van holsteijn en kemna ift ROSENHEIM
research - design - engineering

vito
vision on technology

Final report

LOT 32 / Ecodesign of Window Products
TASK 1 - Scope

ift Rosenheim: Norbert Sack, Andreas Woest (main authors)
VHK: Martijn van Elburg
VITO: Sarah Bogaerts, Karolien Peeters, Carolin Spirinckx

3 June 2015

Specific contract No ENER/C3/2012-418-Lot1/03
Multiple framework service contract No ENER/C3/2012-418-Lot 1

VITO NV
Boeretang 200 - 2400 MOL - BELGIE
Tel. + 32 14 33 55 11 - Fax + 32 14 33 55 99
vito@vito.be - www.vito.be

BTW BE-0244.195.916 RPR (Turnhout)
Bank 375-1117354-90 ING
BE34 3751 1173 5490 - BBRUBEBB

SUMMARY

Product group definition

TASK 1 concludes to focus the full preparatory study on 'windows' on the basis of the harmonized product standard hEN 14351-1 *Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics*:

Standards

Windows are harmonized building products. Based on the mandates M101 (windows) and M122 (roof windows) the harmonized product standard EN 14351-1 "Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics" was drafted by the responsible technical committee CEN TC33, in particular by working group WG1. Due to the implementation of the Construction Products Regulation (EU) No 305/2011 (CPR)[1] EN 14351-1 is mandatory for all member states since 1st July 2013. The standard serves as a "manual" for the evaluation of the relevant characteristics and gives rules for the CE marking of the product.

The harmonized European product standard for windows defines the determination of necessary characteristics of windows and supersedes test standards in individual member states.

The main (energy) performance parameters of windows can be assessed using the relevant European standards for measurement and calculation. These standards are given in the harmonized product standard for windows EN 14351-1.

For the evaluation of the life cycle assessment of construction products there is a European standard EN 15804. The standard provides a structure to ensure that all Environmental Product Declarations (EPDs) are derived, verified and presented in a harmonized way. EPDs for windows should be based on EN 15804.

Legislation at EU Level

Windows are currently regulated by the Construction Products Regulation which has led to the affixing of product performance labels on the product. This has helped to improve transparency and information regarding the product performance. This aspect has to be taken into account when considering and discussing the viability of possible new information requirements under the Directive 2009/125 (Ecodesign)[2] or Directive 2010/30 (Energy labelling)[3].

Also other European regulations and directives are already tackling "ecological characteristics" of windows. In this connection the Energy Performance of Buildings Directive (EPBD)[4] is one of the most relevant. Although the directive states no direct requirement for windows itself, the implementation of the directive in the member states is leading to national requirements for energy related characteristics for windows (see also next chapter).

Legislation at Member State Level

Windows, as building components, may also be regulated by Member States, in the form of prescriptive requirements.

As far as the energy conservation of buildings is concerned, windows are products that have a significant impact on the energy performance of the building envelope. In that context, the requirements set by Member States on new buildings or existing building that undergo a major renovation and on building elements that form part of the envelope will directly or indirectly influence the energy performance of windows installed in the buildings

For the refurbishment of buildings the general approach in most Member States is to set requirements at building element level. For windows, the regulated energy related characteristic is in general only the thermal transmittance (U-value). In the U.K the energy balance can be used to show compliance. In Denmark "only" an energy balance of the window is the requirement. In some Member States there are different requirements for facade and roof windows.

[1] REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC

[2] 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)

[3] 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

[4] DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings

In some member states, the presence of solar shading is considered for both the additional insulation capacity (ΔR-value) and the solar gain control (g_{tot}-value). France is also considering different control systems for solar shading – i.e. manual, motorised and automated - in the thermal building regulation (RT2012).

This aspect also has to be taken into account when discussing the viability of possible prescriptive requirements under the Ecodesign Directive (prescriptive or specific ecodesign requirements do not apply to the Energy labelling Directive).

Regarding the item "dangerous substances" there is only one member state that has national requirements. In France constructions products must be labelled with an emission classification on the basis of VOC emissions test. As a matter of course also windows must be signed with an adequate label.

Energy Labelling Initiatives

At the moment there are several schemes in Europe for the calculation of the energy performance of windows. All of these schemes are not mandatory but voluntary. Most of these existing voluntary energy labelling schemes in Europe are not only based on the heat losses (U-value, air tightness) but calculating the energy performance of a window based on energy balance (including both solar gain and heat loss) For the communication to the "end customer" most labels use the familiar seven efficiency classes from red to green and labelled A to G.

Comparing the existing schemes, there are different approaches for the evaluation of the energy performance. All of the schemes are considering the heating situation. Instead the cooling situation (also indicator for overheating or comfort) is not considered by all schemes (6 schemes were identified). According to the current analysis only few schemes are considering the benefits of sun shading devices, especially as far as the cooling situation is concerned.

Environmental Product Declarations

Sustainability is tackled only by few voluntary private initiatives. Six so called programme operators have developed Product Category Rules for windows that are the basis for the declaration of the environmental footprint. At the moment there is no mandatory requirement to publish EPDs.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS & ACRONYMS

AP	Acidification Potential
BAT	Best Available Technology
BNAT	Best Not yet Available Technology
BOM	Bill of Materials
CA	Concerted Action
C&D	Construction and demolition waste
CENELEC	European Committee for Electro technical Standardization
CEN	European Committee for Normalisation
CPD	Construction Products Directive
CPR	Construction Products Regulation
EN	European Norm
EOL	End Of Life
EOTA	European Organisation for Technical Assessment in the area of construction products
EP	Eutrophication Potential
EPBD	Energy Performance of Buildings Directive
EPD	Environmental Product Declaration
EPS	Expanded Polystyrene
ETAG	European Technical Approval Guidelines
EU	European Union
EuP	Energy using Products
ErP	Energy related Products
FDES	Fiches de Déclaration Environnementale et Sanitaire (from the French EPD system)
GWP	Global Warming Potential
HM	Heavy Metals
IAQ	Indoor Air Quality
JRC	Joint Research Centre
LCA	Life Cycle Assessment
LCC	Life Cycle Cost
MEErP	Methodology for Ecodesign of Energy related Products
MEEuP	Methodology for Ecodesign of Energy using Products
MEPS	Minimum Energy Performance Standard
MS	Member State
NEEAP	National Energy Efficiency Action Plan
NMVOC	Non Methane Volatile Organic Compound

NZEB	Nearly Zero Energy Building
ODP	Ozone Depletion Potential
ODS	Ozone Depleting Substance
OEF	Organisational Environmental Footprint
PEF	Product Environmental Footprint
PEFCRs	Product Environmental Footprint Category Rules
PM	Particulate Matter
POP	Persistent Organic Pollutants
POCP	Photochemical Oxidant Creation Potential
PRODCOM	PRODuction COMmunautaire
RES	Renewable Energy Sources
RoHS	Restriction of the use of certain Hazardous Substances in electrical and electronic equipment
CI/SfB	Construction Index/Samarbetskommitten for Byggnadsfrago
SME	Small and Medium sized Enterprise
TC	Technical Committee
TR	Technical Report
VITO	Flemish Institute for Technological Research
VOC	Volatile Organic Compounds

LIST OF ITEMS OF WHICH PROPERTY RIGHTS CAN NOT BE TRANSFERRED TO THE UNION

CHAPTER 1 PREFACE

This report has been prepared by Van Holsteijn en Kemna BV (VHK) in collaboration with ift Rosenheim and the Flemish Institute for Technological Research (VITO), under the Multiple Framework Contract related to preparatory studies and related technical assistance on specific product groups (ENER/C3/2012-418-Lot 1), and in response to the Terms of Reference included in the Contract for the "Ecodesign study with regard to Windows".

The subject of this report falls under the general context of sustainable industrial policy which aims to foster the development of products with less environmental impacts.

Directive 2009/125/EC ("Ecodesign Directive") is the cornerstone of this approach as it establishes a framework for the setting of Ecodesign requirements for energy-related products (ErPs) with the aim of ensuring the free movement of these products within the internal market. Directive 2009/125/EC targets ErPs as these account for a large portion of the consumption of energy and natural resources, and a number of other environmental impacts, in the Community, in particular during their use phase.

Directive 2010/30/EC on the energy labelling of ErPs is complementary to the Ecodesign Directive as it requires (a.o.) information on the impact by these products on the use of essential resources to be provided to consumers at the point of sale.

Any measure prepared under these directives must be preceded by a study or assessment ('preparatory study') that sets out to collect evidence and stakeholder input, explore policy options and describe the recommended policy mix (ecodesign and/or labelling and/or self-regulation measures).

The product groups considered as priorities for such studies have been listed in the Working Plan 2012-2014 (established according article 16(1) of the Ecodesign Directive) and this list includes "windows". Therefore a preparatory study has been requested by the Commission.

This preparatory study is to be executed according the Methodology for the Ecodesign of Energy-related Products (MEErP, 2011)[5] which identifies eight (1+7) tasks and shall allow stakeholder involvement. This report is the final report of Task 1 of the study.

[5] http://www.meerp.eu/ VHK BV, Netherlands and COWI, Belgium: Methodology Study Ecodesign of Energy-related Products, MEErP Methodology Report, under specific contract SI2.581529, Technical Assistance for the update of the Methodology for the Ecodesign of Energy-using products (MEEuP), within the framework service contract TREN/R1/350-2008 Lot 3, Final Report: 28/11/2011

CHAPTER 2 INTRODUCTION

2.1. METHODOLOGY FOR ECODESIGN PREPARATORY STUDIES

A full preparatory study follows the methodology for ecodesign of energy-related products established in 2011 (MEErP 2011) which itself is a succession of the former methodology dealing with energy-using products (MEEuP 2005) developed in 2005 to contribute to the creation of a methodology allowing evaluating whether and to which extent various energy-using products fulfil certain criteria according to Annex I and/or II of the Ecodesign Directive that make them eligible for implementing measures.

The full preparatory study is executed according seven tasks, as described below:

Task 1 – Scope (definitions, standards and legislation);

Task 2 – Markets (volumes and prices);

Task 3 – Users (product demand side);

Task 4 – Technologies (product supply side, includes both BAT and BNAT);

Task 5 – Environment & Economics (Base case LCA & LCC);

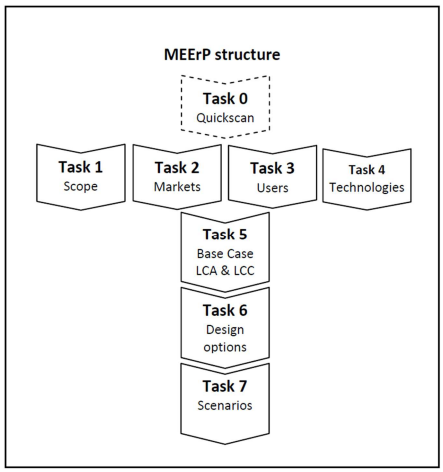
Task 6 – Design options;

Task 7 – Scenarios (Policy, scenario, impact and sensitivity analysis).

The MEErP structure makes a clear split between:

- Tasks 1 to 4 (product definitions, standards and legislation; economic and market analysis; consumer behaviour and local infrastructure; technical analysis) that have a clear focus on data retrieval and initial analysis;
- Tasks 5 (assessment of base case), 6 (improvement potential) and 7 (policy, scenario, impact and sensitivity analysis) with a clear focus on modelling.

Figure 1 MEErP structure



An optional Task 0 quick scan or first product screening has been introduced in the 2011 methodology for those product groups that are characterised by a large variety of products covered by a generic product group description. It was carried out for this study as well. The findings of this Task 0 are incorporated in the following Task 1 report.

Tasks 1 to 4 can be performed in parallel, whereas Task 5, 6 and 7 are sequential.

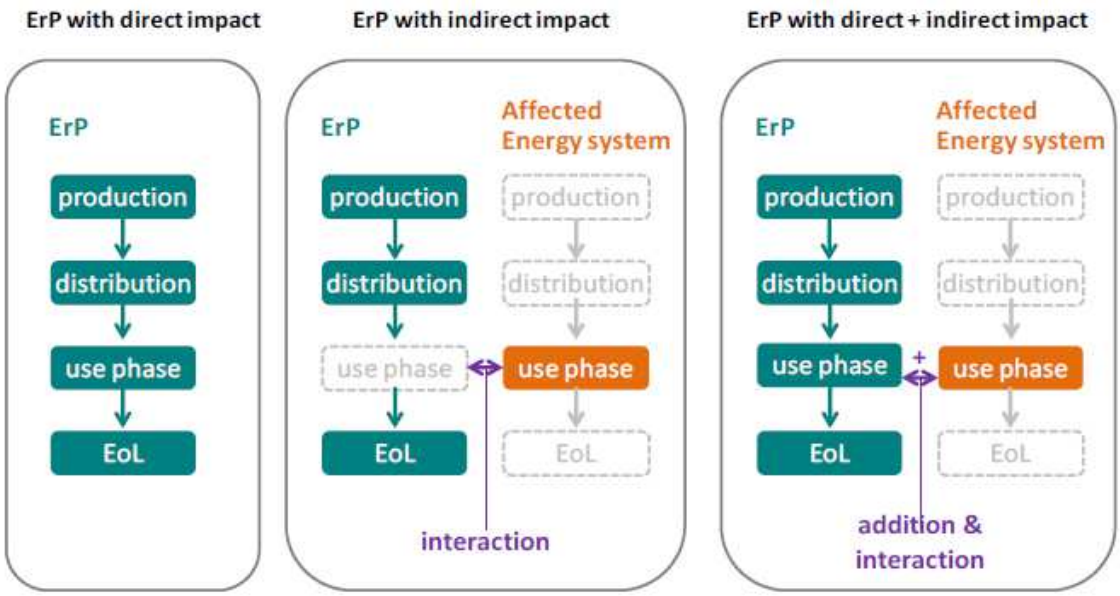
2.1.1. ENERGY RELATED PRODUCTS

Directive 2009/125/EC defines an energy-related product as *"any good that has an impact on energy consumption during use which is placed on the market and/or put into service, and includes parts intended to be incorporated into energy-related products covered by this Directive, which are placed on the market and/or put into service as individual parts for end-users and of which the environmental performance can be assessed independently"*.

The impact on energy consumption during use of an energy-related product may take different forms and the MEErP methodology defined these as either direct and/or indirect impacts. The relevance of this lies in the analysis required and which should or should not include affected energy systems.

The MEErP introduced a grouping of energy related products into products with only direct impacts, only indirect impacts or both.

Figure 2: Three types of ErP (VHK, 2011)



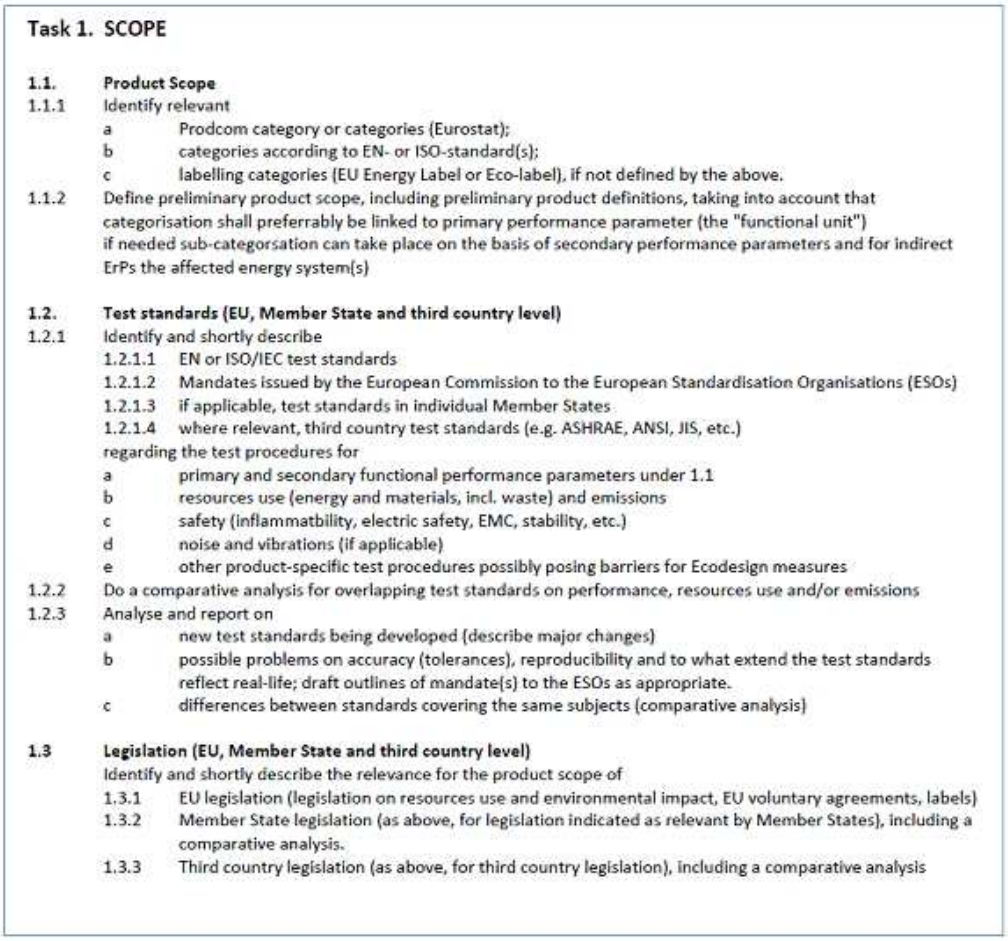
Considering the above indicated grouping in MEErP of ErP products windows are an example of ErP with indirect impact.

2.2. MEERP – DETAILS OF WORK FOR TASK 1

Task 1 should define the product category and define the system boundaries of the 'playing field' for ecodesign. It is important for a realistic definition of design options and improvement potential and it is also relevant in the context of technically defining any implementing legislation or voluntary measures (if any). Furthermore, Task 1 is the basis for the test and calculation methods to be used to regulate relevant ecodesign parameters.
It shall provide information whether accurate, reliable and reproducible methods exist and/or, if they don't exist or the methods are partly flawed, how this problem could be addressed. Finally, Task 1 is important as it makes

- an inventory of what measures already exist in the EU (with possible regulatory failures),
- it analyses the legislation in EU Member States, which the Ecodesign directive tries to harmonise for the sake of a single market and
- It indicates –also in view of the global competitiveness and hinting at feasible target levels—what measures have been taken in the rest of the world outside the EU.

Figure 3: MEErP structure: Task 1 (from: MEErP Methodology Report Part1 (2011))



Task 1. SCOPE

1.1. Product Scope

1.1.1 Identify relevant
- a Prodcom category or categories (Eurostat);
- b categories according to EN- or ISO-standard(s);
- c labelling categories (EU Energy Label or Eco-label), if not defined by the above.

1.1.2 Define preliminary product scope, including preliminary product definitions, taking into account that categorisation shall preferrably be linked to primary performance parameter (the "functional unit") if needed sub-categorsation can take place on the basis of secondary performance parameters and for indirect ErPs the affected energy system(s)

1.2. Test standards (EU, Member State and third country level)

1.2.1 Identify and shortly describe
- 1.2.1.1 EN or ISO/IEC test standards
- 1.2.1.2 Mandates issued by the European Commission to the European Standardisation Organisations (ESOs)
- 1.2.1.3 if applicable, test standards in individual Member States
- 1.2.1.4 where relevant, third country test standards (e.g. ASHRAE, ANSI, JIS, etc.)

regarding the test procedures for
- a primary and secondary functional performance parameters under 1.1
- b resources use (energy and materials, incl. waste) and emissions
- c safety (inflammatbility, electric safety, EMC, stability, etc.)
- d noise and vibrations (if applicable)
- e other product-specific test procedures possibly posing barriers for Ecodesign measures

1.2.2 Do a comparative analysis for overlapping test standards on performance, resources use and/or emissions

1.2.3 Analyse and report on
- a new test standards being developed (describe major changes)
- b possible problems on accuracy (tolerances), reproducibility and to what extend the test standards reflect real-life; draft outlines of mandate(s) to the ESOs as appropriate.
- c differences between standards covering the same subjects (comparative analysis)

1.3 Legislation (EU, Member State and third country level)

Identify and shortly describe the relevance for the product scope of
- 1.3.1 EU legislation (legislation on resources use and environmental impact, EU voluntary agreements, labels)
- 1.3.2 Member State legislation (as above, for legislation indicated as relevant by Member States), including a comparative analysis.
- 1.3.3 Third country legislation (as above, for third country legislation), including a comparative analysis

The methodology for the ecodesign of energy related Products supports the overriding principle that the clustering of products should be based on a quantifiable “functional unit”.

Nevertheless for construction products in Europe the Construction Products Regulation – which is mandatory for placing construction products on the market – is strictly referencing the harmonized technical specifications. These may be either harmonized product standards (hEN) or European Assessment Documents.

→ **Structure**

Accordingly, this report sets out to provide information at the level of a full preparatory study. Therefore the main item for this report is the MEErP task 1. The task is covered by the study according the structure described below.

Table 1: Overview Structure

Task 1: Scope (definitions, standards and legislation)	Covered by:
Subtask 1.1 - Product scope	Chapter 3 – Product Scope
Subtask 1.2 – Measurements/test standards	Chapter 4 – Measurements/Standards
Subtask 1.2.1 – Identify and describe relevant standards	
Subtask 1.2.2 – Comparative analysis of existing test standards	
Subtask 1.2.3 – New standards under development	
Subtask 1.3 - Existing legislation	Chapter 5 – Existing Legislation
Subtask 1.3.1 - Legislation and Agreements at European Union level	
Subtask 1.3.2 - Legislation at Member State level	
Subtask 1.3.3 - Third Country Legislation	

Final Report 3 June 2015

CHAPTER 3 PRODUCT SCOPE

This chapter sets out to describe the product group being considered for the study scope. Then information related to test standards and future developments is presented.

The results are a product group definition and a description of possible exclusions (of products that may also meet the product group definition).

3.1. PRODUCT DESCRIPTION

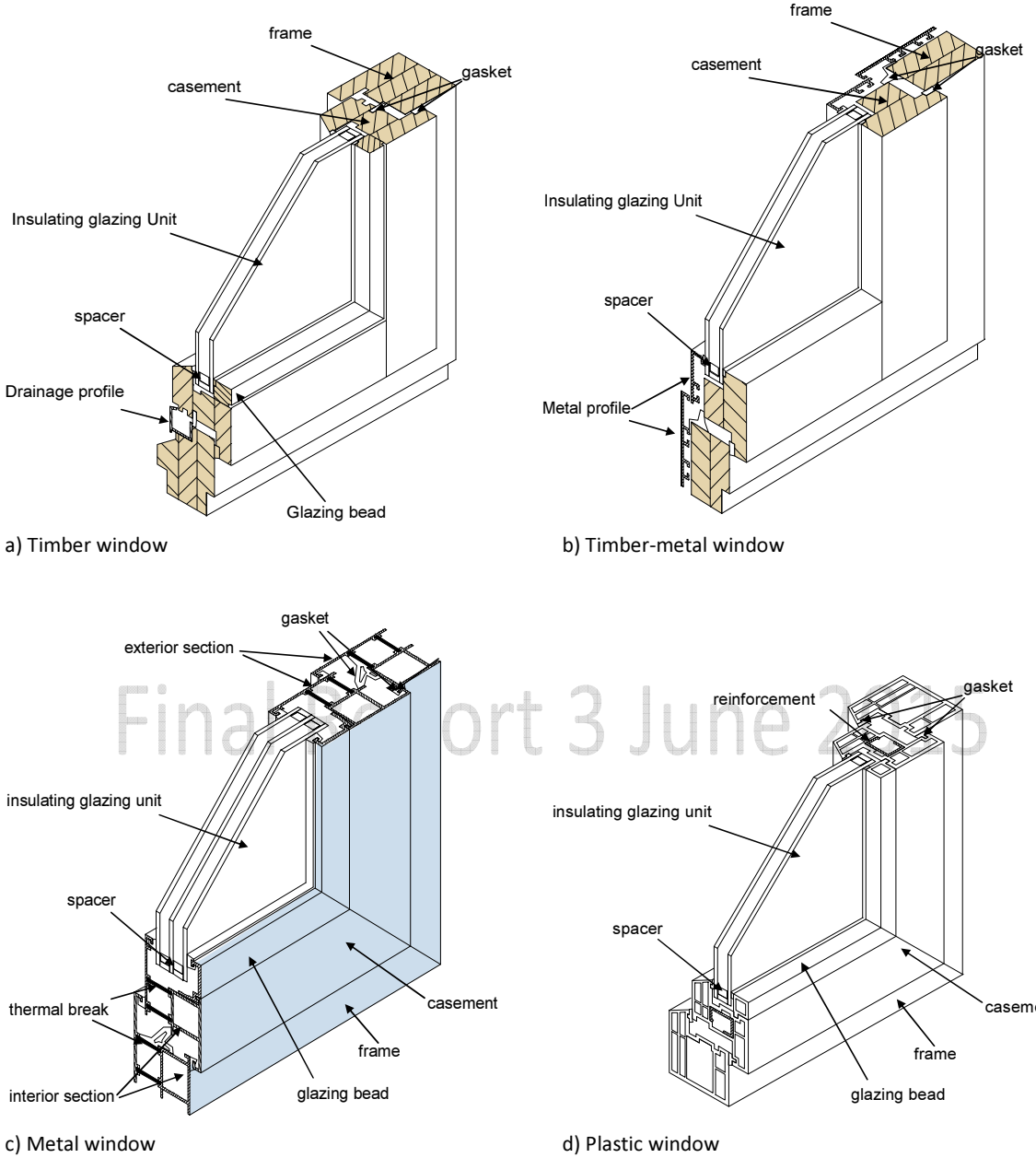
The product group "windows" was identified as a possible energy-related product in recital (4) of Directive 2009/125/EC (together with insulation materials and water-using products such as shower heads or taps).

Windows are generally understood as building components installed in the building envelope (e.g. wall, roof) that admit (day) light, solar heat and may also admit ventilation air to the spaces they (partly) enclose. Often they separate a climate conditioned indoor space from the unconditioned (outdoor) space, thus providing a thermal barrier that admits light, solar heat and possibly air. Windows offer a view to the outdoor environment, essential for the occupant's comfort.

Typically windows consist of a 'frame' and 'glazing'. If the glazing is fit into a moveable (open able) part, this part is called 'sash' (sliding windows) or casement (tilt and turn windows). Other components typical for windows are provisions to prevent air leakage (gaskets), to improve thermal performance (incorporating thermal insulation material, thermal breaks in metallic frames) or to improve durability (profiles for protection against weather) or for general construction purpose (glazing beads). Typical schematic designs are shown in Figure 1.

Note: A more detailed technical description of the product window is given in the TASK 4 report.

Figure 4: Typical cross sections of windows (opening inwards) by frame material



The final report of the background study for the Ecodesign Working Plan 2012-2014 reflected these basic construction elements in the proposed product definition for windows:

> *Window products for buildings (short: "windows") means factory made assembled products consisting of at least the window glazing and the window frame to hold this glazing. Other elements contributing to the energy performance of windows (for example solar shading systems) may form part of the window.*

In the IPTS Green Public Procurement report for Windows and external doors[6] the following definition for windows is proposed:

> *Window: Building component (glazing) for closing an opening in a wall or pitched roof that will admit light and may provide ventilation, including the frame of the window which is defined as the component forming the perimeter of a window, enabling it to be fixed to the structure.*
>
> *Roof Window: Window intended for installation in a roof or the like which is inclined. Roof windows have the same characteristics as windows installed in walls with regard to function, cleaning, maintenance and durability.*

Although the above definitions introduce the elementary parts or components (glazing, frame) and optional components (shading systems) it does not suffice to separate the intended product from products that also admit light and/or air and are part of a building structure.

Such products with similar or related characteristics are (non-exhaustive):

1. (external) doors;
2. roof lights;
3. curtain walling;
4. glass bricks;
5. smoke and heat control systems;

These products also admit light and/or allow ventilation of spaces, whilst being part of the building shell, but are not essentially the same or identical windows.

3.2. STANDARDS

3.2.1. WINDOWS ACCORDING TO ISO

The latest published draft of ISO/DIS 13316:2012-10 (Doors and Windows – Terminology) defines Windows as: "building component for closing an opening in a wall or pitched roof that may admit light and/or provide ventilation." This draft has been rejected, so there is no ISO standard for the Terminology of doors and windows.

Under ISO, for windows and doors there is no "product standard" - only Test Standards exist.

The ISO Test standards for windows apply "to all windows, including door height windows, made of any material…" without further definition. The enclosed definition of an "opening light: any part of a window that can be moved within the main frame" (ISO 6613:1980) could be understood that windows according to ISO also include fixed glazing.

3.2.2. WINDOWS ACCORDING TO CEN

EN 14351-1

Windows are construction products and as such covered by the **C**onstruction **P**roducts **R**egulation (CPR). Under the CPR a harmonised standard exists which is instrumental in defining the "window".

The harmonised standard for windows is EN 14351-1. This standard applies to *"windows, French windows, screens for installation in vertical wall apertures or roof windows"* but does not provide a definition of these products. Instead it refers to EN 12519 *"Windows and pedestrian doors – Terminology"*, in which the following definition can be found:

> A window is a
>
> *Building component for closing an opening in a wall or pitched roof that will admit light and may provide ventilation.*
>
> A roof window is a
>
> *Window intended for installation in a roof or the like which is inclined. Roof windows have the same characteristics as windows installed in walls with regard to function, cleaning, maintenance and durability*

"Roof windows" are therefore a subset of the broader collection of "windows".

[6] IPTS Green Public Procurement, Technical Background Report for Windows and external doors, Report for the European Commission – DG-Environment by JRC IPTS, 2012

The above definition however could still be applied to other products besides windows. To get further information on the "definition" of windows the scope of the relevant product standard EN 14351-1 has to be considered.

EN 14351-1 applies to:

Manually or power operated windows, French windows and screens for installation in vertical wall apertures and roof windows for installation in inclined roofs, complete with:

- *related hardware, if any;*
- *weather stripping, if any;*
- *glazed apertures when intended to have glazed apertures;*
- *with or without incorporated shutters and/or shutter boxes and/or blinds;*

And manually or power operated windows, roof windows, French windows and screens that are

- *fully or partially glazed including any non-transparent infill;*
- *Fixed or partly fixed or open able with one or more casements/sashes (e.g. hinged, projecting, pivoted, sliding).*

EN 14351-1 does not apply to

- *windows and pedestrian doorsets subject to regulations on **smoke leakage and resistance to fire** according to prEN 16034 but individual characteristics and performance requirements given in clause 4 can be relevant for these doors and windows (see prEN 16034);*
- ***roof lights** according to EN 1873 and EN 14963;*
- ***curtain walling** according to EN 13830;*
- *industrial, commercial and garage **doors and gates** according to EN 13241-1;*
- *internal pedestrian **doorsets** according to prEN 14351-2 but individual characteristics and performance requirements given in clause 4 can be relevant for internal doors (see prEN 14351-2);*
- *revolving **doorsets**;*
- ***Windows for escape routes**.*

The above means that windows that need to comply with regulations regarding fire safety are excluded from the scope of the study.

