About Nordic Ecolabelled

Windows and Exterior doors

Consultation paper for Version 4.0

Background to ecolabelling

17 June 2013

Nordic Ecolabelling

Draft for Nordic Ecolabelled Windows and Exterior doors - Background to ecolabelling

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1 Summary

Nordic Ecolabelling established a set of criteria for the ecolabelling of windows in 1997 which was extended to include exterior doors in 2001. The product group includes facade windows, skylights/roof windows and exterior doors covered by the product standard EN 14351–1. Exterior doors between indoor and outdoor climates can carry the Nordic Ecolabel. This background document presents the results of the criteria revision performed in autumn 2012 and spring 2013 that resulted in version 4.0 of the criteria. The revision focuses on the following areas:

- Tightening of energy requirements.
- Overview of the way in which the energy rating of windows should be presented based on national systems for energy balance/energy addition calculations.
- An overview of requirements applicable to components based on a MECO[1] analysis.
- Examination of wood protection methods as a basis for requirement revision.
- Assessment as to whether the product group should be expanded to include windows and doors used in commercial property.

Energy rating
Several LCAs shows that the single most important contributing factor to the overall energy impact of the product is the window's energy consumption when in use. Nearly 5,000 MJ may be lost over the course of the usage phase which is assumed to be 30 years[2]. That's more than double the energy consumed when manufacturing the same window, see table 2. This is based on PVC windows and the relationship differs for other types of materials. Wood windows have a lower energy consumption at the production phase, meaning that the usage phase is even more significant in comparison.

The second most important contributing factor is the emission of greenhouse gases which in turn is affected by the energy consumption. Having the option of using sunlight as a passive contribution in order to lessen the building's heating needs is important, but cooling requirements must not arise/increase as a result. From an LCA perspective, other environmental impact factors include the production phase and raw materials extraction. LCA analyses of exterior doors produce similar results. The main difference is that an exterior door does not normally contribute to lessening the building's heating requirements in the same way, which is why only the door's ability to insulate against heat loss is considered relevant.

On this basis, it is understandable that Nordic Ecolabelling enforces a strict requirement with regard to window's heat transfer coefficient (its U_w value) while also requiring that a satisfactory level of solar energy transmittance (g value) achieved. The U value requirement has been tightened in this revision compared with the previous version of the criteria.

[1] Nordic Ecolabelling's tools for analysis the energy, material, chemicals and other environmental aspects.

[2] Developing an Evidence Base for Windows and External Doors. Base Case Assessment, JRC, itps and AES, Draft Report, April 2012.

The g value measured on the window pane is the same as in version 3 of the criteria, i.e., it must be at least 48% while the g value of the entire window must be 34% or more.

The ± 2% margin has been removed and the value adjusted downward by a corresponding value instead.

The revision has examined the possibility of imposing requirements based on the energy balance concept introduced in Denmark instead of, or in addition to, the above. However, imposing requirements for a certain E_{ref} value entails a risk of windows with varying energy rating being awarded the labelling. In other words, a Nordic Ecolabelled window in one Nordic country could have a lower U value than one in another Nordic country. This is unsustainable within Nordic Ecolabelling and this is the most important argument against basing energy requirements on energy balance calculations. Another reason is that Nordic Ecolabelling's requirements must function and cover all climate zones relevant to the Nordic region.

A requirement for differential climate testing to ensure door air permeability, even when the difference between indoor and outdoor temperature is significant, has been added to the requirement relating to exterior door air permeability.

Raw materials, materials and manufacture

When Nordic Ecolabelled windows or exterior doors are fully or partly manufactured using non-rnewable materials such as metal, plastic, etc., the requirement states that the non-renewable material components must consist of at least 50% recycled raw material. In other words, the requirement has been tightened compared to the previous version which called for at least 30% recycled raw material. At the same time, the requirement has been adjusted to allow the use of plastic composite materials, both as protection against the elements and as part of the load bearing structure. Window profiles manufactured using plastic composite (often a mixture of glass fibre and polymers) are a relatively new and growing product area.

There is good reason for imposing requirements on the various materials. At the same time, there is little scope for managing the extraction and manufacture of e.g. aluminium and composite. That is why Nordic Ecolabelling focuses on imposing requirements that ensure that a large share of recycled raw material is used in the Nordic Ecolabelled products.

The lead and cadmium content of recycled plastic (often PVC) is now in line with Nordic legislation. The limit values are 100 ppm for lead and 1,000 ppm for cadmium. The chemicals requirements remain essentially unchanged but have been made clearer in the sense that they now apply regardless of whether production takes places at the licensee's own premises or with a subcontractor.

One focus area for this revision has been Nordic Ecolabelling's view on wood protection and surface treatment. Facts and reasoning around this matter can be found in chapter 5.6. The conclusion is that Nordic Ecolabelling will continue to accept vacuum impregnation using organic solvents. However, the requirement has been tightened as the VOC emission limit values have been lowered so significantly that only plants with the very best treatment technology systems will be able to meet them. One important reason for allowing this form of vacuum impregnation is that wood protection and surface treatment is one environmental aspect among many that Nordic Ecolabelled windows need to meet. From a lifecycle perspective, the most important issue is the window's energy efficiency.

Other
The requirement for a recycling system for end-of-life windows and doors has been removed. The main reason for this is that the purpose is fulfilled through the requirement calling for 50% recycled raw material to be used in the manufacture of the products. The manufacturer's responsibility to inform the customer of the importance of sun screening solutions has been added to the criteria.

The other requirements of the criteria document have been adapted to the present situation and any uncertainties have been corrected. However, the requirements have not changed in terms of scope or requirement level. Appendix 1 to this report contains an overview of all requirements. With this revision, Nordic Ecolabelling hopes to ensure that the requirements for Nordic Ecolabelled windows and exterior doors are well conceived from an LCA perspective and so stringent that only the very best manufacturers in the industry are able to meet them.

2 Basic facts about the criteria

2.1 What are windows and exterior doors?

Facade windows and roof windows (skylights) have the following primary characteristics:

- providing a barrier between the inside and the outside climate, i.e. precipitation, wind, etc.
- keeping the cold out and the heat in during the heating season
- allowing daylight into the building
- providing a view of the surroundings from inside of buildings

In addition to the above parameters, the window's energy rating is also seen as an important factor when selecting a window product today. Furthermore, various secondary functions are also associated with windows; for example, that they can be opened to allow fresh air in and air-tight to avoid draughts, or that they are fitted with coated glass with a specific function. The window designs may also be important in terms of the value that it adds to the building.

For low-energy buildings, work is underway to give windows an added function, namely the contribution of solar energy to the building during the heating season. However, this function does not come alone as there is a risk that this might cause overheating in the summer period unless measures such as sun screening are put in place to limit sunlight entry outside of the heating season.

The overarching function of an exterior door is to be an integral part of the building envelope that allows entrance and exit to and from the building. The exterior door must also have insulating properties to avoid heat loss and equipped with a lock. In addition, the exterior door may be required to let sunlight through, making it an external glass door, e.g. a patio door.

The frame, casement and door leaf are normally made from either of the following:

- wood
- metal, often aluminium or steel
- composite materials (e.g. glass fibre-reinforced polyester or glass fibre-reinforced polyurethane)
- polymers (often PVC)
- a combination of these materials, e.g. wood windows with aluminium cladding
- insulation materials

2.2 Version and validity of criteria

The window criteria were first established in 1997. Version 2 was created in December 2001 and has since then been extended to include exterior door requirements.

At the end of 2008, version 3 of the criteria for windows and exterior doors was finalised. Compared against the previous version, the U value had been lowered from 1.3 to 1.0 W/m^2K[3]. Requirements for non-renewable materials in frames, casements and door leaves were introduced. These included requirements for the use of recycled materials and a requirement stating that wood raw material to be derived through certified, sustainable forestry. The chemical products requirements were updated and tightened.

The most recent evaluation of the criteria and their functioning was performed in 2011. The evaluation showed that the criteria were in need of revision and this document is the result, please see chapter 3 for further details.

2.3 The Nordic Market

The text below is an extract from the evaluation performed in 2011.

Table 1: Overview of window market shares

Type of window	Denmark[4]	Finland[5]	Sweden[6]	Norway[7]
Wood	30		40	76
Wood/aluminium	50	90	50	10
Plastic (PVC)	12		6 (2010)	12
Other (metal, composite, tropical wood)	8		4 (2010)	2

[3] Calculated based on the entire window including the frame for the dimensions 1,200 x 1,200 mm.

[4] Johny H. Jensen at The Association of Danish Window Manufacturers, 2 February 2010

[5] Confederation of Finnish Construction Industries RT, 2011

[6] Lars-Göran Johansson at the Swedish Federation of Wood and Furniture Industry (TMF), 2 September 2011

[7] Tore Gran at the National Organisation of Norwegian Wood Product Factories (NTL), 9 September 2011

Finland

According to the Finnish industry organisation Confederation of Finnish Construction Industries RT, there were around 200 window manufacturers and 50 exterior door manufacturers in Finland in 2011. The Finnish windows market turns over between EUR 600 million and 700 million (1.6 million windows delivered) each year. The exterior door market turns over EUR 300 million. The import/export share is very small. The market is relatively stable and no major changes are expected in the near future. The main manufacturers include Fenestra, Pihlavan ikkuna, Tiivituote, Skaala, Domus and Eskopuu, in descending size order.

Wood/aluminium accounts for 90% of the market and is thus very dominant. Wood windows are mainly found in wooden houses and cabins while aluminium is primarily used in office buildings. According to the industrial organisation, double glazed windows are all but 'illegal' in Finland. These can be used in cabins that are not heated. Double glazed windows account for about 5% of the total production annually. The majority of windows are triple or quadruple glazed. According to Motiva Oy, discussions are being held to assess the development potential of windows with five panes. However, this might prove unprofitable due to the weight of such windows. The majority of the windows sold have a U value of between 0.8 and 1.0. It is possible to achieve a U value of 0.7 using four glass panes with a gas layer between the panes. According to Motiva OY, the best windows have a U value of 0.52. The g value varies more.

Sweden

There are around 60 window manufacturers in Sweden. The Swedish window market turns over around SEK 5 billion annually (2010). Sweden imports just under 6% and the export share is just under 4%. Norway accounts for half of exports, the UK one fourth and Denmark and Japan just under 10% respectively. The Swedish window market grew by 6% between 2009 and 2010.

Diana Avasoo of WSP Environmental works as project manager for the Frivillig energi-märkning av fönster (Voluntary window energy-labelling), a project initiated by the Swedish Energy Agency in 2005. At the moment, this project is being run by the organisation EQ Fönster www.energifonster.nu. According to Avasoo, windows with a U value of 1.0 or less account for less than 5% of the market in Sweden. There has been a shift toward lower U values; however, most windows sold in Sweden have a U value of between 1.2 and 1.4. Many buy windows with a higher U value from Eastern Europe/the Baltic states due to the low cost. There is demand for windows with low U values, particularly from the low-energy housing/passive house segment but the market share is nevertheless small. Avasoo also stated that companies that energy label their windows rarely have a U value lower than 0.9. In order to achieve low U values they have chosen glass with extremely low U values, in the region of 0.5-0.6 W/m^2K, which increases the risk of external condensation. The Finnish window manufacturer Skaala has solved this problem by introducing a new glass solution that does not cause any external condensation, even at very low U values. It is yet unknown whether this glass could be used in other manufacturers' windows, but it could potentially solve the problem of external condensation and pave the way for lower glass and window U values.

Denmark

Denmark has 70 window manufacturers and the industry turns over DKK 5 billion each year. 15-20% of Danish windows manufactured are exported, two thirds of which are destined for the UK and Ireland. One third of exports relate to Sweden, Norway and Germany. The Danish windows industry employs 5,000 people.

In 2010 Denmark introduced a new energy rating system (A-G) for windows. The rating system is related to the building regulations, where a C-marked window fulfills the present requirements for windows in new build and by replacements. B-marked windows fulfill the future requirements in 2015 and an A-marked window fulfills the requirement in 2020 (- and in the determined nearly energy-neutral building class 2020). The Danish building class 2020 fulfills the EU directive for nearly energy-neutral buildings.

The energy rating A-G is performed on a reference window (size: 1.23 m x 1.48 m) and on the energy balance: $E_{ref} = U_w - g_w$ (multiplied with reference data for a Danish reference house).

The manufacturer is subjected to external inspection, and must, upon request, be able to provide information about E_w (energy balance), U_g, g_g, LT_w of actuel window types produced.

Norway
In Norway there is no industry organisation especially for manufacturers of windows and exterior doors. However, many manufacturers are members of Norske trevarefabrikkers landsforbund (NTL – The National Organisation of Norwegian Wood Product Factories), www.trevare.no. According to data from NTL[8], there are roughly 90 companies manufacturing windows in Norway. The manufacturers tend to be small and total industry turnover is around NOK 3.5 billion. Import accounts for 8% of the market and there are various countries of origin, the most important being Poland and Sweden.

2.4 Nordic Ecolabel licences

There are currently two licences issued in the Nordic region; one to NorDan, the largest Norwegian producer and one to Svenska Fönster; licensee for the brands SP Fönster, Traryd Fönster and Mockfjärds Fönster. Svenska Fönster is an important producerr on the Swedish market. Only Elitfönster have a larger market share. Two applications are also currently being processed. Unfortunately, there is no licensee for exterior doors even though a couple of manufacturers have shown interest in becoming labelled.

2.5 Other labelling systems

Other ecolabelling systems
In addition to Nordic Ecolabelling's 'Swan', US ecolabel Green Seal, the Chinese Ecolabel, the Korean Ecolabel and the Hong Kong Green Label scheme all have criteria for windows. Green Seal's criteria date back to 1995 and include requirements for U values and solar energy transmission above g value (solar energy transmittance/g value > 1). In addition, the requirements include a ban on lead, cadmium, arsenic, mercury and hexavalent chromium in window frames/jambs and a requirement stating that 25% of packaging materials should consist of recycled material[9].

[8] Telephone interview with Tore Gran, 6 September 2011

[9] GS-13, Green seal standard for windows, sec. ed., March 21, 1995

The EU Ecolabel is now revising GPP criteria (please see the section on GPP further down). Based on the EU Ecolabel workplan[10] it was decided in June 2011 to wait for the technical background to GPP before formally deciding on the development of the EU ecolabel criteria. According to the workplan, the criteria for the EU Ecolabel are scheduled to be finished in 2013; however, this has not yet been formally established. At the time of writing, work has not yet started on the creation of an EU Ecolabel for windows and exterior doors.

The German ecolabel Blaue Engel and Canadian Ecologo do not impose requirements for windows.

Green Public Procurement (GPP)
GPP criteria have been developed for windows and exterior doors. These date back to 2010 and are now being revised. The revision work can be accessed here: http://susproc.jrc.ec.europa.eu/windoors/whatsnew.html

Energy labelling
While the EU has been working to develop a shared energy labelling system for windows, Denmark, Sweden and Finland developed their own systems some years ago. The purpose is to develop a voluntary system for presenting window energy rating. Sweden, Denmark and Finland have different energy labelling systems. However, there are some similarities. The label itself and the classification system using A, B etc. are relatively similar. Fundamental window properties and performance, such as insulating properties and the share of surrounding sunlight that permeates as heat, are used as a basis for the labelling. For a more detailed description, please see appendix 3.

Environmental product declarations (EPD)
Environmental declarations (also known as EPDs or environmental product declarations) do not impose requirements on the products. Instead they serve to document the products' environmental impact through production, use and disposal[11]. EPDs are based on the principles of the international standard for type III environmental declarations, ISO 14025, and on LCAs performed on the products. In order to be able to create an EPD a set of Product Category Rules, or PCRs, need to be in place or created for the product category. As previously mentioned, the EPDs do not contain limit requirements and it is difficult to compare different EPDs as there are no standardised methods for calculating the environmental impact of, for example, energy consumption. A new standard for creating PCRs has been introduced for construction materials (incl. windows and doors) in Europe (EN 150804) but no PCRs have been developed for windows based on this standard yet.

[10] http://ec.europa.eu/environment/ecolabel/about_ecolabel/pdf/work_plan.pdf

[11] http://www.sintef.no/Projectweb/Miljodeklarasjoner/Hva-er-miljodeklarasjoner-EPD/

PCRs have been developed for widows in Denmark and Norway. There used to be PCRs for windows in Sweden but these have expired. The PCRs have also expired in Norway but here they are undergoing revision:

- Denmark: (PCR for windows 12 January 2010): http://www.mvd.dk/en-GB/Pages/default.aspx
- Sweden: (PCR for preparing an environmental product declaration (EPD) for WINDOWS Frames, transparent surfaces, shutters. PCR 2008:03 - EXPIRED): http://www.environdec.com/PCR/Detail/?Pcr=5812
- Norway (Windows and doors NPCR 014, EXPIRED 2012): http://www.epd-norge.no/category.php?categoryID=487

The EU's Construction Products Directive (CPD) & harmonised product standard

As of 1 July 2013, all construction products covered by a harmonised standard or European technical assessment (ETA) must, in order to be sold in Sweden and other EU countries, have a performance declaration and be CE labelled. This is regulated by the EU's Construction Products Directive (305/2011/EC), abbreviated CPD, which also applies in Norway, Switzerland, Iceland, Turkey and Lichtenstein. The purpose of this regulation is to facilitate trade between these countries. The appendix to the Construction Products Directive contains a managed template for performance declaration. Once this template has been completed by the manufacturer the product can be CE labelled.

Windows and exterior doors are regulated by a harmonised 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.

Product certification of insulating glass units

The Danish glass industry applies a product certification for insulating glass units which is based on EN 1279-5 - Glass in building - Insulating glass units - Part 5: Evaluation of conformity to create a basis for CE labelling of insulating glass units in accordance with the Construction Products Directive.

