented in the standards. He explained why 'clock control' has been added to the control factors proposed by EVIA, and why leakage requirements have been proposed.

On a question form **Ökopol** about multi-speed drives it was explained that it meant in minimum three speeds, and that this can be incorporated in the definition.

EVIA and **Germany** asked about bypassable heat recovery. **VHK** explained that the intention of this is to allow night cooling. The bypass could be ‘real’or ‘thermal’ or any other solution that would serve the purpose. An exact definition has not yet been included.

On a question from **Systemair VHK** confirmed that also for unidirectional fans a built in controller makes sense. Systemair remarked further that the reference points for the adjustment of the air flow would be determined in practice for real systems differently than explained on slide 39. VHK drew the attention to the fact that this is a calculation approach, which has not been strictly applied in practice. Systemair further commented on the thermal efficiency measurements and the missing reference to the standard, and the preference for voltage control. VHK replied that for legal reasons it is not possible to mention standards in implementing measures, and that the frequency control comes from the fan regulation. If a general consensus would be reached, it could be potentially be changed.

Denmark supported the proposed first tier heat recovery efficiency requirement of 75%, but expressed fears that the proposed benchmark target of 85% would be too high, entailing that the total efficiency of the unit would go down. The target should be reduced to 80%.

Germany asked if demand controlled systems would fall under the horizontal standby regulation, what was negated, and suggested that the standby consumption should be analysed further. **VHK** replied that the potential gain from strict standby energy control, beyond of what is functionally required, seems not to be worth to be regulated for this product group.

Denmark remarked that the definitions of the stagnation pressure and of the Mach factor are not ideal for small devices, and that the reference point should not be evaluated at just one point, which would be for example at 25% for a rotary motor. **VHK** explained that the definitions of the stagnation pressure and of the Mach factor ware taken directly from the fan regulation, and admitted that alternative ways of defining the total and static pressure without the Mach factor could be checked, even if it seems unrealistic that provisions of the fan regulation could be modified. Denmark would supply a better definition.

EVIA expressed their view that, based on tests results, the proposed reference point gives a good average. The different views should be discussed bilaterally between Denmark and EVIA. Furthermore, EVIA expressed concerns that the proposed SPI values could be difficult to reach by small devices (e.g. kitchen ventilation units).

On a comment from **Eurovent** expressing its favour for high efficient filters, **the Commission** agreed that only very efficient filters should be used, but explained that an ecodesign regulation for ventilation unit is not the right tool to require compulsory application of filters, but that the regulation should enable their use if desired.

Sweden asked how the proposed SPI values were derived. **VHK** explained that the assessment was done using manufacturers data, considering a good ambition level, with the goal to go for a market which only allows backward curved and the best forward curved, but no radial fans. Data recently provided from EVIA supported the choice. Regarding the SPI benchmark, Germany suggested a differentiation for balanced and non-balanced units.

ECOS supported demand controlled systems, especially to address the use in warmer climates.

EVIA also supported demand controls, and expressed its favour of a simplified demand control depending on the number of sensors.

EPEE, EVIA, Denmark, Germany and Finland contributed to a discussion about the proposed leakage requirements. Member States suggested to lower the proposed leakage rates of 10/6% to for example 5/3% and Finland to consider leakage requirements from the first tier on. EVIA remarked that the requirements could be more difficult for smaller than for bigger units. VHK explained that the different requirements for recuperative and regenerative systems come from the standard. EPEE, whose members use paper heat exchangers for their ceiling mount balanced units was against lowering the requirements: 10% was already very difficult for them with the proposed testing method. They suggested to check the proposed rates together with the current test measures, and to discuss this within the Joint Industry Expert Group.

Italy and others wondered about the different requirements on SPI and heat recovery for ecodesign, but the combined SEC requirements for the labelling. **The Commission** explained that ventilation units should be both electrically (SPI and thermally (heat recovery) efficient, but that it will consider also the SEC approach for ecodesign. In summary **Italy, Germany, France, EVIA, and Eurovent** supported to use the SEC approach for ecodesign, **ECOS** will reflect on it.

Non-residential ventilation

The Commission gave an introductory presentation into the key requirements for non-residential units and the intention behind it, followed by additional technical explanations by **VHK**.

On the proposed heat recovery requirements, **Eurovent** agreed to the first tier threshold of 64 %, but suggested to lower the second tier threshold from 71% to 67 % to not exclude some types of cross-flow heat exchangers like plate heat exchanges and run-around coils. About face velocity, Eurovent propose slightly higher values, for the first tier 2.0 instead of 1.8 m/s.

The Forum discussed the proposed requirements on minimum efficiency/fan efficiency. It was admitted that there is some redundancy between the minimum fan efficiency originating in the fan regulation, and the minimum efficiency.

EVIA commented on the pressure definitions and asked to check compliance with formulas used for the test and calculation methods. EVIA asked specifically to clarify if the reference electric power consumption shall fulfil both, the supply and the exhaust side. Furthermore, EVIA expressed reservations regarding the minimum fan efficiency and the calculation methods for small units.

Eurovent asked for clarifications of the minimum fan efficiency formula. In reply to a question from Eurovent, VHK explained the % in the formula and technical reasons for differentiating in > or < 10kW.

Germany commented on the exemption of retrofitting, but could not yet suggest a solution how to improve it. Germany noted that the requirements for fan efficiency seem to be lower than in the fan regulation for backwards curved fans. Furthermore, on heat recovery, Germany would prefer an exemption in the second tier for specific applications using waste heat instead of lowering the requirements.

The UK remarked that a higher heat recovery efficiency target of 74 % for second tier as included in the preparatory study for Lot 6 would be feasible. VHK explained that the 71% target for heat recovery energy efficiency derives from a compromise among different stakeholders, and that 74 % would be unrealistic.

EVIA commented on possibly confusing requirements for fans in air handling units and unidirectional fan units. Therefore EVIA repeated its proposal made for residential units to divide also the non-residential units to considering apartly box and roof fans.

EPEE supported the EVIA proposal of the splitting of non-residential ventilation into two groups. VHK replied that the remark from EVIA and EPEE will be analysed in detail. He also explains the background reasons for the chosen calculation method for the efficiency formula.

ECOS referred to scenario 2 in the preparatory study and asked why different values have been chosen for the minimum efficiency requirements. ECOS suggest considering the more ambitious targets.

Denmark supported the use of the SPI factor both for small and big units.

Eurovent expressed for retrofitted units the need to allow higher face velocities, but was not in favour of abolishing the proposed velocities of 2.2 and 2.0 m/s.

SFP

Sweden asked for and made a presentation proposing on ecodesign requirements based on SFP - Specific Fan Power. The presentation is available on CIRCA.

EVIA remarked that the SFP approach had already been discussed several times. It is both related to internal and external pressure, but the external pressure is not in the responsibility of the manufacturer. Furthermore, some assumed values like 350 Pa for the reference internal static pressure are just given values that could also be others. The SFP approach is good to assess a whole ventilation system, but not suitable for a single product.

Eurovent supports EVIA's point of view, and remarked that SFP is a useful approach for systems in buildings.

Sweden stated that SFP is appropriate to evaluate holistically balanced units, and that further components like humidifiers should be allocated to the external pressure drop.

EVIA reconfirmed that they prefer to refer to Pmref and to face velocity.

Denmark supported the use of SFP.

Systemair supported the use of SFP.

Finland supports the Swedish proposal, and confirms that Finnish industry would support is as well.

Ökopol contested EVIA and stated that it would not be impossible to practically apply the Swedish approach.

EVIA declared that it could support the use of the SFP value as an information requirement, but not as a target in ecodesign requirements.

VHK thanked EVIA for providing with their recent comments data helpful to find a good ambition level of the targets, and kindly requested EVIA and other experts to provide further input to for the setting of minimum requirements.

Sweden asked to conclude the discussion about SFP and to decide if this calculation method should be considered further. Sweden expressed that from their point of view the industrial stakeholders present at the Consultation Forum would not fully represent the whole industry, whereas the industry from Nordic countries would be in favour of using the SFP.

Furthermore, Sweden noted that some important Member States like Spain or Poland were not present.

The Chair replied to Sweden. She recalled that the advisory capacity of the Forum is to assist the Commission in defining implementing measures, but not to decide about proposals subject to discussion at the Forum. The Commission will further assess the Swedish proposal, and consider the contributions to the discussion at the Forum, and comments and proposals received afterwards.

Noise

The Commission explained the proposed sound power values for residential and non-residential ventilation units, and highlighted that very silent ventilation is of outmost importance for its acceptance, especially as ventilation units run not temporarily, but most of the time. The Commission recognised a trade-off between noise and energy efficiency. The intention behind the proposal is to ensure very low noise levels in the ventilated areas by setting sound power limits for the units, as their design can contribute to low noise levels, which can of course be further reduced by additional measures like silencers, attenuators or absorbers. The Commission conceded that the available data especially for non-residential ventilation was quite limited, and that therefore the proposed requirements are not technically proofed, but draft proposals for discussion.

Eurovent remarked that the core of the implementing measure should be energy efficiency, and noise should therefore not be considered in this regulation.

EVIA voiced that noise should not be a target for non-residential ventilation units. The proposed thresholds would require for such units silencers up to several meters which would be impracticable. Therefore EVIA proposed to delete the requirements.

EPEE manifested that there are not enough data. EPEE suggested getting data first before proposing targets.

Germany challenged the proposed minimum sound power requirements as not useful as usually attenuators would be used. Germany expressed the need for technically profound data that can be used by engineers, and not only sound power levels in decibel.

Denmark supported EPEE and their request for getting more data on noise, and supported also Germany view on more data and an engineering approach.

Information requirements

The Commission briefly introduced proposed information requirements for residential and non-residential ventilation units, and draw the attention to a new requirement about instructions for disassembly.

ECOS strongly supported the introduction of these information requirements.

EVIA remarked that for individual tailor-made NRVU it will be difficult and burdensome to provide the required data. Furthermore, the proposed requirement to have such information available on the website of the manufacturer would be much too burdensome for NRVUs.

Draft Energy Labelling Reglation

This agenda sub-item on energy labelling was co-chaired by Ismo Gronroos-Saikkala, DG ENER. **The Commission** introduced the draft delegated regulation on energy labelling for RVUs, followed by a presentation by VHK explaining the proposed SEC approach and the calculation methods. A few mistakes in the working document were corrected: SEC formula: c_{air} shall be 0.344*10-3 kWh.K/m^3, not *10-6; AEC/AHS formula: +Q_{defr} shall be moved from the energy consumption side (AEC) to the heating side (AHS); q_{min} in the AHS formula shall be q_{ref}; and the climate zones cold and warm in Table 1 shall be swapped.

EVIA welcomed the proposed approach on labelling. The proposed SEC formula would be similar to an already existing EVIA formula. However, EVIA would prefer labels differentiating the three different climate zones of Europe. EVIA explained this preference with further technical remarks concerning the effects for balanced and unidirectional units, about infiltration, and defrosting.

Germany mentioned that the values are averages, but that averages –e.g. in the case of passive houses—may be misleading as they could be even higher than then heating bill. This requires at least a clear explanation in the technical fiche.

ECOS and **Inforse** welcomed the energy labelling approach, and suggested to check the extension to NRVU.

Eurovent disagreed with ECOS and argued against a labelling for NRVU.

Sweden welcomed the proposal on labelling. Sweden explained that they had already taken up the discussion to base possible ecodesign requirements on the same SEC approach instead of separate requirements for SPI and heat recovery. Accordingly to their preliminary calculations, it seems that the ecodesign limit for the first tier would be within the B label class, and the limit for the second tier near to the A label class. Furthermore, market data would show that many devices would already now fall in class A. Therefore Sweden asked to review the class limits and suggested to increase the limits, especially for class A, as the highest class should not be populated from the beginning on.

VHK thanked Sweden for sharing these interesting results of preliminary calculations, and replied that any contributions supporting the on-going work to rescale the size and range of the energy classes would be highly appreciated. He encouraged all participants to send further data and proposals to improve the labelling.

Eventually, the Chair concluded the meeting and thanked all participants for the overall supportive and constructive Consultation Forum Meeting. She recalled that all presentations can be found on Circa. She invited participants to share their positions, and to send technical comments to Tobias Biermann Tobias.Biermann@ec.europa.eu and/or to the ENTR/B1 functional mailbox ENTR-ECODESIGN@ec.europa.eu by 5 of December.

ANNEX B

PRODUCTS (ILLUSTRATIONS)

The following illustrations were taken from the Commission's Working Document 10.10.2012 and the presentation at the consultation forum

<u>Residential ventilation units (RVUs)</u>

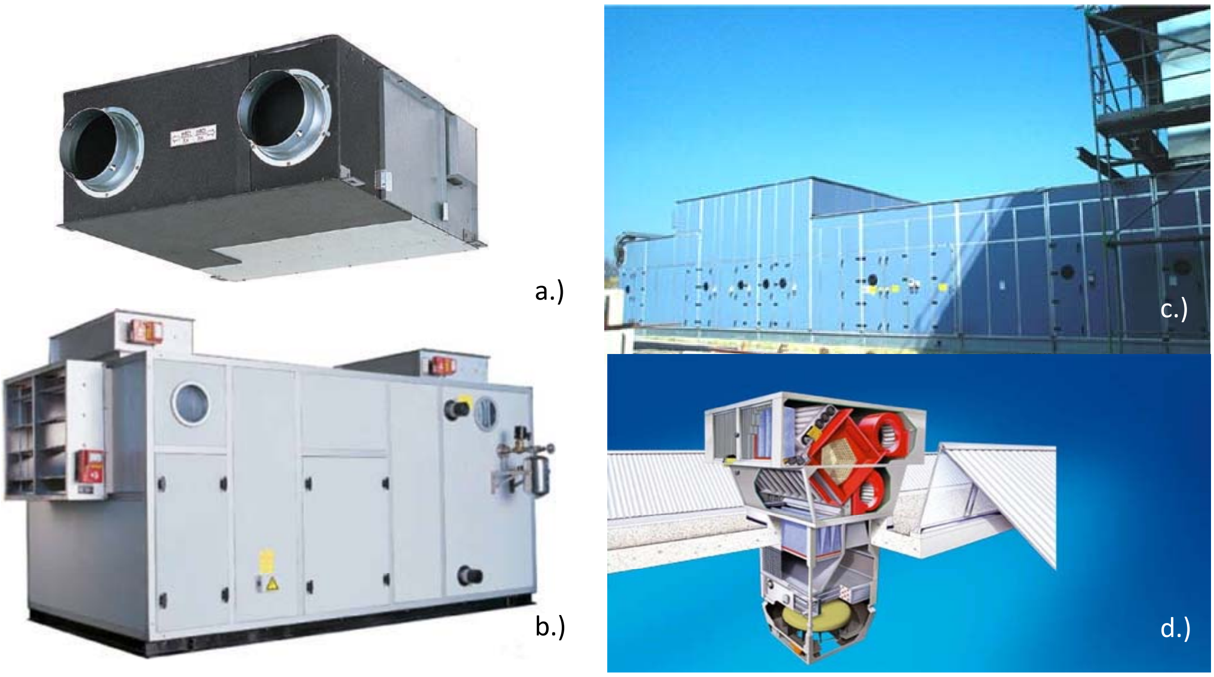
A/F. Boxed fans (exhaust) for central house ventilation (typical 250 m³/h @ 150 Pa).

B/C/D. Rooftop fans (exhaust) for central house, small office, school ventilation. B=centrifugal (radial outlet); C= centrifugal, diagonal outlet. D=mixed flow with vertical outlet.