Windows that offer a certain performance sound insulation and/or burglary resistance are covered by EN 14351-1 and therefore included in the study. Such windows (with improved sound insulation or burglary resistance) could have higher U-values and different g-values than "standard windows", so the presence of such properties could affect the overall energy performance of such windows.

The above overview shows that curtain walling, roof lights, certain types of doorsets, facade openings for smoke/heat control or escape routes are not included in the scope of EN 14351-1, and therefore it can be argued that these products are not "windows" and should be excluded from the study scope.

Included in the scope of EN 14351-1 are so-called 'window doors' which are not external pedestrian doors. Window doors are made out of the same frame profiles as the window. It is a window with the dimensions of a door and allowing the passage of persons and based on hEN14351-1 should fall under the size 1,48m x 2,18m (see hEN14351-1 page 40 Annex E 4.12). Contrary to a normal external door, the passage frequency is less high as window doors are mainly installed to allow the entrance on balconies and terraces. These window doors are not the primary entrance of the house. The figure below presents an example.

Figure 5: Window door [7]

3.2.3. EXCLUSIONS (BASED ON ADJOINING PRODUCT STANDARDS)

→ **Curtain walling - according EN 13830**

The relevant harmonized European product standard is EN 13830 "Curtain walling – Product standard". This standard defines as curtain walling:

An external vertical building enclosure produced with framing made mainly of metal, timber or plastic.

This standard applies to curtain walling ranging from a vertical position to 15° from the vertical, onto the building face.

Therefore a curtain walling usually consists of vertical and horizontal structural members, connected together and anchored to the supporting structure of the building and filled, to form a lightweight space continuous skin, which provides, by itself or in conjunction with the building construction all the normal functions of an external wall, but does not take on any of the load bearing characteristics of the building structure.

Distinctive elements that set curtain walling apart from windows are:

- Curtain walling is not a product which can be completed in all respects within a manufacturing area, but is a series of components and/or prefabricated units which only become a finished product when assembled together on site;
- Curtain walling is mainly installed in non-residential buildings;

As the curtain walling standard does not cover requirements to open able elements/infills in a curtain walling, these must be assessed according to EN 14351-1.

→ **Roof lights - according EN 1873 and EN 14963**

Roof lights are building elements which consists of one or several light transmitting (translucent or transparent) skins. The translucent part of the roof light is one single element. Roof lights provide access of daylight to and a possible means of ventilating interior spaces. The function is therefore similar to that of windows, but their construction - and so the technical requirements - are quite different.

Roof lights may be single or continuous. The relevant harmonized European product standards are:

- EN 14963 "Roof coverings - Continuous roof lights of plastics with or without up stands - Classification, requirements and test methods";
- EN 1873:2013 "Prefabricated accessories for roofing - Individual roof lights of plastics - Product specification and test methods";

[7] Picture sourced from: **ift** Rosenheim (M. Rossa)

According to EN 1873:2013 a roof light is a "*building component used to introduce daylight which consists of a translucent part and associated edge profiles, if applicable".* The standard specifies requirements for roof lights to be made of plastic materials (e. g. GF-UP, PC, PMMA, PVC) with and without up stands made of e.g. GF-UP, PVC, steel, aluminium or wood for installation in roofs. According to the 2013 Version of EN 1873 roof lights can also contain additional layers of glass.

This standard applies to roof lights with a rectangular or circular ground plan , with an opening span (width) or diameter not larger than 2,5 m and an opening length not larger than 3,0 m in roof pitches up to 25°.

This standard applies only to:

- Roof lights which do not contribute to the load-bearing or stiffness of the roof itself.
- roof lights where a single manufacturer provides all components of the roof light with up stand, which are bought in a single purchase;
- Roof lights with one or several translucent parts.

Other differences of the 2013 standard compared to a former version of the standard from 2005 (EN 1873:2005) are that a method for calculating the u-value has been clarified and updated (specification of unclear points and a common calculation method described) and a method for establishing the g-value is included in the EN 1873:2013.

Roof lights may be opened by means of opening devices in one or more parts for ventilation.

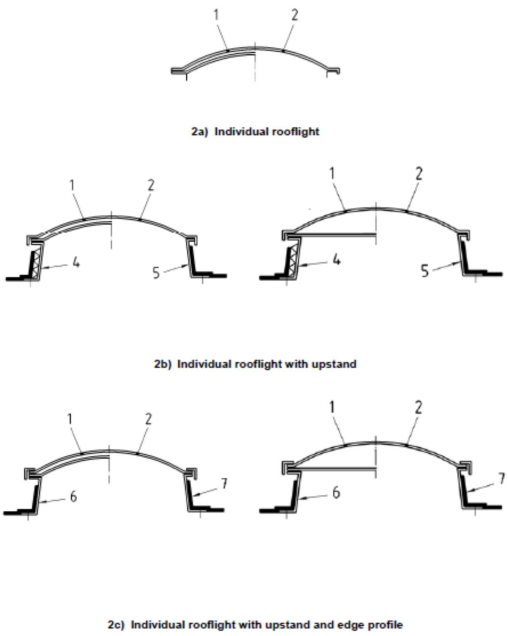
The possible additional functions of day to day ventilation, smoke and heat ventilation e.g. in case of fire in acc. to EN 12101-2, roof access, and/ or slinging point e.g. in acc. to EN 795 are outside the scope of the standards EN 1873 and EN 14963.

As far as the energy related properties are concerned following characteristics must be declared on the CE label:

- Thermal resistance;
- Air permeability.

According to Annex ZA of EN 1873 the solar energy transmittance (characteristic that is related to the energy performance of a roof light) must not be stated on the CE Label.

Figure 6: Typical roof lights (Source: EN 1873)



Roof lights are not considered identical to 'windows" and are therefore excluded from the study scope. This position of the study team is shared by Eurolux, the European roof light manufacturers association, who stated not to contribute in any way to the windows study. Only one industry stakeholder (Velux) argued in favour of inclusion of roof lights under the scope of the 'windows' study.

In order to meet the request by Velux, the study team decided to issue an Annex to the study, covering roof lights. This Annex is not part of the required set of deliverables for the study and is provided solely as extra information. How this

annex is used and the conclusions drawn from it are entirely the responsibility of the European Commission and/or other stakeholders.

→ **Smoke and heat control systems - according EN 12101-2**

Smoke and heat control systems are devices especially designed to move smoke and hot gases out of a building or construction works under conditions of fire. They therefore, like windows, provide an opportunity for ventilation, albeit only under very specific circumstances and with very specific requirements: Smoke and heat control systems must be powered (to open without manual intervention). The smoke extraction itself can be natural (thermal buoyancy as driver) or powered (by smoke ventilators).

The relevant harmonized European product standard is EN 12101-2- "Smoke and heat control systems - Part 2: Specification for natural smoke and heat exhaust ventilators" This standard specifies requirements and gives test methods for natural smoke and heat exhaust ventilators which are intended to be installed in smoke and heat control systems in buildings.

Smoke and heat control systems may be louvres or grilles in a building facade or roof, but windows according to EN 14351-1 and also roof lights according to EN 1873 or EN 14963 can serve as a part of a smoke and heat exhaust systems.

→ **External pedestrian doors - according EN 14351-1**

External pedestrian doors ('doorsets') may appear very much like windows, especially if the glazed area covers the entire door aperture. However, unlike windows, doors are not primarily intended to provide daylight admittance, nor means of ventilation (although it is possible to combine such functions in a door).

The relevant harmonized European product standard is EN 14351-1 "Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics" which is indeed the same standard to be used for windows.

Doorsets are described as products that *separate the internal climate from the external climate of a construction for which the main intended use is the passage of pedestrians.*

The IPTS study defines external doors as:

> *A doorset which separates the internal climate from the external climate of a construction for which the main intended use is the passage of pedestrians, including the frame of the door which is defined as the component forming the perimeter of a door, enabling it to be fixed to the structure.*

A doorset may need not to contain transparent filling elements, whereas for windows this is a primary function.

→ **Glass blocks - according EN 1051-2**

Glass blocks are moulded airtight, hollow glass bodies for use in vertical applications, e.g. walls or horizontally (as pavers). They form part of the load bearing structure of the building component they are integrated in, and (usually) cannot perform ventilation functions. These qualities allow glass blocks to be differentiated from windows.

The relevant harmonized European product standard is EN 1051-2 Glass in building - Glass blocks and glass pavers – Part 2: Evaluation of conformity/Product standard"

3.2.4. COMPARISON OF WINDOWS AND RELATED PRODUCTS

The main differences between windows and excluded products are summarized in Table 2.

Table 2: Main differences of similar products

Product	European Product Standard	Attestation of conformity[1)] - levels	Main difference in respect to windows
Windows	EN 14351-1	3	**(not applicable)**
Curtain walling	EN 13830	3	– **not open able (does not serve for ventilation)** – **is designed as a self-supporting framework not subject to loads transferred from the building** – **mainly used in non-residential building**
Roof lights	EN 1873 EN 14963	3	– **installed in horizontal roofs** – **transparent/translucent filling element is made out of plastic (e. g. GF-UP, PC, PMMA, PVC)**
Smoke and heat control systems	EN 12101-2	1	– **power operated opening mechanism is obligatory** – **main intended use is to serve as a natural smoke and heat exhaust**
External pedestrian door	EN 14351-1	3	– **main intended use is the passage of pedestrians** – **transparent/translucent infill elements are not obligatory**
Glass blocks	**EN 1051-2**	**4**	– **in general not open able** – **no frame**

[1)] For general applications. Special applications could have different levels.

The above overview shows there are reasons and means to differentiate windows from these other products. As the table above refers to the levels of attestation of conformity, the table below gives some further explanation of these levels.

Table 3: Levels of attestation of conformity

Description of means to show conformity	System				
	1+	1	2+	3	4
factory production control and if necessary further testing of samples taken at the factory by the manufacturer in accordance with the prescribed test plan	M	M	M	M	M
determination of the product-type on the basis of type testing, type calculation, tabulated values or descriptive documentation of the product	NB	NB	M	NB	M
initial inspection of the manufacturing plant and of factory production control	NB	NB	NB		
audit-testing of samples taken before placing the product on the market	NB				
continuous surveillance, assessment and evaluation of factory production control	NB	NB	NB		

M Manufacturer

NB Notified body

The above overview shows there are reasons and means to differentiate windows from these other products.

3.3. CATEGORISATION SCHEMES

Another possible way to define the product group 'windows' is to look at schemes used to categorise construction products. Two approaches will be described in short in this section:

1. an approach based on trade nomenclature;
2. an approach based on building component categorisation systems.

3.3.1. RELEVANT PRODCOM CATEGORIES

Windows are traded within the EU and possibly also imported/exported into/from the EU. Windows are therefore included in trade nomenclature such as applied by PRODCOM (EU production) and COMEXT (international trade).

CN 2013 (Combined Nomenclature, 2013) - PRODCOM

The Combined Nomenclature is the goods classification used within the EU for the purposes of foreign trade statistics. It is also used by Directorate General "Taxation and Customs Union" of the European Commission for customs duty purposes. The classification is maintained by Eurostat for the statistical aspects and by Taxation and Customs Union DG for the tariff aspects.

The classification is based on the Harmonized System (HS) which it sub-divides where necessary for purposes of external trade, agricultural regulation and customs duties. The CN was introduced in 1988 together with the HS. Subheadings in the CN are identified by means of an eight-digit numerical code. The very considerable numbers of subdivisions within the CN were introduced with the EU's specific customs and foreign trade statistics requirements in mind. The CN is revised annually and, as a Council Regulation, is binding on the Member States. It appears in all EU official languages (except Irish). (Source: European Commission – EUROSTAT – (RAMON))

The table below gives the descriptions applied in these respective nomenclatures. In addition a further table gives also the relevant codes and descriptions for window related components (transparent fillings, shutters).

Table 4: PRODCOM and CN codes for windows

PRODCOM CODE	PRODCOM Code Description	CN Code	CN Code Description
16.23.11.10	Windows, French-windows and their frames, of wood	4418[.10(.10 + .50 + .90)]	WINDOWS, FRENCH WINDOWS AND THEIR FRAMES, OF WOOD
22.23.14.50	Plastic doors, windows and their frames and thresholds for doors	3925 20	DOORS, WINDOWS AND THEIR FRAMES AND THRESHOLDS FOR DOORS, OF PLASTICS
25.12.10.30	Iron or steel doors, thresholds for doors, windows and their frames	7308 30	DOORS, WINDOWS AND THEIR FRAMES AND THRESHOLDS FOR DOORS, OF IRON OR STEEL
25.12.10.50	Aluminium doors, thresholds for doors, windows and their frames	7610 10	DOORS, WINDOWS AND THEIR FRAMES AND THRESHOLDS FOR DOOR, OF ALUMINIUM (EXCL. DOOR FURNITURE)

Table 5: PRODCOM and CN codes for window related components (transparent fillings, shutters)

PRODCOM CODE	PRODCOM Code Description	CN Code	CN Code Description
23.11.12.12	Non-wired sheets, of float, surface ground or polished glass, having a non-reflecting layer	7005 10 05	FLOAT GLASS AND SURFACE GROUND OR POLISHED GLASS, IN SHEETS, HAVING A NON-REFLECTING LAYER, BUT NOT OTHERWISE WORKED (EXCL. WIRED GLASS)
23.11.12.17	Non-wired sheets, of float, surface ground or polished glass, having an absorbent or reflecting layer, not otherwise worked, of a thickness > 3.5 mm	7005[.10(.30 + .80)]	SHEETS OF HORTICULTURAL FLOAT GLASS OR SURFACE GROUND OR POLISHED GLASS, HAVING AN ABSORBENT OR REFLECTING LAYER (EXCL. WIRED GLASS)

23.12.12.30	Toughened (tempered) safety glass, n.e.c.	7007[.19(.10 + .20 + .80)]	TOUGHENED "TEMPERED" SAFETY GLASS (EXCL. GLASS OF SIZE AND SHAPE SUITABLE FOR INCORPORATION IN MOTOR VEHICLES, AIRCRAFT, SPACECRAFT, VESSELS AND OTHER VEHICLES, AND LENSES FOR SPECTACLES AND GOGGLES, ETC., AND FOR CLOCKS AND WATCHES)
23.12.12.70	Laminated safety glass, n.e.c.	7007 29	LAMINATED SAFETY GLASS (EXCL. GLASS OF SIZE AND SHAPE SUITABLE FOR INCORPORATION IN MOTOR VEHICLES, AIRCRAFT, SPACECRAFT, VESSELS OR OTHER VEHICLES, MULTIPLE-WALLED INSULATING UNITS) {01/01/1988-31/12/1988: LAMINATED SAFETY GLASS (EXCL. FOR VEHICLES, AIRCRAFT, SPACECRAFT OR VESSELS)}
23.12.13.30	Multiple-walled insulating units of glass	7008[.00(.20 + .81 + .89)]	MULTIPLE-WALLED INSULATING UNITS OF GLASS
22.23.14.70	Plastic shutters, blinds and similar articles and parts thereof	3925 30	SHUTTERS, BLINDS, INCL. VENETIAN BLINDS, AND SIMILAR ARTICLES AND PARTS THEREOF, OF PLASTICS (EXCL. FITTINGS AND SIMILAR ARTICLES)

As can be judged from the above the descriptions are not defining windows as products. These descriptions are therefore discarded as a possible means to define windows.

In order to separate the various products and functions, the following sections provide information as to how these products are defined or described in standards that underpin the current Construction Products Regulation.

3.3.2. BUILDING COMPONENT LIBRARIES

Building components are categorised in order to facilitate technical and trade literature in the broad construction area, by assigning codes to building components (so-called technical libraries). One of the oldest systems (since 1959) is the CI/SFB[8].

In the CI/SfB categorisation system windows are assigned code "31.4" but there is a provision for adding more detail, such as:

- the type of window: for example "31.45" classifies a vertically sliding window;
- the construction form: for windows this is "X";
- and the material: for example aluminium has code "h4".

Thus the CI/SfB code for an aluminium vertically sliding widow is: Box 2 -- (31.45) Box 3 -- Xh4

More recent categorisation systems are Uniclass (Unified Classification for the Construction Industry), published in 1997 in UK by the Construction Project Information Committee (CPIC) and Omniclass (the latter being a USA led further development of the first).

Uniclass and Omniclass[9] are based upon ISO 12006-2 (2001) "Building construction — Organisation of information about construction works — Part 2: Framework for classification of information (Stage: 90.92, date: 2012-03-14), by ISO/TC 59/SC 13. This standard is currently under revision, but will be preceded by the new Uniclass.

As an example of proposed categorisation, windows are classed by Omniclass under L4 Access, barrier and circulation products, sub section L41 Doors, windows etc. Examples of these codes are: Windows in general L413; Side hung L41302; Vertical sliding L41306, etc...

The codes only describe the components, and do not define them. Therefore these categorisation systems are not relevant for this purpose.

[8] Extracted from http://www.highwiredesign.com/about-us/uniclass/, visited 3-9-2013

[9] http://www.omniclass.org/about.asp

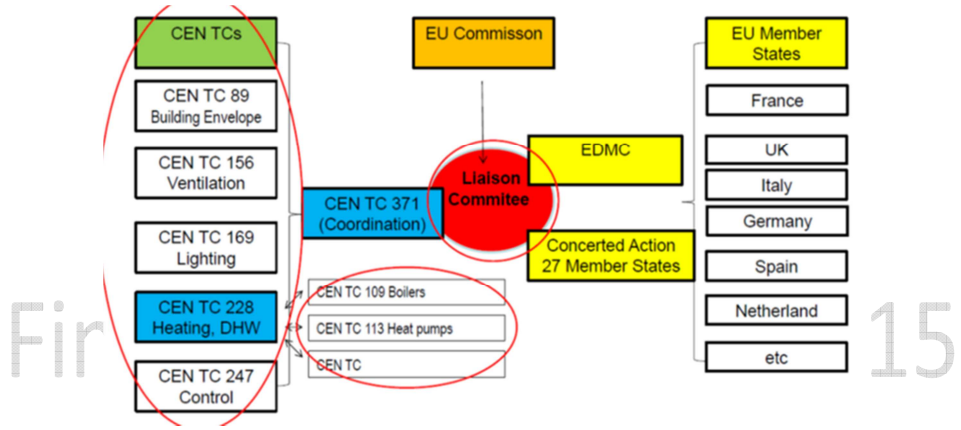
CHAPTER 4 TEST STANDARDS

4.1.1. ORGANISATIONAL STRUCTURE OF STANDARDISATION

As windows are part of a larger building structure / construction works and play an important role for consumer safety as well as in the overall energy (or environmental) performance of buildings or construction works, it is important that the output of specific standards can be used in overarching more generic standards (e.g. on building level).

This principle applies both to standards being developed for the purpose of the Construction Products Regulation as well as standards being developed for the purpose of the EPBD, to be implemented by the Member States. Therefore there is a need to coordinate the development of these standards. An overview of how this is organised is shown below.

Figure 7: Overview of coordination of standardisation activities in the field of EPBD



The standards themselves are prepared by various technical committees, as shown below.

Table 6: Overview of technical committees relevant for windows

Aspect considered	Relevant technical committee	Relevant standard
general window performance (durability)	CEN/TC 33 - standards for windows and doors, including sun shading (product-, test- and classification standards)	EN 14351-1 and various standards for the determination of other characteristics e.g. air tightness, water tightness
	ISO/TC 162 doors and windows	20 published standards on doors, doorsets, windows, including hardware
energy performance of buildings and components	CEN/TC 89	73 Standards for the determination of thermal or hygrothermal performance, no hEN
	ISO/TC 163 - Thermal performance and energy use in the built environment	111 standards published
	ISO/TC 205 – Building Environment design	Indoor air quality/ Lighting 20 standards

	CEN/TC 129 - Committee for Glass in Buildings	76 standards, incl. 17 hEN e.g. hEN 1279 EN 673, EN 674, EN 675, EN 410
sustainability of construction works	CEN/TC 350	CEN/TR 15941:2010 EN 15643-1:2010 EN 15643-2:2011 EN 15643-3:2012 EN 15643-4:2012 EN 15804:2012 EN 15942:2011 EN 15978:2011
	ISO/TC 59 SC 17 Sustainability in buildings and civil engineering works	ISO 15392:2008 ISO 21929-1:2011 ISO 21930:2007 ISO 21931-1:2010
emissions of dangerous substances	CEN TC 351	FprCEN/TS 16637-1 FprCEN/TS 16637-2 CEN/TR 15855:2009 CEN/TR 15858:2009 CEN/TR 16045:2010 CEN/TR 16098:2010 CEN/TR 16220:2011 CEN/TR 16410:2012 CEN/TR 16496:2013 CEN/TS 16516:2013
EPBD	CEN TC 371	EN 15603:2008

Specific window standards are developed within CEN TC33 (also responsible for standards for doorsets). The standards developed by CEN TC 33 however may refer to standards for the assessment of specific functions or parameters. These other standards, often dealing with the thermal performance of windows are in general developed within CEN TC89 "Thermal performance of buildings and building components" and ISO TC 163 “Thermal performance and energy use in the built environment”.

But also other TCs are responsible for the development of standards that are the basis for the evaluation of relevant characteristics for windows. TC 129 for example is responsible for the standards on the determination of the thermal transmittance and solar gains of glazing.

Work on the sustainability of construction works is performed within CEN TC 350 "Sustainability of construction works".

And finally the work of the TC 351 is important in the framework of this study because it concerns the release of dangerous substances from construction products (CEN TC 351 "Construction products: Assessment of release of dangerous substances").

CEN TC 371 is relevant as this committee oversees the work of the preceding technical committees and how it fits into the EU regulatory framework of the EPBD and also the Ecodesign/Energy Labelling Directive. It has a more coordinating role, instead of a role for production of product standards.

4.1.2. HOW ARE STANDARDS MADE?

Mandates are the mechanism by which the European Commission (EC) and the EFTA Secretariat request the European Standards Organizations (ESOs: CEN, CENELEC and ETSI) to develop and adopt European standards in support of European policies and legislation. This mechanism evolves through several steps:

- A provisional draft mandate is received at CEN/CENELEC for possible comments by a due deadline
- A draft mandate, possibly including the proposed modifications, is sent to Standing committee for construction, ensuring a wide consultation of sector authorities at national level
- A mandate is then sent for acceptance to CEN/CENELEC, where a Programme Manager coordinates with the relevant Technical Body and ensures feedback to the Technical Board(s)
- The Technical Board Members are invited (not) to accept the given mandate, with or without restrictions, based on the Technical Body and CEN/CENELEC feedback
- Once the Technical Board has taken its decision, CEN/CENELEC informs the EC accordingly.

In case of acceptance of the mandate, the Technical Body is entrusted with the task of starting expected standardization work within CEN/CENELEC.

Cited after: www.cenelec.eu/aboutcenelec/whatwestandfor/supportlegislation/europeanmandates.html

Before its implementation, the EN must follow the following steps:

Proposal for new work and acceptance

Businesses, users and consumers, lawmakers, non-governmental organisations can propose a new standard. Specific needs, feasibility and resources are assessed.

Once the proposal is accepted, national work is frozen in 31 countries (standstill).

Drafting and building of agreement

An adopted standardization project is allocated to a CEN Technical Committee/ CENELEC Technical Body (experts) for the drafting of the standard at European or international level.

Public Enquiry – generate comments

Once the draft of a European Standard is prepared, it is released for public comment, a process known in CEN and CENELEC as the 'CEN Enquiry' and 'CENELEC Enquiry'. During the public commenting stage, everyone who has an interest (e.g. manufacturers, public authorities, consumers, etc.) may comment on the draft. These views are collated by the NSBs/NCs, and analysed by CEN Technical Committee/CENELEC Technical Body. Technical experts analyse the comments and are able to improve the draft leading to a final draft to be approved as European Standard.

Adoption by weighted vote

Taking into account the comments resulting from the CEN Enquiry or CENELEC Enquiry, a final version is drafted, which is then submitted to the CEN and/or CENELEC Members for a weighted formal voting. The European Standard is then approved.

Ratification and publication of the European Standard (EN)

After ratification by CEN or CENELEC, each NSB/NC adopts the European Standard as an identical national standard and withdraws any national standards, which conflict with the new European Standard. Hence, one European Standard becomes the national standard in the 31 member countries of CEN and/or CENELEC.

Review the standard

A European standard needs to be reviewed at least every 5 years to ensure that it is still current. The standard will then be confirmed, withdrawn or amended and/or revised.

Cited from: "CEN and CENELEC Making European Standards"(www.cen.eu)

4.1.3. COMPARISON ISO/CEN STANDARDS

Under ISO, there is no "Product Standard" which lists the essential characteristics and gives the test and classification standards for windows. There are only ISO standards for the testing or calculation of characteristics. Compared to CEN-Standards, ISO Standards for windows are few and, at least the test standards tend to remain unchanged for long periods.
From a technical view, ISO standards use a similar approach as the CEN standards do. Due to existing differences in detail the results from tests according to ISO- and CEN-standards are not always identical.

For the standards of ISO/TC 163 - Thermal performance and energy use in the built environment – the situation is different, as these standards are developed under the Vienna agreement and taken over into CEN and national standards. An example for this is EN ISO 10077.

Table 7 Comparison ISO/CEN Standards on windows

ISO Code/Year	Title	CEN Code/Year	Title
ISO6612:1980	Windows and door height windows - Wind resistance tests	EN 12211: 2000*	Windows and doors - Resistance to wind load - Test method
ISO6613:1980	Windows and door height windows - Air permeability test	EN 1026: 2000*	Windows and doors - Air permeability - Test method
ISO 8248:1985	Windows and door height windows - Mechanical tests	EN 14608:2004 EN 14609:2004	Windows - Determination of the resistance to racking Windows - Determination of the resistance to static torsion
ISO 8274:2005	Windows and doors - Resistance to repeated opening and closing -- Test method	EN1191:2012	Windows and doors - Resistance to repeated opening and closing - Test method
ISO 10077-1:2006	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 1: General	EN ISO 10077-1:2006	Same title
ISO 10077-1:2006/Cor 1:2009		EN ISO 10077-1:2006/AC:2009	Same title
ISO 10077-2:2012	Thermal performance of windows, doors and shutters - Calculation of thermal transmittance - Part 2: Numerical method for frames		Same title
ISO 10077-2:2012/Cor 1:2012			Same title
ISO 12567-1:2010	Thermal performance of windows and doors - Determination of thermal transmittance by the hot-box method - Part 1: Complete windows and doors	EN ISO 12567-1:2010	Same title
ISO 12567-1:2010/Cor 1:2010		EN ISO 12567-1:2010/AC:2010	Same title
ISO 12567-2:2005	Thermal performance of windows and doors -- Determination of thermal transmittance by hot box method - Part 2: Roof windows and other projecting windows	EN ISO 12567-2:2005	Same title
ISO/DIS 13316	Terminology for doors and windows (rejected draft only)	EN 12519:2004*	Windows and pedestrian doors - Terminology

ISO 15099:2003	Thermal performance of windows, doors and shading devices - Detailed calculations		
ISO 15821:2007	Doorsets and windows - Water-tightness test under dynamic pressure - Cyclonic aspects	EN 1027:2000*	Windows and doors - Water tightness - Test method

4.1.4. PRODUCT PERFORMANCE STANDARDS

The aim of this section is to give an overview of possible product performance parameters for windows. These measurement and test standards or procedures are essential for future legislation, because they allow quantification of the product performance.

For windows the main energy related product performance parameters are relatively easily identified, these being: the (overall) U-value, g-value, daylight transmittance and air-tightness as these are covered by existing standards extensively.

Secondary product performance parameters are more diverse as they may range from aspects that touch upon maintenance/durability, noise, structural safety (e.g. wind loads), personal safety (burglary etc.), privacy (non-transparent glazing).

Many standards have been developed or are being developed to assess these aspects. The development of these standards takes place in technical committees.

However, Annex I of Directive 2009/125/EC specifies that significant environmental aspects, in so far as they relate to product design, must also be identified with reference to the complete life cycle of the product (from raw material selection to end-of-life).

This means that not only parameters relating to the energy or functional performance of the window are relevant, but also parameters related to design (weight, volume, use of recycled material), maintenance (consumables needed for proper use and maintenance) and end-of-life (reuse, recyclability, etc.) as these may have relevant impacts in other life cycle phases than the use-phase or other environmental impact categories than resource use and emissions.

The following sections aim to provide an overview of which standards exists and what parameters they cover.

This section describes in more detail the most relevant product performance standards.

→ **EN 14351-1**

Windows are harmonized building products. Based on the mandates M101 (windows) and M122 (roof windows) the harmonized product standard EN 14351-1 “Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics” was drafted by the responsible technical committee CEN TC33, in particular by working group WG1 (convenor: Ulrich Sieberath / ift Rosenheim).

The standard hEN 14351-1:2006+A1:2010 is harmonised, and the relationship between this European Standard and the Essential Requirements are given in:

- Annex ZA: 89/106/EEC (C 167, 2010-06-25) CPD (Directive 305/2011 , CPR, is not mentioned in standard, but is mentioned on the EC website[10]),
- Annex ZB: 98/37/EC Machinery Directive,
- Annex ZC: Directive 2006/95/EC (codification of Directive 73/23/EEC Low Voltage Directive).
- Annex ZD: Directive 2006/42/EC on machinery, and amending Directive 95/16/EC (recast)

This European Standard identifies material independent performance characteristics that are applicable to windows (including roof windows, roof windows with external fire resistance and French windows), external pedestrian doorsets (including unframed glass doorsets, escape route doorsets) and screens.