The aim of the product certification is to:

- help ensure the quality of insulating glass units and that
- the closure mechanisms meet the requirements outlined in EN 1279-5 and EN 1279-6
- to ensure that the manufacture of insulating glass units take into account the internal and external environment
- to create a documented and guiding basis for assessing the energy properties of insulating glass units[12].

[12] http://www.glasfakta.dk/?page_id=23 accessed 8 November 2012

3 About the revision

3.1 Purpose of the revision

The aim of the project was to revise the criteria for the product group Windows and exterior doors and has had the following focus areas:

- Tightening energy requirements.
- An overview of how the energy rating of window should be reported, particularly in relation to national systems for energy balance/energy addition.
- An overview of requirements applicable to components based on a MECO analysis.
- Investigation into wood protection methods as a basis for requirement revision.
- Assessment as to whether the product group should be expanded to include windows and doors used in commercial property.

3.2 About this revision

The project was started in 2012 and has continued into the first half of 2013. Heidi Bugge, product group manager at Ecolabel Denmark, was project manager up until the year end 2012/2013. Sara Bergman of Ecolabelling Sweden stepped into the project manager role in January 2013. Ingvild Kvien and Elisabeth Magnus also worked on the project. Karen Dahl Jensen holds the position of product development manager and commissioned the revision.

In October 2012, Nordic Ecolabelling held a full-day seminar for invited industry stakeholders. A large number of representatives for the industry, industry organisations, suppliers, quality and control labelling organisation etc. participated in the event.

Telephone meetings have been held with stakeholders and many contacts have been established in order to gather information as part of this work.

4 The environmental impact of windows and exterior doors

Several LCA studies[13] indicate that heat loss during the usage phase is the most important environmental impact of windows over the course of their lifecycle. The thermal surface properties of windows are important in order to ensure energy efficient buildings. Typically, windows account for around 30-50% of the total transmission losses from the building envelope, even though their surface area share of the building envelope is much smaller than this. The reason for this can be found by comparing the windows heat transmission coefficient (U value) with U values for other construction components (walls, roofs and floor structures). In well insulated buildings, the U value of construction components such as walls, roofs and floors tends to be between 0.1 and 0.2 W/m^2K. The best windows have U values of around 0.7-1.0. In low-energy windows the frame's design and the materials used are often of great importance as the frame's performance tends to limit the reduction of the window's overall U value further. For low-energy glass, the U value is between 0.3 and 0.5 while the frame itself has a higher U value based on materials and construction, meaning that the U value of the window overall is between 0.7 and 0.1 W/m^2K for the windows with the best energy rating[14].

As energy losses represent the most significant environmental impact by far due to the energy loss that occurs while in use in the building, the technical service life does not have a very strong impact on the overall result if we assume that windows have a technical service life of around 40 years. If we look only at the environmental impact of the window production, and if the technical service life is relatively short, the technical service life is of considerable importance[15].

The Nordic Ecolabel is a type I ecolabel pursuant to standard ISO 14024 and must thus ensure that various relevant environmental impacts over the window's technical service life are considered that could help window manufacturers reduce overall environmental impact. It is therefore important to assess all relevant environmental impacts over the window long technical service life and not just energy rating. A purely qualitative MECO (Materials, Energy, Chemicals and Other) analysis has therefore been included in Appendix 2 to highlight the different environmental impacts over the window's lifecycle. Based on the MECO analysis, an RPS analysis was also performed as part of the environmental assessment that evaluates environmental impact relevance (R), improvement potential (P) and the possibility of introducing steerable criteria (S).

The analyses are based on windows but the product group also includes exterior doors and it is assumed that many of the environmental parameters can also be applied to these. As exterior doors may lack windows entirely, or have a window that accounts for a smaller share of glass than in windows, many characteristics will overlap.

The MECO and RPS analyses show that it is relevant to impose requirements at all phases of the lifecycle; raw materials extraction, production, use, disposal/end-of-life and

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[13] E.g. "Miljøvurdering av vinduer", By och Byg Documentation 046, Danish Building Research Institute 2003 and the report "Life Cycle Assessment of PVC and of principal competing materials", commissioned by the European Commission, July 2004.

[14] Gustavsen, A., Key Elements of and Materials Performance Targets for Highly Insulating Window Frames, 2011

[15] Kampmann, T., Vinduers samlede miljøbelastning

transport. However, steerability and the potential for ecolabelling to make a difference varies.

As energy consumption is at its highest when the product is in use, rather than during production, Nordic Ecolabelling focuses on requirements relating to the window or door's U value, g value and air permeability. Nordic Ecolabelling believes that it is not relevant to impose direct energy requirements on the production. We do, however, impose indirect energy requirements by calling for a certain share of renewable materials to be used. The production of virgin aluminium requires far more energy than if the raw material is recycled aluminium, for example. Unfortunately, Nordic Ecolabelling assesses the steerability of imposing requirements with regard to transport as low.

It is also relevant to impose environmental requirements on the various materials used to manufacture a window or door in order to be able to have an effect on the environmental impact of extraction and production. Requirements primarily relate to the share of recycled raw materials used in non-renewable materials and hazardous substance content, as well as to the chemical products used in production. PVC is deemed to have steerability and there is thus potential for imposing requirements on the production process.

Insulating gas requirements have significant potential due to the marked difference in energy consumption during the manufacture of the noble gases in question. This energy difference cannot be taken into account during the window's usage phase.

It is still relevant to impose criteria on wood raw material. (Wood) fibre products manufactured entirely from waste generated from wood materials production are exempt from the requirements as it is not relevant when the raw material is waste. Wood protection and surface treatment have a clear environmental relevance and the steerability is good, which is why Nordic Ecolabelling still imposes requirements in this area.

5 Requirement motivation

This chapter outlines proposed requirement revisions and provides a background to why the requirement is applied and the requirement level chosen. The appendices referred to are those attached to the document "Proposed criteria". Firstly, section 5.1 contains an account of the product group definition and any changes compared with version 3 of the criteria.

5.1 Product group definition

Nordic Ecolabelling's experience of licensing and other customer contacts shows that the product group definition has not represented an obstacle to products achieving labelling. The 2011 evaluation highlighted the issue of whether windows for commercial buildings (offices, stores and similar) were excluded from labelling. The revision has shown that this is not the case. Windows for commercial property that meet the criteria requirements are not excluded from ecolabelling under the Nordic Ecolabel. However, this type of window is more often a specially tailored solution and the lack of standard products may obstruct labelling. In this context, the private individual as end customer/consumer should be considered that the primary target group for Nordic Ecolabelling.

Another focus area for this revision has been the review of content materials requirements. The revised criteria are now deemed to contain well adapted requirements for windows manufactured using a composite outer component. The composite material makes it possible to combine strength with slim profiles. Our hope is that this will make it easier for larger windows and also result in windows for commercial property becoming subject to Nordic Ecolabelling.

The changes proposed are:

- Reference to the product standard EN 14351–1 which defines windows and exterior doors and their functional qualities
- Clarification of the product group definition through curtain walling as defined in product standard EN 13830 and skylight domes as defined in EN 1873 not being covered by the criteria for Nordic Ecolabelling.

5.2 What can carry the Nordic Ecolabel?

Nordic Ecolabelling's criteria for Windows and exterior doors, version 4.0, covers both fixed and opening facade and roof windows (manual and electrically operated), window doors (e.g. balcony and patio doors) and exterior doors pursuant to standard EN 14351-1: 2006. Windows and exterior doors not covered by standard EN 14351-1:2006 cannot be labelled. This applies to, for example, rooflight domes[16] regulated by standard EN 1873.

Exterior doors forming the boundary between free and heated areas can be labelled. That is, doors that acts as a barrier between indoor and outdoor environments.

There are various other types of exterior doors that can be subject to various function requirements. Examples of such doors include hallway doors, loft space doors, warm store doors, cold store doors and various gates. These doors are not covered by the product group definition as they are not subject to the same requirements with regard to insulation capacity.

The frame, casement and door leaf may be made from either of these materials, or a combination of the same:

- wood
- metal; often aluminium or steel
- composite material (e.g. glass fibre-reinforced polyester or glass fibre-reinforced polyurethane)
- composite material (often PVC)
- a combination of these materials, e.g. wood windows with aluminium cladding
- insulation materials

Windows and exterior doors manufactured using materials other than those listed above must be assessed by Nordic Ecolabelling before they can be considered for labelling.

[16] Rooflight domes are installed on flat or almost flat roofs but fulfil many of the functions of a 'normal' window.

5.3 Product description

Proposed product description requirements

O 1. Description

Describe the design of the window or exterior door and how it is manufactured.

✉ Description of product and production.

O 2. Materials overview

Specify the materials/components and chemical products of which the window/exterior door comprises. Specify the percentage weight of each material and component of the entire window/exterior door. It is not necessary to specify the percentage weight for chemical products.

✉ Written details, or a drawing, of all materials and components used in manufacturing the window or exterior door and their percentage weights.

Background to product description requirements

Windows do not come in just one version; there are a multitude of different window configurations with differing frames, panes, glazing options, etc. This means that it can be difficult to gain an overview of the products when processing the licence application. Requirement O1 is therefore important when it comes to establishing order with regard to which products the manufacturer is seeking to label. No changes proposed for this requirement.

Requirement O2 is important when it comes to quality assuring the processing of the licence application. The requirement remains unchanged.

5.4 Energy requirements

Proposed energy requirements

O 3. U value, heat transfer coefficient

The U value, or heat transfer coefficient, of a facade window must not exceed 0.90 W/m²K for the entire window, including the frame.

The U value, or heat transfer coefficient, of a roof window (skylight) must not exceed 1.0W/m²K for the entire window, including the frame.

The U value, or heat transfer coefficient, of a window door must not exceed 1.0 W/m²K for the entire window, including the frame.

The U value, or heat transfer coefficient, of an exterior door must not exceed 1.0 W/m²K measured across the entire window, including the frame.

The U value shall be measured through tests or calculations based on the methods stated in product standard EN 14351-1 and performed by an accredited national institutes or equivalent. See also Appendix 1.

The U value shall be stated with two decimal points if less than 1.0 and with one decimal point if it exceeds 1.0. Figures are adjusted downward or upward as follows: 1.049 W/m²K becomes 1.0 while 1.050 W/m²K becomes 1.1.

✉ Test results and calculations, as well as details of how the U value is determined.

O 4. The solar energy transmittance and daylight transmittance of windows

The solar energy transmittance of window glass (g_g value) shall be 0.48 (48%) or higher. The solar energy transmittance of the window (g_w value) shall be 0.34 (34%) or higher. These values are applicable to both facade windows and roof windows.

The daylight transmittance shall be 0.63 (63%) or higher.

The window's g_w value is calculated based on the following formula:

$g_w = g_g \times (A_g/A_w)$. A_g represents the glass area and A_w the window area.

The U value shall be measured through tests or calculations based on the methods stated in product standard EN 14351-1 and performed by an accredited national institute or equivalent. See also Appendix 1.

✉ Test results and calculations, as well as details of how the values were determined.

O 5. Window or exterior door air permeability

The window or exterior door must fulfil Class 4 according to EN 12207 for air permeability under negative and positive pressure.

The exterior door shall first undergo differential climate testing pursuant to standard EN 1121 (climates A and D as a minimum).

Air permeability and differential climate testing shall be measured through tests or calculations based on the methods stated in product standard EN 14351-1 and performed by an accredited national institute or equivalent. See also Appendix 1.

✉ Results of air permeability tests. Details of how air permeability is tested.

✉ For exterior doors, results from differential climate testing and details of how the test was performed. The time of climate testing and of air permeability testing shall be stated.

Background to energy requirements

Windows and exterior doors play an important part in the energy consumption of buildings during their usage phase. In addition, windows can cause problems such as overheating, resulting in a need for air conditioning (cooling), cold air down draught and condensation. Studies conducted on a PVC window show that twice as much energy is consumed during the usage phase as during production of the window. The draft Background to the EU's guidelines for Green Public Procurement (GPP) shows the breakdown of total energy consumption. The relationship may be entirely different for other materials. Wood windows likely have a lower or significantly lower energy consumption at production, making the usage phase consumption all the more important.

Table 2: Breakdown of total energy consumption, UPVC windows[17] with double glazing

	Production	Transport	Use	End-of-life
Share of total energy consumption (%)	29	4	62	5

The same report concludes that the energy consumption during the usage phase is even more important for exterior doors compared with energy consumption during production, transport and end-of-life, please see table 3.

[17] UPVC or uPVC stands for unplasticized polyvinyl chloride, i.e. unsoftened or stiff PVC.

Table 3: Breakdown of total energy consumption, UPVC and wood exterior doors.

	Production	Transport	Use	End-of-life
Share of total energy consumption (%)				
UPVC door	9	1	88	2
Wooden door	2	1	94	2

In addition to this significant environmental relevance, window energy performance requirements also have strong potential and high steerability for; please see Appendix 2 to this report. The energy rating of windows and exterior doors is primarily described using the parameters U value and g value. Below are a brief description of these and the concept of air permeability.

Heat transfer coefficient, U value

Heat and cold enter and escapes through windows in several ways, see figure 1. The U value of windows and doors is a measurement of how well the window or exterior door insulates against heat losses. Heat loss though windows should be minimised through the optimisation of:

1. Window size and orientation
2. Glass type, number of glass panes and glass film
3. Frame, casementmaterial and composition

Note that Nordic Ecolabelling can only influence point 2 and 3.

Different construction legislations apply in the different Nordic countries. All countries impose requirements on new builds with regard to the building's specific energy use (calculated and/or measured). Some countries also impose requirements with regard to the U value of various building components and some also impose requirements with regard to the building envelope. The international and national classification systems that exist for buildings impose requirements with regard to the specific building's energy balance, not the U values of individual windows.

In version 3 of the ecolabelling criteria the U value requirement was set at **0.95 W/m^{2}K** for the entire window measuring 1,480 x 1,230 mm[18]. This criteria revision proposes a tightening of the U value requirement to 0.90 W/m^{2}K. Any further tightening is not considered possible due to the fact that the window

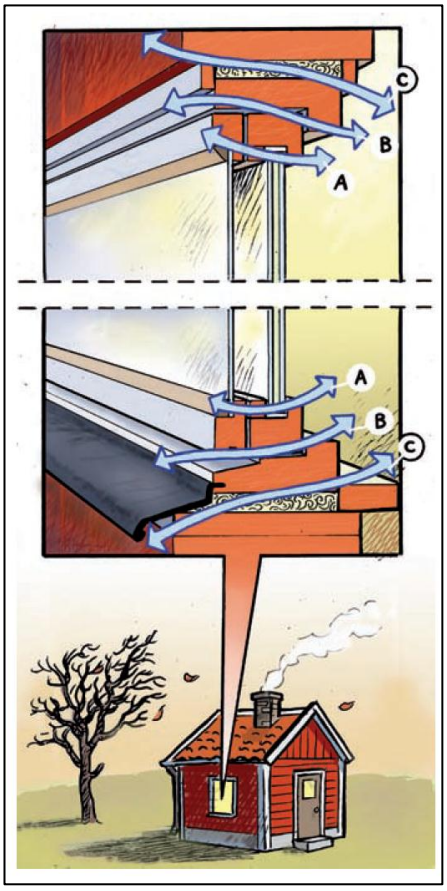


Figure 1: Heat and cold enters and escapes through windows in three ways: between the frame and the glass (A), between the frame and the casement (B) and between the casement and the wall (C). Heat also escapes through the glass itself.

[18] In the past the reference dimensions were 1,200 x 1,200 mm which corresponded to a U value of 1.0 W/m^{2}K

industry has yet to adapt the framework for glass that can be manufactured with very low U values, among other things. As it is the entire glass, frame and casement construction that gives the window's U_w value, 0.90 W/m^{2}K is considered a well balanced level.

For roof windows, the proposed U value is 1.0 W/m^2 K. Roof windows score lower in U value measurements due to the incline at which they are tested. If exactly the same windows was to be used as facade window, the U value would improve. The requirements for passive buildings contain different requirements for roof windows (1.0 W/m^{2}K) and facade windows (0.80 W/m^{2}K). This difference between window types has not been taken into account in the present criteria; an issue which this revision now rectifies.

Solar energy transmittance, g value

Solar energy transmission is a measurement of how much solar energy, in the form of heat, enters through the window. A high g value means that the window allows a high level of heat radiation into the building. It is important to utilise passive solar energy, above all in passive/low-energy buildings where the use of solar energy is an integrated part of the design and construction based on:

Cost effective low-energy building[19]:

1. Reducing heat losses (and need for cooling)
2. Reducing electricity consumption
3. Utilizing solar energy including daylight
4. Controlling and displaying energy use
5. Supplying rest of the energy demand with renewable sources.

In autumn and spring in particular, passive solar energy gains via windows can provide a significant contribution to heating in the Nordic countries. In winter the gains are small at our latitudes as there is so little solar energy available.

It has been proven that many windows are manufactured with aims for low U values while the glass g value is not considered to the same extent. How large a free heating contribution the window creates depends on its positioning (the direction in which the window is facing, the height at which it is fitted, external vegetation and nearby buildings, blinds and other sun protection, among other things). Another determining factor is how much of solar energy can be stored as heat, depending on the building's heating needs and steering and regulation systems.

Windows that allow the entry of high levels of solar energy risk causing an increased need for cooling on warm, sunny days. Buildings with large, south and west-facing glass surfaces may benefit from low solar energy transmittance coefficients in order to limit the solar energy entering the building. In order to achieve gold-level classification in established environmental classification systems (BREEAM, LEED, etc.) offices and commercial buildings are often planned with g values as low as max. 25%. However, this is rarely the case for residential property where mobile sun screening is the most important tool. Mobile sun screening enables the management of solar energy addition, thus helping to avoid high indoor temperatures in spring, autumn and particularly in summer.

