About Nordic Swan Ecolabel

Window replacement

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Nordic Ecolabelling

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1 Summary

Large amounts of glass waste from the construction sector goes to landfill instead of being reused or recycled. The number vary from around 50% (Sweden) to 70% (Norway) up to 100% (Iceland)[1]. Lifecycle calculations from independent third party show that greenhouse gas emissions are reduced by 50% and energy consumption is reduced by 30%, if the float glass/window glass is recycled into new float glass in windows compared to if new raw materials are used in window production (which is standard practice in the industry today)[2]. Furthermore, the global deposits of sand that is of sufficient quality for float glass production is estimated to only last for another 50 years. These are the main environmental potentials identified for the product group and the most critical requirement to succeed with. This gives the Ecolabelled service a strong contribution to circular economy and reduced climate impact.

Nordic Ecolabelling wishes to promote circular business models and developed the criteria during 2024. Companies that offer window replacement on the Nordic market can be Nordic Swan Ecolabelled. The service is not restricted to certain building types. The clients will typically be private individuals (B2C) or professional building owners (B2B).

This first generation of the criteria for replacement of windows has the following key requirements:

- Identification of hazardous materials. Identifies any hazardous materials in both the windows and the installation materials used in the existing building.
- Recycling of float glass. Ensures that float glass identified as suitable for reuse is prepared for and sent to recycling into new float glass.
- Nordic Swan Ecolabelled Windows: Ensures that minimum 80% of the new windows installed are certified according to the Nordic Swan Ecolabel[3] to ensure high energy performance and low environmental impact (e.g. the materials used in the production of the window)*.
- Chemical products and construction products used for installation: Set strict requirements for the content of any harmful chemical substances in the products used in installation.
- Quality control of the installation. Ensures that proper self-monitoring is conducted thereby aiming to ensure a high-quality installation.

** Excluding Windows with the following special requirements: Fire, noise, 2-glas products for holiday homes, laminated glass and hardened glass.*

[1] Ökat Cirkulär Användning av Planglas, RISE Research Institute of Sweden, 2020. Vil samle inn flere ruter - Glass og Fasadeforeningen (glassportal.no),
[2] Increased circular use of float glass, RISE, 2020.
[3] https://www.nordic-swan-ecolabel.org/criteria/windows-and-exterior-doors-062/

2 Justification of the requirements

This chapter outlines the background and justification for the requirements in the first generation of the criteria for Window Replacement. The requirement text is found in the criteria document.

2.1 Background for the product group definition

The product group is defined in chapter 2 "What service can carry the Nordic Swan Ecolabel". This chapter contains more information on the background for product group definition.

Windows and window doors (e.g. balcony and terrace doors) are covered by the harmonized product standard EN 14351-1 and can be Nordic Swan Ecolabelled. In window replacement cases there can also be products that are not covered by this standard: rooflights according to EN 1873 and EN 14963; curtain walling according to EN 13830; industrial, commercial and garage doors and gates according to EN 13241; internal pedestrian door sets according to EN 14351-2; revolving door sets, power operated pedestrian door sets according to EN 16361. All types of window glass handled in the service are subject to all requirements expect O10 that only covers products handled in EN14351-1.

The focus of these criteria is to establish a circular business model with a circular material flow of float glass into new float glass.

Renovation of old or broken windows is an existing service where wooden parts of the window is exchanged and repaired. The old window is also often upgraded with an insulation glass to a better energy performance. Nordic Ecolabelling acknowledges that renovating and upgrading older windows can in many cases be more resource-saving than replacing and installing new ones. Windows manufactured before the 1950s can be of such good quality that it is wise to insert an insulating pane to improve the energy performance of the windows and thus the building. Another advantage of renovating existing windows is that you retain the appearance of the windows, which is important for the character of the building.

However, Nordic Ecolabelling sees a large potential in improving the environmental profile of the replacements conducted in the current Nordic market. Changing windows is one of the most common measures in remodelling and renovation and one of the most climate-impacting[4]. A very large share of the windows currently replaced are from the 60's and 70's. These often do not have the quality to be repaired and in addition there is a relatively high risk that they contain hazardous substances. For these types of windows, the potential for renovating and energy upgrading is low. Furthermore, the installation companies that conduct numerous window replacement and have this as their core business are typically not performing renovation / upgrading of the existing windows. This is also the companies where it is reasonable to have a very organized setup for handling the window glass due to the amounts generated. A carpenter conducting a window replacement now and then will typically not be a potential licensee. Nordic Ecolabelling sees that the decision to replace or

[4] Cirkulära materialflöden i glasbranschen, IVL, rapport Nr B2450, september 2022.

renovate is out of our steerability as the companies that we expect to have as licensees are not performing both services.

also be treated confidentially.

2.2 General requirements

Background to requirement O1 Description of the service

This requirement aims at describing the basics of the service. In addition, it ensures a clear overview of the responsibilites for different processes within the company and any subcontractors used. This requirement is necessary for Nordic Ecolabelling to provide an efficient certification process and understand the service in question. As described in the product group definition these criteria focus on window replacement services and not window renovations.