E. Duct fan.

G. Small central HR ventilation unit (250-500 m³/h).

Non-residential ventilation units (NRVUs)



Examples of balanced non-residential ventilation units: a) ceiling mounted balanced unit (500-1000 m^3/h) small commercial; b) floor-standing balanced unit (5000-12000 m^3/h) medium-size office building; c) extra-large balanced air handling unit (>100 000 m^3/h); d) rooftop non-ducted balanced unit for warehouses and industry.

In addition to the distinction between

- Residential ventilation units (RVUs) and
- Non-residential ventilation units (NRVUs),

A product categorisation can be made by the direction(s) of the mechanically induced flow distinguishing between

Unidirectional ventilation unit meaning a ventilation unit producing an air flow only in one direction, either from indoors to outdoors (exhaust) or from outdoors to indoors (supply), operating in a building ventilation system where the mechanically produced air flow is balanced by natural air supply or extraction provisions and

Balanced ventilation unit meaning a ventilation unit producing a balanced mass air flow between indoors and outdoors and which is equipped with both exhaust and supply fans;

Product categorisation can be also made by the extend of the heated zone and, as a related issue, the use of air-ducts distinguishes between

Ducted' or *Central* ventilation unit means a ventilation unit intended to ventilate multiple enclosed spaces in a building through the use of air-ducts, equipped with appropriate means for duct-connection and

Non-ducted, *room based* or *local* ventilation unit means a ventilation unit intended to ventilate a single enclosed space in a building, not equipped with appropriate means for duct-connection.

In the preparatory studies, the distinction was made on the basis of the electric input power per individual fan, i.e. if the power is ≤125 W then the VU is residential (the scope of the ENER Lot 10 preparatory study) and if the power is >125W then the VU is non-residential (the scope of the ENTR Lot 10 preparatory study). Unless explicitly mentioned otherwise, the data in this IA report refer to the above definition for RVU and NRVU used in the preparatory studies.

The parameter(s) for the distinction between RVUs and NRVUs, for which the preparatory studies proposes different sets of measures and for which also different sets of testing standards apply, has been subject to disputes with the stakeholders. In this context it is relevant that the RVU-category '≤125 W/fan' also comprises ventilation units for small non-residential applications (small shops, offices and schools), whereas the NRVU-category '>125W' also includes most central, unidirectional (exhaust) ventilation units for multi-family properties. The alternative categorisation options will be further discussed in section 4 on policy options.

Following functional boundaries as applied in adjacent measures such as the Ecodesign Fan Regulation 327/2011 and following the results of stakeholder consultations (see Chapter 1), the ventilation units listed in table 1 are excluded from the product scope.

Table 1. Ventilation units explicitly excluded from the product scope

Excluded from the scope: Ventilation units which are		
(a)		unidirectional (exhaust or supply) and equipped with one or more individual fans with a nominal electric power input less than 30 W [1]
(b)		designed specifically to operate in potentially explosive atmosphere as defined in Directive 94/9/EC of the European Parliament and of the Council ([2]);
(c)		designed for emergency use only, at short-time duty, with regard to fire safety requirements set out in Council Directive 89/106/EC ([3])
(d)		designed specifically to operate:
(i)	(a)	where operating temperatures of the air being moved exceed 100 °C;
	(b)	where the operating ambient temperature for the mtor, if located outside the air stream, driving the fan exceeds 65 °C;
(ii)		where the annual average temperature of the air being moved and/or the operating ambient temperature for the motor, if located outside the air stream, are lower than -40 °C;
(iii)		with a supply voltage > 1 000 V AC or > 1 500 V DC;
(iv)		in toxic, highly corrosive or flammable environments or in environments with abrasive substances;
(e)		designed with a heat exchanger and a heat pump for heat recovery .

[1] This includes the intermittently operating local exhaust fans, addressed by Italy. These fans represent a large number of unit sales (5.2 m units sold, stock ca. 90 m fans in EU, 2010) and thus a substantial administrative burden in terms of e.g. market surveillance. On the other hand they have low electric power consumption (most popular range 10-20W, say average 15 W), relatively low operating hours (0 to 2h/day, say average 1 h/day). This means an energy consumption of 5.5 kWh/year.unit and a total electricity consumption of around 0.5 TWh/a, which is less than 10% of total (see later paragraphs). The economic saving potential (at least life cycle costs) is limited, because given the low unit energy consumption (at current prices 5.5 kWh x 17 years x € 0.2/kWh= € 18.7) it will be hard to defend that costly design options will yield a reasonable payback time.

[2] OJ L 100, 19.4.1994, p.1

[3] OJ L 40, 11.2.1989, p. 12

ANNEX C
DETAILED COST BUILT-UP

The following tables and graphs from the (updated) preparatory studies give an insight in the system cost built-up. Note that for the impact analysis in the main report the cost rates were adapted to the (constant) 2010 level, using a 2% inflation rate and actual energy rates 2010.

Table C-1 . Acquisition costs for domestic ventilation units (2003)

	local exhaust	**central exhaust**	**central HR**	**local HR**
Product price				
Manufacturing selling Price, VAT excl.	€ 50	€ 165	€ 1 269	€ 609
Ex. Wholesale price, VAT excl. (msp + 20%)	€ 60	€ 198	€ 1 522	€ 731
Ex. Installer, VAT excl. (wholesaleprice + 20%)	€ 73	€ 237	€ 1 827	€ 877
Consumer street price, VAT included	**€ 87**	**€ 283**	**€ 2 174**	**€ 1 043**
Installation materials				
Installation Kit, VAT included	-	€ 300	€ 600	€ 100
Supply / overflow provisions, VAT included	-	€ 300	€ 150	-
Total	**€ 87**	**€ 883**	**€ 2 924**	**€ 1 143**
Installation costs per unit				
Installation costs New built, VAT included	€ 55	€ 330	€ 1 320	€ 110
Installation costs Renovation, VAT included	€ 55	€ 825	€ 2 200	€ 110
Average installation costs	€ 55	€ 577	€ 1 760	€ 110
Total costs per unit for New Built	€ 142	€ 1 213	€ 4 244	€ 1 253
Total costs per unit for Renovation	€ 142	€ 1 708	€ 5 124	€ 1 253
Total average costs per unit	**€ 142**	**€ 1 708**	**€ 5 124**	**€ 1 253**

Table C-2. Prices base-case non-residential ventilation units (Sales 2010)

Product -->	CEXH	CHRV	AHU-S	AHU-M	AHU-L
Features					
flow rate (m^3/h) [5]	**1.500**	**2.250**	**4.000**	**10.000**	**35.000**
Ext. ΔP (in Pa) [6]	154	181	244	460	670
HRS market share[7]	0%	100%	70%	70%	70%
HRS thermal efficiency [8]	0%	80%	62%	62%	62%
PRICES in Euro 2010	CEXH	CHRV	AHU-S	AHU-M	AHU-L
labour	45	500	680	1 200	2 000
materials	150	1 000	1 520	2 800	6 000
overhead	105	1 000	1 800	4 000	12 000
msp	***300***	**2 500**	***4 000***	**8 000**	**20 000**
wholesale price	390	3 250	4 800	8 800	21 000
installer price [1]	488	4 063	5 760	9 680	22 680
builder price [2]	634	5 281	7 488	12 584	29 484
ducts, grills, ctrls [3]	1 965	7 130	34 445	98 155	383 292
inst. labour avg. [4]	2 172	8 072	37 692	106 229	412 175

[1]= end-customer unit price replacement (excl. VAT)

[2]= end-customer unit price new built/retrofit (excl. VAT)

[3]= not for replacements

[4]= "avg."= For CHRV the split up is 45/45/10 between new built/retrofit/replacement(in 2010); for CEXH and AHU the split up is 35/30/35 between new built/retrofit/replacement(in 2010).

END PRICES					
Inst. labour new built	*2 711*	*10 338*	*51 667*	*147 233*	*574 938*
Inst. labour retrofit	*3 792*	*12 477*	*62 001*	*176 679*	*689 926*
inst. replacement(50% on ex installer price)	*244*	*2 031*	*2 880*	*4 840*	*11 340*

[5] Design flow rate F (in m³/h) assumed at around 65-70% of flow rate at 0 Pa [EN 13799 and other source mentioned in Task 1]

*[6]Design external pressure drop h (in Pa), according to EN 13799 is measured at 65% of maximum (flow rate=0). Practical values above are estimated as follows: if design flow rate F<10 000 m³/h then href= 0.036*F+100 ; if 10 000≤ F <25 000 m³/h then href=0.0146*F+304; if F≥25 000 m³/h then href=75*ln(F)-190.5 (equation Kaup, supply side, but subtract 100 for heat/cool coil)*

[7] HRS=Heat Recovery System. First estimates

Based on the above, the following graphs give a partitioning of the total costs per application: new built, retrofit (1st time installation) and replacements.

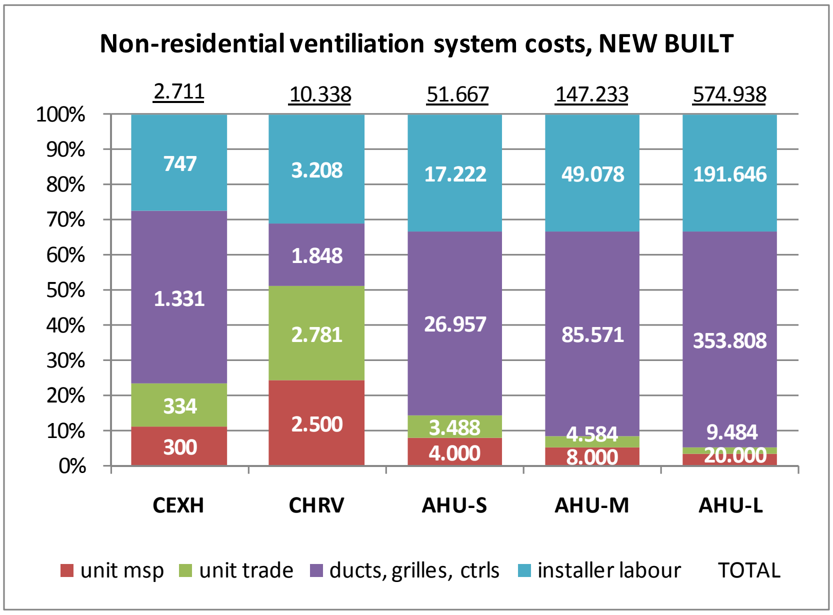


Figure C-1. System costs, ventilation in new buildings, in Euro 2010

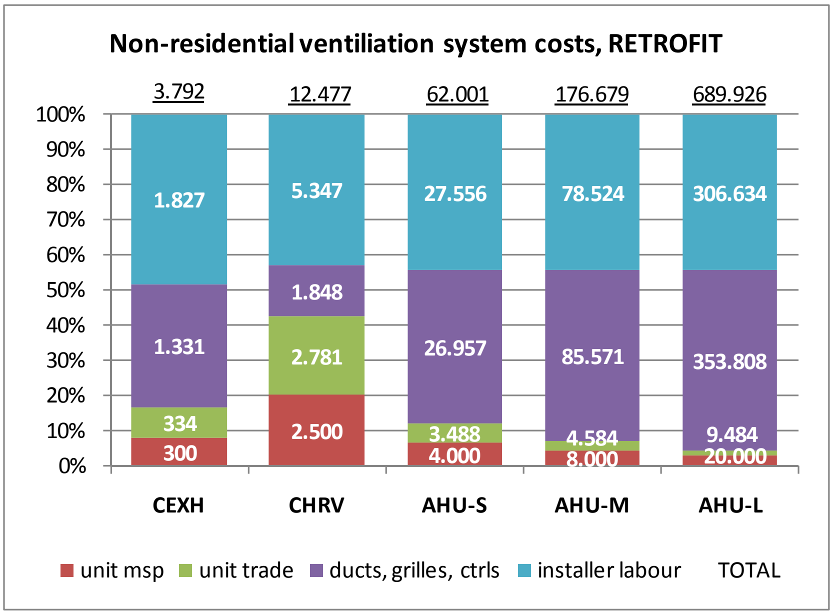


Figure C-2. System costs, ventilation retrofit in existing buildings, in Euro 2010

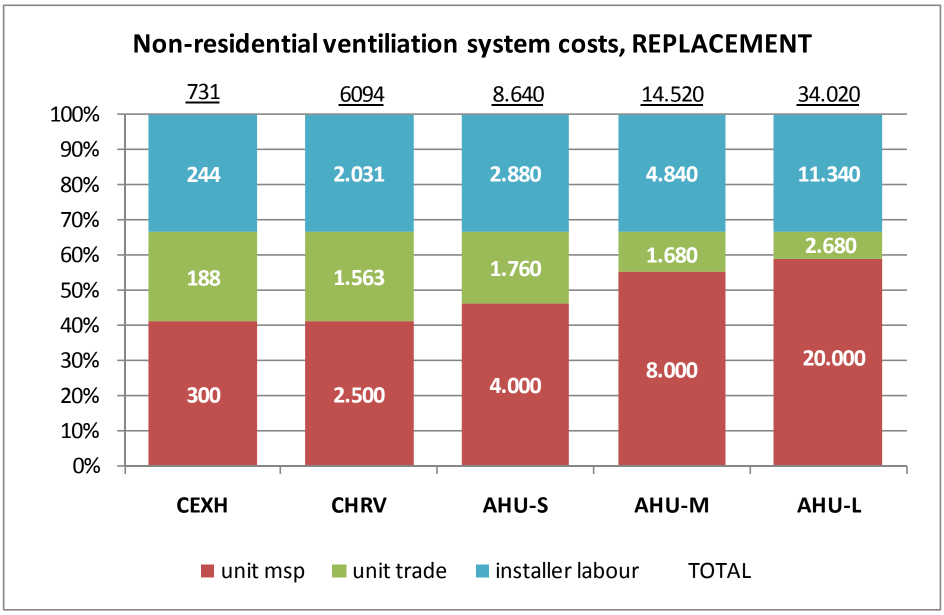


Figure C-3. System costs, unit replacement, in Euro 2010.

ANNEX D

VENTILATION INDUSTRY, STRUCTURE & EMPLOYMENT

INDUSTRY STRUCTURE

The ventilation unit industry, i.e. companies manufacturing products in the scope of the proposed measures, is dynamic and very heterogeneous. The production of residential ventilation units, beyond simple extraction fans, is a relatively young industry, where EU representation (EVIA) has started only recently and commercial market research institutes came into this specific field a few years ago. Policy makers are more and more addressing ventilation units at the systems-level through building regulations, but there are no measures – neither at EU or national level—addressing the products.

For non-residential units, the so called ‘air handling units’ (AHUs) were traditionally not a self-standing product but linked to air-conditioning (central air-cooling). This started to change only in the 1990s when local, hydronic fan coil units and refrigerant-based systems became dominant over central air-cooling/heating. Thus the necessity to decouple non-residential ventilation from the air-cooling/heating function became more evident.

As a result of the above, robust data on revenues and employment in this sector are lacking and making an estimate is a difficult task, aggravated by the fact that ‘ventilation units’ are very rarely the only, or even the most important products of the companies involved.

The different groups of manufacturers and brand-owners of ventilation units have been discussed in the main report.

The share of independent medium-sized companies in ventilation unit manufacturing, in the range of 50-500 employees, is still significant and may represent some 30% of the total. This is also the typical size of a manufacturing unit within the larger multinationals which have expanded though acquisitions and mergers. As the market becomes more mature, however, more acquisitions and mergers can be expected and the share of these independent SMEs can be expected to diminish.

Small and micro-size companies with less than 50 employees, often do not have in-house manufacturing. They are either traders (with or without their own brand) or small, innovative start-ups with their own unique energy-saving product where manufacturing is wholly or partially outsourced to jobbers inside or outside the EU.

EMPLOYMENT

Table 1 gives an (incomplete) listing of brand-owners and EU manufacturing sites, which was used to estimate the size of industrial employment in the sector. In total, the list represents around 200 manufacturing sites in the EU and a direct manufacturing employment of 20 000 jobs. To this, the employment in sales subsidiaries has to be added as well as the employment of generic jobbers, manufacturing parts according to specifications.

