About Nordic Swan Ecolabelled

Durable/resistant wood for outdoor use



Version 2.5

Background to ecolabelling
13 October 2020

Nordic Ecolabelling

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This document is a translation of an original in Norwegian. In case of dispute, the original document should be taken as authoritative.

Addresses

In 1989, the Nordic Council of Ministers decided to introduce a voluntary official ecolabel, the Nordic Swan Ecolabel. These organisations/companies operate the Nordic Ecolabelling system on behalf of their own country's government. For more information, see the websites:

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1 Summary

This document describes the environmental impacts associated with durable wood and proposes and justifies revised criteria for the "Nordic Ecolabelling of Durable wood – Alternative to conventionally impregnated wood."

In order to extend the service life of wood in an outdoor environment, it is treated in various ways. The impregnation agents traditionally used contain active substances that provide protection for the wood through the toxicity of additives (heavy metals and other biocides). One negative side-effect of using toxins is that the substances often have adverse health and environmental properties that can affect humans and the environment during leaching over time. There are alternative methods for achieving durable wood that do not involve the use of heavy metals or other biocides.

Heartwood with naturally long durability, chemically or thermally modified wood, may be Nordic Swan Ecolabelled. The wood must, as a minimum, meet the durability requirements concerning wooden structures above ground that are exposed to moisture and/or weather. Nordic Swan Ecolabelled durable wood is an alternative to conventionally impregnated wood and is characterised by:

- having no added heavy or biocides
- not causing problems or requiring special processing in the waste phase
- being produced from sustainable forestry
- having sufficient biological durability

The following may not carry the Nordic Swan Ecolabel:

- wood which is impregnated with heavy metals or biocides
- wood that is surface treated (for example stained or painted)
- wood plastic composites (WPC)

General

The product group has been expanded from being an environmental pioneer, which means a new product group for Nordic Ecolabelling with simplified requirements, to a regular product group. As such, many of the standard requirements for Nordic Ecolabelling are now included, particularly in the areas of chemistry, quality and regulatory requirements.

Product group definition

The product group definition has been reviewed, with particular consideration given to the inclusion of wood-plastic composites and wood treated with supercritical CO_2 and small quantities of biocides. Nordic Ecolabelling is however not opening up for any of these product types.

A new restriction is also introduced in the product group definition, stating that wood that is surface-treated (eg. painted or stained by the manufacturer after modification) cannot carry the Nordic Swan Ecolabel. Requirements for surface treatment are therefore removed.

Chemical requirements

The chemical requirements have been expanded in several ways, and they have been updated in line with the CLP Regulation (EC) No 1272/2008. Three new chemical requirements have been introduced. The first relates to a ban on chemical substances that are classified as carcinogenic, mutagenic or toxic for reproduction. The second is a list of prohibited substances that have problematic properties in terms of health and/or the environment. The third is a ban on the use of nano particles in chemical substances or in the finished product. The classification requirements for chemical products have been expanded from only setting requirements concerning health classification to also including classification for environmentally harmful effects.

The requirements relating to sustainable forestry (section 5.4) now include a requirement concerning use of biocides on the timber after felling.

Biological durability

It has been researched whether any relevant new tests for durability have been created that could be included in the requirement. No such tests have been found, and the requirement thus remains unchanged. The requirement allows for alternative methods to be used if an independent and competent test institution judges the methods to be equivalent in terms of quality. Sound new test methods may therefore be used if they become established.

Energy consumption and emissions of greenhouse gases

An attempt has been made to gather relevant energy data for the raw material and production phases, with a goal of establishing level requirements for energy consumption, which is an important factor in the life cycle of durable wood. In examining the data and considering possible requirement levels, it became clear that the data is associated with a great deal of uncertainty. It was also judged that the manufacturers have low steerability when it comes to affecting energy consumption for the drying of sawn timber, since this is often carried out by a supplier, and it would often require major investments for the manufacturers to switch energy sources. These circumstances make it difficult to set good and appropriate requirement levels for permitted energy consumption in this version of the criteria. Instead, monitoring requirements have been introduced for energy consumption during the raw material processing stages (drying of the wood) as well as the production of the final durable wood product. There is also a requirement that the manufacturers must have a plan for energy savings at its production facility. The goal is to collect good data so that level requirements can be set in the next revision.

2 Basic facts about the criteria

Products eligible for ecolabelling

Wood is a biological material and must be used properly and/or treated in order to avoid degradation. To extend the service life of wood, it can be protected and treated in various ways: constructive wood protection[1], surface treatment or impregnation, or a combination of these.

[1] Constructive wood protection aims to keep the wood dry (moisture content < 20%), so that one of the conditions for a rot attack does not occur. http://www.svensktlimtra.se

The impregnation agents traditionally used contain active substances that provide protection for the wood through the toxicity of additives (heavy metals and other biocides). One negative side-effect of using toxins is that the substances often have adverse health and environmental properties that can affect humans and the environment through leaching over time during the use and waste phases.

There are, alternative methods for achieving durable wood that do not involve the use of heavy metals or other biocides, often referred to as modified wood. A general definition is that wood modification involves a chemical, biological or physical treatment of the wood that helps to improve the properties of that wood. In addition, the modified wood must not be toxic or emit toxic substances during use[2]. The criteria for the Nordic Ecolabelling for Durable wood relate to these alternative methods. The most relevant alternatives available on the Nordic market are thermally and chemically modified wood. Appendix 1 provides an introduction to the various wood modification methods.

Durable wood has many potential applications, including cladding, terraces, steps, fences, bridges, outdoor furniture and jetties. The durability class of the wood determines the potential areas of use (see section 5.4).

Heartwood with naturally long durability and chemically or thermally modified wood, may be Nordic Swan Ecolabelled. The wood must, as a minimum, meet the durability requirements concerning wooden structures above ground that are exposed to moisture and/or weather.

Products that cannot be Nordic Swan Ecolabelled

The following may not carry the Nordic Swan Ecolabel:

- wood which is impregnated with heavy metals or biocides
- wood that is surface treated (for example stained or painted)
- wood plastic composites (WPC)

Wood-plastic composites were given particular consideration during the revision. The main reasons for not including them are listed below (for more details, see Appendices 2 and 4). Composites will be reassessed during the next revision, since advances are expected in the future and better environmental products may be developed. One benefit of wood-plastic composites in the use phase is that they do not require surface treatment.

- Wood-plastic composites (WPC) can be manufactured using virgin or recycled thermoplastics. Since plastic is based on fossil raw material, there are substantial CO_2 emissions associated with the material, compared to pure wood products. Virgin plastic may account for over 50% of the composite's climate impact over its life cycle. The emissions are lower if recycled plastic is used and there is therefore considerable potential to reduce the environmental impact of the product by using a high proportion of recycled plastic. A study of various composite products has, however, concluded that it is currently often difficult to achieve a sufficient quality when using recycled plastic, which is why the majority of manufacturers in the Nordic region use virgin plastic. As of today, there is consequently little steerability towards using a high proportion of recycled plastic.

[2] Plesser, Thale Sofie Wester et al., Miljøanalyse av trefasader, SINTEF Byggforsk, ISBN 978-82-536-1339-0, 2013

- Wood-plastic composites involve significantly higher energy consumption in the production phase than other pure wood products that are covered by the criteria for durable wood.
- The opportunities for material recovery are more limited for WPC than for pure wood products. The mix of wood, plastic and various additives causes a degradation of the plastic, and plastic from end-of-life composite cannot be separated out and used in other types of product. Theoretically, used composite can be recycled in new composite products of the same type, but there are currently no established take-back systems for collection.

During the revision of the criteria and the consultation period the use of biocides (below 200 g/m^3 wood) by impregnation with supercritical CO2 was considered and proposed. Responses from the consultation showed that there was great resistance that the proposed criteria would move away from requiring biocide-free options, regardless of the amount biocide. Biocides are in principle toxic and often have adverse health and environmental effects. It is therefore an advantage to limit the use in particular when there are biocide-free products having good performance and quality. Products containing small quantities of biocides are, based upon the abovementioned reasons, not included in this product group.

Surface treatment of modified wood has also been considered. Surface treatment means the treatment of surfaces after the timber is modified (such as staining or painting). Experiences from version 1 of the criteria are that such treatment seldom is carried out by manufacturers of durable wood. Surface treatment of wood in the use phase can have a large impact on the products environmental impact over its life cycle (see details in section 4.2). Durable wood is modified to provide good resistance and the need for surface treatment by the manufacturer should thus be minimal. Nordic Ecolabelling therefor prefers that such treatment is not performed since an important environmental and practical benefit of durable wood is a low need for maintenance/surface treatment. For these reasons, surface-treated modified wood is excluded from the criteria.

Justification for Nordic Ecolabelling

The Nordic region has a long tradition of using wood outdoors for many purposes. The durability and service life of the wood are affected by climatic and biological conditions. In order to extend the service life of the wood, it is treated in various ways.

Originally, the most familiar environmental problems from durable wood were associated with the use of copper, chromium and arsenic (CCA) and creosote as impregnation agents. CCA impregnation has been prohibited in the Nordic region since 2012, and the use of creosote is only permitted in an industrial context. The chemical impact from conventionally impregnated wood has been significantly reduced. However, significant quantities of copper and other biocides are still being used in conventionally pressure impregnated timber, causing sizeable environmental impacts from the use and the leaching of substances harmful to health and the environment.

The most widely used impregnation agents are currently water-borne preservatives that normally contain copper salts together with organic fungicides as the active substances.

As a result of the ban on CCA impregnation the quantity of copper used in impregnation agents increased as they are not as effective against rot fungus. The copper content seemed to increase from 0.5 kg to 1-2 kg per cubic meter depending on the salt formulation[3]. An attempt from 2010 where wood was treated with copper and boron estimates that between 8 to 15% copper and about 30% boron was leached out during a 20 years' time period. The experiment was conducted by the International Research Group on Wood Production[4].

Water-soluble copper compounds (copper salts) are toxic to humans and can be highly toxic, even in small quantities, to aquatic organisms. The compounds can also cause long-term adverse effects in the aquatic environment[5]. Copper does readily bond to organic substances/organic compounds, and remains less available and thus less harmful as long as it is in this bound state. The Earth's copper reserves from ore are estimated at around 350 million tonnes, making it a limited resource, considering the annual consumption of around 10 million tonnes. It is therefore important to make effective re-use of copper[6] and to use alternatives where this is possible.

Increased use of alternative methods for wood impregnation has the potential to achieve significant environmental gains by reducing the use of toxic chemicals. In addition, there is potential to reduce the consumption of the Earth's limited copper reserves.

Other key environmental considerations are ensuring that wood comes from sustainably managed forests, and ensuring that the products have sufficient biological durability and a low need for maintenance.

Ecolabelling is a targeted tool for identifying environmentally positive alternatives within the product group and for influencing the environmental aspects listed above. This is why Nordic Ecolabelling has criteria for durable wood.

Nordic Swan Ecolabelled durable wood is an alternative to conventionally impregnated wood and is characterised by:

- having no added heavy metals or biocides
- not causing problems or requiring special processing in the waste phase
- being produced from sustainable forestry
- having sufficient biological durability

Criteria version and validity

Version 1 of the criteria document was adopted by the Nordic Ecolabelling Board in April 2004 and remained valid until April 2007. The criteria were developed as an "environmental pioneer" and have been amended twice. The first amendment came in June 2006, when the requirement for the proportion of certified wood was changed from 90% to 70%. The exemptions concerning certified forestry were also removed and the wording concerning alternative test methods was adjusted.

[3] Webpage, Treteknisk: http://www.trefokus.no/fullstory.aspx?m=329&amid=13078 (2014)
[4] Morsing et. al., 2010: "Comparison of laboratory and semi-field tests for the estimation of leaching rates from treated wood - part 1: above ground (UC 3). IRG/WP 10-50274.
[5] Norwegian Pollution Control Authority, Vurdering av virkemidler for å redusere utslippene av kobber. 2005
[6] Big Norwegian lexicon: http://snl.no/kobber

The second amendment came in March 2009, when the classification of furfuryl alcohol was changed by authorities. An exemption for furfuryl alcohol, classified as carcinogenic: R40 in requirement R4, was introduced on condition that the new requirements R5 (maximum allowable concentration for chemical substances classified by R40) and R8 (chemical residues) must be fulfilled. In addition, the criteria have been extended and version 1.5 is valid until 31 December 2015.

The Nordic market

The manufacturers of durable wood primarily sell their products to builder's merchants and directly to construction projects. The builder's merchants sell the products either to private consumers or to developers. The customers may thus be anybody from developers, makers of outdoor furniture and gardeners to public sector buyers, wholesalers, importers and private consumers.

The market for durable wood is largely dominated by conventionally copper impregnated wood (pressure impregnated). There is also some use of creosote treated wood (for industrial purposes) and wood impregnated with organic solvent plus the addition of pesticides/biocides. Figure 1 shows the amount of impregnated wood produced in 2009 in the Nordic region, according to the impregnation agent[7]. Water-borne substances accounted for the greatest proportion.

Table 2 Production of treated wood in 2009 by type of preservative, m³.
Figures in brackets show the production of treated spruce. These figures are included in the total.

Country	Creosote	Water-borne	LOSP*	Total
Denmark	0	93 950 (32 550)	2 100 (0)	96 050 (32 550)
Finland	75 900	244 000		319 900
Iceland	0	0	0	0
Norway	16 000	398 400	30 300	444 700
Sweden	66 800	1 228 650 (428 650)	18 650	1 314 100 (428 650)
Total	**158 700**	**1 965 000** **(461 200)**	**51 050** **(0)**	**2 174 750** **(461 200)**

*LOSP = Light Organic Solvent Preservatives

Figure 1: Production of conventionally impregnated wood in the Nordic region, 2009 (source: Nordic Wood Preservation Council)

There is, however, a growing market for alternatives to pressure impregnated wood in the Nordic region. A general observation is that there are currently only a limited number of manufacturers making alternatives to pressure impregnated wood in the Nordic region, and the industry is new and developing. Interest in such alternatives is growing, including internationally. This is particularly the case with professional customers who have an environmental focus.

[7] Nordic Wood Preservation Council: www.ntr-nwpc.com (February 2014)

In recent years, many architects and landscape architects have begun to embrace the use of alternatives to pressure impregnated wood, for example as facade cladding and other exterior uses. The purchase price of modified wood remains somewhat higher than for ordinary pressured impregnated wood, but the prices are expected to drop as volumes increase. It is usual that many types of modified wood are not surface treated during the user phase, and for those products the maintenance costs are lower.

The following alternatives to pressure impregnated wood are the most common in the Nordic market (not ranked by market share):

- Thermally modified wood
- Chemically modified wood
- Untreated wood with natural durability, such as pine heartwood
- Wood plastic composite (WPC)
- Wood impregnated with supercritical CO_2 and small quantities of biocides

ThermoWood, for example, has seen steadily rising sales over the past decade, as shown in figure 2. The sales relate partly to the Nordic region, but the majority is exported to other parts of Europe.

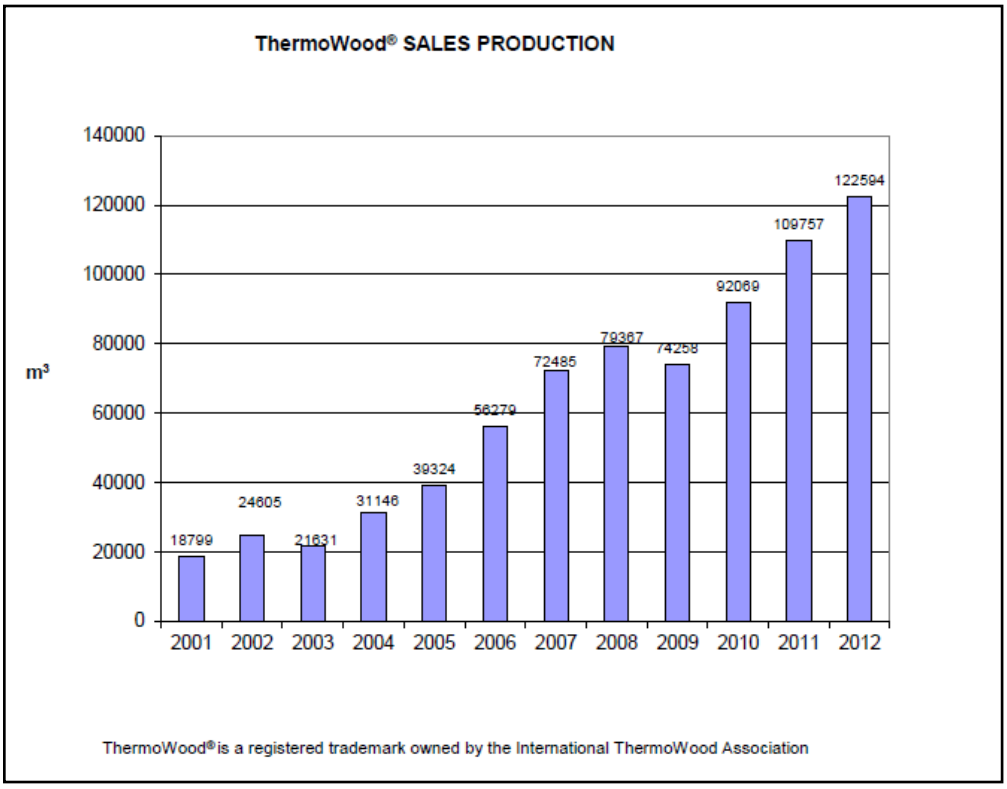


Figure 2: Increase in production volume of thermally modified wood over the period 2001-2012[8]

[8] International ThermoWood Association: www.thermowood.fi (February 2014)

Industry organisations
The Nordic Wood Preservation Council (NTR) and its national member organisations Metsäteollisuus and Kestopuuteollisuus in Finland, Skogsindustrierna and Svenska Träskyddsföreningen in Sweden, Treindustrien in Norway and Dansk Træbeskyttelse in Denmark are important partners for the Nordic wood industry in the areas of wood promotion and marketing, market surveillance, standardisation, quality control, research and development. Europe has the European Organisation of the Sawmill Industry (EOS), the European Confederation of Woodworking Industries (CEI-Bois) and the European Institute for Wood Preservation (WEI). Under the "European Wood Initiative", the industry organisations work together in Norway, Sweden, Finland, Austria, Germany and France to improve access to Asian markets. NTR and its member organisations work on the testing of wood preservatives for industrial use, as well as standards and quality control relating to impregnated wood.

There is no industry organisation specifically for modified wood. Manufacturers of thermally modified wood in the Nordic region tend, however, to be affiliated to the International ThermoWood Association, which had 13 members as of March 2014. ThermoWood® is a registered trademark owned by the International ThermoWood Association. The goal of the organisation is to generally promote the use of ThermoWood® products. The members collaborate on standardisation, quality control and research in order to increase the use of the products.

The section below describes the market situation for alternatives to pressure impregnated wood in the Nordic countries.

Market overview Finland
The market for thermally modified wood has grown relatively strongly in Finland. Thermally modified wood has many applications both indoors and outdoors. Overall, the market for thermally modified wood is quite small. However, Finland is a world leader in the production of thermally modified wood. There are nine manufacturers, and production has risen significantly from around 25 000 m^3 in 2002 to around 123 000 m^3 in 2012 and 85% of production is exported. The exports head primarily to other Nordic countries, to Central Europe and to the UK. The production is worth approximately EUR 50 million. The largest manufacturer of thermally modified wood is Lunawood Oy, which produced 45 000 m^3 in 2011.

There is also a new and growing market for composite products in wood fibre and plastic. The global market for composite products is relatively large, and in Europe it amounts to around EUR 500 million.

Market overview Sweden
The market in Sweden has long been quite stable. Builder's merchants, builders, public sector buyers and consumers influence the industry since they govern what is manufactured (pressure impregnated versus thermally modified). Industry organisations and other systems such as ThermoWood influence the industry through their membership numbers and large market share.

Sales of thermally modified wood are low compared with pressure treatment. Sweden has four manufacturers of thermally modified wood (Moelven, Heat Treated Wood in Hudiksvall, Scandinavian FineWood and Termo Plus in Arvidsjaur). Their total sales are at least SEK 700 million, with Moelven being by far the largest. The Swedish licensees are affiliated to the ThermoWood system[9].

There are also other production techniques that can make wood durable and resistant. The technique using silicon particles to fossilize wood has been developed and patented by the Swedish company OrganoWood. There are no manufacturers of furfurylated or acetylated wood in Sweden.

Market overview Norway
According to an article from June 2012 on the Treteknisk website[10] the production and import of modified wood accounted for 5-8% of the total consumption of durable wood in Norway.

Norway has seen an increasing interest in furfuryl alcohol modified wood (FM wood) in recent years. Norwegian company Kebony is the only manufacturer in the Nordic region, and has made a strong breakthrough via particular chains of builder's merchants. In 2010, Kebony produced around 10 000 m^3 FM wood and saw a doubling in sales[11]. The company has a production capacity of 25 000 m^3. FM wood has the same applications as thermally modified wood, but has a higher use class and is therefore particularly suitable for outdoor use, and can also be used in contact with water and the ground.

There are also several manufacturers of thermally modified wood in Norway (Granvin Bruk, Sørtre Bruk AS, Moelven Timber AS, BT Pall & Emballasje/Waba Europaller AS).

Market overview Denmark
Denmark has seen the market for thermally modified wood grow quite considerably in recent years. ThermoWood is sold in the construction market, primarily as cladding and decking, but also for outdoor furniture/play apparatus (sandboxes and children's furniture). Manufacturer Royal Træ has also developed a product comprising thermally modified wood that is then treated with linseed oil for greater protection.

Another relatively new impregnation method uses supercritical carbon dioxide as the carrier for small quantities of biocides with which the wood is impregnated. Hampen Træforarbejdning A/S in Jutland, Denmark, has one of the world's first facilities for impregnating spruce in this way, known as Superimpregnation, on a reasonably large scale.

Nordic Swan Ecolabel licences
The table below shows the licences held in the Nordic region as of June 2014.

[9] Gustav Åström, owner of Heatwood Hudiksvall, Peter Johnson, Product Manager at Moelven Wood, Johan Pal of Träcentrum Nässjö, Mangus Wålinder, Project Manager, SP Trätek EcoBuild
[10] http://www.trefokus.no/fullstory.aspx?m=329&amid=13078
[11] Interview with the licensee.

Table 1 Number of licences and registrations in the Nordic region as of April 2014

Manufacturer (country)	Products	Licence number
Moelven Danmark A/S (Denmark)	Finnforest ThermoWood (pine, for use above ground)	586 003
Royal Træ (Denmark)	Royal Termo Træ for outdoor use	586 006
Kebony AS (Norway)	Kebony Pine, Kebony Maple, Kebony SYP, Kebony Radiata	286 001
Oy Lunawood Ltd (Sweden)	Lunawood®	386 005
Accsys Technologies (Sweden)	Accoya Radiata Pine and Accoya Scots Pine	3086 0007
Moelven Wood AB (Sweden)	Thermowood (pine)	386 004

There are a total of 6 licences in the Nordic region, with three in Sweden, two in Denmark and one in Norway. One of the Swedish licences belongs to the Finnish manufacturer Oy Lunawood Ltd and is registered in Finland. The system of registering licences in the Nordic countries has now ceased, and in version 2 of the criteria there will only be Nordic licences.