Prior to replacement

This section sets the framework for the work that must be done prior to the actual window replacement.

Background to requirement O2 Measurement of new windows and doors

Faulty productions of windows and window doors are a common issue in the industry and an unnecessary waste of resources. After dialogue with the industry Nordic Ecoabelling sees a potential for ensuring that windows are measured correctly to minimize faulty productions. The best means of ensuring this is to require that all windows must be measured by a professional working for the installation company. The maginitude of the potential environmental benefit is hard to quantify, but as this is a commonly known problem in the industry, it is considered that this requirement will have an actual effect on the market. A procedure for conducting measurements of windows and doors must be handed in to verify that the licensee has a defined setup for measurements.

Background to requirement O3 Identification of hazardous materials[5],[6],[7]

Older buildings may have been constructed using materials containing various hazardous substances. In the case of windows and the associated installation materials, the use of PCB, asbestos, chloroparaffins, and heavy metals is a common issue. PCB and asbestos have been used in the production of windows from the1950's to 1980's in the Nordic, but there are national variations. Chloroparaffins we used in window production in the 1980's. Heavy metals are typically found in paints. Asbestos, PCB and chloroparaffins (SCCP and MCCP) can be found in materials used during installation, e.g. the soft sealants that have been used to seal the area between window and building. During a window replacement or larger renovation, it is critical that the risk related to these

[5] Metoder til fjernelse af miljøproblematiske stoffer – Udredning af teknologier til identifikation og fjernelse af miljøproblematiske stoffer og materialer fra bygninger til nedrivning eller renovering. Miljøprojekt nr. 1656, 2015. https://www2.mst.dk/Udgiv/publikationer/2015/03/978-87-93283-86-2.pdf
[6] Materialeatlas. InnoBYG projekt fra 2016. https://www.innobyg.dk/media/75876/materialeatlas.pdf
[7] https://www.dmr.dk/miljoescreening-bygningsundersoegelse/miljoekortlaegning-miljoefarlige-stoffer/

hazardous substances is identified and eliminated. Depending on the substances, they pose a risk to the environment and/or human health.

Nordic Ecolabelling are convinced that the handling of hazardous materials can be improved in the industry. Especially in the case of smaller construction projects, it is found that sufficient investigations are not always performed[8]. The ecolabelled service must ensure that such materials are identified and handled properly either by an existing hazardous material survey or a hazardous material screening of the specific building parts. Due to the rapid changes in regulations and knowledge within the field of environmental surveys, a previously conducted survey must not be more than three years old.

Nordic Ecolabelling have found that the identification of Chloroparaffins (SCCP and MCCP) in windows is currently not done to a sufficient extent in large parts of the Nordic. Sampling and analysis can be difficult as the substances are typically present between the layers of glass. In addition, there is currently no overview of which producers and in what timeframe the substances have been used. Svensk Planglasförening and Glasbranschföreningen in Sweden is currently assessing the situation in Sweden regarding chloroparaffins. Ruteretur in Norway have conducted the assessment "Kartlegging av isolerglasslim"[9] and have concluded the windows produced after 1990 can be handled as non-hazardous waste. However, the assessment in fact found windows with Chloroparaffins in windows from 2020. In these criteria for Window replacement, it is a clear requirement that all hazardous materials/waste must be identified and handled in accordance with the legislation

The high risk associated with the soft sealants between window frame and the building means that material samples must always be taken of the window sealant and any exterior caulk must be analysed for asbestos.

The survey must include the list of substances that are harmful to human health and the environment, according to the requirements/recommendations of the national authorities, national guidelines, and industry standards. The national legislation must have implemented Commission Decision 2000/532/EC establishing a list of hazardous waste, Commission Regulations (EU)1357/2014 replacing Annex III to Directive 2008/98/EC and (EU)2017/997 amending Annex III to Directive 2008/98/EC. The methods used can include both analysis of samples and e.g. risk assessments based on reports/surveys that have determined the presence of certain substances (PCB, asbestos, chloroparaffins etc.) for the material in question based on e.g. production year or producer. If there is suspicion of hazardous substances and the content cannot be determined by the methods mentioned above, the material in questions must be handled as hazardous waste as required in national legislations.

Background to requirement O4 Identification and marking of window glass

Recycled glass intended for manufacturing of new float glass is very sensitive to contamination. For example, a few grams of aluminium per tonne of glass pulp

[8] Boverket, Uppdrag att förbättra kunskapsnivån om hantering av asbest i byggnader, Rapportnummer: 2023:14

[9] Kartlegging av isolerglasslim, 2023, Ruteretur, Kristin Runde (prosjektleder), Guro K. Milli-Solheim (kvalitetssikrer) og Sverre Valde

can cause bubbles in the float glass, and lead to a loss of several days of production. In addition, not all types of float glass are suitable for recycling.[10] Depending on the recycling facilities preconditions, simple float glass, insulating glass, heat-hardened glass and laminated safety glass are often mentioned as recyclable. Examples of non-recyclable glass products are fire-resistant glass and wire glass[11].