[19] Bülow-Hübe, H., Blomsterberg, Å, 2011, Important design aspects of very low energy buildings, NorthPass.

In version 3 of the criteria the g value was set at **at least 50 ± 2%** measured on the window pane. The reason for this was that there was a common g value and one that creates an addition of energy to the building. The requirement level was considered reasonable in order to achieve a proactive and well conceived choice of window construction. This g_g value corresponds to **34-38%** depending on the width of the frame and casement converted to give the g value of the entire window (g_w).

It is suggested that the g value requirement for the window pane be kept unchanged with regard to requirement level but reformulated to exclude the uncertainty interval to g_g = 48% or higher. In order to achieve as true a picture a possible of a window's solar energy transmittance, a combination whereby both the window glass g value and the g value for the entire window are met has been proposed. This avoids the risk of windows being manufactured with too wide a frame in relation to the surface of the window pane. The window's proposed g value is 34%.

The solar energy transmittance requirement must be met by both windows and window doors but not by exterior doors which have significantly less window glass (or none at all).

Energy addition calculation
In connection with the 2008 revision of the criteria, Nordic Ecolabelling, together with Lund University, assessed the possibility of imposing requirements on the window's energy properties using a so called energy addition calculation. This means that the window's energy addition is calculated as a function of the g and U values to help determine how much energy permeates the window, i.e. solar energy in minus heat out.

Since the criteria were adopted, a method for calculating energy addition (or energy loss) from windows and for a fictional building, the so called energy balance, has been developed and established in Denmark. Please see Appendix 3 for further information. The Finnish voluntary energy labelling system for windows also estimates a corresponding annual energy consumption for a fictional building.

The energy balance concept has been met with some criticism in Denmark. One argument against it has been that the heating season has been assumed to be too long, i.e. that the number of degree hours in the equation is too high. This means that there is too much confidence in the g value. Analogue reasoning can be applied to newly built low-energy buildings as these have very limited heating needs. The heating season is even shorter for low-energy buildings. There are thus fewer days that the building would benefit from incoming solar energy (a high g value). The risk that a need for cooling will arise increases. Other arguments against using this method to calculate the building's energy addition include that the reference building is fictional. The 'real' building would look entirely different and would thus have an entirely different energy balance. Furthermore, Nordic Ecolabelling does not have steerability over in what building, or where in a building individual windows are fitted.

The present revision examined the possibility of imposing requirements for U and g values, including requirements for a certain E_{ref} value (nil or positive, ideally). There are several reasons why this is deemed to be impossible. Since E_{ref} is a function of two variables, it is not possible to determine all three. Either the U or the g value can be fixed at a certain value. Such a requirement formulation would result in requirements differing between Denmark and the rest of the Nordic region. A window could thus have a higher U value in Denmark but still receive the Nordic Ecolabel.

Finally, it was concluded that since Finland too has its own method for energy calculation, this method should also be taken into account. Another important argument is that the energy balance is based on one single climate zone. As windows are 'moveable products' a Nordic labelling would need to take into account all the climate zones relevant to the Nordic region.

Reasoning behind the proposed energy requirements
A total of 14 manufacturers have chosen to join the Swedish, voluntary energy labelling scheme for windows. Out of the 201 rated windows, 30 models would pass Nordic Ecolabelling's proposed energy requirements pursuant to the above, i.e. both U and g value. This corresponds to 15% of all rated windows. It should be noted here that far from all manufacturers have had their windows rated, but that the major stakeholders are represented.

A total of 21 manufacturers have joined the Danish energy labelling scheme and 135 window models have been rated. Out of these, 26 (19%) meet the energy requirements proposed by Nordic Ecolabelling.

A review of the rated Finnish windows found that about 123 out of a total of 893 windows, i.e. about 14%, would meet the Nordic Ecolabel's requirements. The 12 Finnish window manufacturers who joined have very low U_w values for a large number of windows, but the g values are often too low.

Overall, Nordic Ecolabelling believes that the requirement for window U values max. 0.90 W/m^2K for facade windows and 1.0 W/m^2K for roof windows is reasonable considering that:

- It represents so-called high-end products for window manufacturers.
- A Nordic Ecolabelled window should be a good choice for a new-build as well as for window replacement/renovation.
- The U value should be met *and* the g value requirement fulfilled.
- The labelling is for the Nordic region and should suit the entire Nordic market, taking into account that the Nordic countries have different focuses with regard to low U values.
- There is scope for legislation requirements which, according to Nordic Ecolabelling, will remain in place for the duration of the criteria lifespan.
- Although energy is the most important issue when it comes to windows, there must be a balance with regard to other requirement areas such as wood protection, materials and chemical products.

Daylight transmittance
Daylight transmittance is a measurement of the amount of daylight that enters a building through a window. The main function of a window is to let light into the building. In version 3 the requirement was min. 63 ± 2% daylight transmittance measured on the window pane. The requirement was the same in version 2 of the criteria. It has been suggested that the requirement be kept unchanged but that the margin of uncertainty be removed.

Air permeability

Wood is a flexible material that moves in different ways at different temperatures and humidity levels. Seals shall ensure that the window closes tight. In order to ensure satisfactory permeability in the Nordic Ecolabelled product it must be tested accordning to EN 12 207 (standard for measuring and rating the air permeability of windows and doors). Windows shall meet Class 4 which is in line with NDVK's[20] and SFDK's[21] air permeability requirements. Neither the Danish Windows Industry nor the P-labelling impose any requirements with regard to air permeability. It is suggested that the requirement relating to window and exterior door air permeability be left unchanged in version 4.0.

Energy requirements for exterior doors

Lowering the U value by 0.1 W/m^2K results in a saving of about 25 kWh per year and door which is very little considering the total energy consumption of a building. Viewed against this background, it is not relevant to impose any further tightening of the present requirements. There are some doors marketed in the Nordic region with U values as low as 0.7 W/m^2K. In order to achieve such a low heat transmission coefficient, the doors have been made so thick that practicality and aesthetic values have been compromised. In addition, the more the manufacturer lowers the door's U value, the greater the risk of tension differences in the door material and the harder it becomes to ensure good air permeability at different climate conditions, i.e. the type of climate that a door needs to be able to withstand in winter.

Nordic Ecolabelling focuses on imposing requirements in areas with the best potential for environmental improvement, which for exterior doors means ensuring good air tightness even at different climates. An exterior door that has been tested for air permeability, i.e. that meets Class 4 pursuant to EN 12 207 may lose its air permeability properties in a real operating environment. Doors will bend at different climates and the air permeability will be compromised unless the manufacturer has taken this into account. If the door is not airtight, up to 800 kWh/h may be lost each year once the door has been fitted. There is a European standard for climate testing, EN 1121 'Doors-behaviour between two different climates'. The procedure for the Nordic countries is to test climate A first, followed by climate D. The humidity is then measured.

Climate A corresponds qualities 23 °C and 30% Rh[22] and 18 °C and 50% Rh respectively.

Climate D corresponds to 23 °C and 30% Rh and -15 °C respectively.

In order to ensure that the door will not leak energy in a real setting, a requirement stating that the exterior door shall undergo a climate test pursuant to standard EN 1121, followed by an air permeability test is added to requirement R5. In order to make sure that the door does not revert to its original shape, tests shall be performed in immediate succession. This requirement can be met by following the test standard (EN 1121) referred to in the harmonised product standard. Both tests are normally performed using the same test rig that was used to assemble the door. If it becomes necessary to move the door from the climate rig in order to test air permeability using a different rig, the

[20] Norwegian Window and Door Control (NVDK). A voluntary system for quality labelling windows and doors in Norway.

[21] Swedish Window and Door Control (SFDK); the Swedish equivalent.

[22] Relative humidity.

standard clearly states that the bend resulting from the climate test should be secured in this, second rig.

5.5 Material requirements

Proposed recycled material share requirements

O 6. Recycled material in 'non-renewable' materials

Components used in windows, window doors and exterior doors such as frames, casements or door leaves consisting of non-renewable raw material should per component, consist of at least 50 % by weight recycled material.

The requirement does not apply to:

- materials that account for less than 3 per cent by weight of the window's, window door's or exterior door's total weight;
- hinges, handles, fittings, stabiliser plates and kick plates;
- window and exterior door insulation;
- non-renewable components in glass/insulation panes;
- materials used for weather protection that do not form part of the load bearing structure (plastic composite may form part of the load bearing structure) provided that these do not exceed:
  - Aluminium - max. 8% by weight of the total weight of the exterior door or 11% by weight of the window door's total weight.
  - PVC - max. 4% by weight of the total weight of the window or window door.
  - Plastic composite - max. 12% by weight of the total weight of the window or window door.*

Recycled material is defined as post-consumer recycled material, recycled waste materials from window and door manufacturing and waste from other production such as plastics and metals. Production waste from the manufacture of window and door profiles is not considered recycled material. This is in line with the definitions contained in ISO 14021 on ecolabelling and environmental statements.

**Plastic composite may form part of the load bearing structure if it also serves to protect against the weather.*

For all types of materials, the percentage weight should be calculated based on a standard size, double-glazed window, window door or exterior door (for windows 1,230 x 1,480 mm).

Windows and exterior doors manufactured from materials other than those listed above must be assessed by Nordic Ecolabelling before they can be considered for labelling.

✉ Non-renewable materials: specify the proportion of recycled materials used. Declaration from the supplier that the raw material is recycled.

Background to recycled material shares requirements

Introduction

Wood/aluminium are the most common frame materials used for residential buildings in the Nordic market. PVC (with steel plate) and pure aluminium are also used in frames. Plastic composite window profiles are a new type of window that appeared on the Danish market, among others, rather recently. Plastic composite are windows manufactured using glass fibre-reinforced plastic, not only windows made up of various different materials (sandwich elements). In addition to the main materials, other materials may also be used in frames to insulate, prevent thermal breaks or to harden the material.

A large number of LCA studies on windows; however, the majority of these are based on windows with different U values, meaning that the studies do not only rate the window materials alone. Three studies assessing the materials have been examined by the project group in order to compare the materials. They are:

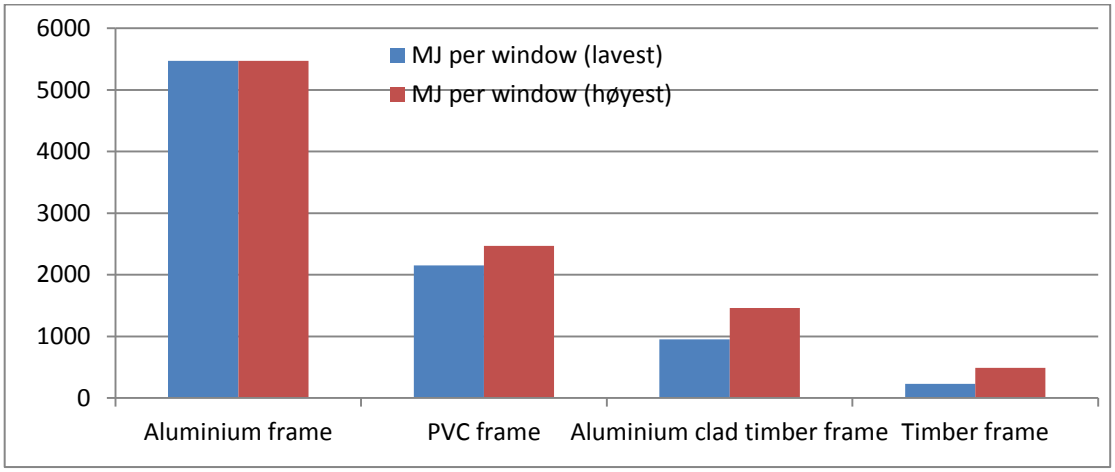
1. LEED, Study of points allocation for PVC in LEED Green Building[23].
2. A study from the University of Bath, England, summarising data for construction materials in the report 'Inventory of Carbon & Energy (ICE)', Version 2.0, 2011.
3. Life cycle analysis of windows, The Technical University of Denmark, student project, 2011[24].

Neither study has assessed windows manufactured solely using plastic composite, however, the study from the Technical University of Denmark did assess a window made from wood and plastic composite.

The LEED study examines both parts of and the entire lifecycle, which has an impact on both health and environmental parameters. It concludes by pointing out that a ban on PVC may result in a shift to worse alternatives, such as Al windows.

The University of Bath has examined the energy content associated with manufacturing the materials, compiled embodied energy from cradle to gate and assessed the volumes of the materials in the different windows I.e., the window's usage phase and the waste phase have not been taken into account. Material composition in windows is described as Al, PVC, wood/Al and ranked in this order with wood being the best material, see figure 1. The figures are taken from the summary report and the project group has not assessed the study itself.

Table 4: The table shows the embodied energy of materials used in windows. Figures from the 'Inventory of Carbon & Energy' (ICE) Version 2.0, 2011, a database at the University of Bath, England.



The LCA study from the Technical University of Denmark assessed the environmental impact of wood, wood/Al, PVC and wood/plastic composite windows. Wood/Al windows have aluminium in the load bearing structure. Wood/plastic composite windows are constructed in the same way as wood/Al windows, except that the Al

[23] Assessment of the Technical Basis for a PVC-Related Materials Credit for LEED 2007, Downloaded from: http://www.usgbc.org/News/PressReleaseDetails.aspx?ID=2957 (accessed 10 March 2013)

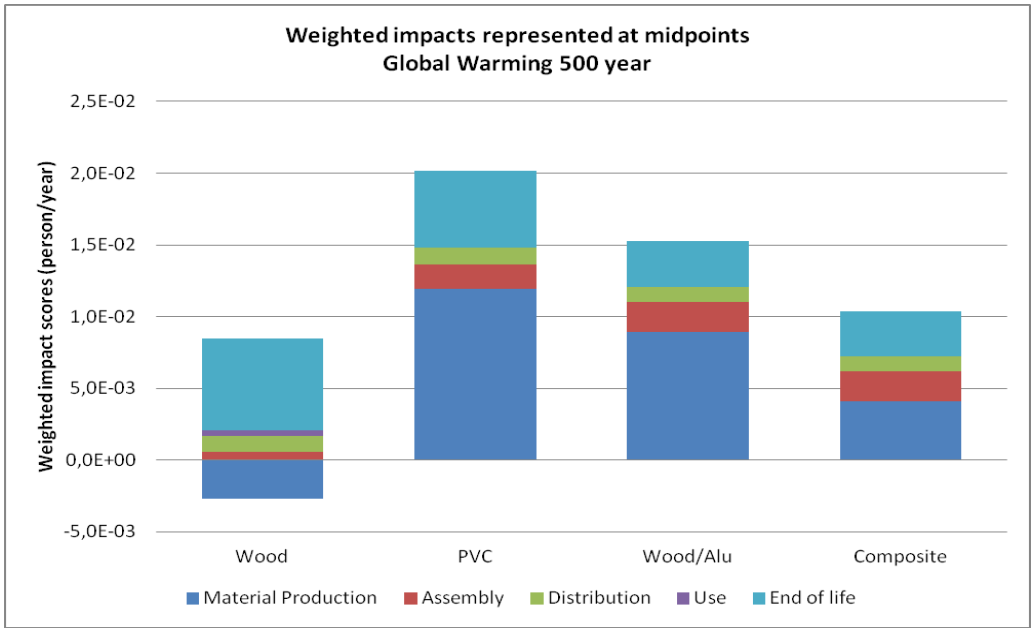
[24] "Life cycle analysis of windows", Appendix 5. From the course DTU 42372 Life cycle assessment of Products and Systems, Group 11, 1 December 2011, DTU 2011

content has been replaced by plastic composite. As composite is less airtight than aluminium, a smaller level of composite has been assumed. The study did not include wood windows where aluminium is used to protect against the elements; this is the type of window that currently holds the Nordic Ecolabel. When comparing windows with the same U values, one should remember to look at the insulation properties of the different materials as this is not included in the analysis.

The results expressed as CO_2 equivalents are shown in table 5 which shows that the three best material combinations, in order of preference, are wood/composite, wood/Al and PVC. This study looked at the window's entire lifecycle. However, as the windows' U values are the same, the usage phase could be left out of the materials evaluation. The lifecycle phases included in the study are materials production, window assembly, packaging, distribution, surface treatment in the usage phase, waste collection and waste management (it was assumed that all window frames were incinerated). The window's long technical service life was set at 40 years with replacement of the glass after 20 years. The study has not made cradle to gate comparisons, but looked at various waste scenarios including 100% wood incineration, 30% recycling of Al and PVC, 30% incineration of plastic composite in a cement oven where the volume of glass fibre has been replaced by a corresponding volume of sand. The materials ranking did not change with the inclusion of different waste scenarios.

The LCA study is based on figures for a plastic composite consisting of polyamide and glass fibre. Plastic composite windows available on the market are made from glass fibre-reinforced, unsaturated polyester or polyurethane which has a higher energy content than polyamide according to 'Inventory of Carbon & Energy (ICE)' Version 2.0, 2011, the University of Bath, England.

Table 5: The wood/Al window has aluminium in the load bearing structure. Note that the composite window is constructed in the same way as the wood/Al window except that the Al has been replaced by a somewhat smaller volume of composite. The windows have been assumed to contain the same volume of wood.



What lifecycle phases should be included in a materials comparison?
The most accurate materials evaluation is achieved by looking solely at manufacturing (from cradle to gate). The new standard for the creation of PCRs (product category rules) for construction materials in Europe (EN150804) also calls for cradle to gate data, but information about other parts of the lifecycle could also be included. The PCRs form the basis for environmental product declarations (EPDs). If the usage phase and the subsequent waste phase are included for products with a long technical service life, the assumptions take on a high level of uncertainty.