Other labels

FSC/PEFC – raw material labelling

Certification bodies the Forest Stewardship Council (FSC) and PEFC (Promoting Sustainable Forest Management) are the biggest names in durable wood. The purpose of labelling the source material is to guarantee that the wood comes from sustainable forestry.

Environmental classification of construction and building materials

There are many different systems used in the Nordic region for the environmental classification of construction and building materials. Some of the best-known are LEED, BREEAM and DGNB. Many of these set material requirements or award points for eco-friendly materials.

The European Committee for Standardisation is also developing standards and tools for the assessment of a building's sustainability and environmental quality (CEN TC 350). The work is based on international standards for LCAs and environmental declarations, and also includes conditions related to the indoor environment and life cycle costs[12]. The purpose of the standardisation is to create general and horizontal standards for the assessment of a building's environmental performance over its life cycle[13].

Other assessment systems/labels

There are a number of national registration systems and environmental assessment systems for building products and building materials that are widely used in the market. Sweden has:

- BASTA Online, which involves self-registration and self-declaration, followed by random sample-based audits by an independent third party
- Sunda Hus, and
- Byggvarubedömningen, an environmental assessment/evaluation system for building materials that the manufacturers sign up to.

[12] Annual Report 2009, Byggvareindustriens Forening
[13] CEN/TC 350 Sustainability of Construction Works, European Committee for Standardisation

Norway has SINTEF Byggforsk Teknisk Godkjenning, which attests that a building product has been found fit for purpose in terms of quality and technical specifications. Since 2010, the system has also assessed whether the product contains substances on the Norwegian Priority List, or on the REACH Candidate List. Another system in Norway is ECOproduct, which is both a method for environmental assessment and a database of already assessed products. An environmental product declaration (EPD) forms the basis for assessment of a product.

There is no EU Ecolabel criteria document for durable wood.

Manufacturers of thermally modified wood often have ThermoWood, PEFC/FSC and/or ISO 9001 certification.

It is possible for the manufacturers to produce an environmental declaration for their products. Environmental product declarations (EPDs) do not set requirements for the products, but provide documentation of the product's environmental impact associated with production, use and disposal[14]. EPDs are based on the principles of the ISO standard for type III environmental declarations, ISO 14025, and on a life cycle analysis (LCA) of the product. In order to produce an EPD, Product Category Rules (PCR) must be drawn up, or in existence for the product category. The relevant PCR for durable wood is "NPCR 015 Solid wood products, 2009".

Legislation/standards
EU legislation has a steering effect in relation to durable wood. This relates primarily to REACH, the EU Biocidal Product Regulation (EU/528/2012), and the EU Timber Regulation (EU/995/2010). REACH requires manufacturers to register the chemical substances used in the products manufactured. If it is discovered that illegal timber has been imported into the European market, this can lead to sanctions such as fines, confiscation of material and professional bans.

3 About the criteria revision

Purpose of the criteria revision

The revision has had the following focus areas:

- The criteria are to be changed from being an environmental pioneer, which means a new product group for Nordic Ecolabelling with simplified requirements, to a regular product group.
- The product group definition is to be reviewed and consideration given to adding new products. In particular, there should be an assessment of whether composite products made from wood and plastic should be included. Biocide and fire retardant impregnated wood are generally not included in the criteria, but new products such as wood treated with supercritical CO_2 and small quantities of biocides are to be given initial consideration in the revision.

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

- Requirements concerning chemicals (residues and classification of constituent substances), durability (test systems included) and forest certification are to be assessed and updated where appropriate.
- There is to be an assessment of whether energy requirements/climate requirements could be introduced for the production process, with a focus on energy efficiency.
- Requirements concerning waste, quality and user instructions are to be reviewed.
- The background document is to make clearer what Nordic Ecolabelling brings in terms of sustainability and reduced chemical and energy consumption from a life cycle perspective.

About this criteria revision
The revision was conducted by the secretariats of Nordic Ecolabelling, and involved a complete evaluation of the criteria.

The revision began in autumn 2012. The revision was carried out as an internal project within Nordic Ecolabelling. As part of the revision process, stakeholders and licensees were contacted via physical meetings and telephone calls. Contact was also made with other experts in the field of durable wood in order to gather information. Available Life Cycle Analyses were studied and information was gathered from licensees and stakeholders.

4 Environmental impact and Nordic Swan Ecolabelling as an influential tool

Section 4.1 describes how Nordic Swan Ecolabelling is a targeted tool for reducing the environmental impact from the production and use of durable wood. The section also contains a description of the potential environmental impact of this product group.

4.1 Relevance, Potential and Steerability (RPS) through Nordic Ecolabelling

The Nordic Swan Ecolabel is a type I ecolabel that follows the standard ISO 14024 and must therefore ensure account is taken of the various relevant environmental impacts in the product's life cycle, and where there is potential for the manufacturers to reduce the environmental impact.

Based on a MECO analysis (Materials, Energy, Chemicals and Other, see Appendix 2), an RPS analysis has been performed that evaluates environmental impact relevance (R), improvement potential (P) and the possibility of introducing steerable criteria (S) for durable wood. The RPS analysis is used to assess the areas in which Nordic Ecolabelling is able to set different requirements.

Relevance
The MECO analysis and background information show that there is an environmental impact associated with the production and use of durable wood. This environmental impact is described in section 4.2. There is therefore a high relevance in setting environmental requirements for all the phases of the products' life cycle. The environmental impact is particularly great in the raw material phase and in the production and use phases.

Potential and Steerability

In terms of the choice of raw materials there is considerable potential for differentiating between wood raw material from poorly run forests and wood from forests managed in a more sustainable way. The manufacturers of durable wood also have extensive steerability over this and can ensure that they purchase sustainable wood. There is, however, low steerability concerning which type of wood the producers use, because the wood type is often critical for the quality of the end product.

In terms of energy used in drying the wood in the raw material phase, there is potential to reduce consumption, through heat recovery, energy optimisation and improved technology. The drying usually takes place at the premises of a supplier to the producers of durable wood, which are to a large degree reliant on special types of wood for their product. The opportunity for the manufacturers to influence the energy consumption of their suppliers is judged to be low, since the manufacturers of modified wood are relatively small customers of the wood suppliers, and may have difficulty convincing a wood supplier to invest in new systems/change energy supply. There is thus little steerability.

The potential to improve the efficiency of the manufacturers' treatment processes is also judged to be low. The technologies and production equipment are relatively new, and there are therefore reasons to believe that the energy efficiency of the processes is already as high as it can be. In addition, there are only a few manufacturers in the market within each of the treatment processes. The potential for a reduction in greenhouse gas emissions by switching to bio-based energy sources is judged to be moderate to high. Steerability is, however, likely to be low, since it would take major investments to switch to a different energy source, which could prove a financial challenge for the manufacturers.

The potential for using less toxic chemicals to treat durable wood, and for creating durable wood with a low need for maintenance, is considered to be high. Steerability in reducing the use of toxic chemicals is judged to be high in professional manufacturers of durable wood, which are also able to easily control work environment conditions at the factory. For wood where the end user must carry out much of the chemical application/ maintenance, steerability is considered to be lower.

The potential for environmental improvements in the waste phase is judged to be moderate to low. The difference between pressure impregnated wood and modified wood is that modified wood do not need any special waste treatment whereas copper impregnated wood cannot be incinerated in most common incinerators (small- or wood chip incinerators). This is because copper during incineration is functioning as a catalyst for the emission of chlorinated dioxins and furans. It is therefore important that the incineration is carried out in incinerators with adequate air purification.

In Norway and Sweden copper impregnated wood is transported to waste facilities and incinerated in special incinerators with such purposes. In Finland copper impregnated wood is still treated as hazardous waste and in Denmark it is collected and shipped to Germany for incineration (was previously disposed) Steerability over how Cu-impregnated and modified wood is treated at the waste facility is judged to be low. Reason is that it is difficult to differentiate between end-of-life CCA and other types of discarded wood and both are often treated as hazardous waste if there is doubt about whether CCA impregnated wood is present.

The environmental impact from transport varies much, and is determined by how far the wood has to travel to the production site. In some cases, there is thus high potential for reducing the impact from transport. Steerability is, however, often judged to be low, since the products, as mentioned before, are often dependent on a particular type of wood.

Summary

The MECO and RPS analyses show that it is relevant to set requirements in all phases of the life cycle: raw material extraction, production, use, disposal and transport. Potential and steerability, on the other hand, vary in terms of whether ecolabelling can make a significant difference within the various life cycle phases and environmental themes.

4.2 Environmental impact of durable wood

The environmental impact of durable wood relates primarily to the following:

- Wood raw material
- Chemicals used for impregnation/modification/treatment and maintenance
- Energy consumption and CO_2 emissions, mainly from the raw material and production phases, and transport
- Waste management for end-of-life products

Below is a brief description of the potential environmental impacts associated with the themes above. Readers are also directed to the MECO analysis in Appendix 2, which is a qualitative assessment of Materials, Energy, Chemicals and Other to show where in the life cycle of durable wood the environmental impact can be found.

Raw materials

Wood

Various species of wood are the main raw material for durable wood products. Potential problems when using wood are that it may come from protected areas, areas of disputed ownership or genetically modified trees. It is also important that the forest is managed in a sustainable way and that operations do not destroy natural forest, biodiversity, special ecosystems or social assets. Forestry also has an important role to play in combating climate change. However, that is on condition that the forest is managed sustainably[15]. Sustainable forestry is important in being able to continue using the resources of the forest over the long term. Greater demand for wood from forest areas that are run sustainably will reduce the pressure on vulnerable areas. This is important for all forest environments where wood is harvested. The availability of wood from certified forests is currently limited, but it is expected to increase in years to come.

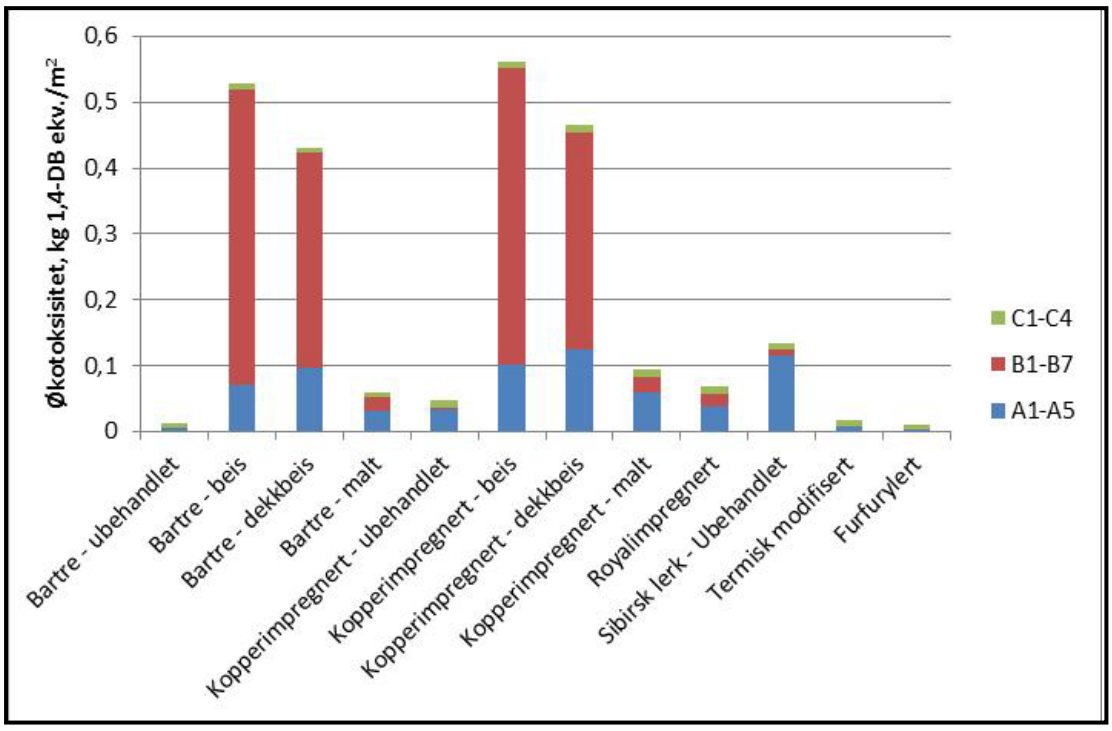
Another potential problem is that the wood raw material may come from the illegal felling of tropical timber. Tropical woods have many good properties and are therefore much sought after. Illegal felling of tropical timber is one of the greatest threats to the world's rainforests, which play a role in mitigating the effects of climate change. In addition, the rainforests are home to 50-80% of the planet's species and to 60 million people[16].

[15] PEFC Norway: www.pefcnorge.org (March 2014)
[16] Rainforest Foundation Norway: www.regnskog.no/no/om-regnskogene (March 2014)

Chemicals for impregnation/modification/treatment

The environmental impact of impregnated wood has primarily been associated with toxins that were/are used as impregnation agents. The most common agents that have been used over the years to impregnate wood are creosote, arsenic, copper, chromium, boron, tin and a number of organic substances (fungicides)[17]. One negative side-effect of using toxins for impregnation is that the substances often have adverse health and environmental properties that can affect humans and the environment during leaching over time. The greatest emissions from impregnated material derive from materials that are still in use[18].

Today, the most common impregnation agents are copper-based. The substances often also contain other active substances such as boric acid and/or organic biocides/fungicides. A leaching experiment from 2011 with Danish and Norwegian impregnated pine with Wolmanitt CX-8 showed that appr. 18% copper and boric acid was leached out[19]. Another study from 2010 estimated that between 8 to 15% copper and 30% boron was leached during a time period of 20 years[20].A study of wood facades conducted by SINTEF Byggforsk and others in 2013 shows major differences in the emissions of substances that are harmful to health and the environment, depending on which treatment methods are used to make the wood durable. Untreated solid wood naturally has the lowest emissions, but thermally modified wood and furfurylated wood also have low emissions. Copper and Royal impregnated wood has higher emissions. Whether or not the wood undergoes surface treatment in the use phase also has a major effect on the environmental impact, see figure 3.



[17] Danish Environmental Protection Agency: www.mst.dk (March 2014)
[18] Information from the Norwegian Pollution Control Authority's report "Vurdering av virkemidler for å redusere utslippene av kobber", December 2005.
[19] Kängsepp, K. et al. 2011. Leaching of commonly used impregneation agents affected by wood properties.
[20] Morsing et. Al, 2010.: "Comparison of laboratory and semi-field tests for the estimation of leaching rates from treated wood - part 1: above ground (UC 3). IRG/WP 10-50274.

Figure 3. Emissions of compounds that are toxic to aquatic and terrestrial organisms. The figure illustrates emissions related to the treatment method for wood facades. It is taken from the study "Miljøanalyse av trefasader" (Environmental analysis of wood facades) conducted in Norway as a collaboration between SINTEF Byggforsk, the Norwegian Institute of Wood Technology and the Norwegian Forest and Landscape Institute[21]. Phases A1-A5 include raw material extraction, production and installation of the cladding including transport. Phases B1-B7 include the use phase (emissions from the surface treatment and maintenance). Phases C1-C4 include demolition and waste management.

Energy consumption and CO_2 emissions

The greatest contributors to energy consumption and CO_2 emissions from durable wood and composites are extraction of raw materials (wood and plastic), processing of the raw materials, impregnation or modification of the wood and transport between the parts of the chain.

During processing of the wood in the raw material phase, drying accounts for the greatest energy consumption in the Nordic region, averaging out at around 1500 MJ/m^3 [22,23,24,25,26]. The climate impact is, however, low since the energy source in the Nordic region is based chiefly on renewable materials such as bark and wood chips. Extraction and transport usually account for around 10% of the energy consumption involved before finishing in the Nordic region. The environmental impact from transport can vary considerably depending on transport distance, while the climate impact may range from a few percent to around 20% of the total climate impact over the life cycle.

In the production phase there is a major difference in energy consumption for different treatment processes. Copper impregnated wood has a relatively low energy footprint since the technology does not usually use heat in the manufacturing process. Various EPDs suggest a very low energy consumption of 30-40 MJ/m^3 (large production volumes, figure uncertain) but there is also data for less efficient processes, where the energy consumption may be ten times greater (figure uncertain). Thermally modified wood tends to have somewhat higher energy consumption, around 500 MJ/m^3, compared with impregnated wood due to the need for high temperatures in the process (figure uncertain). Chemically modification using known technology such as furfurylation or acetylation have a much higher energy consumption compared with impregnated work and thermally modified wood. Energy consumption can be 4-5 times as high (figures uncertain, little data) compared with thermally modified wood.

The study of wood facades mentioned above shows that greenhouse gas emissions vary a great deal for different treatment methods. Maintenance (type of chemicals and frequency) also plays a substantial role in emissions of greenhouse gases, see figure 4.

[21] Plesser, Thale Sofie Wester et al., Miljøanalyse av trefasader, SINTEF Byggforsk, ISBN 978-82-536-1339-0, 2013
[22] Silje Wærp et al., Livsløpsanalyser av norske treprodukter, MIKADO, SINTEF Byggforsk, 2009. Norway.
[23] Jungmeier, G. et al, Allocation in Multi Product Systems – Recommendations for LCA of Wood-based Products
[24] Andersson, B-I, (1996) Environmental declaration for sawn timber, Trätek.
[25] Jarnehammar, A. (2000): LCA for multi-layer parquet flooring in Life Sys Wood. Trätek.
[26] Adebahr, 1995, Energy consumption for roof building related to 1 m³ structural timber

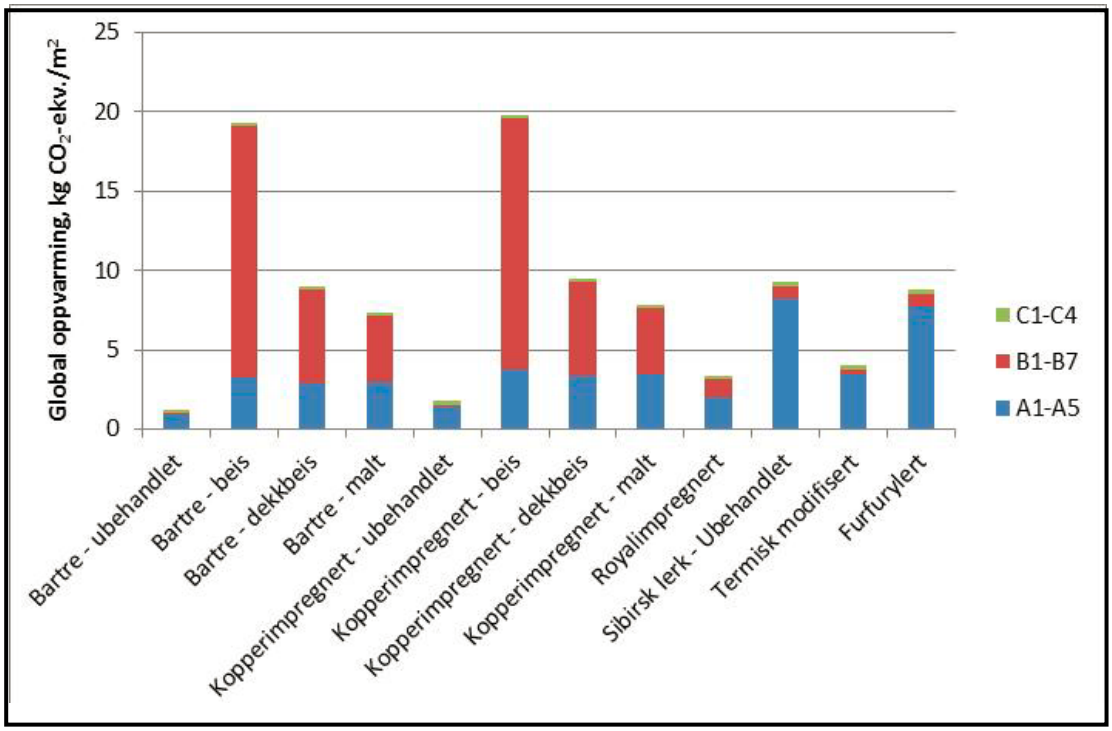


Figure 4. Emissions of greenhouse gases for each type of cladding. Total for the production, installation and use phases. The figures are from the report "Miljø-analyse av trefasader" (Environmental analysis of wood facades – SINTEF Byggforsk, the Norwegian Institute of Wood Technology and the Norwegian Forest and Landscape Institute)27. Phases A1-A5 include raw material extraction, production and installation of the cladding including transport. Phases B1-B7 include the use phase (emissions from the surface treatment and maintenance). Phases C1-C4 include demolition and waste management. According to the report, the results for Royal impregnated wood are too low, since energy use during impregnation with oil is not taken into account due to lack of data.

Waste management for end-of-life products

The environmental aspects of the waste phase are primarily associated with the necessary treatment of end-of-life wood due to the chemical substances in the wood. In addition, the possibility of recycling the materials is an important aspect.

New copper impregnated wood must not be incinerated in most common incinerators (small- or wood chip incinerators) as copper during incineration is functioning as a catalyst for the emission of chlorinated dioxins and furans. It is therefore important that the incineration is carried out in incinerators with adequate air purification. According to the Norwegian Directorate for Environment[28] this means probably in praxis that waste incinerators are suitable and not any wood chip incinerator. In the website of "Treteknisk" the following is stated: In order not to spread the copper still existing in wood during waste phase, it is important that the waste is correctly taken care of and not incinerated privately as nearly 90% of the copper will end up concentrated in the ash[29]. In Finland

[27] Plesser, Thale Sofie Wester et al., Miljøanalyse av trefasader, SINTEF Byggforsk, ISBN 978-82-536-1339-0, 2013
[28] Consulation comment from the Norwegian Directorate for Environment "Miljødirektoratet", September 2014
[29] http://www.trefokus.no/fullstory.aspx?m=329&amid=13078

the impregnated wood is delivered to special receiving units at waste centres or at wood dealers.[30]

It is treated after collection as hazardous waste and incinerated at waste plant for hazardous waste. In Denmark pressure impregnated wood is collected and sent to Germany for incineration. In Sweden and Norway copper impregnated wood is incinerated in plants with good purification suitable for such purposes. Unfortunately, it can be difficult to tell the difference between copper impregnated wood and older types of wood dangerous to burn (CCA-treated timber is hazardous waste requiring permits to burn in waste incinerators). In practice therefore, much copper impregnated waste (cutting, demolition wood, etc.) is also treated as hazardous waste. The same issue may apply to the modified wood.