The first step in the recycling process is an inventory of the available float glass. This basically means that all glass must be correctly identified and marked correctly. To achieve an economically viable and quality-assured recycling of window glass, it must be ensured that the inventory is carried out by a competent technician. Hence, Nordic Ecolabelling have therefore defined a competence requirement covering both identification of the type of glass and any potential hazardous substances in the glass / window frame (partly handled in O3). This includes all hazardous substances regulated by national legislation e.g. PCB, asbestos and chloroparrafins.

The Swedish industry's joint technology and training centre “Glascentrum”, has developed a new training course for glass inventors[12]. The aim is that, after completing the training, you should be able to carry out an inventory of flat glass in the interior and exterior of the building for recycling/reuse. The training focuses on knowledge and methods for identifying glass and carrying out an inventory. It is essential to be able to distinguish between glass that can be recycled and those that today cannot be recycled into new flat glass. Currently, similar courses have not been identified in the other Nordic Countries, but as the industry evolves, we expect this to happen. According to our information participants from Norway has already taken the course. Based on consultation input and the Danish glaziers' education is also considered as sufficient education. Other courses must be approved by Nordic Ecolabelling.

Background to requirement O5 Handling of identified hazardous materials[13]

The hazardous material survey/screening aims to identify all hazardous materials relevant for remediation The remediation firm or internal personnel conducting the remediation work is responsible for choosing the method for the removal, storage, and transport of the hazardous waste. There may be multiple removal methods available, but the choice of most appropriate method often depends on the equipment available to the remediation firm or personnel conducting the work.

After dialogue with the industry, it has been identified that remediation is not always handled properly – especially in the case of smaller projects (e.g. work on private houses). This requirement is a mean of verifying that remediation is performed before the window replacement work continues.

[10] Email correspondence with a leading float glass producer in Europe.
[11] Suomen tasolasiyhdistys, Kierrätys, https://www.tasolasiyhdistys.fi/lasitietoa/kierratys/
[12] https://glascentrum-mtk.se/utbildningar/
[13] Metoder til fjernelse af miljøproblematiske stoffer – Udredning af teknologier til identifikation og fjernelse af miljøproblematiske stoffer og materialer fra bygninger til nedrivning eller renovering. Miljøprojekt nr. 1656, 2015. https://www2.mst.dk/Udgiv/publikationer/2015/03/978-87-93283-86-2.pdf

The Housing Authority in Sweden (Boverket) has carried out an investigation[14] about the state of knowledge about asbestos management in the construction industry, which showed major knowledge gaps. Ignorance, time pressure and other factors often mean that the inventory and remediation of asbestos is not done at all or takes place in an incorrect way, which implies major health risks for the professionals on the construction site.

Nordic Ecolabelling expects that in some cases the hazardous material screening will not show any findings that lead to the necessity to hire a remediation contractor on site. This strongly depends on the buildings construction method and the products used in the joint between the window frame and wall. If wooden lists are e.g. used instead of chemical sealants the likeliness of hazardous materials is significantly lower. The licensee must describe when and how internal and external personnel is used for handling of hazardous waste. This includes accounting for the qualifications of relevant personnel. Relevant courses within work environmental education can be an example of relevant education. Being educated solely as e.g. carpenter or glazier is not considered as sufficient education.

Background to requirement O6 Moisture and ventilation assessment[15]

Replacement of windows can affect the existing building's indoor climate, primarily due to their higher level of air tightness. In order not to damage the existing building and create mould and moisture problems, this issue should be taken into consideration before the windows are replaced.

An example is properties with self-drafting, where new airtight windows can affect the house's ventilation and thereby can cause issues with moisture in the indoor climate. Ultimately it can lead to mould damage or that it is necessary to invest in a new ventilation system.

Another general challenge is that it is normally necessary to have a controlled source of supply air as buildings usually have exhaust air in kitchens and bathrooms. Too much exhaust air compared to the air supply causes a negative pressure which would draw cold air from outside through cracks and leaks inside. In the long run this causes moisture damages in these places. This balance can be affected if all windows in the building are replaced.

It needs to be fulfilled that information and guidance on the effects of the window replacement on moisture and ventilation in the building are given to the end-customer. It is better to identify a potential issue with moisture/mould before the installation is conducted. A potential for improvement is seen compared to the standard practice in the industry that can be verified through specific assessment of all individual window replacement cases.

[14] Boverket, Uppdrag att förbättra kunskapsnivån om hantering av asbest i byggnader, Rapportnummer: 2023:14
[15] Boverket, Risker med fönster och dörrar, https://www.boverket.se/sv/byggande/forebygg-fel-brister-skador/risker/risker-fuktskador/fuktrisker-yttervaggar/fasadmaterial-ytskikt/risker-fonster-dorrar/

2.3 Circular Economy

Background to requirement O7 Storing and packaging of windows and windows doors

The basis of an effective circular recycling service is that the raw materials (e.g. glass) can be collected efficiently and safely. If pick-ups of material must be cancelled due to problematic storage locations or glass is broken during transport, the environmental benefit of the recycling will be diminished or become economically unfeasible. Dialogue with the industry has shown that this can be a challenge.