Table D-1. Ventilation unit brand-owners and manufacturing sites EEA (incomplete), source VHK 2012

AUSTRIA
Drexel und Weiss(-->VKR)
Euroclima AT(-->Euroclima)
Frivent (-->VKR)
GEA AT(-->GEA)
Troges AT
BELGIUM
Daikin Europe HQ
JAGA
Renson
Ventilair
CZECH REPUBLIC
Atrea
GEA CZ
Interklima
Trane CZ
GERMANY
Aerex
Airflow
AL-KO Therm (-->AL-KO group)
Alpha-InnoTec (--> NIBE)
Balzer Lüfter
Benzing
Berliner Luft
Bosch Thermotechnik
Burckhart Projekt
EBM Papst DE
EnEV-Air (--> Centrotec)
GEA DE
GLT Grohmann (-->Ventilair)
Halmburger
Hansa-Klima
Heinemann
Helios DE
Howatherm
Huber & Ranner
Hüning Elementbau
inVENTer
Kampmann
Klimatec
Lüftec
Lunos
Maico
Meltem
Nicotra-Gebhardt DE (--> N-G)
Nova
Olsberg
Paul (--> Zehnder).
Pluggit
Robatherm
Rosenberg
ROX
Schako
Schrag
Schüco(-->Schüco Group)
Siegenia-Aubi
Stiebel Eltron
Systemair DE (-->Systemair)
Trox
Vaillant
Ventomaxx
Viessmann
Westaflex
Wolf Geisenfeld
Wolf GmbH (-->Centrotec)
DENMARK
Airmaster
Danfoss
Dantherm DK (-->Dantherm)
Exhausto DK (--> VKR)
Genvex (-->NIBE)
NB Ventilation
NILAN
NOVENCO
Systemair DK (-->Systemair)
FINLAND
Enervent
Swegon FI (--> Swegon)
Vallox Oy
FRANCE
Aereco
Airwell
Aldes
Anjos
Atlantic
Autogyre
Caladair
Carrier EU HQ (-->Carrier-->UTC)
CIAT
Fläkt Woods FR (-->Fläkt Woods)
France Air
GREECE
Helios FR
Interklima
Lennox EU HQ (-->Lennox Int. US)
Trane EU HQ (-->Trane-->IR)
Unelvent (-->Soler & Palau)
Ventil´distribution
VIM (-->Soler & Palau)
ITALY
Euroclima IT (-->Euroclima)
Giordano Riello (GRIG)
Mekar (-->Aliseo Group)
Mitsubishi HQ airco (--> Mitsubishi)
Nicotra-Gebhardt IT (--> N-G)
Saiver
Swegon IT (--> Swegon)
Systemair IT (-->Systemair)
TCF
Vortice
Weger
LIECHTENSTEIN
Hoval
Trivent
LATVIA
Salda
LITHUANIA
Alitas (-->Systemair).
Amalva
NETHERLANDS
Bergschenhoek
Brink Climate Systems (-->Centrotec)
Carrier Holland Heating (-->Carrier US)
ClimaRad BV
Ferroli (--> Ferolli)
ITHO Daalderop
Orcon
Rucon (-->Systemair)
Smeets Luchtbehandeling
Zehnder /J.E. Storkair (--> Zehnder)
NORWAY
Covent AS (--> Soler & Palau)
Dantherm NO (-->Dantherm)
Exhausto NO (-->Exhausto)
Flexit NO (-->Flexit)
POLAND
ASK
VTS
PORTUGAL
Evac
Sandometal
Vieira Lopes
SLOVENIA
HIDRIA IMP KLIMA d.o.o.
Systemair SL (-->Systemair).
SLOVAKIA
Systemair SK (-->Systemair).
Troges SK (-->Troges)
SWEDEN
Air-Site
AirStar
Dantherm SE
Enventus
Fläkt Woods SE
Flexit SE
Fresh(-->Volutions)
Freshman (--> Zehnder)
GEA SE
IV Produkt
Luftmiljö
Munters
Rec Indovent
Suxess ERV (-->Östberg)
Swegon SE
Systemair SE (excl.Frico)
VoltAir System
Weland
SWITZERLAND
Kapag
Zehnder
SPAIN
Soler & Palau ES
Systemair ES (-->Systemair)
UNITED KINGDOM
Dantherm UK (-->Dantherm)
Dimplex (-->Glen Dimplex)
Enviro Vent (-->Soler&Palau)
Fläkt Woods UK (-->Fläkt Woods)
GEA UK (-->GEA)
Greenwood (-->Zehnder)
Nuaire
Passivent
Systemair UK (-->Systemair)
Titon (--> Titonholding)
Vent Axia (--> Volution)
Xpelair(--> Glen Dimplex)

In this context it is important to note that especially for non-residential ventilation units and the larger (>30 W) residential units are certainly not commodity products. They require substantial support from the indirect industry staff not only in marketing and distribution but also in planning, design, training, after-sales and service. Each of the larger companies and many of the medium-sized companies has sales & service subsidiaries and agents in all major EU Member States with a staff of 5-50 people.
From this, the proportion between direct (manufacturing) and indirect industry staff is estimated to be at least 60-40, if not 50-50.

In total, the industrial EEA employment (EU27, NO, CH, LI) is thus estimated at 35-40 000 jobs, of which around 10-15000 SME-jobs. At an average revenue per employee of around € 0.15 million per employee this comes down to a market size in manufacturer selling prices (msp) of around € 5-6 billion. The split-up of employment is given in Figure 1 below, and it shows Germany (28%) and Sweden (16%) with the highest number of jobs, followed by France (10%), the UK (10%) and Italy (7%). Relatively (per capita) the number of jobs is also high in Northern Europe with Denmark 6%, Lithuania 3% and Norway 2%. For the Netherlands (3%) and Finland (1%) the share in jobs is proportionate to their share in the EU population.

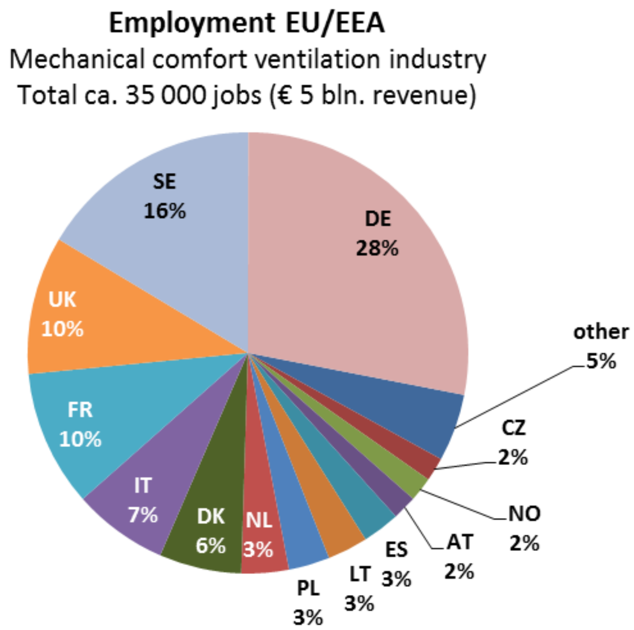


Figure D-1. Ventilation unit industry employment (estimate VHK 2012)

Contrary to the situation with other products that have been found eligible for Ecodesign measures, the share of Eastern Europe in total EU employment is (still) relatively modest. The lower labour costs have attracted some production, but the lack of a substantial Eastern European home market has probably deterred from a large scale migration that can be seen with e.g. domestic appliances.

OEM SUPPLIERS

The listing in Table 1 and the employment figures do not include OEM component manufacturers that have not ventured into the production of ventilation units. These include large companies such as EBM Papst (fans), Alfa Laval (heat exchangers), Camfill Far (filters), Vokes-Air (filters), Honeywell (controls), Siemens (controls). Also the jobs that relate to component manufacturing for third-party AHUs within companies that also have their own ventilation unit production are not taken into account. Also here only a rough estimate can be made, but it may amount to an extra 10-15 000 jobs related to ventilation units at the level of EU suppliers. The share of SME-suppliers, mainly generic jobbers producing casings or (parts of) controls, is estimated relatively modest at 30% (3000 – 5000 SME supplier jobs EU-wide).

The employment of extra-EU OEM suppliers working for EU companies placing mechanical ventilation products on the EU market is at least as high as that of OEM suppliers in the EU, i.e. around 10-15 000. Most of the hardware for smaller (residential) unidirectional ventilation units is produced in S.E. Asia. Also most EU manufacturers of non-residential units have manufacturing subsidiaries in S.E. Asia, India and/or Turkey. The same goes for the EU OEM suppliers; they also produce the smaller and more standard products in S.E. Asia and India. There are also a number of Asian manufacturers that try to sell standard fans and ventilation units directly to large DIY-chains and installers, i.e. without an intermediate EU importer, but –given the support that is indispensable for the more sophisticated units—their market share is limited to the range <30 W, which is outside the scope of measures, or rooftop and boxed fans that are just within the scope.

WHOLESALE & RETAIL

The role of general construction products wholesale companies like Saint Gobain, Wolseley, etc. is relatively limited. The smaller unidirectional extraction fans (<30 W), rooftop and boxed fan units constitute the bulk of the products. Residential heat recovery units are also sold through this channel, but the level of support is critical and without an infrastructure to supply this service it would be extremely to sell them under their own brand name. For larger non-residential products, i.e. air-handling units, this is most certainly the case and these are therefore not sold through this channel. The employment with general wholesale companies that can be partitioned to ventilation units is thus estimated at not more than around 1000-1500 jobs.

For retailers, i.e. DIY chains and shops for installation-professionals, the situation is comparable to that with wholesellers: Only the smaller unidirectional ventilation units can be sold as own-brand products. Balanced ventilation products are currently not sold as DIY-product and the offering in retail-outlets for professionals is limited. It is estimated that around 5000 EU-jobs can be partitioned to retail activities with ventilation units, of which roughly 30% with independent SME retailers, i.e. not part of a large chain.

PLANNING, INSTALLATION & SERVICE

Especially for the non-residential ventilation units there is a host of independent consulting engineers and system designers as well as planners and specifiers with the builders. In this light it may be indicative that the professional association REHVA has over 100 000 members, of which probably some 10 000 to 15 000 can be partitioned to ventilation systems. On top of that, both for the residential and non-residential ventilation units, there are installers working on-site.
An educated guess, mainly based on the share of ventilation units and AHUs in the costs of installing the total ventilation system (including ductwork, air terminals, possibly chillers, etc.), is that the equivalent of around 30-40 000 installer jobs in the EU goes to mounting, connecting and outside servicing of the ventilation units.

The day-to-day service and maintenance of non-residential ventilation units, i.e. filter replacement, cleaning and small repairs, is usually part of the work of internal building maintenance staff. The number of hours in this activity is difficult to estimate, but as a rough estimate it may involve around the equivalent of 10 000 jobs.

All in all, between production, distribution and installation of ventilation units around 110 000 EU jobs, of which 30% SME-jobs, are involved.

<u>*Legal notice*</u>

The information in this Annex is based on data from manufacturer's websites, annual reports and other public information gathered by VHK in the context of technical assistance contract to the Commission services. In many cases the information was incomplete and had to be supplemented by VHK-estimates that were done to the best of VHK-abilities, but VHK nor the Commission services assume no liability for damages, material or immaterial, that may arise from the use of the information mentioned in this Annex.

ANNEX E

STOCK MODEL METHODOLOGY & DETAILED RESULTS

The impact analysis uses the variable **inputs** as defined in the following paragraphs.

The **calculation method** for the analysis of baseline and scenarios is the so-called **Stock Model,** which means that it is derived from accumulated annual sales of the products over the period 1990-2030 (with a start-up period 1986-1990).

The stock-model sets the pace for the sub-options. The direction is determined by trends in dwelling size, number of households and characteristics (operating hours. W). From these stock data the fitting sales data were calculated

Outputs for each sub-option are:

- Electricity consumption in TWh/a;
- Primary energy consumption in PJ/a (for a simple conversion 1 TWh electric = 2.5 *3.6 PJ primary; for a dynamic conversion see MEErP 2011);
- Carbon emission in Mt CO_2 equivalent/a. using a multiplier based on electricity and gas shares (see below) and the values from the EcoReport in the preparatory study;
- Customer-related economical parameters: purchase price, energy expenditure, repair cost and total expenditure in billion euros per year (2010 Euro, inflation-corrected at 2%/a);
- Business-related economical parameters: turnover per sector (industry, trade, etc.);
- Employment: calculating job creation/loss using the sector-specific turnover per employee and trade margins.

Final outcomes are presented at a high aggregation level (totals), but in the intermediate stages a distinction is made by the typology and by size.

For the economic calculations, an average energy price in €/ kWh primary energy is built from:

- Electricity rates per kWh and heating fuel rates per MJ, for RVUs at domestic tariffs, for NRVUs at an average sales weighted fuel mix rate for small/medium and large non domestic user.
- Differentiated energy price rate increases before (escalation rate 0%) and after 2007 (escalation rate 4%).

Data from the (updated) preparatory studies are used for the definition of the base case and calculated on the basis of the relative market shares of the categories considered. The tables below give the characteristics of the base-case ventilation units and their substitutes.

STOCK MODEL Residential Ventilation Units
VARIABLES & FORMULAS

MSPcentralex	165	manufacturer selling price [€/ unit ex VAT], central exhaust units
MSPcentralHR	1269	manufacturer selling price [€/ unit ex VAT], central HR unit
MSPlocalHR	609	manufacturer selling price [€/ unit ex VAT], local HR unit
KITcentralex	290	msp installation kit [€/ unit ex VAT], central exhaust units
KITcentralHR	362	msp installation kit [€/ unit ex VAT], central HR unit
KITlocalHR	48	msp installation kit [€/ unit ex VAT], local HR unit
INSTcentralex	484	installation labour costs [€/ unit ex VAT], central exhaust units
INSTcentralHR	1480	installation labour costs [€/ unit ex VAT], central HR unit
INSTlocalHR	92	installation labour costs [€/ unit ex VAT], local HR unit
WholeMargin	20%	Margin Wholesaler [% on msp]
RetailMargin	20%	Margin Installer on product [% on wholesale price]
VAT	19%	Value Added Tax [in % on retail price]
CONScentralex	1 356	consumer price inc. VAT [€/ unit]= (1+VAT)* {(MSP…+KIT…)*(1+WholeMargin)*(1+RetailMargin) + INST…}
CONScentralHR	4 556	as above
CONSlocalHR	1 235	as above
Inflation	2%	Inflation rate [%/ a]
PriceInc	-2%	Annual product & kit price increase (negative value=decrease) through production rationalisation [%/ a],
PriceInfDec	-4%	Inflation corrected price increase [%/a]--> constant prices 2005
Discount rate	4%	Interest 6% minus inflation 2%; used in LCC calculation
ManuWages	0.12	WH manufacturer turnover per employee [mln €/ a]
OEMfactor	0.3	OEM personell as fraction of WH manufacturer personell [-]
WholeWages	0.2	WH manufacturer turnover per employee [mln €/ a]
RetailWages	0.06	WH manufacturer turnover per employee [mln €/ a]
ExtraEUfrac	0.6	Fraction of OEM personell outside EU [% of OEM jobs]
MAINTcentralex	9	annual unit maintenance costs [€/ unit ex VAT], central exhaust units
MAINTcentralHR	48	annual unit maintenance costs [€/ unit ex VAT], central HR unit
MAINTlocalHR	20	annual unit maintenance costs [€/ unit ex VAT], local HR unit
MAINTinc	2%	Annual increase maintenance costs
MAINTinfinc	0%	Increase maintenance costs, inflation corrected (2%)--> constant prices 2005
SPIcentralex	0.3	Specific Power Input [W/m³/h] at 70% of flow@0 Pa, central exhaust units
SPIcentralHR	0.4	Specific Power Input [W/m³/h] at 70% of flow@0 Pa, per fan, central HR unit
SPIlocalHR	0.35	Specific Power Input [W/m³/h] at 70% of flow@0 Pa, per fan, local HR unit
CTRLcentralex	1	Control factor, central exhaust units
CTRLcentralHR	1	Control factor, central HR unit
CTRLlocalHR	0.9	Control factor, local HR unit
REFV	1.3	Reference ventilation demand [in m³/h per m2]