Modified wood does not create problems or require special handling during the waste phase which theoretically provides it an environmental benefit compared to copper impregnated wood. Combustion tests of durable wood show that wood behaves as normal untreated wood during incineration. Flue gas studies show that emissions of some components are actually less when burning for instance furfurylated wood than untreated wood.

5 Background for the requirements

This section presents proposals for new and revised requirements, and explains the background to the requirements, the chosen requirement level and any changes since version 1. The appendices that are referred to in the proposed requirements are included in the criteria document "Durable/resistant wood for outdoor use".

5.1 Description of the product

O1 Description of the product

Applicants must provide the following information about the product:

- Trade name/brand
- A description of the product/products and all the materials involved
- A description of production methods/treatment techniques. Suppliers must be described with the name of their business, production site, contact person and the production steps carried out

✉ Detailed description of the points above. Product data sheets can be sent in as part of the documentation. Use a flowchart to describe the production process.

Background

The requirement specifies more points than before to clarify what must be included in the product description. The intention is to give a general, clear picture of which raw materials and production processes that are used. The information is important in obtaining a good overview and ensuring efficient evaluation of applications. A description of any suppliers is also important in achieving a true and complete picture. A description of the chemicals used shall be given in the next requirement, O2.

[30] http://www.tukes.fi/en/For-Consumers/Home-and-home-technology/How-to-use-and-dispose-of-impregnated-wood/Waste-management-of-impregnated-and-painted-wood-/

5.2 Chemical requirements

What do the chemical requirements cover?
The chemical requirements cover all chemical products used for impregnation, modification or other treatment of the wood.. The requirements apply to the chemicals used by the manufacturer and those used by any supplier.

What is considered to be a constituent substance?
This definition applies for all the chemical requirements:

The term constituent substance refers to all substances in the chemical product, including additives in the ingredients (such as preservatives and stabilisers) but does not include impurities from primary production. Impurities are defined as residual products from the ingredient production that can be found in the final product in concentrations below 100 ppm (0.01% by weight, 100 mg/kg), but not substances added to an ingredient or product deliberately and with a purpose, regardless of amount. Impurities of over 1% concentration in the primary product are, however, regarded as constituent substances. Substances known to be degradation products of the constituent substances are also themselves considered to be constituent substances.

O2 Chemicals used

All chemicals used for impregnation/modification/treatment of the wood are to be stated.

✉ Safety data sheets and formulations for the chemicals used to impregnate, modify or treat the wood.

Background
The requirement remains unchanged from the previous version. The intention of the requirement is to obtain a complete overview of all the chemicals used in order to evaluate these against the chemical requirements in this section. A ban on the use of biocides and other stringent restrictions concerning the properties of the chemicals establish strong limits on the chemicals that may be used.

O3 Biocides

Biocides are not to be used in the impregnation, modification or treatment of wood. In this context, biocides are defined as chemical substances used in the wood to combat vermins, insects, bacteria, fungi and so on, as governed by the Biocidal Products Regulation (EU) No 528/2012.

✉ Declaration that biocides are not used. If no chemicals are used, this must be stated in the process description (see O1).

Background
The ban on the use of biocides is one of the core requirements of the criteria. A biocide product contains one or more active substances that enable the product to be used to destroy, neutralise or in some other way prevent the effects of harmful organisms. Many biocide products have properties that are harmful to health and the environment, since it is the toxicity of the products that provides the desired effect on the harmful organisms such as fungi, insects or pests[31]. By switching to modified wood without the addition of heavy metals or other biocides, environmental gains can be achieved through reduced use

[31] www.miljodirektoratet.no/no/Tema/Kjemikalier/Kjemikalieregelverk/Biocider/ (March 2014)

and emissions of substances that are harmful to health and the environment. These are the main reasons why Nordic Ecolabelling does not permit the use of biocides in Nordic Swan Ecolabelling durable wood.

The criteria have been drawn up to promote other treatments that achieve the equivalent durability in wood as when impregnating with biocides, but where that durability is due to the wood being modified. In alternative treatments such as chemical or thermal modification, the chemical composition of the cell walls in the wood is changed, and during modification that involves impregnation (without biocides), chemicals are used that polymerise in the wood[32]. All these alternative technologies change the wood so that it does not swell or suffer attacks by insects, fungi, etc., and the wood therefore does not need to contain an active biocide in order to desired durability and use class.

The requirement has been updated to account for the current European regulations. Biocides were previously governed by EU Directive 98/8/EC. In summer 2012, a new Biocidal Products Regulation was adopted in the EU (528/2012/EU), which now applies in the Nordic countries.

O4 Classification of chemical products

Chemical products used in the impregnation, modification or treatment of wood must not be classified according to the table below.

Classification under CLP Regulation (EC) No 1272/2008	
Hazard class and category	**Hazard phrases**
Toxic to aquatic organisms Category acute 1 Category chronic 1-2	H400, H410, H411, H412
Acute toxicity Category 1-3	H300, H310, H330, H301, H311, H331
Specific target organ toxicity (STOT) with single and repeated exposure STOT SE category 1-2 STOT RE category 1-2	H370, H371, H372, H373
Carcinogenic Carc 1A/1B/2	H350, H350i or H351
Mutagenic Mut 1A/B/2	H340, H341
Toxic for reproduction Repr 1A/1B/2	H360, H361, H362

Exempted are products with the classifications:

- H301, H330, H311, H351 and H373 due to the presence of furfuryl alcohol (CAS 98-00-0)
- H372 and H373 due to the presence of maleic acid anhydride (CAS 108-31-6)
- H330 due to the presence of acetic acid anhydride (CAS 108-24-7).

Such products may be used on condition that the requirements in O9 and O10 are fulfilled.

✉ Declaration from the manufacturer/supplier of the chemical product, see Appendix 2.

[32] Hill, C.A.S.: "The potential for the use of modified wood products in the build environment", Proceedings of the 11th International Conference on Non-conventional Materials and Technologies (NOCMAT 2009) 6-9 September 2009, Bath, UK. Available from: http://opus.bath.ac.uk/16170/1/papers/Paper%2080.pdf (06 November 2011)

☒ Safety data sheet in line with prevailing legislation in the country of application, e.g. Annex II to REACH (Regulation 1907/2006/EC) for all chemical products.

Background

The requirement has been updated in line with official regulations and has also been tightened/expanded to include prohibition of the following classifications:

- Toxic to aquatic organisms, category acute 1 and category chronic 1-2
- Acute toxicity, category 1-3
- Specific target organ toxicity (STOT) with single and repeated exposure, STOT SE category 1-2 and STOT RE category 1-2

The previous requirement set stringent requirements regarding health classification and these continue to form part of the requirement. The aim of these requirements is to ensure that the chemicals used do not entail serious health problems. The requirement has now been expanded to include stringent requirements concerning classification of environmentally harmful effects. In addition, the hazard classes and categories are primarily described in relation to the CLP Regulation (EC) No 1272/2008 (only hazard class and risk phrases are given under the EU Dangerous Substances Directive 67/548/EEC, which expires on 1 June 2015).

Nordic Ecolabelling works to ensure that the health and environmental effects of the chemical products are as few as possible. This is the reason why the requirement has now been expanded to include classification related to environmental harm. It has not been shown that chemical products with this type of classification are necessarily used in durable wood, but it is desirable to exclude them from use to cover any new products that may come onto the market.

The requirement applies to all chemicals used for the impregnation, modification or other treatment of wood, from the wood is modified/treated until the product is ready for sale to the consumer.

Since March 2009, there has been an exemption from the carcinogenic requirement for furfuryl alcohol, which at the time was classified as R40 (may cause cancer) – under the CLP Regulation this equates to the classification Carc 2, H351. The exemption only applies if the requirements concerning workplace limits (O9) and chemical residues in the product (O10) are fulfilled. The starting point in this context is that the use of chemicals classified as "may cause cancer" is undesirable. In the case of chemically modified wood (furfurylation), the furfuryl alcohol is polymerised during hardening after penetrating the wood. Furfurylated wood is therefore generally judged to be a more eco-friendly alternative than ordinary impregnated wood, which uses copper or other biocides that leach out during use. A more in-depth explanation of the exemption is given in the background to version 1.

In version 2.0 exemptions are given for classification H330 (acute toxic, category 2) using acetic acid anhydride (CAS 108-24-7). The exemption applies only if the requirements for workplace exposure limit (O9) and residues of acetic acid anhydride in the product (O10) are fulfilled. The exceptions were necessary after the requirement in version 2 was expanded with several more classifications. Acetic acid anhydride is a very important

reagent, used for acetylation, and also for instance of cellulose to cellulose acetate (synthetic silk industry)[33].

It is also the modifying chemical used in acetylation of wood. The process is shortly described here: the acetic acid anhydride reacts with hydroxyl groups on the lignin and hemicellulose at 120-130 oC. Acetylation contributes to chemical modification of the cell walls of the timber, which provides increased biological durability, hardness and dimensional stability[34]. The classification of H330 acetic acid anhydride is primarily an occupational health problem and it is therefore essential that the chemical product is not inhaled as it is very harmful. Good HSE-procedures must be followed when using the material.

Due to new classifications for two chemicals used in the process of the chemical modification of wood the Nordic Criteria Management Group decided on 4 May to complete requirement O4 with more exemptions. Since earlier an exemption was valid for furfuryl alcohol Suspected of causing cancer (Carc 2, H351). Since Nordic Ecolabelling wish to continue accept furfurylation as a method to chemically modify wood to durability against decay, the new classifications regarding the substance Acute toxicity and Specific target organ toxicity must be accepted.

In addition an exemption must med made for maleic acid anhydride with the classification Specific target organ toxicity (STOT RE 1-2). In the process maleic acid anhydride are mixed with water, reacts and forms maleic acid which has no classification in conflict with the requirement O4.

Nordic Ecolabelling stress that the cause of the exemptions is new classifications due to the global system CLP and not because of the chemicals having a different health- and environmental hazard or a different concentration. Nordic Ecolabelling also stress that furfuryl alcohol and maleic acid are process chemicals with the purpose of altering the structure of the wood and will not remain in the wood.

At the same time the former chemical legislation is withdrawn and only CLP remains in the requirement.

O5 CMR substances

The chemical products used in the impregnation, modification or treatment of wood must not contain chemical substances that are classified as carcinogenic (Carc), mutagenic (Mut) or toxic for reproduction (Rep), according to CLP Regulation (No) 1272/2008 as amended, see table below.

Classification under CLP Regulation (EC) No 1272/2008	
Hazard class and category	**Hazard phrases**
Carcinogenic* Category Carc 1A/1B/2	H350, H350i or H351
Mutagenic Mut 1A/B/2	H340, H341
Toxic for reproduction Repr 1A/1B/2	H360, H361, H362

[33] The Big Norwegian Lexicon (Store norske leksikon)
[34] SINTEF, Miljøanalyse av trefasader, 2013

** There is an exemption for products where the classification Carc 2 H351 is due to the presence of furfuryl alcohol (CAS 98-00-0). The substance may be used on condition that the requirements in O9 and O10 are fulfilled.*

✉ Declaration from the manufacturer/supplier of the chemical product, see Appendix 3. In addition, safety data sheet in line with prevailing legislation in the country of application, e.g. Annex II to REACH (Regulation 1907/2006/EC) for all chemical products.

Background

The requirement is new to the criteria for Durable wood. The requirement is harmonised with equivalent requirements in other criteria for Nordic Swan Ecolabelling, such as those pertaining to Chemical building products.

Alongside requirement O4 – Classification of chemical products, this requirement prohibits chemical substances classified as CMR from being included in any chemical products used. Substances that may cause cancer, change genetic material or interfere with reproduction (known as CMR substances in categories 1A and 1B) are prioritised substances within the EU's chemical legislation due to their inherently dangerous properties. It is therefore of central importance to considerably reduce, and in the long term move away entirely from, the use of CMR substances. It is not permitted to use CMR substances in chemical products that are accessible to consumers[35], but they do occur in other goods. The most common applications at this time are in fuels, soft plastics, rubber tyres, paints and pressure impregnated wood.

An exemption is made for furfuryl alcohol, classified as R40 (may cause cancer) in 2009 – under the CLP Regulation this equates to the classification Carc 2, H351. The exemption only applies if the requirements concerning workplace limits (O9) and chemical residues in the product (O10) are fulfilled. See also the background to O4.

O6 Other substances excluded from use

The following substances must not be present in the chemicals and chemical products used in the production of durable wood.

- Substances on the Candidate List*
- Substances that the EU judges to be PBT (persistent, bioaccumulative and toxic substances) and vPvB substances (very persistent and very bioaccumulative) in accordance with the criteria in Annex XIII of REACH**
- Substances considered to be potential endocrine disruptors in category 1 or 2 on the EU's priority list of substances that are to be investigated further for endocrine disruptive effects. See following link: http://ec.europa.eu/environment/chemicals/endocrine/strategy/being_en.htm
- APEO – alkylphenol ethoxylates and alkylphenol derivatives (substances that release alkylphenols on degradation)
- Halogenated organic compounds***
- The following heavy metals or heavy metal compounds must not be present in the products: lead, cadmium, chromium VI, mercury and arsenic

** The Candidate List can be found on the ECHA website: http://echa.europa.eu/sv/candidate-list-table*

[35] Information from: http://www.regjeringen.no/nb/sub/europaportalen/eos/eos-notatbasen/notatene/2005/okt/begrensningsdirektivet---cmr.html?id=523623

*** PBT and vPvB substances are defined in Annex XIII of REACH (Regulation (EC) No 1907/2006). Substances that meet, or substances that form substances that meet, the PBT or vPvB criteria are listed at http://esis.jrc.ec.europa.eu/index.php?PGM=pbt. Substances that are "deferred" or substances "under evaluation" are not considered to have PBT or vPvB properties.*

**** Paint pigments that meet the EU's requirements concerning colourants in food packaging under point 2.5 of Resolution AP (89) are exempted.*

✉ Declaration from the manufacturer/supplier of the chemical product, see Appendix 3. In addition, safety data sheet in line with prevailing legislation in the country of application, e.g. Annex II to REACH (Regulation 1907/2006/EC) for all chemical products.

Background

The requirement is new to the criteria for Durable wood, but is included in many other Nordic Ecolabelling criteria where relevant. The purpose of the requirement is to contribute to the phasing out of the substances due to their problematic properties as regards health and the environment. They are therefore excluded from use in the Nordic Swan Ecolabelling of durable wood. Appendix 6 describes the environmental aspects associated with the substances excluded from use by the requirement. The requirement covers all chemical products used at the factory/place of manufacture or by any supplier.

O7 Nanoparticles

Nanoparticles (from nanomaterial*) must not occur in chemical products or in the finished product. The following are exempt from the requirement:

- Pigments**
- Naturally occurring inorganic fillers***
- Polymer dispersions

** The definition of nanomaterials follows the European Commission's definition from 18 October 2011 (2011/696/EU): "A nanomaterial is 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 50% of the particles in the number size distribution, one or more external dimensions is in the size range 1–100 nm."*
*** nano-titanium dioxide is not considered a pigment, and is thus not covered by the requirement.*
**** this applies to fillers covered by Annex V point 7 in REACH.*

✉ The manufacturer must declare any nanomaterials that occur in the product.

✉ Declaration in line with Appendix 3 from the manufacturer of the durable wood and the manufacturer of each raw material.

Background

The requirement is new to the criteria for Durable wood. The requirement was recently drawn up and introduced in version 4 of the criteria for Windows and exterior doors and version 2 of the criteria for Chemical building products.

Nanoparticles are increasingly used in a number of consumer products to provide new and improved product properties. However, there remains a great deal of uncertainty about how nanoparticles affect human health and the environment[36]. Nanoparticles may pose an unforeseen risk to health and the environment. The particles can reach parts of the body and the environment that are otherwise protected and their minute size may result in increased reactivity as small structures have a far larger available surface area

[36] European Council, Recommendation 2017 (2013), Provisional version, Nanotechnology: balancing benefits and risks to public health and the environment Available online: http://assembly.coe.int/ASP/Doc/XrefViewPDF.asp?FileID=19730&Language=EN (21 May 2013)

relative to larger ones. Research into the risk associated with nanomaterials has focused on health impacts and some cases of damage have been recorded. This does not mean that all nanoparticles 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. Based on the precautionary principle, Nordic Ecolabelling wishes to adopt a restrictive stance on the use of nanoparticles, and thus proposes that nanomaterials are restricted in chemical products. The definition of nanomaterials in the requirement follows the European Commission's definition of nanoparticles[37].

EU´s definition is based solely on particle size and not particles potential danger or risk. An aggregate in the EU definition is "a particle comprising of strongly bound or fused particles". These aggregates are moreover incorporated in a solid material.

For a full explanation of the requirement, see the justification and requirement O11 in version 2 of the background document for the product group Chemical building products (available on the Nordic Ecolabelling websites).

Consequences of the requirement
The requirement means that nanomaterials produced with the intention of containing nanoparticles must not be used. Examples of such nanoparticles are fullerenes, carbon nanotubes, nanosilver, nanogold and nanocopper. Traditional fillers are, however, permitted. Pigments are exempted from the requirement, such that TiO_2 may be used in pigment form.

The possibility to exempt amorphous silica (colloidal silica) from the nano-requirement is removed in this product group. The substance is inter alia used in surface treatment products to increase performance of scratch resistance and hardness. As the criteria document for Durable wood version 2.0 no longer permits surface treatment of the finished wood product, (see justification for this above in Chapter 2, "Basic facts about the criteria" and "Products that cannot be Nordic Swan Ecolabelled") and as Nordic Ecolabelling strives to pursue a precautionary principle in areas where knowledge of environmental and health effects remain low, the exemption is not considered to be justified.

It can be difficult to find out the particle size of inorganic fillers from raw material suppliers. Naturally occurring inorganic fillers such as chalk, marble, dolomite and lime are exempted from registration under Annex V, point 7 of REACH, as long as these fillers are only physically processed (ground, sifted and so on) and not chemically modified. They are also exempted from registration in the Danish Environmental Protection Agency's draft Regulation on a register of blends and goods that contain nanomaterial and the duty of producers and importers to update the register[38].

In REACH directive (1907/2006/EC[39]) it is stated in article 2, point 2, point 7b:
"The following shall be exempted from Titles II, V and VI":
(Title II relates to registration of substances, Title V relates to downstream user and Title VI relates to evaluation)

[37] COMMISSION RECOMMENDATION of 18 October 2011 on the definition of nanomaterial (2011/696/EU)
[38] Link to the Danish Environmental Protection Agency hearing: http://hoeringsportalen.dk/Hearing/Details/16910 (visited 20 January 2014)
[39] Link to the REACH Regulation: http://eur-lex.europa.eu/LexUriServ/site/en/oj/2006/l_396/l_39620061230en00010849.pdf

(b) substances covered by Annex V, as registration is deemed inappropriate or unnecessary for these substances and their exemption from these Titles does not prejudice the objectives of this Regulation;"

Annex V Exemptions from the obligation to register in accordance with article 2(7)(b): "The following substances which occur in nature, if they are not chemically modified. Minerals, ores, ore concentrates, cement clinker, natural gas, liquefied petroleum gas, natural gas condensate, process gases and components thereof, crude oil, coal, coke."

After the public consultation period an exemption has been added for inorganic fillers as long as they are covered by appendix V, point 7 in REACH.

Polymer dispersions are also exempted from the requirement after the public consultation period. The European Commission's report[40] to accompany the second "Regulatory Review on Nanomaterials" from 2012[41] states that solid nanomaterials in the dispersant in a liquid phase (colloid) are to be considered nanomaterials in accordance with the European Commission's recommendation. Nano emulsions are however not covered by the definition. Polymers/monomers may occur in different phases and sizes, and it is therefore chosen to explicitly state that polymers are exempted from the definition.

O8 Volatile organic compounds (VOC)

The chemicals used for the impregnation, modification or other treatment of wood must contain no more than 5% by weight volatile organic compounds (VOC).

The aromatic content of the solvent must be no more than 5% by weight.

Volatile organic compounds (VOC) are defined as any organic compound with a boiling point < 250°C at 101.3 kPa (1 atm).

Any solvents that polymerise in the wood may be used if the degree of polymerisation is at least 95%.

✉ Overview of the organic solvents included in the chemicals, stating the boiling point and aromatic content.

If there is any polymerisation of solvent in the wood, submit a report documenting that the degree of polymerisation is at least 95%.

Background

The requirement has been amended and updated to include definitions and wording that reflect similar requirements in other product groups for Nordic Swan Ecolabelling. One of the reasons for setting requirements concerning volatile organic compounds (VOC) is Nordic Ecolabelling's goal of reducing ground level ozone formation. Some organic solvents also contribute to the greenhouse effect and some to the breakdown of the ozone layer[42]. The capacity for solvents to dissolve other substances and their volatility make then extremely useful, but they can also be highly harmful to health and can create a health issue in the workplace. Solvents that evaporate pollute the air that is inhaled and

[40] European Commission, COMMISSION STAFF WORKING PAPER, Types and uses of nanomaterials, including safety aspects, Accompanying the [..] second regulatory review of nanomaterials, SWD(2012) 288 final
[41] Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee, Second Regulatory Review on Nanomaterials, COM(2012) 572 final
Website of DaNa: http://nanopartikel.info/cms
[42] Miljøvejledninger Ordbog, 2009: Section on organic solvents in the glossary at Miljøvejledninger.dk, which can be found at http://www.miljoevejledninger.dk/ordbog/uddybendeforklaringer/o/organiskeoploslashsningsmidler.

are then carried onward from the lungs and the blood. They can cause dizziness, headaches and lasting damage to the nervous system.

O9 Occupational exposure limit

During the production of Nordic Swan Ecolabelled durable wood, air pollution in the production premises must not exceed a limit value of 1 ppm for furfuryl alcohol (CAS 98-00-0) or 0,6 ppm for acetic acid anhydride (CAS 108-24-7)

The limit value of 1 ppm (furfuryl alcohol) or 0,6 ppm (acetic acid anhydride) states the highest acceptable limit value over an eight hour shift, and may be exceeded by a maximum of 200% for periods of 15 minutes.

The classification shall be according to the CLP Regulation (No) 1272/2008 with subsequent amendments and adaptations.

Sampling and analysis methods must comply with the instructions given for national measurements in the administrative standards issued by the authorities. The analysis laboratory/test institute must fulfil the general requirements for analysis laboratories, see Appendix 1.

✉ Test results from measurements showing compliance with the limit value.

Background

Furfuryl alcohol is a chemical extracted from vegetable by-products such as bagasse from sugar cane production. Furfuryl alcohol is included in moulding sand for making cast iron and in anti-corrosion products and paint removers, plus it reduces the viscosity of epoxy resin[43].

Furfuryl alcohol is also used as a flavouring in food, and WHO has set an acceptable daily intake level of 0.5 mg/kg body weight per day[44].