Nordic Ecolabelling sees a potential in ensuring clear instructions for the licensee to ensure efficient collection by the waste contractor.

Background to requirement O8 Recycling of float glass

The environmental benefits of recycling float glass are great. The production of float glass is both resource- and energy-intensive. In the production of float glass with virgin raw materials, sand, lime and soda are melted down in a furnace at approximately 1500 °C. If recycled flat glass is used instead, the energy requirement for melting the raw materials can be reduced by 30%, and the CO_{2e} emissions by over 50%. Each ton of glass shards reduces the need for virgin raw materials by more than 1.2 tons.[16],[17]

The enormous amount of sand mining in the world, which is the main component of glass, has led to major ecological and humanitarian consequences. Because sand from the desert is too smooth to be used in the manufacture of glass and concrete, the raw material is usually mined from rivers or sea beaches and seabeds. This happens at a higher rate than new sand is generated, as it is formed by erosive processes over thousands of years. Especially, sand used for the production of float glass has very high purity requirements and only a fraction of the world's sand resources are usable for this. Peak sand is an issue of concern and some experts fear the raw material to run out in 50 years.[18,19]

Large amounts of glass waste from the construction sector goes to landfill instead of being reused or recycled. The number vary from around 50% (Sweden)[20] to 70% (Norway)[21] up to 100% (Iceland)[22]. There is a lot of raw material available, but it is a challenge for the recycling industry that landfill is the cheapest way of handling glass.

The recycling process consists of many steps and partly involves manual work. Some processes can lead to losses of the raw material, for example glass remaining in frames in the separation process. Minor losses of the dismantled float glass caused by the facilities preconditions do not need to be accounted for in the requirement. The same applies to dismantled windows that the licensees customer wishes to keep for the purpose of own reuse or selling on the reuse

[16] 2020: Ökat Cirkulär Användning av Planglas, RISE Research institutes of Sweden;
[17] Suomen tasolasiyhdistys, Kierrätys, https://www.tasolasiyhdistys.fi/lasitietoa/kierratys/
[18] 2014: Sand, rarer than one thinks, UNEP
[19] Nature, Time is running out for sand, https://www.nature.com/articles/d41586-019-02042-4
[20] Ökat Cirkulär Användning av Planglas, RISE Research Institute of Sweden, 2020.
[21] Vil samle inn flere ruter - Glass og Fasadeforeningen (glassportal.no)
[22] Mail correspondence with 3 recycling companies from Island

market. Fire resistant glass, wire glass, float glass contaminated with PCB or FA (Fluoroacetate) is exempted from this requirement as it can currently not be recycled. Nordic Ecolabelling will follow the development of this closely in the future.

The current situation in the Nordic is that a collection system is available in more or less the whole of Sweden whereas the situation in the other countries is different. In Finland the possibility to recycle dissmantled window glass to new float glass is possible through the collaboration between the construction sites waste contractor and Uusioaines Oy, the biggest glass recycling facility in the country. In Norway dialogue with the industry shows that recyling of float glass into new float glass is under consideration but currently no plans of implementation are available. Norway already has a very well functioning system (Ruteretur) for collection of PCB contaminated windows where the glass is currenlty send for recycling into glass wool. In addition, Ruteretur are now considering to start collection of non-contaminated double glazed windows. Nordic Ecolabelling sees a potential for Norway's collection systems to be a source of float glass for recycling ot new float glass in the future. In Denmark there are currently no plans for sending float glass seperated from window frames for recycling to manufacturing of new float glass. However, based on the environmental potential and the future lack of suitable sand we expect that this will happen in the future.

Nordic Ecoalbelling recognizes that it can be a challenge for the producers of glass wool if significant amounts of float glass is recycled into new float glass. However, the purpose of this requirement is to keep the glass at the highest possible state of the waste hierachy therey preserving the quality of the ressoruce. In addition, there a large amounts of float glass currently send for landfill available in the market, that is currently send for landfill. The solution for the industry could therefore be to increase the amount of glass recycled to solve this problem.

The requirement is designed to verify the route of the float glass to promote that it is used for new float glass to as high an extent as possible. Due to the lack of certification systems or similar, it is based on agreements and confirmations from waste management company and producers. In addition, a threshold limit is set to verify that the glass send to the float glass producers are actually used for float glass production and not discarded. Threshold limit is set after dialogue with the industry.

Hazardous materials can potentially be present in both the window and the installation materials. Materials and windows/doors classified as hazardous waste must be stored on site in a secure way and transported by waste contractors with accurate permit for transportation. In addition, the receiver(s) of the hazardous waste must have permission for handling of hazardous waste.

Background to requirement O9 Waste management

When the old windows are removed and new ones are installed, waste is generated on site. This waste needs to be sorted and handled in a way that gives opportunities for material recycling but also minimizes the risk of local environmental impact.

When windows are replaced on single family houses (B2C) normally only very small amounts of waste are generated. The requirement covers the four most common fractions; wood (various remains of wood material. lining, frame, painted wood and wooden boards), mineral wool, aluminium (e.g. windowsills and frames) and plastic materials (mainly packaging). The remaining must be sorted for incineration.