REFS	100	Reference heated surface area of dwelling [in m2]
HRcentralex	0%	Heat Recovery thermal efficiency [%], central exhaust units
HRcentralHR	80%	Heat Recovery thermal efficiency [%], central HR unit
HRlocalHR	64%	Heat Recovery thermal efficiency [%], local HR unit
MISCcentralex	1.33	Vent. effectiveness (1)*duct leakage (1,1) factor*system-correction fsys(1,21), central exhaust units
MISCcentralHR	1.1	Vent. effectiveness (1)*duct leakage (1,1) factor*system-effectiveness (1), central HR unit
MISClocalHR	1.2	Vent. effectiveness (1,2)*duct leakage (1) factor*system-effectiveness (1), local HR unit
NRcentralex	1	RFLOW/Design flow rate per unit [in m³/h], central exhaust units
NRcentralHR	1	Design flow rate per unit [in m³/h], central HR unit
NRlocalHR	2	Design flow rate per unit [in m³/h], local HR unit
		Relevant for electricity consumption
RFLOWcentralex	173	Required ventilation dwelling [in m³/h], central exhaust = REFV * REFS * CTRLcentralex*MISCcentralex
RFLOWcentralHR	143	Required ventilation dwelling [in m³/h], central exhaust = REFV * REFS * CTRLcentralHR*MISCcentralHR
RFLOWlocalHR	140	Required ventilation dwelling [in m³/h], central exhaust = REFV * REFS * CTRLlocalHR*MISClocalHR
		Per dwelling electricity use [8,760 is nr. Hours x 0,001]
ELECcentralex	454	Electricity use [in kWh/a], central exhaust = 8,760 * SPIcentralex * RFLOWcentralex
ELECcentralHR	501	Electricity use [in kWh/a], central HR = 8,760 * SPIcentralHR *RFLOWcentralHR
ELEClocalHR	430	Electricity use [in kWh/a], local HR= 8,760 * SPIlocalHR * RFLOWlocalHR
		Per dwelling electricity use
ELECUcentralex	454	Electricity use [in kWh/a], central exhaust = ELECcentralex/ NRcentralex
ELECUcentralHR	501	Electricity use [in kWh/a], central HR = ELECcentralHR/ NRcentralHR
ELECUlocalHR	215	Electricity use [in kWh/a], local HR= ELEClocalHR/ NRlocalHR
		Relevant for space heating calculation
HFLOWref	220	Natural ventilation demand [in m³/h], weighted between 50% airing only (236 m³/h) and 50% airing and passive stack (206 m³/h)
HFLOWnat	206	Product-corrected ventilation demand in 100 m2 dwelling [in m³/h], natural ventilation & passive stack (source FGK)
HFLOWcentralex	173	Product-corrected ventilation demand dwelling [in m³/h], central exhaust = REFV * REFS * CTRLcentralex*MISCcentralex

HFLOWcentralHR	29	Product-corrected ventilation demand dwelling [in m³/h], central exhaust = REFV * REFS * CTRLcentralHR*MISCcentralHR*(1-HRcentralHR)
HFLOWlocalHR	51	Product-corrected ventilation demand dwelling [in m³/h], central exhaust = REFV * REFS * CTRLlocalHR*MISClocalHR*(1-HRlocalHR)
Rel2005	0.152	Electricity rate 1.1.2006 [€/ kWh electric] Eurostat
Rel2009	0.172	Electricity rate 1.7.2010[€/ kWh electric] Eurostat
Relinc	2%	Electricity annual price increase
RelInfInc	0%	Electricity annual price inflation corrected (2%)--> constant prices 2005
Rgas2005	0.047	Gas rate 2005 [€/ kWh primary GCV]
Roil2005	0.061	Oil rate 2005 [€/ kWh primary GCV]
Rfuel2005	14.71	[€/ GJ primary GCV]= € 0,053/kWh x277. 2005 average space heating mix rate [€/ kWh primary GCV] : rates as above, weighting at 76% gas, 21% oil, 3% electric
Rfuel2009	16.94	[€/ GJ primary GCV]= € 0,061/kWh x277. 2010 average
Rfuelinc	7.30%	Eurostat official annual fuel price increase July 2007-July 2009. Note that avg. annual fuel price increase over period Jan 2006-July 2009 from 14,7 to 16,21 €/GJ was higher, at 9%. But Eurostat was used.
RfuelDiscInc	5.30%	Fuel annual price increase inflation corrected (2%) --> constant price 2005
Rfuel2018 (NAME Rfuel2018)	28.3	[€/ GJ primary GCV]= € 0,102/kWh; Used in LCC-calculations. Fuel price halfway product life, starting 2010/2011
ProductLife	**17**	product life (source FGK)
HHoursA	5112	Heating season hours per year in Average EU Climate (=213 days)
HHoursW	4392	Heating season hours per year in Warmer EU Climate (=183 days)
HHoursC	6552	Heating season hours per year in Colder EU Climate (=273 days)
CHoursW	2300	Cooling season hours per year in Warmer EU Climate (=273 days)
ΔT_A	9.5	Average indoor(16 oC)/outdoor temperature difference [in K] Average Climate (incl. solar gain and internal load) in heating season
ΔT_W	5	Average indoor(16 oC)/outdoor temperature difference [in K] Warmer Climate in heating season
ΔT_C	14.5	Average indoor(16 oC)/outdoor temperature difference [in K]Colder Climate in heating season
ΔT_WC	6	Average indoor(22 oC)/outdoor temperature difference [in K] Warmer Climate in cooling season
BoilerEff	60%	Space heating boiler efficiency in 2010 (on Gross Calorific Value)
BoilerEffInc	1%	add 1%-point to BoilerEff of previous year
AircoPrimEff	100%	Cooling primary energy efficiency=Air conditioning SEER (=3,25)/{primary energy factor (=2,5)*LatentHeatCorrection(=1,3)}
AircoPen	10%	Room Air Conditioning, market penetration Warmer Climate
AirDensity	1.23	Air density in [kg/m³]
AirEnthalpy	1.007	Specific heat of air at reference conditions [kJ/kg.K]
Year	pointer	pointer in array of year numbers [2010;2025]
	value2010	*Saving on space heating(cooling), in GJ/unit, per product typology and climate*
	MJ/a	*Average climate (values 2010 as illustration, kWh/a per dwelling)*

SAVE_A_centex	4 722	=0,001 * AirDensity * Airenthalpy * ΔT_A * HHoursA *{1/(BoilerEff+(Year-2010)*BoilerEffinc)} * (HFLOWref-HFLOWcentralex)
SAVE_A_centHR	19 188	=0,001 * AirDensity * Airenthalpy * ΔT_A * HHoursA *{1/(BoilerEff+(Year-2010)*BoilerEffinc)} * (HFLOWref-HFLOWcentralHR)
SAVE_A_locHR	16 988	=0,001 * AirDensity * Airenthalpy * ΔT_A * HHoursA * {1/(BoilerEff+(Year-2010)*BoilerEffinc)} * (HFLOWref-HFLOWlocalHR)
		<u>*Warmer climate (incl. saving on cooling)*</u>
SAVE_W_centex	2 216	=0,001 * AirDensity * Airenthalpy * {CHoursW *ΔT_WC * (AircoPen/AircoPrimEff) + ΔT_W *HHoursW*[1/(BoilerEff+(Year-2010)*BoilerEffinc)]} * (HFLOWref-HFLOWcentralex)
SAVE_W_centHR	9 004	=0,001 * AirDensity * Airenthalpy * {CHoursW *ΔT_WC * (AircoPen/AircoPrimEff) + ΔT_W *HHoursW*[1/(BoilerEff+(Year-2010)*BoilerEffinc)]} * (HFLOWref-HFLOWcentralHR)
SAVE_W_locHR	7 972	=0,001 * AirDensity * Airenthalpy * {CHoursW *ΔT_WC * (AircoPen/AircoPrimEff) + ΔT_W *HHoursW*[1/(BoilerEff+(Year-2010)*BoilerEffinc)]} * (HFLOWref-HFLOWlocalHR)
		<u>*Colder climate (heating only)*</u>
SAVE_C_centex	9 237	=0,001 * AirDensity * Airenthalpy * ΔT_C * HHoursC *{1/(BoilerEff+(Year-2010)*BoilerEffinc)} *(HFLOWref-HFLOWcentralex)
SAVE_C_centHR	37 538	=0,001 * AirDensity * Airenthalpy * ΔT_C * HHoursC *{1/(BoilerEff+(Year-2010)*BoilerEffinc)} *(HFLOWref-HFLOWcentralHR)
SAVE_C_locHR	33 234	=0,001 * AirDensity * Airenthalpy * ΔT_C * HHoursC *{1/(BoilerEff+(Year-2010)*BoilerEffinc)} *(HFLOWref-HFLOWlocalHR)

		<u>*Partitioning to the 3 climates 66-28-6% for A-W-C*</u>
	MJ/a	<u>*Per dwelling*</u>
SAVE_centex	4 291	=0,66*SAVE_A_centex+0,28*SAVE_W_centex+0,06*SAVE_C_centex
SAVE_centHR	17 438	=0,66*SAVE_A_centHR+0,28*SAVE_W_centHR+0,06*SAVE_C_centHR
SAVE_locHR	15 438	=0,66*SAVE_A_locHR+0,28*SAVE_W_locHR+0,06*SAVE_C_locHR
		<u>*Per unit*</u>
SAVEU_centex	4 291	=SAVE_centex/NRcentralex
SAVEU_centHR	17 438	=SAVE_centHR/NRcentralHR
SAVEU_locHR	7 719	=SAVE_locHR/NRlocalHR

			price increase	
			centex	centHR
		base	1 356	4 556
CTRL	Euro	<u>central HR & exhaust</u>		
	-50	CTRL= 1,5; no control (single nom. speed) [EPBD TO CORRECT]	-4%	-1%
	0	CTRL= 1; manual (70% position of 3 speed) [BASE CASE]	0%	0%
CTRL1_centex/HR	100	CTRL= 0,8; clock control (price 50% RF, 50% wired version) [MEPS1]	7%	2%
CTRL2_centex/HR	500	CTRL=0,7 ; central CO2-sensor &CPU [MEPS2]	37%	11%
CTRLBAT_centex/HR	1 500	CTRL= 0,5; 3 room-based CO2 satellites (with dampers) , 1 or 2 RH-sensors, Central CPU, RF communication [BAT]	111 %	33%

			base	1 235
CTRL		local HR		
	-100	CTRL=1,5; no control (single nom. speed) [EPBD TO CORRECT]		-8%
	-50	CTRL= 1; manual (mid-position of 3 speed) [EPBD TO CORRECT]		-4%
	0	CTRL= 0,9; manual variable [BASE CASE]		0%
CTRL1_locHR	80	CTRL= 0,8; clock control [MEPS1]		6%
CTRL2_locHR	140	CTRL= 0,7; RH-sensor or occupancy sensor only [MEPS2]		11%
CTRLBAT_locHR	200	CTRL= 0,5; CO2 + RH sensor + manual override [BAT, but higher ELEC]		16%
SPI		Specific Power Input		
SPI -0,06 extra (e.g. from 0,24 to 0,18)	40 Euro	From AC to DC fan (incl. SMPS), costs new market distribution above MEPS level, applies to local fans, for central fans (>150 m³/h) twice that sum. Includes design measures to reduce internal pressure loss (HR)		
		Estimated price increase vs. Basecase due to market shift following setting MEPS1 at current average SPI (cut-off rate 50%)		
SPI1_centex	10%	central exhaust (current 0,23 -> MEPS1 shift -->0,20)		
SPI1_centHR	1%	central HR (current 0,26 but higher pressure drop, 2 fans; -> MEPS1 shift --> 0,23)		
SPI1_locHR	1%	local HR (current 0,28 but higher pressure drop, 2 fans; compact design necessary -> MEPS1 shift --> 0,24)		
		Estimated price increase vs. Basecase due to market shift following setting MEPS2 at ca. 0,05 SPI-points below MEPS1 (avg. cut-off rate 70%)		
SPI2_centex	20%	central exhaust (MEPS1: 0,23 --> MEPS2: 0,16)		
SPI2_centHR	2%	central HR (MEPS1: 0,26 --> MEPS2: 0,17 or [CTRL= 0,5 & MEPS2: 0,32])		
SPI2_locHR	2%	local HR (MEPS1: 0,28--> MEPS2: 0,17)		
HR				
		Improvement thermal efficiency Heat Recovery		
		Price increase vs. Base Case		
HR1_centHR	2%	MEPS1: 0,8		
HR1_locHR	2%	MEPS1: 0,8		
HR2_centHR	4%	MEPS2: 0,9		
HR2_locHR	4%	MEPS2: 0,9		
MEPS1_centex	17%	=CTRL1_centex+SPI1_centex		
MEPS1_centHR	5%	=CTRL1_centHR+SPI1_centHR + HR1_centHR		
MEPS1_locHR	9%	=CTRL1_locHR+SPI1_locHR + HR1_locHR		
MEPS2_centex	57%	=CTRL2_centex+SPI2_centex		
MEPS2_centHR	17%	=CTRL2_centHR+SPI2_centHR + HR2_centHR		
MEPS2_locHR	17%	=CTRL2_locHR+SPI2_locHR + HR2_locHR		
MEPSBAT_centex	131%	=CTRLBAT_centex+SPIBAT_centex		
MEPSBAT_centHR	39%	=CTRLBAT_centHR+SPI2_centHR + HR2_centHR		
MEPSBAT_locHR	22%	=CTRLBAT_locHR+SPI2_locHR + HR2_locHR		

CONVERSION

primenergy	2.5	conversion kWh primary/ kWh electric energy (situation ca. 2018, includes power generation as in PRIMES + electricity distribution)
TWhel_to_PJprim	9	(1 kWh=3,6 MJ)--> 3,6 x primenergy= 3,6 x 2,5 = 9
CO2_kWhel	0.4	Mt CO2/TWh (or kg/kWh) electric (situation ca. 2018, includes power generation as in PRIMES + electricity distribution)
CO2_PJheat	0.0577	Mt CO2/ PJ primary energy (fuel mix: gas 76%, oil 22%, electric 2%; IPPC values on Gross Calorific Value fossil fuels)

STOCK MODEL Non-Residential Ventilation Units
Variables

elast	**56**		Euro purchase price increase (2010)/% efficiency increase (versus BaseCase) untill llcc
elastbat	**119**		Euro purchase price inc. (2010)/% efficiency increase (versus LLCC) beyond llcc
Plife	**17**		Product life in years
Growth rate <2000	**2%**		annual growth rate sales 1990-2000
Growth rate 2000-'20	**1%**		annual growth rate sales 2000-2020
Growth rate <2020	**0.5%**		annual growth rate sales 2020-2050
Rel1	**0.12**		Electricity rate 1.1.2011 [€/ kWh electric] , weighted average small, medium , large users
Rgas1	**0.037**		Gas rate 1.1.2011 [€/kWh GCV], incl. VAT, weighted average small, medium , large users
Relinc	**6%**		Annual price increase electricity [%/ a]
Rgasinc	**6%**		Annual price increase gas [%/ a]
Inflation	**2.50%**		Inflation rate [%/ a]
Interest	**6.50%**		Interest rate [%/a]
Discount	**4%**		The discount rate is expressed in real terms, taking account of inflation. This rate of 4%, used in the Commission's impact assessments, broadly corresponds to the average real yield on longer-term government debt in the EU over a period since the early 1980s. For impacts occurring more than 30 years in the future, the use of a declining discount rate could be used for sensitivity analysis, if this can be justified in the particular context