The requirement was first introduced in version 1.3 of the criteria and remains unchanged. Furfuryl alcohol, classified as Carc 2 H351, may be used on condition that the production fulfils this requirement (O9) concerning workplace limits and the requirement on chemical residues in the product (see O10 below). The workplace limit is set at 1 ppm in the workplace atmosphere during the production of Nordic Swan Ecolabelled durable wood. This is half the limit value in Finland, which is the strictest in the Nordic region. The limit value states the highest acceptable limit value over an eight hour shift, and may be exceeded by a maximum of 200% for periods of 15 minutes. The odour limit for furfuryl alcohol is 8 ppm.

For furfuryl alcohol, the authorities in Sweden, Denmark and Norway have set an official limit for pollution in the workplace atmosphere of 5 ppm. In Finland the official limit is 2 ppm. This means that the highest acceptable average concentration of air pollutants over an eight hour shift is 2 ppm in Finland and 5 ppm in the other countries. The limit standard may be exceeded for a short time if the concentration is otherwise kept so low that the average concentration for the whole eight hour period falls below the official limit. The scale and duration of the acceptable exceedances must be judged in relation to the other environmental factors in the workplace (noise, heat and so on). The Norwegian Labour Inspection Authority gives the following rule of thumb for the scale of

[43] International Furan Chemicals. A marketing organisation in the field of furfural and furfuryl alcohol worldwide, based in the Netherlands. Available from: http://www.furan.com/furfuryl_alcohol_applications.html (25 January 2009)
[44] Evaluation of Certain Food Additives and Contaminates. WHO Technical Report Series, 901, 2001. Available from: http://whqlibdoc.who.int/trs/WHO_TRS_901.pdf (25 January 2009)

acceptable exceedances over periods of up to 15 minutes. (This is on condition that the average concentration for the eight hour shift is kept below the official limit):

- 200% of the limit for limits of less than or equal to 1 ppm
- 100% of the limit for limits of 1 to 10 ppm
- 50% of the limit for limits of 11 to 100 ppm
- 25% of the limit for limits of 101 to 1000 ppm

Nordic Ecolabelling has chosen to use the Norwegian authority's rule of thumb, allowing the limit value to be exceeded by 200% (i.e. 2 ppm) for periods of 15 minutes.

The requirement concerning furfuryl alcohol remains unchanged, since the level has proven to be strict but appropriate. Occupational hygiene measurements have shown that the requirement can be achieved, but the industry will have to implement measures to come in below the requirement level. The requirement has therefore not been tightened during this revision.

A limit value of 0.6 ppm has also been added for acetic acid anhydride based on the exemption from the classification H330 in requirement O4. The limit value has been added to requirement O9 in order to secure a safe working environment or workplace conditions while using the chemical product. It is assessed that risks associated with the classification H330 (Fatal if inhaled) is a working environment aspect. This must be handled by the manufacturers via regulatory requirements handling hazardous substances. The limit value of 0.6 ppm in requirement O9 is set 8 times lower than the Norwegian occupational exposure limit value which is 5 ppm[45]. In Sweden there is no occupational exposure limit value norm for acetic anhydride.

O10 Chemical residues in the product

The product can contain a maximum of 0.2% by weight of furfuryl alcohol (CAS 98-00-0) or maximum of 0.1% by weight of acetic acid anhydride (CAS 108-24-7). The amount is to be calculated in relation to wood is pre-dried.

The analysis laboratory/test institute must fulfil the general requirements for analysis laboratories, see Appendix 1.

✉ Test report showing that the average values fulfil the requirement.

Background

This is the second requirement that must be fulfilled in order for furfuryl alcohol to be exempted from the ban on CMR substances. Under the requirement, the finished modified wood may contain a maximum of 0.2% furfuryl alcohol by weight. The amount is to be calculated in relation to wood that has been pre-dried. The intention of the requirement is that residues of a substance classified as Carc 2 H351 will not leach out during use of the modified wood, or that they will leach out in such small quantities that they do not constitute a risk to health or the environment. A previous leaching test has shown that moisture from brand new furfurylated wood is more toxic to algae and crustaceans than untreated wood, but that moisture from wood that was furfurylated 1 year earlier showed no difference compared with untreated wood. It could not be ruled out that the toxicity was due to the low pH of the moisture that leached out.

[45] Guidance on Administrative norms for pollution of the working atmosphere, Directorate of Labour Inspection (Norway) 15th Edition, December 2011.

Furfuryl alcohol is readily soluble in water, and according to the industry organisation's data sheet, it is assumed to be readily degradable in water, and not bioaccumulative[46]. Bioaccumulative potential is measured as log(oil/water) = 0.28. The degradation products are less toxic than the furfuryl alcohol itself.

Test results have shown that the requirement concerning furfuryl alcohol can be achieved, but the industry will have to implement measures to come in below the requirement level. The requirement has therefore not been tightened during this revision.

There has also been introduced a limit of 0.1% by weight of acetic acid anhydride in the final product due to the exemption for classification H330 in O4. When using acetic anhydride in the acetylation process acetic acid is formed as a by-product. When the reaction / acetylation is complete, the acetic acid anhydride and the acetic acid are extracted from the wood product[47]. Although an extraction is carried out in the process, a limit value for eventual residual content of acetic anhydride in the end product is required. The limit value is set to <0.1% by weight as acetic acid anhydride is exempted from the hazard statement of H330 in requirement O4.

5.3 Sustainable forestry

Introduction to forest requirements

Nordic Ecolabelling wants to contribute to sustainable forestry (ecologically, economically and socially). From a life cycle perspective, forestry is a key part of the wood product's environmental impact, and it is important that the renewable raw material is grown/used in a sustainable way.

Sustainably managed forests deliver a wealth of benefits for society, beyond the wood for materials and energy. The forests slow global warming by capturing and storing CO_2, they provide daily necessities for local communities and indigenous peoples, ensure biodiversity (wild animals and plants), protect water and soil from pollution and erosion, and so on. Preservation or improvement of these forest characteristic are all elements in sustainable forest management, and Nordic Ecolabelling wish to promoted this by setting requirement to sustainable wood.

It is also often environmentally beneficial and a good climate strategy to promote the use of wood from sustainably managed forests, rather than using other less environmentally and CO_2 intensive materials such as steel, aluminium or concrete.

Using wood from sustainably managed forests will also create the incentive to preserve and continue to develop forests in a sustainable manner for the benefit of future generations. Sustainable management may also imply that parts of the areas is being protected against interference. The alternative, as seen in many places and frequently in tropical areas, may be that forests are cleared for other uses. This could be mining or various forms of agriculture such as cattle grazing or cultivation of soy, corn, palm oil, sugar cane, coffee or cocoa, etc.

[46] ATP to the CLP Regulation (the EU's new regulation on the classification of chemicals). Amendment to EU Directive 67/548/EEC of 15 January 2009 (2009/2/EC). Available at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:011:0006:0082:EN:PDF (25 January 2009)
[47] Consultation comment from Accsys Technologies (2014)

Forests can also be gradually impoverished, if the exploitation is not sustainable, e.g. if the amount of timber persistently harvested exceeds the annual growth. It can lead to increased CO_2 emissions that increase global warming, and may also harm the forest's biodiversity.

Non-sustainable forest management may also consist of a breach of terms regarding forest workers, small communities, or indigenous people who live in dependence on forests. Using wood that is not documentable sustainable, may risk stimulating such effects.

Therefore, Nordic Ecolabelling requires that wood raw materials used in Nordic Swan Ecolabelled products have to come from sustainable forestry through requirements to traceability and certification. Nordic Ecolabelling has not developed its own requirements for sustainable forestry but has instead opted to require that wood material must comply with existing forestry and certification standards. Nordic Ecolabelling also wants to prevent the use of endangered tree species and tree species from vulnerable areas. Nordic Ecolabelling has prepared a list of tree species, which is not permitted to be use in Nordic Swan Ecolabelled products.

Scope

Since 4 May 2016, the chapter requirements O11 and O13 consist of two sets of requirements in the following way:

- Requirements marked A are the forestry requirements that were introduced in the criteria for Durable/resistant wood for outdoor use in conjunction with the establishment of criteria document version 2.0 on 25 February 2015.
- Requirements marked B are the (new) forestry requirements that were established by the Nordic Ecolabelling Board in 14 June 2016.

Licence applicants can choose to fulfill and verify either requirements marked A or requirements marked B. It is not possible to mix between the two sets of requirements.

The chapter also comprise of requirement O12 which is valid regardless of which set of requirements (A or B) that has been fulfilled.

O11 Origin

A) Origin and traceability of the wood

The requirement applies to both certified and uncertified wood. The licensee must:

1. Demonstrate traceability for all wood raw material. State the name (in Latin and in a Nordic language) and geographic origin (country/state and region/province) of the types of wood used.
2. Have a written procedure for sustainable wood raw material supply. The wood 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
   - Genetically modified trees or plants

Furthermore, forestry operations must not damage:

- Natural wood land, biodiversity, special ecosystems or important ecological functions
- Social and/or cultural preservation values

Nordic Ecolabelling may require further documentation if there is any uncertainty surrounding the origin of the raw material.

☒ Name (in Latin and in English) and geographic origin (country/state and region/province) of the kinds of wood used. Appendix 4a can be used.

☒ The manufacturer of the durable wood must have a written procedure for sustainable wood raw material supply. The procedure shall include up-to-date lists of all suppliers of wood raw material.

B) Prohibited or restricted tree species

Nordic Ecolabelling's list of prohibited and restricted tree species* consist of virgin tree species listed on:

a) CITES (Appendices I, II and III)
b) IUCN red list, categorized as CR, EN and VU
c) Rainforest Foundation Norway´s tree list
d) Siberian larch (originated in forests outside the EU)

Tree species listed on a) CITES (Appendices I, II and III) are not permitted to be used.

Tree species listed on either b), c) or d) may be used if it meets all of the following requirements:

- the tree species does not originate from an area/region where it is IUCN red listed, categorized as CR, EN or VU.
- the tree species does not originate from Intact Forest Landscape (IFL), defined in 2002, http://www.intactforests.org/world.map.html.
- the tree species shall originate from FSC or PEFC certified forest/plantation and shall be covered by a valid FSC/PEFC chain of custody certificates documented/controlled as FSC or PEFC 100% through the FSC transfer method or PEFC physical separation method. Tree species grown in plantation shall in addition originate from FSC or PEFC certified forest/plantation, established before 1994.

*The list of prohibited and restricted tree species is located on the website: http://www.nordic-ecolabel.org/certification/paper-pulp-printing/pulp--paper-producers/forestry-requirements-2020/

☒ Declaration from the applicant/manufacturer/supplier that tree species listed on a-d) are not used. Appendix 4d may be used.

<u>If species from the lists b), c) or d) is used:</u>

☒ Declaration from the applicant/manufacturer/supplier that tree species listed on a) CITES I, II and III are not used.

☒ The applicant/manufacturer/supplier is required to present a valid FSC/PEFC Chain of Custody certificate that covers the specific tree species and demonstrate that the tree is controlled as FSC or PEFC 100% through the FSC transfer method or PEFC physical separation method.

☒ The applicant/manufacturer/supplier are required to document full traceability back to the forest/certified forest unit thereby demonstrating that:

- the tree does not originate from an area/region where it is IUCN red listed, categorized as CR, EN or VU;
- the tree species does not originate from Intact Forest Landscape (IFL), defined in 2002 http://www.intactforests.org/world.webmap.html;
- For plantations the applicant/manufacturer/supplier is required to document that the tree species does not originate from FSC or PEFC certified plantations established after 1994.

Background to O11 A)
The requirements have been updated according to the latest version of Nordic Ecolabelling's forestry requirements. The requirement level remains unchanged.

Version 1 of the criteria contained a requirement that the wood raw material should not come from forestry environments with a great need for protection for biological and/or social reasons. This requirement remains relevant, since wood from tropical regions and from many parts of the world does appear on the Nordic market. The requirement applies to all wood raw material, regardless of geographic origin, even if the problem of illegal felling is greater in the tropical regions overall.

The new EU Timber Regulation (995/201/EU) 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 fulfilment of the Nordic Ecolabelling's requirements with regard to wood raw material origin and traceability. However, it does not completely replace the Nordic Ecolabelling's requirements, even though it can help to document the origin of the wood raw material and its ecological functions. The Nordic Ecolabelling's requirements, stating that wood raw material must not be sourced from natural forests, areas with a high level of biodiversity, unique ecosystems or important ecological functions, nor compromise important social or cultural 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.

Background to O11 B)
A number of tree species are restricted or not permitted for use in Nordic Ecolabelled floor coverings. The requirement applies only to virgin forest tree species and not tree species defined as recycled material according to ISO 14021.

The list of restricted tree species is based on the wood species that are relevant to Nordic Ecolabelling's criteria, i.e. tree species that have the potential to be included in Nordic Ecolabelled products. Listed tree species are indicated by the scientific name and the most common trade names. The scientific name/trade name is not always adequate, as there may be more than one scientific name/trade names for the listed tree species than the list indicates.

Criteria for tree species found in the list are wood originating from:

a) Tree species listed on CITES Appendices I, II and III.

b) IUCN red list, categorized as critically endangered (CR), endangered (EN) and vulnerable (VU).

c) Regnskogsfondet (Rainforest Foundation Norway) tree list

d) Siberian larch (originated in forests outside the EU)

CITES[48] is an international convention for the control of trade (across borders) of wild fauna and flora. CITES includes around 5600 animal species and around 28.000 plant species wherein a part is relevant timber tree species (mainly tropical species). The tree species is, dependent on how threatened they are, listed in Appendix I, II or III. Species listed in Appendix I, are highly endangered and trade with these species is totally banned. For the remaining tree species, special permits for import and export is required (Appendices II and III). CITES is regulated by EU legislation (Council Regulation (EC) No 338/97) and trees with valid CITES permits are considered to be legally harvested under EUTR (EU Timber Regulation). Nordic Swan Ecolabel's ban on the use of tree species listed in CITES (Appendix I, II or III) goes beyond the EU legislation. CITES regulates trade in endangered species, and there are also challenges with corruption in the trade in wild animals and plants[49]. Therefore, Nordic Ecolabelling does not want to approve species on any of the appendices.

IUCN Red Lists[50] are the world's most comprehensive inventory of the global conservation status of the planet's biological species, including trees. IUCN Red List has established clear criteria to assess the risk of extinction among thousands of species and subspecies according to the origin of the tree species. These criteria cover all countries and all species in the world. Nordic Swan Ecolabelling is aware that the IUCN's red list system only focuses on the extinction risk of species, and therefore is not designed for an overall assessment of whether a tree species can be provided with sustainable origin. However, the list is continually being updated and thereby is an important tool to estimate a specific tree species' conservation status on a global scale. Nordic Swan Ecolabel wishes to prohibit tree species listed as endangered (categories CR, EN and VU).

Regnskogfondet[51] (Rainforest Foundation Norway) is an NGO in Norway that works to protect the world's remaining rainforests. Currently, Regnskogsfondet does not see any credible certification schemes working in the tropics, and therefore recommends full stop of buying tropical timber. Regnskogsfondet has developed a list of tropical tree species based on tree species found on the Norwegian market. This list works as a guide to comply with Norwegian guidelines regarding non-use of tropical wood in public construction. We consider this a pragmatic approach for handling tropical tree species on the Nordic market.

In addition, Siberian larch (originated in forests outside the EU) is on the tree list. Siberian larch is a coveted tree species in the construction industry due to its high quality. The tree species is widespread in the Eurasian northern boreal climate zone, and particularly the species Larix sibirica, Larix gmelinii, Larix cajanderi and Larix sukaczewii are widespread in the large areas of intact forest landscapes (IFL) in Russia. Siberian larch is to be seen as an indicator species for boreal IFL-areas which are important to keep intact.

[48] https://www.cites.org/ (visited January 2020)
[49] Addressing corruption in CITES documentation processes Willow Outhwaite, Research and Analysis Senior Programme Officer, TRAFFIC, 2020: https://www.traffic.org/site/assets/files/12675/topic-brief-addressing-corruption-in-cites-documentation-processes.pdf
[50] http://www.iucnredlist.org/ (visited January 2020)
[51] https://www.regnskog.no/no/hva-du-kan-gjore/unnga-tropisk-tommer/tropiske-treslag (visited January 2020)

Exemption from the tree list

Nordic Swan Ecolabelling is aware that tree species originating from b), c) or d) can originate from legal and sustainable forestry. Therefore, it is possible to use tree species listed on b), c) or d) if the applicant/manufacturer/supplier can demonstrate compliance with a number of strict requirements regarding certification and traceability.

Many of the tree species on the list are grown in countries which still have large areas of IFLs. These are important to protect due to biodiversity and climate. Many of these countries also have a high risk of corruption and the national legislation related to environment, human rights and ownership to land are weak and/or not controlled by the authorities. There are different views on whether certification is good enough to meet the challenges of forest management in land with a high risk of corruption and illegal logging. For instance, relevant challenges related to this have been published by Danwatch in a number of articles in 2018 [52],[53] and by redd-monitor.org in 2019[54]. Greenpeace International has ended its memberships in FSC on the grounds that the certification body is no longer meeting its aims of protecting forests and human rights[55]. Other environmental organisations like WWF support certification as an important tool for sustainable forestry in these countries. However, due to the uncertainty whether FSC and PEFC certification systems are good enough in protecting important areas of biodiversity and ethical aspects like human rights and land ownership in areas with a high risk of corruption, Nordic Ecolabelling have a precautionary approach and wants further documentation about the tree species and its origin.

In order to document full traceability of the tree species, the applicant/manufacturer/supplier must present a valid FSC/PEFC Chain of Custody certificate that covers the specific tree species and demonstrate that the tree is controlled as FSC or PEFC 100%, through the FSC transfer method or PEFC physical separation method. This means that Nordic Swan Ecolabelling does not accept the FSC percentage or credit control system as well as PEFC percentage system. Full traceability of the tree species back to the forest/certified forest unit, enables the applicant/manufacturer/supplier to document that the tree species does not come from an area/region where it is IUCN red listed, categorized as CR, EN or VU. Full traceability also makes it possible to document that the tree species does not come from Intact Forest Landscape (IFL), defined by Intactforest.org in 2002[56]. Intact Forest has been monitoring IFL-areas since 2000 and has developed an online up to date mapping tool that shows the extent of IFL back to 2002. The monitoring results shows that the world's IFL are being degraded in an alarming speed, and that is the reason for Nordic Swan Ecolabelling referring back to 2002.

Plantation: Nordic Swan Ecolabelling believe, that responsibly run forest plantations can play a role in preserving natural IFLs by reducing the pressure to harvest the world's remaining natural forests. In order to secure that plantation has not replaced native ecosystems (forest/grasslands) within the last 25 years, tree species has to come from

[52] https://danwatch.dk/undersoegelse/dokumentfalsk-og-millionboeder-danske-byggemarkeder-saelger-trae-forbundet-til-ulovlig-hugst-i-amazonas/
[53] https://danwatch.dk/undersoegelse/baeredygtighedsmaerke-er-ingen-garanti-for-baeredygtigt-trae/
[54] https://redd-monitor.org/2019/08/29/evicted-for-carbon-credits-new-oakland-institute-report-confirms-forced-evictions-for-green-resources-plantations-in-uganda/
[55] https://www.greenpeace.org/international/press-release/15589/greenpeace-international-to-not-renew-fsc-membership/
[56] http://www.intactforests.org/world.webmap.html, visited January 2020

FSC or PEFC certified plantations that were established before 1994. 1994 is in line with FSCs international forest management standard (version 5.2), whereas PEFC is working with 2010. The list of restricted tree species is located on http://www.nordic-ecolabel.org/certification/paper-pulp-printing/pulp--paper-producers/forestry-requirements-2020/.

O12 Biocides

After harvesting, the wood must not be treated with biocides classified by WHO as type 1A and type 1B.

This requirement applies to the treatment of logs after felling.

WHO classification: An overview is available at: http://www.who.int/ipcs/publications/pesticides_hazard/en/, "The WHO recommended classification of pesticides by hazard and guidelines to classification 2009" or by contacting one of the secretariats.

✉ Report from the suppliers of the wood stating which biocides were used and a declaration in line with Appendix 4a for each individual product.

Background

The requirements concerning the wood have been expanded with the addition of O14, which relates to the treatment of logs after harvesting. The aim of the requirement is to ensure that the most harmful biocides, classified by WHO as type 1A "extremely hazardous" and type 1B "highly hazardous", are not used. The requirement has been harmonised with other relevant Nordic Ecolabelling criteria.

O13 Certified forestry

A) Wood from certified forestry

On an annual basis, at least 70% of the wood raw material content shall be derived from areas where forestry operations are certified according to a forestry standard and certification system that meet the criteria stated in Appendix 4c.

Nordic Ecolabelling may request the submission of further documentation to enable it to assess whether the requirements concerning the standard and certification system and certified proportion have been fulfilled. Such as name of forest management certificate holder and certificate number, 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.

✉ A statement showing the quantity of all constituent wood and the percentage of certified wood used in the applicant's Nordic Swan Ecolabelled production on an annual basis. Appendix 4b can be used.

The following can be used as documentation: valid Chain-of-custody certificate from nearest supplier of certified wood raw material and verification (for instance an invoice/delivery note) from the supplier showing that certified credits have been withdrawn from the suppliers account for certified wood raw material.

B) Wood raw material

The applicant must state the name (species name) of the wood raw material used in the Nordic Swan Ecolabelled durable/resistant wood for outdoor use.

Chain of Custody certification

The applicant/manufacturer must be Chain of Custody certified by the FSC/PEFC schemes.

Applicant/manufacturer using only recycled material in the Nordic Swan Ecolabelled durable/resistant wood for outdoor use are exempted from the requirement to Chain of Custody certification. Definition of recycled material, see glossary/below.*

Certified wood raw material

A minimum of 70% by weight of all wood raw material (virgin/recycled material) used in the Nordic Swan Ecolabelled durable/resistant wood for outdoor use, must origin from forestry certified under the FSC or PEFC schemes or be recycled material.

The remaining proportion of wood raw material must be covered by the FSC/PEFC control schemes regarding FSC controlled wood/PEFC controlled sources or be recycled material.

Certified wood raw material (FSC and PEFC credits) must be accounted/recorded from the manufacturer's Chain of Custody account to the Nordic Swan Ecolabelled product/production line.

[*] *Recycled material defined according to ISO 14021 in the following two categories:*

Pre-consumer material: Material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

Post-consumer material: Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.

Nordic Ecolabelling considers products from primary wood processing industries (sawdust, wood chips, bark, etc.) or residues from forestry (bark, branches, roots, etc.) as recycled material.

☒ Name (species name) on the wood raw material used in the Nordic Swan Ecolabelled durable/resistant wood for outdoor use.

☒ Applicant/manufacture must present a valid FSC/PEFC Chain of Custody certificate covering all wood raw material used in the Nordic Swan Ecolabelled durable/resistant wood for outdoor use. (Exempted from this requirement is applicant/manufacturer using only recycled material.