The Nordic Ecolabel is lifecycle-based and takes into account environmental impact in all phases. However, that does not mean that the impact of all phases needs to be summarised, especially not when uncertainty is high and steerability low in the individual phases. What is unique about the Nordic Ecolabel is that it is not only relevance and potential that is assessed, but also steerability.

A minimum requirement for insulation properties is imposed on Nordic Ecolabelled windows, i.e. the energy consumption in the usage phase should be low regardless of the material used in the jambs and frames. This means that a requirement is imposed on the main environmental impact arising from the usage phase. The function requirement for wooden components that are exposed to the elements help reduce the need for maintenance on wood windows in the usage phase. It is difficult to assess the waste scenarios for construction products with a long technical service life such as windows. We need to reduce our CO_2 emissions in order to tackle the major climate challenges we are currently facing. This means that a high climate impact from production of the window cannot be compensated through the Nordic Ecolabel criteria in the form of reduced impact in the future. In order to be able to assess materials for Nordic Ecolabelled windows, Nordic Ecolabelling thus wishes to emphasise the environmental conditions at production of the materials while also ensuring the materials protection against the elements in order to extend the technical service life and reduce maintenance.

One obstacle to comparison is the fact that windows may contain a wide variety of material combinations, including:

- Wood windows with or without aluminium weather protection manufactured with or without PUR insulation.
- Al windows can be insulated using a wooden core, glass fibre reinforced PA or other materials.
- PVC windows can have a wooden core or foam PVC as insulation and steel can be used to harden the jamb and frame.
- Plastic composite can consist of various plastic materials, for example 80% glass fibre and 20% PUR.
- Plastic composites may contain various insulation materials and steel for hardening the jamb and frame.

It is therefore impossible to make exact comparisons and we do not know whether the studies referenced reflect the windows available on the Nordic market. Table 6 shows the energy values for manufacturing the materials per kilo of material. As the table shows, wood has the lowest values and primary aluminium and plastic resin, e.g. unsaturated polyester and PUR, the highest.

Table 6: Various materials' embodied energy values.

Material	Embodied energy, MJ/kg
Sawed (broadleaf)	10.4
Sawed conifer	7.4
Al 50% recycled	108.6
Al primary	224
PVC	77.2
Glass fibre	25.6
Plastic resin	200
Plastic composite (65% glass fibre and 35% plastic resin)	86.6
Polyurethane insulation (stiff foam)	101.5
Steel (general - average recycled content)	25.3
Stainless steel	56.7

Source: Inventory of Carbon & Energy (ICE) Version 2.0, 2011, a database at the University of Bath, England. Embodied energy is the energy required in order to produce the material and includes the materials' inherent energy.

There is a gradual development towards the use of more materials and materials other than wood in the Nordic market. The Nordic Ecolabel has already approved the use of Al to protect wood windows against the elements and the environmental impact of such windows is considered a good basis for comparison when assessing windows made from other materials. As in other product groups there is a lack of exact data and the variation is great. Resource efficiency should be assessed. Looking at table 4 and assuming a linear correlation, about 65% of Al and 50% of PVC needs to be recycled in order to bring the energy content down to the same level as wood/Al windows. A requirement of 50% recycled material is thus not unreasonable. Recycled means post-consumer materials (production waste from the window manufacturer is included here but waste from the profile manufacturer is not).

Even though few Nordic manufacturers sell windows made purely from plastic composite, the same requirement should be applied to this material which consists of approx. 35% non-renewable plastic resin. The remainder is glass fibre which, in order to be strong enough, must be produced from new glass raw material. The plastic composite polymer is hardened plastic and will thus not meet the requirement relating to the share of recycled material at present.

Insulation materials should be exempt from the recycled share requirement as before as they contribute to a lower energy consumption in the usage phase. In order to ensure a long technical service life for the windows, no recycled share requirements should be imposed on the weather protection of various materials, only a de minimis limit. Weather protection should not be part of the load bearing structure. However, an exceptions from the recycled materials share requirement has been proposed for plastic composite in the outermost part of the jamb/frame which may form part of the load bearing structure while also providing weather protection. Profiles made from glass fibre-reinforced plastic are strong, meaning that these functions can be combined to avoid the need for additional materials. One advantage of glass fibre-reinforced plastic is that it gives thin window frames, meaning that you get a larger glass surface for the same window surface. It also has better insulation properties than e.g. aluminium.

Fact box: Definition of 'recycled' pursuant to ISO 14021

Pre-consumer materials:

Material redirected from the waste stream during the production process. Recycling of materials means that e.g. reworked materials, reground materials or waste generated by a process can be reused in the same process.

Post-consumer materials:

Material from households, commercial, industrial or institutional facilities as end-users of the product that can no longer be used for its intended purpose. This includes waste materials from the distribution chain.

Information from window manufacturers producing windows with exterior parts containing plastic composite state that max. 12% by weight would be reasonable. If the share of composite exceeds 12% by weight of the entire window or window door, at least 50% of the composite material needs to be made from recycled raw material.

There is no corresponding exception for Al, even though Al profiles too can have a load bearing function. Al has a much higher energy content per kg than plastic composite, which is probably a negative. Al can be recycled, meaning that when the industry is capable of recycling Al profiles, they will meet the requirements. PVC has a somewhat lower energy content than plastic composite and it has been discussed whether PVC should be considered equal to plastic composite in this exception. The project group is not aware of the existence of windows with PVC in the exterior part only, and as PVC can be recycled it has been decided that such an exception is unnecessary. Nor is it clear that PVC would result in slimmer profiles. When used to protect against the elements, PVC may account for max. 4% by weight in order to be exempt from the requirement of at least 50% recycled raw material.

The criteria already contained an exception from the requirement relating to the share of recycled material for aluminium when used as weather protection (not as part of the load bearing structure). The following percentage weights are deemed reasonable based on information from manufacturers.

- max. 8% by weight aluminium for windows and exterior doors
- max. 11% by weight aluminium for window doors25.

These percentage weights are still considered relevant but a requirement stating that all percentage weights should be calculated based on a standard size, double-glazed window or window door has been added.

Licensing experience shows that the exception for stabilising plates in exterior doors is also still relevant and an exception has been added for kick boards in this revision. In exterior doors both these components tend to be made from aluminium or steel plate.

Proposed plastic requirements

O 7. Non-recycled plastic material

Lead, cadmium, halogenated paraffin, organic tin compounds, bisphenol A, phthalates and halogenated flame retardants may not be actively added to plastic materials.

The requirement does not apply to plastic details such as capping plates, clips or glass blocks.

✉ Declaration from the plastics manufacturer that plastic parts fulfil this requirement. Appendix 2 can be used for documentation purposes.

O 8. Recycled plastic

Recycled plastic must not contain more than 100 ppm lead or 1,000 ppm cadmium.

The recycled plastic shall be tested to for lead, cadmium, halogenated paraffin, organic tin compounds, bisphenol A, phthalates and halogenated flame retardants.

The requirement does not apply to plastic details such as capping plates, clips or glass blocks.

Appendix 1 describes the method for testing the contents of plastics.

✉ Test results demonstrating the fulfilment of the requirement.

Background to plastic requirements

Requirements for non-recycled plastic materials

A new report on the addition of substances to plastic materials from the Norwegian Climate and Pollution Agency (Klif) shows that bisphenol A can be added as part of the process to manufacture PVC.

Bisphenol A, often abbreviated BPA, is used to manufacture certain plastics and is common in many everyday objects. Studies have shown that BPA may act as an endocrine disrupter even at low doses.

[25] The reason why this figure is higher is that the metal plate can cover as much as 50 cm of the window door.

BPA is classified as follows[26] (codes pursuant to the new CLP labelling system and the old system KIFS 2005:7): Risk of serious damage to eyes (H318, R41); respiratory irritation (H335, R37); allergic skin reaction (H317, R43); harmful to aquatic life (R52). The substance is also believed to have a harmful effect on reproduction ability (H361f, R62). BPA is a biological substance that is readily biodegradable in fresh water and soil. (Source: ECHA)

The use of BPA is in some cases prohibited or restricted, above all in materials/packaging that might come into contact with foodstuffs.

Requirements for recycled plastic materials

Window profiles are currently being manufactured using a share of post-consumer recycled PVC in the UK and in Germany[27]. According to a PVC manufacturer that we have been in contact with[28] the recycled material is used for the core with new PVC surrounding. The PVC manufacturer points out that it is difficult to achieve less than 1,000 ppm lead in recycled PVC[29], meaning that it is not possible to achieve a 50% share of post-consumer recycled material while requirements stating that levels of lead and cadmium in recycled PVC may not exceed 100 ppm are imposed.

Nordic Ecolabelling proposes that the limit values for lead and cadmium content follow Danish legislation as this it contains the strictest regulations for lead and cadmium of the Nordic countries. This would mean an increase in the limit value for cadmium from the current 100 ppm to 1,000 ppm. The lead content requirement remains unchanged.

Proposed production requirement

O 9. Chlorine production for plastic manufacturing

Mercury and asbestos must not be used to produce chlorine for making plastics. This requirement does not include small plastic parts such as capping plates, clips and glass blocks.

✉ Declaration from the plastic manufacturer regarding the method used to produce chlorine. Appendix 2 may be used.

Background to production requirement

PVC

The number of PVC windows on the Nordic market is increasing and currently accounts for 12% of the windows market in Denmark and Norway. The summary of LCA analyses for PVC and competing materials presented by the EU Commission in 2004 concludes that for PVC, the production of intermediaries contributes significantly to the environmental impact. It is important to have specific requirements for the various production stages, particularly for the extraction of crude oil and the production of salt for the VCM production.

There are three electrolysis processes used to derive chlorine from salt: the mercury - method, the diaphragm method and the membrane process. In Europe, the membrane

[26] Source: European Chemicals Agency, ECHA

[27] Website of window manufacturer VEKA: http://www.veka-recycling.co.uk/ and YouTube clips on the recycling of PVC windows. http://www.youtube.com/watch?v=oLJanVPUenY

[28] Meeting with INEOS 29 November 2012, Ecolabelling Norway

[29] Telephone interview with INEOS, October 2012

process accounts for about 46% of chlorine production, the diaphragm method for 14% and the mercury method for 32%[30]. In the membrane process, asbestos is sometimes used in the electrolysis cell[31]. According to the industry organisation the Swedish Plastics and Chemicals Federation, European chlorine producers have pledged to phase out the mercury process before 2020[3]. The membrane process or an asbestos-free diaphragm method is BAT for new electrolysis cells in the draft BREF document for chlorine production from 2011[2].

The project group has reviewed the BAT documents for the production of PVC and chlorine gas and been in contact with the industry. The project group's dialogue with the industry has not yet resulted in any further production requirements that could cause the PVC materials' environmental performance to differ. It is therefore suggested that the requirements for the production of chlorine gas remain in place. To summarise, there is still relevance, potential and steerability for imposing requirements on the production of chlorine gas without mercury and asbestos.

Aluminium

According to a literature study on construction and construction materials by Ostfold Research in 2011, the collection of data from specific aluminium production processes is often made difficult due to the fact that the industry has signed an agreement stating that only average data for the industry as a whole may be published. This means that analyses of aluminium as a construction material are largely based on industry averages. Consequently, it is not possible to identify potential for improvement. Contacts with the aluminium industry also showed that it is very difficult to ensure traceability in the chain, from extraction to finished product. After the extraction of bauxite and production of aluminium, the aluminium is 'swapped' on the market, making traceability difficult. The steerability of imposing requirements for the extraction of bauxite is therefore low. Experience from application processing shows that it is possible to achieve traceability from the aluminium profile back to the electrolysis cell. However, traceability is sometimes complicated and not commercially viable. Based on contacts with the industry, it appears to be difficult to establish specific, quantitative requirements for the electrolysis cell. Consequently, the overall RPS for imposing ecolabelling requirements for aluminium production is low despite a high relevance.

If it is not possible to impose ecolabelling requirements on aluminium production, and thus not possible to reduce the environmental impact of production, aluminium's environmental impact could instead be reduced through the introduction of ecolabelling requirements that can help limit the production of new aluminium. The issue as to whether recycled aluminium will result in a reduced environmental impact, or whether the use of recycled aluminium in a product will simply result on an increased use of new aluminium in another product, is currently being discussed.

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[30]Industry organisation the Swedish Plastics and Chemicals Federation: http://www.plastkemiforetagen.se/sektorgrupper/pvcforum/om_pvc/Pages/HurtillverkasPVC.aspx (05.02.12)

[31] Joint Research Centre, BAT Reference Document for the Production of Chlor-alkali, draft 1, Dec 2011. Available at: http://eippcb.jrc.ec.europa.eu/reference/

The International Aluminium Institute (IAI) published the following figures for 2008:

- primary aluminium produced: 39.3 million tonnes
- recycled aluminium (re-melted and recycled): 39.2 million tonnes
- 'recycled' aluminium (cutoffs/scraps from further processing + post-consumer): 18.4 million tonnes
- post-consumer aluminium recycled: 8.7 million tonnes
- non-recycled aluminium: 4.5 million tonnes
- aluminium unaccounted for: 3.5 million tonnes

The figures show that the volume of aluminium that is not recycled, or that cannot be accounted for, is almost as large as the volume of post-consumer aluminium that is recycled. The report 'Roadmap from Europe and North America, Workshop on Aluminium Recycling' from 2010 indicates that a significant share of the aluminium that is not recycled relates to aluminium components from durable products that are no longer accepted in the existing take-back systems. The report emphasises that it is very important to focus on improving take-back in order to increase the overall efficiency of the aluminium recycling system. The report is a summary of an international workshop on aluminium recycling held in 2010 that involved various industry and research stakeholders.

The project group is of the opinion that there is little steerability in the waste phase and that collection and recycling of aluminium could be encouraged through a requirement stating that a certain share of the aluminium in the window profile must be of recycled origin. Another important issue today is the reduction of climate gases, i.e. high greenhouse gas emissions are not acceptable from product with a long technical service life today, even if these may result in lower emissions at a later stage, as discussed earlier in this chapter. In practice, a requirement calling for a certain share of recycled aluminium means that although aluminium profiles in the load bearing structure may not meet the standard today, the will be able to do so in the future. The requirement for 50% recycled aluminium currently helps to limit the use of aluminium in windows. In order to ensure a long technical service life, no minimum requirement should be imposed for shares of recycled material in materials used for weather protection, only a de minimis limit for aluminium which is currently 8% by weight.

Plastic composite

According to one manufacturer of composite windows[32], recycled glass is currently nor used to produce glass fibre as the purity of the glass is important when it comes to producing the fibre. The glass fibre industry as a whole publishes information about the energy consumed at production and it can be difficult to find a realistic requirement level. As already mentioned, no BAT values have been proposed for the energy consumed when producing glass fibre.

A meeting with a window profile manufacturer found that it is difficult to find polymer resin manufacturers, and steerability is therefore low.

The project group does not see any steerability in imposing requirements on the manufacturing process for plastic composite materials. Please see Appendix 4 for further information on the manufacturing process.

[32]Notes from the meeting with Fiberline Composites AS at DS, 11 January 2013, made available at LS.

Proposed labelling requirement

O 10. Marking of plastic parts

Plastic parts heavier than 50 g must be visibly labelled for recycling in accordance with ISO 11469. This requirement does not apply to glazing gaskets or glazing blocks that constitute less than 3% by weight of the total weight of the window.

✉ Description of materials labelling for plastic parts.

Background to the labelling requirement

The purpose of the requirement is to facilitate correct sorting of end-of-life plastic materials, thus enabling materials recycling. There have been indications that marking is of no importance to waste separation and thus of no importance to recycling. At the same time, manufacturers state that they do mark their plastic components and that there is no problem with marking or imposing marking requirements for plastic components.

In conclusion, Nordic Ecolabelling has decided to let the requirement remain unchanged. The argument for this is that manufacturers are already marking their components and that this works and helps facilitate the sorting of end-of-life construction products.

Proposed filler gas requirements

O 11. Filler gas

Filler gas used for insulation must not contribute to global warming; i.e. the GWP (Global Warming Potential) must be nil over a period of 100 years.

Krypton and xenon must not be used as filler gases due to the high energy consumption at production.

The noble gas argon has GWP=0.

✉ Details of filler gases used for insulation, and confirmation that the gases do not contribute to the greenhouse gas effect.

Background to filler gas requirement

A mixture of gases are used to lessen energy losses through the window pane of modern windows. The most common mixture is argon (90 volume per cent) and air (10 volume per cent) but krypton and possibly xenon are also used. The noble gases are found naturally in low concentrations in the air and are produced through air distillation followed by further separation processes. The production of these gases results in the production of oxygen and nitrogen. Considerably more energy is required for the production of krypton, which means that the window's environmental impact increases when this gas is used.

Table 7. Energy consumption, production of argon and krypton

	Volume-% in air	Energy consumption (GJ/t)
Argon	0.9	6.06
Krypton	0.000108	10.3

Source: Miljøvurdering af vinduer, By og Byg Dokumentation 046, The Danish Building Research Institute, 2003.

The 2003 report 'Miljøvurdering af vinduer' (Environmental Assessment of Windows) compares environmental indicators for double glazed windows with argon, triple-glazed windows with argon and a triple-glazed window with krypton. It shows that climate impact, air pollution and waste from energy production are all significantly higher when krypton is used as the filler gas.

A research based report[33] produced by window manufacturer NorDan examined the possibility of using xenon as the filler gas. Even though xenon has better insulating properties, its embodied energy[34] is far too high. The energy saving made possible by the use of xenon is far smaller than the amount of energy required in order to produce the filler gas. Xenon requires just over 75 GJ more than argon. Krypton requires almost 10 GJ more than argon. On the basis of this, Nordic Ecolabelling does not allow the use of krypton or xenon as filler gas in Nordic Ecolabelled windows or exterior doors.