Power gen. & distr. Fixed	40%	Electric power generation & distribution efficiency						
		1960	**1990**		**2010**	**2018**	**2030**	**2050**
Power gen. & distr. dynamic, in %	kg/kWh elec.	30%	33%		38,50%	40%	43%	47%
		1960	**1990**	**2000**	**2010**	**2020**	**2030**	**2050**
GWP electric, in Mt/TWh (=kg/kWh)	kg/kWh elec.	0,55	0,5	0,43	0,41	0,38	0,34	0,28
GWPgas	0,202	Mt CO2 eq./TWh NCV						
GWPoil	0,267	Mt CO2 eq./TWh NCV (gas/diesel oil)						
GWPlpg	0,227	Mt CO2 eq./TWh NCV						
		1960	**1990**	**2000**	**2010**	**2020**	**2030**	**2050**
oil share (% of CH stock)	kg/kWh elec.	30%	18%	14%	10%	6%	2%	0%
lpg share (% of CH stock)		0%	4%	4%	4%	4%	4%	4%
gas share (rest % of stock)		70%	78%	82%	86%	90%	94%	96%

aggregate GWPfossil (CH)	0,2215	0,2147	0,2121	0,2095	0,2069	0,2043	0,203

Growth rates NRVU

The baseline scenario growth rates are based on the following:

Growth indicators stock model	
GDP 2010 (bln. Euro, current prices)	**12256**
Annual Growth '95-'10 (in current prices)	3.8%
Annual Growth '10-'13 (in current prices)	3.0%
GDP in 2005 prices (inflation and exchange rate corrected)	
GDP 2010 (bln. Euro 2005)	**11555**
GDP 2005 (bln. Euro 2005)	11060
Annual Growth '95-'10	1.9%
Annual Growth '10-'13	1.2%
Index 2010 (2005=100)	106.1
Purchasing Power Standard PPS 2010 (000 Euro/inhabitant)	**24.4**
Annual growth 1995-2010	3.4%
Final expenditure 2010 (in bln. Euro 2005)	**9211**
growth rate 2004-2010	1.2%
growth rate 2010-2013	0.4%
Household & NPISH final consumption expenditure (bln. Euro 2010)	**6699**
growth rate 2004-2010	1.0%
growth rate 2010-2013	0.5%
Households number, 2010 (in mln.)	**197**
househ. annual growth rate <=1990	1.20%
househ. annual growth 1990-2010*	0,26%+0,028%*(2010-Year)
househ. annual growth rate >2010*	0.25%
*= multiplier before 2010 is 1/(1+x) ; after 2010 is (1+x)	
Population number of inhabitants 2010 (in mln.)	**501.1**
pop. annual growth rate <=2010	0,2%+0,009%*(2010-Year)
pop. annual growth rate >2010	0,2%-0,003%*(Year-2010)
Dwellings	
avg. dwelling surface 2010 in m2	89.91
m2 surface/dwelling growth rate	0.35%

number of dwellings=1,25*households (80% of dwelling stock is conventional, permanent use; rest is 2nd home, vacant, unconventional, etc.)

demolished no. of dwellings = ca. 10% of new built dwellings

“household” (building statistics) is individuals sharing 1 primary dwelling

“family” (building statistics) = marriage or similar

“housing shortage” = new built - demolished - families - divorces

The following tables are in addition to the baseline data from Chapter 2 and give the detailed results from chapter 5 for the sub-options in tabular format:

	RVU									NRVU									TOTAL								
Sales and stock (000# /a)																											
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Sales	229	311	376	449	532	560	590	623	655	1080	1127	2213	2582	2664	2880	3051	3433	3814	1309	1438	2589	3032	3196	3440	3642	4055	4469
Stock	2783	3454	4365	5451	6694	7865	8839	9604	10369	9331	14872	21098	27739	35369	43686	49377	53717	58058	12114	18326	25463	33189	42063	51551	58216	63321	68427
Electricity consumption (TWh electric/year)																											
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
BAU	25	33	42	51	59	66	72	75	79	4	7	10	13	16	20	22	24	26	29	39	51	63	75	86	94	99	104
Scen 1	25	33	42	51	59	66	68	69	70	4	7	10	13	16	11	13	14	15	29	39	51	63	75	77	81	83	84
Scen 2	25	33	42	51	59	65	65	63	61	4	7	10	13	16	13	15	17	18	29	39	51	63	75	79	80	80	79
Scen 3	25	33	42	51	59	66	67	66	66	4	7	10	13	16	12	14	15	17	29	39	51	63	75	78	81	81	82
Saving Space Heating Energy (PJ/a)																											
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
BAU	650	956	1 300	1 724	2 210	2 640	3 016	3 331	3 646	42	69	101	137	181	247	318	391	463	692	1 025	1 401	1 860	2 392	2 887	3 335	3 722	4 109
Scen 1	650	956	1 300	1 724	2 210	2 663	3 170	3 585	4 000	42	69	101	137	181	485	585	670	756	692	1 025	1 401	1 860	2 392	3 148	3 755	4 255	4 756
Scen 2	650	956	1 300	1 724	2 210	2 687	3 471	4 303	5 135	42	69	101	137	181	576	692	796	900	692	1 025	1 401	1 860	2 392	3 263	4 163	5 099	6 035
Scen 3	650	956	1 300	1 724	2 210	2 660	3 276	3 917	4 559	42	69	101	137	181	530	638	733	828	692	1 025	1 401	1 860	2 392	3 190	3 914	4 650	5 387
electricity generation & distribution																											
efficiency	33%	34.4%	35.8%	37.1%	38.50%	39.4%	40.5%	41.8%	43.0%	33.0%	34.4%	35.8%	37.1%	38.5%	39.4%	40.5%	41.8%	43.0%									
Net primary ENERGY saving (PJ/a)																											
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
BAU	376	614	880	1 231	1 660	2 035	2 378	2 683	2 988	- 5	- 2	4	15	32	67	121	184	247	372	612	885	1 246	1 692	2 101	2 499	2 867	3 235
Scen 1	376	614	880	1 231	1 660	2 065	2 565	2 991	3 418	- 5	- 2	4	15	32	383	472	552	632	372	612	885	1 246	1 692	2 448	3 037	3 543	4 049
Scen 2	376	614	880	1 231	1 660	2 092	2 894	3 759	4 625	- 5	- 2	4	15	32	454	556	651	747	372	612	885	1 246	1 692	2 546	3 449	4 411	5 372
Scen 3	376	614	880	1 231	1 660	2 062	2 681	3 346	4 011	- 5	- 2	4	15	32	418	514	602	689	372	612	885	1 246	1 692	2 480	3 195	3 948	4 701
energy-specific greenhouse gas emissions (MtCO2 eq. GWP100 per energy unit)																											
Mt/TWh el.	0.500	0.465	0.430	0.420	0.410	0.395	0.380	0.360	0.340	0.500	0.465	0.430	0.420	0.410	0.395	0.380	0.360	0.340									
Mt/PJ	0.060	0.059	0.059	0.059	0.058	0.058	0.057	0.057	0.057	0.060	0.059	0.059	0.059	0.058	0.058	0.057	0.057	0.057									
GHG emission savings in Mt CO2 eq./year																											
	1990	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
BAU	26	41	59	80	105	126	146	163	180	0	1	2	3	4	6	10	14	18	27	42	60	82	108	133	156	177	198
Scen 1	26	41	59	80	105	128	156	180	204	0	1	2	3	4	24	29	33	38	27	42	60	82	108	152	185	213	241
Scen 2	26	41	59	80	105	130	175	223	271	0	1	2	3	4	28	34	39	45	27	42	60	82	108	158	209	262	316
Scen 3	26	41	59	80	105	128	163	200	237	0	1	2	3	4	26	31	36	41	27	42	60	82	108	154	194	236	278

	RVU									NRVU									TOTAL								

tariffs, weighted average tariff small, medium , large non-residential users — *tariffs households*

€/kWh	0.1	0.1	0.1	0.1	0.12	0.146	0.177629	0.216113	0.255	0.14	0.14	0.14	0.14	0.18	0.219	0.266	0.324	0.382
€/MJ	0.009	0.009	0.009	0.009	0.0103	0.0125	0.015247	0.01855	0.022	0.013	0.013	0.013	0.013	0.0146	0.018	0.022	0.026	0.031

escalation rate ≤2007-->0%; >2007-->4%; all prices in constant 2010 euros

Energy Costs saving in bln. EUR (constant 2010) /year

	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU	3	5	8	10	16	23	33	46	58	- 0	- 0	- 0	0	- 0	0	1	3	4	3	5	8	10	15	23	34	48	62
Scen 1	3	5	8	10	16	24	36	52	67	- 0	- 0	- 0	0	- 0	6	9	13	17	3	5	8	10	15	30	45	65	84
Scen 2	3	5	8	10	16	24	41	66	91	- 0	- 0	- 0	0	- 0	7	11	15	20	3	5	8	10	15	31	52	82	111
Scen 3	3	5	8	10	16	24	38	58	79	- 0	- 0	- 0	0	- 0	7	10	14	19	3	5	8	10	15	30	48	73	97

Unit consumer price (Euro/unit) , incl. up-front EoL costs

	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU	3 749	3 749	3 712	3 763	3 795	3 836	3 876	3 913	3 951	236	261	240	271	328	502	578	590	602	850	1 015	744	789	904	1 044	1 112	1 100	1 091
Scen 1	3 749	3 749	3 712	3 763	3 795	8 122	9 205	9 711	10 217	236	261	240	271	328	1 283	1 527	1 569	1 611	850	1 015	744	789	904	2 396	2 772	2 820	2 859
Scen 2	3 749	3 749	3 712	3 763	3 795	8 847	11 966	12 480	12 995	236	261	240	271	328	1 401	1 658	1 710	1 761	850	1 015	744	789	904	2 613	3 329	3 364	3 393
Scen 3	3 749	3 749	3 712	3 763	3 795	8 122	10 513	11 023	11 533	236	261	240	271	328	1 342	1 593	1 639	1 686	850	1 015	744	789	904	2 445	3 038	3 080	3 115

Total VU industry revenu msp (bn Euro/a)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU	0.9	1.2	1.4	1.7	2.0	2.1	2.3	2.4	2.6	0.3	0.3	0.5	0.7	0.9	1.4	1.8	2.0	2.3	1.1	1.5	1.9	2.4	2.9	3.6	4.1	4.5	4.9
Scen 1	0.9	1.2	1.4	1.7	2.0	4.5	5.4	6.0	6.7	0.3	0.3	0.5	0.7	0.9	3.7	4.7	5.4	6.1	1.1	1.5	1.9	2.4	2.9	8.2	10.1	11.4	12.8
Scen 2	0.9	1.2	1.4	1.7	2.0	5.0	7.1	7.8	8.5	0.3	0.3	0.5	0.7	0.9	4.0	5.1	5.9	6.7	1.1	1.5	1.9	2.4	2.9	9.0	12.1	13.6	15.2
Scen 3	0.9	1.2	1.4	1.7	2.0	4.5	6.2	6.9	7.5	0.3	0.3	0.5	0.7	0.9	3.9	4.9	5.6	6.4	1.1	1.5	1.9	2.4	2.9	8.4	11.1	12.5	13.9

Net Consumer Expenditure (bn Euro/a)

	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990	1995	2000	2005	2010	2015	2020	2025	2030
BAU	2.5	4.2	6.1	8.7	13.7	21.3	31.0	43.1	55.3	- 0.3	- 0.3	- 0.6	- 0.7	- 1.1	- 1.4	- 0.8	0.5	1.8	3.7	3.9	4.6	4.6	2.7	- 0.8	- 8.7	- 19.9	- 31.2
Scen 1	2.5	4.2	6.1	8.7	13.7	19.3	30.8	45.6	60.3	- 0.3	- 0.3	- 0.6	- 0.7	- 1.1	2.5	4.6	7.8	11.0	3.7	3.9	4.6	4.6	2.7	- 2.7	- 13.9	- 29.7	- 45.5
Scen 2	2.5	4.2	6.1	8.7	13.7	19.2	34.3	58.4	82.5	- 0.3	- 0.3	- 0.6	- 0.7	- 1.1	3.3	5.8	9.6	13.4	3.7	3.9	4.6	4.6	2.7	- 3.4	- 18.7	- 44.4	- 70.1
Scen 3	2.5	4.2	6.1	8.7	13.7	19.2	31.9	51.5	71.1	- 0.3	- 0.3	- 0.6	- 0.7	- 1.1	2.9	5.2	8.7	12.2	3.7	3.9	4.6	4.6	2.7	- 3.0	- 15.6	- 36.5	- 57.5

ANNEX F
TEST STANDARDS FOR RVU AND NRVU REGULATIONS

The organisation publishing references with prefix 'EN' is CEN. References with prefix 'ISO' are published by ISO. Reference 'Eurovent 4/11'is published by Eurovent.

Measured parameter	Reference	Title
non-residential unit performance	EN 13053:2006 and EN13053/A1:2010.	Ventilation for buildings — Air handling units — Rating and performance for units, components and sections
residential unit performance	EN 13141-4:2004	Ventilation for buildings – Performance testing of components/products for residential ventilation – Part 4: Fans used in residential ventilation systems
	EN 13141-6:2004	Ventilation for buildings – Performance testing of components/products for residential ventilation – Part 6: Exhaust ventilation system packages used in a single dwelling
	EN 13141-7:2009	Ventilation for buildings – Performance testing of components/products for residential ventilation – Part 7: Performance testing of components/products of mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for single family dwellings
	prEN 13141-8:2011	Ventilation for buildings — Performance testing of components/products for residential ventilation — Part 8: Performance testing of un-ducted mechanical supply and exhaust ventilation units (including heat recovery) for mechanical ventilation systems intended for a single room, CEN/TC 156, May 2011.
	prEN 13142:2010 (rev. V7)	Ventilation for buildings – Components/products for residential ventilation – Required and optional Performance Charateristics. January 2010
heat recovery efficiency non-residential	EN 308:1997	Heat exchangers - Test procedures for establishing performance of air to air and flue gases heat recovery devices
Low energy consuming fine filter definition	EN 779:2012	Particulate air filters for general ventilation - Determination of the filtration performance
	Eurovent 4/11, Jan. 2011	Energy efficiency classification of air filters for general ventilation purpose
HEPA, ULPA filter definition	EN 1822:2009	High efficiency air filters (EPA, HEPA and ULPA) – Parts 1 to 5 (Part 1 : Determination of the filtration performance)
Internal and external leakage	EN 1886:2007	Ventilation for buildings - Air handling units - Mechanical performance. 2007
SFP definition	EN 13799: 2007	Ventilation for non-residential buildings; Performance requirements for ventilation and room-conditioning systems
Fans	EN ISO 13348:2007	Industrial fans - Tolerances, methods of conversion and technical data presentation
	ISO 12759:2010	Fans -- Efficiency classification for fans
	EN ISO 5801:2008	Industrial fans - Performance testing using standardized airways
Acoustics	EN ISO 3741:1999	Acoustics — Determination of sound power levels of noise sources using sound pressure — Precision methods for reverberation rooms

	EN ISO 3744:1994	Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane
	EN ISO 3746:1995	Acoustics — Determination of sound power levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane
	EN ISO 5136:2003	Acoustics — Determination of sound power radiated into a duct by fans and other air-moving devices — In-duct method
	EN ISO 10140:2010	Acoustics - Laboratory measurement of sound insulation of building elements. Parts 1 to 5, especially Part 2: Measurement of airborne sound insulation. Part 4: Measurement procedures and requirements(replaces EN 20140:1992 and ISO 140:1991)
SEC calculation background (EPBD)	EN 15665:2009	Ventilation in buildings – Determining performance criteria for residential ventilation systems
	EN 15251:2007	Indoor environmental input parameters for design and assessment of energy performance of buildings, addressing indoor air quality, thermal environment, lighting and acoustics
	EN 15242:2007	Ventilation for buildings – Calculation methods for the determination of air flow rates in buildings including infiltration
	EN 15241:2007	Ventilation for buildings – Calculation methods for energy losses due to ventilation and infiltration in commercial buildings
	EN 15243:2007	Ventilation for Buildings – Calculation of room temperatures and of load and energy for buildings with room conditioning systems
	CEN/TR 14788:2006	Ventilation for buildings – Design and dimensioning for residential ventilation systems
	EN 13465:2004	Ventilation for buildings – Calculation methods for the determination of air flow rates in dwellings
Market surveillance	EN 14134:2004	Ventilation for buildings - Performance testing and installation checks of residential ventilation systems.
	EN 12599 : 2000	Ventilation for buildings - Test procedures and measuring methods for handing over installed ventilation and air conditioning systems (standard under revision, Nov. 2010)

ANNEX G
FINE-TUNING NRVU ECODESIGN REQUIREMENTS

In its draft Working Document (WD) of 10.10.2012 the Commission supported the view of the European ventilation industry, because it is in line with the principles that have been employed in other installation products with a system-nature. Furthermore, the EN 13053 and underlying standards on which the requirements are based represent a robust framework of test- and calculation methods that are indispensable for effective compliance assessment by market surveillance authorities. The table below summarizes the draft requirements of the Commission document.