[10] Source: http://ec.europa.eu/enterprise/policies/european-standards/harmonised-standards/construction-products/index_en.htm

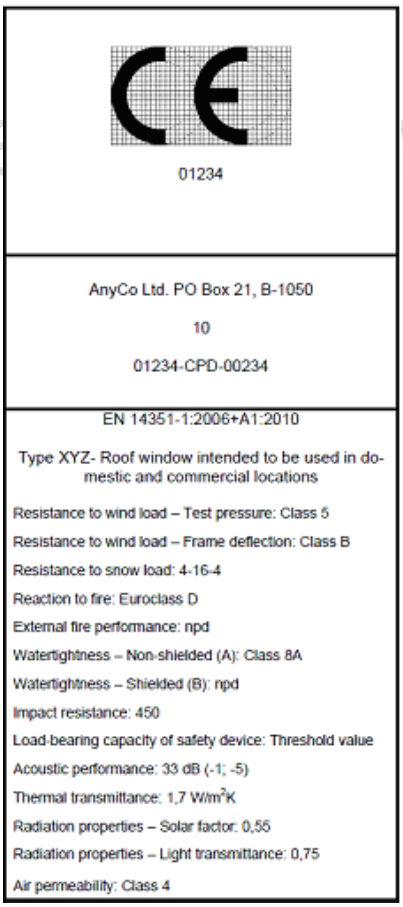
This European Standard applies to:

1) Manually or power operated windows, French windows and screens for installation in vertical wall apertures and roof windows for installation in inclined roofs, complete with:
   a) related hardware, if any;
   b) weather stripping, if any;
   c) glazed apertures when intended to have glazed apertures;
   d) with or without incorporated shutters and/or shutter boxes and/or blinds;
2) Manually or power operated windows, roof windows, French windows and screens that are
   a) fully or partially glazed including any non-transparent infill;
   b) fixed or partly fixed or open able with one or more casements/sashes (e.g. hinged, projecting, pivoted, sliding).
3) Manually operated external pedestrian doorsets with flush or panelled leaves, complete with:
   a) integral fanlights, if any;
   b) adjacent parts that are contained within a single frame for inclusion in a single aperture, if any.

The products covered by this European Standard are not assessed for structural applications.

Applying EN 14351-1 for the CE marking of windows and roof windows has been mandatory for most Member States in Europe since 1st February 2010 (under the former Construction Products Directive). Due to the implementation of the CPR EN 14351-1 it is mandatory for all member states since 1st July 2013. The standard serves as a "manual" for the evaluation of the relevant characteristics and gives rules for the CE marking of the product. As the example according EN 14351-1 below shows, there are several product performance parameters that have to be stated in the product CE marking.

Figure 8 : CE Marking for roof windows (example) (Source: EN 14351-1)



As stated before, the CPR as mandatory law requires manufacturers of products to be put on the market in the EU to follow the provisions of the relevant harmonized standard. For windows as well as roof windows, the relevant harmonized standard is EN 14351-1 in an amended Version of 2010.

The energy related requirements of this standard are currently:

- Thermal transmittance
- Radiation properties
- Air permeability

In Annex ZA, all of the above are required for CE-Marking "when required", i.e. when the member state, where the product shall be placed on the market has legal requirements for these properties.

The provisions in detail are:

→ **Thermal transmittance**

The thermal transmittance for windows and external pedestrian doorsets shall be determined by using:

EN ISO 10077-1:2006, Table F.1 Thermal transmittances for vertical windows with fraction of the frame area 30 % of the whole window area and common types of glazing spacer bars

or EN ISO 10077-1:2006, Table F.3 Thermal transmittances for vertical windows with fraction of the frame area 30 % of the whole window area, glazing spacer bars with improved thermal performance and, for windows with bars, Annex J

or by calculation using:

EN ISO 10077-1 or

EN ISO 10077-1 and EN ISO 10077-2

or by hot box method using:

EN ISO 12567-1 or

EN ISO 12567-2

as appropriate.

Calculation previously performed in accordance with EN ISO 10077-1:2000 and tabulated values in accordance with EN ISO 10077-1:2000, Table F.1, may be taken into account with an addition of 0.1 W/m^2K.

EN ISO 12567-1 shall be used as reference method for windows and doorsets, EN ISO 12567-2 as reference method for roof windows.

The collective symbols for thermal transmittance are U_w for windows and U_D for doorsets, i.e. the symbol U_{st} used in EN ISO 12567-1 is equivalent to U_w or U_D and the symbol U_m used in EN ISO 12567-2 is equivalent to U_w.

→ **Radiation properties**

The determination of the total solar energy transmittance (solar factor, or g-value) and light transmittance of translucent glazing's shall be carried out in accordance with EN 410, or if relevant, with EN 13363-1 or EN 13363-2 (reference method).

→ **Air permeability**

Two air permeability tests shall be carried out in accordance with EN 1026 (reference method), one with positive test pressures and one with negative test pressures.

The tests for air permeability of screens shall be carried out on the screen or on its individual parts including joints between the individual parts. In the latter case the air permeability of the screen shall be calculated as the sum of the air permeability of the individual parts and the joints.

The test result, defined as the numerical average of the two air permeability values (m^3/h) at each pressure step shall be expressed in accordance with EN 12207:1999, 4.6.

The following table states the characteristics that are mandatory for CE marking as far as they are regulated in the member states.

Table 8: Window characteristics relevant for CE marking

		Symbol	Units	Window	Roof Window
Environmental characteristics	Thermal transmittance	U_w	W/m^2K	Y (when required)	Y (when required)
	Total solar energy transmittance	g	-	Y (when required)	Y (when required)
	Light transmittance	τ_v	-	Y (when required)	Y (when required)
	Air permeability		Technical class	Y (when required)	Y (when required)
	Dangerous substances			Y (indoor impact only)	N
Water tightness			Technical class	Y	Y
Acoustic performance		R_w (C,Ct_r)	dB	Y (when required)	Y
Resistance to wind load				Y	Y
Resistance to snow and permanent load				N	Y
Impact resistance				N	Y
Load-bearing capacity of safety devices				Y	Y
Reaction to fire				N	Y
External fire performance				N	Y

("when required" considers the different national requirements of the EU member states)

For the determination of these characteristics standards listed in Table 9 shall be used.

Table 9: Overview of standards relevant for CE marking of windows

		Standard	Name	Committee
Environmental characteristics	Thermal transmittance	EN ISO 10077-1	Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 1: General	ISO TC 163/SC2 In collaboration with CEN/TC 89
		EN ISO 10077-2	Thermal performance of windows, doors and shutters — Calculation of thermal transmittance — Part 2: Numerical method for frames	ISO TC 163/SC2 In collaboration with CEN/TC 89

		EN ISO 12567-1 (reference method)	Thermal performance of windows and doors — Determination of thermal transmittance by hot box method — Part 1: Complete windows and doors	ISO TC 163/SC1 In collaboration with CEN/TC 89
		EN ISO 12567-2 (reference method)	Thermal performance of windows and doors — Determination of thermal transmittance by hot box method — Part 2: Roof windows and other projecting windows	ISO TC 163/SC1 In collaboration with CEN/TC 89
	Solar energy transmittance	EN 410	Glass in building — Determination of luminous and solar characteristics of glazing	CEN/TC 129
		EN 13363-1	Solar protection devices combined with glazing — Calculation of solar and light transmittance — Part 1: Simplified method	CEN/TC 89
		EN 13363-2 (reference method)	Solar protection devices combined with glazing — Calculation of total solar energy transmittance and light transmittance - Part 2: Detailed calculation method	CEN/TC 89
	Light transmittance	EN 410	Glass in building — Determination of luminous and solar characteristics of glazing	CEN/TC 129
		EN 13363-1	Solar protection devices combined with glazing — Calculation of solar and light transmittance — Part 1: Simplified method	CEN/TC 89
		EN 13363-2 (reference method)	Solar protection devices combined with glazing — Calculation of total solar energy transmittance and light transmittance - Part 2: Detailed calculation method	CEN/TC 89
	Air permeability	EN 1026	Windows and doors — Air permeability — Test method	CEN/TC 33
		EN 12207	Windows and doors — Air permeability — Classification	CEN/TC 33
	Dangerous substances		No standard given in EN 14351-1	
Water tightness		EN 12208	Windows and doors — Water tightness — Classification	CEN/TC 33
Acoustic performance		EN ISO 717-1	Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation	ISO/TC 43 In collaboration with CEN/TC 126
Resistance to wind load		EN 12211	Windows and doors — Resistance to wind load — Test method	CEN/TC 33
		EN 12210	Windows and doors — Resistance to wind load — Classification	CEN/TC 33
Resistance to snow and permanent load			When appropriate European Standards are in place, the determination of the load-bearing capacity should be carried out as prescribed in those European Standards.	

Impact resistance	EN 13049	Windows — Soft and heavy body impact — Test method, safety requirements and classification	CEN/TC 33
Load-bearing capacity of safety devices	EN 14609	Windows — Determination of the resistance to static torsion	CEN/TC 33
Reaction to fire	EN 13823	Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item"	CEN/TC 127
External fire performance	EN 13501-5	Fire classification of construction products and building elements — Part 5: Classification using test data from external fire exposure to roof tests	CEN/TC 127

For Dangerous Substances, the relevant test standards are still not published as ENs but as non-binding Technical Reports (TR) or Technical Specification (TS) only.

A report from the commission to the European parliament and the council report were submitted pursuant to Article 67(1) of Regulation (EU) 305/201111, the Construction Products Regulation (CPR). The report comes to the following conclusion:

"The independent study on specific needs for information on the content of dangerous substances in construction products found that there are no sector specific schemes both focusing solely on content and dealing only with construction products. The study has also not identified any specific needs for information on the content of dangerous substances in construction products outside the schemes examined by the study.

The current harmonised technical specifications for construction products cover all aspects of product performance in relation to regulatory provisions on dangerous substances in place today at national and at European level.

The standardisation work which has been undertaken under Mandate M/366 for the elaboration of European assessment methods covers also content related national or European regulatory provisions. Standardisers (CEN) are expected to introduce shortly these assessment methods in harmonised European standards and the EOTA bodies will also use them in the European Assessment Documents (EADs).

The manufacturer is thus empowered to inform about the required product performance, where appropriate including the content of dangerous substances, through the DoP. This ensures the availability of this information for all downstream users of the product. The manufacturer is to provide the information requested in Article 31, or Article 33, of the REACH Regulation, together with the DoP. This information (Safety Data Sheets for substances and the information on dangerous substances contained in the products for them) accompanies the product in all steps of the supply chain till the final end user (contractor, worker and consumer).

The notion of "dangerous substances" under REACH is comprehensive because the term covers all substances which are carcinogenic, mutagenic, toxic for reproduction, persistent, bio-accumulative or toxic, as well as all substances for which scientific evidence exists of probable serious effects to human health or the environment.

Furthermore, the REACH related information which the manufacturer has to provide takes into account the protection of users, workers and consumers.

Any future extension of the REACH Regulation to cover new substances will automatically apply also to the obligation of construction products manufacturers to disseminate the relevant information, thus keeping pace with scientific progress.

Moreover, the manufacturers of construction products, especially SMEs consider any extension of the current information obligations to be a significant and unjustifiable burden.

The European Commission considers therefore that the specific needs for information on the content of hazardous substances in construction products, for the purpose of consolidating the Internal Market for construction products, are sufficiently addressed by the current provisions of the CPR, in particular Article 4 in combination with Article 6(5).

Furthermore, the European Commission considers that the information obligation provided for in Article 6(5) of the CPR is

[11] Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC (OJ L 88, 4.4.2011, p.5).

sufficient and, under the present level of scientific knowledge, does not need to be extended to other substances."

The European harmonized product standard for windows EN 14351-1 allows different approaches to determine relevant characteristics.

For example the thermal transmittance U_W can be determined according to (see also page 30):

- Tabulated values (Source EN ISO 10077-1)
- Calculation (EN ISO 10077-1, EN ISO 10077-2)
- Measurement (EN ISO 12567-1, EN ISO 12567-2)

→ **Dangerous substances**

Also relevant for ecodesign, the "dangerous substances" are a requirement of EN 14351-1, but for the reason of missing European standards, EN 14351-1 references the national provisions:

"In so far as the state of the art permits, the manufacturer shall establish those materials in the product which are liable to emission or migration during normal intended use and for which emission or migration into the environment is potentially dangerous to hygiene, health or the environment. The manufacturer shall establish and make the appropriate declaration of content according to the legal requirements in the intended country of destination."

→ **Outlook**

The mandate of the European Commission to CEN for windows (M/101) has been extended for the Basic Requirement 6 "Energy Economy and heat retention" in regard to the following properties:

- The Frame area ratio (F_F)
- Radiation properties

There is also an additional requirement under ER 3 (Hygiene, health and environment) which will be influencing the Energetic behaviour, as it is essentially a minimum temperature requirement for the window frame and not a durability requirement:

- Moisture resistance

This will also extend the mandatory requirements for CE-marking in those countries of the EU, which have legal requirements.

In regard to the assessment of the sustainable use of resources, the recitals of the CPR recommend the use of EPDs – when available:

(55) The basic requirement for construction works on sustainable use of natural resources should notably take into account the recyclability of construction works, their materials and parts after demolition, the durability of construction works and the use of environmentally compatible raw and secondary materials in construction works.

(56) For the assessment of the sustainable use of resources and of the impact of construction works on the environment Environmental Product Declarations should be used when available.

EPDs shall be in line with EN 15804 – which shall be cited in the product standards for that purpose.

→ **ISO 18292:2011**

ISO 18292:2011 specifies a procedure for calculation of the energy performance of fenestration systems used in residential buildings, for rating of fenestration systems, doors and skylights, including the effects of frame, sash, glazing, and shading components. ISO 18292:2011 specifies procedures for the calculation of the heating and cooling energy use in residential buildings, internal and external climatic conditions, and relevant building characteristics.

These procedures can accommodate all climatic conditions and installation details. ISO states *"it is the responsibility of the appropriate regulatory authority to identify the clauses of ISO 18292:2011 to be applied in their area of jurisdiction and the climatic data and reference building specification(s) to be used".*

Table 10: ISO 18292 versions

Version	Name	information
ISO 18292:2011	Energy performance of fenestration systems for residential buildings -- Calculation procedure	ICS: 91.120.10 Stage: 60.60 (2011-03-16) TC/SC: ISO/TC 163/SC 2 Number of Pages: 33
ISO 18292:2011/Cor 1:2012		ICS: 91.120.10 Stage: 60.60 (2012-03-23) TC/SC: ISO/TC 163/SC 2 Number of Pages: 1

Due to the reason that the individual characteristics of the window, needed for the calculation of the energy performance of a window system are in general already evaluated according to the product standard EN 14351-1 and declared by CE marking, ISO 18292 could be described as a document defining the conversion of all the energy related characteristics into one value.

Energy performance of the fenestration system, calculated according to ISO 18292 is expressed through energy performance indices, one representative of the heating season, $P_{E,\ H,W}$, and one representative of the cooling season $P_{E,\ C,W}$. The $P_{E,H,W}$ and $P_{E,C,W}$ values are the energy needs per area of the fenestration system per year, i.e. the contribution of the fenestration system to the energy needs of the building for heating and cooling.

$P_{E,\ H,W}$ is the fenestration heating energy performance index, expressed in kilowatt hours per square meter (kWh/m^2), while $P_{E,\ C,W}$ is the fenestration cooling energy performance index, expressed in kilowatt hours per square meter (kWh/m^2).

Different calculation procedures are possible as given in EN ISO 13790:

- monthly energy balance calculation method;
- seasonal energy balance calculation method;
- hourly energy balance calculation method.

4.1.5. TEST STANDARDS IN EU MEMBER STATES

The harmonized European product standard for windows defines the determination of necessary characteristics of windows and supersedes test standards in individual member states.

Nevertheless there are some countries defining different/additional methods to consider the impact of windows on the energy demand of the building. In general these methods should be based on the energy related characteristics stated in CE mark.

4.1.6. BUILDING PERFORMANCE STANDARDS

→ **EN 15603 – Energy performance of buildings –Overall energy use and definition of**

As stated above, CEN TC 371 is responsible for the development of standards that address the energy performance of buildings, and which are to be used in the context of the EPBD.

The overarching standard published for this purpose is EN 15603:2008 "Energy performance of buildings - Overall energy use and definition of energy ratings". This standard describes a calculation methodology, using parameters and values derived from other (product) performance test standards. For the calculation of the energy use for space heating and cooling EN 15603 refers to EN ISO 13790.

→ **EN ISO 13790 - Energy performance of buildings — Calculation of energy use for space heating and cooling**

EN ISO 13790 gives calculation methods for the assessment of the annual energy use for space heating and cooling of a residential or a non-residential building, or a part of it, referred to as "the building". EN ISO 13790 includes the calculation of:

a. the heat transfer by transmission and ventilation of the building zone when heated or cooled to constant internal temperature;
b. the contribution of internal and solar heat gains to the building heat balance;
c. the annual energy needs for heating and cooling, to maintain the specified set-point temperatures in the building – latent heat not included;
d. the annual energy use for heating and cooling of the building, using input from the relevant system standards

4.1.7. LIFE CYCLE ASSESSMENT STANDARDS

Besides product performance and building performance standards that focus on (energy) performance during the use phase, there are also standards being developed to describe the (environmental) impacts of construction products in other life cycle phases or related to other parameters than energy consumption. Standards for this purpose are being developed by CEN TC 350 and CEN TC 351.

→ **CEN TC350 - Sustainability of construction works**

CEN TC350 is responsible for the development of a suite of European Standards for the assessment of the sustainability aspects of new and existing construction works and for standards for the environmental product declaration of construction products.

The intention of the standard is: to integrate the assessment of both the operational and embodied environmental impacts of buildings; to ensure that the evaluation of embodied impact of materials is done in a consistent manner using life cycle assessment; and that information is provided in a way that allows the information for materials to be aggregated to allow evaluation at the building level.

The standards are intended (could be used) to be the mechanism for assessing Basic Works Requirement 3 and 7 from the Construction Products Regulation[12] and they also integrate with the Energy Performance of Buildings Directive[13] to ensure that the assessment of operational impacts is consistent.

The following standards have been published:

At product/component level:

- EN 15804: 2012: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products

At whole building/construction works level:

- EN 15643-1: 2010: Sustainability of construction works - Sustainability assessment of buildings - Part 1: General framework
- EN 15643-2: 2011: Sustainability of construction works - Assessment of buildings - Part 2: Framework for the assessment of environmental performance
- EN 15643-3: 2012: Sustainability of construction works. Assessment of buildings. Framework for the assessment of social performance

[12] Regulation No 305/2011

[13] 2010/31/EU

- EN 15643-4: 2012: Sustainability of construction works - Assessment of buildings - Part 4: Framework for the assessment of economic performance
- EN 15978: 2011: Sustainability of construction works. Assessment of environmental performance of buildings. Calculation method
- CEN TR 15941: 2010: Sustainability of construction works - Environmental product declarations - Methodology for selection and use of generic data

Short description CEN TC 350 – EN 15804

Sustainability of Construction Works – Environmental product declarations – Core rules for the product category of construction products

The EN 15804 provides core product category rules for all construction products and services. It provides a structure to ensure that all Environmental Product Declarations (EPDs) are derived, verified and presented in a harmonized way.

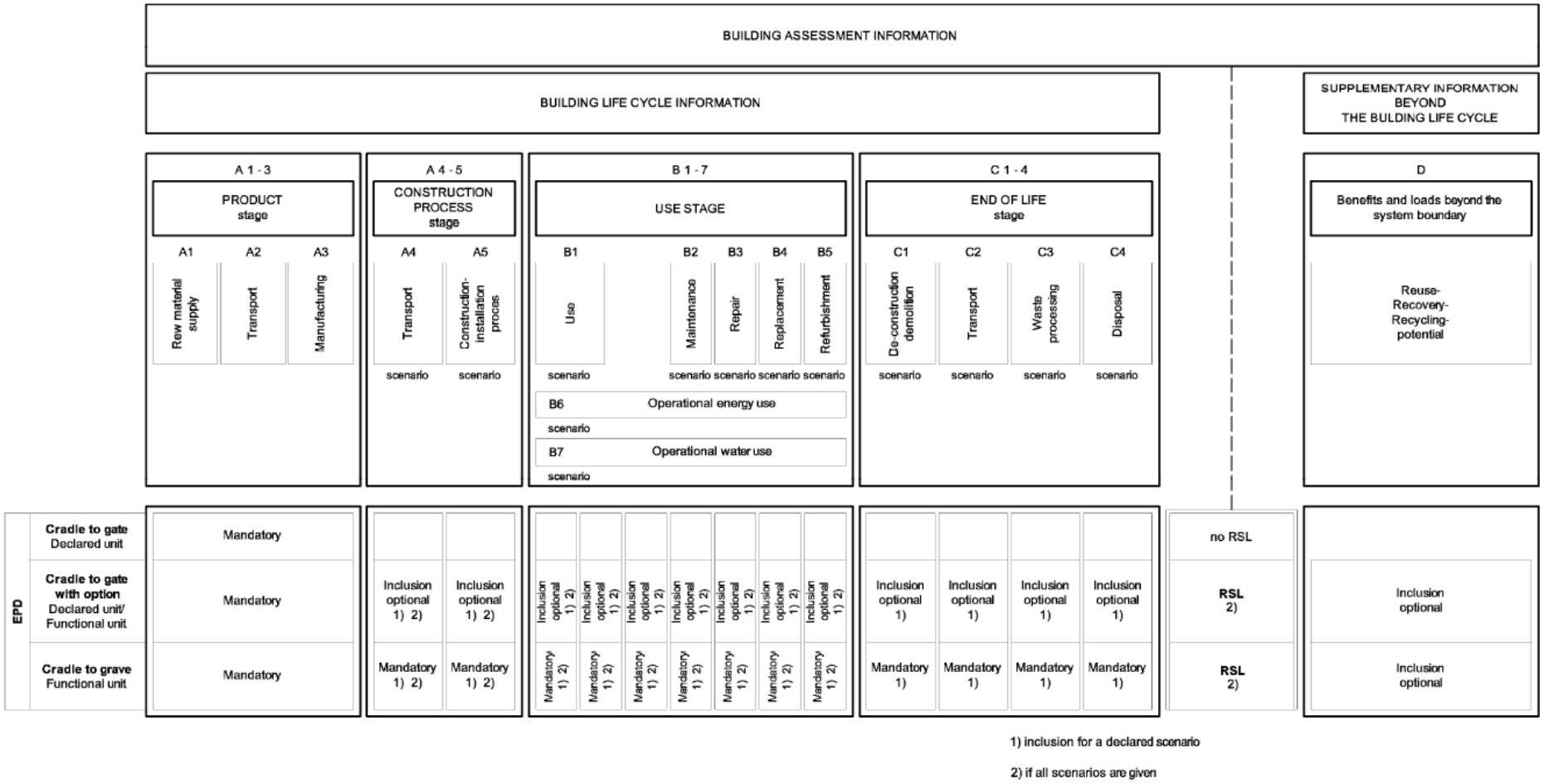
It is organized in modules covering different life cycle stages. Some modules are mandatory, others are optional. The indicators declared in the individual information modules of a product life cycle shall not be added up in any combination of the individual information modules into a total or sub-total of the life cycle stages.

The LCA based information in an EPD may cover (see Figure 9):

- The product stage only. Such an EPD covers raw material supply, transport, manufacturing and associated processes; this EPD is said to be “cradle to gate” and becomes an EPD based on information modules A1 to A3;
- The product stage and selected further life cycle stages. Such an EPD is said to be “cradle to gate with options” and becomes an EPD based on information modules A1 to A3 plus other selected optional modules, e.g. end-of-life information modules C1 to C4. Information module D may be included in this EPD;
- The life cycle of a product according to the system boundary. In this case the EPD covers the product stage, installation into the building, use and maintenance, replacements, demolition, waste processing for re-use, recovery, recycling and disposal and is said to be 'cradle to grave' and becomes an EPD of construction products based on a LCA, i.e. covering all information modules A1 to C4. In this EPD the information module D may be included.

Declarations based on the EN 15804 are no comparative assertions.

Figure 9 : LCA Based information in an EPD (EN 15804)



→ **CEN TC351 - Construction products: Assessment of release of dangerous substances:**

CEN TC 351 aims to develop standardised test and assessment methods for the release scenario of dangerous substances from construction products. These methods will be integrated into the Standards from CEN TC350 where relevant.

The following documents are in development within CEN TC350:

- FprCEN/TR 16496 Construction Products - Assessment of release of dangerous substances - Use of harmonised horizontal assessment methods No (89/106/EEC)
- FprCEN/TS 16516 Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air No (89/106/EEC)
- FprCEN/TS 16637-1 Guidance standard for CEN Product TCs for selection of leaching tests appropriate for their product(s) - General principles No (89/106/EEC)
- FprCEN/TS 16637-2 Generic horizontal dynamic surface leaching test (DSLT) for determination of surface dependent release of substances from monolithic or plate-like or sheet-like construction products No (89/106/EEC)
- CEN/TC 351/WG 1 N 162 Generic horizontal up-flow percolation test for determination of the release of substances from granular construction products No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Terminology No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Guidance on evaluation of conformity No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Determination of the activity concentrations of 226Ra, 232Th and 40K using gamma-ray spectrometry No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Analysis of inorganic substances in digests and eluates No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Digestion of construction products by aqua regia No (88/609/EEC)
- Construction products - Assessment of release of dangerous substances - Analysis of inorganic substances in digests and eluates - Part 1: Analysis by Inductive Coupled Plasma - Optical Emission Spectrometry (ICP-OES) No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Analysis of inorganic substances in digests and eluates - Part 2: Analysis by Inductive Coupled Plasma - Mass Spectrometry (ICP-MS) No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Determination of dose assessment and classification for emitted gamma radiation No (89/106/EEC)
- Construction products - Assessment of release of dangerous substances - Analysis of inorganic substances in digests for content analysis No (89/106/EEC)

→ **PEF – Product Environmental Footprint**

Additionally there are standards, rules, procedures and guidelines of more generic nature, to be used for the life cycle assessment of miscellaneous products (such as washing machines, televisions, but also construction products). These 'standards' are developed by a variety of institutions, but most relevant for the EU policy context is the work performed under the responsibility of DG Environment and DG JRC-IES, who have worked on EU product category rules.

Together with DG Environment and other European Commission services the European Commission's Joint Research Centre (JRC IES) has developed a methodology for the assessment of the environmental footprint of products. This methodology pulls together methods and conclusions from the International Reference Life Cycle Data System (ILCD) Handbook as well as other existing methodological standards and guidance documents (ISO 14040-44, PAS 2050, BP X30, WRI/WBCSD GHG protocol, Sustainability Consortium, ISO 14025, Ecological Footprint, etc.).

The proposed PEF methodology was published as an Annex to the Commission Recommendation[14] on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations.

[14] COMMISSION RECOMMENDATION of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organizations -Text with EEA relevance - 2013/179/EU

Testing the methodology

The technical guide developed by JRC IES was tested using a limited number of pilot studies representative of a wide variety of goods and services based on a call for volunteers. Due to time and resource constraints, the number of pilot tests was limited to ten. The sectors covered through the testing included: agriculture, retail, construction, chemicals, ICT, food, manufacturing (footwear, televisions, paper). The results of the testing were used for the development of the final technical guide.

As the PEF is a very generic methodology, and the variety of products that can be assessed through this is vast, there is a need to set more specific rules for specific products that are to be assessed. These product specific rules for assessment are called *Product Environmental Footprint Category Rules* (PEFCR).

The aim of the Product Environmental Footprint Category Rules PEFCRs is to provide specific rules to calculate the environmental footprint for a certain product group, including benchmark and, if appropriate, performance grades. PEFCRs complement general methodological guidance for environmental footprint by providing further specification at the product level.

Each PEFCR focuses on the most relevant life cycle stages, processes and impact categories for the product group in scope. A declaration compliant with a PEFCR can be used to make comparisons and comparative assertions. PEFCRs will increase reproducibility and consistency in product environmental footprint studies.

So far no PEFCRs have been issued for windows by DG ENV/DG JRC-IES. Such rules however do exist within the various EPD schemes that have been established for products, and which do include windows (see section 3.8.4).

→ **EN 15804 and PEF –methodological differences?**

Both EN 15804 and PEF aim to set out rules or guidelines on how to perform and assessment of the environmental impacts of (construction) products. This section tries to highlight some of the main methodological differences.

End of life (EOL)

According to the EN 15804 the system boundary is defined as “until the end-of-waste state is reached”. Furthermore the EN 15804 standard states: “Materials from which energy is recovered with an efficiency rate below 60% are not considered materials for energy recovery.”

The PEF method applies different allocation rules in case of recycling and energy recovery at end of life (EOL).

The most recent information available from the Product Environmental Footprint (PEF) News website[15] of 30 September 2014 states that the "End of Life (EoL) formulas" will be discussed by pilot study consultants/companies and other stakeholders

Impact categories and assessment methods

The PEF method comprises a more extended list of impact categories. These might be reduced to the EN 15804 list in future PEFCRs for construction products if proven to be justified. Also some measurement units are different in the EN 15804 compared to PEF.

An overview is given in the table below.