Argon does not contribute to the greenhouse gas effect, nor does any other noble gas. The reasons for this are purely physical. For molecules such as N_2, O_2 and monatomic molecules such as argon gas, there is no change in the dipole moment when they vibrate and they are virtually unaffected by infrared radiation. In simple terms: there is no argon gas atom bind capable of absorbing IR, nor can it twist or bend as this requires three atoms bound to one another within the molecule. Requirement R11 was thus changed to state that filler gas must not contribute to the greenhouse gas effect, expressed in GWP_{100} in excess of 0. However, this change has little or no practical impact.

Proposed wood requirements

O 12. Traceability and control of wood raw material

The requirement applies to both certified and uncertified wood and fibre raw material. The licensee shall:

1. State the name (in Latin and in a Nordic language), quantity and geographic origin (country/state and region/province) of the type(s) of wood and fibre raw material used.
2. Demonstrate traceability for all wood and fibre raw materials.
3. Have a written routine for sustainable wood and fibre raw materials supply.
4. Ensure that all wood and fibre raw material is sourced from legally acceptable sources.

Wood and fibre raw material may not be sourced from:

- protected areas or areas in the process of being awarded protected status;
- areas where ownership or usage rights are unclear;
- illegally felled trees;
- genetically modified trees or plants.

Furthermore, forestry operations must not damage:

- standing natural timber, bio diversity, special ecosystems or important ecological functions;
- social and/or cultural preservation values.

[33] Academic Research, NorDan AS, 2008

[34] Embodied Energy is the total amount of energy bound in the product, from raw materials extraction, through all the different manufacturing stages to the finished product, including energy used for transport.

✉ Name of wood (in Latin and one Nordic language) and geographic origin (country/state and region/province) of the kinds of wood used. Appendix 3 may be used.

✉ System for traceability for all wood and fibre raw materials. Chain of Custody may be used but this is not required.

✉ A written routine for sustainable wood and fibre raw material supply. The routine shall include up-to-date lists of all suppliers of wood and fibre raw material.

O 13. Certification of wood and fibre raw material

On an annual basis, at least 70% of the wood and wood fibre raw material content shall be derived from areas where forestry operations are certified pursuant to a forestry standard and certification systems stated in Appendix 4, or certified as organically cultivated or undergoing transition to organic production.

The requirement applies to solid wood, fibreboard, veneer and plywood.

The requirement does not apply to wood chip, wood shavings, waste wood, untreated demolition wood and recycled fibre from other industrial activities used in fibreboard.

Nordic Ecolabelling may request the submission of further documentation to enable it to assess whether the requirements of the standard and certification system and certified proportion have been fulfilled. Such documentation may comprise copies of the certification body's final report, a copy of the forestry standard, including the name, address and phone number of the organisation that established the standard, as well as references to individuals representing parties and interest groups who have been involved in the development of the standard.

✉ The amount of timber derived from certified forests must be stated and the basis for calculations must be shown. Appendix 3 may be used by the timber supplier.

✉ Copy of relevant forestry certificates that meet the guidelines for forestry certification and organic cultivation described in Appendix 4.

Background to wood requirements

Version 3 of the criteria contained a requirement stating that the wood raw material must not originate from forest environments meriting protection due to their high biological and/or social value. This requirement remains relevant as windows and doors made using wood raw material from tropical regions continue to be sold on the Nordic market. The requirement applies to all wood raw material, regardless of geographic origin, even if the problem with illegal felling is greater in the tropical regions overall .

This wood requirement has been reformulated to correspond to Nordic Ecolabelling's formulation of its equivalent. The traceability requirement was included in the previous version of the criteria but has now been clarified.

The new EU Timber Regulation (995/201/EC) came into force in April 2013 and affects timber felled and wood products manufactured both within and outside the EU. The purpose of the regulation is to tackle the global problem of illegal felling and prevent the inflow and trade of illegally felled wood and wood products in the EU.

The Timber Regulation's requirements of businesses do somewhat facilitate the meeting of the Nordic Ecolabel's requirements with regard to wood raw material origin and traceability. However, it does not completely replace the Nordic Ecolabel's requirements, even though it can help to document the origin of the wood war material. The Nordic Ecolabel's requirements stating that wood raw material must not be sourced from natural forests, areas with a high level of bio diversity, unique ecosystems or important ecological functions, nor compromise social or cultural protection values, are not covered by the

Timber Regulation. The Timber Regulation applies to illegal felling and is consistent with the legislation of the country in question. It therefore fails to provide sufficient guarantees that the wood raw material has been sourced from sustainable forestry operations.

Windows do not normally contain fibreboard. Instead, wood components tend to be made from solid wood. Exterior doors, on the other hand, are constructed more like a sandwich composing many different materials including solid wood, fibreboard, insulation, metal plates, etc. It is not unusual that the wooden front of an exterior door is made from veneer, chipboard, MDF or water resistant HDF. Furthermore, Nordic Ecolabelling requires wood and wood fibre components in exterior doors to be derived from legal sources. The requirement has therefore been reformulated to make it clear that it also applies to fibreboard.

Version 3 of the criteria also contained a requirement calling for at least 70% of solid wood to be sourced from certified sustainable forests. The requirement applies to solid wood, e.g. in the frame and casement, as well as to exterior door veneer material, etc. The recommendation is to let the requirement remain unchanged but to update the formulation so that is corresponds to Nordic Ecolabelling's most recent formulation.

The exception has been changed so that only fibreboard manufactured using waste from sawmills is exempt from the requirement calling for 70% from certified, sustainable forestry. If the fibreboard contains part waste, the waste part is exempt.

For information on the relevance of wood requirements, please see Appendix 4.

Proposed insulation material requirements

O 14. Insulation materials

Thermal insulation materials must not contain halogenated flame retardants or flame retardants containing borax or boric acid.

Expanding insulation materials must not be produced using halogenated organic compounds as blowing agents.

✉ Declaration from the supplier of the insulation material and product specifications for the product.

Background to insulation material requirements

Flame retardants[35] [36] [37] [38] [39] [40]

Halogenated flame retardants is the common name for a large group of organic compounds. The substances vary in terms of structure but all contain fluoride, chlorine or bromine. When subjected to intense heat, these compounds release halogen radicals which stop the chain reaction in the combustion process, thus having a flame retarding effect. In recent years, brominated flame retardants in particular have been under the spotlight due to their poor biodegradability. They can concentrate in the food chain and have been found in live organisms and human breast milk. Some of these substances have been shown to have a harmful impact on human health and the environment. These substances are not very toxic to humans but some halogenated flame retardants are acutely toxic to aquatic organisms. Prolonged exposure has been proven to cause liver damage. Certain brominated flame retardants are believed to be endocrine disruptors and may cause damage to the nervous system. Against this background, among other things, Nordic Ecolabelling has banned the use of halogenated flame retardants. Cellulose based insulation materials (paper, cellulose fibre) can have borax or boric acid added as flame retardants[41]. Borates (borax and boric acid) may be toxic and corrosive. These substances are included in the REACH candidate list[42].

Expanding insulation materials

Expanding insulation materials may not have been produced using halogenated organic compounds.

Stiff polyurethane (PUR) foam may be used to insulate windows and doors. PUR foam is produced using gas propellant. Halogenated fluorocarbons such as CFC (chlorofluorocarbon) and HCFC (hydro chlorofluorocarbon) were previously common gas propellants[43]. The use of CFC and HCFC is regulated by the international Montreal Protocol[44]. In accordance with Norwegian regulations and EU rules, the use of the ozone

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[35] PUR-skum produkter i et livsløpsperspektiv – en vurdering av arbeidsmiljø og ytre miljø. ISBN no.: 82-7520-446-1. Ostfold Research, BA8 Rådgivende Ingeniører and the National Institute of Technology. Norway, 2002.

[36] Bruken av bromerte flammehemmere I produkter: Materialstrømanalyse. The Climate and Pollution Agency (Clif - formerly STF), TA-1947. Norway, 2003.

[37] Kartlegging av utvalgte nye organiske miljøgifter – bromerte flammehemmere, klorerte parafiner, bisfenol A og triclosan (TA-2006/2004). http://www.sft.no/publikasjoner/overvaking/2096/ta2096.pdf. ISBN 82-577-4488-3. Norwegian Institute for Water Research (NIVA). Norway, 2004.

[38] Hvor brannsikre er stoppete møbler og madrasser? http://nbl.sintef.no/publication/lists/docs/NBL_A06103.pdf. NBL A06103. SINTEF. Norway, 2007

[39] Konsekvensutredninger av forslag til regulering av visse miljøgifter i forbrukerprodukter. Appendix 4. http://www.sft.no/artikkel____42872.aspx. The Climate and Pollution Agency (Clif) Norway, 2008.

[40] Bromerte flammehemmere I avfallsstrømmen. TA-2380. http://www.sft.no/publikasjoner/2380/ta2380.pdf. The Climate and Pollution Agency (Clif) Norway, 2008.

[41] http://www.byggogbevar.no/miljoe-og-enoek/artikler-miljoe-og-enoek/isolasjonsmaterialer-a-aa.aspx (10 April 2013)

[42] Link to the candidate list on the ECHA website: http://echa.europa.eu/addressing-chemicals-of-concern/authorisation/substances-of-very-high-concern-identification/candidate-list-of-substances-of-very-high-concern-for-authorisation

[43]Report from the Climate and Pollution Agency (now Clif) Reduksjon i utslippene av HFK, PFK og SF6, SFT-rapport 1754/2001. Can be accessed on: http://www.klif.no/publikasjoner/luft/1754/ta1754.htm

[44] The Montreal Protocol, http://www.miljostatus.no/Tema/Klima/Ozonlaget/Montrealprotokollen/

depleting substance HCFC was banned in all foam production as of 1 January 2004. However, most Norwegian insulation foam manufacturers have changed their production processes to avoid the emission of ozone depleting substances already in 2002[45]. Pentane is the main blowing agent used in PUR foam today[46].

In summary, the reference in the requirement is removed as mineral insulation materials are no longer classified as carcinogenic according to the EU's Dangerous Substances Directive (97/69/EC). The requirement is otherwise unchanged.

Proposed separability requirement

O 15. Separability

It must be possible to separate glazing and metal and plastic profiles in the window/exterior door for recycling at the end of the unit's service life.

✉ Description of how the materials wood, metal, plastic and the glass component can be separated.

Background to the separability requirement

Version 3 of the criteria introduced a separability requirement following recommendations from consultation bodies. The purpose of the requirement is to facilitate the recycling of, above all, non-renewable materials. The requirement is still considered relevant and reasonable and no change is suggested.

5.6 Chemical requirements

The chemicals requirements apply to unhardened paints, lacquers, glues, plaster and sealants used by the manufacturer of the Nordic Ecolabelled products and their subcontractors for parts for Nordic Ecolabelled products.

The requirement does not apply to improvement/repair products used by the manufacturer or its subcontractors.

Filler gas and insulation materials are covered by requirements in previous sections; 'Material requirements'.

Proposed chemicals requirements

O 16. Classification of chemical products

Chemical products used to manufacture Nordic Ecolabelled windows or exterior doors must not be classified pursuant to the table below. The classification applies pursuant to the EU's Dangerous Substances Directive 67/548/EEC with later amendments and adaptations and/or the CLP regulation 1272/2008 with later changes.

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[45] http://www.klif.no/no/Aktuelt/Nyheter/2003/April/Redusert-bruk-av-ozonreduserende-stoffer/

[46] PUR-skum produkter i et livsløpsperspektiv – en vurdering av arbeidsmiljø og ytre miljø. ISBN no.: 82-7520-446-1. Ostfold Research, BA8 Rådgivende Ingeniører and the National Institute of Technology. Norway, 2002.

The EU Dangerous Substances Directive or the CLP regulation can be used in the transition period, i.e. up until 1 June 2015. Once the transition period is over, only the CLP regulation may be used for classification (see table below):

Classi-fication	**Hazard classification, hazard category and hazard designation** *CLP regulation 1272/2008/EC*	**Hazard symbols and R phrases** *EU Dangerous Substances Directive 67/548/EEC*
Toxic to the environment	Toxic to aquatic organisms Category acute 1 H400 Category: chronic 1 H410, category: chronic 2 H411*	N with R50, R50/53 or R51/53*
Very toxic	Acute toxicity, category 1 or 2 with H330, H310 and/or H300 and/or Specific organ toxicity, single exposure, category 1 with H370	T+ with R26, R27, R28 and/or R39
Toxic	Acute toxicity, category 2 or 3 with H330, H331, H311 and/or H301 and/or Specific organ toxicity, single exposure, category 1 with H370 and/or Specific organ toxicity, repeated exposure, category 1 with H372	T with R23, R24, R25, R39 and/or R48
Harmful to health	Acute toxicity, category 4 with H302 Specific organ toxicity, single exposure, category 2 with H371 and/or Specific organ toxicity, repeated exposure, category 2 with H373	Xn with R20, R21, R22, R48, R65 and/or R68
Carcinogenic	Carc. 1A or 1B; H350 Carc. 1A or 1B; H350i Carc. 2; H351	Carc. cat. 1 or 2; R45 Carc. cat. 1 or 2: R49 Carc. cat. 3; R40
Mutagenic	Muta. 1B; H340 Muta. 2; H341	Muta. cat. 2; R46 Muta. cat. 3; R68
Toxic to reproduction	Repr. 1A or 1B; H360F Repr. 1A or 1B; H360D Repr. 2; H361f Repr. 2; H361d	Repr. cat. 1 or 2; R60 Repr. cat. 1 or 2; R61 Repr. cat. 3; R62 Repr. cat. 3; R63

**Exception for vacuum impregnation where the classification 'Toxic to aquatic organisms category chronic 2 H411 and/or N with R51/53' is accepted.*

✉ Material safety data sheet pursuant to the applicable legislation in the country of application, e.g. Annex II to REACH (Council Regulation 1907/2006/EEG) for all chemical products.

O 17. Handling of chemical products

For chemical products used to manufacture Nordic Ecolabelled windows or exterior - doors classified according to the table below, there should be a description outlining the recommended handling procedures in order to avoid environmental and/or personal damage. The classification applies pursuant to the EU Dangerous Substances Directive 67/548/EEC with later amendments and adaptations, and/or the CLP regulation 1272/2008 and later amendments.

The EU Dangerous Substances Directive or the CLP regulation can be used in the transition period, i.e. up until 1 June 2015. Once the transition period is over, only the CLP regulation may be used for classification (see table below):

Classification	**Hazard classification, hazard category and hazard designation** *CLP regulation 1272/2008/EC*	**Hazard symbols and R phrases** *EU Dangerous Substances Directive 67/548/EEC*
Toxic to the environment	Ecotoxicity Chronic Cat. 3, H412 Ecotoxicity Chronic Cat. 4, H413	R52, R53 or R52/53 without N
Allergenic	Respiratory Sensitisation Cat.1, H334 Skin Sensitisation Cat. 1, H317	Xn with R42 or Xi with R43
Corrosive	Skin Corrosion/Irritant Cat. 1A, H314 Skin Corrosion/Irritant Cat. 1A, H314	C with R34 and R35
Harmful to health	Acute Toxicity Cat. 4, H332 Acute Toxicity Cat. 4, H312 Aspiration Hazard Cat. 1, H304	Xn with R20, R21, R65
Explosive	Explosives – Unstable Explosive, H200 Explosives – Division 1.1, H201 Explosives – Division 1.2, H202 Explosives – Division 1.3, H203 Explosives – Division 1.4, H204 Organic Peroxides Type A, H240 Organic Peroxides Type B, H241 Self-reactive substances and Mixtures Type A, H240 Self-reactive substances and Mixtures Type B, H241	E with R2 and R3
Extremely flammable	Flammable Gases Cat.1, H220 Flammable Aerosols Cat.1, H222 Flammable Liquids Cat. 1, H224	F+ with R12
Very flammable	Flammable Gases Cat. 2, H221 Flammable Aerosols Cat. 2, H223 Flammable Liquids Cat. 3, H225 Flammable Solids Cat. 1, H228 (Flammable Solids Cat.2, H228)	F with R11, R15 and R17

✉ Description of how chemicals are handled in a safe manner to avoid personal injury.

O 18. CMR substances

Substances classified as following must not be included in chemical products used to manufacture Nordic Ecolabelled windows or exterior doors:

- carcinogenic (Carc. with R45/H350 and/or Carc. with R49/H350i)
- mutagenic (Mut. with R46/H340) and/or
- toxic to reproduction (Rep. with R60/H360F and/or Rep. with R61/H360D)

The total content of substances classified as following must not exceed 0.5% by weight in products used to manufacture Nordic Ecolabelled windows or exterior doors:

- carcinogenic (Carc. with R40/H351)
- mutagenic (Mut. with R68/H341) and/or
- toxic to reproduction (Rep. with R62/H361f and/or Rep with R63/H361d)

Exceptions are made for levels of Dibutyltin (DBT) compounds and dioctyltin compounds (DOT) in the following three products types where the below limit values* are accepted:

- 0.5% in SMP polymers such as MS polymers
- 0.2% in silicon products and PUR polymers containing silanes instead of isocynates
- 0.03% in PUR polymers with isocyanates

Constituent substances are all product contents, including additives (e.g. preservatives or stabilisers) in the ingredients but not impurities deriving from raw materials production. Impurities include residue from raw materials production included in the finished product at concentrations lower than 100 ppm (0.0100 weight per cent, 100 mg/kg) but not substances added to a raw material or product deliberately and purposely, regardless of the volume.

Impurities accounting for more than 1% of the product are nevertheless been considered constituent substances. Known release products from constituent substances are also considered constituent substances.

For two component products it is the ingredients in the separate components that shall comply with the requirements Alternatively; the requirement can be applied to the finished product if it can be documented that; safety equipment is used when the hardener is mixed with the paint/lacquer and if the application of the finished two-component product takes place in a closed system.