☒ Documentation showing that the quantity of certified wood raw material or recycled material is met by the applicant's/manufacturer's Chain of Custody account.

Background to O13 A)

Version 1 of the criteria contained a requirement calling for at least 70% of the constituent wood to be sourced from certified sustainable forests. The recommendation is to leave the requirement unchanged but with the formulation updated so that it corresponds to Nordic Ecolabelling's most recent formulation and to the introduction of the EU Timber Regulation.

The section below explains the benefits of certification systems for wood.

Sustainable forest management

There is no unified global standard for sustainable forestry. The understanding of what is sustainable depends on social and cultural values and as such can vary from country to country, and over time. There is, however, some international consensus on the overarching principles and criteria.

The Statement of Forest Principles from the United Nations Conference on Environment and Development in Rio de Janeiro 1992 established that "forest resources and forest lands should be sustainably managed to meet the social, economic, ecological, cultural and spiritual needs of present and future generations." The document also sets out a number of other principles for sustainable forestry, including a nation's right to utilise, manage and develop its own forests (www.un.org). As a result of this, various organisations have been formed with the aim of drawing up internationally recognised principles, rules and standards for ensuring socially and environmentally appropriate

forestry. The objectives have since been expanded to also include certification of wood products, in order to enable manufacturers to show that their products are eco-friendly and socially sustainable, and to provide consumers with an easily understandable tool for assessing the consequences of their purchases.

Forestry and traceability certification
The aim of forest management certification, based on sustainability principles, is to establish rules on how forests should be managed in order to meet social, economic, ecological and cultural needs. Today's certification systems all include management related aspects and environmental and social requirements.

The leading certification bodies have developed regulations, policies and standards that more clearly define various specific requirements.

Below are some of the basic requirements that occur in various forestry certification systems. They may seem obvious, but in many parts of the world not even these basic requirements are fulfilled. It is in these areas that forest management can have the greatest positive impact:

- Ban on converting forest or other natural biotopes for other purposes
- Compliance with international labour law
- Ban on the use of harmful chemicals
- Compliance with the Universal Declaration of Human Rights, with a specific focus on indigenous peoples
- No corruption – compliance with all prevailing legislation
- Identification and appropriate management of areas that require special protection (e.g. cultural and sacred sites, and habitats for endangered animals or plants)

Background to O13 B)
Name of the wood raw material. Nordic Ecolabelling sets requirements to gain information about which tree species are used in Nordic Swan Ecolabelled products. The requirement makes it possible to control the Chain of Custody certificates in the supply chain (check whether the stated tree species is covered by the Chain of Custody certificate) as well as provide information for future forest requirements. If recycled material is used in the Nordic Swan Ecolabelled flooring, and particularly in the form of recirculated fiber, it is not always possible to specify the name (species name) of all wood raw materials used. In this case, the requirement for documentation of recycled material is to be met.

FSC, PEFC and EUTR. Forest Stewardship Council (FSC) and Programme for the endorsement of Forest Certification schemes (PEFC) cover together 98% of the world total certified sustainable managed forest area[57], and are predominant in the global market for certified sustainable wood. Both schemes cover Forest Management certification of forests and subsequent Chain of Custody (CoC) certification, which documents the traceability of timber and timber products from certified forests. Both systems are considered common among forest owners, forest industries, manufacturers and distributors of wood products, and public authorities as reliable systems for sustainable forestry.

[57] UN: Forest Products – Annual market review 2011-2012, ch. 10

FSC updated traceability standard from 2015[58] and PEFCs traceability standard from 2013[59] fully meets the requirements of EU Timber Regulation (995/2010/EC)[60] prohibiting the marketing and sale of illegal timber in the EU. This applies to imported wood, as well as wood harvested in the EU. Nordic Ecolabelling recognizes both the FSC and PEFC as schemes that provide sufficient guarantees for legal and sustainable forestry.

Traceability Certification. Nordic Ecolabelling requires that the applicant/ manufacturer is Chain of Custody certified by the FSC/PEFCs schemes. The requirement for Chain of Custody certification contributes to traceability in the supply chain within the FSC and PEFCs guidance and control systems for traceability.

The company's Chain of Custody certification proves how certified wood is kept separate from not certified wood in the production, administration and warehousing and is checked annually by independent certification bodies. There exist different types of Chain of Custody certifications, which varies according to the minimum content of certified wood and the way this is calculated. Both schemes allows, within specified circumstances and rules, to mix wood from certified forests with recycled material or legal wood from non-certified forests. Therefore, it is not certain that a specific batch of FSC or PEFC certified wood necessarily come from certified forest. In all cases, the remaining share of the wood shall comply with a number of minimum requirements to ensure that it can be considered as "legal timber". Both the FSC and PEFC schemes allow several methods to verify the traceability: Physical separation method, percentage based method and volume credit method. Nordic Ecolabelling accepts all FSC and PEFCs methods to verify traceability and the share of certified and controlled wood/sources. The applicant/manufacturer must submit a valid FSC/ PEFC Chain of Custody certificate, covering all wood raw material used in the Nordic Swan Ecolabelled flooring as documentation.

Nordic Ecolabelling equates recycled material with virgin wood material from sustainable forestry. Recycled materials not covered by an FSC/PEFCs Chain of Custody certification can also be used in Nordic Swan Ecolabelled products. Suppliers of recycled material are exempted from the requirement regarding FSC/PEFCs Chain of Custody certification.

Recycled material. Definition of recycled material (pre-consumer and post-consumer) is based on ISO 14021.

"Pre-consumer material" is defined as material diverted from the waste stream during a manufacturing process. Excluded is reutilization of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it.

"Post-consumer material" is defined as material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.

[58] https://ic.fsc.org/en/our-impact/timber-legality/ensuring-compliance, visited 2015-12-21
[59] http://www.pefc.org/certification-services/eu-timber-regulation, visited 2015-12-21
[60] http://ec.europa.eu/environment/forests/timber_regulation.htm

Nordic Ecolabelling considers by-products from the primary wood-using industries (sawdust, wood chips, bark, etc.) or residues from forestry (bark, branches, roots, etc.) as recycled material. Industries, who buy virgin wood (round wood) and primarily converts it into e.g. chips, are not counted as recycled material. Industries that process virgin wood (round wood) are counted as primary wood-using industries.

It should be noted that the EU Timber Regulation, as opposed to Nordic Ecolabelling, do not define by-products from the primary wood-using industries as recycled material. Sawdust, wood chips, bark, etc. or residues from forestry (bark, branches, roots, etc.) is subjected to the EU Timber Regulation, i.e. subject to requirements of traceability and legality.

The applicant/manufacture shall demonstrate that the wood has the status of recycled material according to the above definitions.

Certified wood raw materials. Applicants must document that at least 70% of all wood raw material (virgin/recycled material) used in the Nordic Swan Ecolabelled product/production line comes from forestry certified under the FSC or PEFC schemes or is recycled material. The remaining proportion of wood must meet the requirements of FSC controlled wood or PEFC controlled sources, or be recycled. The requirement limit, a minimum of 70% of all wood raw material (virgin or recycled), correspond to the FSC and PEFCs requirement limits for use of the respective labels on products, such as "FSC Mix" and "PEFC certified". FSC and PEFC has together five recognized official existing labels. Further information about the use of labels can be found on FSC[61] and PEFCs[62] websites. The requirement can make it easier for manufacturers of Nordic Swan Ecolabelled products to document the requirement, as they can demand labelled FSC/PEFC products. Recycled material is explicitly highlighted in the requirement as both FSC and PEFCs schemes include certified recycled materials.

Nordic Ecolabelling equates as previously mentioned recycled material with virgin wood material from sustainable forestry. Recycled materials <u>not</u> covered by FSC/PEFC's Chain of Custody certification, can also be used in the Nordic Swan Ecolabelled products. The share (% units) of recycled material must meet the requirement regarding the share of wood raw material certified as FSC or PEFC sustainable forestry.

It is specified in the requirement that certified wood raw material (FSC and PEFC credits) must be accounted/recorded from the manufacturer's Chain of Custody account to the Nordic Swan Ecolabelled product/production line. This ensures that the FSC/PEFC credits on a production levels is accounted/recorded to the Nordic Swan Ecolabelled production, and not to other FSC/PEFC labelled products. I.e. the amount of certified wood raw material that is "sold" into the Nordic Swan Ecolabelled product/production line subsequently is removed from the manufacturer's Chain of Custody account, ensuring that the certified wood material is not sold twice. This will also stimulate increased demand for certified products.

The applicant/manufacture must demonstrate that the quantity of certified wood raw material or recycled material is met. The certification % shall be documented through the applicant's/manufactures Chain of Custody account and invoice or delivery note (paper

[61] http://welcome.fsc.org/understanding-the-fsc-labels.27.htm
[62] http://www.pefc.co.uk/chain-of-custody-logo-use/pefc-label

or via e-invoicing), which also indicates the companies certification codes from which the wood raw material is purchased from. It must be clear which parts of the packing slip or invoice delivery that is certified (e.g. claim/material category must appear, such as FSC MIX and FSC 100% associated with the product concerned on the invoice or delivery note).

Certification and accreditation. The certification (control and approvement of requirements in the standard, chain of custody and eventual use of label) must be conducted by an independent, competent and accredited third party and follow the relevant international guidelines for the certification: "ISO/IEC 17065:2012 Conformity assessment – Requirements for bodies certifying products, processes and services" or equivalent and accredited by an accreditation body operating in accordance with "ISO 17011:2004 Conformity assessment – General requirements for accreditation bodies accrediting conformity assessment bodies" or equivalent.

The accreditation (i.e. verification and approval of the certification firm is working properly) must be undertaken by a national or international body, systems and procedures are consistent with ISO 17011:2004 Conformity assessment – General requirements for accreditation bodies accrediting conformity assessment bodies or equivalent.

5.4 Biological durability and use classes

O14 Biological durability

The wood must as a minimum fulfil the test methods for one of the areas of use given in the table below.

Wood with natural durability* that fulfill class 1 or 2 for Natural durability to wood-destroying fungi according to the standard EN 350-2, is also in compliance with the requirement.

Area of use	Test methods
Wood used in marine environment**	- Fungi test EN 113. The wood must be aged with relevant method, i.e. EN 73 or EN 84. - Soft rot test in accordance with ENV 807, part 2. - Marine test EN 275 over at least 5 years in a Nordic test field
Wood used in contact with soil**	- Fungi test in accordance with EN113. The wood must be aged with relevant method, i.e. EN 73 or EN 84. - Soft rot test in accordance with ENV 807. - Field test in accordance with EN 252, over at least 5 years in 2 fields, one of them in a Nordic country.
Wood used above soil**	- Fungi test in accordance with EN113. The wood must be aged with relevant method, i.e. EN 73 or EN 84. - Field test in accordance with CEN/TS 12037 (ENV 12037) or EN 330. The tests must be carried out in accordance with EN 599.

** Certain species are already excluded by requirement O11B).*

*** Wood classified in class M, A or AB in accordance with the Nordic Wood Preservation Council (NTR) system fulfils the respective durability requirement with regard to use in marine environment, soil contact or above soil (exposed to the elements).*

Alternative test methods may be used if an independent and competent test institution judges the methods to be equivalent in terms of quality.

✉ Analysis report showing test results or certificate showing approved usage class. There must be a clear declaration of which methods were used, who conducted the analyses and the independence of the test institution, see Appendix 1. For wood with natural durability, name of tree species and durability class according to EN 350-2 shall be described.

Background

The requirement level remains unchanged, but the requirement has been reformulated. A study has been conducted to see whether any relevant new tests for durability have been created that could be included in the requirement, but few relevant newly established test methods have been found. A new fungal test method that can be used to test ThermoWood is, however, described in US standard AWPA 10 (soil-block test). The test is conducted under optimum conditions for degradation by basidiomycete fungi (white and brown rot fungi). The evaporation procedure equates to the procedure in EN84, and the calculation of natural durability follows EN 350-1. This test may be used if an independent and competent test institution judges the method to be equivalent to the methods named in the requirement in terms of quality.

One of the greatest challenges in developing alternative products to conventionally impregnated wood has been achieving sufficient durability. This issue now appears to have been resolved and some of the alternative products have biological durability in line with pressure impregnated wood.

Pressure impregnated wood is assessed in the Nordic Wood Preservation Council (NTR) system of 4 classes: M, A, AB and B. The classes state the degree of protection and durability. The system has been harmonised with the European standards EN 351 and EN 599 regarding wood and woodbased products durability, and states requirements concerning penetration and absorption of different impregnation agents for each class. EN 599 contains a description of the various test methods for durability.

The more environmentally aware alternatives to impregnated wood are not based on the penetration of active substances, but on the modification of the wood itself. The NTR test methods are not specifically adapted to these methods. Alternative tests that will be able to be used for such methods are currently under development. Until these become available, a modified version of the EN standards and the NTR system is used. Established EN tests and requirement levels, corresponding to the NTR system for classes AB, A and M are taken as the starting point. Following excerpts are from the NTR website[63] and describe different NTR classes and the relationship to the risk classes (also called use/usage classes) in the European standard EN335 Durability of wood and wood based products - Use classes, definition:.

- Wood impregnated according to class M is intended to be used in wooden constructions which are in danger of being attacked by marine pest organisms, e.g. shipworm, and in constructions subjected to extreme stress or structures that which special safety requirements are put, i.e. class 5 according to European Standard EN 335. Examples of applications include quay facilities, foundation piles and cooling towers.
- Wood impregnated according to class A is intended to be used for timber in ground contact and in fresh water, and in specific cases above ground, where there is a significant risk of rotting, i.e. class 4 according to EN 335. Examples of applications include utility poles, sleepers, fence posts and decking in direct contact with the ground.

[63] Website NTR: http://www.ntr-nwpc.com/1.0.1.0/4/1/ (2014)

- Wood impregnated according to class AB is intended for use in exposed above-ground structures, i.e. class 3 according to EN 335, such as fences and roofing/weather boards.
- Wood impregnated according to class B is intended for exterior joinery/carpentry such as windows and doors (this use class is not covered by these criteria for ecolabelling of durable/resistant wood).

Wood in usage class AB accounts for the largest volume in the current market, and it is in this segment that the greatest environmental gains can be made by switching from traditionally impregnated wood to more environmentally aware wood. One of the most important properties of the newly developed alternatives is that they have a similar biological durability to traditionally impregnated wood. Chemically modified wood can be used in contact with the ground and in freshwater, as well as above ground. Thermally modified wood is generally used above ground.

There is also a standard for testing the wood's natural durability[64]: "Durability of Wood and Wood-based Products – Natural Durability of Solid Wood", EN 350-1. Durability of wood from rot are classified into five classes:

1. Highly durable
2. Durable
3. Moderately durable
4. Little durable
5. Not durable

Durability against attack by wood decay organisms for softwoods is an expression of the woods relative durability compared to sapwood of pine. Sapwood from each tree species is considered to belong to durability class 5 (not durable) unless other results are not proven.

EN 350-2 states durability against rot attack for untreated wood, and not for impregnated or modified wood. The classification gives an indication of the performance of the wood in contact with the ground. According to EN 350-2, the durability classes for some relevant wood species are as follows:

- Spruce: 4
- Pine heartwood: 3-4
- European larch heartwood: 3-4
- Oak heartwood: 2
- Western red cedar: 2 (grown in North America)
- Western red cedar: 3 (grown in the UK)

Applying the same classes as in EN 350-1, one obtains the following durability classes for impregnated and modified wood:

- Impregnated wood (in line with NTR): 1
- Thermally modified wood: 1-5 (depending on wood type and process)

[64] Website, Treteknisk: http://www.trefokus.no/fullstory.aspx?m=1748&amid=18250 (2014)

- Acetylated radiata pine: 1-2
- Furfurylated pine: 1-2

To clarify how naturally durable/resistant wood shall verify the requirements on durability, the same wording as in the criteria for Nordic Swan Ecolabelled Outdoor furniture and playground equipment were added, on 4 May 2016. It is positive to harmonize requirements in different criteria documents and good that it is clearly stated how naturally resistant wood shall meet the requirement since naturally resistant wood is part of the product group definition.

5.5 Energy and climate

O15 Monitoring energy consumption

The following information is to be documented by the licensee. If the data is not available at the time, it must be submitted no later than one year after the Nordic Swan Ecolabel licence is issued.

Raw material phase:

e) Drying of the wood: The drying method must be described. Total energy consumption and energy consumption per energy source* is to be reported on an annual basis. Energy consumption is to be expressed as MJ/m^3 dried wood.

If the drying takes place somewhere other than at the premises of the durable wood manufacturer, the information should as far as possible be sourced from the supplier/sawmill. As a minimum, drying method and energy source for drying must be reported.

Production phase:

a) The manufacturer of the durable wood must report, on an annual basis, which energy sources that have been used and the amount of energy used in the manufacturer's production. Energy consumption is to be expressed as MJ/m^3 wood.

Moisture content of incoming wood raw material and final product should also be reported.

b) The manufacturer must have an energy efficiency plan that is not less than three years old. The energy efficiency plan must identify potential improvements at the facility and identify cost-effective measures that are realistic to implement.

Annual follow-up:

The manufacturer of durable wood must have an environmental management system that ensures the annual collection of energy data as described above.

** In this context, energy source means electricity, district heating (supplier is to be stated) and fuels (e.g. wood waste, wood chips, biogas, straw, peat, pellets, natural gas, heating oil).*

If the manufacturer has a surplus of energy and sells this in the form of electricity, steam or heat, the energy quantity is withdrawn from the fuel consumption. Only fuel that actually is consumed for production should be taken into account.

✉ Documentation regarding the points in the raw material phase and production phase above. Appendix 5 can be used. The calculations must be per cubic metre of wood, and may be stated for the Nordic Swan Ecolabelled production or the total production.

✉ Energy efficiency plan according to the energy management system standard ISO 50001 or equivalent.

✉ Procedures in environmental management system that ensure annual collection of energy data.

Background

This requirement is new. The MECO analysis and the various life cycle analyses of durable wood show that energy consumption in the raw material and production phases often accounts for a substantial amount of the product's environmental impact. One goal in this revision was therefore to draw up energy/climate requirements with a focus on energy efficiency. In gathering the data and considering possible requirement levels, it became clear that the data is associated with a great deal of uncertainty. It was also judged that the manufacturers have low steerability when it comes to affecting energy consumption for drying, since this is often carried out by a supplier, and it would often require major investments for the manufacturers to switch energy sources. See also the RPS analysis in section 4. These circumstances make it difficult currently to set fair and appropriate requirement levels for permitted energy consumption.

The requirement has therefore instead been formulated as an information/follow-up requirement in this version, with the objective of obtaining good data so that level requirements can be set for energy consumption in the next revision. The manufacturer shall declare annual energy consumption for the raw material phase (drying of the wood) and for the production phase where the production of the final modified wood product is done. Many manufacturers have conducted LCA-analysis and should have access to such information. There is also a requirement that the manufacturers must have an energy efficiency plan in place at their production facilities. The intention behind setting requirements concerning energy efficiency is to encourage manufacturers to identify any potential for improvement at their facility, and come up with cost-effective measures that can be realistically implemented. In the requirement the energy management system standard IS0 50001 (with user manual) is referred to. The standard specifies requirements for establishment, implementation, maintenance and improvements of energy management systems. The objective is that an organization shall follow a systematic approach in order to achieve continual improvements of the energy performance.

Appendix 4 summarises the energy data that has been studied for the raw material phase and outlines how level requirements for energy consumption may be set in the next revision.

5.6 Wood during use and disposal

O16 Product specification/instructions for use

The product specification/instructions for use shall, as a minimum, contain information and recommendations related to the following topics:

- Biological durability
- Areas of use
- Instructions for optimum installation
- Recommended maintenance and possible surface treatment* during the use phase.
- Waste management. It must be specifically stated that the durable wood does not need to be treated as hazardous waste.

**If surface treatment is recommended in order to extend the products service life, Nordic Swan Ecolabelled products shall be recommended to be used as much as possible.*

✉ Product specification/instructions for use containing the points above.

Background

The requirement has been adjusted somewhat and expanded to require instructions for optimum installation and information regarding waste disposal. Information is to be given on correct waste management, since there is a danger that durable wood may unnecessarily be treated as hazardous waste by the recycling centres. Furthermore, the requirement shall ensure that consumers receive adequate information for the intended use and optimal maintenance so that the product shall remain of high quality and have a long service life.

O17 Waste management

Durable wood should not need to be treated as hazardous waste in any of the Nordic countries.

✉ Declaration from the country's authorities about appropriate waste management.

Background

The requirement is new and is aimed at ensuring that none of the methods used for the modification of wood can lead to the wood having to be treated as hazardous waste at the end of its life. With the exception of this requirement on waste, there is no requirement on waste management in the criteria, since this is dealt with indirectly in the chemical requirements, where substances harmful to health and the environment are strictly limited.

5.7 Quality and regulatory requirements

The following requirements, O18 to O25, are general requirements that are always included in Nordic Ecolabelling's criteria for products. The purpose of these requirements is to ensure compliance with environmental legislation and fundamental requirements for quality management. Requirements O18 to O25 are new compared with version 1 of the criteria and replace previous requirements R13 and R14 in version 1 of the criteria.

O18 Nordic Swan Ecolabel licence person

The company shall appoint a person responsible for ensuring the fulfilment of Nordic Ecolabelling's requirements, and a contact person for communications with Nordic Ecolabelling.

✉ A chart of the company's organizational structure detailing who is responsible for the above.

O19 Documentation

The licensee must be able to present a copy of the application and factual and calculation data supporting the documents submitted with the application (including test reports, documents from suppliers and suchlike).

🔑 Checked on site

O20 Quality of durable wood

The licensee must guarantee that the quality of the production of the Nordic Swan Ecolabelled durable wood is maintained throughout the validity period of the licence.

✉ Procedures for collating and, where necessary, dealing with claims and complaints regarding the quality of the Nordic Swan Ecolabelled durable wood.

O21 Planned changes

Written notice must be given to Nordic Ecolabelling of planned changes in products and markets that have a bearing on Nordic Ecolabelling's requirements.

✉ Procedures detailing how planned changes in products and markets are handled.

O22 Unforeseen non-conformities

Unforeseen non-conformities that affect Nordic Ecolabelling requirements must be reported to Nordic Ecolabelling in writing and logged.

✉ Procedures detailing how unforeseen non-conformities are handled.

O23 Traceability

The licensee must have a traceability system for the production of the Nordic Swan Ecolabelled durable wood.

✉ Description of/procedures for fulfilment of the requirement.

O24 Take-back system

The Nordic Ecolabelling's Criteria Group decided on the 9 October 2017 to remove this requirement.

O25 Laws and regulations

The licensee must ensure compliance with the applicable legislation on health and safety, environmental legislation and installation-specific terms/permits at all the production sites for the Nordic Swan Ecolabelled product.

Documentation is not required. However, Nordic Ecolabelling may revoke the licence if the requirement is not fulfilled.