[15] http://ec.europa.eu/environment/eussd/smgp/product_footprint.htm

Table 11: Overview of impacts categories according EN 15804 and PEF

PEF	EN 15804	Comments
Global warming, kg CO2 eq	Global warming, kg CO2 eq	identical
Ozone depletion, kg CFC eq	Ozone depletion, kg CFC eq	identical
Acidification, mol H+ eq	Acidification, **kg SO2 eq**	different unit and thus model (+ characterisation)
Eutrophication terrestrial, mol N eq	Eutrophication, **kg (PO4)3- eq**	different unit and thus model (+ characterisation)
Eutrophication freshwater, kg P eq		not included in EN 15804
Eutrophication marine, kg N eq		not included in EN 15804
Photochemical ozone creation, kg NMVOC eq	Photochemical ozone creation, **kg ethene eq**	different unit and thus model (+ characterisation)
Abiotic, non fossil, kg Sb eq	Depletion of abiotic resources, non fossil, kg Sb eq (characterisation factors shall be taken from CML)	identical
Abiotic, fossil, kg Sb eq	Depletion of abiotic resources, fossil, **MJ net calorific value** (characterisation factors shall be taken from CML)	EN 15804:CML is mentioned to be used for characterisation factors, but CML expresses it in Sb eq
Ecotoxicity, CTUe		not included in EN 15804
Human Toxicity - cancer effects, CTUh		not included in EN 15804
Human Toxicity – non-cancer effects, CTUh		not included in EN 15804
Particulate Matter/Respiratory Inorganics, kg PM2.5 eq		not included in EN 15804
Ionising Radiation – human health effects, U235 eq		not included in EN 15804
Resource Depletion – water, m3 water use		not included in EN 15804
Land Transformation, % or Mg/ha		not included in EN 15804

	identical (category and unit/method)
	identical category but different unit/method
	included in PEF, not included in EN 15804

The PEF method provides a single EoL equation which is applicable for both open-loop and closed-loop recycling; and can accommodate-date both the recycled content (R_1) and recyclability rate (R_2), if relevant. The resources consumed and emissions are calculated as[16]:

$$E = \left(1 - \frac{R_1}{2}\right) \times E_V + \frac{R_1}{2} \times E_{recycled} + \frac{R_2}{2} \times \left(E_{recyclingEoL} - E^*_V \times \frac{Q_S}{Q_P}\right) + R_3 \times \left(E_{ER} - LHV \times X_{ER,heat} \times E_{SE,heat} - LHV \times X_{ER,elec} \times E_{SE,elec}\right) + \left(1 - \frac{R_2}{2} - R_3\right) E_D - \frac{R_1}{2} \times E^*_D$$

with all parameters as defined in the table below:

Table 12 Terms and definitions for parameters of PEF EoL equation

Term	Definition
E	Resources consumed/emissions for the production and the EoL stages of one product life cycle
EV	Resources consumed/emissions for the acquisition and pre-processing of virgin material
E'V	Resources consumed/emissions for the actual virgin material substituted through open-loop recycling
E*V	Resources consumed/emissions for the acquisition and pre-processing of virgin material assumed to be substituted by recyclable materials. If only closed-loop recycling takes place: E∗V = EV ; if only open-loop recycling takes place: E∗V = E_V
Erecycled	Resources consumed/emissions for the production process of the recycled material, including collection, sorting and transportation processes

[16] K. Allacker, F. Mathieux∗, S. Manfredi, N. Pelletier, C. De Camillis, F. Ardente, R. Pant, Allocation solutions for secondary material production and end of liferecovery: Proposals for product policy initiatives, Resources, Conservation and Recycling 88 (2014) 1–12

ErecyclingEoL	Resources consumed/emissions for the recycling process at the EoL, including collection, sorting, transportation and recycled material production processes. In some cases, when technologies used are similar, Erecycled can be similar to ErecyclingEoL
ED	Resources consumed/emissions for disposal of waste material (e.g. landfilling, incineration, pyrolysis)
E*D	defined as the resources consumed and emissions for the disposal of waste material (e.g. landfill, incineration, pyrolysis) at the EoL of the material from which the recycled content is derived.
EER	Resources consumed/emissions for the energy recovery process
ESE	Avoided resources consumed/emissions for the specific substituted energy source
ESE,heat **ESE,elec**	Avoided resources consumed/emissions for the specific substituted energy source, heat and electricity respectively
R1	"Recycled content of material" is the proportion of material input to the production process that has been recycled in a previous system (0 = < R1 < = 1)
R2	"Recyclability rate" is the proportion of the material in the product that will be recycled in a subsequent system (i.e. the rate between recycled output and virgin material input). R2 takes into account any inefficiencies in the collection and recycling processes (0 = < R2 = <1)
R3	The proportion of material in the product that is used for energy recovery (e.g. incineration with energy recovery) at EoL (0 = < R3 = <1)
LHV	Lower Heating Value of the material in the product that is used for energy recovery
XER	The efficiency of the energy recovery process (0 < XER < 1) (i.e. the ratio between the energy content of output (e.g. output of electricity) and the energy content of the material in the product that is used for energy recovery). XER takes into account the inefficiencies of the energy recovery process
XER,heat **XER,elec**	The efficiency of the energy recovery process (0 < XER < 1) for both heat and electricity (i.e. the ratio between the energy content of output (e.g. output of heat or electricity) and the energy content of the material in the product that is used for energy recovery). XER takes into account the inefficiencies of the energy recovery process
K or Qs/Qp	Ratio for any differences in quality between the secondary material and the primary material ("down-cycling"). K = QS/QP, where QS is the quality of the secondary material and QP the quality of the primary material. In line with the general allocation hierarchy defined in ISO 14044 (2006), identifying a relevant, underlying physical relationship as a basis for the quality correction ratio is the preferred option. If this is not possible, some other relationships have to be used, for example, economic value. In this case, the market prices of primary versus secondary materials are assumed to serve as a proxy for quality
Q_{Sin}/Q_{Pin}	Ratio for any differences in quality between the secondary material and the primary material of the recycled content, where QSin is the quality of the secondary material and QPin the quality of the primary material
$E^{\$}_{V}$	Resources consumed/emissions for the acquisition and pre-processing of virgin material assumed to be substituted by the secondary material.

Main discrepancies between EN15804 and PEF are:

Table 13 Main discrepancies between EN15804 and PEF

	EN15804	PEF
Scope	Quite flexible but should correspond to the scope of Product Technical Committee established for the implementation of the Construction Product Regulation	Based on NACE codes
Objective	Delivering robust environmental data/information at product-level to be used for assessing the building environmental performances	Assessing the product environmental performance over its life
End of life	Environmental aspects resulting from reuse, recycling & Energy recovery at end of life are considered in a separate module (using a methodology avoiding any double counting)	Only 50% of the environmental aspects resulting from recycling at end of life are considered, generating a discrimination vs; energy recovery which is fully considered.

On 6 October a workshop on End of Life (EoL) formulas in the context of the Environmental Footprint pilot phase will take place. One presentation will deal with translating EN 15804 and module D into a formula using PEF nomenclature[17]. Another presentation will focus on an "integrated approach"[18] in which a new EoL formula (below) will be discussed:

$E = (1 - R1) * EV + R1 * QSin/QPin * E^{\acute{S}}_{V} + R2 * (ErecyclingEoL - E^{*}V * QS/QP) + R3 * (E_{ER} - LHV * X_{ER,elec} - E_{SE,elec} - LHV * X_{ER,\ heat} - E_{SE,heat}) + (1 - R_2 - R_3) * ED)$

This formula can also be re-arranged and split up into the modular logic of the construction standard EN 15804.

Other issues:

- PEF have clear nomenclature rules;
- The EN 15804 allows cut-offs whilst no cut-offs are allowed in the PEF;
- PEF includes more stringent requirements related to data quality;
- PEFCRs requires normalization and weighting;
- In the EN 15804 there are no requirements for reviewer qualifications.

[17] Christian Leroy and Staf Laget on behalf of the metal industry, Carolin Spirinckx, Wim Debacker and Karolien Peeters on behalf of VITO, presentation dated 3/10/2014

[18] Staf Laget, Marc-Andree Wolf, The Integrated formula, Workshop on End of Life (EoL) formulas in the context of the Environmental Footprint pilot phase Brussels, 6 October 2014

CHAPTER 5 LEGISLATION

This section identifies the relevant legislation and voluntary initiatives relevant for windows. It is divided into four parts:

1. Legislation at EU level;
2. Legislation at Member State level;
3. Third Country Legislation;
4. Labelling initiatives.

5.1. EU LEGISLATION

The impact of Legislation may be direct (explicit requirements which will be relevant for windows (banned toxic substances – EC 842/2006)) or indirect (EPBD, which will initiate national requirements).

5.1.1. LEGISLATION AT EU LEVEL (INSTRUMENTS OVERVIEW)

The main goal of the EU is the progressive integration of Member States' economic and political systems and the establishment of a single market based on the free movement of goods, people, money and services.

To this end, its Member States cede part of their sovereignty under the Treaty on the Functioning of the European Union (TFEU) which empowers the EU institutions to adopt laws.

These laws (regulations, directives and decisions) take precedence over national law and are binding on national authorities. The EU also issues non-binding instruments, such as recommendations and opinions, as well as rules governing how EU institutions and programmes work, etc.

Regulations are the most direct form of EU law - as soon as they are passed, they have binding legal force throughout every Member State, on a par with national laws. National governments do not have to take action themselves to implement EU regulations, as they apply automatically in their entirety.

They are different from directives, which are addressed to national authorities, who must then take action to make them part of national law, and decisions, which apply in specific cases only, involving particular authorities or individuals.

Regulations are passed either jointly by the EU Council and European Parliament, or by the Commission alone.

EU **directives** lay down certain end results that must be achieved in every Member State. National authorities have to adapt their laws to meet these goals, but are free to decide how to do so. Directives may concern one or more Member States, or all of them.

Each directive specifies the date by which the national laws must be adapted - giving national authorities the room for manoeuvre within the deadlines necessary to take account of differing national situations.

Directives are used to bring different national laws into line with each other, and are particularly common in matters affecting the operation of the single market (e.g. product safety standards).

A Directive can delegate to the Commission the power to adopt implementing regulations on detailed topics. These are agreed with the Member States and apply directly. The specific rules on the EcoDesign of individual products are an example of such implementing regulations.

Decisions are EU laws relating to specific cases. They can come from the EU Council (sometimes jointly with the European Parliament) or the Commission.

They can require authorities and individuals in Member States either do something or stop doing something, and can also confer rights on them.

EU decisions are:

- addressed to specific parties (unlike regulations),
- fully binding.

Cited from: http://ec.europa.eu/eu_law/index_en.htm

5.1.2. LEGISLATION AT EU LEVEL (RELEVANT REGULATIONS AND DIRECTIVES OVERVIEW)

Of the 31 regulations and directives under the new framework, the following are considered to have an impact on windows:

Table 14 Legislation at EU level, with possible relevance to window products

Number	Subject	Relevance for ecodesign
(EU) 305/2011	Construction products (CPR)	**x**
2010/30/EU	**Energy labelling**	**x**
2009/125/EC	**Ecodesign**	**x**
2010/31/EU	Energy performance of buildings	**x**
(EC) 1907/2006	Chemical substances (REACH)	**x**
(EU) 995/2010	**obligations of operators who place timber and timber products on the market** (relevant for wooden windows)	**x**
EC 842/2006	**F-Gas Regulation**	**x**
2006/95/EC	Low Voltage (LVD) (power operated windows only)	
2006/42/EC	Machinery (MD) (power operated windows only)	
2011/65/EU	Restriction of the use of certain hazardous substances (RoHS) (restriction of the use of certain hazardous substances in electrical and electronic equipment – relevant for power operated windows only)	

5.1.3. CONSTRUCTION PRODUCTS REGULATION.

Windows are building products and as such are covered by the Regulation 305/2011/EC (Construction Products Regulation - CPR), replacing Directive 89/106/EEC (Construction Products Directive - CPD). The regulation is embedded in the goal of creating a single market ("Article 95") for construction products through the use of CE Marking. It outlines basic requirements for construction works (as the sum of its components) that are the basis for the development of the standardization mandates and harmonized technical specifications i.e. harmonized product standards and European Assessment Documents (EADs).

While the CPR regulates the processes and the roles of the parties involved for all products alike, the necessary specific characteristics of each product is taken account of in the specific standard (hEN) or EAD.

The basic idea is to harmonize the way the performance of a construction product is determined and declared in levels or classes while each member state may have individual requirements regarding the required minimum level or class for a given use.

The basic requirements for construction works are mechanical resistance and stability, safety in case of fire, hygiene, health and environment, safety and accessibility in use, protection against noise, energy economy and heat retention and sustainable use of natural resources.

The Regulation mandates standardisation organisations such as CEN to develop standards in consultation with industry (CEN TC 350 and CEN TC 351). A list of these standards can be found on the European Commission's website[19]. Where harmonised standards are not available, existing national standards apply.

In comparison to other products, the cross-border trade on construction products within the Internal Market has traditionally not been as commonplace. National markets have often obstacles preventing foreign products from being efficiently commercialized. Therefore, as one of the first efforts of such Community-wide harmonisation, the Council adopted in 1988 the Construction Products Directive (the CPD), based on Article 95, referring to the single market. The replacement of Council Directive 89/106/EEC by the Regulation (CPR) serves the aim to better define the objectives of Community legislation and make its implementation easier[20].

Concerning the Construction activity itself, the focus is on the competitiveness of the sector, in particular by accompanying and encouraging actions from industry and Member States, not least in the field of sustainable

[19] http://ec.europa.eu/enterprise/newapproach/standardization/harmstds/reflist/construc.html

[20] http://ec.europa.eu/enterprise/construction/index_en.htm

construction and by promoting actions and supporting the development of common tools facilitating for companies and other actors to better adapt to the changes in the sector.

The CPR now includes in Annex I three basic requirements for construction works that specifically relates to ecological matters[21]:

3) Hygiene, health and Environment;

6) Energy Economy and heat retention;

7) Sustainable use of natural resources.

For the latter, it states in detail: "The construction works must be designed, built and demolished in such a way that the use of natural resources is sustainable and ensure the following:

a) Recyclability of the construction works their materials and parts after demolition;
b) Durability of the construction works;
c) Use of environmentally compatible raw and secondary materials in the construction works."

Safety in construction and the free movement of services, engineering and construction services, are also an important policy priority, which is developed through the promotion of the Eurocodes and their implementation by the Member States.

Yet is must be kept in mind, that the CPR is – in spite of its name - a regulation which is focussed on the free trade of building products – as the European Commission has no competencies regarding building safety, which is within the competence of the member states.

Due to that, the abovementioned Annex I "shall constitute the basis for the preparation of standardization mandates and harmonized technical specifications" (article 3(1) of the CPR) – it is not a binding list of requirements which directly requires the manufacturers to act accordingly.

The particular nature of construction products, predominantly intended to be used by professionals (constructors, architects, civil engineers) has also brought along a need to differentiate the regulatory structure and the role of standards from the general horizontal rules of the Internal Market Package for Goods. Also the meaning of the CE marking in this context is specific: it attests that the information accompanying the product has been attained in accordance with the methods specified in the standards and that the manufacturer takes responsibility that the product has the declared performance.

The objective of the CPR is thus not to define the safety of construction products, but to ensure that reliable information is presented in relation to their performance. This is achieved by providing, mainly in standards, a common technical language, to be used not only by manufacturers, but also by public authorities when defining their requirements on construction works, directly or indirectly influencing the demands placed on the products to be used in them.

Finally it has to be noted, that according to CPR Article 3 it could in principle be possible, that the European Commission sets minimum performance requirements for construction products.

"Where appropriate, the Commission shall also determine, by means of delegated acts in accordance with Article 60, the threshold levels for the performance in relation to the essential characteristics to be declared". [22]

Recital 14 clarifies that: *(14) Where an intended use requires threshold levels in relation to any essential characteristic to be fulfilled by construction products in Member States, those levels should be established in the harmonised technical specifications*.

As far as windows are concerned, for the time being the minimum performance requirements are defined by the member states, not by the Commission. Recital 14 clarifies that: *(12) The methods used by the Member States in their requirements for construction works, as well as other national rules relating to the essential characteristics of construction products, should be in accordance with harmonised technical specifications.*

5.1.4. ENERGY EFFICIENCY RELATED EU DIRECTIVES

With the intent of managing specific energy consumption, the EU has adopted two main legislative instruments: The European Energy Labelling Directive of products in 1992 (recast in 2010 as Directive 2010/30/EU) and the EuP (Energy-using Products) Directive (2005/32/CE) in 2005, amended in 2009 under the name ErP (Energy-related Products) Directive or Ecodesign Directive (2009/125/CE).

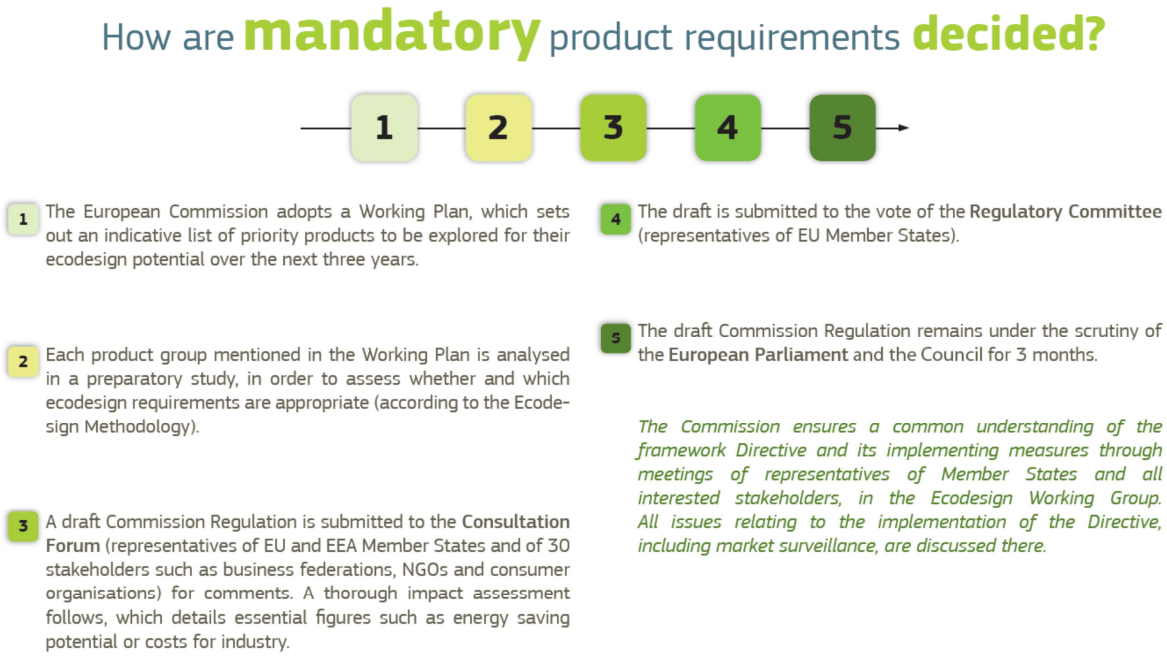
[21] The other basic requirements relate to various forms of safety and noise primarily

[22] REGULATION (EU) No 305/2011, Article 3

→ **Ecodesign directive**

In order to combine environmental and energy efficient products for a European market, the Ecodesign Directives 2005/32/EC and 2009/125/EC establish a framework for the setting of Ecodesign regulations for respectively energy-using and energy-related products, aiming at free movement of those products on the European market. Both directives are not binding, but provide rules and criteria for setting product (or product system) requirements through implementing measures.

Figure 10 Regulatory process[23]



Such implementing measures are prepared by the European Commission only for products which fulfil three important conditions. According to paragraph 2 of Article 15 of Ecodesign Directive 2009/125/EC products have to:

a) represent a significant volume of sales and trade, indicatively more than 200 000 units a year within the Community to the most recently available figures;
b) have a significant environmental impact within the Community – as specified in the Community strategic priorities as set out in Decision No 1600/2002/EC – considering the quantities placed on the marker and/or put into service;
c) present significant potential for improvement in terms of its environmental impact without entailing excessive costs, taking into account in particular:
    i. the absence of other relevant Community legislation or failure of the market forces to address the issue properly; and
    ii. a wide disparity in the environmental performance of products available on the market with equivalent functionality.

Additionally, the Ecodesign directive 2009/125/EC requires that the (entire) life cycle of the product and all its significant environmental aspects (including energy efficiency during the use phase of the product) is considered (article 15, paragraph 4, item (a)). Furthermore, implementing measures shall meet the following criteria (article 15, paragraph 5):

a) there shall be no significant negative impact on the functionality of the product, from the perspective of the user;
b) health, safety and the environment shall not be adversely affected;
c) there shall be no significant negative impact on consumers in particular as regards the affordability and the life cycle cost of the product;
d) there shall be no significant negative impact on industry's competitiveness;

[23] Source: Ecodesign Your Future, http://ec.europa.eu/enterprise/policies/sustainable-business/ecodesign/files/brochure_ecodesign_en.pdf

e) in principle, the setting of an Ecodesign requirement shall not have the consequence of imposing proprietary technology on manufacturers; and
f) no excessive administrative burden shall be imposed on manufacturers.

In accordance with Article 16(1) of the Ecodesign Directive, the Commission adopted on 7 December 2012 a Working Plan for the period 2012-2014, setting out an indicative list of energy-using products which will be considered in priority for the adoption of implementing measures[24]. "Windows" is included in the list of priority product groups.

→ Energy Labelling Directive[25]

Directive 92/75/EEC introduced a mandatory product labelling scheme in Europe for electric products in terms of their energy efficiency and consumption of other resources. This Directive was replaced in May 2010 by "Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products." Based on the provisions of this Directive, the EU Commission can from now adopt so-called delegated acts for specific product groups. These acts can take the form of regulations.

In line with the Ecodesign Directive, the Labelling Directive covers not only energy-using, but all energy-related products (ErPs) except for means of transport. Another modification concerns the classes to which products are assigned according their efficiency. For some product groups the classes A+ and A++ have been introduced already in the past. On the basis of the 2010 directive, three additional classes be assigned above the A class if required by technological progress. In some of the new product group specific proposals the planned label includes class A+++ already from the beginning.

The product labelling scheme is closely interlinked with the implementing measures under the Ecodesign Directive. The decision, which environmental parameters of a product – besides energy consumption e.g. the water consumption of washing machines – are considered to be relevant for the labelling is made on the basis of the respective ecodesign implementing measure and the preparatory study carried out beforehand.

The new Labelling Directive, adopted in 2010, is based on the changes to European law stipulated in the Lisbon Treaty which came into force in December 2009, whereas the Ecodesign Directive was adopted in 2009 and is therefore based on former Community law, applying the so-called "Comitology procedure". In the new treaties, changes to some procedures for the adoption of legal acts were introduced. The Commission-led comitology procedure with its Regulatory Committee was replaced by a new procedure for the adoption of delegated acts (cf. art. 290 Treaty of the Functioning of the European Union). In this procedure, the interested parties are still consulted (cf. Consultation Forum), but the Regulatory Committee is omitted. After the consultation of interested parties, the Commission itself adopts the delegated act, which can still be rejected by the European Parliament or the Council within a period of two months.

The Energy Labelling Directive requires retailers to display a comparative label showing the level of energy consumption of household appliances to consumers at the point of sale. This Directive complements other instruments including the Ecodesign Directive and the Eco-label Regulation.

→ Energy Performance of Buildings Directive (2002/91/EC) and recast Directive (2010/31/EU)

The 2002/91/EC Energy Performance of Buildings Directive (EPBD) is, at European level, the main policy driver affecting energy use in buildings. As originally formulated in 2002, the EPBD sets out the following key requirements for Member States:

- Minimum standards on the energy performance of new buildings and large (>1000m²) existing buildings undergoing 'major renovation';
- A general framework; for a methodology for calculating the integrated energy performance of buildings;
- Energy certification for both new and existing buildings whenever they are constructed, sold or rented out;
- Implement an inspection and assessment regime for air conditioning and medium and large size heating systems or, in the case of the latter, develop information campaigns on the subject. (BPIE, 2011)

In 2010 the EPBD was revised (Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings), adding several new or strengthened requirements, in particular:

- Setting up EU-wide nearly Zero Energy Buildings (NZEB) obligation for all new buildings by 2020;
- Development of national plans for increasing the number of NZEB buildings;
- Abolishment of the 1000m² threshold for major renovations (see below);

[24] COMMISSION STAFF WORKING DOCUMENT Establishment of the Working Plan 2012-2014 under the Ecodesign Directive (SWD(2012) 434 final, Brussels, 7.12.2012)

[25] Most of text based on: http://www.eup-network.de/background/labelling-directive

- Setting up energy performance requirements at cost-optimal levels, including requirements on building elements when retrofitted, replaced or upgraded;
- Independent control systems for Energy Performance Certificates (EPC) and inspection reports;
- Requiring an inspection report for heating and air-conditioning systems;
- Reinforcement of the energy certification of the buildings.

The recast EPBD defines building elements as either a technical building system or an element of the building envelope which separate the interior from the outdoor environment, typically roof, floors, walls and the filling of recesses. Therefore, even if the elemental requirements can potentially be fulfilled by single products, the elemental requirements shouldn't be understood product requirements.

The Directive offers Member States to introduce requirements for large renovations whereby 'large' can be defined as either renovation costs being more than 25% of the value of the building, or 25% of the surface area of the building envelope (see Article 2, 31/2010/EU).

In 2005 a Concerted Action (CA) EPBD was launched by the European Commission to assist the Member States (MS) in implementing the Energy Performance of Buildings Directive and to support dialogue and exchange of best practice between MS. This CA approach was elaborated more in 2007, with Member States sharing real operating experiences. Besides the EU27 Member States, also Norway and Croatia are part of this CA.

The activities of the Concerted Action comprise meetings and working groups. The current Concerted Action (third) aims at transposition and implementation of the EPBD recast, and it runs from 2011 until 2015. The first part (until 2012) focused on transposition of the recast EPBD, the second part of the Concerted Action will focus on implementation and lessons learned..

Since 2008, every two years, the CA EPBD reports on the status and on the progress achieved in a book containing national reports with snapshots of the status of implementation[26].

The CA EPBD works on following core themes:

- Certification;
- Inspections;
- Training Experts;
- Energy Performance Requirements using the Cost Optimal Methodology;
- Towards 2020 – Nearly Zero-Energy Buildings (NZEBs);
- Compliance and Control;
- Effectiveness of Support Initiatives.

The Core Themes in bold have an impact on windows since they include requirements or recommendations for the building elements part of the envelope.

Certification

Member States shall ensure that an energy performance certificate is issued for (a) buildings or building units which are constructed, sold or rented out to a new tenant; and (b) buildings where a total useful floor area over 500 m 2 is occupied by a public authority and frequently visited by the public. On 9 July 2015, this threshold of 500 m² shall be lowered to 250 m².

Certification refers mainly to following articles of the recast EPBD[27]:

- Article 11 'Energy Performance Certificates';
- Article 12 'Issue of Energy Performance Certificates';
- Article 13 'Display of Energy Performance Certificates'.

The issuing of EPCs has an important role in the transformation of the building sector. By providing information, potential buyers and tenants can compare buildings/building units. Also recommendations are provided for a cost-effective improvement, encouraging home owners to refurbish their building to a better energetic standard.

The EPBD recast requires that the EPC contain recommendations for improving energy performance. These recommendations (standard or tailor-made) are an important communication tool for the energetic improvement potential of the building. However specific energy audits have a broader scope than the building as such, including recommendation on the energy management or behavioural changes with more in-depth analysis of opportunities for improving the building.. Standard recommendations for improving the thermal envelope will mostly depend on the U-value of the building element. Recommendations should not only focus on an improved U-value, but also require attention to the indoor climate[28].

[26] Reports can be downloaded from www.epbd-ca.eu.

[27] Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2012

[28] Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2010

Energy Performance Certificates (EPCs)

The implementation of the EPC schemes has been gradual in almost all Member States due to the nature of application of the certificates. While most countries set up the first certification relation to new buildings, the scheme for renovated, existing and new and existing public buildings were usually left for later implementation. Before the EPBD was adopted, both The Netherlands and Denmark had already set up energy certification schemes for buildings at national level (in 1995 and 1997 respectively). Germany started in 2002 (having recast it in 2009) and from then on, most of the countries stared the implementation and enforcement of the EPC schemes from 2007 to 2009. Generally, Member States found it easier to introduce requirements for new buildings, as there are already processes in place to approve new buildings. However, greater benefit can be derived from identifying and stimulating uptake of energy savings measures within the existing stock. (BPIE, 2011)

According to the report of BPIE[29], by the end of 2010 all countries had started the certification process, but Greece, Romania, Spain, Luxembourg, Lithuania and the Brussels Region of Belgium were due to implement some remaining requirements in 2011, while Hungary was due in 2012 and the Flanders Region of Belgium in 2013. Slovenia and Latvia had not reported a planned date to have running EPC schemes for all the buildings required by the EPBD and in Switzerland, there was only a voluntary EPC scheme. Also, some countries (Bulgaria, Denmark, Estonia, Greece, Ireland, Lithuania, the Netherlands, Portugal, Sweden, Slovakia and the UK) already had an up and running database for the registered EPCs.

Cost-optimal methodology

Member States shall calculate cost-optimal levels of minimum energy performance requirements using the comparative methodology framework established in accordance with paragraph 1 of the recast EPBD and relevant parameters, such as climatic conditions and the practical accessibility of energy infrastructure, and compare the results of this calculation with the minimum energy performance requirements in force.

Following articles of the recast EPBD are mainly important for the cost-optimal methodology:

- Article 3 'Adoption of a methodology for calculating the energy performance of buildings'
- Article 4 'Setting of minimum energy performance requirements'
- Article 5 'Calculations of cost-optimal levels of minimum energy performance requirements'
- Article 6 'New buildings'
- Article 7 'Existing buildings'
- Article 8 'Technical building systems'

The cost optimal level is defined as "the energy performance level which leads to the lowest cost during the estimated economic lifecycle[30]" (Article 2.14) it is intended as a tool for MS to see if they need to adjust their own regulations with regard to the economic optimum. Cost optimal framework aims at ensuring a similar level of ambition across EU but is not intended for comparisons between Member States. Member states must set national minimum energy performance requirements to achieve these cost-optimal levels. Also measures must be taken so that cost-optimal level are achieved by new buildings or building undergoing a major renovation, but also for replaced or retrofitted building elements that are part of the building envelope.

A framework for cost-optimal procedures is provided by the Commission Delegated Regulation (EU) No 244/2012 accompanied by Guidelines (2012/C 115/01). The Regulation is partly based on CEN-standards but Member States can use their national calculation method for the energy performance calculations as far as it is compliant with the general framework set out in Annex I of EPBD-recast. Default estimations on energy price developments on the long-term are provided by the Commission. Member States must define reference buildings (new, and existing, both residential as non-residential) and energy efficiency measures that are assessed for those reference buildings. Both for the reference buildings, as well as the reference buildings with the energy efficiency measures applied final and primary energy needs are assessed en costs are calculated. Cost optimal levels from a macroeconomic as well as from a financial perspective are calculated, but MS can choose on which perspective they base their energy performance requirements.

New buildings need to develop towards Nearly Zero-energy Buildings (NZEBs), but also the existing housing stock needs to be improved. Therefore also requirements for existing buildings are set in place, building requirements as well as element requirements. Requirements for elements are easily comprehensible and might be adopted easier by people planning minor renovation works. However they miss an holistic approach and are less ambitious than whole-building requirements for major renovations.

Cost-optimal methodology (CA EPBD 2012) and Nearly Zero-Energy Buildings (CA EPBD 2012)

Member states are busy implementing the cost-optimal methodology and NZEB. More information on the status of this implementation can be found in Implementing the Energy Performance of Buildings Directive(EPBD) – featuring country

[29] BPIE, 2011. "Europe's Buildings under the Microscope. A county-by-country review of the energy performance of buildings", October 2011, Buildings Performance Institute Europe.

[30] Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports 2012

reports. An overview about the actual requirements on the energy related characteristics of the building element "window"[31] in the member states is given in chapter 5.2.1.

Nearly Zero-Energy Buildings

Member States shall ensure that (a) by 31 December 2020 all new buildings are nearly zero-energy buildings; and (b) after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings. Member States shall draw up national plans for increasing the number of nearly zero-energy buildings. These national plans may include targets differentiated according to the category of building. Member States shall furthermore, following the leading example of the public sector, develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings.

The following article of the recast EPBD is important for the Nearly Zero-Energy Buildings:

- Article 9 'Nearly zero-energy buildings'.

A NZEB is defined as "a building that has a very high energy performance, determined in accordance with Annex I. The nearly zero or very low amount of energy required should to a very significant level be covered by energy from renewable sources, including renewable energy produced on-site or nearby" (VHK 2011). This definition was left vague to allow MS to define their own standards (DG Environment 2010). The recast EPBD requires Member States to set out a detailed application in practice of the above-mentioned definition.

Heating and cooling energy needs are part of the NZEB regulations relating to building elements part of the envelope. Besides the main indicator (primary energy for most MS), also mean U-values, thermal transmittance coefficient or transmission losses will be used as indicator by some MS.