Table . NRVU Ecodesign requirements in draft Commission WD 10.10.2012

Parameter	Tier 1, 1.1.2016	Tier 2, 1.1.2018
drive	multi-speed or variable speed mandatory	
bypass	mandatory (thermal bypass allowed)	
min. **energy** efficiency heat recovery sys.	**64%**	**71%**
min. fan efficiency (with P is nominal electric power input)	4.56%*ln(P)-10.5% +**53%** for P≤ 10 kW	4.56%*ln(P)-10.5% +**57%** for P≤ 10 kW
	1.1%*ln(P) – 2.6%+**53%** for P>10 kW	1.1%*ln(P) – 2.6%+**57%** for P>10 kW
min. electric efficiency balanced VU*	0.001Δpstat·qv / **0.9**Pmref	0.001Δpstat·qv / **0.85**Pmref
min. electric efficiency unidirectional VU (with P is nominal electric power input)	4.56%*ln(P)-10.5% +**45%** for P≤ 10 kW	4.56%*ln(P)-10.5% +**50%** for P≤ 10 kW
	1.1%*ln(P) – 2.6%+**45%** for P>10 kW	1.1%*ln(P) – 2.6%+**50%** for P>10 kW
max. face velocity	**1.8 m/s**	**1.6 m/s**
max. rated energy consumption fine filter	**1200** kWh/a (→ 106 Pa @ 2.7 m/s face velocity; F7 performance)	
max. sound power	**50** dB A re 1 pw	**45** dB A re 1 pw
Max. leakage rates pressurization method		**10% or**
or max. leakage rates tracer gas method		**6%**

**= static pressure difference Δpstat, air flow qv and reference power consumption Pmref as defined in EN 13053*

Following the negative reactions from a significant number of the Member States to the chosen methodology for this particular item in the Consultation Forum, the Commission and its technical assistant VHK, have tried to work out a compromise, at possibly the same ambition level as was presented in the Working Document but trying to approximate the apparent simplicity and flexibility of the SFP-concept.

Key elements of the new solution, to which eventually all sides could agree, are:

- The WD requirements on Pm_{ref}, which were anyway largely overlapping with the fan efficiency η_f requirements, would be stricken.
- Manufacturers would not be made responsible for the external pressure drops (Δp_{ext}) and the additional pressure drops (Δp_{add}) from client-specific non-ventilation components, nor directly (strictly following EN 13799) nor indirectly (e.g. by setting up a 'library' of default values for these items in all possible situations);
- Instead, a new 'internal SFP' (SFP_{int}) parameter would be defined, which would depend – apart from the air flow-- only on the internal pressure drop (Δp_{int}) and the fan efficiency (η_f). Ecodesign requirements would relate only to SFP_{int} and –because of its wider impact also on Δp_{ext} and Δp_{add} – fan efficiency η_f. The Ecodesign limit values would have

the same ambition level as in the WD, but the bilateral meetings and additional analysis also showed that more lenience should be given to solutions like the liquid-coupled heat recovery heat exchangers (‘run-around coils’) that are particularly suited to solve structural barriers in retrofit situations.

- The WD requirements on face velocity would be stricken and –for reasons of consistency, simplicity and flexibility—also the requirements on energy efficiency of the heat recovery heat exchanger (η_e =thermal efficiency ηt minus efficiency penalty for its pressure drop and auxiliary electricity) would be substituted by requirements on its thermal efficiency (η_t) only. The requirements on the filter pressure drops would be stricken, but –as part of the definition of SFPint—the filter performance requirements (F7 and M5 for room in- and outlet respectively) would be maintained.

The main definition of SFP_{int} would be given in the Commission Regulation, with further details in a transitional method to be published as a Commission Communication. For incorporation and detailing in the standards, the Commission will issue a mandate to the European Standardisation Organisations (ESOs).

The tables 2 and 3 in the main report summarize the Ecodesign limit values for the new proposal and includes also some of the requirements that were not disputed, or where the industry even requested more stringent requirements, e.g. on leakage rates.

The SFP-dispute was not the only dispute arising from discussions with industry stakeholders. Several special interest groups feared that their current business, e.g. of low-cost rooftop and boxed unidirectional units with single-speed AC motor driven forward-curved (FC) fans, was threatened. As a result, a series of alternative proposals was brought forward by these special interest groups, ranging from

- lowering general fan efficiencies,
- defining a special ‘rooftop and boxed ventilation unit’ category with lower fan efficiencies,
- giving high bonuses for control options that would raise the aggregated efficiency of unidirectional units to the same level as balanced heat recovery units (with RVUs),
- giving more flexibility in the product scope by abolishing strict technical limits and allowing a practically unlimited choice between the two sets of RVU and NRVU requirements based solely on ‘intended use’,
- to using ambiguous test and calculation methods for unidirectional fan efficiency that could allow tests at unrealistic near-zero pressure drop conditions.

Other manufacturers with a vested interest proposed exceptions for low cost, low efficiency cross-flow heat recovery heat exchangers or a special bonus enthalpy recovery heat exchangers.

These manufacturers found no support for their general cause in the Consultation Forum. In fact, several Northern Member States demanded equally ambitious fan-efficiency requirements (SPI or otherwise) for both unidirectional and balanced units and were against the leniency towards efficiency of unidirectional units in the WD.

Nonetheless, the Commission has its own responsibility, mandated by Art. 15, sub 5 of the 2009/125/EC, in trying to avoid significant negative impacts and –even if they were not vocal on this issue during the CF—also take into account that Southern and Eastern European Member States are lagging behind. Most importantly, it was proposed to introduce the measures only 2 (tier 1) and 4 years (tier 2) after entry into force, instead of 1 and 3 years as with some other Ecodesign products, which means that the most critical tier will only apply from 1.1.2018.

ANNEX H
MEASUREMENTS AND CALCULATIONS RVU

1. For the purposes of compliance and verification of compliance with the requirements of the Regulation, measurements and calculations shall be made using harmonised standards the reference numbers of which have been published in the Official Journal of European Union, or other reliable, accurate and reproducible method, which takes into account the generally recognised state of the art methods, and whose results are deemed to be of low uncertainty.
2. The specific energy consumption SEC is calculated with the following equation:

$$SEC = t_a \cdot pef \cdot q_{net} \cdot MISC \cdot CTRL^{x} \cdot SPI - t_h \cdot \Delta T_h \cdot \eta_h^{-1} \cdot c_{air} \cdot (q_{ref} - q_{net} \cdot CTRL \cdot MISC \cdot (1-\eta_t)) + Q_{defr}$$

where

- SEC is Specific Energy Consumption for ventilation per m² heated floor area of a dwelling or building [kWh/m².a];
- t_a is annual operating hours [h];
- q_{net} is net ventilation rate demand per m² heated floor area [m³/h.m²];
- q_{ref} is the reference natural ventilation rate per m² heated floor area [m³/h.m²];
- pef is primary energy factor for electric power generation and distribution [-];
- $MISC$ is an aggregated general typology factor, incorporating factors for ventilation effectiveness, duct leakage and extra infiltration [-];
- $CTRL$ is ventilation control factor [-];
- x is an exponent that takes into account non-linearity between thermal energy and electricity saving, depending on motor and drive characteristics [-];
- SPI is Specific Power Input [kW/(m³/h)];
- t_h is total hours heating season [h];
- ΔT_h is the average difference in indoor (19°C) and outdoor temperature over a heating season, minus 3K correction for solar and internal gains [K];
- η_h is the average space heating efficiency [-];
- c_{air} is the specific heat capacity of air [kWh/m³]
- η_t is the thermal efficiency of heat recovery [-];
- Q_{defr} is the annual heating energy per m² heated floor area [kWh/m².a] for defrosting, with --based on a variable electric resistance heating--

$Q_{defr}= t_{defr}\cdot\Delta t_{defr}\cdot c_{air}\cdot q_{net}\cdot pef$,

where

- t_{defr} is the duration of defrosting period, i.e. when the outdoor temperature is below -4°C, and
- Δt_{defr} is the average difference in K between the outdoor temperature and -4°C during the defrosting period.

Q_{defr} applies only to balanced units (with heat recovery); for unidirectional units Q_{defr}=0.

SPI and η_t are values derived from tests and calculation methods, as defined in Annex I. Other parameters and their defaults are given in Table 1. The SEC for label classification is based on the 'Average' climate.

3. The annual electricity consumption per 100 m² floor area AEC (in kWh/m².a electric per year) and the annual space heating saved per 100 m² floor area AHS (in kWh fuel gross calorific value per year) is calculated as follows, using the definitions in point 2. and the default values given in Table 1, for each of the three given climates Average, Warm and Cold

AEC = $t_a\cdot pef\cdot q_{net}\cdot MISC\cdot CTRL^x\cdot SPI+Q_{defr}$;

AHS = $t_h\cdot\Delta T_h\cdot\eta_h^{-1}\cdot c_{air}\cdot (q_{ref}- q_{min}\cdot CTRL\cdot MISC\cdot(1-\eta_t))$.

Table 1.

SEC calculation parameters

general typology		effective-ness	duct leakage	extra infiltration	MISC
Balanced ventilation units					**1,10**
Unidirectional ventilation units					**1,21**
ventilation control					**CTRL**
Manual control (no DCV)					**1**
Clock control (no DCV)					**0,9**
Central DCV single variable (ducted units)					**0,85**
Central DCV multi-variable (ducted units), Local DCV single variable (non-ducted units)					**0,65**
Local DCV multi-variable (non-ducted units, ducted units with local flow rate control)					**0,5**
motor & drive					**x-value**
on/off & single speed					**1**
2-speed					**1,2**
3-speed					**1,5**
variable speed					**2**
climate	$\mathbf{t_h}$ in h	$\mathbf{\Delta T_h}$ in K	t_{defr} in h	ΔT_{defr} in K	$\mathbf{Q_{defr}}$ * in
Warm	**6552**	**14,5**	1003	5,2	**5,82**
Average	**5112**	**9,5**	168	2,4	**0,45**
Cold	**4392**	**5**	-	-	-

* Defrosting applies only to balanced units and is calculated as $Q_{defr}= t_{defr}*\Delta t_{defr}*c_{air}*q_{net}*pef$. For unidirectional units Qdefr=0.

defaults	value
specific heat capacity of air, c_{air} in kWh/m³/K	**0,000344**
net ventilation requirement per m² heated floor area, q_{net} in m³/h.m²	**1,3**
reference natural ventilation rate per m² heated floor area, q_{ref} in m³/h.m²	**2,2**
annual operating hours, t_a in h	**8760**
primary energy factor electric power generation & distribution, *pef*	**2,5**
space heating efficiency, η_h	**75%**

ANNEX I
COMMON RULES FOR ENERGY LABEL AND MEPS

In designing an energy label scheme along these lines, there are some written (from directive 2010/30/EU) and unwritten rules (from the experience of >20 approved regulations and discussions in the Consultation Forum) pertaining to energy labelling and its relationship with minimum ecodesign requirements:

1. In principle there shall be no more than 7 energy classes, e.g. A+ and A++ are only to be introduced when F and G are banned. (cf. 2010/30/EU, art. 10, sub 4, subsub d).
2. At the time of the market analysis in the preparatory study or –if appropriate—during additional analysis in the impact assessment study, the 'A' class will be empty or maybe populated with 1 or 2 exceptionally good products. It is reserved for new models to come on the market after that date.[see also comments of Sweden, who protested that there were too many 'A' models in the Commission WD] (also cf. 2010/30/EU, art. 10, sub 4, subsub d).
3. The borderline between 'C' and 'D' class is usually the anchor-point for the average product on the market (the so-called 'BaseCase'). Together with the point 2 above this usually gives a good indication of the energy label class-width that is appropriate (unless there are technical reasons to deviate).
4. Another important factor in determining a *minimum* energy label class-width are the measurement tolerances, i.e. the tolerances can never exceed an energy label class width or --vice-versa—the energy label class width can never be less than the tolerances would allow. In other words, a manufacturer that –through exceptional good control of all the measurement and production tolerances—could use the margins given by the tolerances to declare a 'B' for a product that would –without tolerance margin—be a 'C'. This is –unfortunately—unavoidable. However, to declare a 'C' to be an 'A' with the same mechanism should never be possible.
5. Member States prefer, for the sake of clarity vis-à-vis consumers, surveillance authorities and manufacturers, that minimum Ecodesign requirements are linked to the elimination of energy label classes (if –as is the case—the direct and indirect use of energy is the dominant factor) at the same timing.
6. In 2012 it was agreed in the Consultation Forum and Reg. Committee to have three tiers in Ecodesign. Common practice is that the 1st tier, 1 or 2 years after publication of the regulation, has a modest ambition level and serves to introduce the stakeholders/authorities to the procedures involved and guarantee a smooth transition. The 2nd tier, 2 to 4 years after publication, has an ambition level that is appropriate for the Least Life Cycle Cost point, as could be established at the time of the analysis. The 3rd tier, 3 to 6 years after publication of the measure and always preceded by a review, sets the long term ambition level at the life cycle costs and technological progress that can be expected at that time. For ventilation units it was decided not to introduce the 3rd tier, as the ambition level for Tier 2 is already high according to current standards.
7. Although the energy label may contain information on different climate zones (warm, cold, average), for Ecodesign measures only the energy label classification of ***one***

climate zone, the average, is used to link the measures as outlined above. The main reason is legal: Ecodesign requirements apply to products as they leave the factory gates and there is no 100% secure way by which all manufacturers can guarantee that the product ends up in a specific climate zone. The second reason is political: The basis for the directive is the creation of a free internal EU market. Implicitly forbidden products to move from a location with a certain climate to another location with a different climate would create a barrier to trade. Hence, different ecodesign requirements for different climate zones is out-of-the question.