Background

The above procedures must be implemented to ensure that Nordic Ecolabelling's requirements are fulfilled. It is necessary for Nordic Ecolabelling to know, at all times, who the licensee's contact person is for the Nordic Swan Ecolabel. The applicant must therefore appoint a person who is responsible for ensuring constant compliance with the requirements applicable to the Nordic Swan Ecolabelled products. The contact person is also responsible for communication with Nordic Ecolabelling.

If the company has an environmental management system that is certified to ISO 14 001 or EMAS and the following procedures are applied, it is sufficient if the accredited auditor certifies compliance with the requirements.

The requirements ensure that the holder of the Nordic Swan Ecolabel licence is responsible for health and safety, environmental legislation and installation-specific terms/permits at the production facility for the Nordic Swan Ecolabelled product.

Changes to the ecolabelled production process may have repercussions for the Nordic Swan Ecolabel licence. A written report of all changes that may relate to the requirements set for the ecolabelled product must therefore be submitted to Nordic Ecolabelling. This will enable Nordic Ecolabelling to provide information on what needs to be done to ensure that the change does not impact on the licence.

In the event of unforeseen non-conformities, Nordic Ecolabelling can assess the consequences of the non-conformity and provide advice on what action the licensee should take.

Take-back system

There has previously been a voluntary industry agreement on packaging operations in Norway, which has led Nordic Ecolabelling to have a requirement to ensure that licensees for a number of (45) product groups comply with this regulation. Requirements for return systems have now been incorporated into the Norwegian Waste Regulations, which means that the Nordic Ecolabelling requirement for membership in a return company will be out of date and therefore no longer need to be managed by Nordic Ecolabelling in a separate requirement.

The Nordic Ecolabelling's Criteria Group decided on the 9 October 2017 to remove this requirement.

6 Changes compared to previous version

Comparison of requirements for durable wood in criteria version 1 and version 2.

Req. version 1	Proposed requirements version 2	Comments
R1	O1	The requirement has been clarified and more points added.
R2	O2	The requirement remains unchanged.
R3	O3	The requirement remains unchanged.
R4	O4	The requirement has been updated in line with official regulations and expanded to include a prohibition of more classifications. An exemption for acetic acid anhydride from hazard statement H330 has been given.
-	O5	New requirement on CMR substances.
-	O6	New requirement on chemical substances that are excluded from use.
-	O7	New requirement on nanoparticles.
R5	O9	An occupational exposure limit value for acetic acid anhydride has been added. Apart from the exposure limit value, the requirement remains unchanged.
R6	O8	The requirement text has been amended/updated, but the requirement limit remains unchanged.
R7	-	The requirement concerning surface treatment has been removed and the product definition states that surface treated wood cannot carry the Nordic Swan Ecolabel.
R8	O10	A new limit content of residual acetic acid anhydride in final modified wood products has been added. Apart from the limit content, the requirement remains unchanged.
R9	O11	The text has been amended/updated.
-	O12	New requirement on biocides for newly harvested wood.
R10	O13	The requirement text has been amended/updated, but the requirement limit remains unchanged.
R11	O14	The text has been amended.
-	O15	New requirement on monitoring of energy consumption in raw material and production phase.
R12	O16	The requirement has been clarified and new points have been added on instructions for optimal installation, plus the point about surface treatment has been made more specific.
-	O17	New requirement on waste management for durable wood.

R13 and R14	O18	New standard requirements for Nordic Swan Ecolabelling products that replace previous requirements R13 and R14 in version 1.
	O19	
	O20	
	O21	
	O22	
	O23	
	O25	

Appendix 1 Different treatment methods for durable wood

This appendix gives a summary of the different treatment methods for durable wood. The following is described: modified wood (thermally and chemically modified), traditional pressure impregnated wood and new types of impregnated wood. Finally, there is a brief description of wood with naturally long durability.

Thermally modified wood

This process uses high temperatures and steam, with no chemicals involved. The wood is heated to around 130°C and is kept there for a certain period of time, before being further heated to around 185-225°C. This final part of the process requires an inert atmosphere. There are several patented processes for this. The inert atmosphere may be water vapour, nitrogen or oil. The product is then conditioned, with the final treatment taking about 8 hours. In all, production takes approximately 36 hours. One of the patented processes is called ThermoWood and is owned by the Finnish ThermoWood Association[65].

Together, spruce and pine account for over 90% of the production of thermally modified wood. The wood takes on a brown colour and its properties change slightly, in that it becomes more brittle and has lower flexural strength. On the other hand, the product has improved dimensional stability and lower density. Over time, the wood turns grey on exposure to the elements. Results of durability tests have so far concluded that the wood is not recommended for use in contact with the ground or in marine applications.

The method can be adapted and used for all types of wood. The wood is divided into different classes after treatment: Thermo-S (S=stability) and Thermo D (D=durability). Thermo D meets biological durability class 2 in line with the standards EN 113, EN 807 and EN 350-2. The areas of use are as follows:

- Softwood (conifers):
  Thermo-S: structural elements, interior fittings, furniture, outdoor furniture, components for doors and windows, sauna fittings
- Thermo-D: Fittings for exterior walls, exterior doors, window frames, structural elements, sauna and bathroom fittings, flooring, outdoor furniture
- Hardwood:
  Thermo-S, Thermo-D: interior fittings, furniture, outdoor furniture, flooring, sauna fittings

Since no chemicals are used in the process, the wood waste can be incinerated or handled the same way as untreated wood. Energy demand for drying accounts for 80% of the total demand. Energy/heat demand during the production of ThermoWood is about 25% higher than for traditional drying.

Thermally modified wood with linseed oil

In Denmark, the company Royal Træ produces thermally modified wood that is then treated with linseed oil. The process is described as follows[66]:

[65] http://www.thermowood.fi/ (11 April 2014)
[66] E-mail correspondence with Lars H. Kristensen, Royal Træ, March 2014

The first step is thermal treatment, where the wood is heated and the glucose-containing cellulose is caramelised, with the resin hardening and changing structure. Thermal treatment reduces the movement in the wood by between 80 and 90%, and absorption of moisture is reduced by around 50%. Following thermal treatment, the wood remains vulnerable and needs to undergo further treatment – which involves a supplementary Royal process. Linseed oil, which is the main ingredient in the Royal oil, contains proteins, stearin and paraffin. Proteins are nutrients for bacteria and fungi. Stearin and paraffin make the Royal oil unstable (liquid) when temperatures are high and the sun shines. In Royal wood oil the, proteins, stearin and paraffin has been removed. The actual Royal process takes place in a modern autoclave. The thermally modified wood undergoes a process where the wood absorbs up to 5 times as much Royal oil as when wood is normally painted or treated with wood preservative.

There is also the option of leaving the wood entirely untreated. It will still last a long while, but will turn grey and begin to split over time.

Chemically modified wood

There are three main variants of chemically modified durable wood:

Furfurylation/Kebonisation

In 1996, the company Wood Polymer Technology (WPT) developed a non-toxic technology for modifying wood that gives similar durability results to pressure impregnated wood. The durability arises from chemical modification/polymerisation using furfuryl alcohol, which "saturates" the timber to make it harder and more resistant. Furfuryl alcohol is derived from biological waste from sugar cane production. Kebony does not contain chemicals that can be leached out in the environment. The polymer is permanently bound to the wood and the process is irreversible. In the waste phase Kebony can be treated as ordinary untreated wood.

Norwegian company Kebony is responsible for manufacturing furfuryl modified wood in the Nordic region.

The technology is called furfurylation or Kebonisation, and has many features in common with the technology used in traditional impregnation systems. The wood is treated/ "impregnated" in an autoclave, i.e that the furfuryl alcohol is pressed into the wood under pressure. The difference lies in the post-treatment. The products are hardened in a heat chamber after pressure treatment. During the hardening process, the chemicals react with the components of the cell walls in the wood and polymerise. Once the hardening is complete, the wood is transferred to the warehouse. The process is described as follows[67]:

The steps in the process:

1. The input substances are blended to a patented recipe
2. The liquid is added under pressure
3. Drying and hardening of the wood by heating to over 100°C
4. Packaging

The closed-loop production process includes recycling of the input liquid.

[67] http://www.kebony.com

Kebony's patented modification methods were developed over several years of research and development in Norway, Sweden and Canada. There were also additional collaborations with universities and institutes in Germany, the Netherlands, the USA and South Africa. Among these are the Norwegian Institute of Wood Technology (NTI), the Norwegian Forest and Landscape Institute, SP Trätek in Sweden, SHR in the Netherlands and the University of New Brunswick and Woodtech, both in Canada.

The product is just as flexible in its applications as traditionally impregnated wood. It has improved dimensional stability, which means that it moves less than other wood when subject to climatic changes. The wood has a golden brown colour after treatment, and turns grey over time when exposed to sun and wind. Beyond normal cleaning, Kebony products require no form of maintenance.

Acetylation
Another method of chemical modification is the acetylation of wood. The process basically involves acetic anhydride reacting with hydroxyl groups in lignin and hemicellulose at 120-130°C. Acetylation causes the chemical modification of the cell walls in the wood, providing increased biological durability, hardness and dimensional stability[68]. In Europe, acetylated wood is manufactured in the Netherlands under the trade name of Accoya[69].

OrganoWood
A relatively recently tehnology where silicon particles are used to fossilize wood has been developed and patented by the Swedish company OrganoWood

On its website, OrganoWood describes the technology as follows[70]:

OrganoWood's technology is based on modifying the wood to provide effective protection against rot, fire or water and moisture. The fibres are changed at a molecular level, using non-toxic silicon compounds. The natural fossilisation process is accelerated using catalysts to encourage the silicon compounds to bond with the wood fibres. A physical barrier is created that prevents fungi from eating the wood fibres.

Impregnated wood (not included in the Nordic Ecolabelling product group)

Conventionally impregnated wood
There are generally three different production processes: pressure impregnation, vacuum impregnation and dip impregnation.

Pressure impregnation is used for wooden structures subject to a substantial risk of biological degradation. These may be wooden structures in direct contact with the ground or load-bearing elements of structures exposed to the weather, such as terraces, steps, balconies and so on. Pressure impregnation is the dominant industrial process. The technique involves impregnation agents being forced into the wood under pressure.

[68] SINTEF, Miljøanalyse av trefasader, 2013
[69] http://www.accoya.com/
[70] www.organowood.com

There are three main types of pressure impregnation agent, 1) water-borne substances such as salts, 2) creosote and 3) oil-borne substances (Skogstad, 2009)[71].

The most common agent used in pressure impregnation comprises heavy metals suspended in water. Copper is now the most common impregnation agent, together with one or more organic fungicides, as a replacement for chromium and arsenic. Other active substances are boric acid and/or organic biocides/fungicides.

There are also tight restrictions on creosote impregnation, which has been banned in Denmark since 1989. Some creosote treated wood is still manufactured in Finland, Norway and Sweden, but volumes have fallen considerably since a ban on private use came into force in 2003. Creosote impregnated wood is only permitted in an industrial context, and largely relates to telegraph poles, jetty posts and glulam bridges[72].

Vacuum impregnation is usually based on organic solvents. The agent used comprises around 90% organic solvent, often turpentine, and 10% active ingredient/fungicide. The most common fungicides are Propiconazole and/or Tebuconazole (see further descriptt-ion in section below). Vacuum impregnation is used for wood where there is a risk of attack from wood-decaying fungi, but not for wood in contact with the ground or permanently in water. Several approaches require follow-up surface treatment and ongoing maintenance throughout the lifetime of the product. Vacuum impregnation is used almost exclusively for the impregnation of window frames and doors.

In Sweden and Norway copper impregnated wood is delivered to waste collection for incineration in appropriate furnaces. In Finland the copper impregnated wood is still treated as hazardous waste and in Denmark the wood is collected and sent to Germany for incineration (previously it was landfilled)

More recent types of impregnated wood

Royal impregnation

Royal impregnation is a combination of salt impregnated wood (usually copper salts) followed by boiling in linseed oil.

On its website Norwegian manufacturer Talgø, which produces the product MøreRoyal®, describes the process of impregnation as follows[73]:

In the process of manufacturing MøreRoyal®, the wood undergoes two treatments. It is first impregnated with a copper-based impregnation agent. Then it is boiled in oil for 6 to 8 hours in a vacuum – a full litre of oil per m^2 is boiled into the wood in this way.

According to descriptions from other producers, it appears that the length of time the wood is boiled in linseed oil varies.

Wood treated with supercritical CO_2 and small quantities of biocides

A relatively new impregnation method uses supercritical carbon dioxide as the carrier for small quantities of biocides with which the wood is impregnated. Hampen Træforarbejdning A/S in Jutland, Denmark, has one of the world's first facilities for impregnating spruce in this way, known as Superimpregnation/Superwood, on a

[71] SINTEF, Miljøanalyse av trefasader, 2013
[72] Evans, Fred (Trefokus og Treteknisk), Fokus på tre issue 21, Trykkimpregnering, 2008
[73] http://hoved.talgo.no/byggevare/trelast/om-moereroyal/

reasonably large scale[74]. The product is marketed as an ecofriendly alternative to conventionally impregnated wood and received the EU's environmental award for clean technology in 2002.

The wood is impregnated with SC200. The impregnation takes place in a closed-loop process where the carbon dioxide acts as a carrier and under high pressure (supercritical level) forces the impregnation agent fully into the wood. At the end of the process, the carbon dioxide and impregnation agent are pumped back round and re-used.

The active components in SC200 are the following biocides: propiconazole (8% in the product), tebuconazole (8% in the product) and IPBC (3-iodo-2-propynyl butyl carbamate, 4% in the product). The first two are both classified as category II biocides (moderately harmful) in line with WHO's recommended classification of biocides (2009). The biocides are not in conflict with the Biocide Directive and the impregnation agent is approved by the Danish Environmental Protection Agency. Tebuconozole has the classifications Rep. 2, H361d toxic for reproduction (formerly R63) and very toxic to aquatic organisms, H411 (formerly R51/53). Propiconazole has the classification very toxic to aquatic organisms H400 and H410 (formerly N; R50/53). IPBC has the classification very toxic to aquatic toxic H400 and H410. Generally, little biocide remains in the product but it is a requirement that the wood should contain 120 grams of active substances / m3 treated to protect against attack by fungal decay[75].

Superwood has a durability/wood protection effect that fulfils DS/EN 335 with a use/risk class of 3 (outdoors above ground). The Danish Technological Institute tests the products every 6 months. The product has also been tested in Malaysia and the test results indicate that the product may have a service life of 30 years even in a temperate climate. Tests in Denmark indicate no decay (above ground) after 8 years of horizontal exposure.

The product will (according to the product description) fade over time and may, like other untreated wood products/pressure impregnated wood, suffer splitting and splintering. The product can be surface treated and worked on like normal wood. The product is described as being best suited to horizontal surfaces (for example as facade cladding) and to a lesser extent for exterior decking. The product is not suitable for a marine environment.

Wood with natural durability (untreated wood)

There are woods with natural durability that may be used for certain applications as an alternative to impregnated wood. Natural durability refers to the wood's capacity to resist fungal and insect attack[76]. Good examples are the heartwood of pine, oak, and larch. The availability of pine heartwood, for example, is limited however, particularly due to the methods employed by the sawmills.

[74] www.superwood.dk
[75] Consultation comment from the Danish Ministry of the Environment (2014)
[76] Evans and Flæte (Trefokus og Treteknisk), Fokus på tre issue 2, Treslag og holdbarhet, 2009

Appendix 2 MECO analysis – durable wood

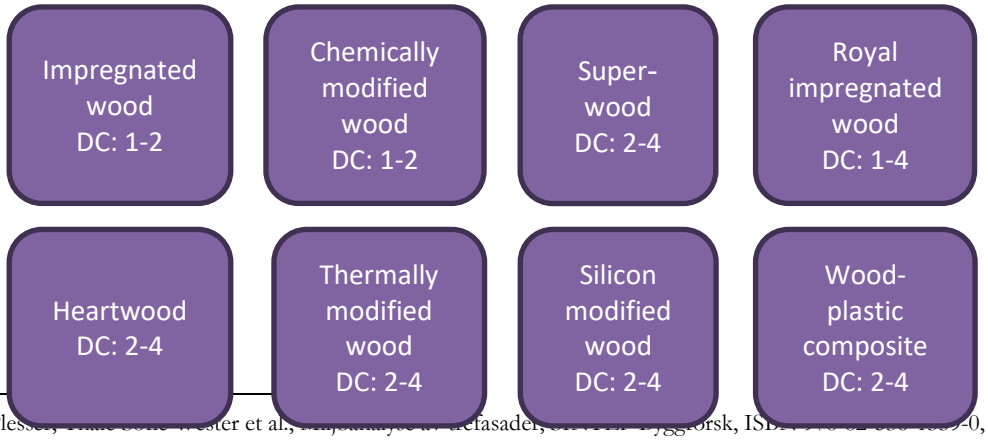
A qualitative MECO analysis (an assessment of Materials, Energy, Chemicals and Other) is presented in the table and text below. The purpose of the analysis is to show where in the life cycle the environmental impact occurs for different types of durable wood and wood-plastic composites, and to assess whether there is any potential to reduce that environmental impact. The analysis is general, and shows some of the most common materials and processes used. The analysis covers products inside and outside the product group as defined in the criteria for the Nordic Swan Ecolabelling of Durable wood.

Unfortunately, there is a general lack of good LCA studies within this product group (particularly for the newest treatment methods), but there are a few LCA studies with a focus on climate impact and these have been used. There are also certain EPDs, but these are often based on different assumptions, which make it difficult to obtain exactly comparable data. Specific production data has also been collected for some of the production processes. The data presented in the MECO analysis therefore entails a great deal of uncertainty and must be interpreted with care. A practical study that has been used is "Miljøanalyse av trefasader" (Environmental analysis of wood facades) conducted in Norway as a collaboration between SINTEF Byggforsk, the Norwegian Institute of Wood Technology and the Norwegian Forest and Landscape Institute[77]. The study focuses specifically on building facades, which is one of many areas of use for durable wood. The facade materials were assessed with regard to potential global warming, human and ecological toxicology.

The text below provides a summary of the environmental impact in the different phases of the products' life cycle. For underlying data and qualitative assessments, also see the MECO table at the end of the appendix.

General information about products, materials and durability

There are a wide range of products on the market with different degrees of durability. The durability of different products is an important factor in any life cycle analysis and is therefore a requirement in the Nordic Ecolabelling criteria. In the criteria, durability is divided into three classes in line with the NTR system: M (marine environment), A (in contact with the ground) and AB (above ground). These equate to the classes M=1, A=2, AB=3-4 as set out in EN-350-1. The figure below gives some products and their typical associated durability classes (DC). Some of these products are excluded from Nordic Ecolabelling's product definition for durable wood.



[77] Plesser, [illegible] et al., [illegible] trefasader, [illegible] Byggforsk, ISBN [illegible]-0, 2013

When assessing the environmental impact of durable wood, area of use and durability are important factors, since they are linked to the lifetime of the products. The environmental factors should be seen against this background. The products with the highest durability are chemically modified wood and impregnated wood. For this reason, these products will also have the broadest possible areas of use, since they are suitable for use in contact with water and the ground, as well as use above ground. Heartwood and thermally modified wood have different degrees of durability, depending on the type of wood, and the type of thermal treatment (see background to requirement O16).

Raw material phase
In the raw material phase, the environmental impact relates primarily to: forestry (sustainable or not), harvesting and processing the wood, extraction and processing of the plastic for composites (new or recycled) and raw material extraction for chemicals. In addition to this, there is the issue of transport for all materials.

Materials based on solid wood generally have a lower environmental impact, on condition that the forest is managed in a sustainable way. The raw material phase for wood includes the harvesting of roundwood, debarking, transport and processing at the sawmill (including drying). Drying sawn timber entails the greatest energy consumption, and in the Nordic region it accounts for around 90% of the environmental impact from processing. In the raw material phase, the drying process in the Nordic region makes up around 90% of an energy consumption that stands at around 1700 MJ/m^3. The climate impact tends to be low, however, since the energy source in the Nordic region is based chiefly on renewable materials such as bark and wood chips. Extraction and transport usually account for around 10% of the energy consumption involved before finishing in the Nordic region. The environmental impact from transport can vary considerably depending on transport distance, while the climate impact may range from 1% to approx. 20% of the total climate impact over the life cycle (see MECO table).

Impregnated wood and chemically modified wood generally have around the same energy/climate impact in the raw material phase, but transport can be a significant factor in increasing the environmental impact.

The plastic used in wood-plastic composites has a high environmental impact compared with wood, because plastic is an oil-based raw material. There is a substantial climate impact in the raw material phase if virgin plastic is used. Using recycled plastic can considerably reduce the environmental impact, depending on the degree of recycling. For composite products, the climate impact in the raw material phase for virgin plastic, such as PP, accounts for over 50% of the total climate impact over the lifetime of the product (this is described in more detail in Appendix 3).

Raw material extraction for the chemicals used in impregnation or modification may increase the environmental impact through increased energy consumption (10-20% cradle to gate) and higher greenhouse gas emissions (10-50% cradle to gate).

Production phase
The greatest environmental impact during the production phase is associated with the chemicals used to treat the wood (potential emissions to the outdoor environment and working environment), and with the energy used during production.

The production phase can differ greatly for different products and the environmental impact varies significantly in this part of the life cycle. Unsurprisingly, solid wood products with natural durability (such as heartwood) generally fare best, since no chemicals are added and the products do not undergo any form of thermal or pressure treatment. If a surface treatment, in the form of a stain or paint, is applied to the finished sales product, this will, however, increase the environmental impact considerably in the production phase. Generally speaking, impregnated wood (Cu impregnation) will also have a low climate and energy impact in the production phase, since this technology does not usually use heat in production. Various EPDs suggest a very low energy consumption of 30-40 MJ/m^3 (large production volumes, figure uncertain) but there is data for less efficient processes, where the energy consumption may be ten times greater (figure uncertain). In the production phase, thermally modified wood usually has a somewhat higher energy consumption than impregnated wood due to the nature of the process (figures uncertain). Chemical modification using known technology such as furfurylation or acetylation has a much higher energy consumption compared with impregnated wood and thermally modified wood. Energy consumption can be 4-5 times as high (figures uncertain, little data) compared with thermally modified wood. Wood-plastic composites have even higher energy consumption in the production phase, with data suggesting up to twice the energy consumption of chemically modified wood where virgin plastic is used (figure is uncertain, little data).

When it comes to the carbon footprint of durable wood in the production phase, this is, as in the raw material phase, primarily determined by the kind of energy source used. In general terms, manufacturers in the Nordic region mainly use electricity in combination with propane or natural gas in the production phase. This often leads to a high carbon footprint where fossil energy sources are used in production. There is considerable potential here for a reduction in greenhouse gas emissions by switching to bio-based energy sources (bark, wood chips, pellets, etc).