By early 2019 (public buildings, leading the way) and 2021 (all new buildings) cost-optimal calculations and NZEB will have to meet. Therefore NZEB shall have a cost-optimal combination of building envelope and building service systems. Cost-optimal calculations for 2012 have to be reviewed for 2019/2021 (ADENE 2013).

Following the EPBD, requirements have gradually started shifting from prescriptive to a performance-based approach which is regarded as a major change in the building code trends. Major changes are also expected through the application of the cost optimality concept in the energy performance requirements as introduced by the recast of the EPBD in 2010 (2010/31/EU). Member States are required to set their national requirements in accordance with cost optimal levels by applying a harmonised calculation methodology (Article 5 and annex III of EPBD recast). Cost optimal levels should also gradually converge to nearly zero energy standards which would comprise a requirement for new buildings from 2020 onwards.

5.1.5. DANGEROUS SUBSTANCES RELATED EU DIRECTIVES

→ **REACH (EC 1907/2006).**

The REACH Regulation came into force on 1 June 2007 and deals with the Registration, Evaluation, Authorisation and Restriction of Chemical substances. It provides an improved and streamlined legislative framework for chemicals in the EU, with the aim of improving protection of human health and the environment and enhancing competitiveness of the chemicals industry in Europe. REACH places the responsibility for assessing and managing the risks posed by chemicals and providing safety information to users in industry instead of public authorities, promotes competition across the internal market and innovation.

Manufacturers are required to register the details of the properties of their chemical substances on a central database, which is run by the European Chemicals Agency (ECHA) in Helsinki. The Regulation also requires the most dangerous chemicals to be progressively replaced as suitable alternatives are developed.

Since the start of the registration at the 01.06.2008 until 30.08.2013 over 37.000 registrations for more than 7400 different substances have been sent to ECHA.

On the 16 December 2013, ECHA amended the Candidate List for authorisation with seven new substances of very high concern (SVHCs) with seven new substances. The Candidate List now contains 151 substances (http://www.echa.europa.eu).

[31] To be understood as 'building elements'

EPPA (European PVC Window Profile and Related Building Products Association) is bound by the Voluntary Commitment of the PVC industry in Europe, which sets out targets to be achieved in sustainable development. These are

- to substitute the use of lead stabilisers by 2015;
- to support all kinds of national activities with regard to the post-industrial and post-consumer recycling of used PVC-U windows in Europe (EU-15 and the enlarged EU-27); and
- to make relevant waste streams transparent in terms of audited and certified figures.

The CPR (Art. 6 (5.)) requires manufacturers to provide information in accordance with REACH art. 31 or 33 with the mandatory Declaration of Performance (DoP) for their products. By doing so, the REACH information, which was primarily understood as a "Business to Business" communication, has to be forwarded to the customer of the building product. This requirement of the CPR is additional to the "dangerous substances" declaration which has to be made within the DoP and the CE-Mark.

→ **F-Gas Regulation (Regulation (EC) No 842/2006)**

The objective of Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases is to contain, prevent and thereby reduce emissions of the fluorinated greenhouse gases covered by the Kyoto Protocol.

Fluorinated gases (F-gases) are a family of man-made gases used in a range of industrial applications. Because they do not damage the atmospheric ozone layer, they are often used as substitutes for ozone-depleting substances. However, F-gases are powerful greenhouse gases, with a global warming effect up to 23 000 times greater than carbon dioxide (CO_2), and their emissions are rising strongly[32].

The three groups of F-gases are hydro fluorocarbons (HFCs), per fluorocarbons (PFCs) and sulphur hexafluoride (SF_6) Excluded are substances controlled under Regulation (EC) No 2037/2000 of the European Parliament and of the Council of 29 June 2000 on substances that deplete the ozone layer.

Impacts of F-Gas Regulation on windows:

The placing on the market of sulphur hexafluoride SF6 (with a global warming potential of 22200) was prohibited in the EU as follows

- Windows for domestic use 4 July 2007
- Other windows 4 July 2008

SF6 was mainly used for the significant improvement of the sound insulation of insulating glazing units.

5.1.6. OTHER EU DIRECTIVES

→ **"Timber Regulation" (Regulation (EU) No 995/2010)**

Regulation (EU) No 995/2010 of the European Parliament and of the Council of 20 October 2010 laying down the obligations of operators who place timber and timber products on the market – also known as the (Illegal) Timber Regulation counters the trade in illegally harvested timber and timber products through three key obligations:

- It prohibits the placing on the EU market of illegally harvested timber and products derived from such timber;
- It requires EU traders who place timber products on the EU market to exercise 'due diligence';
- Once on the market, the timber and timber products may be sold on and/or transformed before they reach the final consumer. To facilitate the traceability of timber products economic operators in this part of the supply chain (referred to as traders in the regulation) have an obligation to keep records of their suppliers and customers.

The Regulation covers a broad range of timber products including solid wood products, flooring, plywood, pulp and paper. Not included are recycled products, as well as printed papers such as books, magazines and newspapers. The product scope can be amended if necessary.

The Regulation applies to both imported and domestically produced timber and timber products.

[32] http://ec.europa.eu/clima/policies/f-gas/index_en.htm

The Regulation is legally binding on all 27 EU Member States, which are responsible for laying down effective, proportionate and dissuasive penalties and for enforcing the Regulation.

→ **Green Public Procurement**

Green Public Procurement (GPP) is a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured.[33]

In 2004, the Council and the European Parliament adopted two directives aimed at clarifying, simplifying and modernising existing European legislation on public procurement.

Directive 2004/18/EC covers public works contracts, public supply contracts and public service contracts.

Directive 2004/17/EC covers the procurement procedures of entities operating in the water, energy, transport and postal services sectors.

In contrast with the earlier EU Directives governing procurement, the 2004 Directives contain specific reference to the possibility of including environmental considerations in the contract award process. The preamble to Directive 2004/18/EC identifies the objective of clarifying how contracting authorities "...may contribute to the protection of the environment and the promotion of sustainable development, whilst ensuring the possibility of obtaining the best value for money for their contracts."

More detailed provisions permit

- the inclusion of environmental requirements in technical specifications (Article 23(3)b);
- the use of eco-labels (Article 23(6));
- setting social and environmental conditions for the performance of contracts (Article 26);
- requiring economic operators to demonstrate they have met their environmental obligations (Article 27);
- requiring economic operators to demonstrate they can perform a contract in accordance with environmental management measures (Articles 48(2)f and 50); and
- applying award criteria based on environmental characteristics (Article 53).

The Directives thus offer a number of opportunities for GPP to be implemented, throughout the contract award process.
cited from: http://ec.europa.eu/environment/gpp/eu_public_directives_en.htm

The Energy Efficiency Directive (2012/27/EU) requires Member States to ensure that central government only purchases products, services and buildings with high energy efficiency, as long as this is cost effective, economically feasible and technically suitable.

For the use of eco-labels, a number of conditions must be met:

- Procurers are not allowed to demand that a product carries an ecolabel, but may only indicate that the criteria underpinning a certain ecolabel must be met and that the ecolabel may be used as one form of proof of compliance.
- Procurers may only use ecolabel criteria that refer to characteristics of the product or service itself or production processes, not those relating to the general management of the company.
- Procurers may only refer to ecolabels that meet a number of requirements (the Type I or ISO 14024 ecolabels, such as the EU Ecolabel, meet these requirements).
- The requirements for the label are based on scientific evidence.
- The ecolabels are adopted with the participation of all stakeholders, such as government bodies, consumers, manufacturers, distributors and environmental organisations.
- They are accessible to all interested parties.

A list of existing labels that can be used for GPP is published under http://ec.europa.eu/environment/ecolabel/ecolabel-and-green-public-procurement.html

The EU GPP is a voluntary system. However, Member States are invited to formally endorse the already developed common GPP criteria. Formal endorsement by Member States would imply that the common GPP criteria would be included in the National Action Plans and guidance on GPP which Member States have set up or are in the process of setting up.

[33] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, COM 2008

Impacts on windows:

In 2012 a study started[34] on revising the EU Green Public Procurement (GPP) criteria for "Windows and external doors. The study has been carried out by the Joint Research Centre's Institute for Prospective Technological Studies (JRC-IPTS) for the European Commission's Directorate General for the Environment.

The purpose of this pilot project was to revise the EU GPP criteria to have updated, clear, verifiable, justifiable and ambitious environmental criteria for this product group, based on a life-cycle approach and scientific evidence base. The GPP criteria could reduce considerably the administrative burden for economic operators and for public administrations implementing GPP. In addition, this work aims at collecting the scientific basis to develop other environmental policy tools such as EU Ecolabel or Ecodesign in the coming years. EU Ecolabel criteria will award the best environmental performance windows and external doors while the Ecodesign criteria that will set up the minimum environmental performance of this product group.

The criteria development process for Windows and External Doors has been put on hold. The draft criteria set developed in discussion with stakeholders from industry, NGO and member states does, in the context of existing legislation related to construction and buildings, not provide sufficient environmental benefits which would justify separate Green Public Procurement provisions.

Cited from: http://susproc.jrc.ec.europa.eu/windoors/index.html

5.2. MEMBER STATE LEGISLATION

Member States are not allowed to set requirements for products and aspects that are already regulated at EU level. This means that the performance information to be provided with window products cannot be regulated by Member States as this is already regulated through the CPR and the harmonised standards developed in that context.

However, Member States are allowed to set minimum performance requirements to construction products if these are not already incorporated in the relevant harmonised standards and it does not result in a restriction on the free movement of goods within the EU internal market.

Experience from the Background study on the Ecodesign Working Plan learned that some building experts state that it is preferred not to have EU wide performance requirements on building components such as windows, so that individual Member States have the opportunity to regulate such performance at national level. This is in line with the principles of subsidiarity and proportionality[35].

5.2.1. REQUIREMENTS ON ENERGY CHARACTERISTICS

The above is confirmed by the approach applied by the EPBD, which lays down requirements upon Member States as regards the application of minimum requirements to the energy performance of *"building elements[36] that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced;"* (Article 1.2.c.ii).

The current status is that in Member States that have correctly and timely implemented the EPBD there are requirements related to the energy performance (holistic approach) of new buildings and buildings receiving major renovation. Usually this does not exclude the existence of prescriptive requirements for building components with a very strong influence on the energy performance of the whole structure (or components with relatively long lifetimes), which includes windows, as the national legislator wants to ensure that a good building energy performance considers structural elements and is not only achieved by adding components that are easily removed, replaced or have a relatively short useful life. In other words, prescriptive requirements should ensure an adequate minimum energy performance on a longer term.

---

[34] http://susproc.jrc.ec.europa.eu/windoors/index.html

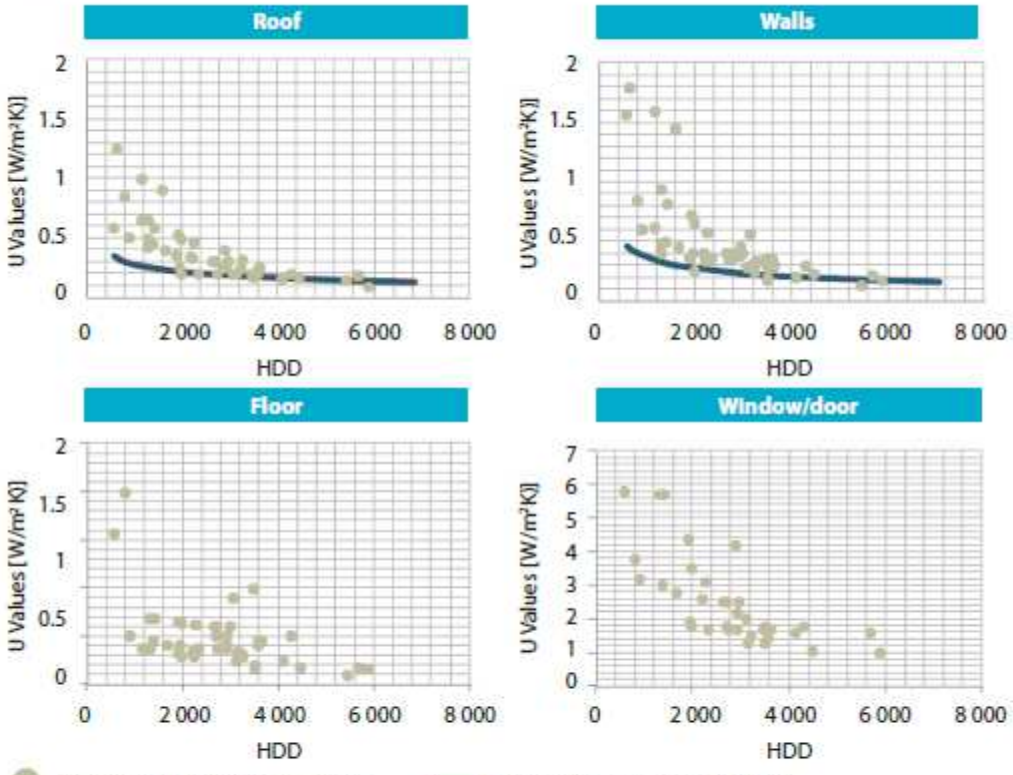
[35] The principle of subsidiarity is defined in Article 5 of the Treaty on European Union. It ensures that decisions are taken as closely as possible to the citizen and that constant checks are made to verify that action at Union level is justified in light of the possibilities available at national, regional or local level. Specifically, it is the principle whereby the Union does not take action (except in the areas that fall within its exclusive competence), unless it is more effective than action taken at national, regional or local level. It is closely bound up with the principle of proportionality, which requires that any action by the Union should not go beyond what is necessary to achieve the objectives of the Treaties.
(from: http://europa.eu/legislation_summaries/glossary/subsidiarity_en.htm)

[36] The recast EPBD defines building elements as either a technical building system or an element of the building envelope which separate the interior from the outdoor environment, typically roof, floors, walls and the filling of recesses. According to DG ENER "even if the elemental requirements can potentially be fulfilled by single products, the elemental requirements shouldn't be understood product requirements".

A study by BPIE shows an inventory of the level of minimum requirements for various building shell elements, including windows.

Figure 11: Building envelope insulation requirements[37]

Source : BPIE survey. Cost optimality line is based on the analysis undertaken by Ecofys in the study on U-Values for Better Energy Performance of Buildings, 2007



	MT	CY	PT	GR	ES	IT	LV[1]	FR	BG	BE	NL	IE	HU	SI
HDD[5]	560	782	1 282	1 663	1 842	1 907	1 970	2 483	2 686	2 872	2 902	2 906	2 922	3 053
Roof	0.59	0.85	0.9-1.25	0.35-0.5	0.45-0.65	0.32-0.65	0.2κ-0.35κ	0.2-0.25	0.3	0.3	0.4	0.25	0.25	0.2
Walls	1.57	0.85	1.45-1.8	0.4-0.6	0.57-0.94	0.33-0.62	0.25κ-0.5κ	0.36-0.40	0.35	0.4	0.4	0.37	0.45	0.28
Floor	1.57	2		0.45-0.5	0.62-0.69	0.29-0.38	0.2κ-0.35κ	0.37-0.40	0.5	0.6	0.4	0.37	0.45	0.9
Window/ Door	5.8	3.8		2.6-3.2	3.1-5.7	1.3-3.7	1.8κ-2.4κ	1.7-1.9	1.8	2.5	4.2	2.2	1.6	1.1-1.6

	UK[3]	RO	DE	SK	CH[2]	DK	CZ	AT	PL	LT	EE	SE[4]	NO	FI
HDD	3 115	3 129	3 239	3 453	3 482	3 503	3 571	3 573	3 616	4 094	4 444	5 444	5 646	5 850
Roof	0.2	0.2	0.24	0.19	0.17 or 0.2	0.2	0.24	0.2	0.25	0.16	0.15-0.2		0.18	0.09
Walls	0.3	0.56	0.24	0.32	0.17 or 0.2	0.3	0.3	0.35	0.3	0.2	0.2-0.25		0.22	0.17
Floor	0.25	0.35	0.3		0.17 or 0.2	0.2	0.45	0.4	0.45	0.25	0.15-0.2	0.4-0.6	0.18	0.16
Window/ Door	2	1.3		1.7	1.3	1.8	1.7	1.4	1.7	1.6	0.7-1.4		1.6	1.0

NOTES

(1) Depending on type of building (residential, public, industrial etc.) where κ is a temperature factor, κ = 19/(Tin-Tout), Tin and Tout denote indoor and outdoor temperatures, respectively.
(2) Depending on evidence of thermal bridges
(3) For England & Wales
(4) Depending on type of building (residential and non residential) & type of heating (electric and non electric). These represent overall U values
(5) Mean HDD values for period 1980-2004 based on Eurostat data

LEGEND
HDD: Heating degree days.

[37] The window/door U value for "NL" seems unrealistically high and shall be checked.

This BPIE study shows that windows have to meet higher thermal insulation standards (i.e. a lower U-value) in relatively colder climates (the U-value of the window decreases as the average number of heating degree days increases). Also the cost optimal U-values published by EURIMA/Ecofys in 2007 are represented, showing that U-value requirements of the Member States could be made more demanding.[38]

In principal there are two possible ways to tackle the energy efficiency of buildings by setting relevant requirements:

1. To set requirements for the total energy consumption of the building for heating and cooling. Therefore a holistic approach is necessary to optimize the energy demand of the building.
2. To set requirements for components energy related characteristics.

In the following table the current defined requirements in the member states are presented. The data is mainly based on the booklet "*Implementing the EPBD – Featuring country reports 2012*" and on additional information by some experts. This pre--analysis was used to generate a questionnaire to ask further national experts about the energy related requirements of windows in the national legislation. The national experts were also asked to answer some general questions.

1. Are there different requirements/methods for new buildings and refurbishment?
2. Are there different requirements/methods for residential buildings and non-residential buildings
3. Is the summer situation (overheating) considered?
4. If the summer situation (overheating) is addressed, is there a direct requirement for the window/transparent element?

All the information

submitted by national experts and the stakeholders were used to draft the following table. It has to be noted that for some Member States different requirements were submitted by the experts.

Table 15: Requirements in the Member States on the energy related characteristics of windows

	New buildings				Existing buildings / refurbishment			
	Residential buildings		**Non Residential buildings**		**Residential buildings**		**Non Residential buildings**	
	Window	**Roof Window**	**Window**	**Roof Window**	**Window**	**Roof Window**	**Window**	**Roof Window**
Austria	Requirement for the heating demand and		Requirement for the heating and cooling demand and		Requirement for the heating demand if extensive refurbishment and		Requirement for the heating and cooling demand if extensive refurbishment and	
	$U_W \leq 1.4$	$U_W \leq 1.7$	$U_W \leq 1.4$	$U_W \leq 1.7$	$U_W \leq 1.4$	$U_W \leq 1.7$	$U_W \leq 1.4$	$U_W \leq 1.7$
	Summer situation has to be considered according to national guideline				If extensive refurbishment the summer situation has to be considered according to national guideline			
Belgium Flemish Region	$U_W \leq 1,8$ (in 2016 raised to max. 1.5, with Ug max 1.1)	no info	$U_W \leq 1,8$	no info	$U_W \leq 1,8$	no info	U_W U≤1,8	no info
Belgium Wallonie	$U_W \leq 1,8$	no info	$U_W \leq 1,8$	no info	$U_W \leq 1,8$	no info	$U_W \leq 1,8$	no info
Belgium Brussels Region	Situation in 2011 : Uw-2,5 and Ug-1, Uw=0.85 W/m²K in 2015 (advised)	no info	no info	no info	no info	no info	no info	no info

[38] BPIE, 2011. "Europe's Buildings under the Microscope. A county-by-country review of the energy performance of buildings", October 2011, Buildings Performance Institute Europe.

Bulgaria	$U_W \leq 1.7$	no info	$U_W \leq 1.7$	no info	$U_W \leq 1.7$	no info	$U_W \leq 1.7$	no info
Croatia	$U_W \leq 1.8$	$U_W \leq 1.8$	$U_W \leq 1.8$	$U_W \leq 1.8$	$U_W \leq 1.8$	$U_W \leq 1.8$	$U_W \leq 1.8$	$U_W \leq 1.8$
Cyprus	$U_W \leq 2.8$ g<0,3 (for summer month)	$U_W \leq 2.8$ g<0,3 (for summer month)	no info	no info	$U_W \leq 2.8$ g<0,3 (for summer month)	$U_W \leq 2.8$ g<0,3 (for summer month)	no info	no info
Czech Republic	Skylights and roof windows in slope ($0^0 - 45^0$): Uw: 1,4 Windows and roof windows ($45^0 - 90^0$): 1,5		Skylights and roof windows in slope ($0^0 - 45^0$): Uw: 1,4 Windows and roof windows ($45^0 - 90^0$): 1,5		Skylights and roof windows in slope ($0^0 - 45^0$): Uw: 1,4 Windows and roof windows ($45^0 - 90^0$): 1,5		Skylights and roof windows in slope ($0^0 - 45^0$): Uw: 1,4 Windows and roof windows ($45^0 - 90^0$): 1,5	
Denmark	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -33 2015 -17 2020 0	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -10 2015 0 2020 10	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -33 2015 -17 2020 0	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -10 2015 0 2020 10	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -33 2015 -17 2020 0	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -10 2015 0 2020 10	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -33 2015 -17 2020 0	Requirement on the complete building. Besides that, the energy gain kWh/m2year for the window system (reference window) must not be less than: 2010 -10 2015 0 2020 10
Estonia	no requirements for components		no requirements for components		no requirements for components		no requirements for components	
Finland	$U_W \leq 1,0$ ($U_W \leq 1,8$ *)(also offices) *requires compensation calculation				quite complicated calculation			
France	For new buildings: No direct requirement for components. Requirements on the whole building envelope performance. Requirement on the overall consumption of the building to be < 50 kWh/ m2 /year in primary energy. The only component requirement for new buildings are related to summer comfort. There is maximum Sw values for windows, with different requirements for facade and roof windows.		no info	no info	For big renovation (more than 1000 m²), a complete building calculation shall be carried out. For any other renovation, the following applies: Sliding window $U_W \leq 2,6$ Other $U_W \leq 2.3$	Roof windows shall be equipped with mobile solar shading leading to a solar factor less than 0.15.	no info	no info
Germany	No direct requirement for components. Requirement on the complete building		No direct requirement for components. Requirement on the complete building		$U_W \leq 1.3$	$U_W \leq 1.4$	$U_W \leq 1.3$	$U_W \leq 1.4$

	and envelope. Reference values for the components are given (U_W=1.3/ U_W=1.4 (roof window)).		and envelope. Reference values for the components are given. Requirement on the average U value of transparent components General: U=1,9 (2016: U=1,5); Curtain Wall: U=1,9 (2016; U=1,5); Roof lights: U=3,1 (2016: 2,5)					
	Summer situation (risk of overheating) is addressed DIN 4108-2.				No requirement for the summer situation			
Greece	U_w≤2.6-3.0 (depends on climatic zone)	no info	U_w≤1.8-2.2 (depends on climatic zone)	no info	U_w≤2.6-3.0 (depends on climatic zone)	no info	U_w≤1.8-2.2 (depends on climatic zone)	no info
Hungary	Metal frame U_W ≤2.0 Non-metal frame U_W ≤1.6	no info	no info	no info	Metal frame U_W ≤2.0 Non-metal frame U_W ≤1.6	no info	no info	no info
Ireland	U_w≤1.6 Average of window, roof windows and doors Individual component U≤3,0		no info	no info	U_w≤1.6 Average of window, roof windows and doors Individual component U≤3,0		no info	no info
Italy	U_W ≤2,0-4,6 (depends on climatic zone (6 in total))		no info	no info	U_W ≤2,0-4,6 (depends on climatic zone (6 in total))		no info	no info
Lithuania	Uw≤1,6-0,7 (depends on energy class (B,A,A,+,A++)) values of the building, depend also on temp. difference		Uw≤1,9-1,1 (depends on energy class (B,A,A,+,A++)) values of the building, depend also on temp. difference		Same as for new buildings		Same as for new buildings	
Luxembourg	U_w≤1.5 (2008 value)	no info	no info	no info	U_w≤1.5 (2008 value)	no info	no info	no info
Latvia	U_W ≤1,8	U_W ≤1,8	U_W ≤2,2-2,4 non-resid./Industrial	U_W ≤2,2-2,4 non-resid./Industrial	U_W ≤1,8	U_W ≤1,8	U_W ≤2,2-2,4 non-resid./Industrial	U_W ≤2,2-2,4 non-resid./Industrial
Malta	U_W ≤5,8 Limits on the window fractions are set 15%-25% (except showrooms) Window area is also restricted due to summer situation,	no info	no info	no info	U_W ≤5,8 Limits on the window fractions are set 15%-25% (except showrooms) Window area is also restricted due to summer situation, values differ per orientation	no info	no info	no info

	values differ per orientation							
Nether-lands	Max. U_W 1,65 W/m².K.				For major renovation (> 25% of area) requirements are at level of new buildings, for smaller renovations the requirements depend on the original requirements at time the building was erected or on the actual performance.			
Norway[39]	U_W ≤1,6: This is the "minimum requirement" (upper limit of value), and must be compensated by other energy measures. The "ordinary requirement is U_W ≤1,2. Both values apply to the average value of transparent elements. A limit for the total area of transparent elements is also given.		U≤1,6		The intention is "that same requirements as for new buildings applies" But If minor refurbishments, then requirements applicable on the time the building was erected, can be chosen..			
Poland	For Ti> 16°C U_W≤1.3 (1.1.2014) U_W≤1.1 (1.1.2017) U_W≤1.3 (1.1.2021)	For Ti> 16°C U_W≤1.5 (1.1.2014) U_W≤1.3 (1.1.2017) U_W≤1.1 (1.1.2021)	U_W≤1.3	U_W≤1.5	For Ti> 16°C U_W≤1.3 (1.1.2014) U_W≤1.1 (1.1.2017) U_W≤1.3 (1.1.2021)	For Ti> 16°C U_W≤1.5 (1.1.2014) U_W≤1.3 (1.1.2017) U_W≤1.1 (1.1.2021)	U_W≤1.7-2.6	U_W≤1.7-1.8
	In all kinds of buildings total solar energy transmittance (solar factor, g-value) of windows, glass and transparent partitions calculated according to formula: g = fc•gn where: gn - coefficient of total sun energy transmission for a given type of glazing, fc - coefficient of radiation reduction because of applied shadowing device must not be greater in summer period than 0,35. The requirement is not applicable for vertical surfaces and surfaces inclined more than 60 degree to the level, headed from North-West to North-East (North ±45 degree), windows guarded against sun radiation by shading device fulfilling conditions listed before and windows of the area lesser than 0,5 m2							
Portugal	U_W≤2.4-2.9; g<0,15 (light building) g<0,56 (medium, heavy building) Energy for cooling is limited to 15-18 kWh/m2a	no info	no info	no info	U_W≤2.4-2.9; g<0,15 (light building) g<0,56 (medium, heavy building) Energy for cooling is limited to 15-18 kWh/m2a	no info	no info	no info
Romania	U_W≤1.3	no info	requirement on the average U value of the envelope		no info	no info	no info	no info
Slovak Republic	U_W ≤1,4 (recommended 1,0; target value 0,60); requirement on the		requirement on the average U value of the envelope		as for new, if not realisable then U_W ≤1,7		requirement on the average U value of the envelope	

[39] Norway is not a member of the EU but an associated country

	average U value of the envelope - STN 73 0540-2:2012					
Slovenia	no info	no info	no info	no info	no info	no info
Spain	Requirement on energy demand and consumption of the building, depending on climate zones. Moreover, Uw maximum values depending on climate zones (from 5.7 to 2.5), table 2.3. Guiding values to fulfil energy demand of the building (from U_W 5.7 to U_W 1.2 W/m² K, depending on climate zones and solar gains). Guiding values for solar factor in specific summer climate zone (zone 4) g factor less than 0,55-0,57 depending on the window orientation.		A or B class for the building, according to Spanish Energy rating of buildings.	When the refurbishment of the building consists on more than 25% of the envelope: the new demand of the refurbished building shall be less than the demand of the reference building (building that fulfilled the 2006 version of the Spanish Code). U_w values in Annex D, depending on climate zones, % windows on façade and orientation. If the refurbishment does not cover more than 25% of the envelope: table 2.3 (Uw values from 5.7 to 2.5, depending on climate zones).	Percentage of demand savings (between 10-25%) related to the reference building (building that fulfilled the 2006 version of the Spanish Code). These savings depend also of the summer climate zone	
Sweden	Requirement only on the average U-value of the envelope U=0,4 and the energy demand of the building depending on Climate (North, South, Mid) and source of energy (electrical, other) Maximum U-value requirement for Sweden according to building regulations (if a total U-middle value for the whole building is not calculated) is 1,3 W/m2K and for houses heated with electricity 1,1 W/m2K for areas up to 100 m2.		Requirement only on the average U-value of the envelope U=0,4 and the energy demand of the building depending on Climate (North, South, Mid) and source of energy (electrical, other)	For major refurbishments in existing buildings, the same requirements as for new buildings are required. No rules for just replacement of windows.	no info	no info
United Kingdom[1)]	Requirements (CO2 Emission, limited solar gains in summer, etc.) for the complete building/building fabric) and U_W≤2.2			U_W≤1.6 or Energy Label ≤C		

1) Version April 2014

The following figures give examples of how (selected) Member States communicate the requirements to stakeholders.

Figure 12 Detailed example Belgium (requirements as of 2016)[40]:

[40] Source: http://www.energiesparen.be/epb/eisentransmissie

MAXIMAAL TOELAATBARE U-WAARDEN	
Constructiedeel	**U_{max} (W/m^2K)**
1 SCHEIDINGSCONSTRUCTIES DIE HET BESCHERMD VOLUME OMHULLEN, met uitzondering van de scheidingsconstructies die de scheiding vormen met een aanpalend beschermd volume	
1.1 TRANSPARANTE SCHEIDINGSCONSTRUCTIES, met uitzondering van deuren en poorten (zie 1.3), lichte gevels (zie 1.4), glasbouwstenen (zie 1.5) en scheidingsconstructies andere dan glas (zie 1.6)	1.5 en $U_{g,max}$ = 1.1

Figure 13 Detailed example Netherlands[41]:

4. Ramen, deuren, kozijnen en daarmee gelijk te stellen constructieonderdelen in een in het eerste tot en met derde lid bedoelde scheidingsconstructie hebben een volgens NEN 1068 bepaalde warmtedoorgangscoëfficiënt van ten hoogste 1,65 W/m².K.