**TBT and TPT are prohibited.*

✉ Safety data sheet pursuant to applicable legislation in the country of application, e.g. Annex II to REACH (regulation 1907/2006/EEC) for all chemical products and Appendix 5, duly completed and signed by the chemicals manufacturer.

O 19. Prohibited substances

The following substances are prohibited from chemical products used in the manufacture of Nordic Ecolabelled windows and exterior doors:

- Halogenated organic compounds
- Alkylphenolethoxylates (APEO) and alkylphenol derivatives (APD)
- Perfluoroalkyl and polyfluorinated alkylated substances (PFAS)
- Phthalates, with the exception of sealants
- Sealants may not contain the following phthalates:
    - Di-2-ethylhexyl phthalate (DEHP)
    - Dibutyl phthalate (DBP/DnBP)
    - n-butyl benzyl phthalate (BBP)
    - Palatinol (711P)
    - Diisobutyl phthalate (DIBP)
    - Bis(2-methoxyethyl) phthalate
    - Diisodecyl phthalate (DIDP)
    - Diisononyl phthalate (DINP)
- Halogenated flame retardants
- Boron compounds
- bisphenol A
- Antibacterial compounds (including silver ions, nano silver and nano copper)

- Nano particles (from nano materials*) may not be actively added to the chemical product.

Constituent substances are all product contents, including additives (e.g. preservatives or stabilisers) in the ingredients but not impurities deriving from raw materials production. Impurities include residue from raw materials production included in the finished product at concentrations lower than 100 ppm (0.0100 weight per cent, 100 mg/kg) but not substances added to a raw material or product deliberately and purposely, regardless of the volume.

Impurities accounting for more than 1% of the product are nevertheless been considered constituent substances. Known release products from constituent substances are also considered constituent substances.

**Nano materials: "a natural, incidental or purposely manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for at least 1% of the particles in the number size distribution, one or more external dimensions is in the size range 1-100 nm"*

This definition of nano particles corresponds to the EU Commission's definition of nano materials of 18 October 2001, with the exception of the stated particle size spread which is reduced to 1%.

✉ Appendix 5, duly completed and signed by the chemicals manufacturer.

Background to chemicals requirement

The MECO analysis, see Appendix 2, shows that the main chemical products used to manufacture windows and doors are: paint, lacquer, glue, sealants, caulking compounds and plaster. Thus, it is these chemical products that chemicals requirements are relevant for. In order to improve clarity, this is spelled out initially under the criteria heading "Chemicals requirements".

To further clarify the matter it is also stated that special requirements for filler gas and materials are included in the section "Materials requirements".

Licence application processing has identified a need to clarify the application of the chemicals requirements in connection with subcontracting, e.g. of filler gas cassettes.

A section stating that subcontractors are also covered by the chemicals requirements for the chemical products listed is therefore added to the chemicals requirements.

Licence application processing has also identified a need to make products used to repair and improve the manufacture of the Nordic Ecolabelled products exempt from requirements. These products include plaster and touch-up paint used in very small volumes compared to the chemical products used for standard production. We are thus not talking about repairs to old windows or doors, but to minor damage that may occur in connection with production and that is rectified before the product is given 'final approval' for warehousing and sale. This section is added to the introduction to the chemicals section.

Hazard categories and designations pursuant to the CLP regulation 127/2008/EC have been added to requirements O16 to O18. No changes to the requirement limits.

Requirement O19, which is a list of prohibited substances, has been reviewed to make sure it is as clear as possible and to avoid differing interpretations. This has resulted in the phthalate names being included in full, not just the abbreviations.

A ban on nano has also been added to the requirements. Nano particles may be included in chemical products used to manufacture windows and doors, e.g. sealants, paint, glue, etc.

The explanatory texts for requirements O18 and O19 have been updated and made clearer in order to comply with Nordic Ecolabelling's internal guidelines.

The exception relating to organic tin compounds in sealants in O18 is still deemed relevant. There are no alternatives to the sealants required for these technical applications.

Proposed requirement

O 20. Nano materials

Nano particles (from nano materials*) may not be actively added to the glass/the window's/door's glass surface.

**Nano materials: "a natural, incidental or purposely manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for at least 1% of the particles in the number size distribution, one or more external dimensions is in the size range 1-100 nm."*

This definition of nano particles corresponds to the EU Commission's definition of nano materials of 18 October 2001, with the exception of the stated particle size spread which is reduced to 1%.

✉ Declaration from the manufacturer of the window or exterior door that nano materials are not used.

Background to requirement

General information about nano particles

Nano particles are increasingly used in a range of products to add to or enhance their properties. However, nano particles can pose an unforeseen threat to human health and the environment. The particles can reach parts of the body and the environment that are otherwise protected and their minute size result in increased reactivity as small structures have a far larger available surface area than larger ones[47]. Research into the risk associated with nano materials has focused on health impacts and some cases of damage have been recorded. For example, it has been proven that nano particles can permeate cells and harm DNA[48]. This does not mean that all nano particles cause damage, but at present we lack sufficient knowledge of their effects on human health and the environment, and of long-term effects in particular. According to the report by the Scientific Committee on Emerging and Newly Identified Health Risks[49], the procedures for risk assessment of nano materials are still under development. In order to put in place such procedures we need to further develop, asses and standardise knowledge on the methods used to estimate exposure to nano materials and identify hazards.

The EU Commission presented a recommended nano particle definition on 18 October 2011[50]. According to this definition, a material is only to be considered a nano material if 50% of the particles are of nano size, with one exception: "In specific cases and where warranted by concerns for the environment, health, safety or competitiveness the number size distribution threshold of 50% may be replaced by a threshold between 1 and

[47] Norwegian Board of Technology, 2008: Nanomaterialer, risiko og regulering, report 2008.

[48] Folkmann, Janne K. et. al., 2009: Oxidatively Damaged DNA in Rats Exposed by Oral Gavage to C60 Fullerenes and Single-Walled Carbon Nanotubes, Environ. Health Persp, 117(5), 2009.

[49] SCENIHR, 2009: Risk Assessment of Products of Nanotechnologies,

Scientific Committee on Emerging and Newly Identified Health Risks (SCENIHR), 2009.

[50] The EU Commission, 2011: Commission Recommendation of 18 October 2011 on the definition of nanomaterial, (2011/696/EU), Official Journal of the European Union.

50%". Based on the precautionary principle, Nordic Ecolabelling wishes to set the limit at 1% as there are no standardised methods for risk assessment of nano materials and due to the major uncertainty attaching to the long-term effects of nano material exposure on human health and the environment.

Nano particles in windows and doors

The surface of windows and doors, and glass in particular, can be coated with nano titanium dioxide (TiO_2). TiO_2 is naturally found in three mineral forms, anatase, rutile and brookite[51]. Anatase and rutile are the most common forms. Nano-TiO_2 in rutile form absorbs UV light and is also used in products to scratch-proof them and provide optical effects (anti-reflection, etc.). Nano-TiO_2 in anatase form is used for its photocatalytic properties[52]. This means that in the presence of light, nano-TiO_2 can catalyse degradation or otherwise react with unwanted chemicals or microorganisms. It can thus be used to give window glass self-cleaning properties in order to save resources such as water, chemicals and labour that would otherwise be used to clean windows. Window glass coated with nano-TiO_2 is currently available on the market.

An extensive review article by the U.S. Environmental Protection Agency (EPA) (see reference above) on how nano-TiO_2 affects human health and the environment indicates that there are significant variations in the test results depending on the concentration, test conditions and the material's physical properties (surface area and mineral form). In other words, there is significant uncertainty with regard to how nano-TiO_2 affects human health and the environment. The report by the EPA indicates that exposure to nano-TiO_2 may arise from coated surfaces when these are subjected to wear. However, few studies have been carried out on this topic. A study examining the use of nano-TiO_2 as a coating agent for window glass shows that the substances reduces the photocatalytic effect and that TiO_2 is released from the surface when it is subjected to aging tests (water, salt, UV light)[53]. It is not clear whether the TiO_2 is released in the form of nano particles or larger particles. We currently lack knowledge of how nano-TiO_2 affects human health and the environment and how the environment is exposed to nano-TiO_2 when the substances is used to coat various surfaces. Based on the precautionary principle, Nordic Ecolabelling wishes to adopt a restrictive approach to the use of nano-TiO_2 as a window coating agent but will reassess this in connection with the next revision.

Proposed wood protection requirement

O 21. Solvents for impregnation and surface treatment

Pressure impregnation is not permitted.

The emission of volatile organic compounds (VOCs) from vacuum impregnation shall not exceed 6 kg/m^3.

The emissions from surface treatment must not exceed 60 mg TOC/Nm^3.

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[51] Titanium Compounds, Inorganic. In Kirk-Othmer Encyclopedia of Chemical Technology, (Online) ed.; Wiley: New York, 2000; pp 1-58.

[52] State of the Science Literature Review: Nano Titanium Dioxide Environmental Matters; Eastern Research Group, EPA, 2010

[53] J. Olabarrieta et al, Aging of photocatalytic coatings under a water flow: Long run performance and TiO2 nanoparticles release, Applied Catalysis B: Environmental, Volumes 123–124, 23 July 2012

Volatile organic compounds (VOC) are defined as organic compounds that at 293.15 K have a vapour pressure of 0.01 kPa or greater. Appendix 1 describes the requirements of the test body used for VOC classification.

The requirement must be met regardless of whether the wood protection treatment is performed by the manufacturer or by a subcontractor.

Nordic Ecolabelled sustainable wood already meets this requirement as no solvents are used.

☒ Calculation of the solvent balance or measurement of the emissions using the method described in EU directive 99/13/EC.

Background to wood protection requirement

Solvents for impregnation and surface treatment
Wood can be damaged by bacteria, fungi, insects or other bugs. These organisms can cause rot, discolouration or mechanical damage. Impregnation or surface treatment using wood protection products can help protect against these attacks. Wood treated with wood protection products is used when it is not possible to protect the wood from damp and guarantee its durability using construction technology. Examples include window and exterior door carpentry.

The impregnation methods are pressure impregnation and vacuum impregnation. Pressure impregnation is now often water-based with the use of various salts (copper, chromium, etc.). Pressure impregnation is not allowed for Nordic Ecolabelled windows and exterior doors and is therefore not described further in this document[54].

Vacuum impregnation is only used to impregnate finished construction carpentry such as windows, doors and garden furniture. The process is less deep and saturating than pressure impregnation but is still considered adequate for the purpose. Vacuum impregnation is normally performed using organic solvents. The product used often consists of 90% organic solvent, usually turpentine, and 10% active substance/fungicide. The most common fungicides are Propikonazol and/or Tebukonazol, see table 16 in appendix 5. Vacuum impregnation using organic solvents results in emissions of volatile organic compounds, so called VOCs, to the air. VOCs are primarily a mixture of aliphatic (as opposed to aromatic) hydrocarbons and contribute to the formation of low level ozone, a substance that is harmful to health and the environment. The use of VOCs also involves working environment risks. However, there are ways of reducing VOC emissions to the air. Mainly, this involves using products with a lower solvent volume. One end-of-pipe measure that could be applied is the treatment of emissions through combustion, adsorption or recycling. A BAT/BREF report for Surface Treatment Using Organic Solvents[55] within the EU indicates that emissions could be reduced by 70%. This should not be taken to mean that pressure impregnation using turpentine is BAT for window production. As the title of the report indicates, the BAT report relates to surface treatment using organic solvents in general. Unfortunately, the planned BAT report for Wood and Wood Products Preservation has not been started yet.

Version 3 of the criteria allows impregnation using organic solvents provided that the limit value for emissions of volatile organic compounds (VOC) of max. **11 kg VOC/m^3** is not exceeded. Furthermore, the limit value of max. **75 mg C/Nm^3** for surface

[54] It is neither relevant nor neccesary to use pressure impregnated wood in windows and exterior doors covered by use class 3 in standard EN 335-1.

[55] BREF 2007; Joint Research Centre, IPTS, The European IPPC Bureau.

treatment emissions must also be met. This requirement corresponds to already existing legislation through the EU's VOC Directive (99/13/EC) but has a wider area of application as the requirement needs to be met simultaneously by all that use solvent based technology, not just larger plants falling under the VOC Directive's scope definition.

Table 8: Emission values pursuant to the VOC directive (99/13/EC)

Solvent consumption threshold (t/y)	VOC emission limit value in residual gases (mg C/Nm^3)	Fugitive emissions (% in solvent input)	Total emission limit values (kg VOC/m^3 of wood treated)
> 25	100	45	11

In the VOC directive, emission limit values are stated in mg C (carbon)/Nm^3 air. Consequently, in order to enable comparison, the volume/mass of VOC needs to be converted into carbon emissions.

One way of avoiding the problem of VOC emissions and the cleansing of these altogether is to move to entirely water-based techniques or to use vacuum impregnation with bearers other than organic solvents, for example supercritical carbon dioxide. The water-based 2ØKO system has become very popular in, for example, Denmark where 90-95% of the industry has switched to this technology. 2ØKO involves the wood being treated using a substance containing fungicide (a primer), normally through dipping or rinsing to give a so called flowcoat. The wood is then surface treated/painted using approved surface treatment products that also contain fungicide. This method is recommended in combination with a high share (approx. 90%) of heartwood. When water-based techniques are used the wood protection agent does not permeate nearly as deep into the wood as when impregnation techniques are used. The idea is that the use of heartwood compensates as it has a natural resistance to effect and degradation.

Appendix 5 contains a more in-depth description of the techniques.

The fact that the Nordic countries' views on the need for vacuum impregnation using turpentine in order to ensure durability and long window technical service lives vary was strongly emphasises at the time of the previous revision. The various national quality certification systems impose different requirements for impregnation and surface treatment, as well as for the share of heartwood used. The 2011 evaluation again highlighted the differing views of the different Nordic countries when it comes to wood protection methods.

Table 9: National certification systems for wood protection and surface treatment

Quality system	Requirements for wood protection treatment	Requirements for surface treatment
Danish Window Certification(DVC). Technical stipulations for DVV 7, edition rev 3-2012	For sapwood/coniferous trees one of the following three alternatives must be met: Alternative 1: Priming using turpentine (vacuum impregnation) or supercritical CO_2 impregnation. At least 6 mm lateral penetration into the sapwood. Alternative 2: Priming using turpentine (vacuum impregnation) or supercritical CO_2 impregnation. At least 3 mm lateral penetration into the sapwood. In both cases, the impregnation substance needs to meet the requirements pursuant to risk class 3 in EN 599-1. Alternative 3 (2ØKO): Primer treatment using a product containing fungicide in combination with at least 90% heartwood.	For sapwood/coniferous wood: If priming system 1 or 2 have been used, the surface treatment must meet the requirements of EN 927-1 and the lacquer thickness must be: min. 60 µm (alternative 1) or min. 80 µm (alternative 2) If the 2ØKO priming system has been used, the surface treatment must also meet the requirements of EN 927-1, classification Stable and the lacquer thickness must be at least 80 µm. In addition, there are a range of specific requirement in the appendix to the technical stipulations. For heartwood/hardwood: A priming treatment (transparent or opaque) using a wood protection product that meets risk class 2 pursuant to EN 599 -1. followed by surface treatment pursuant to the requirements outlined in EN 927-1.
Norsk Dør och Vinduskontrol (NDVK). Rules as of May 2012.	NDVK allows the use of 2ØKO provided that 90% heartwood is used from the internal fold edge to the external edge of the window. NDVK also accepts flowcoat without the use of heartwood, provided that the manufacturer primes using a fungicide and performs a subsequent two-step surface treatment.	All visible surfaces of windows that are to be delivered surface treated shall be surface treated. No reference to EN standards.
Svensk Fönster & Dörrkontroll (SFDK). Approval rules for wood-based windows, June 2008	No requirements	All visible surfaces of windows that are to be delivered surface treated shall be surface treated. Standards EN 927-1 and EN 927-2 shall be met. For class see 'semi-stable' and a coat thickness of at least 80 µm (dry).
P labelling of windows made from wood and wood/metal (Sweden). Rules as of February 2010	For surfaces that are exposed to the elements[56] one of the following three must be met. Alternative 1: 100% heartwood Alternative 2: Impregnation using wood protection class B pursuant to NTR. This corresponds to a penetration of 6 mm pursuant to product standard EN 351-1, but with an absorption requirement (kg/m^3) pursuant to SP's list of approved wood protection agents.	All wood shall be surface treated, including end surfaces. At least two coats of covering treatment shall be applied to achieve a min. thickness of 60 µm (dry coat).

[56] Profiles covered by metal cladding are not considered exposed to the elements.

Quality system	Requirements for wood protection treatment	Requirements for surface treatment
	Alternative 3 - another suggestion: Impregnation with at least 4 mm (lateral) penetration into the sapwood. All end wood shall be sealed using primer and/or covering paint. Joins at the underside of jambs and sashes, and muntin bars, shall be sealed by applying sealant to the end wood of the profiles prior to assembly.	

Based on this, Nordic Ecolabelling proposes to continue to allow vacuum impregnation *but* to significantly tighten the VOC emission requirements so that only the very best cleansing techniques are eligible for labelling. The arguments for this are:

- Wood protection and surface treatment is one environmental factor among many that must be met by Nordic Ecolabelled windows. From a lifecycle perspective, the window's energy efficiency is the most important issue.
- Different views on how the water-based techniques work over time. Some representatives feel that the potential negative impact on quality is unclear due to shortcomings in the studies performed and a lack of shared, standardised measurement methods.
- Some manufacturers have encountered difficulties with imposing requirements for a large share of heartwood (difficult, expensive, etc.) while others have had no problems with this.
- Switching from solvent-based to water-based techniques requires major technical and financial investments.
- Version 3 of the criteria contains limit values that do not correspond to the best technology, meaning that there is scope for lowering the limit values significantly. The result is that only factories that have invested in treatment technologies of hydrocarbon emissions to the air using adsorption or catalytic combustion may be approved for Nordic Ecolabelled windows.