When windows are replaced on professional properties the waste can be sorted and handled according to the waste sorting system on the construction site. This system will in many cases offer a greater number of material fractions to be sorted but can never be less that what is generally required. It needs to be fulfilled that the licensee has written waste routines that cover the various types of waste that arise.

It is accepted that some fractions are sorted by the waste management company after collection of the waste, if this can be documented in a waste report. This can be relevant in minor window replacement cases where sorting on site in many fractions, in some cases, can be challenging.

2.4 New windows and installation materials

Background to requirement O10 Nordic Swan Ecolabelled windows

Nordic Swan Ecolabel windows and external doors:

- Have a low climate impact due to low energy losses through the window/door
- Meet strict requirements for materials and chemicals
- Must document good function and quality
- Offer a long service life
- Contribute to circular economy through design for disassembly, take-back systems, recycling of float glass and waste management
- Have good instructions for installation and maintenance

Further details can be found in the background document for Nordic Swan Ecolabel windows and external doors: https://www.nordic-swan-ecolabel.org/criteria/windows-and-exterior-doors-062/.

Based on this Nordic Ecolabelling wishes to promote the use of ecolabelled windows by setting a minimum annual share of the number of replaced windows (80%) for the window replacement service. The steerability of the requirement is high as the annual status will be controlled. Windows with the following special requirements can be excluded from the calculation: Fire, noise, 2-glas products for holiday homes, laminated glass and hardened glass. These are excluded as it is more difficult to produce these windows with the same low U-values as the standard products. These products will therefore typically not fulfil the NSE requirements for Windows and exterior door. However, the national minimum U-values will off course still apply.

Due to the high share of ecolabelled windows in the service, the vast majority of installed standard windows with no special properties will be certified and controlled in detail in relation to all life cycle perspectives. Nordic Ecolabelling sees a low potential to further impacting the energy efficiency (U-values) of the windows with special properties. Therefore, no further requirements are set on

the energy efficiency of the remaining windows (apart from national legislation that always applies).

Nordic Swan Ecolabelled Windows and exterior doors are widely available in Sweden and Norway. Only one producer has available products in Denmark. No NSE windows and doors are available in Finland and in Iceland for the time being (autumn 2024).

The requirements for Nordic Swan Ecolabelled windows and doors have been tightened (generation 5 of the criteria was published in 2026) and the producers are therefore recertifying their products. The new requirements require larger technological changes at the producers that takes time. Due to this there is in the years 2026-2027 a smaller availability of Nordic Swan Ecoalbelled windows and doors. Therefore, the requirement level is temporarily lowered to 40 % until 31 March 2028.

Background to requirement O11 List of installation materials

The licensee must deliver a list of installation materials to account for all installation materials used. This is the basis for the requirement O12 Chemical products and construction products in installation. In addition, the list provides Nordic Ecolabelling with knowledge of the installation techniques used.

Background to requirement O12 Chemical products and construction products in installaion

Chemical – and construction products can contain harmful substances. Nordic Ecolabelling has specific knowledge on this issue due to the many Nordic Swan Ecolabelled new buildings that are certified every year. When installing windows a relatively small amount of installation material is used (sealant, insulation, wooden lists, tape, etc.). However, on an annual basis the service company will use a significant amount of material, and a significant number of buildings will be affected.

Furthermore, it is considered relevant to ensure that the final customer can rely on, that a Nordic Swan Ecolabelled service sets requirements for any harmful substances used during installation.

See background for appendix 1 for the specific details for the individual material requirements.

2.5 Quality and environmental management

Background to requirement O13 Quality control of the installation

The requirement aims to ensure a solid quality self-monitoring system for the Window replacement service. A low-quality installation can for instance cause lower lifetime of the windows, a less airtight building with higher energy demand and issues with moisture in the constructions. The requirement is designed to include the most critical elements in a typical window replacement and defines that both installer and supervisor must control the work performed. Important points to check are typically: air tightness, fixing of the windows, properly

performed insulation, control of rain density[23]. noise level (when a requirement from the end customer), and fire safety when relevant.

Thermography is an efficient way of ensuring proper installation of the windows. It will lead to identification of systematic mistakes and ensure good air tightness. Measurements must be conducted as random yearly samples in accordance with ISO 6781-1:2023. Interpretation of the results requires experience which is why a competence requirement of minimum three years' experience is set.

Background to requirement O14 Warranty

A guarantee/warranty is a voluntary commitment and always gives the consumer rights in addition to those that apply according to consumer law. The scope of the warranty and how long it shall apply must be clearly described in a durable and legible form for the consumer. A guarantee both for the installation work and different product guarantees covering the windows and window doors that are installed needs to be fulfilled. A warranty can be designed in many ways, but Nordic Ecolabelling set as a minimum requirement that states which parameters must be included.

A Nordic Swan Ecolabel service must have a good quality, and together with other requirements in the criteria, warranty is a factor that signals the product's lifetime and says something about what the customer can expect from the execution of the work and the product. However, warranty should not solely be equated with longevity, which is affected by many factors, including how careful and often the product is used.