Figure 14 Detailed example Germany[42]

Tabelle 1: Höchstwerte der Wärmedurchgangskoeffizienten bei erstmaligem Einbau, Ersatz und Erneuerung von Bauteilen

Zeile	**Bauteil**	Maßnahme nach	Wohngebäude und Zonen von Nichtwohngebäuden mit Innentemperaturen mindestens 19°C	Zonen von Nichtwohngebäuden mit Innentemperaturen von 12 bis unter 19°C
			Höchstwerte der Wärmedurchgangskoeffizienten U_{max} 1)	
1	2	3	4	5
1	Außenwände	Nr. 1 a bis d	0,24 W/(m²·K)	0,35 W/(m²·K)
2 a	Außen liegende Fenster, Fenstertüren	Nr. 2 a und b	1,30 W/(m²·K) 2)	1,90 W/(m²·K) 2)
2 b	Dachflächenfenster	Nr. 2 a und b	1,40 W/(m²·K) 2)	1,90 W/(m²·K) 2)
2 c	Verglasungen	Nr. 2 c	1,10 W/(m²·K) 3)	keine Anforderung
2 d	Vorhangfassaden	Nr. 6 Satz 1	1,50 W/(m²·K) 4)	1,90 W/(m²·K) 4)
2 e	Glasdächer	Nr. 2 a und c	2,00 W/(m²·K) 3)	2,70 W/(m²·K) 3)
3 a	Außen liegende Fenster, Fenstertüren, Dachflächenfenster mit Sonderverglasungen	Nr. 2 a und b	2,00 W/(m²·K) 2)	2,80 W/(m²·K) 2)
3 b	Sonderverglasungen	Nr. 2 c	1,60 W/(m²·K) 3)	keine Anforderung

Certain member States, have also introduced legal obligations related to ventilation in case the building envelop is changed. As an example, Belgium requires establishing air supply features in case windows are replaced[43]. It doesn't state however the ventilation must be incorporated in the window itself. In how much such requirements affect the design of windows for either new builds or renovation has to be assessed and discussed with stakeholders. Open able windows and windows with integrated ventilation devices (e.g. ventilation grilles or ventilation flaps) are some of the important measures for ensuring proper ventilation in new and energy renovated buildings, as it supports good indoor air quality

[41] Source: http://www.bouwbesluitonline.nl/Inhoud/docs/wet/bb2012/hfd5/afd5-1/art5-3/lid4

[42] Source: http://www.enev-online.org/enev_2009_volltext/enev_2009_anlage_03_anforderungen_aenderung_aussenbauteile_ab_1._juli_2013.htm#Anlage%203_Nr_7._Anforderungen

[43] Source: http://www.energiesparen.be/epb/eisenventilatie

and summer comfort. Operable windows and window integrated ventilation are – of course - also important in existing buildings for the same reasons.

5.2.2. REQUIREMENTS FOR OTHER CHARACTERISTICS

→ **Life cycle assessment**

At present there are no legal requirements in the Member States regarding life cycle assessment of building elements. All schemes for the evaluation of the sustainability of building are voluntary.

→ **Release of dangerous substances**

VOC emissions

France is the only country in Europe where there are requirements for the release of dangerous substances (VOC emissions) to the indoor air caused by windows.

According to "Decree n° 2011-321", published on March 25th, 2011 constructions products (but beginning 2017 also decoration and furnishing products) must be labelled with an emission classification on the basis of VOC emissions test. As a matter of course also windows must be signed with an adequate label.

This is mandatory in France since 1. January 2012 for products that are traded in France. Since 1. September 2013 also products which are already placed on the French market must have that label.

Figure 15: French VOC label

The basis of testing is ISO 16000. The French document *"Protocole de préparation des éprouvettes d'essai de portes et de fenêtres(mars 2012)"* gives recommendations for the preparation of the test specimen for the measurement of VOC emissions for windows.

5.3. THIRD COUNTRY LEGISLATION

The availability of minimum requirements (or minimum energy performance standards - MEPS) for buildings and/or building components in third (non EU countries) can be checked on various websites and a short survey shows that many countries have MEPS for buildings in place.

The World Energy Council (WEC) offers an online database on energy efficiency policies and measures[44].

The Sustainable Buildings Centre offers the BEEP database as the global one stop-shop for Building Energy Efficiency Policies from all over the world[45].

The Global Buildings Performance Network (GBPN) has recently reviewed 25 state of the art building energy efficiency codes using 15 criteria developed with some of the world's leading experts in the field[46].

Providing a detailed picture of the actual building codes (expressed in U-value per component for instance) from all over the world however is much more elaborate as most websites do not always provide a full description of these codes.

[44] http://www.wec-policies.enerdata.eu/measure.php#resultat

[45] http://www.sustainablebuildingscentre.org/pages/beep

[46] http://www.gbpn.org/databases-tools/purpose-policy-comparative-tool

5.4. LABELLING INITIATIVES

Labelling of windows, be it an energy label or an endorsement label, is done in several countries, within and outside the EU.

5.4.1. ENERGY LABELLING

→ **Labels in Europe**

Denmark

Vindues Industrien is the operator of the voluntary window rating scheme in Denmark, using seven efficiency classes from red to green and labelled A to G.

The rating of the window depends on the calculated energy demand for the heating season. The following characteristics of the window are taken into account:

- U_w in W/m2K — Thermal transmittance of the window
- g — solar energy transmittance of the glazing
- A_g/A_w — ratio of the area of the glazing to the window area

The energy demand of the window is calculated for a dimension of 1,23 m x 1,48 m (standard dimension according to EN 14351-1) by the following formula (seasonal approach):

$$E_{ref} = 196{,}4 \cdot g \cdot \frac{A_g}{A_W} - 90{,}36 \cdot U_W$$

For very energy efficient windows this score is positive (>0), for average and worse windows the score is negative (<0) indicating an overall net energy loss.

Figure 16: Danish energy efficiency rating of windows - classes

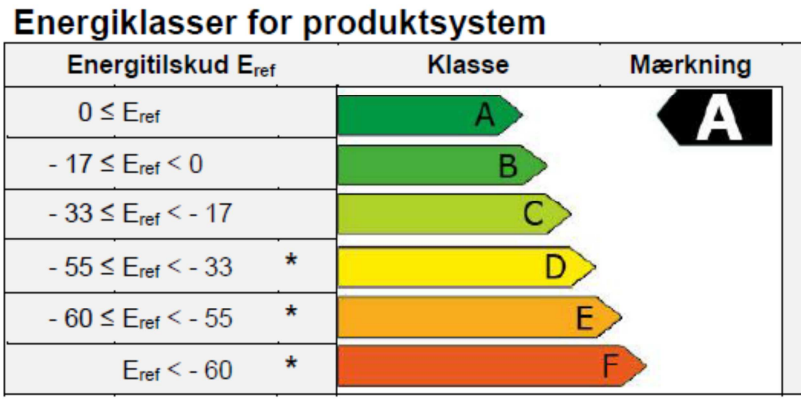


Figure 17: Danish energy efficiency rating of windows - information

Energidata for produktsystem **Referencevindue:** 1-fløjet vindue med oplukkelig ramme i den europæiske standardstørrelse 1,23 x 1,48 m	
E_{ref} = 196,40 · g_w – 90,36 · U_w	+17,2 kWh/m²
U_w : U-værdi	0,85 W/m²K
g_w : solenergitransmittans	0,48
A_g/A_w : glasandel	0,76

Standardrude:	3 lags rude 4-18-4-18-4 mm
U_g : center U-værdi	0,62 W/m²K
g_g : solenergitransmittans	0,63
LT : lystransmittans	0,74
L_λ : ækv. varmeledningsevne spacer	0,3485 W/mK

Er vinduessystemet underlagt kontrol	**Ja**	**Nej**
i henhold til VinduesIndustriens Tekniske Bestemmelser for fremstilling af vinduer og yderdøre 7.udgave, rev. 2 – 2010	✓	

The Danish label displays the following information:

1. The rating level – A to F
2. The energy rating e.g. +17.2 kWh/(m²)
3. The window U value e.g. 0.85 W/(m²·K)
4. The solar heat gain coefficient of the window e.g. g_W=0.48
5. The ratio of glass to window area e.g. Ag/Aw=0.76
6. The U value of the glazing e.g. U_g=0.85 W/(m²·K)
7. The solar heat gain coefficient of the glazing e.g. g_g=0.63
8. The light transmittance of the glazing e.g. LT=0.70

The new regulatory requirements are written into the Danish Building Code (BR10). According to the building code the energy gain through the window in the heating season must not be less than – 33 kWh/m²/year; meaning a C rated window according to the Danish label. It is also expected that the statutory requirement is upgraded to B-rated windows in 2015.

Finland

A window energy labelling scheme in Finland is operated by Energia Ikkuna. The label itself allows seven classes, starting with class A++ and ending with class (E-G).

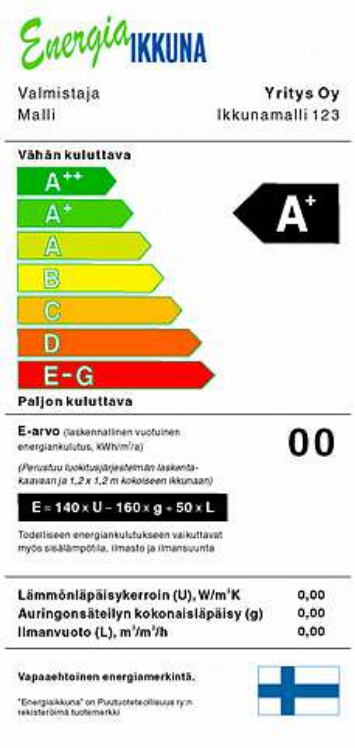
The rating of the window depends on the calculated energy demand for the heating season. The summer situation is not considered. The following characteristics of the window are taken into account:

- U_w in W/m2K — Thermal transmittance of the window
- g_w — solar energy transmittance of the window
- L in $m^3/(m^2h)$ — air-tightness of the window

The energy demand of the window is calculated for a dimension of 1,23 m x 1,48 m by the following formula (seasonal approach):

$$E = 140 \cdot U_W - 160 \cdot g + 20 \cdot L$$

Figure 18: Finland energy efficiency rating of windows - information



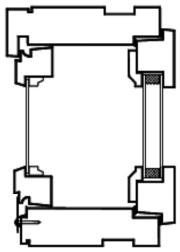
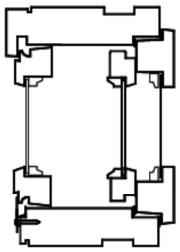
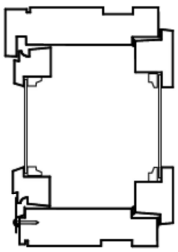
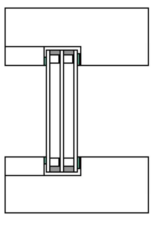
The definition of the individual classes is as follows

A++	45 ≥ E
A+	65 ≥ E > 45
A	85 ≥ E > 65
B	105 ≥ E > 85
C	125 ≥ E > 105
D	145 ≥ E > 125
E-G	E > 145

The Finnish label displays the following information:

1. The rating level – A^{++} to E-G
2. The energy rating e
3. The window U value in W/(m²·K)
4. The solar heat gain coefficient of the complete window g
5. The air leakage rate L in $m^3/(m^2h)$ at 50 Pa

Figure 19: Default values of air leakage L for different types of windows[47]

					
0,3 $m^3/m^2/h$	0,3 $m^3/m^2/h$	0,3 $m^3/m^2/h$	0,3 $m^3/m^2/h$	0,3 $m^3/m^2/h$	0,1 $m^3/m^2/h$

France

The "Union des Fabricants de Menuiseries Extérieures" (UFME) is the operator of an voluntary energy labelling scheme for windows in France. [48]

The calculation of the energy rating is based on the energy demand for the heating season and the cooling demand for the summer. Additionally a so called "summer comfort" is calculated and is equivalent to the calculated cooling demand.

The UFME approach considers three different climatic zones in France and distinguishes between windows and roof windows.

The following characteristics of the window are taken into account:

- U_w in W/m2K — Thermal transmittance of the window/roof window
- S_w — solar energy transmittance of the complete window

The formulas for the calculation of the energy rating are given below

[47] Kari Hemmilä; Experiences of Piloting Window Energy Rating System in Finland; GLASS PROCESSING DAYS 2005

[48] Sourced from: http://www.etiquette-energie-menuiserie.fr/e2mf

Table 16: Formulas for the calculation for the energy rating of windows

	Heating	Cooling	Total
Z1	78,59 + 8,55Uw - 21,30Sw	-2,77 + 9,46Sw	75,82 + 8,56Uw - 11,86Sw
Z2	66,34 + 7,11Uw - 31,04Sw	-4,93 + 17,75Sw	61,40 + 7,15Uw - 13,41Sw
Z3	50,81 + 5,21Uw - 40,56Sw	-8,12 + 37,07Sw	41,78 + 4,95Uw

Table 17: Formulas for the calculation for the energy rating of roof windows

	Heating	Cooling	Total
Z1	70,52 + 9,24Uw - 27,45Sw	-2,51 + 9,69Sw	68,01 + 9,20Uw - 17,59Sw
Z2	56,36 + 7,57Uw - 31,31Sw	-5,42 + 25,62Sw	49,80 + 7,02Uw
Z3	25,18 + 2,78Uw - 16,99Sw	-4,96 - 0,23Uw + 39,55Sw	20,22 + 2,54Uw + 22,56Sw

The classification of an individual window/roof window is achieved by the means of comparing the total energy demand and cooling demand of the window/roof window with the total energy demand and cooling demand of a reference window/roof window. The classes itself are defined by the relative improvement of the actual window with the reference window.

Table 18: Definition of the classes for a window

	Improvement of the total energy demand compared to the reference window		Summer comfort (energy consumption for cooling in kWh/m^2)		
	min	**max**	**min**	**max**	
A	26,0 %		0.00	1.50	A
B	24,5 %	26,0 %	1.50	3.00	B
C	22,0 %	24,5 %	3.00	5.00	C
D	19,0 %	22,0 %	5.00	7.00	D
E	16,0%	19,0 %	7.00	10.00	E
F	13,0%	16,0%	10.00	15.00	F
G		13,0%	15.00		G

Table 19: Definition of the classes for a roof window

	Improvement of the total energy demand compared to the reference window		Summer comfort (energy consumption for cooling in kWh/m^2)		
	min	**max**	**min**	**max**	
A	19.5 %		0.00	1.00	A
B	16.0 %	19.5 %	1.00	1.50	B
C	13.0 %	16.0 %	1.50	2.00	C
D	10.0 %	13.0 %	2.00	5.00	D
E	7.0 %	10.0 %	5.00	8.00	E
F	4.0 %	7.0 %	8.00	11.00	F

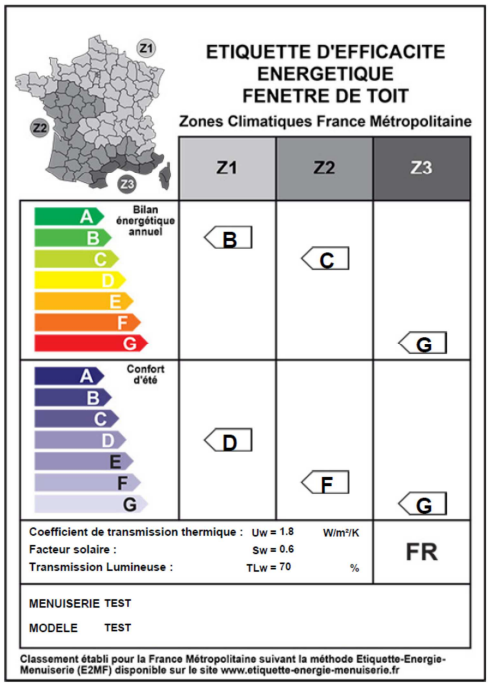
G	4.0 %	11.00	G

The definition of the reference window/roof window is given below.

Table 20: Reference window/roof window

	Window	Roof window
U_W	4.9	3.3
S_W	0.7	0.48

Figure 20: UFME energy efficiency rating of roof windows - information



Germany

The ift Rosenheim has developed a methodology for determining energy efficiency parameters of a window and attribute it with an appropriate energy rating. The basis for evaluation of energy efficiency has been developed by the International Committee ISO TC1632 SC2 "heat calculation", ISO 18292: 2010-12 "Energy performance of fenestration systems for residential buildings - Calculation procedure."

The ift methodology is proposing an assessment method relating to the calculation of the energy efficiency of windows and the relevant labelling. The calculation is based on a simplified hourly simulation (according to EN 13790[49]) of a single room

- with artificial climatic data (external temperature and irradiance for three “winter” or heating days and three “summer” or cooling days
- with standardized window dimensions (1,23 x 1,48 m²)
- an averaged orientation of the windows.

[49] EN 13790 is currently being revised

The following parameters of the window are taken into account:

- U_w in W/m^2K Thermal transmittance of the window/roof window
- A_g/A_W ratio of the area of the glazing to the window area
- g solar energy transmittance of the glazing
- L in $m^3/(m^2h)$ air-tightness of the window
- F_c or g shading coefficient of a sun shading device / shutter and solar energy transmittance of the combination glazing/sun shading respectively
- α in ° inclination of the window (roof windows)

In contrast to all other labelling schemes in Europe the ift Rosenheim approach does not consider real local climate but uses artificial climates for a so called heating day and a cooling day to consider the heating demand and also the cooling demand of a building. The approach of that concept is, that the label itself is not restricted to a special climate but can give relevant information to the end user overall Europe. Dependent of the location of building the user has to decide if the heating situation is dominant or the cooling situation. Additionally the methodology allows considering different parameters for the calculation of the heating and cooling load. So for the cooling situation the effect of a sun shading device can be taken into account. Without that approach the calculation of the heating demand and the cooling demand would lead to misleading results. So the **ift** methodology allows considering the effects of a dynamic window.

The voluntary label shown below is stating the following major information:

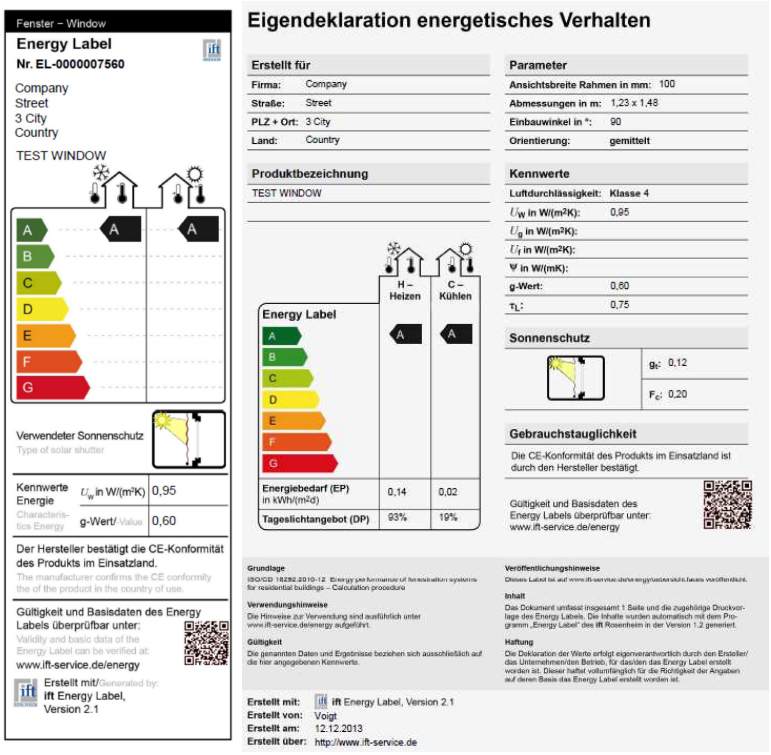
1. Label number (and QR code) as registered at ift Rosenheim - allows the end user to verify the authenticity of the label
2. Two rating levels – A to G for heating and also for cooling
3. The type of sun shading considered (external, internal, integrated)
4. The window U value e.g. 0.95 $W/(m^2 \cdot K)$
5. The solar heat gain coefficient of the glazing e.g. g=0.60

The related “self declaration” (also shown below) is not attached to the product directly but serves for stating more information if necessary:

6. Width of the frame A_f e.g. 100 mm
7. Dimension of the window 1.23 m x 1.48 m
8. Inclination of the window e.g. 90° (vertical)
9. Air tightness class e.g. Class 4
10. U value of the window and of the components frame, glazing etc.
11. The light transmittance of the glazing e.g. τ_v=0.75
12. The total solar energy transmittance of the combination glazing/sun shading e.g. 0.12
13. The shading coefficient of the sun shading device e.g. 0.20
14. The calculated energy demand for heating and cooling
15. The daylight potential according to ISO 18292 for the winter and summer situation

All parameters necessary for the calculation are based on the product standard for windows EN 14351-1. Via the website http://www.ift-service.de/energy/energy/start.faces all window manufacturers are able to generate a label for their product.

Figure 21 : ift Rosenheim energy rating label and self-declaration for windows



Italy

Two independent voluntary labelling schemes were launched in Italy in summer 2014 and in spring of 2015.

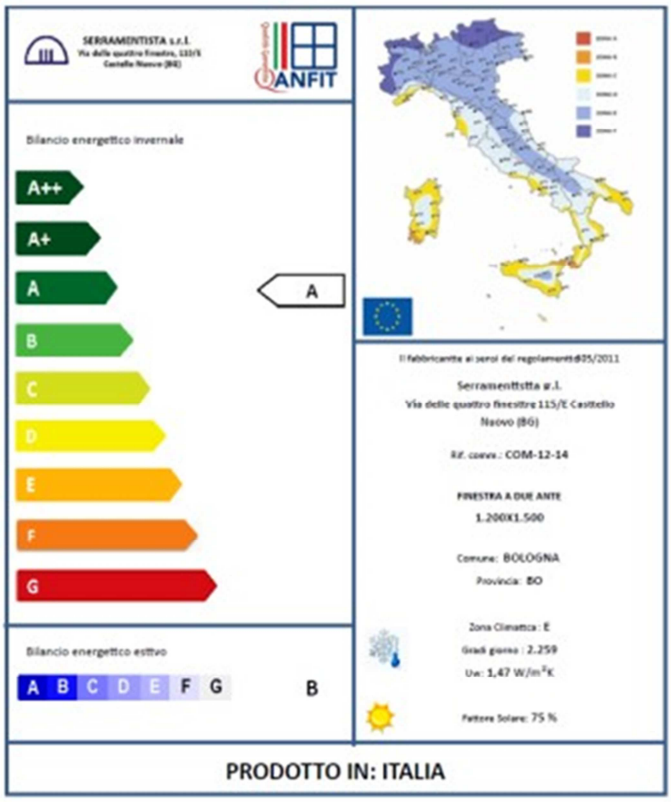
Rating scheme of ANFIT

ANFIT is the National association for the protection of windows Made in Italy. ANFIT has launched its Rating scheme and the corresponding label in summer 2014.

As it can be seen in **Error! Reference source not found.** the ANFIT rating scheme leads to a separate classification for winter and summer. For the winter (heating) there are 9 classes in total (A++ to G); for the summer there are the well-known seven classes A to G. Italy is divided in 6 climatic zones. The energy label is only valid for the zone where the window is installed. Therefore the location where the window is installed must be known before drafting the label.

The energy performance for the winter is only based on the thermal transmittance of the window U_W. The energy performance for the cooling is based on the transmitted solar radiation of the window. Therefore a fixed daily solar irradiation of 2 MJ/m^2 is used independent of the climate zone.

Figure 22: ANFIT energy rating label



The classification for heating is based on the thresholds given in Table 21. The values for the Class A are the minimum requirements for transparent building elements according to the Ministerial Order (DM) 28/12/2012. Therefore every window that fulfils the mandatory requirement in Italy will get a Class A.

Table 21: Definition of the individual classes for heating according to the ANFIT Label

	A	B	C	D	E	F
A++	2,08	1,35	1,18	1,13	1,02	0,90
A+	2,66	1,73	1,51	1,44	1,30	1,15
A	3,08	2,00	1,75	1,67	1,50	1,33
B	3,59	2,33	2,04	1,95	1,75	1,55
C	4,05	2,63	2,30	2,20	1,97	1,75
D	4,52	2,93	2,57	2,45	2,20	1,95
E	5,33	3,46	3,03	2,89	2,59	2,30
F	6,04	3,92	3,43	3,28	2,94	2,61

The classification for heating is based on the thresholds given in Table 22.

Table 22: Definition of the individual classes for cooling according to the ANFIT Label

MIN gg	568	604	901	1401	2101	3001
g %	A	B	C	D	E	F
20	2,1	1,87	1,18	0,66	0,4	0,24
30	3,2	2,81	1,77	0,99	0,6	0,35
40	4,2	3,74	2,35	1,32	0,81	0,47
50	5,3	4,68	2,94	1,64	1,01	0,59
60	6,4	5,61	3,53	1,97	1,21	0,71
70	7,4	6,55	4,12	2,3	1,41	0,83
80	8,5	7,48	4,71	2,63	1,61	0,94

Classe Label	DA	A
A	0	0,59
B	0,60	1,01
C	1,02	1,64
D	1,65	2,94
E	2,95	4,68
F	4,69	5,30
G	5,31	99,0

Rating scheme of SiPVC

SiPVC is a subgroup for windows of PVC Forum Italia (Italian association which represents the entire PVC value chain).

The Rating scheme of SiPVC was launched in March 2015.

According to the information submitted by SiPVC the calculation of the energy performance is based on ISO 18292. Therefore a calculation tool was developed. The tool is not public domain and only available for members of SiPVC. Therefore detailed information about the assumed boundary conditions are not available. The classification method and definition of thresholds for the classification are not public and will not be disclosed at the moment.

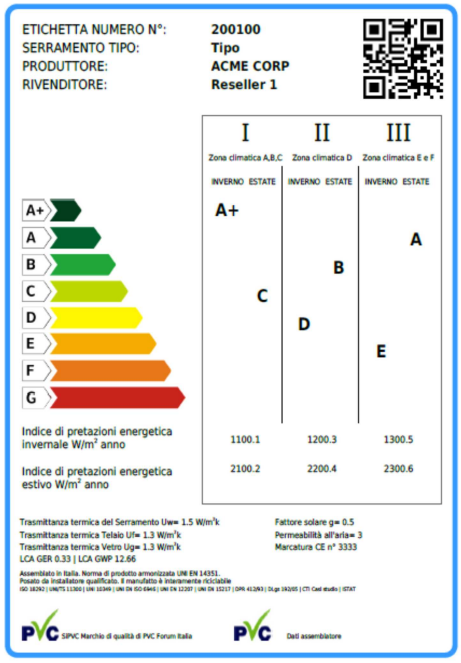
The necessary chararceristics for the calculation of the energy performance are determined according to hEN 14351-1:

- Thermal transmittance of the window U_W
- Solar energy transmittance g of the glazing
- Frame fraction F_F of the window
- Air leackage class

With these characteristics a energy performance for winter (heating) and a separate energy peformance for summer (cooling) is calculated. The effect of sun shadings/shutters are not considered at the moment. It is planned to integrate this effect in the near future.

Three different climatic zones are considered in the SiPVC label shown in **Error! Reference source not found.**.

Figure 23: SiPVC Energy label for windows



Beside the classes for winter and summer further information is shown on the label:

- Thermal transmittance of the window U_W, the frame U_f and the glazing U_g
- Solar energy transmittance g of the glazing
- Class of the air permeability of the window
- A QR code
- Two LCA indicators : GWP (Global Warming Potential) and GER (Gross Energy Requirement)

Portugal

A Portuguese labelling scheme "**SEEP JANELAS"** managed by **ADENE** is voluntary and is linked with the thermal requirements of the new Thermal Code for Portugal published in December 2013 and with the Energy Efficiency Management System of the Buildings.

The Portuguese scheme, based on ISO 18292 has been developed using a reference room according to EN 13791. The energy needs are calculated on an hourly basis.

Till now there is no information about the detailed calculation process. Therefore the Portuguese association of window manufacturers was asked to give more explanation. They replied that "The detailed methodology is under the responsibility of ADENE but confidential".

According to the available information the following parameters of the window are taken into account:

- U_w in W/m^2K Thermal transmittance of the window
- g solar energy transmittance of the glazing
- L in $m^3/(m^2h)$ the class of the air-tightness of the window

Figure 24: Energy label for windows in Portugal

The classes are based on the overall energy performance (winter + summer) and the thresholds are the following:

A 18,5 kWh/m^2
B 22,2 kWh/m^2
C 25,9 kWh/m^2
D 29,6 kWh/m^2
E 33,3 kWh/m^2
F 37,0 kWh/m^2

In addition to the class of the annual energy performance index the individual energy performance indices for winter (heating) and summer (cooling) are stated

Slovakia

No detailed information was submitted by the experts in Slovakia.

Spain

In Spain a voluntary energy labelling scheme is operated by the Spanish association of windows producers ASEFAVE[50] and distinguishes between windows and roof windows.

There is no link with the Spanish regulation (Building Technical Code (CTE in Spanish)).

The following characteristics of the window are taken into account:

- U_w in W/m2K Thermal transmittance of the window/roof window

[50] Sourced from: http://www.ventanaseficientes.com/

- g — solar energy transmittance of the glazing/transparent part
- L — in $m^3/(m^2h)$ — air-tightness of the window

The calculation of the energy rating is based on the energy demand for the heating season and the cooling demand for the summer. Additionally a so called “summer comfort” is calculated and is equivalent to the calculated cooling demand.

According to information given by ASEFAVE the rating of the windows is a combination of the U-value and the air tightness for winter and, only, the g-value for summer.

"*The thresholds of our rating system are not published and ASEFAVE prefers not to share this information with third parties.*"

Figure 25: Energy label for windows in Spain

Sweden

The Swedish window energy labelling scheme is operated by EQ Fönster (EQ Window). The label itself allows seven classes, starting with class A and ending with class G.

The rating of the window depends on the thermal transmittance and the air leakage of the window. Solar gains are not taken into account; there is no calculation of the energy balance. The following characteristics of the window are taken into account:

- U_w — in W/m2K — Thermal transmittance of the window
- L — in $m^3/(m^2h)$ — air tightness of the window

Table 23: Classes according to the Swedish Label[51]

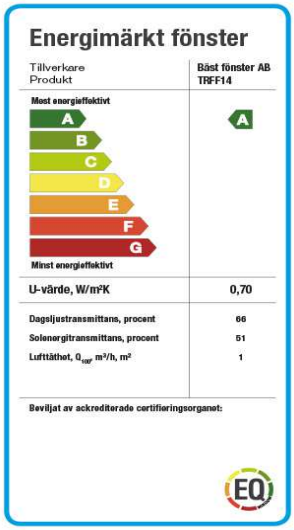
Energy class	Max U-value	Max air leakage
A	0,70	1)
B	0,80	1)
C	0,90	1)
D	1,0	1)
E	1,1	2)
F	1,2	2)
G	1,3	2)

The U_w value of the window is determined in accordance with the product standard EN 14351-1. The air leakage rate is determined according to EN 1026. To achieve class 2) for the air leakage the window has to fulfil the requirements of Class 4 according to EN 12207 meaning a maximum air leakage rate of 3 $m^3/(m^2h)$ at a pressure difference of 100 Pa. This

[51] Sourced from: http://www.energifonster.nu/sv/english.aspx

approach is in accordance with the product standard EN 14351-1. For the Swedish air leakage class 1) a maximum air leakage of 1 $m^3/(m^2h)$ has to be achieved by a measurement according to EN 1026. This approach is not in line with EN 14351-1 because such a value cannot be declared according to EN 14351-1.