Use phase

In the use phase, leaching of impregnation agents from the wood and the need for maintenance, particularly surface treatment, account for the greatest environmental impact. The fact that durable wood lasts a long time is extremely important (as described above) since the material does not have to be replaced as often. For pressure impregnated wood, around 10-15% of copper and at least 30% boron are leached out over the course of a service life of 20–30 years[78] [79]. Leaching is not a problem for thermally modified wood, since it does not use chemicals. It is also not a problem for furfurylated or acetylated wood, where the polymer is permanently bound into the wood.

The environmental impact from surface treatment over the life cycle of wood is documented in the report from SINTEF Byggforsk et al, as mentioned above. The study shows the significance of surface treatment on untreated wood, compared with impregnated wood and a range of other durable facade products. The types of chemicals and the frequency of the treatment are decisive factors in the environmental impact, including climate impact of different claddings.

[78] Kängsepp, K. et al. 2011. Leaching of commonly used impregnation agents affected by wood properties.
[79] Morsing et. al. 2010: "Comparison of laboratory and semi-field tests for the estimation of leaching rates from treated wood - part 1: above ground (UC 3). IRG/WP 10-50274.

In the majority of cases, untreated wood and impregnated wood will be given a number of surface treatments over the course of the use phase.

Traditional impregnated wood does not need any surface treatment for the purpose of durability but surface treatment is many times done for decorative purposes. Durable wood like acetylated and furfuryl aclohol treated wood are surface treated in a lesser extent, something that can give an environmental benefit.

The report also clearly shows the significance of emissions to soil, air and water in the form of ecotoxicity and human toxicity. It is here, in particular, that many of the environmental gains offered by durable wood become apparent. Sintef Byggforsks comments below in chapter 4.2 in their report[80]:

"Focusing on greenhouse gas emissions and energy consumption can make other equally important environmental aspects of products and processes such as emission of harmful chemicals into the air, water and soil as well as the impact of these emissions on all living beings, less in prioritized. These are issues that traditionally belong to the core area of environmental consideration, but have, in relation to the construction sector and building materials, received less attention than energy use and greenhouse gas footprint".

One benefit that should be mentioned for wood-plastic composites in the use phase is that they do not require surface treatment.

Disposal/waste phase
The environmental aspects of the waste phase are primarily associated with the treatment of end-of-life wood due to the chemical substances in the wood. In addition, the possibility of recycling the materials is an important aspect.

Impregnated wood that only contains copper salts (since 2002) is not defined by the Swedish or Norwegian authorities as hazardous waste, but has to be taken to a recycling centre[81] for incineration in furnaces with sufficient flue gas cleaning technology. Copper can act as a catalyst in the formation of dioxins and furans during incineration. It is therefore important that the plant which will be destroying the wood has optimised the process to prevent this happening. Ash with metal content must also be processed correctly. After CCA impregnated wood was banned, theoretically the waste problem from pressure impregnated wood was reduced. Unfortunately it is often not possible to tell the difference between Cu impregnated wood and other types that are hazardous waste, and therefore all types of pressure impregnated waste are generally treated as hazardous waste. This issue is also valid for modified wood. In Finland, copper impregnated wood is still treated as hazardous waste, and in Denmark it is collected and sent for incineration in Germany (it was previously sent to landfill).

The durable wood alternatives (thermally modified and chemically modified) have the advantage that they can be processed in the same way as ordinary untreated wood and can be recycled into new products or sent for energy recovery.

When it comes to wood-plastic composites (WPC), the scope for material recovery is more limited than for pure wood products.

The mix of wood, plastic and various additives causes the plastic to degrade, and plastic from used composite cannot be separated out and used in other types of product. End-

[80] Plesser, Thale Sofie Wester et al., Miljøanalyse av trefasader, SINTEF Byggforsk, ISBN 978-82-536-1339-0, 2013
[81] Norwegian Environment Agency: www.miljodirektoratet.no (March 2014)

of-life composite can be ground down and used in the production of new composite products, but there is no system in place for this in the Nordic region.

Table 3: Qualitative MECO analysis of durable wood and WPC

Type of durable wood (DW)*	Raw material extraction	Production	Use	Waste	LCA (total)
*CM = Chemically Modified with furfuryl alcohol (FA), acetylation, silicon treatment and linseed impregnation (Royal Træ), TW = ThermoWood, Thermally modified wood, WPC = Wood-Plastic Composite, IW = Impregnated Wood (copper impregnation), SW=supercritical CO_2 impregnation with biocides.					
Materials	CM, TW, SW and IW = pine/spruce/maple WPC = wood chips, PP(virgin)/PP(recycled) Felling, debarking, sawing, drying, processing.	Modified recycling PP, recycling paper fibre/recycling TW	Surface treatment in use phase can have major impact. Fuel for transport of wood from forest to sawmill and then to manufacturer.	End-of-life DW can be incinerated or have material recovered. In practice, most DW sent to the recycling centres is incinerated.	Materials based on solid wood have a low footprint, while materials such as polypropylene (PP) have a high footprint. See point on climate.
Energy MJ/m³** **The figures are generally highly uncertain, and many factors cause a major bias. The choice of energy mix in the electricity supply, for example, will be a decisive factor for CO_2 emissions.	Raw material extraction – solid wood[82] (transport +): approx. 200 MJ/m³ Drying of solid wood[83],[84],[85],[86],[87]: approx. 1500 MJ/m³ CM, WPC, SW, IW: Raw material extraction – chemicals: FA[88],[89]= 661 MJ/m³	CM: FA = approx. 2400-3300 MJ/m³ depending on wood type[90], gas (propane) accounts for almost 90% and electricity just over 10%. TW[91] = approx. 2400 MJ/m³ for all production and transport. Gas (LPG) accounts for 80% and electricity 20% in production. It is assumed that drying is included in the figure, and that energy for drying	Indications are that for solid wood products use and waste may account for just over 10% of the life cycle. Surface treatment and other maintenance is not normally included in the LCA, and may be significant over the lifetime of the product, depending on the quantity	Energy from incineration or energy saved in production through recycling. In general, conventional wood and durable wood can be recycled, and this has a positive effect on the life cycle, but in practice durable wood is often processed as	For solid wood products, energy use relates mainly to drying and processing the wood. Energy consumption is approx. 2000 MJ/m³ over the life cycle. For Norwegian exterior cladding surface treated with water-based paint, energy consumption over the life cycle is approx. 6000 MJ/m³.

[82] http://www.klimatre.no/uploads/KlimaTre/Presentasjoner/101111%20Fagdag%20biprodukter/101111%20Henning%20Horn.pdf
[83] Silje Wærp et al., Livsløpsanalyser av norske treprodukter, MIKADO, SINTEF Byggforsk, 2009. Norway.
[84] Jungmeier, G. et al, Allocation in Multi Product Systems – Recommendations for LCA of Wood-based Products
[85] Andersson, B-I, (1996) Environmental declaration for sawn timber, Trätek.
[86] Jarnehammar, A. (2000): LCA for multi-layer parquet flooring in Life Sys Wood. Trätek.
[87] Adebahr, 1995, Energy consumption for roof building related to 1 m³ structural timber

Type of durable wood (DW)*	Raw material extraction	Production	Use	Waste	LCA (total)
*CM = Chemically Modified with furfuryl alcohol (FA), acetylation, silicon treatment and linseed impregnation (Royal Træ), TW = ThermoWood, Thermally modified wood, WPC = Wood-Plastic Composite, IW = Impregnated Wood (copper impregnation), SW=supercritical CO_2 impregnation with biocides.					
	IV = 255-400 MJ/m^3 Raw material extraction – PP: High compared with wood as it is an oil-based material. Reduced when recycled plastic is used.	amounts to approx. 1500 MJ/m^3 of the total. WPC = high, estimated to > 6000 MJ/m^3 SW = approx. 823 MJ/m^3 [92] IV = approx. 30-40 MJ/m^3 Figures uncertain. Thermally modified wood with linseed oil = approx. 500 MJ/m^3 [93] Royal impregnated wood = approx. 2200 MJ/m^3 [94]	of the chemical product and frequency of use. Must be assessed separately. The MIKADO study indicates that where water-based paints are applied to exterior cladding, the use phase may account for 67% of energy consumption.	specialist waste. According to the manufacturers, WPC can be recycled into new composite, but this has not been documented.	Chemical modification has relatively high energy consumption. Wood-plastic composite has high energy consumption, but if hollow boards are used, the impact will be almost halved if the functional unit for energy is set per kg of product.
Climate** **The figures are generally	CM: Transport of wood (0.06) + chemicals FA (0.07) + production of FA and auxiliary	The energy sources in production account for the vast majority of the climate impact.	Surface treatment and other maintenance is not normally included in the	In general, conventional wood and durable wood can be recycled, and this	CM (FA)= 0.5-0.7 kg CO_{2eq}/kg

[88] Christian Rostock, Nicole Lambert. Carbon footprints of Ipê vs. Kebony Southern yellowpine – A comparative study. Published: Oslo, NORWAY /September 2010. Bergfald Miljørådgivere, Kongens gate 3 NO-0153 Oslo.
[89] Christian Rostock, Nicole Lambert. Carbon footprints of Burmese teak versus Kebony Maple – A comparative study Published: Oslo, NORWAY/April 2010. Bergfald & Co as, Kongens gate 3 0153 Oslo, NORWAY.
[90] Correspondence with manufacturer. March 2014.
[91] Executive summary – ThermoWood: Life cycle assessment (LCA) of Finnish thermally modified wood cladding, Finnish ThermoWood Association, Publishing House Koivuniemi Ltd., Finland. 2008.
[92] Correspondence with manufacturer. April 2014.
[93] Correspondence with manufacturer. April 2014.
[94] Correspondence with manufacturer. April 2014.

Type of durable wood (DW)*	Raw material extraction	Production	Use	Waste	LCA (total)
*CM = Chemically Modified with furfuryl alcohol (FA), acetylation, silicon treatment and linseed impregnation (Royal Træ), TW = ThermoWood, Thermally modified wood, WPC = Wood-Plastic Composite, IW = Impregnated Wood (copper impregnation), SW=supercritical CO_2 impregnation with biocides.					
highly uncertain, and many factors cause a major bias. The choice of energy mix in the electricity supply, for example, will be a decisive factor for CO_2 emissions.	chemicals (0.22) = Total 0.36 kg CO_{2eq}/ kg WPC: PP production accounts for up to 65% of total climate impact. Additives account for 7-11%, transport < 5%. See also Appendix 3.	It is still common in the Nordic region to use propane/natural gas alongside electricity. There is potential to switch to bio-based energy sources.	LCA, and may be significant over the lifetime of the product, depending on the quantity of the chemical product and frequency of use. Must be assessed separately. Surface treatment with a stain, decking stain or paint increases the climate impact by a factor of 10, 5 and 4 respectively (see figure 4, section 4).	has a positive effect on the life cycle, but in practice durable wood is often processed as specialist waste. According to the manufacturers, WPC can be recycled, but in practice this has not been documented.	CM (Ac)[95] = 0.4-1.1 kg CO_{2eq}/kg WPC = 0.7-0.9 kg CO_{2eq}/kg IV = ± 0.05 kg CO_{2eq}/kg
Chemicals and emissions	Chemical raw material extraction and associated emissions. See climate impact in row above.	Biocide, furfuryl, acetylation, silicon treatment and other additives.	Leaching of chemicals from impregnated wood in particular. Stain and paint in the use phase. Emissions of greenhouse gases and particulates.	Leaching of chemicals.	
Other	Sustainable forestry, biodiversity.	Working environment. Closed-loop process.	Ease of cleaning has impact on quality.		

[95] Vogtländer, J.G. Life Cycle Assessment of Accoya, Final 21 March 2010.

Appendix 3 Product group definition – assessment of new product types

One of the aims of the revision was to review the product group definition and consider adding new products. The products under consideration for inclusion in the criteria for durable wood were wood impregnated with supercritical CO_2 and small quantities of biocides, and wood-plastic composites (WPC). The conclusion was to put out for consultation the possibility of including supercritical impregnation but not WPC. The reasons for this are given below. The possibility of adding WPC will be re-examined as part of the next revision. There will be a particular focus on investigating whether manufacturers would use more recycled plastic or bioplastic and a greater proportion of post-consumer waste as a consequence.

1 Wood-plastic composites (WPC)

The use of wood-plastic composites (WPC) has grown sharply in recent years. This growth has occurred primarily in North America, but over the past few years we have also seen a clear increase in Europe. The market was expected to reach 270 000 tonnes in Europe and 1.7 million tonnes in North America in 2010[96]. The main areas of use are exterior applications such as decking, terraces, walkways, railings, furniture, cladding and fences. The products are sold primarily to B2B customers for public environments such as schools, parks, hotels, and so on, but also to private individuals. Some composite manufactures have shown interest in Nordic Ecolabelling.

Production and content

WPC is made by mixing wood chips/wood particles and melted plastic/polymer. The plastic acts as a binder. WPC may be manufactured from virgin plastic or recycled thermoplastic, usually polypropylene (PP), polyethylene (PE) or polyethylene terephthalate (PET). When WPC first came onto the market, it tended to comprise 50% wood and 50% plastic. Now it is usually made up of 70-80% wood raw material, but the ratio can vary. In addition to the main ingredients of wood chips and plastic, WPC often contains small quantities of additives such as colourings, binders, UV stabilisers, blowing agents and so on, in order to give the product its desired properties. WPC is manufactured both as solid and hollow profiles[97].

Since WPC can be used in thermoplastic processes, it is excellent for extruding and casting. Quality is important, particularly for consumer products such as exterior decking, where WPC is clearly comparable with ordinary decking in terms of known properties and expected service life. Wood-plastic composite can be manufactured from recycled plastic bottle caps mixed in with wood chips, which are themselves a by-product of the wood processing industry. Test runs of WPC have been made using bio-PP, but there is currently no commercial production.

[96] Wood Plastic Composites made from Modified Wood, Kristoffer Segerholm, Licentiate Thesis, KTH 2007.
[97] Wikipedia

The development of WPC is taking place in various areas, which are summarised below (in no particular order):

- Increased proportion of recycled plastic raw material
- Increased proportion of post-consumer raw material
- Shift from fossil polymers to biopolymers
- Improved quality (splitting, swelling, etc.) and service life



In this review, products from four producers have been examined in more detail: LunaComp and The Biofore Company, both based in Finland, Polyfiber from Norway and Megawood, which is a German manufacturer. Only one of these manufacturers uses recycled plastic in its production. The main reason for this is that there have been problems achieving sufficient quality when using recycled plastic. There are, however, manufacturers outside the Nordic region that use a high proportion of recycled material (including plastic). One example is the world's biggest manufacturer of WPC, Trex in the USA, which uses 95% recycled material (plastic bags and by-products from projects involving wood and wood chips)[98].

None of the products examined contain PVC. No manufacturers use bio-polymers.

Waste phase

One aspect of composites in the waste phase is that the opportunities for material recovery are more limited than for pure durable wood. The blending of wood, plastic and various additives causes degradation of the plastic and the wood. Plastic and wood from end-of-life composite cannot be separated and used in other types of product.

All the manufacturers state that the products are recyclable at the end of their service life, or can be incinerated as ordinary household waste. Conversations with Polyfiber and LunaComp indicate, however, that in practice the limit of material recovery is that end-of-life composite can be ground up and used in the production of new composite products. It is uncertain what proportion of post-consumed composite they can use in the production of new composite products. The manufacturers currently have no established take-back system for collecting old products.

What do the life cycle analyses say?

We have not found any LCA studies that directly compare WPC with modified wood.

[98] http://www.trex.com/why-trex/how-to-choose-a-deck/eco-friendly-decking/ (April 2014)

There has, however, been a general comparison of LCA climate data for Kebony (chemically modified wood), ThermoWood (thermally modified wood) and the wood-plastic composites LunaComp and UPM ProFi. There is a great deal of uncertainty associated with the data (see Appendix 2, MECO analysis). Nevertheless, one distinct difference between the composites and pure wood products made from durable wood is that composite has a considerably higher environmental impact over its lifetime (raw material phase), due to the use of virgin plastic. This impact is naturally lower if recycled plastic is used, but only one of the three composite types examined currently uses recycled plastic.

Polymer production is thus responsible for the largest contribution of CO_2 emissions in the life cycle. The carbon footprint[99] calculated for the WPC product UPM ProFi, manufactured in Lahti, Finland, shows the following distribution:

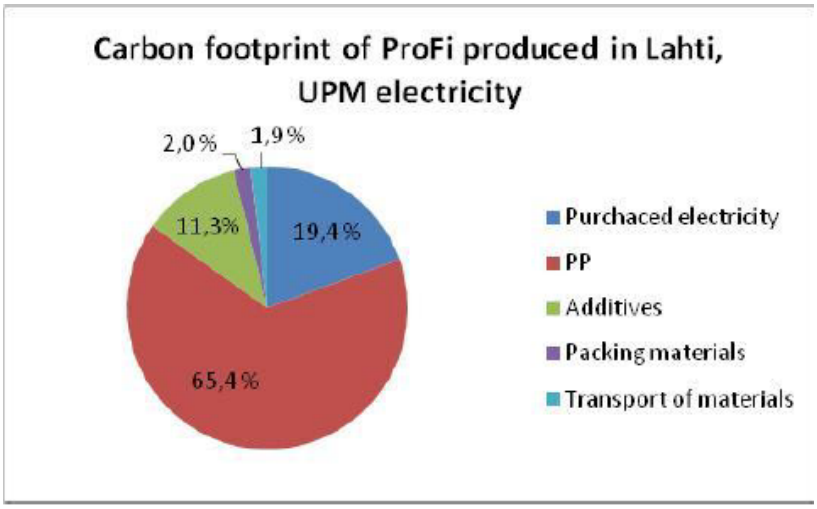


Figure 3: Carbon footprint WPC product UPM ProFi (source: VTT Research Report VTT-R -02591-11.2011)

UPM ProFi is made from production waste arising from the manufacture of self-adhesive labels, plus virgin polypropylene (PP). The ratio varies, but the proportion of recycled plastic raw material is never less than 50%. It is unclear what type of electricity the calculation is based on. The diagram should not be studied in detail, but provides an indication of the ratios involved. The phases after manufacture and packaging of the product are also not included in the carbon footprint calculation.

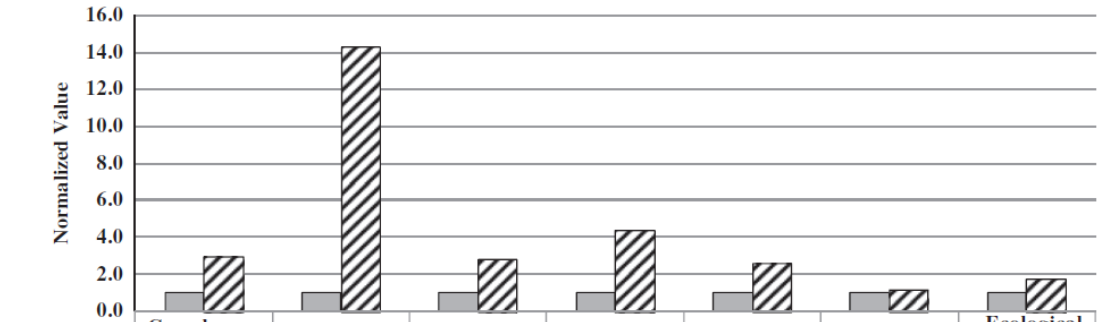
There are also three LCA studies that compare WPC with other materials. A summary of these can be found in Table 1.

[99] Carbon Footprint of UPM ProFi, VTT Research Report VTT-R -02591-11, 2011

Table 1. Summary of LCA studies. WPC versus other materials

Materials compared (LCA study conducted by)	Material facts	Summary
Untreated, naturally resistant cedar wood versus WPC decking (Bowyer, J. 2010)[100]	- Untreated cedar wood compared with - WPC using virgin PE - WPC using 100% recycled PE	For each environmental aspect (GWP, acidification, particulates, eutrophication, etc.), WPC using virgin PE shows the highest values (greatest impact). For each environmental aspect, natural wood shows the lowest impact. If recycled PE is used in WPC, the environmental impact is significantly lower compared with virgin PE, but in all cases the impact is higher for WPC than for ordinary decking.
Pressure impregnated wood decking versus WPC (Bolin, C.A and Smith, S. 2011) [101]. See figure 4 below.	- Wood impregnated with water-based impregnation agent for wood above ground using copper (oxide) and ammonium compounds (ACQ) compared with - WPC using 50% recycled wood raw material, 25% post-consumer HDPE and 25% virgin HDPE	The analysis shows that WPC decking has a higher environmental impact for indicators, see figure 4 below. The analysis also shows that if surface treatment is assumed to be carried out every three years, the environmental impact for ACQ wood increases for all indicators, except "ecological impact". However, the impact is still higher for WPC. It is assumed in the analysis that the WPC does not have a hollow cavity. If it is a hollow structure, all the indicators for WPC decking fall in line with the percentage of hollow cavity. If 100% recycled HDPE is used instead of 50%, the fossil fuel indicator falls from 14 times to 4 times more than for ACQ wood. Total energy consumption falls from 8.5 times more energy to 2.8 times more than ACQ wood.
WPC decking in spruce and exotic African woods (Kuntzstoff Zentrum, SKZ, Germany)	- Spruce and exotic African woods compared with - WPC using 70% wood fibre and 30% virgin polyethylene	The study concludes that: - The production phase dominates - Maintenance is not relevant in this context - The waste phase is less important, except for GWP, but recycling is a possibility for WPC - Spruce is the most ecofriendly choice for all categories - If the service life is increased from the normal assumption of 15 years to 30 years for WPC, hollow WPC is environmentally comparable with spruce for all parameters except GWP

[100] Wood-Plastic Composite Lumber vs. Wood Decking – A Comparison of Performance Characteristics and Environmental Attributes, Dr. Jim Bowyer, Dovetail Partners Inc, 2010.
[101] Life-cycle assessment of ACQ-treated lumber with comparison to wood plastic composite decking, Journal of Cleaner Production, Bolin, C.A and Smith, S, 2011.



	Greenhouse Gases	Fossil Fuel Use	Water Use	Acid Rain	Smog	Eutrophication	Ecological Impact
ACQ Lumber	1.0	1.0	1.0	1.0	1.0	1.0	1.0
WPC Decking	2.9	14	2.8	4.3	2.6	1.1	1.7

Figure 4: Cradle to grave comparison of a number of indicators for the average sized wooden deck (for an American family). Source: (Bolin, C.A and Smith, S. 2011)

The three LCA studies show that the use of plastic accounts for a large part of the total environmental impact, and that WPC has a higher environmental impact than the other materials with which WPC was compared. However, the analyses also indicate that the environmental impact can be changed by making different choices in terms of materials (including the proportion of recycled plastic), hollow cavities and production techniques.