For the Nordic Swan Ecolabelled windows, the bullets 2-4 are already covered by the requirements for Nordic Swan Ecolabelled Windows and doors.

Background to requirement O15 Annual reporting

Annual reporting is a mean of ensuring that core requirements in the criteria are always fulfilled. The two core requirements of the criteria are selected for the annual follow up. Furthermore, it provides Nordic Ecolabelling with detailed knowledge of any challenges with fulfilling these requirements.

Background to requirement O16 Information and training of personnel

The requirement covers the need for the licensee to define the training programme, showing the content and scope of the training/information. The aim is to provide information on the Nordic Ecolabelling requirements and how the requirements can affect standard processes and routines. All employees, supervisors, site managers, subcontractors and subcontractors involved in the service must have the relevant knowledge to be able to ensure fulfilment of the requirements in relation to the project.

Background to requirement O17 Planned changes and non-conformities

The requirement ensures that proper routine(s) are defined so that planned changes and unforeseen nonconformities will be handled in the licence period.

[23] Unngå byggskader ved innsetting av vinduer - SINTEF

Background to requirement O18 Customer complaints

The company must have an implemented customer complaint handling system. To document your company's customer complaint handling, you must upload your company's routine describing these activities. The routine should be dated and signed and will normally be part of your company's quality management system.

If your company does not have a routine for customer complaint handling, it is possible to upload a description of how your company perform these activities. During the on-site visit, Nordic Ecolabelling will check that the customer complaint handling is implemented in your company as described. The customer complaints archive will also be checked during the visit.

2.6 Appendix 1

Background for Appendix 1: Installation materials

This Appendix show all the requirements that must be meet for all chemical products and construction products.

The requirements are directly aligned with the following requirements in the criteria for Nordic Swan Ecolabel New Buildings (089, generation 4):

- O14 Classification of chemical products,
- O15 CMR substances
- O16 Preservatives in indoor paint and indoor varnish
- O17 Preservatives in other chemical products intended for indoor use,
- O18 Prohibited substances,
- O19 Nanoparticles in chemical products
- O25 Excluded substances in construction products, construction goods and materials.

All materials must be documented in Nordic Ecolabelling's supply chain declaration portal (SCDP).

Background to Classification of chemical products

Nordic Ecolabelling seeks to ensure that the health and environmental effects of chemical products are as low as possible. The requirements therefore specify that products classified as environmentally hazardous, highly toxic, toxic, carcinogenic, mutagenic or reprotoxic must not to be used.

The requirement concerns the classification of the actual chemical products and not the individual compounds in the products, which are governed by subsequent requirements.

There are a few exemptions from the prohibited classifications of chemical products where the functionality requires substances for which unclassified alternatives are not available.

Background to CMR substances (Chemical products)

In addition to the requirement concerning the classification of the chemical products, it is also required that chemical products cannot contain substances that are carcinogenic, mutagenic or reprotoxic (CMR substances cat 1A and 1B).

Nor may chemical products contain substances that are suspected to be carcinogenic, mutagenic or reprotoxic (category 2).

Substances that may cause cancer, change genetic material or interfere with reproduction 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.

There are a few exemptions from the prohibited classifications of chemical products where the functionality requires substances for which unclassified alternatives are not available.

Background to Preservatives in indoor paint and varnish, and other chemical products intended for indoor use

The requirement and the levels for highest permitted preservatives are partly harmonised with equivalent requirements in the criteria for Nordic Swan Ecolabel indoor paints and varnishes and for products for indoor use in the criteria for Nordic Swan Ecolabel chemical building products respectively. Levels for the highest permitted concentrations of the respective preservatives are partly the same as those that apply to Nordic Swan Ecolabel indoor paints and varnished. For all other chemical products for indoor use, the levels are the same as for Nordic Swan Ecolabel fillers, which is considered reasonable for a Nordic Swan Ecolabel building.

Updates for total preservatives and total isothiazolinone compounds in indoor paint and indoor varnish have been updated to 900 ppm and 600 ppm respectively, in accordance with corresponding updates for Nordic Swan Ecolabel indoor paints and varnishes.

Background to Prohibited substances (Chemical products)

Several harmful substances are banned in products used for Nordic Swan Ecolabelled Window replacement. This is to ensure a minimum impact on both health and environment but also to ensure the best possible potential in future reuse of building products.

The Candidate List identifies substances of very high concern which fulfil the criteria in article 57 of the REACH Regulation (EC 1907/2006). The list includes carcinogenic; mutagenic; and reprotoxic substances (CMR, categories 1A and 1B in accordance with the CLP Regulation); and PBT (persistent, bioaccumulative and toxic) and vPvB (very persistent and very bioaccumulative) substances (as defined in REACH Annex XIII). In addition, two more substance groups are included if they are of equivalent level of concern (ELoC) as the ones previously mentioned. These are endocrine disruptors and substances which are environmentally hazardous without fulfilling the requirements for PBT or vPvB. Based on these adverse characteristics, Nordic Ecolabelling prohibits substances on the Candidate List. This means that we act ahead of the legislation and ban the substances before they are subject to authorisation and restriction in accordance with REACH.