Figure 26: Energy label for windows in Sweden



The Swedish label displays the following information:

1. The rating level – A to G
2. The window U value e.g. 0.9 W/(m²·K)
3. The light transmittance e.g. τ_v=0.70
4. The solar heat gain coefficient e.g. g=0.45

Switzerland

On the 1 January 2015 a voluntary labelling scheme was launched in Switzerland. The scheme is operated by the two Swiss window associations FFF (Schweizerischer Fachverband Fenster- und Fassadenbranche) and SZFF (Schweizerische Zentrale Fenster und Fassaden).

The rating of the window depends on the thermal transmittance and the solar gains. The air leakage of the window is not taken into account.

An equivalent U-value $U_{W,eq}$ is calculated as a balance of the heat losses and the solar gains:

$$U_{W,eq} = (U_W \cdot A_W \cdot 1 - g \cdot A_g \cdot 2) / A_W$$

With

$U_{W,eq}$	equivalent U-value of the window
U_W	thermal transmittance of the window
g	solar energy transmittance of the transparent filling element (glazing)
A_W	Area of the window
A_g	Area of the transparent filling element (glazing)

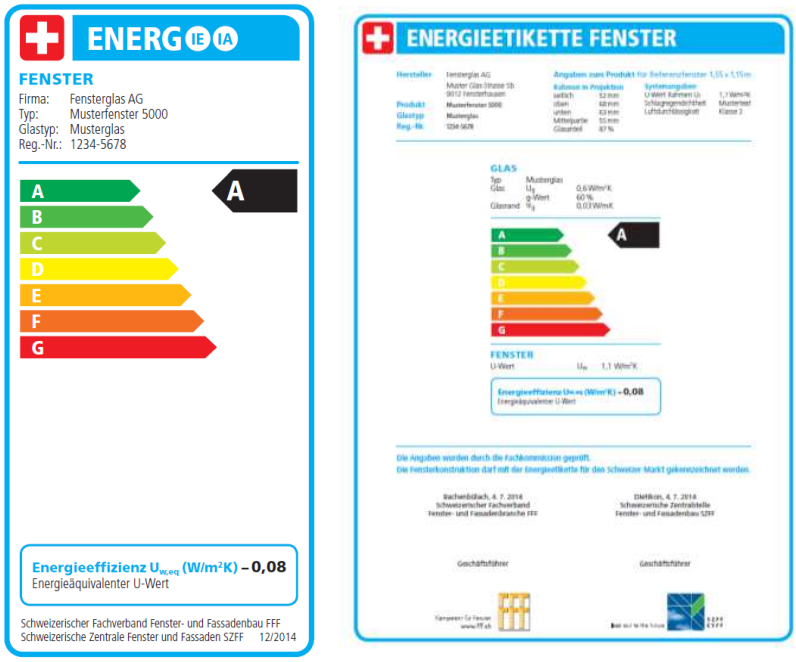
The classes are defined as follows:

Class A			$U_{W,eq}$	<	0
Band B	0	≤	$U_{W,eq}$	<	0.1
Band C	0.1	≤	$U_{W,eq}$	<	0.2
Band D	0.2	≤	$U_{W,eq}$	<	0.3
Band E	0.3	≤	$U_{W,eq}$	<	0.4
Band F	0.4	≤	$U_{W,eq}$	<	0.8

Band G	0.8	≤	$U_{W,eq}$

The energy label displays the Energy class (A to G) and the calculated equivalent U-value. Further information(U value of the glazing, g value of the glazing, Ψ value of the spacer, U_W value of the window, class of air tightness of the window, class of water tightness of the window) is stated on a separate additional document.

Figure 27: Energy label (left) and Certificate (right) for windows in Switzerland



United Kingdom

The UK's national system for rating the energy efficiency of windows WER is defined in the Building Regulation L1B and is recognised within the Building Regulation L2B as one method to show compliance for the requirements for the refurbishment of domestic buildings. The rating scheme is not mandatory but voluntary.

According to information received by BFRC the compliance with the national building regulation is demonstrated approx. half by using the WERS and the other half by the U value of the window.

The rating of the window depends on the calculated energy demand for the heating season. The summer situation is not considered. The following characteristics of the window are taken into account:

- U_w in W/m^2K — Thermal transmittance of the window
- g — solar energy transmittance of the glazing
- L_{50} in $m^3/(m^2h)$ — air-leakage rate of the window at 50 Pa pressure difference
- A_g/A_w — ratio of the area of the glazing to the window area

The energy demand of the window is calculated by a seasonal approach for a dimension of 1,23 m x 1,48 m:

$$WER = 218.6 \cdot 0.9 \cdot \frac{A_g}{A_W} \cdot g - 68.5 \cdot (U_W + 0.0165 \cdot L_{50})$$

For very energy efficient windows this score is positive (>0), for average and worse windows the score is negative (<0) indicating an overall net energy loss.

The classes itself are defined according to Building Regulation L1B as follows:

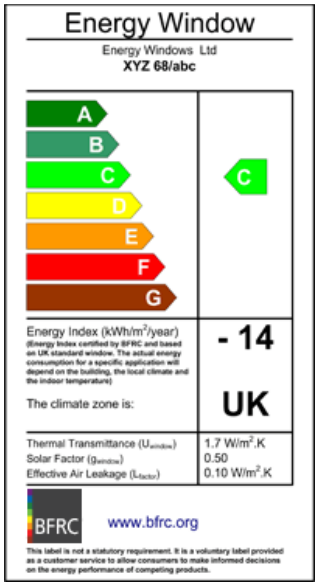
Band A			WER	≥	0
Band B	0	>	WER	≥	-10
Band C	-10	>	WER	≥	-20
Band D	-20	>	WER	≥	-30
Band E	-30	>	WER	≥	-50
Band F	-50	>	WER	≥	-70

Band G -70 > WER

At the moment there are three institutions operating the Window Energy Rating Scheme in the U.K.:

- The British Fenestration Rating Council - BFRC
- Certass Limited
- The British Standards Institution – BSI

Figure 28: BFRC window energy label



The BFRC label displays the following information:

1. The rating level – A, B, C, etc…
2. The energy rating e.g. -14 kWh/(m²·K)
3. The window U value e.g. 1.7 W/(m²·K)
4. The solar heat gain coefficient e.g. g=0.53
5. The effective heat loss due to air leakage as L, e.g. 0.1 W/(m²·K

To collect additional information a survey was drafted and published on the project website. Furthermore the survey was sent directly to the labelling scheme operators. The submitted information is shown in the following tables.

Table 24 Results survey window labelling schemes in EU

Describing the window label scheme	SPAIN	DENMARK	FINLAND	GERMANY	U.K.	Italy (Scheme PVC Forum)	Italy (Scheme Anfit)
Organisational							
1 Who initiated the label scheme? Industry, academia, other?	Industry	Danish Energy Agency and the industry	industry, ministry of environment, Motiva Group (expert company promoting efficient and sustainable use of energy), VTT Technical	ift Rosenheim together with industry	It was commercial scheme developed from the European Save II EWER Project.	industry	Our Association
2 When was the scheme first introduced?	June 2013	2009	2005	2011	Developed in 2001. First licences granted in 2005. BFRC Ltd established in 2006.	the project began about 2010 with ENEA , The label will be introduced in spring 2015	May 2014
3 What were the main reasons or drivers to start the window label scheme?	To promote eficiency through windows and promote the refurbishment activity, marketing tool	Parlament dessision in 2008	inform buyers of energy efficient windows and make easier to select windows by their performance	To promote the use of energy balance and not only U-value, to take into account also the summer situation, to develop a product label not based on zones	To provide consumers with an easily uderstood alternative to U values. To drive innovation in the window industry to develop more energy efficient products.	ecodesign eurepean directive	Helping the final customer choosing the product
4 What changes have been made to the sch	No changes	None	Class A was devided to A, A+ and A++ because class A became too big The factor of air leakage in the formula had been changed to smaller	No changes yet. Additional thermal resistance due to shutters will be implemented in the next revision	Simplified energy licences introduced in 2010. Door set energy ratings in 2011. A+ banding introduced in 2013. BFRC Homeowner Certificates introduced in 2014.	no changes	We have simplified the approach to the producer by not considering the ventilation losses (they will be studied into a further label on the laying)
5 - changes in calculation method for labelling? (calculation, label design)		No	see above	none	Numerous updates to calculation method made to reflect new fenestration products and changes to appliceable standards.	no changes	Yes, both in design and in the formula
6 - changes in scope of labelling scheme (other products, other markets)		No	none	none	See answer 4	no changes	We are using the label also to establish the non-preferential origin of the product
7 - changes in organisation of labelling? (professionalisation, paid employees?)		No	none	none	BFRC has grown in terms of staff numbers to cope with increasing licence applications. Currently comprises 3 full time staff members, 3 part time and one external consultant. Also work carried out by various comittees made up of relevant industry specialists.	no changes	No. At the moment the label is issued by the window manufacturer thanks to a validated software, that has been expressely made by a software house.
8 Does the scheme also cover verification of performance of products? (certification process, or..)	No	Yes		input data is the data on the CE Mark. According to CPR these values have to be evaluated by a notified body. Therefore there is no need to implement additional verification processes.	Yes - all WER and DSER licences are subject to independent verification of their energy performance and manufacturing systems capability.	no	Before the company gets the right to use the energy label, they have to obtain the ANFIT Quality label, that verifies both the production process and the performance of products
9 What is the geographical scope of the scheme? (multiple countries?)	Spain	Denmark	Finland	In prinicipal no limit (Label is not based on geographical zones)	Scheme is open to licence holders world wide, but ONLY for windows installed in the UK.	only for Italy	No, only Italy, following Italian legislation

Financing								
10	How is the scheme financed?		Industry	by industry by means of rating fees	Use is free of charge	Licence holders pay an annual subscription for the use of the WER or DSER licence.		Companies pay the cost of the software (per year), and the annual audit process to get the right use
11	- scheme is self-financed, label is free to use	Self-financed by ASEFAVE	No	see above	see 10	NO	the starting is financed by PVCFORUMITALY	-
12	- fee on use of label (please indicate fee)	Fee on use of the software (from 100 euros - 300 euros)	€ 200,00 pr year pr system	rating 1100 euros (excluding calculation of properties) annual fee 200 euros + 10 euros/window	no fee	YES - individual licences are charged at either £200 for detailed or £300 for simplified licences. Fees are capped for large numbers of licences.	then the users will pay a fee - not fixed yet	Each adhesive label costs 0,10€. If you print it on paper, you pay the cost of the print.
Markets								
13	What are the main markets for this window label scheme?		Replacement	Finland		UK only		Only Italy
14	- residential market only, or also commercial?	Residential market only	Residential	residential	Residential market	Residential only	both	Both
15	- renovation market (existing buildings) only, or also new builds?	Mainly renovation market	Renovation	new and renovated buildings	Mainly renovation market	Both	both	Both
16	Please state the products the label is used for (eg. windows, roof windows, roof lights, doors)	Windows and roof windows	The label is used on all types of elements made from the same profile system (windows and doors), but the energy class is calculated only on an openable window of standard CEN-size.	vertical windows	vertical windows, roof windows	Windows, roof windows, glazed doors and pedestrian access doors.	only for vertical external window	Windows and door window
The effect of window labelling								
17	How many companies have signed up / used the label scheme since its introduction - please provide multiple figures (1 year after start, 2 years after start, etc.)	1st year: 24 companies	A total of 26 today	1st year: 8 2nd year: 8 now: 12	approx. 4000 labels were produded. No information available how many companies used it because there is no "contract"	2004 0 2005 14 2006 204 2007 570 2008 1211 2009 1930 2010 2250 2011 3315 2012 3640 2013 4392 2014 4664	up to the present day , we haven't started yet	1st year: 30 companies
18	If known, please indicate why companies sign up (or do not sign up?)	Marketing tool	Competition	competition on label ratings	No information	To assist marketing of their products. To demonstrate compliance with UK building regulations.	(for example: competition on label ratings?)	Tehy signed up also because our label has the indication "Made in Italy" and the final customer gives a lot of importance to this.

Changes in window properties?								
19	How have properties of windows labelled changed since the introduction of the scheme?	No data	Higher (better) figures for the energy balance	The class of rated windows have become better In the same time the requirements in building code have become stricter	No data	There has been a general trend towards better energy performance windows.	no changes	No data at the moment
20	Is that because of labelling or also other market factors? (regulation?)	Thermal performance regulation of windows has changed - new more efficients requirements in Spanish Building Code, not related with the window label.	Labelling/regulation and future requirements	see above		Both. Energy rating drives innovation, but alos UK Building regulations have been updated to improve minimim acceptable performance.		No data at the moment
21	Did end-customers (home-owner) respond by asking for / demanding windows with a certain label rating?	Not yet	Unsure - but beginning to manifest in the marked	At first rarely but nowadays more often	No data	Yes - licence holders report significant demand for A and A+ rated windows (Building regs mandate C rated as a minimum)	probably yes	Yes, thay are asking for A, A+ and A++ class windows
22	What are the shares of A-class, B-class, etc.	No data	A: 25 %, the rest on B and C. None below that (D to F)	There is no statics of shares of different classes	No data	A+ 3%, A 38%, B 27%, C 31% - Licences registered. 61%, B 6%, C 33% - Installed windows	no shares at the moment, label will be introduce in spring 2015	it is almost never in B class
Link to requirements?								
23	Did the average labelled window exceed the national requirements for the windows (if applicable)?	Yes	See below in 24	yes	No data	Yes - see answer 22	yes	Yes usre. They are more high performing
24	Does the label scheme interact with National requirements? If so, how?	No	Yes. Buildingregulation: "C" is today, "B" is 2015 and "A" is 2020	no	No	Yes - WER of C and DSER or of E is deemed to comply to with UK Building regs for replacement windows.	not for the moment	Yes. For the A-class determination, we have used a law dedicated to the financial incentives given for the
25	- are national requirements linked to label classes/rating? Which market segments? etc.	No	Both repalcement and new buildings and both private and commercial	no	No	yes - see answer 24	not for the moment	The minimum national requirements are higher than the ones required at the moment for the Public Administration, with reference to the law indicated in question #24
26	What is your opinion on a mandatory EU Energy Label scheme for windows?	It would be desirable	Always better to have an EU labeling scheme but based on energybalance and national requirements - NOT U-values	Common voluntary labelling system and the way to calculate the annual energy consumtion of windows are OK, but the constants in the formula and the classes must be national because of so different climates and building culture in EU. Labelling system may be too expensive for small window manufacturers and if the system is mandatory, they may have to stop making windows.	Positve. Better one mandatory EU label as different national ones.Label will influence the performance and the sales figures to more energy efficient windows.	The currently proposed scheme is very complex. BFRC's experience is that homeowners and industry prefer simple schemes as they find them much easier to understand.	we are firmily convinced of its usefulness	We think that the will be a lot of difficiluties in building a common European scheme because of the different national legislation. We would support the intruction of a legislation on energy saving on European level and the definition of a common scheme about the window, door and façade sector, if only it happened!
	Information submitted by	ASEFAVE (Spanish Association of Windows and Curtain Walling manufacturers	Danish Technological Institute	VTT	ift Rosenheim	BFRC	PVC Forum Italy	ANFIT

Figure 29: Overview chart showing the 12 identified Energy Labels for windows in Europe in spring 2015

→ **EU/Nordic ecolabelling**

The Nordic Ecolabel is the official Ecolabel of the Nordic countries and was established in 1989 by the Nordic Council of Ministers. It is not an 'energy label' as the preceding labels, but an environmental label, such as the EU Ecolabel. The purpose of the Ecolabel is to contribute to sustainable consumption and production, with a vision to a sustainable society.

The label is an endorsement type label, indicating the product has passed certain threshold levels.

Figure 30: Nordic Ecolabelling endorsement label

The Nordic Ecolabel has established criteria that may apply to fixed and opening windows, window doors and exterior doors. These criteria relate to:

- U-value;
- g-value (solar energy transmittance);
- daylight transmittance;
- air permeability;
- recycled material content (if not made of renewable materials);
- presence of additives of dangerous/harmful substances/nanomaterials (including in insulation materials);
- raw material production (presence of chlorine, origin of wood, use of solvents);
- marking of plastic parts;
- filler gas;
- separability;
- waste during manufacturing;
- functional requirements.

Overall the criteria include significant requirements related to the production phase of the window. Nonetheless, the scheme shows several businesses having applied for the label for windows.

→ **Non-European Level**

USA/NFRC

NFRC[52] is a non-profit organization that administers the only uniform, independent rating and labelling system for the energy related characteristics of windows, doors, skylights, and attachment products in the USA.

In order to apply the NFRC label to products, manufacturers must first test their FENESTRATION products according to NFRC procedures, which include independent testing at NFRC approved laboratories.

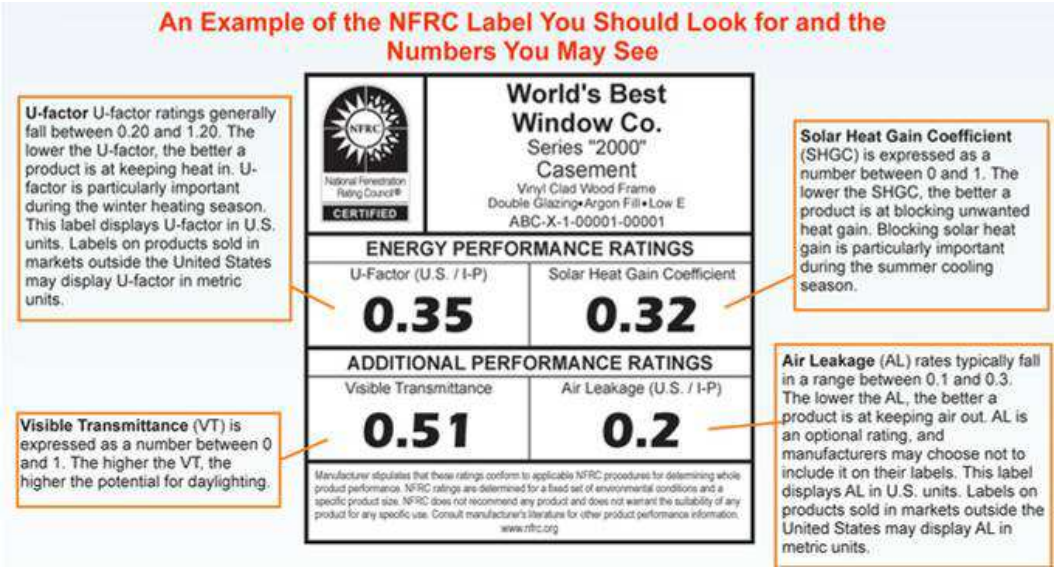
The NFRC label provides ratings for:

[52] http://www.nfrc.org/WindowRatings/Energy-Ratings.html#sthash.u8dewNZO.dpuf

- U-factor;
- Solar Heat Gain Coefficient;
- Visible Transmittance (required ratings);
- and may include information on Air Leakage and Condensation Resistance.

The information that is published in the NFRC label is in general similar to the information stated in Europe in the CE Mark. There is neither a calculation of the energy balance of a window nor a rating in Energy classes.

Figure 31: NFRC Window rating label



→ **USA/Energy Star**

The ENERGY STAR[53] for windows is developed by the U.S. Department of Energy and the U.S. Environmental Protection Agency.

Windows, doors and skylights originally qualified for the ENERGY STAR label in March, 1998, but the current set of specifications has applied since January 4, 2010. Windows and skylights must meet U-Factor and, where applicable, Solar Heat Gain Coefficient (SHGC) requirements based on climate zone. Doors must meet U-Factor and, where applicable, SHGC requirements based on glazing level (amount of glass). The methods are established by the NFRC (see above).

Since the energy efficiency performance of windows, door, and skylights can vary by climate, product recommendations are given for four climate zones: a mostly heating zone (Northern), two heating and cooling zones (North/Central and South/Central), and a mostly cooling zone (Southern).

[53] www.energystar.gov

Figure 32: US ENERGY STAR climate zones for windows

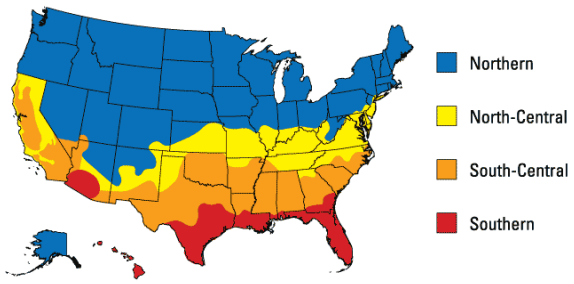


Figure 33: US ENERGY STAR window requirements

Windows

Climate Zone	U-Factor[1]	SHGC[2]	
Northern	≤ 0.30	Any	Prescriptive
	=0.31	≥ 0.35	Equivalent Energy Performance
	=0.32	≥ 0.40	
North-Central	≤ 0.32	≤ 0.40	
South-Central	≤ 0.35	≤ 0.30	
Southern	≤ 0.60	≤ 0.27	

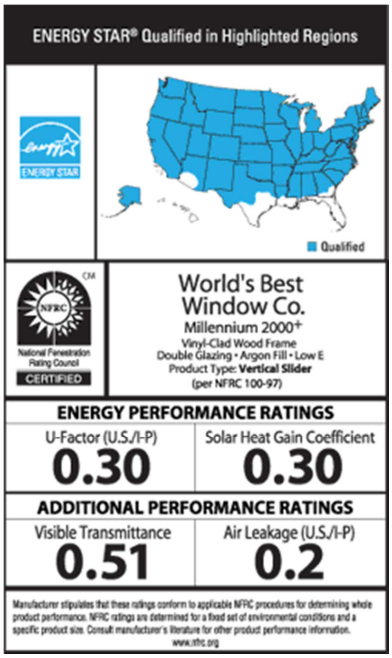
Skylights

Climate Zone	U-Factor[1]	SHGC[2]
Northern	≤ 0.55	Any
North-Central	≤ 0.55	≤ 0.40
South-Central	≤ 0.57	≤ 0.30
Southern	≤ 0.70	≤ 0.30

[1] *Btu/h-ft²-°F*

[2] *Fraction of incident solar radiation*

Figure 34: US ENERGY STAR window label



→ **China**

According the Global Ecolabelling Network[54] China is working on label criteria for windows and doors, under the reference "45, HBC 14-2002 , "Energy-saving Doors & Windows" [55].

The content of this document could however not be assessed.

→ **USA/Green Seal**

This endorsement label establishes requirements for residential fenestration products including windows, skylights, glazed exterior doors, and storm doors. Products specifically excluded from this standard include curtain walls, glazing cast into precast concrete, greenhouse windows, and glass blocks.

Figure 35: US Green Seal endorsement label

The product-specific performance requirements are:

- The ratio of the product's visible light transmission (NFRC Standard No. 300-93) over its solar heat gain coefficient (NFRC Standard No. 200-93) shall be greater than 1.

The product-specific environmental requirements relate to the following aspects:

- U-Value. Glazed exterior doors and windows shall have U-values for NFRC Model Size AA no greater than 0.36. Skylights shall have a U-value for NFRC Model Size AA no greater than 0.44. Exception: storm doors are exempt from the U-value requirement.
- Air Leakage. Fixed products shall have an ALR no greater than 0.10 scfm/ft.² Operable products shall have an ALR no greater than 0.30 scfm/lfc.
- Product Frame and Sash Material. The product manufacturer shall demonstrate that the product frame and sash materials have not been formulated with the heavy metals lead, cadmium, arsenic, mercury, or hexavalent chromium. Exception: Products with aluminium parts treated for anti-corrosivity with organic conversion coatings containing chromate are exempted from this requirement.

And there are packaging and consumer information requirements.

5.4.2. ENVIRONMENTAL PRODUCT DECLARATIONS

Many institutions and organisations offer the possibility to create Environmental Product Declarations for building products, including windows. Environmental performance of products/services shown on EPDs must be based on life cycle analysis through application of the Life Cycle Assessment (LCA) according to ISO 14040 series and other (international) assessment standards or rules. The information provided by EPD is usually only informative, as often no evaluation mode, preference criteria or minimum levels to be respected by the environmental performance are provided. EPD not in a building context are not tools to compare construction products and construction services.

Ideally the (information contained in) EPDs should allow feeding into overarching building environmental performance assessment methodologies, such as set out in EN 15804, but also other building assessment tools such as BREEAM and

[54] http://www.globalecolabelling.net/categories_7_criteria/list_by_program/1506.htm

[55] http://www.sepacec.com/cecen/labelling/pclp/200510/t20051010_94155.htm

LEED. Accordingly, the establishment of EPDs will have to follow certain product category rules, in order to harmonise the method, assumptions and calculations underlying the information.

→ **European Aluminium Association**

As EPD program operator, the EAA has developed, in partnership with PE-International (www.pe-international.com), a flexible web-based software tool to generate EPDs. This EAA EPD tool allows the users to develop EPDs according to their own product specifications. The EAA EPD tool has been verified for aluminium windows and is intended to support aluminium window manufacturers in producing EPDs for their own products. The EAA EPD tool is based on ISO standards and is not in accordance to EN15804. The European Aluminium Association is EPD program operator according to EN15804 and owns a software generating environmnetal impacts according to the same standard, which can serve as a basis to develop EPDs for its members. .. Any interested company based in Europe is invited to contact the EAA to get more information. [56]

Figure 36: Example of an EAA EPD


Environmental Product Declaration

Program Operator
EAA - European Aluminium Association
Av. de Broqueville 12
B-1150 Brussels
www.eaa.net

10, rue du Débarcadère
F-75852 Paris Cedex 17
www.snfa.fr

Producer

EAA-2009-02-02-5556-ENG — Declaration number

02. Feb 2009 — Date of issue

Product Name: prod1-tilt&turn-100*120-powder coating — Declared product
Project Name: EPD verification - Feb 09

This EPD applies to a single tilt & turn window using the declared aluminium profile and a standard glazing system in the given dimensions. — Product type

This verified declaration applies to the above mentioned products for three years from date of issue. It is based on ISO 14040/44 and ISO 14025. The window producer is liable for the specific information and evidence given which refers to the declared product. EAA is not liable for the window producer's individual input for the declaration. — Validity

This EPD is based on information modules that do not cover all aspects of the product's use. An environmental assessment of a product has to consider also the product's application in the building and the respective environmental aspects during the use stage. Comparisons of building products or EPDs without considering the use stages in the context of the environmental impacts of the whole building are not valid. EPDs from different programs may not be comparable. — Comparability

This Environmental Product Declaration applies to the described aluminium windows produced with the described profile system, in the given dimensions and a standard glazing unit. — Scope of validity

→ **ift Rosenheim / Germany**[57]

Within the project "The development of environmental product declarations for transparent construction elements – windows and glass – for assessing the sustainability of buildings, funded by the research initiative of future-oriented construction "Zukunft Bau" of the Federal Institute for Research on Building, Urban Affairs and Spatial Development, Germany, detailed life cycle analyses were carried out. The project was handled by **ift** Rosenheim in cooperation with PE International and IBU. The project was supported by the four associations Bundesverband Flachglas e.V.; Fachverband Schloss und Beschlagindustrie e.V., Qualitätsverband Kunststofferzeugnisse e.V. and Verband Fenster und Fassade.

One of the more difficult aspects of this study was the definition of the functional unit, which forms the basis for the analysis. While defining the declared unit, it became apparent that the preparation of sample EPDs for construction systems (e.g. windows) cannot be done uniformly as in the case of simpler construction products such as bricks, for example. As a result of the diversity of variants in window systems, among others, the reproduction of an industrial cross-section and the required and detailed definition of the products was complex. Based on a sensitivity analyses, however, a practical description of the declared unit could be found by defining three variants.

1. Variant 1 is oriented only at the product standard DIN EN 14351-1 for windows and doors and describes the declared unit by the standard windows (1.23 m x 1.48 m) and standard doors (1.23 m x 2.18 m) defined in the standard;
2. Variant 2 is defined on the basis of the frame portion of the window (frame relative to surface);
3. Variant 3 permits a specific definition of the unit (actual dimensions determine frame percentage).

Accordingly, one variant for the description of the declared unit needs to be selected when preparing (sample) EPDs.

[56] http://www.alueurope.eu/environmental-product-declarations/

[57] http://www.ift-rosenheim.de

The following documents including the defined life cycle scenarios have been issued by the IBU technical experts' committee:

- PCR windows and doors;
- PCR flat glass in construction.

Moreover, scenarios covering the entire life cycle have been worked out. These are expected to provide the building auditor with realistic and representative scenarios of the windows and doors for an assessment of the building.

Life cycle assessments were calculated on the basis of generic data and data from the industry for the preparation of the EPDs. Data acquisition in the respective divisions of the industry proved to be difficult. Life cycle assessments and sample EPDs over the entire life cycle were prepared for the following products within the scope of the project:

- wooden windows
- aluminium windows
- plastic windows
- flat glass, single-layer safety glass and laminated safety glass
- 2-layer and 3-layer insulated glazing

The LCA comparison (see Table 25) shows that for almost all impact categories considered the use-phase is the most dominant phase, in particular for non-renewable energy consumption. The comparison also shows that for acidification, eutrophication and photochemical ozone creation the manufacturing phase is also quite relevant.

When considering only the manufacturing stage, the type of material, the upstream manufacturing chain of the respective material and coatings, if any, affect the impact on the environment. In contrast, the analysis of different window types showed that by considering the entire life cycle taking the energy requirement during the utilisation stage into consideration, the choice of the frame materials has a negligible impact if the performance is comparable.

As a programme operator ift Rosenheim has drafted PCR for windows and glazing's on the basis of the descript R&D project.

Manufactures can get EPDs for their window products based on the representative data evaluated in the R&D project. Furthermore it is possible to generate individual EPDs based on a detailed analysis of the individual window product and the individual manufacturing process.

All EPDs generated by ift Rosenheim are published on the following web site:

http://www.ift-service.de/epd/uebersicht.faces

Up to now **ift** Rosenheim published 30 EPDs for windows and over 50 EPDs for insulating glazing units. Most of them are based on the representative EPDs developed with the R&D project.