In summary, Nordic Ecolabelling proposes the following limit values:

- Impregnation: Lowered from the current 11 kg/m^3 to 6 kg/m^3 wood which corresponds to a 45% reduction.
- The limit value for the subsequent surface treatment (painting) is also lowered. The proposed limit value is 60 mg TOC/Nm^3 which corresponds to a 20% reduction. As we can see, the decrease is not as great as for the impregnation step. At the same time, the most important thing is to lessen emissions from impregnation as these make up the lion's share of total VOC emissions.

The revision makes it clear that the requirement must be met regardless of whether wood protection treatment is performed by the manufacturer or whether the wood is procured already treated. This is not entirely clear in today's requirements. It should also be added that in cases where the window manufacturer uses Nordic Ecolabelled sustainable material these requirements are automatically met and no further documentation is required.

5.7 Waste management requirements

Proposals for waste criteria

O 22. Production waste

Window and exterior door manufacturers, as well as manufacturers of insulation glass, shall separate the waste generated in connection with production. Furthermore, a plan for separating waste must be drawn up, stating waste fractions and describing how the waste is dealt with (e.g. recycling, landfill and incineration).

Hazardous waste must be treated and dealt with in accordance with the regulations applicable in the country of manufacture.

✉ Waste plan featuring waste fractions and waste recipients. Declaration on hazardous waste, if applicable, and a statement on how hazardous waste is handled in accordance with the regulations applicable in the country of manufacture.

Background to waste requirement

Production waste
Requirement R22 has been updated and simplified. The purpose of the requirement – ensuring that the manufacturer has a good system for waste management – is met even if the requirement is now less detailed/micromanaging.

Take-back system for plastic windows and doors
Version 3 of the criteria introduced a requirement for a take-back system for recycling and that licence applicants and their plastic profile suppliers must be members of this system.

The European PVC industry's environment initiative Vinyl 2010, which is now called VinylPlus, would have established a system for the collection of stiff PVC from windows, and other sources, in December 2007. PVC profile manufacturers would have joined the collection system and financed collection for recycling. Despite the PVC industry's aims, of the Nordic countries only Denmark has introduced a system for collection of stiff PVC from construction waste through WUPPI AS. The waste is ground up and transported to Germany. Germany has had a take-back system for end-of-life PVC windows and doors for many years which ensures that the material is recycled and used to manufacture new PVC windows, doors and pipes. Approximately 19,000 tonnes of PVC were collected through the German system, which is called Rewindo, in 2011[57].

There are no take-back systems for PVC windows for materials recycling in Sweden, Norway or Finland. The industry's explanation for this is that the windows have a long technical service life and have not been available on the market for very long.

Nor are there any take-back or recycling systems for composite windows or windows made from other materials.

Considering that the technical service life of windows and exterior doors is at least 20 years, it is not relevant for Nordic Ecolabelling to impose requirements for a recycling system for end-of-life windows. Newly manufactured windows and exterior doors are produced using today's materials and it is impossible to say how the handling of these products should be managed so far in advance. The main aim of the recycling system

[57] www.rewindo.de

requirement was to help increase materials recycling. Instead, this is achieved through the requirement relating to the share of renewable raw material in the new window/exterior door. For this reason, the requirement for a recycling system for end-of-life windows has been removed in its entirety.

Packaging
Requirement R24 in version 3 of the criteria states that treated timber and halogenated plastics must not be used as packaging material. The requirement is no longer relevant as these materials are not used in wooden pallets[58] or in packaging plastics such as stretch or shrink wrap. It is therefore suggested that the requirement be removed in its entirety.

5.8 Functional requirements

Proposed durability/longevity requirement

O 23. Durability/longevity of exposed wood parts

To guarantee the durability of the window, the wood needs to be suitably treated. Wood that is exposed to the elements that lacks natural resistance against wear and deterioration must meet one of the below:

a) Impregnated using impregnation that meets penetration class NP3 pursuant to EN 351-1 and 351-2

b) Impregnated with least 4 mm lateral penetration into the sapwood. All end wood shall be sealed using primer and/or covering paint. Joins at the underside of frames and casement, and muntin bars, shall be sealed by applying sealant to the end wood of the profiles prior to assembly.

c) Coated with wood preservative through dipping or flowcoating (e.g. 2ØKO in Denmark) and be made of heartwood or wood of similar quality.

d) Nordic Ecolabelled pursuant to the criteria for Durable wood.

The systems for surface treatment shall be tested according to EN 927 "Coating materials and coating systems for exterior wood". The system shall fulfil the limit values "stable end use category" in Table 1 of EN 927-2. The "Exposure condition" defined in Table 2 of EN 927-1 shall be "Medium".

Profiles covered by aluminium, other metal, composite or polymer materials are not considered weather exposed.

✉ Test reports complying with EN 351-1 and 351-2 for wood preservatives and EN 927 for surface treatment systems.

Background to durability/longevity requirement

The requirements are virtually identical to the previous requirement version (version 3). The purpose of the requirement is to ensure satisfactory durability of parts exposed to the elements over time. Version 3 of the criteria contained the requirement a) that impregnated wood material needed to meet the penetration requirements pursuant to the product standard EN 351 (table 1) and the requirement c) tailored for water-based wood

[58] Conversation with companies that manufacture and distibute EUR pallets (Trollhättans Emballage Renovering AB and Åsljungapallen AB)

protection combined with heartwood. The class designation in the current standard has changed since the 2007 version, from P5 to NP3.

The technology group of the Technical Research Institute of Sweden (SP) presented a proposal for reworked wood requirements in 2010. This proposal results in the approval of impregnation down to 4 mm penetration into the sapwood, see table 9. Nordic Ecolabelling feels that the extension is reasonable and quality assured and proposes that this be added to the requirement relating to the durability of parts exposed to the element.

It should be noted that wood structures that are *protected* by metal (e.g. aluminium clad wood windows) or plastic composite/polymer materials are not considered to be exposed to the elements.

The surface treatment requirements remain unchanged.

Proposed technical requirement

O 24. Technical requirement

Ecolabelled windows and exterior doors must fulfil the relevant standards in the country in which they are sold, e.g. SFD, NCDK, DVC or P-labelling.

The measurement and calculation methods shall be in line with the stipulations of product standard EN 14351–1.

✉ Details of and declaration stating which standards are fulfilled in the country in which the window or exterior door is sold.

Background to technical requirement

As of 1 July 2013, all construction products covered by a harmonised standard or European Technical Assessment (ETA) must have a performance declaration and be CE labelled in order to be sold in Sweden and other EU countries, including Norway, Switzerland, Iceland, Turkey and Lichtenstein. This is regulated by the EU Construction Products Directive, (305/2011/EC), abbreviated CPR. The purpose of the CPR is to facilitate trade between the member states. If all EU manufacturers use the same methods to assess and describe the key product properties and also have an organised manufacturing control system, the product can be sold in all countries without the need for further testing or labelling.

The appendix to the EU Construction Products Directive contains a steered template for performance declaration. It should be completed by the manufacturer, after which the product may be CE labelled. A correctly completed performance declaration means, among other things, that the company must have a reliable system for production control to make sure that products display the performance stated when manufactured in series. The EU Construction Products Directive obligates the manufacturer to operate a production control system. For some product properties (see harmonised standard) it is necessary to contract a third-party capable of controlling that the company's own system for production control works, and in some cases to verify product performance.

There is a harmonised product standard for windows and exterior doors: EN 14351-1:2006+A1:2010 - Windows and doors - Product standard, performance characteristics - Part 1: Windows and external pedestrian doorsets without resistance to fire and/or smoke leakage characteristics. This means that in order to be sold within the EU,

windows and exterior doors must come with a completed performance declaration and be CE marked by 1 July 2013 at the latest. No independent third-party control of the manufacturer's production control systems is required for windows and exterior doors.

It is the construction regulations of the individual EU member states that determine what parameters should be performance declared. Consequently, the information provided for a window or exterior door may vary from country to country.

Windows are also defined as chemical products pursuant to the EU's chemicals regulation; REACH. This means that the manufacturer must also declare the window's hazardous substance content, listing the substances included in the REACH candidate list.

The aim of the shared EU CE labelling scheme for construction products was that all national certification schemes would be phased out and rendered obsolete. This has not happened. European standard labelling does not automatically mean that the product in question can withstand the Nordic climate or that it complies with Nordic environmental regulations. The national door and window certification systems in Denmark, Sweden and Norway are based on European standards for calculating and testing a product's properties *but* the product requirements are specially adapted to the Nordic climate. The national certification systems (SFDK, P-labelling, DVC and NDVK) will probably co-exist with the CE labelling but may change so that they do not relate to the same characteristics as the latter but rather complete it by looking at other properties or through a manufacturing control.

In summary, Nordic Ecolabelling proposes that the requirement for national certifications be retained in order to ensure that good functionality and quality is maintained. The added value of taking into account specific Nordic conditions that affect windows and exterior doors in this region is important. The requirement is clarified by stating that only those measurement and calculation methods stated in the product standard may be used. The aim is to avoid performance being measured according to different parameters and to ensure that the result that is the most advantageous to the manufacturer is presented.

Proposed guarantee requirement

O 25. Guarantee

The window manufacturer must provide a 10-year guarantee covering function, insulation glass and wood rot. The guarantee must encompass all functional requirements in the applicable/relevant standards.

The exterior door manufacturer must provide a 10-year guarantee for form stability and a 2-year guarantee for function.

✉ Guarantee certificate supplied with the window/exterior door or information on the manufacturer's website.

Background to guarantee requirement

The guarantee requirement remains unchanged compared to version 3 of the criteria. The guarantee periods are deemed realistic and reasonable, both for the consumer and the manufacturer. The purpose of this requirement was never to be far ahead of the industry in general in this regard. The warranty applies provided that maintenance has been performed continually and in accordance with the window manufacturer's recommenddations.

Proposed information requirements

O 26. Customer information

Manufacturers of Nordic Ecolabelled products shall submit:

a) information on the window's g-value and U-value or the exterior door's U-value. Specify for which format the U-value applies. Information stating that the window is not recommended for installation in buildings that need to be cooled, due to properties of the glass that is constructed to contain as much heat as possible inside the building. If these windows are installed in a building with a calculated need of cooling, the customer needs to be informed of solutions for energy efficiency, for example sun blinds or sun-screening;

b) information on how to select U and g values based on the window's positioning in order to achieve good heating economy and a good indoor climate;

c) information on various sun screening solutions and the importance of such, either as part of the own product portfolio or through an agreement with partners.

✉ Information about the above on website or in brochure.

O 27. Installation information

The following shall be attached to each window or exterior door delivery, or alternatively a reference to information available on a website:

a) instructions on the handling of the window/exterior door during transportation, reception and storage at the building site.;

b) instructions on how the window/exterior door shall be installed into a wall, adjusted and protected during the construction period. General physical parameters for fitting must be specified. Instructions on how the window/exterior door should best be installed from an energy point of view, in order to prevent heating loss as a result of poor installation. In addition, the fitting instructions must assist installation without the risk of the window/door, or the wall into which it is placed, suffering damage resulting from the effects of moisture from convection, diffusion or external factors such as rain or snow;

c) Instructions describing the recommended maintenance for the window/exterior door. Care instructions must contain details on how often the finish should be checked and maintained/re-applied, and which surface treatment is recommended;

d) Information about how the window or exterior door should be handled at end-of-life.

✉ Written recommendations included with the delivery of the window/exterior door to the customer, or reference to the website where such information is available.

Background to information requirements

The requirements have worked relatively well in connection with licence application processing. The point that required manufacturers to inform customers that a window with a low U-value increases the risk of condensation on the outside in humid conditions when the radiant efficiency between the window and surroundings is great has been removed. The reason for this is the weak or non-existent link to environment and energy and the low steerability.

The requirement has been split into one that relates to installation and one that relates to customer information. To the latter, a requirement has been added relating to how licensees inform their customers of how the U and g values should be chosen based on the positioning of the window. In addition, the licensee must now inform the customer of the importance of sun screening solutions in order to avoid an increased need for cooling. These two requests were raised at an industry seminar held in autumn 2012.

5.9 Quality and regulatory requirements

Requirements O29 to O37 in version 3 of the criteria are general requirements that are always included in Nordic Ecolabelling's product criteria. The purpose of these requirements is to ensure compliance with environmental legislation and fundamental requirements for quality management. Furthermore, there is a requirement that regulates how the Nordic Ecolabelled product may be marketed. No changes suggested for these requirements.

6 Changes compared with the previous version

Appendix 1 to this report contains a summary of all requirements and the changes made.

Appendix 1. Overview of changes to criteria compared with previous versions

Previous criteria (version 3.4)	Revised criteria (version 4.0)	Comment
R1	O1	Unchanged
R2	O2	Unchanged
R3	O3	Facade windows: A tightening of the U value from 0.95 to 0.90 W/m^{2}K. Roof windows (skylights): Made clear that the U value shall be 1.0 W/m^{2}K. Window and exterior doors: The U value is unchanged. The U value relates to the entire window or exterior door. Testing, calculations and areas pursuant to the harmonised product standard EN 14351-1.
R4	O4	The requirement relating to the window glass' solar energy transmittance, g_g, has been reformulated but the requirement level remains unchanged at 48% or more. Requirement stating that the window's g value must be 34% or higher added. The requirement relating to daylight transmittance remains unchanged.
R5	O5	The requirement for window and exterior door air permeability remains unchanged. A requirement stating that the door must first be tested for differential climate impact according to standard EN 1121 has been added.
R6	O6	The recycled share requirement has been tightened from 30% to 50%. An exception for PVC as protection against the elements in windows at max. 4% by weight has been added to the requirement. An exception for composite material used as protection against the elements, and in the load bearing structure, has been added to the requirement. The max. weight share for composite is 12%.
R7	O7	Bisphenol A has been added to the list of additives which may not be added to new plastic materials.
R8	O8	The limit value for max. cadmium content has been changed to 1,000 ppm. The use of bisphenol A shall also be monitored
R9	O9	Unchanged
R10	O10	Unchanged
R11	O11	The use of filler gases xenon and krypton are prohibited. Filler gases must not contribute to the greenhouse gas effect. (GWP_{100}= 0). This is irrelevant for argon.
R12	O12	The requirement is essentially unchanged but has been reformulated for clarification.

Previous criteria (version 3.4)	Revised criteria (version 4.0)	Comment
R13	O13	The scope of the requirement has been expanded to include fibreboard, veneer and plywood. Exceptions exist for wood chip, wood shavings, waste wood, untreated demolition wood and recycled fibre from other industrial activities used in fibreboard.
R14	O14	The requirement is practically unchanged.
R15	O15	Unchanged
R16	O16	Hazard classes and designations pursuant to the CLP regulation have been added to the requirement. The requirement is otherwise unchanged.
R17	O17	Hazard classes and designations pursuant to the CLP regulation have been added to the requirement. The requirement is otherwise unchanged.
R18	O18	Hazard classes and designations pursuant to the CLP regulation have been added to the requirement. The requirement is otherwise unchanged.
R19	O19	A ban on nano particles in chemical products has been added to the requirement.
R20	O20	The requirement has been reformulated for clarification but is otherwise unchanged.
R21	O21	The limit values for VOC emissions have been tightened considerably. For impregnation, they are lowered from max. 11 to max. 6 kg/m^3. For surface treatment they are lowered from max. 75 to max. 60 mg TOC/Nm^3.
R22	O22	The requirement has been simplified to be less micromanaging while still achieving its purpose.
R23 & R24	--	The requirements have been removed entirely.
R25	O23	A statement indicating that parts that are exposed to the elements have sufficient wood protection with a depth of penetration of 4 mm into the sapwood has been added.
R26	O24	Unchanged
R27	O25	Unchanged
R28	O26 & O27	The requirement has been divided into Customer information and Installation information. The point relating to U value and condensation has been removed. Requirements added as follows: Information on how to select U and g values based on the positioning of the window. Information on various sun screening solutions and the importance of such.
R29-R37	O28-O36	The quality and authority requirements are essentially unchanged.

Appendix 2. MECO analysis

The results from the MECO analysis performed is available in a Nordic language and may be obtained from sara.bergman@svanen.se

A summary of the results is included in the main body of this report, chapter 4.

Appendix 3. Voluntary ecolabelling of windows

1.1 Introduction

While the EU has been working to develop a shared energy labelling system for windows, Denmark, Sweden and Finland developed their own systems some years ago. Norway does not have an energy labelling system for windows but is displaying a great deal of interest in the Swedish model. The European product standard now uses the dimensions 1,230 x 1,480 mm which is then converted into square metres. Both the Danish and the Swedish energy labelling systems use these dimensions. According to the website, Finland uses other measurements.

The U value calculated based on the entire window, i.e. glass, jamb and casement is called the U_w value.

Solar energy transmittance is expressed in the same way. The window's g value (g_w) is always lower than the g value for the glass pane (g_g) as no heat permeates the jamb and sash.

1.2 Description of the Nordic systems

Denmark
In recent years, Denmark has introduced the energy balance concept (E) through its construction regulations. E_w expresses the window's energy balance during the heating season sunlight entry minus heat loss. A positive E value mans that more heat is added than is lost, i.e. that the window contributes positively to the building's heating requirements.

The E_{ref} value indicates the entire system's energy balance during the heating season. Here, the window is fitted into a context; a so called reference building. E_{ref} is calculated for a reference building with medium-level insulation and a certain window orientation (41% south-facing, 33% east/west-facing and 26% north-facing).