PBT and vPvB are abbreviations for substances that are persistent, bioaccumulative and toxic, and very persistent and very bioaccumulative,

respectively, in accordance with REACH Annex XIII. This means that they are not biodegradable and that they accumulate in living organisms. Based on these adverse characteristics they pose a threat to the environment and human health. They are prohibited in all Nordic Swan Ecolabel products/Services.

Endocrine disruptors (EDs) are chemicals that alter the functioning of the endocrine (hormone) system and consequently cause adverse health effects. The term potential EDs is used for chemicals with properties that make them suspected to be EDs. The hormone system regulates many vital processes in living organisms and when normal signalling is disturbed, adverse effects may result. EDs raise high concern for their risk of causing serious negative impact on the environment as well as on human health specifically. Special concern is raised for effects on reproduction and development and about possible links to increases in public health diseases. While effects in wildlife populations have been confirmed, evidence is pointing to effects also in humans.

Per- and polyfluoroalkyl substances (PFAS) are used in many types of products due to their water and dirt repellent properties. These compounds constitute a group of substances that have highly problematic intrinsic hazardous properties. They are extremely persistent and accumulate in the body. They are spread all over the globe, from the large oceans to the Arctic, and are found in e.g. wild birds and fish and their eggs. Also, shorter chain compounds (2–6 carbon atoms) have been discovered in nature. The substances in this group are suspected to be endocrine disruptors, carcinogenic and to have a negative impact on the human immune system. PFOA, APFO (ammoniumpentadecafluorooctanoate) and certain fluoro acids are included in the Candidate List due to being reprotoxic, as well as having PBT properties.

The non-ionic APEO group of surfactants are produced in large volumes and their uses lead to widespread release to the aquatic environment. APEOs are highly toxic to aquatic organisms and degrade to more environmentally persistent compounds (APDs). Ethoxylated nonylphenol and several other alkylphenols are included in the Candidate List due to endocrine disrupting properties.

Flame retardants are suspected of contributing to a number of unwanted health effects. Several of the substances are suspected of causing birth defects, cancer, and endocrine disrupting effects. Many of them are on the EU candidate list under REACH.

Many brominated flame retardants are persistent and bio accumulative chemicals that can now be found dispersed in nature. The focus on phasing out brominated flame retardants has led to the use of alternatives such as phosphorus and nitrogen-based flame retardants.

A number of phthalates are identified as endocrine disruptors and some of them are classified as reprotoxic. For these reasons several phthalates are included in the Candidate list. Based on their hazardous properties' phthalates pose a threat to the environment and human health and there is a ban on this group of substances.

Bisphenol A, CAS No. 80-05-7, is used as a monomer in, inter alia, the following relevant areas and products: Various plastic and epoxy mixes, various building parts, paint, varnish, glue (binding agents, hardeners) and polyol in the

production of polyurethane. Bisphenol A can be released into the environment from the production process. Bisphenol A (BPA) is on the Candidate List of substances that may have serious effects on human health and the environment, and the goal is to eliminate emissions by 2020. BPA is identified as damaging to the eyes, irritating to the respiratory tract, skin sensitizing and may also affect reproductive performance. The substance may be endocrine disrupting and is toxic to aquatic organisms. Bisphenol F and S can be used as substitutes for bisphenol A. A screening programme conducted to determine the occurrence of environmental toxins in surface water, sediment and biota in Norway found bisphenols A, F and S in the samples that were taken. These are substances with the same properties as bisphenol A26.

Nordic Ecolabelling restricts heavy metals because they are toxic to humans and other organisms, both on land and in the aquatic environment. Mercury, cadmium and lead are toxic to the human nervous system, kidneys and other organs, and the metals can accumulate in living organisms. Chromium (VI) is classified as very toxic, CMR and harmful to the environment.

Volatile aromatic hydrocarbons (VAH) are volatile organic compounds where one or more benzene rings are contained within the molecule, e.g. toluene, benzene, and xylene. VAHs are very stable and have a specific impact on the environment and human health, including damage to DNA28. Exposure to these products should be minimised. For this reason, no more than 1% by weight is permitted in the chemical product.

Organotin compounds mainly originated from antifouling paints, but more commonly used as catalysts in industrial production, stabilizers, biocides, and surface disinfectants. Organotin compounds are harmful and toxic to the aquatic organisms at low concentration and have been linked to adverse effects in humans, such as reproductive toxicity and therefore many of these compounds are listed as substances of very high concern.

An exemption is given for the use of naphtha-based primers and adhesives classified H411 for outdoor use (containing up to 20% by weight of VAH). This is needed to ensure proper attachment. No alternatives have been found.

Dibutyltin (DBT) compounds and dioctyltin (DOT) compounds is allowed in sealing products ≤5000 ppm (0.5% by weight) in the final product as no alternatives are currently available.