Figure 37: Example of an ift Rosenheim EPD

Umweltproduktdeklaration nach ISO 14025 und prEN 15804

Kurzfassung

Kunststofffenster aus PVC-U

ROSENHEIM

Programmhalter	**ift Rosenheim GmbH** Theodor-Gietl-Strasse 7-9 83026 Rosenheim
Deklarations-inhaber	Bayerwald Fenster Haustüren GmbH & Co. KG Gewerbepark 7 94154 Neukirchen v. Wald
Deklarations-nummer	M-EPD-KS-000147
Bezeichnung des deklarierten Produktes	Kunststofffenster aus PVC-U gemäß EN 14351-1
Anwendungs-bereich	Kunststofffenster zur Verwendung in Wohn- und Nichtwohngebäuden

Ergebnisse der Ökobilanz pro m² Fenster		Herstellung A1 – A3	Nutzung B1 – B7	Nachnutzung C1 – C4	Recycling-potenzial D
Primärenergie nicht regenerativ		1393	B1: 9061 B2-B7: 992	200	-1000
Primärenergie regenerativ		46	B1: 4 B2-B7: 22	13	-20
Treibhauspotenzial (GWP 100)		85	B1: 540 B2-B7: 43	14	-63
Ozonabbaupotenzial (ODP)		$5,0 \times 10^{-6}$	B1: $8,3 \times 10^{-7}$ B2-B7: $2,1 \times 10^{-5}$	$1,4 \times 10^{-6}$	$-2,6 \times 10^{-5}$
Versauerungspotenzial (AP)		0,332	B1: 0,421 B2-B7: 0,187	0,018	-0,267
Eutrophierungspotenzial (EP)		0,0394	B1: 0,0624 B2-B7: 0,0284	0,0027	-0,0269
Photochem. Oxidantienbildungs-potenzial (POCP)		0,0334	B1: 0,0505 B2-B7: 0,0142	0,0038	-0,0122
Abiotischer Ressourcenverbrauch elements (ADP_{el})		n.v.	n.v.	n.v.	n.v.
Abiotischer Ressourcenverbrauch fossil (ADP_{fos})		n.v.	n.v.	n.v.	n.v.

Ulrich Sieberath

Unterschrift des Institutsleiters, ift Rosenheim GmbH

Bernd Strufe

Unterschrift des Verifizierers

Grundlagen

- DIN ISO 14025:2006
- prEN 15804:2011

Allgemeiner Leitfaden zur Erstellung von Typ III Umweltproduktdeklarationen

Die Deklaration beruht auf dem PCR Dokument „Fenster" PCR-FE-1.0 : 2011

Gültigkeit

Diese verifizierte Umweltproduktdeklaration gilt ausschließlich für die genannten Produkte und hat eine Gültigkeit von 5 Jahren vom Ausstellungsdatum an.

Der Deklarationsinhaber haftet vollumfänglich für die zugrundeliegenden Angaben und Nachweise.

Erstellungsdatum: 01. November 2011

Ausstellungsdatum: 03. August 2012

Nächste Revision: 01. Oktober 2016

Rahmen der Ökobilanz

Die Ökobilanz wurde nach DIN EN ISO 14040 und DIN EN ISO 14044 durchgeführt. Als Datenbasis wurden spezifische Daten von verschiedenen Firmen, generische Daten der Datenbank „GaBi 4" herangezogen. Die Ökobilanz wurde für alle Lebenszyklusphasen unter Berücksichtigung sämtlicher Vorketten wie Rohstoffgewinnung, Energiebereitstellung und Transporte („cradle to grave") durchgeführt.

Die Ökobilanz wurde erstellt durch PE INTERNATIONAL AG.

Basis

Diese EPD wurde auf Basis einer Muster-EPD erstellt.

Veröffentlichungshinweise

Es gelten die „Bedingungen und Hinweise zur Verwendung von ift Produktdokumentationen"

Table 25: LCA assessment of windows

Impact category / frame material		Timber				Aluminium				Plastic			
LCA results per m^2		Manufacture A1 – A5	Use phase B1 – B7	End of life C1 – C4	Recycling - potential D	Manufacture A1 – A5	Use phase B1 – B7	End of life C1 – C4	Recycling - potential D	Manufacture A1 – A5	Use phase B1 – B7	End of life C1 – C4	Recycling - potential D
Prim. Energy - non-renewable in MJ		1089	B1: 9061 B2-B7: 840	16	-514	2253	B1: 9061 B2-B7: 735	258	-1510	1393	B1: 9061 B2-B7: 592	200	-1000
Prim. Energy - renewable in MJ		436	B1: 4 B2-B7: 31	0	-19	397	B1: 4 B2-B7: 33	1	-356	46	B1: 4 B2-B7: 22	13	-20
Global warming pot. (GWP 100) in kg CO_2 eq.		39	B1: 540 B2-B7: 54	29	-41	157	B1: 540 B2-B7: 50	13	-119	85	B1: 540 B2-B7: 43	14	-63
Ozone depletion pot. ODP in kg R11 eq.		$5,2 \times 10^{-6}$	B1: $8,3 \times 10^{-7}$ B2-B7: $2,6 \times 10^{-6}$	$8,5 \times 10^{-9}$	$-9,4 \times 10^{-7}$	$1,4 \times 10^{-5}$	B1: $8,3 \times 10^{-7}$ B2-B7: $2,7 \times 10^{-6}$	$1,2 \times 10^{-7}$	$-9,6 \times 10^{-6}$	$5,0 \times 10^{-6}$	B1: $8,3 \times 10^{-7}$ B2-B7: $2,1 \times 10^{-6}$	$1,4 \times 10^{-6}$	$-2,6 \times 10^{-6}$
Acidification pot. AP in kg SO2 eq.		0,260	B1: 0,421 B2-B7: 0,251	0,007	-0,155	0,730	B1: 0,421 B2-B7: 0,214	0,012	-0,573	0,332	B1: 0,421 B2-B7: 0,187	0,018	-0,267
Eutrophication pot. EP in kg PO43- eq.		0,0345	B1: 0,0624 B2-B7: 0,0309	0,0021	-0,0185	0,0558	B1: 0,0624 B2-B7: 0,0309	0,0022	-0,0375	0,0384	B1: 0,0624 B2-B7: 0,0284	0,0027	-0,0269
Photochem. ozone creation pot. POCP in kg C_2H_4 eq.		0,0305	B1: 0,0505 B2-B7: 0,0551	0,0006	0,0014	0,0482	B1: 0,0505 B2-B7: 0,0168	0,0010	-0,0172	0,0334	B1: 0,0505 B2-B7: 0,0142	0,0038	-0,0122
Abiotic resources depletion pot. (elements) $ADP_{el.}$ In kg Sb eq.		n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.
Abiotic resources depletion pot. (fossil) $ADPf_{os.}$ in MJ		n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.	n.v.

→ **The International EPD® System / Sweden**[58]

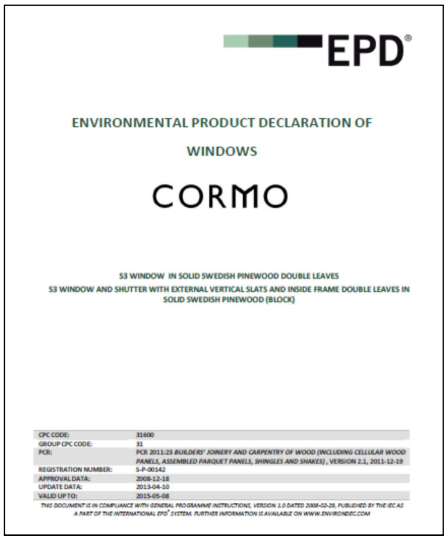
The Swedish Environmental Management Council (SEMCo) acts as the Programme Operator and has the overall responsibility of the International EPD® System.

The International EPD System has developed Product Category Rules (PCR) for a variety of products in different categories.

For windows a separate PCR provides rules for the assessment of the life-cycle environmental performance of "Builders' joinery and carpentry of wood, including cellular wood panels, assembled parquet panels, shingles and shakes" as well as for the declaration of such performance by an Environmental Product Declaration. This PCR partly replaced PCR 2008:03 Windows. The title of the PCR indicates that the scope is limited to timber windows and the PCR cannot be used to generate EPDs for windows made out of other materials.

According to the analysis only one EPD is based on that PCR so far (see next figure).

Figure 38: Window EPD by the International EPD system



→ **The Norwegian EPD Foundation / Norway**[59]

The Norwegian EPD Foundation was established in 2002 by the Confederation of Norwegian Enterprise (NHO) and the Federation of Norwegian Building Industries (BNL). The reason for its establishment was an expressed desire for standardized and internationally valid Environmental Product Declarations for products and services.

The Norwegian EPD Foundation develops PCR and EPDs for the following product categories:

- Building materials
- Furniture
- Electricity
- Chemicals
- Package

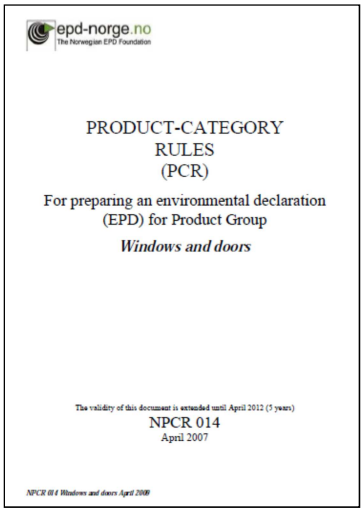
EPDs for windows are based on the “Product category rule For preparing an environmental declaration (EPD) for Product Group Windows and doors”. The PCR addresses all kind of windows and doors prepared for trade made of different materials like; wood, steel, aluminium, plastic, glass etc.

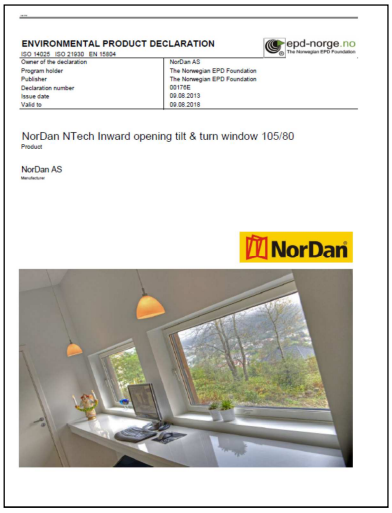
According to the website only one window EPD is published so far.

[58] http://www.environdec.com/en

[59] http://www.epd-norge.no/

Figure 39 Window PCR developed by the Norwegian EPD Foundation (left)
EPD based on that PCR (right)



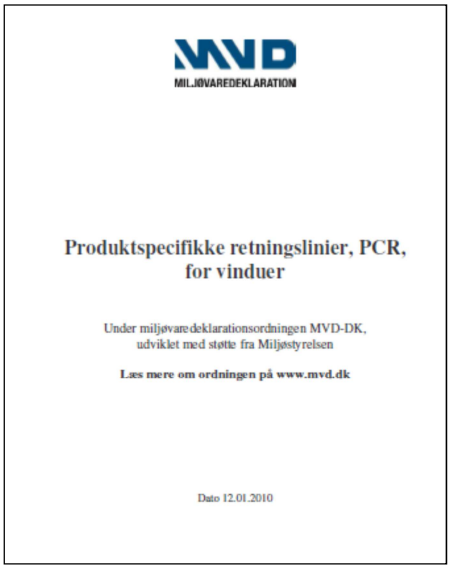


→ **Denmark**[60]

There is a Danish PCR for windows drafted by MVD-DK Fonden Dansk Standard that is in accordance with ISO 14000-standards but not EN 15804.

At the moment it is not clear if the Danish MVD programme is closed, but it is de facto not working. No EPD could be found published by the Danish programme operator.

Figure 40: Front page of the window PCR developed in Denmark

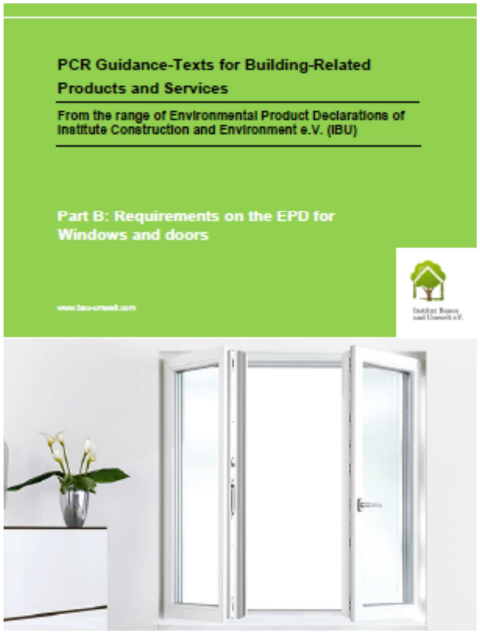


[60] http://www.mvd.dk/en-gb/pages/default.aspx

→ **IBU/Germany**[61]

The Institute Construction and Environment (IBU) is an industry-wide association which runs a program to procure Type III Environmental Product Declarations (EPD) for building products according to ISO 14025 and EN 15804. IBU also developed a PCR for windows and doors. At present there are no EPDs for windows based on the IBU PCR published.

Figure 41: Window PCR developed by IBU



[61] http://construction-environment.com and https://epd-online.com/

CHAPTER 6 CONCLUSIONS OF TASK 1

The section presents the main conclusions from the TASK 1 SCOPE as part of the Ecodesign preparatory study of windows.

6.1. PRODUCT GROUP DEFINITION

TASK 1 concludes to focus the full preparatory study on 'windows' on the basis of the harmonized product standard hEN 14351-1 *Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics*:

Windows, including 'window doors'

building component for closing an opening in a wall or pitched roof that will admit light and may provide ventilation and incorporates at least:

- *frame;*
- *transparent filling element, made out of glass;*

and may incorporate (optionally)

- *opaque filling element;*
- *internal, integrated or external shutter / sun shading device.*

Roof windows

window intended for installation in a roof or the like which is inclined. Roof windows have the same characteristics as windows installed in walls with regard to function, cleaning, maintenance and durability

Windows, or products that meet the definition of windows, that meet one or more of the following descriptions shall be excluded from the study:

- roof lights (definition to be based on EN 1873 and prEN 14963);
- curtain walling (definition to be based on EN 13830)[62];
- windows subject to regulations on smoke leakage and resistance to fire (definition to be based on prEN 16034);
- windows for escape routes.

The above means that windows that need to comply with regulations regarding fire resistance are excluded from the scope of the study.

Windows that offer a certain performance sound insulation and/or burglary resistance are covered by EN 14351-1 and therefore included in the study. Such windows (with improved sound insulation or burglary resistance) could have higher U-values and different g-values than “standard windows”, so the presence of such properties can affect the overall energy performance of such windows. This aspect needs to be taken into account when setting requirements (subject of Task 7).

The above also means that doors are excluded from the study scope. To be exact the following door products shall be excluded:

- external pedestrian doorsets according to prEN 14351-1;
- internal pedestrian doorsets according to prEN 14351-2;
- pedestrian doorsets subject to regulations on smoke leakage and resistance to fire according to prEN 16034;
- industrial, commercial and garage doors and gates according to EN 13241-1;
- revolving doorsets;

The advantage to align the scope with windows as covered by EN 14351-1 is that if any measures are proposed for windows (e.g. energy labelling) it would be clear which products are addressed as there will be a full alignment with windows that have a CE mark according to EN 14351-1.

[62] In case part of the curtain wall is an element that can be opened, then this element covered by EN 14351-1

The scope also excludes windows as used in means of transport (windows for cars, buses, trains, ships, aeroplanes, etc.) as 'means of transport' is outside the scope of Directives 125/2009 (Ecodesign) and 30/2010 (Energy labelling). The study will focus only on windows for buildings.

6.2. STANDARDS

Windows are harmonized building products. Based on the mandates M101 (windows) and M122 (roof windows) the harmonized product standard EN 14351-1 "Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics" was drafted by the responsible technical committee CEN TC33, in particular by working group WG1. Due to the implementation of the CPR EN 14351-1 is mandatory for all member states since 1st July 2013. The standard serves as a "manual" for the evaluation of the relevant characteristics and gives rules for the CE marking of the product.

The harmonized European product standard for windows defines the determination of necessary characteristics of windows and supersedes test standards in individual member states.

The main (energy) performance parameters of windows can be assessed using the relevant European standards for measurement and calculation given in the harmonized product standard for windows EN 14351-1.

For the evaluation of the life cycle assessment of construction products there is an European standard EN 15804. The standard provides a structure to ensure that all Environmental Product Declarations (EPDs) are derived, verified and presented in a harmonized way. EPDs for windows should be based on EN 15804.

6.3. LEGISLATION

6.3.1. EU LEVEL

Windows are currently regulated by the Construction Products Regulation which has led to the affixing of product performance labels on the product. This has helped to improve transparency and information regarding the product performance. This aspect has to be taken into account when considering and discussing the viability of possible new information requirements under the Ecodesign Directive or Energy labelling Directive.

It has to be noted, that according to CPR Article 3 it could in principle be possible, that the European Commission sets minimum performance requirements for construction products.

Also other European regulations and directives are already tackling "ecological characteristics" of windows. In this connection the Energy Performance of Buildings Directive (EPBD) is one of the most relevant. Although the directive states no direct requirement for windows itself, the implementation of the directive in the member states is leading to national requirements for energy related characteristics for windows (see also next chapter).

6.3.2. MEMBER STATE LEVEL

Windows, as building components, may also be regulated by Member States, in the form of prescriptive requirements.

As far as the energy conservation of buildings is concerned the requirements are set in the context of the EPBD (national implementation of a European directive).

According to the analysis of TASK 1 all member states of the EU have set requirements on the energy related characteristics of buildings and therefore direct or indirect requirements on the window itself.

For the refurbishment of buildings the general approach in the member states is to set direct requirements on component level. The regulated energy related characteristics for the window is in general only the thermal transmittance. In some Member States there are different requirements for facade and roof windows, and in a few Member States requirements are based on energy balance calculations".

This aspect also has to be taken into account when discussing the viability of possible prescriptive requirements under the Ecodesign Directive (prescriptive or specific ecodesign requirements do not apply to the Energy labelling Directive).

Regarding the item "dangerous substances" there is only one member state that has national requirements. In France constructions products must be labelled with an emission classification on the basis of VOC emissions test. As a matter of course also windows must be signed with an adequate label.

6.3.3. LABELLING AND OTHER INITIATIVES

At the moment there are several schemes in Europe for the calculation of the energy performance of windows. The present study identifies twelve schemes but these vary greatly in their effective use by stakeholders in the market place. The schemes in the UK, in Denmark and Finland are the oldest ones. All schemes are not mandatory but only voluntary. Only one of these schemes, the UK one is defined and introduced in the building regulation. Most of these existing voluntary energy labelling schemes in Europe are not only based on the heat losses (U-value, air tightness) but calculating the energy performance of a window based on energy balance (including both solar gain and heat loss) For the communication to the "end customer" most labels are using the familiar seven efficiency classes from red to green and labelled A to G.

Comparing the existing schemes, there are different approaches for the evaluation of the energy performance. All of the schemes are considering the heating situation. Instead the cooling situation (also indicator for overheating or comfort)is not considered by all schemes (6 schemes were identified: Portugal, France, Spain, Germany, Italy). According to the current analysis of 12 schemes in Europe only one scheme (ift Rosenheim) is considering the effects of sun shading devices, especially as far as the cooling situation is concerned.

Based on the contributions to the survey published on the project website, it appears that all schemes are aiming at the **residential market** and most of them tackling **renovation** and window **replacement**.

Sustainability is tackled by few voluntary private initiatives. Six so called programme operators have developed Product Category Rules for windows that are the basis for the declaration of the environmental footprint. At the moment there is no mandatory requirement to publish EPDs.

ANNEX I - EU REGULATIONS AND DIRECTIVES

The following regulations and directives may be considered as relevant for windows or window manufacturers. The authors consider them to have comparatively lesser direct impact on the focus of this study.

→ ETS - EU Emissions trading system

The EU emissions trading system (EU ETS) is a cornerstone of the European Union's policy to combat climate change and its key tool for reducing industrial greenhouse gas emissions cost-effectively. The first - and still by far the biggest - international system for trading greenhouse gas emission allowances, the EU ETS covers more than 11,000 power stations and industrial plants in 31 countries, as well as airlines[63]

It covers:

- CO_2 emissions from installations such as power stations, combustion plants, oil refineries and iron and steel works, as well as factories making cement, glass, lime, bricks, ceramics, pulp, paper and board, petrochemicals, ammonia and aluminium, and the aviation sector;
- N_2O emissions from the production of nitric, acidic and glycolic acid production;
- perfluorocarbons from the aluminium sector;
- the capture, transport and geological storage of all greenhouse gas emissions.

By putting a price on carbon and thereby giving a financial value to each tonne of emissions saved, the EU ETS has placed climate change on the agenda of company boards and their financial departments across Europe. A sufficiently high carbon price also promotes investment in clean, low-carbon technologies[64]. The 2013 cap for emissions from power stations and other fixed installations in the 27 EU Member States (before Croatia's accession on 1 July 2013) has been provisionally set at 2,039,152,882 allowances. Croatia's contribution to the cap is being determined. For each year after 2013, this cap will decrease by 1.74% of the average total quantity of allowances issued annually in 2008-2012. In absolute terms this means the number of general allowances will be reduced annually by 37,435,387. Thanks to the decreasing cap, in 2020 emissions from fixed installations will be 21% lower than in 2005. The annual reduction in the cap will continue beyond 2020, but may be revised no later than 2025.

→ Effort Sharing Decision (406/2009/EC)

The Effort Sharing Decision establishes binding annual greenhouse gas emission targets for Member States for the period 2013–2020. These targets concern emissions from most sectors not included in the EU Emissions Trading System (see above), such as transport (except aviation), buildings, agriculture and waste. The Effort Sharing Decision forms part of a set of policies and measures on climate change and energy – known as the climate and energy package - that will help to move Europe towards a low-carbon economy and increase its energy security. Many of the important decisions will be made at Member State level.

→ Directive on Packaging and Packaging Waste 94/62/EC, amended by 2004/12/EC, 2005/20/EC and Regulation No 219/2009

The EC Packaging Directive seeks to reduce the impact of packaging and packaging waste on the environment by introducing recovery and recycling targets for packaging waste, and by encouraging minimisation and reuse of packaging. A scheme of symbols, currently voluntary, has been prepared through Commission Decision 97/129/EC48. These can be used by manufacturers on their packaging so that different materials can be identified to assist end-of-life recycling. The Packaging Directive (94/62/EC) was amended in 2004 by Directive 2004/12/EC49. This amendment included a number of key revisions. These included further clarification regarding the definition of packaging, amendments to the provisions relating to prevention and revised targets for the recovery and recycling of packaging materials.

[63] http://ec.europa.eu/clima/policies/ets/index_en.htm

[64] http://ec.europa.eu/clima/policies/ets/index_en.htm

Member States must ensure that packaging placed on the market complies with the essential requirements (VHK, 2011):

- To limit the weight and volume of packaging to a minimum in order to meet the required level of safety, hygiene and acceptability for consumers;
- To reduce the content of hazardous substances and materials in the packaging material and its components;
- To design reusable or recoverable packaging.

With the exception of roof windows, which are almost exclusively delivered to the customer in an outer packing, windows will be delivered with few if any packaging or in multi-use racks owned by the manufacturer.

Figure 42: Packaging of roof windows (Source VELUX)

Roof windows packed

special packaging concept for roof windows

→ **Ecolabel Regulation (Regulation (EC) No 66/2010)**

The EU Ecolabel helps to identify products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw material through to production, use and disposal. Recognised throughout Europe, EU Ecolabel is a voluntary label promoting environmental excellence which can be trusted[65].

Figure 43: EU Ecolabel http://www.eu-ecolabel.de

At the end of 2013 there was no category rule for windows. (http://ec.europa.eu/ecat/)

[65] http://ec.europa.eu/environment/ecolabel/information-and-contacts.html

→ **Regulation on Substances that Deplete the Ozone Layer (EC 1005/2009)**

This Regulation[66] applies to organisations that produce, import, export, sell and recover/recycle or destroy substances such as CFCs and HCFCs, which are classified as ozone depleting substances (ODSs). One difference to the Montreal protocol is that it specifies an accelerated HCFC phase-out schedule.

The Regulation 1005/2009 is a recast of original Regulation 2037/2000. A recast was deemed appropriate due to the large number of amendments that had been made to the original regulation and further amendments that needed to be made. The original regulation phased out a large proportion of ODS previously produced in the European Community, with others still to be phased out between 2010 and 2015. This means that further environmental benefits from production controls will be limited, therefore the new regulation addresses issues such as identifying measures to prevent ODS in existing products and equipment from escaping into the atmosphere. (DG Environment, 2010)

→ **Waste Framework Directive (2008/98/EC)**

Directive 2008/98/EC sets the basic concepts and definitions related to waste management, such as definitions of waste, recycling or recovery. It explains when waste ceases to be waste and becomes a secondary raw material (so called end-of-waste criteria), and how to distinguish between waste and by-products. The Directive lays down some basic waste management principles: it requires waste to be managed without endangering human health and harming the environment, and in particular without risk to water, air, soil, plants or animals, without causing a nuisance through noise or odours, and without adversely affecting the countryside or places of special interest. Waste legislation and policy of the EU Member States shall apply as a priority order the following waste management hierarchy:

Figure 44: Waste treatment hierarchy (VHK, 2011)

The Directive introduces the "polluter pays principle" and the "extended producer responsibility". It incorporates provisions on hazardous waste and waste oils (old Directives on hazardous waste and waste oils being repealed with effect from 12 December 2010), and includes two new recycling and recovery targets to be achieved by 2020: 50% preparing for re-use and recycling of certain waste materials from households and other origins similar to households, and 70% preparing for re-use, recycling and other recovery of construction and demolition waste. The Directive requires that Member States adopt waste management plans and waste prevention programmes.

→ **Energy Efficiency Directive (2012/27/EU)**

Directive 2012/27/EU amends Directive 2009/125/EC on Ecodesign requirements for energy-related products and Directive 2010/30/EU on energy efficiency labelling of energy-related products, and repeals Directive 2004/8/EC on the promotion of cogeneration and Directive 2006/32/EC on energy end-use efficiency and energy services.

The new Energy Efficiency Directive entered into force on 4 December 2012. Most of its provisions will have to be implemented into national legislation by the Member States by 5 June 2014. Article 4 (Building renovation strategy) requires each Member State to submit its long term strategy for building renovation with its National Energy Efficiency Action Plans by 30 April 2014 and every three years thereafter.

66 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:286:0001:0030:EN:PDF

The Directive establishes a common framework for promoting energy efficiency in the Union to ensure the target of 20 % primary energy savings by 2020 is met and to pave the way for further energy efficiency afterwards. It lays down rules designed to remove barriers and overcome some of the market failures that impede efficiency in the supply and use of energy. For end-use sectors, the Directive focuses on measures that lay down requirements on the public sector, both as regards renovating the buildings on it owns and applying high energy efficiency standards to the purchase of buildings, products and services. The Directive requires Member States to establish national energy efficiency obligation schemes. It requires regular mandatory energy audits for large companies and lays down a series of requirements on energy companies regarding metering and billing.

For the energy supply sector, the Directive requires Member States to adopt national heating and cooling plans to develop the potential for high-efficiency generation and efficient district heating and cooling, and to ensure that spatial planning regulations are in line with these plans. Member States must adopt authorisation criteria that ensure that installations are located in sites close to heat demand points and that all new electricity generation installations and existing installations that are substantially refurbished are equipped with high-efficiency combined heat and power units. Member States should however be able to lay down conditions for exemption from this obligation where certain conditions are met. The Directive also requires Member States to establish an inventory of energy efficiency data for installations undertaking the combustion of fuels or the refining of mineral oil and gas and sets requirements on priority/guaranteed access to the grid, priority dispatch of electricity from high efficiency cogeneration and the connection of new industrial plants producing waste heat to district or cooling networks.

Other measures include efficiency requirements for national energy regulatory authorities, information and awareness-raising actions, requirements concerning the availability of certification schemes, action to promote the development of energy services, and an obligation for Member States to remove obstacles to energy efficiency, notably the split of incentives between the owner and tenant of a building or among building owners.

Finally, the Directive provides for the establishment of national energy efficiency targets for 2020 and requires the Commission to assess in 2014 whether the Union can achieve its target of 20 % primary energy savings by 2020. The Commission is required to submit its assessment to the European Parliament and the Council, followed, if appropriate, by a legislative proposal laying down mandatory national targets. (VHK, 2012)

Available data suggests that the targets will not be met. The European windows industry estimates that the volume of windows to be replaced needs to be doubled.

→ **Regulation on the classification, labelling and packaging of substances and mixtures (CLP)**

CLP is the Regulation on classification, labelling and packaging of substances and mixtures. This Regulation aligns previous EU legislation on classification, labelling and packaging of chemicals to the GHS (Globally Harmonised System of Classification and Labelling of Chemicals). Its main objectives are to facilitate international trade in chemicals and to maintain the existing level of protection of human health and environment. The GHS is a United Nations system to identify hazardous chemicals and to inform users about these hazards through standard symbols and phrases on the packaging labels and through safety data sheets (SDS).

The CLP Regulation was published in the Official Journal 31 December 2008 and entered into force on 20 January 2009. According to the Regulation, the deadline for substance classification according to the new rules will be 1 December 2010. For mixtures, the deadline will be 1 June 2015. The CLP Regulation will ultimately replace the current rules on classification, labelling and packaging of substances (Directive 67/548/EEC) and preparations (Directive 1999/45/EC) after this transitional period.

The substances and mixtures covered under the CLP are in general not part of the windows delivered by the manufacturer. The need for windows manufacturers to be informed about relevant substances in their raw materials – if any - through a SDS has been enforced through the CPR (see above).

→ **Biocide Product Directive (98/8/EC)**

Directive 98/8/EC of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market.

The Directive applies to biocidal products, i.e. non-agricultural pesticides as defined in Article 2 of the Directive.

The Directive concerns:

- the authorisation and placing on the market of biocidal products in the Member States;
- the mutual recognition of authorisations within the Community;
- the establishment at Community level of a list of active substances which may be used in biocidal products.

Member States must ensure the authorisation, classification, labelling, packaging and proper use of the biocidal products in line with this Directive. Proper use includes measures necessary to keep the use of biocidal products to a minimum as well as an obligation to ensure that their use in the workplace is in compliance with the directives on health and safety protection for workers.

An active substance for use in biocidal products may be placed on the market if:

- a dossier has been submitted to a Member State accompanied by a declaration that the active substance is intended for inclusion in a biocidal product. This condition applies to active substances which did not have an authorisation to be placed on the market before 14 May 2000;
- the active substance is classified, packaged and labelled in accordance with Directive 67/548/EEC which is applicable until 1 June 2015.

A system of specific information is introduced in order to enable professional and industrial users of biocidal products to take the necessary measures for the protection of the environment and health. This system must take the form of a data safety sheet provided by those responsible for placing the product on the market.

As this directive has an effect primarily on the substances available for the preservation process (impregnation) for wooden windows and for substances used on PVC windows to avoid algae and mould growth under unfavourable climate conditions it is considered to have a lesser impact on the focus of this study .