$E_{ref} = 196.4 \times g_w - 90.36 \times U_w$. This formula applies to facade windows. There is a different formula for roof windows.

- ✓ the factor 196.4 is the sunlight entry into the house with standardised window positioning.
- ✓ the factor 90.36 is the number of degree hours during the heating season.

The Danish energy labelling scheme rates the windows on a scale of A-F. In addition, information about the U value, g values and daylight transmittance is stated for all energy rated windows. Danish construction legislation (BR10) demands class C windows, or better, be used when replacing windows in existing buildings. This is expected to be changed to class B, or better, in 2015.

Table 10: The Danish energy labelling scheme rates windows based on an energy balance calculation.

Class	Energy balance E_{ref} (kWh/m^2)
A	$0 \leq E_{ref}$
B	$-17 \leq E_{ref} < 0$
C	$-33 \leq E_{ref} < -17$
D	$-55 \leq E_{ref} < -33$
E	$-60 \leq E_{ref} < -55$
F	$E_{ref} < -60$

Sweden

The Swedish energy labelling scheme rates windows based solely on the U_w value, i.e. based on the entire window's heat loss. Windows are given an energy rating of A-G based on their U value. A is the top energy rating. Even though the Swedish energy labelling is based only on the U value, g values and daylight transmission are stated alongside the classification for reference.

Table 11: The Swedish energy classification system for windows

Class	U_w (W/m^{2}K)
A	0.9 or lower
B	1.0
C	1.1
D	1.2
E	1.3
F	1.4
G	1.5

The system for energy classification has been revised. One change has been the review of the requirement levels. In the future (unclear when exactly) class A will correspond to windows with a U value of 0.8 or lower.

Norway

The Norwegian industry has not developed an energy labelling/classification scheme for windows like the rest of the Nordic countries. There is, however, a product labelling for windows called 'Enova Anbefaler'. It is not clear what is required in order for windows to be awarded this label. It appears as though tripe-glazed windows may be labelled. Possibly, the U value must be 1.0 W/m^2 K or lower.

Finland

The Finnish energy labelling system for windows is based on annual energy consumption, E_a, which is a function of the window's U value, g value and air permeability (L) according to;

$$\mathbf{E_a = 140 \times U_w - 160 \times g_w + 50 \times L}$$

The air permeability (L) represents the air permeability of the window structure (glass, frames and sashes) and is measured in m^3/m^2h. For example, an E_a value of 100 means that each square metre of window surface consumes 100 kWh of energy annually. This means that the lower the E the better insulation the window provides.

Table 12: The Finnish energy labelling system which rates windows from A++ to G

Class	**Annual energy loss per square metre E_a (kWh/m^2year)**
A^{++}	E < 45
A^{+}	E < 65
A	E < 85
B	E < 105
C	E < 125
D	E < 145
E	E < 165
F	E < 185
G	E ≥ 185

It should be noted that the Finnish rating system uses a different surface area than that stipulated in the European product standard, which means that it is not possible to directly compare the U and g values. The energy rating label itself states, aside from rating and E value, the U value, g value and air permeability.

Appendix 4. In-depth materials description

This appendix is available in a Nordic language and may be obtained from sara.bergman@svanen.se

A summary of the materials can be found in the main part of this report, chapter 5.3

Appendix 5. Description of techniques used to protect and treat wood

Introduction

Wood can be damaged by bacteria, fungi, insects or other bugs. These organisms can cause rot, discolouration or mechanical damage. Impregnation or surface treatment using wood protection products can help protect against these attacks. Impregnated wood is used when it is not possible to protect the wood from damp and guarantee its durability using construction technology. Examples include window and exterior door carpentry.

Durability/wood protection effect

The Nordic countries have applied an official standard for the classification of impregnated wood since 1976 (the NTR standard). The standard designates wood one of four wood protection classes: M, A, AB or B. The Nordic Wood Preservation Council (NTR) industry standards are Nordic application documents for the European wood protection standards EN 351-1 and EN 351-2.

Wood impregnated according to class AB is intended for use in exposed structures above ground, i.e. risk class 3 pursuant to EN 335, such as fences, barge boards, etc. Wood impregnated according to class B is only intended to be used for external carpentry such as windows and doors. The other two classes are not described in further detail in this document as they are intended for more challenging environments than these windows are subjected to.

Biocides

Traditional wood protection treatment involves the use of biocides (fungicides). In order for a biocide to be released on the European market, the active substance must have been approved for the EU and included in the positive list in the Biocide Directive (98/8/EC), appendix 1. Those who sell biocides are then responsible for ensuring that the products have been approved by the relevant body for the country in question. In Sweden it's the Chemicals Agency that is responsible for product approval in accordance with the Biocide Directive. In Denmark the equivalent is the Environmental Protection Agency, etc. In the approval process, this body also takes into account the usage phase and the risk of leaks and a diffuse spread of biocides. The risk of diffuse spread is also minimised by painting/lacquering the wood profiles which creates a protective, encapsulating shell. The biocides used in connection with wood protection treatment are fungicides and contain one or several of the active substances listed in table 16.

Table 13: Common active substances in wood protection agents.

Active substance	Classification	Risk phrase	Chemical designation
Propikonazol	R22	Harmful if swallowed	
	R43	May cause sensitisation by skin contact	
	R50/53	Very toxic to aquatic organisms; may cause long term adverse effects to the aquatic environment	
Tebukonazol	R22	Harmful if swallowed	
	R63	Possible risk of foetal damage	
	R51/53	Toxic to aquatic organisms; may cause long term adverse effects to the aquatic environment	
IPBC	R50	Very toxic to aquatic organisms	3-iodo-2-propynyl butyl carbamate
	R50/53	Highly toxic to aquatic organisms; may cause long term damage to the aquatic environment	

The most common sources of environmental pollution are the addition of chemicals, storage of chemicals, spillages during the impregnation process, accidents, spillages from drip locations and leaching from storage locations. This applies to both types of impregnation. It is therefore important that these processes take place under controlled circumstances. The Danish Technological Institute has designed and tested an outdoor method together with the Technical Research Institute of Sweden, the Norwegian Institute of Wood Technology, Dyrup A/S, Bayer AG, Troy Corporation and Jansen Pharmaceutica. Here the focus is on products containing Tebuconazol and Propiconazol, two of the products that have replaced older heavy metal-containing products. The test showed that a larger volume of biocide leached was greater for horizontal panels (decking) than for vertical panels (facade) and that all impregnation methods resulted in some degree of leaching. Surface treatment resulted in more than twice as much leaching as the other three impregnation methods (vacuum, pressure and supercritical). This indicates that leaching is very much a surface phenomenon. Leaching was on the same level for the other three methods. The volume of biocide leached from chemical wood protection naturally depends on whether or not the wood undergoes subsequent surface treatment [59].

Processes

Impregnation

The impregnation methods are *pressure impregnation* and *vacuum impregnation*. Pressure impregnation is now often water-based with the use of various salts (copper, chromium, etc.). Pressure impregnation is not allowed for Nordic Ecolabelled windows and exterior doors and is therefore not described further in this document[60]. Vacuum impregnation is only used to impregnate finished construction carpentry such as windows, doors and garden furniture. The process is less deep and saturating than pressure impregnating but is still considered adequate for the purpose.

[59] Udvaskning af biocider fra imprægneret træ - Viden om Træ 3/2004

[60] It is neither relevant nor neccesary to use pressure impregnated wood in windows and exterior doors covered by use class 3 in standard EN 335-1.

Vacuum impregnation is normally performed using *organic solvents*. The product used often consists of 90% organic solvent, usually turpentine, and 10% active substance/fungicide. The most common products are Propikonazol and/or Tebukonazol, see table 16.

The company Osmose Timber Technologies covers 95% of the Nordic vacuum impregnation market. According to the safety data sheet, their biocide product, Protim P-Vac 11, contains 1.6% by weight of the active substance Propikonazol. Protim P-Vac 11 is classed as R43, R65, R66 and R51/53. As there are exceptions for classification R51/53 in vacuum impregnation (see R16 in version 3 of the criteria) there is nothing to stop the product being used.

The Nordic Wood Preservation Council (NTR) imposes requirements relating to the wood's absorption of the active substance of the various wood protection agents. For Protim P-Vac 11 the (min.) requirement is 0.41 kg/m^3 impregnated wood for class B. In practice, about 11 kg of fluid is applied to each square metre of wood. The impregnation takes place in a vacuum and 6 mm of the sapwood is impregnated to at least 0.41 kg/m^3 and all excess is removed either directly to the air or via catalytic combustion in order to efficiently reduce VOC. Process optimisation has resulted in a reduction from about 16-20 kg/m^3 of product to the current 11 kg per cubic metre of material produced. The driving force here has been a wish to reduce drying times.[61].

Another approved wood protection product is Gori 605, manufactured by Teknos. It contains Propikonazol, Tebukonazol and IPBC, all at 0.33 weight per cent. Gori 605's risk classification does not contradict the Nordic Ecolabel's current requirements. The total content of substances classed as R63 must not exceed 0.5 weight per cent in order to meet the Nordic Ecolabel's present requirement R18, and Tebukonazol does not in this product.

Vacuum impregnation using organic solvents results in emissions of volatile organic compounds. These so called VOCs are primarily a mixture of aliphatic (as opposed to aromatic) hydrocarbons and contribute to the formation of low level ozone, a substance that is harmful to health and the environment. The use of VOCs also involves working environment risks. There are ways of reducing the VOC emissions to the air. Mainly, this involves using products with a lower solvent volume. One end-of-pipe measure that could be applied is the treatment of emissions through combustion, adsorption or recycling. A BAT/BREF report for Surface Treatment Using Organic Solvents[62] within the EU indicates that emissions could be reduced by 70%. This should *not* be taken to mean that pressure impregnation using turpentine is the BAT for window production. As the title of the report indicates, the BAT report relates to surface treatment using organic solvents in general. Unfortunately, the planned BAT report for Wood and Wood Products Preservation has not been started yet.

Impregnation can also be performed using *carbon dioxide* as the bearer in a so called supercritical impregnation process. Hampen Træforarbejdning A/S on Jutland, Denmark, has one of the world's first large-scale plants for impregnating spruce wood using super critical carbon dioxide, so called Super impregnation/Superwood[63]. One

[61] Conversation with Lars Nyborg, technical manager at Osmose Timber Technologies.

[62] BREF 2007; Joint Research Centre, IPTS, The European IPPC Bureau.

[63]For further information, please see www.superwood.dk

advantage of the supercritical phase is that some of the carbon dioxide's properties are retained while new properties are added. For example, it behaves like a solvent while penetrating the wood like a gas. The impregnation substance Gori SC200 is applied to the wood. The impregnation takes place in a closed process where carbon dioxide acts as the bearer that helps the wood protecting agent penetrate the wood using high pressure (supercritical level). At the end of the process, the carbon dioxide and wood protectant are pumped back and reused, apart from a small volume left inside the material.

The active components of Gori SC200 are:

- Propikonazol (8-9 % in product)
- Tebukonazol (8-9% in product)
- IPBC (3-5% in product)

Impregnation using the biocide Gori SC200 is on average 0.12 kg/m^3 wood in the Jutland plant. This should be seen as an indication of the amount of biocide remaining in the finished product. This type of impregnation penetrates the entire material and not just, as in the case of vacuum impregnation, a small part. Superwood is approved for use class 3 pursuant to standard EN 335-1 (wood above ground that is often moistened to 20%). As Superwood is currently only able to impregnate spruce wood, reference cannot be made to NTR's use classes as these apply to pine wood. Apparently the residual volumes of 0.12 and 0.14 (for Protim P-Vac using vacuum impregnation) are relatively comparable. The active substances are also relatively similar. When it comes to biocide use there is no risk of a burden shift between the techniques.

Fact box. Heartwood and sapwood

Heartwood is the innermost part of the tree and is surrounded by sapwood. The sapwood transports water from the root to the needles. The heartwood, however, consists of inactive cells that act as protection and nutrient stores. A cross section of the log clearly shows the line between sapwood and heartwood as a difference in colour (see the image below).



It became clear from conversations with Anders Kjellow at Superwood Denmark that they sell impregnated spruce wood to window manufacturers. However, the Superwood treated wood is not used for all-wood windows but as a core in plastic windows. The wooden core needs to be protection treated due to the risk of moisture permeating the wood through screw holes, etc.

Anders Kjellow states that their product development is currently focused on developing processes that will allow them to super impregnate pine for use in windows, with satisfactory results. In summary, there are good chances of Superwood being used to produce standard pine wood windows in the future. However, this is currently not commercially viable and will not be required in this revision.

Flowcoat and subsequent surface treatment (the 2ØKO concept)
Water-based *wood* protection techniques have also been developed as an alternative to traditional vacuum impregnation. These are often used together with varying volumes of heartwood. Dipping means that the wood is dipped into a vat containing wood protection product without changing the pressure or temperature. Flowcoat is an

application technique whereby the wood is rinse painted/sprayed. One advantage of these techniques is that they are performed in a continuous flow and not in batches.

2ØKO is a two-step surface wood protection technique. First the wood is treated (primed) by being dipping into a vat of fungicidal solution, or given a so called flowcoat. The surface is then treated/painted with a product also containing fungicide and approved surface treatment products. The Association of Danish Window Manufacturers has a list of all certified surface treatment systems on its website.[64]. The Association of Danish Window Manufacturers recommends that 2ØKO be used only in combination with a high share, at least 90%, of heartwood.

The method is very common in Denmark and has been for about ten years. Between 90% and 95% of the Danish windows industry use water-based wood protection and surface treatment.[65]. The 2ØKO system has almost succeeded in phasing out vacuum impregnation in Denmark. The number of such plants in Denmark has fallen from 60-70 to about seven. It should be noted that even though 2ØKO is normally taken to mean a water-based system, there are also approved solvent based 2ØKO systems on the market!

All water-based techniques are characterised by a far shallower level of penetration than impregnation. The idea is that the use of heartwood[66] compensates as it has a natural resistance to effect and degradation.

Water-based flowcoat technology has been used by the licensee Svenska Fönster in Sweden for almost ten years. Becker Acroma (now a part of the Sherwin-Williams Group) is the supplier and the name of the biocide used is AA1939 Laqvin Seal. The active substance is IPBC (see table 16). Svenska Fönster uses wood with about 50% heartwood on average.

What do the national quality labelling systems say?
Vacuum impregnation does not require heartwood as the wood protecting agent penetrates 5-8 mm into the wood with the help of the solvent and the pressure applied. Both vacuum impregnation, the solvent turpentine and supercritical impregnation using carbon dioxide can be used on sapwood.

2ØKO treatment involves a penetration of about 1.5 mm and in order to ensure durability, a certain share, normally 90%, heartwood is required in the window.

Denmark switched to the water-based 2ØKO systems years ago and these are believed to meet the EN 152 anti-mould requirements. The 2ØKO system is one of three treatment systems approved for doors and windows under the Danish certification system Danish Window Certification (DVC). The other two systems are impregnation using turpentine or supercritical carbon dioxide with various penetration classes (6 mm and 3 mm) for sapwood. According to the technical stipulations, 2ØKO shall be used with 90% heartwood. Compliance with this is monitored through regular on-site inspections.

The Norwegian labelling system NDVK recently accepted 2ØKO as a treatment method provided that 90% heartwood is used from the internal fold edge to the exterior edge of

[64] www.vinduesindustrien.dk

[65] Conversation with Director Johny Jensen at Vindues Industrien (the Danish Windows Industry).

[66] The Nordic countries apply the same definition of heartwood, conversation with Hans Brolin, P labelling of windows, SP.

the window. According to NVDK[67], they also accept flowcoat without the use of heartwood, provided that the manufacturer primes using a fungicide and performs a subsequent two-step surface treatment.

The Swedish window quality labelling scheme the P label approves the following three alternatives:

The Swedish manufacturers using a water-based wood protection and surface treatment technique are maintaining a dialogue[68] with the Technical Research Institute of Sweden (SP) with a view to introducing this as an approved treatment method. Discussions are also being held with the Nordic Wood Preservation Council (Nordic Wood Preservation Council) on how to define wood protection classes treated using water-based systems. Representatives for P labelling[69] are not overly positive to water-based systems for the following reasons:

1. The negative impact on quality is unclear due to a lack of studies.
2. It has yet to be established how to measure and present results in a standardised manner. Should a certain volume on the surface be shown, as in Denmark, or should the volume in the wood be shown in the same way as for impregnation?
3. It is naive to think that a high share of heartwood can compensate for permeation. The wood available today is not heartwood as it was in the 1700s.

Alternative treatment methods without the use of fungicides (modified wood)
Modified wood may be heat treated wood, acetylated or furfurylated wood. All these methods are environmentally adapted alternatives to pressure impregnation as they do not contain biocides. The three methods mentioned above are included in the Nordic Ecolabelling of Durable wood-alternative to conventionally impregnated wood.

Modified wood is still a new material in this context. Tests etc. show that modified wood is well suited to window production. However, there are a number of reasons why it is not a commercially viable option yet:

- Modified wood is far more expensive than normal window wood. Heat treated wood is about twice the price.
- The process is not standardised, meaning that it is not steerable nor possible to show how variations affect product quality.
- Environmentally adapted water-based treatment options work really well, so why try something new?
- The best results with heat treated wood were achieved with beech while the windows industry in the Nordic region uses almost exclusively pine.

  Acetylation and furfurylation increases the risk of the window's metal parts becoming corroded.

In summary, modified wood is not yet an alternative to vacuum impregnated, dipped or flowcoat treated window wood.

[67] Conversation with Ivar Hansen at NDVK.

[68] Conversation with Kent Wahlén at SP Fönster (Swedish licencee)

[69] Conversation with Jöran Jerner, expert on wood protection treatment and P labelling of windows, SP.