Relevance, Potential and Steerability (RPS)

Relevance

The objective of the criteria for durable wood is to find alternatives that are environmentally better than conventionally impregnated wood. It would be a positive thing to be able to expand the product group to include more alternatives, if they are environmentally better than conventionally impregnated wood. LCA studies show that there is an environmental impact associated with the production of WPC, and there is therefore high relevance in setting environmental requirements for such products in order to promote more environmentally aware products.

Potential

The LCA data and assessments that have been conducted show a considerable difference in the environmental impact of different composite materials, and there is therefore high potential for improving such products.

Steerability

Can Nordic Ecolabelling do anything about the environmental issues? Nordic Ecolabelling can set relevant requirements for composites and can steer the products towards a lower environmental impact. There currently appears to be little steerability in the Nordic region, however, regarding the use of virgin plastic, which constitutes the greatest environmental impact, since many of the manufacturers have stopped using recycled plastic due to quality issues. There are also limited opportunities for material recovery from composites at the end of their service life. There is therefore low steerability for these two aspects, which are important in the life cycle of the composite.

Conclusion wood-plastic composite

Nordic Ecolabelling will not be expanding the criteria to include composite materials in this revision because:

- Studies have shown that composite has higher energy consumption and CO_2 emissions than impregnated wood and modified wood due to the plastic used (use of recycled plastic reduces the CO_2 emissions). Research into the use of biopolymers is under way, but there is no commercial production as yet.
- Only one of the manufacturers examined uses recycled plastic today, and that is primarily only pre-consumer material. Since the plastic is what makes the environmental impact of WPC higher from an LCA perspective than products made from 100% wood, there is not a sufficient environmental argument in the current circumstances for expanding the product group to include WPC.
- There is low steerability over the proportion of recycled plastic in composites, due to quality issues (this may improve in the future through product development).
- The opportunities for material recovery are more limited for composite than for durable wood. The mix of wood, plastic and various additives causes the plastic to degrade, and plastic from end-of-life composite cannot be separated out and used in other types of product.
- There is no established take-back system for collecting and recycling end-of-life WPC in new composite products.

2 Wood impregnated with supercritical CO_2 and small quantities of biocides

In the Nordic region today, there is one Danish supplier of wood treated with super-critical CO_2 and small quantities of biocides. The impregnation agent comprises three organic biocides (fungicides) approved by the Danish Environmental Protection Agency and the EU. The impregnation agent is suspended in supercritical carbon dioxide, which carries it into the core of the wood. The wood preservatives remain in the wood, while the carbon dioxide is drawn out and re-used. The impregnation is carried out in a closed-loop system that recycles all auxiliary substances. See Appendix 1 for further information about the process.

The Danish product (Superwood) is approved for "use above ground". Superwood showed good results in a ten-year field study looking at the durability of pine treated in different ways[102]. Other studies however show that impregnated wood with organic biocides do not give satisfying results regarding durability in field or laboratory experiments due to decomposition/leaching of the biocides[103]. The applications are most closely comparable with thermally treated wood approved for the same areas of use.

[102] Schabacher, A. et al. System treatments of Pinus sylvestris – influence on moisture, decay and discoloration. June 2013.
[103] Consultation comment from SP, Sveriges Tekniska Forskningsinstitut, September 2014. Refers to IRG paper IRG/WP 13-20535 "Report on COST E37 Round Robun Tests - Comparison of results from laboratory and field tests, 2013.

Chemically modified wood and pressure impregnated wood have greater durability, can also be used in contact with the ground and freshwater, and have less need for surface treatment.

A comparison has been made between wood treated with supercritical CO_2 and small quantities of biocides, and wood impregnated with Cu salts and biocides. In terms of chemical use and leaching, superimpregnated wood shows itself to be a better environmental alternative, but an important difference is that the use class is more limited and that the durability is not as good as wood impregnated with copper salt and biocide. The greatest advantages of superimpregnated wood are:

- The quantity of impregnation agent used is in the order of 30 times less than Wolmanit. According to data in a Norwegian EPD from 2010 for "Copper-impregnated wood" (Nordic class AB, preservation Wolmanit CX-8), 5.5 kg impregnation agent is used per m^3 wood[104]. Ecoinvent gives figures down around 3.5 kg/m^3. In comparison, 120-160 g/m^3 impregnation agent is used for supercritical impregnation.
- The agent used in supercritical impregnation, SC200, contains fewer active substances (three biocides), while Wolmanit contains copper compounds and boric acid, as well as small quantities of three biocides.
- The leaching potential from superimpregnated wood is lower than from conventionally impregnated wood, since much less impregnation agent is used and bound to the cell walls of the wood. The Danish Technological Institute has conducted experiments on this[105].
- It is assessed by the Danish Ministry of the Environment[106] that supercritically impregnated wood can be processed as ordinary combustible waste, in contrast to wood impregnated with copper and biocides. In in Denmark it is collected and sent for incineration in Germany. In Finland is treated as hazardous waste. In Norway and Sweden, wood impregnated with copper and biocide are incinerated in special furnaces.
- Spruce is used for superimpregnation, despite being a wood that is not usually well suited to impregnation.

With the above advantages in mind, Nordic Ecolabelling wished to put out for consultation the question of whether the criteria should allow small quantities of biocides associated with impregnation using supercritical CO_2. The consequences would include giving an exemption for the use of biocides in concentrations below 200 g/m^3 in requirement O3, and an exemption for the classifications H361, H400, H410 and H411 in O4. Responses from the consultation however showed that there was great resistance that the proposed criteria would move away from requiring biocide-free options, regardless of the amount biocide. Moreover, several consultation bodies that such products have a too limited application or too poor durability against biological decomposition.

[104] EPD no. 087E "Copper impregnated wood": http://www.epd-norge.no/getfile.php/PDF/EPD/Byggevarer/NEPD087E_Wolmanit_vugge_til_port_en.pdf
[105] Venås and Morsing, The performance of supercritical impregnated wood, February 2014
[106] Vejledende udtalelse fra Miljøstyrelsen vedr. håndtering af imprægneret træaffald, May 2014 http://mst.dk/media/mst/9242486/Vejledende%20udtalelse%20om%20håndtering%20af%20imprægneret%20træaffald.pdf

Nordic Ecolabelling chose therefore not to move forward with this particular proposal in the final version 2.0 of the criteria.

3 Fire resistant wood

There has also been interest in Nordic Swan Ecolabelling wood treated with fire retardants. The product uses no chemicals that require hazard classification, but no durability tests have been conducted. Traditionally, fire retardants have been products that use a wide range of undesirable chemicals, but the same effect is now possible without toxic chemicals. Nordic Ecolabelling has, however, not assessed products with this function when drawing up the criteria, and therefore has no underlying data for comparing this product with the traditional alternatives from an environmental perspective.

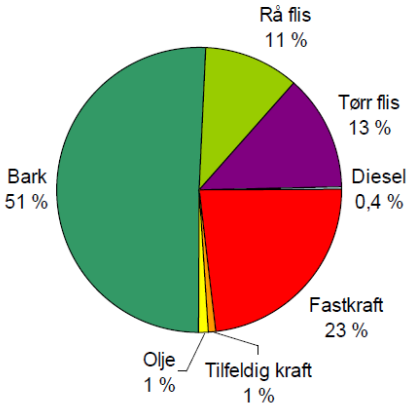
Appendix 4 Background to energy requirements in raw material phase

Energy use – drying sawn timber

According to a Norwegian study by ENØK into drying kilns in the sawn timber industry (Horn 2008) the average energy use in production at 16 sample companies is 1529 MJ/m^3. The data, from 2000-2003, is based on the Nordic electricity mix. There are major variations between the companies in certain areas, and it has not been possible to explain these differences entirely, although the type of drying process used is a critical factor.

There are two main types of drying plant used in the commercial production of sawn timber in Norway: the batch kiln and the progressive kiln. In a batch kiln, batches of sawn timber are placed inside, the doors are closed and the heating begins, with moisture also added to the air. Gradually during the process, the air humidity is changed to create a drier climate. In a progressive kiln, sawn timber is conveyed continuously through different climate zones. The climate is kept constant in each zone, with the wood moving through the different zones over the course of the drying time. Since the progressive kilns have a constant climate, they are ideal for the installation of heat exchangers, and will thus consume less energy. Since this is a continuous process, it also avoids the energy hungry warm-up period that is required in a batch kiln. As a rule, progressive kilns are used for large quantities of single species wood, while batch kilns are often used for specially adapted wood.

The study also shows that the drying process accounts for around 80% of energy consumption, with 20% going towards the heating needs in the production premises and other buildings. Potential energy efficiencies in the Norwegian companies amount to around 6.5% savings in the form of optimising the drying process (approx. half of the saving) and insulation of the drying system and connecting pipes (approx. half of the saving).



Kilde: Bransjenettverket 2001

Figure 1 to the left is taken from a presentation by Henning Horn[107] and shows the distribution of energy sources in Norwegian energy consumption. The energy source is primarily biomass used in biofuel incineration plants. There are good grounds to believe that the proportion of biomass is also very high in the rest of the Nordic region.

[107] http://www.klimatre.no/uploads/KlimaTre/Presentasjoner/101111%20Fagdag%20biprodukter/101111%20Henning%20Horn.pdf

Another, more recent, Norwegian study[108] (Silje Wærp et al., 2009) shows that energy consumption for 1 m^3 Norwegian timber up to the sawmill (cradle to gate) is approx. 193 MJ. If one includes production at the sawmill, where drying (1516 MJ/m^3) is a significant component, the average energy consumption is around 1709 MJ/m^3 up until the finishing of the wood. Timber "extraction" thus accounts for just over 10 percent of energy consumption up until the finishing stage. The figures are closely aligned with the ENØK study described above, and are likely to derive from the same source. Figure 2 below shows the system limits for these figures.

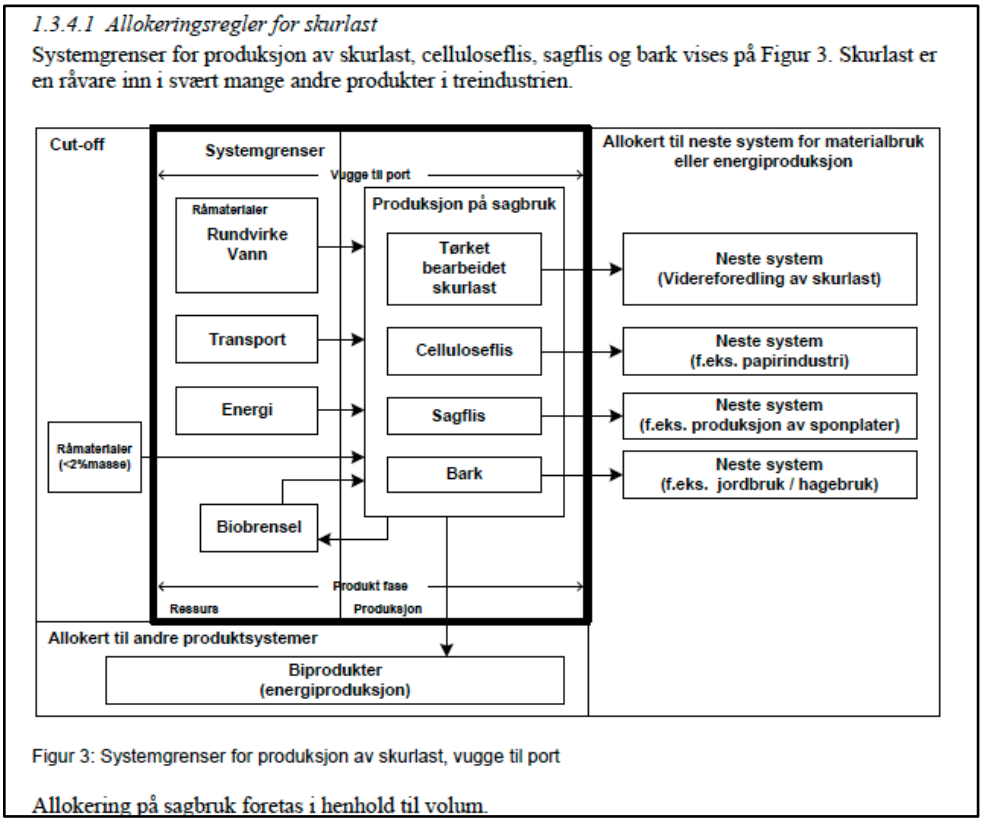


Figure 2. System limits for production of sawn timber, cradle to gate (source: SINTEF Byggforsk)

Figure 3 below[109], taken from Jungmeier et al., shows different ways of calculating energy consumption used for the production of construction timber, according to how energy consumption is allocated to the different products from the sawmill. In the allocation to the left, the sawmill is divided into different separate processes, where all the steps are considered as co-products, with the intention of preventing individual allocations. In the right-hand section of the figure, all environmental impact is allocated to the sawn timber, with the various processes at the sawmill gathered into one process. The functional unit is MJ/m^3.

[108] Silje Wærp et al., Livsløpsanalyser av norske treprodukter, MIKADO, SINTEF Byggforsk, 2009. Norway.
[109] Jungmeier, G. et al, Allocation in Multi Product Systems – Recommendations for LCA of Wood-based Products

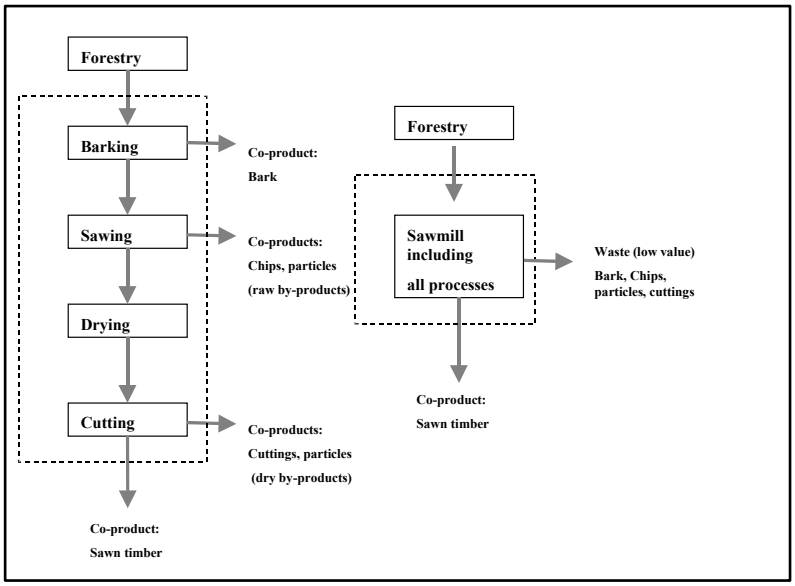


Figure 3. Different allocation of energy consumption to different products from sawmill (source: Jungmeier et al.)

If one takes the energy consumption allocated to one product, sawn timber, the total energy consumption at the sawmill is 1580 MJ/m^3 timber. The data is taken from Anderson[110] (1996) and Jarnehammar (2000)[111]. In addition to this, there is the energy for forestry and transport, plus the inherent energy (calorific value) in the actual wood. Adebahr, 1995 puts forestry at around 165 MJ/m^3 and transport at around 270 MJ/m^3.[112]

Outline of future energy requirements

The next revision of the criteria should set level requirements for maximum permitted energy consumption for the drying and production of the wood as well as energy consumption for chemicals used for modification. The requirement should be set in MJ/m^3 on an annual basis. A requirement should also be set for the maximum permitted proportion of fossil energy sources used.

[110] Andersson, B-I, (1996) Environmental declaration for sawn timber, Trätek.
[111] Jarnehammar, A. LCA for "multi-layer parquet flooring in Life Sys Wood. Trätek. (2000).
[112] Adebahr, 1995, Energy consumption for roof building related to 1 m³ structural timber

Appendix 5 Background to requirements on undesirable substances in chemical products

Requirement O6 which lists undesirable substances has been introduced. Below is a brief background to the ban for each of the substances:

Substances of Very High Concern and the Candidate List

Substances of Very High Concern (SVHCs) are, as the name suggests, substances that require great caution due to their inherent properties. They meet the criteria in Article 57 of the REACH Regulation: Substances that are CMR (category 1 and 2 under the Dangerous Substances Directive 67/548/EEC or category 1A and 1B under the CLP Regulation), PBT substances, vPvB substances (see section below) and substances that have endocrine disruptive properties or are environmentally harmful without meeting the criteria for PBT or vPvB. SVHCs may be included on the Candidate List with a view to them being inscribed on the Authorisation List, which means that the substance becomes regulated (ban, phasing out or other form of restriction). Since these substances face being phased out or banned, it is logical for Nordic Ecolabelling not to permit this type of substance in ecolabelled products.

A substance may meet the criteria for SVHC without being included on the Candidate List, so there is no direct equivalence between SVHC and the Candidate List.

To avoid cross-references between PBT, vPvB, CMR and endocrine disruptors, instead of excluding SVHC (which does cover some CMR, PBT, vPvB, etc.) Nordic Ecolabelling chooses to exclude from use the substances on the Candidate List and to separately exclude PBT, vPvB and endocrine disruptors. This should still cover all SVHC substances.

PBT-substances and vPvB-substances

"Persistent, bio accumulative and toxic (PBT) organic substances" and "Very persistent and very bio accumulative (vPvB) organic substances" are substances whose inherent properties are not desirable in Nordic Swan Ecolabelled building products. PBT- and vPvB- substances are defined in Annex XIII of REACH (Regulation 1907/2006/EC). Materials that meet or substances that form substances that meet the PBT or vPvB criteria can be found at: http://esis.jrc.ec.europa.eu/

Substances "deferred" or substances "under evaluation" are assumed not to have PBT or vPvB properties.

Potential endocrine disruptors

Potential endocrine disruptors are substances that may affect the hormone balance in humans and animals. Hormones control a number of vital processes in the body and are particularly important for development and growth in humans, animals and plants. Changes in the hormone balance can have unwanted effects and here there is an extra focus on hormones that affect sexual development and reproduction. Several studies have shown effects on animals that have been traced to changes in hormone balance.

Emissions to the aquatic environment are one of the most significant routes for the spread of endocrine disruptors[113].

Nordic Ecolabelling bans the use of substances that are considered to be potential endocrine disruptors, category 1 (there is evidence of a change in endocrine activity in at least one animal species) or category 2 (there is evidence of biological activity related to changes in hormone balance, in line with the EU's original report on "Endocrine disruptors" or later studies[114], see http://ec.europa.eu/environment/endocrine/documents/final_report_2007.pdf.

This entails a ban on substances such as bisphenol A, several phthalates and certain alkylphenols.

APEO[115,116,117]

Alkylphenol ethoxylates and alkylphenol derivatives, i.e. substances that release alkyl-phenols on degradation, must not be used in ecolabelled chemical building products. APEOs can occur in binders, dispersants, thickeners, siccatives, anti-foaming agents, pigments, waxes, etc. APEOs have a host of properties that are problematic and harmful to health and environment. They are not readily degradable according to standardised tests for ready degradability, they tend to bioaccumulate and they have been found in high concentrations in waste sludge. Degradation products of APEOs, alkylphenols and APEOs with one or two ethoxy groups are very toxic to aquatic organisms and certain alkylphenols are suspected of being endocrine disruptors. Alkylphenols and bisphenol A are among the more potent chemicals with oestrogen effects that may occur in wastewater.

Halogenated organic substances

Organic substances that contain halogenated substances such as chlorine, bromine, fluorine or iodine must not appear in chemical products. Halogenated organic substances include many substances that are harmful to health and the environment, in that they are very toxic to aquatic organisms, carcinogenic or harmful to health in some other way. Halogenated organic substances persist in the environment, which means they pose a risk of having harmful effects. This means that brominated flame retardants, chlorinated paraffins, perfluoralkyl compounds (PFOA and PFOS) and certain plasticisers are not permitted in chemical products for Nordic Swan Ecolabelled durable wood.

Heavy metals

Heavy metals or compounds thereof: cadmium, lead, chromium VI, mercury and arsenic must not be present. It is acceptable for ingoing substances to contain traces of these substances, deriving from impurities. The trace quantities of the individual heavy metal must not exceed 100 ppm (0.1 mg/kg, 0.01% by weight) in the raw material.

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[113] Miljøstatus i Norge, 2008
[114] http://ec.europa.eu/environment/endocrine/documents/final_report_2007.pdf
http://ec.europa.eu/environment/endocrine/documents/bkh_report.pdf#page=1
http://ec.europa.eu/environment/endocrine/documents/wrc_report
http://ec.europa.eu/environment/docum/pdf/bkh_main.pdf
[115] Substitution af alkylphenolethoxylater (APE) i maling, træbeskyttelse, lime og fugemasser, Arbejdsrapport fra Miljøstyrelsen Nr. 46, 2003
[116] Nonylphenol og nonylphenolethoxylater i spildevand og slam, Miljøprojekt nr. 704, 2002
[117] Feminisation of fish, Environmental Project no. 729, Miljøstyrelsen, 2002

Chromium
Chromium (III) and chromium (VI) are used, inter alia, in chrome plating, dyes and pigments. Chromium (III) is essential, i.e. living organisms need chromium. The effects of the various forms of chromium differ. All chromium compounds are toxic.

However, the most harmful effects are associated with chromium (VI) in particular, this being a carcinogen and an allergen. A number of chrome compounds are on the Danish EPA's list of undesirable substances. Accordingly, it continues to be relevant to prohibit chromium in the criteria.

Arsenic
The risk associated with the disposal arises primarily when private households incinerate wood waste treated with arsenic. An unacceptable risk was also ascertained in connection with impact on organisms living in aquatic environments in certain seawater areas. Based on this risk assessment, the Commission's Directive 2003/2/ EC of January 6th 2003 relating to restrictions on the marketing and use of arsenic, prohibited the use of arsenic-treated wood for consumer purposes (e.g. for fences and as construction timber).

Lead
Lead is a toxic heavy metal with both acute and chronic health and environmental effects. Lead is acutely toxic for aquatic organisms and mammals. Lead gives chronic toxic effects in many organisms, even in small concentrations. Chronic lead poisoning may have neurotoxic and immunological effects and cause damage to the blood-forming system in warm-blooded animals. Lead compounds can cause fetal damage and possible risk of reduced reproductive capacity. There has also been conducted much research on children's exposure to lead in low concentrations. It is suspected that exposure to lead can affect children's intellectual development.

Cadmium
Cadmium and cadmium compounds are both acutely and chronically toxic to humans and animals. Most cadmium compounds are carcinogenic. Cadmium can accumulate and be stored in fish and animals. When cadmium has entered the body, it takes a very long time before it is excreted from the body. Small amounts can damage the liver, lungs, kidneys and bones. Cadmium can also damage the ability to have children and cause damage to the fetus[118].

Mercury
Mercury can accumulate in animals and humans. It can damage the nervous system and kidneys. High levels in maternal blood, can cause birth defects. Mercury can also provide a contact allergy. The organic mercury compounds are most toxic. Mercury poisoning can also occur if you inhale mercury vapours.

[118] Nettstedet Er det farlig: http://www.erdetfarlig.no