8. The above principles usually work out on the elimination of energy classes as follows:
    a. in tier 1, classes 'F' and 'G' (which could be used in a voluntary stage preceding tier 1) are eliminated and new classes (e.g. A+ and A++) can then be introduced.
    b. In tier 2, classes 'D' and 'E' are eliminated and new classes can then be introduced (but never more than A+++)
    c. In tier 3, which is not applicable to ventilation units, it appears that class 'C' is usually eliminated. If not already done so in previous tiers, new classes can be introduced.

ANNEX J
ADMINISTRATIVE COSTS

This Annex addresses administrative cost as discussed in Chapter 5.2.11 and based on the background study to SEC(2008)2862, the Impact Assessment on the recast of the Energy Labelling Directive. The presented figures are indicative.

Main administrative costs for Members States and the Commission:

Amendment of the Framework Directive: €5 million in total (€1 million for administrative work on the amendment and €4 million for transposition by Member States).

Transposition cost for the 27 Member States from amended Framework Directive or amended or new implementing Directives of €4 million[66].

Amend an existing implementing Directive or develop a new implementing Directive under the existing ELD: €4.7 million (720.000[67] million for administrative work on the amendment/development of the new Directive and €4 million for transposition by Member States).

It is to be noted that if the amendment to the Framework ELD would lead to implementation of the ELD with implementing Regulation or Decisions instead of Directives, the one-off €5 million revision cost would lead to savings of €40 million in transposition costs alone for the ten first upgraded or newly developed implementing measure adopted under the new framework.

Administrative cost for manufacturers and retailers

Changes in administrative cost to manufacturers and retailers will occur only if the scope is extended and/or implementing measures are set on new products. These costs will be assessed in product specific impact assessments. The background study shows that the costs are likely to vary considerably depending on the product involved, the number of models subject to testing and the degree of testing already carried out for other purposes, such as under the Ecodesign Directive. One of such shared costs is the testing for conformity assessment, which is estimated to €1000-3000 per product type. Another cost for manufacturers is to provide the background label for retailers on products that are displayed in shops and the black-and-white strip for every product shipped.

The information required for the label and information fiche is derived from measurements manufacturers already carry out in the course of product development and quality control. Most manufacturers already publish the basic information in their brochure or technical

[66] Precisely €4.050.000 (27 MS x 150 000€).

[67] The background study estimated that the revision of an existing implementing Directive would cost less (€360.000) than the development of a new one. However, there is no such difference in cost given that new technical studies are needed due to market and technical development, including product development, and the same administrative/legal procedure will be used for both. This does not include any add on for overhead costs.

literature but not in easily accessible form for consumers.[68] Thus the matter seems to be more about the accessibility and easiness to understand the information rather than the additional cost of providing it.

The cost for retailers is limited to the display of the right label on the product associated with the strip provided in the product packaging. Accordingly, given that only simple information requirements are set on manufacturers and retailers there is no risk that these actors would not be able to meet the set criteria, unlike in some cases when setting minimum requirements.

In summary, the background study shows that most of the energy efficiency measures are cost-effective, including energy labelling. In many cases there is some increase in operating cost to manufacturers and retailers due to energy labelling requirements. However, these costs can be passed on the consumer. The background study shows that energy labelling leads to net money savings for the use, as electricity cost over the life time of the appliance will be bigger than any additional purchasing cost for the more efficient model. For example, in the case of EU white goods manufacturers, their operation has become more profitable, appliances cost less and the efficiency has improved with help of technological development and guidance towards more efficient and profitable appliances by the energy label – despite fears by manufacturers when the policy action was initially introduced in the 90s.

[68] Compliance cost assessment, The energy labelling (refrigerators and freezers) regulations 1994, Department of the Environment.

ANNEX K
EXPLANATORY NOTES

Section K.1

Production and trade

For non-residential ventilation units, Eurostat mixes the trade and production data with parts of air-conditioning (cooling) installations. Nonetheless, if the figures on *'non-cooling air conditioning machines, including central station air handling units'* are used as an indicator, the EU-production exceeds the EU apparent consumption[69], i.e. there is a small export surplus. Extra-EU imports amount to 13% of the value of EU apparent consumption. Reliable data on the share of countries of origin and destination are not available, but based on the presence of brands it would appear that Japan (e.g. Mitsubishi), the US and possibly Turkey play a role. Extra-EU exports amounts to 21% of said value, with probably a significant share for the Middle-East, based on the presence of EU-industry sales offices in that region.

For the trade of residential ventilation units no reliable data are available. Industry sources estimate the share of imports and exports, mainly due to the small unidirectional units, at a maximum of 33% of the EU-market, which means that overall –especially for the balanced residential units—the EU production more or less equals the EU consumption.

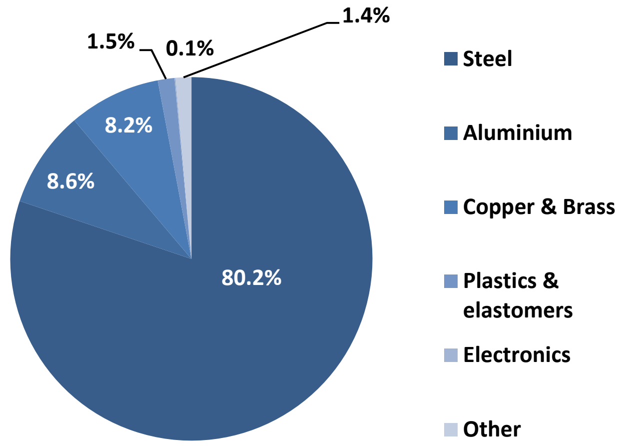
The preparatory studies report that major EU producers of ventilation units are Germany (28% of production value/jobs), Sweden (16% of EU-production value /jobs), UK (10%) and France (10%). The production of mechanical ventilation units in the South of the EU is relatively limited.

Section K.2

Production and End-of-Life resources aspects

Figure 11. Non-residential ventilation units, materials composition

69 Apparent consumption= production + imports – exports



In principle, for this type of product, the recycling will be shredder-based, after dismantling of some of the bigger pieces. The motors, which for some non-residential ventilation units can be quite big, contain certain critical raw materials (CRM) like the Rare Earth Metals, for which it might be worthwhile for recyclers to consider targeted disassembly action. The same goes for precious and critical materials in the controls-section (i.e. the electronics and printed circuit boards) of the product.

For residential ventilation units in the scope, the updated ENER Lot 10 preparatory study estimates materials use of around 21 kt in the EU 2005, of which around 13 kt (62%) is estimated to be recycled and the rest, mostly plastics, will predominantly be incinerated with energy recovery.

Section K.3

Technical design options

- *More efficient fans, drives and motors.* Especially for unidirectional units as well as smaller non-residential balanced units (range 500 – 5000 m³/h) a significant share of single-speed forward curved AC fans is in use, while more efficient (EC or DC motor, backward curved impeller, variable speed drive) alternatives exists. In the market segments of small balanced ventilation units for single family homes (<500 m³/h) as well as the larger balanced non-residential units (>5000 m³/h) the saving potential is less because they would already use the most efficient fans available.

- *Lower pressure drop of ventilation-components of the unit.* This relates to the individual components such as the casing (optimised aerodynamics), filters (low energy consuming alternatives are on the market but not always used) and the heat recovery heat exchanger (finding the optimal balance between low pressure drop and good thermal efficiency) and parts that are using auxiliary energy (rotary heat exchanger motor, circulator pump of run-around heat exchanger system, etc.). Lower pressure drop for all components can also be realised by lowering the face velocity, e.g. from the current 2.7-3 m/s to below 2 m/s at design speed, and –again—by applying a variable speed drive that not only adjusts air flow during demand-induced part load but also the pressure drop.

- *Increase heat recovery.* Currently not all balanced non-residential ventilation units have heat recovery, which constitutes a large potential for retrofit improvements. In situations where the space requirements of the heat recovery modules (in combination with a higher face velocity) constitute a barrier, run-around ('liquid coupled') heat recovery heat exchangers could be a good solution in the non-residential sector. In case there are no space limitations, the market should realize that there is a wide disparity of heat recovery options, ranging from zero heat recovery for unidirectional units, 40-55% efficiency for cross-flow heat exchangers and more than 80% efficiency for counter-flow and rotary heat exchangers. For the run-around heat exchangers efficiencies are just below that number, at typically around 65-70% efficiency.

- *Better controls.* At the moment, most residential ventilation units for single family homes are equipped with a 3-speed control, which is constantly set to the mid-speed, unless special circumstances occur (party=high speed, holiday=low or zero speed). Multi-family homes are commonly equipped with single-speed unidirectional (exhaust fans) with no user-operated control. Non-residential ventilation units are most commonly equipped with a timer control that tunes down the ventilation outside business hours. Demand Control Ventilation, that regulates the air flow on the basis of gas (CO_2, VOC)/occupancy sensors, both in combination with relative humidity (RH) sensors, have been introduced only recently and there is still a huge saving potential, both in residential and non-residential settings.

Section K.4

<u>Sensitivity analysis of baseline</u>

Economic Crisis

In several consumer product sectors the 2008-2009 crisis has led to drops in sales up to 20 or 25%, after a considerable growth in the 2006-2007 period. In 2010-2011 the sales were slowly rising again. The overall effect that is assumed, in line with standard scenarios used by the Commission, is that the 2010 sales equal those of 2005. After 2010 a 2% annual growth rate (1% after 2020) is assumed. While it seems that the crisis in the construction sector is structural and new sales of ventilation units will not grow, the positive growth projection is based on a) a growth retrofit applications in the face of steep energy price increases, and b) a geographical expansion of the ventilation market also towards the Eastern and Southern parts of the EU. Investing in retrofit energy-efficient ventilation is an economically attractive option in itself, but it is especially attractive vis-à-vis alternative investment options such as stocks, bonds, saving accounts or real estate that currently –and probably for some years to come—give a lower yield at a higher risk. This statement is of course only true, and this is the uncertainty of the baseline projection, as long as there are enough potential investors (consumers, companies) with money to invest.

Timing and speed of savings

Related to uncertainties of the future economic situation is the uncertainty regarding the timing and speed of possible energy savings. Typically, the retrofit of new solutions in the construction sector is slow and in the worst case scenario it takes as long as the service-life of the buildings, i.e. on average around 50 years for residential buildings and 30 years for non-residential buildings. Under normal circumstances, and assuming a fair share of retrofit, seems to fit the 2% growth rate that is assumed in the unit sales projections after 2010. But circumstances are not 'normal': Over the last year the construction production index has dropped by 6% [70] and there is no telling when it will stabilize or recover. If this situation continues then also for the ventilation industry, with its relatively good retrofit prospects, the sales will be lower than projected.

Energy prices

As regards the influence of the energy rates, the scenarios have been adapted to the latest findings in the MEErP study[71], which signals that the energy rates were subject to an escalation rate (real growth, i.e. above inflation) of 3-4% over the last 5 years. At the time of previous IA studies, it was still believed that the sharp rise in energy rates was a temporary phenomenon and thus would return to their usual pace of slightly higher than inflation. Now, after five years, it can be assumed that the 3-4% real price increase of energy rates is a structural phenomenon. Therefore the energy escalation rate is assumed to be 4% from 2007 on. The result is that the real running costs over the 2010-2030 period will more than double. The question is, although it is generally acceptable to extrapolate longer term historic trends to the future, if this is really going to happen. A second question is, if energy costs are going to double over the next 20 years, will it move the market—and especially the retrofit market—for ventilation units and will the 2% (1% after 2020) annual growth rate stay as projected or increase (see paragraph on 'economic crisis') ?

Technology trends

The projections assume that unit sales of unidirectional (exhaust) units will slightly decline, while the market volume for balanced units with heat recovery will continue to grow (see fig. 1). However, as the retrofit market will become more important there may be more technology shifts towards balanced ventilation solutions that are more flexible in their lay-out and require less adjustments of the building construction to accommodate the necessary ductwork. For instance, in the non-residential sector the ventilation units with liquid-coupled ('run-around coil') heat recovery heat exchangers may become more popular, because the supply and exhaust air ducts do not necessarily have to be both connected to the ventilation unit. E.g. it is enough to just make new supply ductwork and use the existing exhaust side to realize a balanced heat recovery solution. In the retrofit market for both the residential and non-residential sector, proper[72] local balanced ventilation units just need air in- and outlet solutions on the façade to realize energy-efficient heat recovery. These technology shifts, which may have a small penalty in energy-efficiency of the unit but substantial energy efficiency gain in the unit they are replacing (natural or exhaust ventilation) were only moderately taken into account.

Rebound effect

The 'rebound effect' is a phenomenon whereby the increased popularity of an energy-saving technology has not only triggered replacement of inefficient products, but –presumably

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[70] EU construction production index in June 2012 is 5-6% lower than in June 2011 and there are no signs of possible recovery. Source: Eurostat, News Release 122/2012 - 20 August 2012. *'June 2012 compared with May 2012*, Production in construction down by 0.5% in euro area, Down by 1.7% in EU27'.

[71] Methodology for the Ecodesign of Energy-related Products (MEErP), VHK for European Commission, 2011.(see www.meerp.eu)

[72] Meaning proper products, i.e. where the recirculation rate is less than 10% as in- and outlet flows are far enough apart. Also proper installation is important, i.e. especially in high-rise buildings (with otentially high wind-force) special facade solutions are required.

because consumers no longer felt 'guilty'—also created completely new applications or stimulated a more intensive use. For instance, in buildings where previously an insufficient ventilation was accepted, it is possible that with comfortable heat recovery ventilation the air change rate climbs again to the required level. This is an important gain for the health of humans and buildings (with also their positive indirect energy effects) but may also mean that the energy saving will be less than projected.

Section K.5.

Generic ('horizontal') legislation

The possible use of brominated or chlorinated flame-retardants is tackled in the RoHS Directive (2011/65/EU recast), but from literature it is clear that these are not a 'hot' environmental issue.

The WEEE Directive (2012/19/EU recast) was set up to handle recovery/recycling of electronic and electrical waste. For ventilation units, with high metal content leading to high shares of recovery and recycling, this seems relatively unproblematic (see environmental impact).

The packaging of ventilation units has long been regulated through the Packaging directive (94/62/EC, 2004/12/EC[73]) and after the switch to simple mono-material solutions (cardboard/paper inside and outside for residential, wooden pallets for non-residential) it can actually no longer be considered a priority environmental issue.

The safety of ventilation units is regulated through the Low Voltage Directive LVD (2006/95/EC) for residential units, the Machinery Directive MD (2006/42/EC) for the non-residential sector and the Construction Products Regulation CPR (305/2011/EU). Possibly also rational use of energy can be regulated here, but for ventilation units this is not the case.

Other applicable legislation with little bearing on the environmental impact is the directive on Electromagnetic Compatibility EMC (2004/108/EC).

Section K.6

Table. Annual savings policy scenarios 2020 versus BaU 2020

ANNUAL SAVINGS POLICY SCENARIOS 2020 vs BAU 2020

		Scenario 1 (extra) saving	**Scenario 2** (extra) saving	**Scenario 3** (extra) saving
Electricity TWh/a		13	14	13
Space heating fuel saving PJ/a		420	828	579
Net primary energy saving PJ/a		537	950	695
GWP MtCO_2/a		29	53	38
Acquisition € bn/a (incl. VAT)		38.1	50.8	44.2
Revenue VU industry € bn/a		6.0	8.1	7.0
Revenue trade, installers & related industry € bn/a		30.4	40.6	35.3
Employment industry '000 jobs		73	97	85

[73] Amendments to Directive 94/62/EC by Directives 2004/12/EC, 2005/20/EC and Regulation (EC) 219/2009.

Employment trade, installers & related ind. '000 jobs		276	369	321
Energy costs € bn/a		11	18	14
Consumer expenditure € bn/a (incl. VAT)		5.2	10.0	6.9

Table. Accumulative savings policy scenarios 2011-2020 versus BaU 2011-2020

Period 2011-2020	**Scenario 1** saving	**Scenario 2** saving	**Scenario 3** saving
Electricity TWh/a	100	87	91
Space heating fuel saving PJ/a	2532	3693	3035
Net primary energy primary PJ/a	3348	4330	3756
GWP $MtCO_2$	207	306	240
Energy costs € bn	68	90	76
Expenditure € bn	26	38	30

Section K.7

Sensitivity analysis sub-options

In the model, the annual price increases of gas and electricity are set on 4%, since the price increase of energy is higher than the inflation rate. Halving the annual price increase at 2%, would decrease the energy costs with 7 billion euros in scenario 3. Setting the annual price increase to 6% would increase the energy costs with 7 billion euros in scenario 3, but the changes in price increase would not change the scenarios' ranking.

On the long term (2030), halving the price increase of energy would lead to an energy price decrease of 28% in scenario 3; doubling the price increase to 6% would lead to a price increase of 28%, but again would not lead to a change in policy, because in scenario 3 the boundary conditions of no significant impacts (Art. 15.a of the Ecodesign directive) takes priority over the target levels at Least Life Cycle Costs (Annex II of the Ecodesign Directive). In the most ambitious scenario 2, there would be significant effects.

The introduction of EU energy labelling is supported by all EU stakeholders: industry, consumer associations and Member States. Prescriptions for internet publication are not new but merely a requirement in line with what is customary in mandatory energy labelling. At this moment, Member States have not indicated their desire to introduce their own stringent requirements for ventilation units that would go beyond what is proposed.

As regards the external societal costs, they are mostly linked to electricity consumption. They would add in the order of magnitude of 10% of electricity costs, but would hardly differentiate between the scenarios.

There is not enough information to assess whether the proposed Ecodesign and labelling measures pose a significant threat to the flexibility of Member States in meeting the goals of the national energy efficiency plans, nor whether there will be any detectable interaction between the measures and the functioning of the emissions trading scheme, but both seem unlikely.

All in all, it is considered that the scenarios are robust.

ANNEX L

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ANNEX M
ABBREVIATIONS & ACRONYMS

Abbreviations, acronyms, country denominators, denominators and units used in main report, annexes and background material.

24/7	All the time, i.e. 24 hours a day during 7 days a week
@	at
€	Euro
AC	1. Air Conditioning 2. Alternate Current
AEGPL	Association of European LPG suppliers
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
AHU	Air Handling Unit
AIVC	Air Infiltration and Ventilation Centre
ANEC	Organisation representing the European consumer interest in the creation of technical standards
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers (standard)
AV	Surface Area/Volume (ratio)
BAT	Best Available Technology
BAU	Business-as-Usual (baseline scenario)
BC	Backward Curved (fan impeller, a.k.a. 'B-wheel')
BEP or bep	Best Efficiency Point
BEUC	European consumer organisation
BFC	Bypass Flow rate Control
BNAT	Best Not yet Available Technology (e.g. at prototype/lab stage)
BPO	Bypass Options
BS	British Standard
BSRIA	Building Services Research and Information Association
CAV	Constant Air Volume
CBS	Centraal Bureau voor de Statistiek (Netherlands statistics office)
CE-marking	Compliance mark (safety, Ecodesign, etc.) for placing products on the EU-market
CEN	Comité Européen de Normalisation (French: European Committee for Standardization)
CENELEC	Comité Européen de Normalisation Électrotechnique (European Committee for Electrotechnical Standardization)
CF	(Ecodesign) Consultation Forum
CHRV	Central Heat Recovery Ventilation
CIRCABC	Communication and Information Resource Centre Administrator (website of the European Commission distributing relevant documents to/from stakeholders, amongst others on ecodesign)
CN8	Combined Nomenclature (at eight digit level)
COM	Prefix of a Commission Communication
Commission	European Commission
COP	Coefficient of Performance, synonimous for efficiency but used when efficiency can be >100% due to not-accounted external energy sources (e.g. with heat pump)
Council	European Council
CP	Competitiveness Proofing

CPD	Construction Products Directive (predecessor of CPR)
CPR	Construction Products Regulation
CPU	Central Processing Unit
DC	Direct Current
degree	degree Kelvin K (for temperature differences) or Celsius, °C (absolute temperature) unless specified differently
DG	Directorate General
DIN	Deutsche Industry Norm
DIY	Do-It-Yourself (store)
DMU	Decision Making Unit
EAP6	6tht Environmental Sction Plan
EATR	Exhaust Air Transfer Ratio (UK)
EC	European Communities, European Commission, electronically commutating (of motors)
ECA	Enhanced Capital Allowance
ECBCS	Energy Conservation in Buildings and Community Systems (an IEA Implementing Agreement)
ECCP	European Climate Change Programme
Ecodesign	Relates to policy measures in the context of the directive on Ecodesign of Energy-related products 2009/125/EC
Eco-labelling	Relates to (voluntary) Community eco-labelling measures in the context of Regulation (EC) No 66/2010
Ecoreport	MEEuP/MEErP spreadsheet tool providing environmental profile of a product over its life cycle (production, distribution, use, disposal/recycling), in terms of resources (materials, energy, water, waste) and emission-categories currently addressed in EU-policy measures. Weighting of environmental impacts is in accordance with emission limit values and conversion factors in EU-legislation.
EED	Energy Efficiency Directive, Directive 2012/27/EU
EEIG	European Economic Interest Grouping
EHA	Exhaust air, i.e. airflow discharges to the atmosphere
EHVA	European Ventilation Hygien Association
EMC	Electromagnetic Compatibility (Directive 2004/108/EEC)
EMOTA	European Multi-channel and Online Trade Association
EN	European Standard, followed by number and possibly year of publication
ENER	European Commission, Directorate-General Energy (a.k.a. 'DG ENER')
EnEV	EnergieEinsparungsVerordnung
ENTR	European Commission, Directorate-General Enterprise (a.k.a. 'DG ENTR')
ENVI	Envrionment, Public Health and Food Safety Committee of the EP
EP	European Parliament
EPA	Environmental Protection Agency (US)
EPAct	Energy Policy Act (US)
EPBD	Energy Performance of Buildings Directive, Directive 2010/31/EU (recast)
EPC	Energie Prestatie Coëfficient (Netherlands)
ErP	Energy-related Products
ESOs	European Standardisation Organisations (CEN, Cenelec, ETSI)
ETA	Extract air, i.e. the airflow leaving the treated room
ETS	Emission Trading Scheme EU
EU	European Union

EU-27	European Union of 27 Member States (relates to statistics after 2007)
EuP	Energy-using Product
Eurelectric	Association of European electric utilities
EUROSTAT	Statistical Office of the European Union
EUROVENT	European Committee of Air Handling and Refrigeration Equipment Manufacturers
EVIA	European Ventilation Industry Association
FAQ	Frequently Asked Question
FBC	Flow Balance Control
FC	Forward Curved (fan impeller, a.k.a. 'F-wheel')
FCU	Fan Coil Unit
FGK	Fachinstitut Gebaude-Klima e.V.
FIT	Filter Indicator Type
FMEG	Fan & Motor Efficiency Grade (-)
FRC	Flow Rate Control
FRV	Flow Rate Variations
GBP	Great Britain Pound
GDP	Gross Domestic Product
GF	Ground Floor
GHG	GreenHouse Gas
GWP	Global Warming Potential. When not specified GWP100, i.e. time horizon 100 years (emission in kg CO2 eq.)
HEPA	High-Efficiency Particulate Air (filter)
HR	Heat Recovery.
HR	Heat Recovery
HRV	Heat Recovery Ventilation
HVAC	Heating Ventilation and/or Air-Conditioning
HWS	Hot Water Service
IA	Impact Assessment
IAB	Impact Assessment Board
IAG	Impact Assessment Guidelines
IAQ	Indoor Air Quality
IDA	Indoor air, i.e. air in the treated room or zone
IEA	International Energy Agency
IEC	International Electrotechnical Commission
IEE	Indicador de Efficiencia Energética (Portugal)
INIVE	International Network for Information on Ventilation and Energy Performance
ISC	Inter Service Consultation
ISO	International Standards Organisation
ITRE	Industry, Research and Energy Committee of the EP
JIS	Japanese Industrial Standard
Labelling	Relates to policy measures within the context of Energy Labelling directive 2010/30/EU or its predecessor 92/75/EC
LCA	Life Cycle Analysis
LCC	Life Cycle Costs (monetary)
LCIA	Life Cycle Impact Assessment
LEA	Leakage, i.e. unintended airflow through leakage paths in the system
LHRV	Local Heat Recovery Ventilation

LPG	Liquefied Petroleum Gas (propane, butane or mix of both)
LT	Low Temperature
LTHW	Low Temperature Hot Water
LVD	Low Voltage Directive 2006/95/EC
Marcogas	Association of European gas utilities
MD	Machine Directive
MEErP	Methodology for Ecodesign of Energy-related Products (VHK 2011 for DG ENTR), methodology used in Ecodesign preparatory studies (replaces MEEuP for studies started after 2011)
MEEuP	Methodology for Ecodesign of Energy-using Products (VHK 2005 for DG ENTR), methodology used in Ecodesign preparatory studies
MEEuP	Methodology for Ecodesign of Energy-using Products
MEPS	Minimum Energy efficiency Performance Standards
NACE	Eurostat classification of Economic Activities
NEN	Nederlands Normalisatie-Instituut (Netherlands Standards Institute)
NF	Norme Française (French Standard)
NGO	Non-Governmental Organisation
NHO	Confederation of Norwegian Enterprises
NTPF	Nominal Temperature Performance Factor (-)
ODA	Outdoor air, i.e. air entering the system or opening from outdoors before any air treatment
OEM	Original Equipment Manufacturer (component supplier)
OEM	Original Equipment Manufacturers
Orgalime	European Engineering Industries Association
prEN	draft EN standard, 'pre-standard' (not officially approved by ESO)
preparatory study	Ecodesign preparatory study. Specifically in this report: Studies by ARMINES and VHK
PRODCOM	PROduction COMmunautaire, product category denomination in the official CE (Eurostat) publication of EU production and trade data (a.k.a. 'Europroms')
R&D	Research and Development
RCCTE	Regulamento das Caracteristicas de Comportamento Térmico dos Edificios (Portugal)
REHVA	Federation of European heating, ventilation and air-conditioning associations
RF	Radio Frequency (a.k.a. 'wireless')
RH	Relative Humdity
RITE	Reglamento de Instalaciones Térmicas en los Edificios (Spain)
RLT	Herstellerverband Raumlufttechnischer Gerate
RoHS	Restriction of the use of certain Hazardous Substances in electrical and electronic equipment, Directive 2011/65/EU (recast of 2002/95/EC)
RSECE	Regulamento dos Sistemas Energeticos de Climatização em Edificios (Portugal)
RT	Réglémentation Thermique (France)
SEC	In this report: Specific Energy Consumption
SEC	Prefix of a Commission Staff Document
SEC	Secondary air, i.e. airflow taken from a room and returned to the same room after any treatment
SFP	Specific Fan Power (in W per m^3/s)
SG	Steering Group (Ecodesign Inter-Service Impact Assessment Group), also (but not in this report) Secretary General
SI	Système International d'unités

SME	Small- and/or Medium sized Enterprise(s) [< 250 employees]
SPI	Specific Power Input (in W per m^3/s or m^3/h)
SUP	Supply air, i.e. airflow entering the treated room, or air entering the system after any treatment
TC	Technical Committee (of an ESO)
TEC	Treaty on the European Communities (since Dec. 2009 replaced by TFEU)
TFEU	Treaty on the Functioning of the European Union
TFP	Type of Frost Protection
TIA	Territorial Impact Assessment
ToR	Terms of Reference
TRA	Transferred air, i.e. indoor air which passes from the treated room to another treated room
UF	Upper Floor(s)
USDOE	United States Department of Energy (also 'DOE' or 'DoE')
VAT	Value Added Tax
VAV	Variable Air Volume
VHK	Van Holsteijn en Kemna BV, technical assistant to the Commission Services (framework contract IA)
VRF	Variable Refrigerant Flow
VRF	Variable Refrigerant Flow
VRV	Variable Refrigerant Volume
VSD	Variable Speed Drive (a.k.a. ASD, Adjustable Speed Drive)
WEEE	Waste of Electrical and Electronic Equipment directive 2012/19/EU (recast of 2002/96/EC)
WFD	Waste Framework Directive
WG	Working Group (of an ESO)
WTO-TBT	World Trade Organisation-Technical Barriers on Trade agreement

Common parameter denominators in this report

A	Surface (in m^2)
c	Specific heat (in $J/dm^3.K$ or J/kg.K)
C	Generic for 'coefficient' or 'constant' (-)
Eff or η	Efficiency (-)
h	Height (in m)
P	Power (in W)
q	Flow rate (in m^3/s or m^3/h)
Q	Energy or heat (in Joule or kWh)
R	Rate (in other reports reserved for Reynolds number)
t	Time (s or h) (also used for temperature
V	Air velocity (in m/s); Volume (in m^3)
x	absolute humidity (g/kg air)
Δp	Pressure difference (in Pa)
ΔT	Temperature difference (in K)
ε	Efficiency (for local ventilation efficiency) or 'coefficient of performance' (-)
θ or T	Temperature (in oC)
ρ	Density (in kg/dm^3)

Units used in this report

bhp	brake horse power, unit for power (745.7 W)
BTU	British Thermal Unit, unit for energy (0.293 Wh)
BTU/h	British Thermal Unit per hour, unit for power (0.293 W)
BTU/h-ft2	BTU per hour and square feet, (≈3.147 W/m^2)
°C	Degree Celcius, unit of temperature
cf or ft^3	cubic feet, US unit for volume (0.028316847 m^3)
cfm	cubic feet per minute, US unit for flow rate (1.69865 m^3/h)
CO2 eq.	Carbon dioxide equivalent, unit for Greenhouse Gas Emissions (usually over 100 years, Global Warming Potential-100)
dB(A)	Decibel, unit of A-weighted equivalent sound pressure
eq.	equivalent
g	gramme, ISO-unit of mass
h	hour, also used as 'height' denominator
hp	horse power, unit for power (745.7 W)
J	Joule, SI-unit of energy
K	(Degree) Kelvin, unit of temperature (0 K= -273 °C)
l or ltr	litre (10^{-3} m^3),
m, m^2, m^3	meter, square meter, cubic meter; SI-units of length, surface, volume
Pa	Pascal, SI-unit of pressure
s	Second, SI-unit of time
sq ft or ft^2	square feet, unit for surface (0.0929 m^2)
V	Volt, unit for electric voltage
W	Watt, unit of power
Wh	Watt hour, unit of energy (1 Wh= 3.6 kJ)

Country denominators

EU27	European Union with 27 Member States (compared to EU25, EU15, etc.)
AT	Austria
BE	Belgium
BU	Bulgaria
CY	Cyprus
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia (also EST)
EL	Greece (also GR)
EI	Ireland (also IRE)
ES	Spain
EST	Estonia (preferably EE)
FI	Finland (also FIN)
FIN	Finland (preferably FI)

FR	France
GR	Greece (preferably EL)
HU	Hungary
IRE	Ireland (preferably EI)
IT	Italy
LT	Lithuania
LV	Latvia
LU	Luxemburg
MT	Malta
NL	Netherlands
PL	Poland
PT	Portugal
RO	Romenia
SI	Slovenia
SK	Slovakia
SV	Sweden
UK	United Kingdom

Numerical prefixes etc.

n	nano, 10^{-9}
µ	micro, 10^{-6}
m	milli, 10^{-3}
k	kilo, 10^{3}
M	Mega, 10^{6}
G	Giga, 10^{9}
T	Tera, 10^{12}
P	Peta, 10^{15}

bln. / bn	Billion, 10^{9}
mln. / m	Million, 10^{6}