Background to Nanoparticles in chemical products

There is still uncertainty related to how nanoparticles affect health and the environment.[24] Nordic Ecolabelling wishes to take a restrictive approach to the use of nanoparticles and the requirement is based on the environmental consequences when nanoparticles are released to the surroundings (indoor environment or the surrounding environment, seen over the entire life cycle). The requirement concerns chemical products that are used for Nordic Swan Ecolabelled Window replacement and is in line with equivalent requirements concerning Nordic Swan Ecolabel chemical building products.

[24] European Council, Recommendation 2017 (2013), Provisional version, Nanotechnology: balancing benefits and risks to public health and the environment. Available on page: (21/5-13).

The definition of nanomaterials follows the European Commission's definition of nanoparticles[25], see Definitions.

The requirement means that newer nanomaterials produced with the intention of containing nanoparticles must not be used. Examples of such nanoparticles are fullerenes, carbon nanotubes, nano silver, nano copper and nano-titanium dioxide.

Background to Excluded substances in construction products, construction goods and materials

The requirement comprises two parts. First comes a description of which construction products are included, i.e., those for which the chemical content must be verified. The purpose is to focus on the most important construction supplies and thereby the material within the vapour barrier (moisture barrier), supplemented with known problematic material outside the vapour barrier. The second part of the requirement concerns a list of the substances/groups of substances that may not be contained in these construction supplies in quantities of 100 ppm or more.

The list is based on the general principles from Nordic Swan Ecolabelling regarding undesirable compounds in combination with corresponding requirements for other Nordic Swan Ecolabelled construction products. A few exemptions are made when deemed necessary for the quality and technical performance of the product.

For further detailed information on the specific substances and list regulated see the background text for Prohibited substances for chemical products.

3 Environmental impact of Window replacement

3.1 MECO analysis

To ensure that requirements are set in the entire life cycle of the service, a MECO (material, energy, chemicals and other impacts) analysis is performed. The following scheme shows the result of the mapping of environmental impacts in the raw material, production, use and end of life phase.

[25] COMMISSION RECOMMENDATION of 18 October 2011 on the definition of nanomaterial (2011/696/EU).

	Raw material	Production	Use	End-of-life
Material	Primary materials used for window production: sand for glass, wood, aluminium, and PVC. Other window materials: insulation, glue, filler gas etc. Materials for installation products such as such as glue, paint, putty and filler and many other building materials of solid texture such as sealing strips, insulation material (e.g. glass wool for insulation between the window frames and the wall), window sills and wooden interior lists.	Primary material used for window production are: sand for glass, wood for frame and cladding. Other materials such us aluminium, PVC, composites and steel are also used for frames. Energy for production of raw material and production of the window. Filler gas.	Wooden frames can (and often must) be refurbished. Oil, paint and putty are often used in refurbishment.	Glass: landfill or recycling. Wood: recycling or inceneration. Aluminium: recycling. PVC: recycling or landfill. Old and new Installation materials: recycling, inceneration and deponi. Strongly depend on the material in question and if it is contaminated or classified as hazardous waste. Leakage from windows of fillers gases with high GWP (Global Warming Potential).
Energy	Energy for glass, aluminium and PVC production. Energy for other materials, se above. Energy for wood production (from forest to sawmill). Fuel / electricity for vehicles.	Energy used for production of windows and doors.	High energy consumption due to heat loss through windows and doors.	Large loss of internal energy due to downgrading or deponi of float glass. Incineration of wood.
Chemicals and emissions	Chemicals and emissions related to PVC production, impregnation/treatment of wood and surface treatment of windows. Several different chemicals are used in the production of installation products, for details se criteria 089 New Buildings.	Emissions to air from impregnation and surface treatment in window production. Emssions related to the production of installation products.	Use of chemical products for maintenance purposes (e.g. paint). Very limited for windows with outer surfaces in aluminum or PVC.	Hazardous substances in existing materials and windows (e.g. PCB and asbestos) Emissions to air from combustion of waste/materials from windows and doors. Reduced material recycling due to content of hazardous chemicals in materials .
Other	Transportation of raw materials and windows. Transport of installation personnel. Loss of forest/biodiversity (forestry, mining, etc.).			

Reference list used for the MECO mapping:

a: 2022: Rapport B 2450 Cirkulära materialflöden i glasbranschen – Glasmästeriers samt glas- och metallentreprenörers specifika förutsättningar för cirkulära flöden i bygg- och fastighetssektorn, s. 17

b: 2020: Ökat Cirkulär Användning av Planglas, RISE Research institutes of Sweden

c: 2019: Time is running out for sand, Mette Bendixen, Nature

d: 2014: Sand, rarer than one thinks, UNEP

e: 2023: Materialgjenvinning og ombruk av vinduer og planglass, hvor stort er potensialet?, Glas og facadeforeningen, Per Henning Graff, https://www.byggemiljo.no/wp-content/uploads/2020/02/Dag-1_1455-1510_Per-Henning-Graff.pdf

f: https://www.ragnsells.se/om-oss/nyheter--press/inspireras/samarbete-mojliggor-cirkular-losning-for-planglas/, 2024

g: https://www.saint-gobain.com/en/news/when-old-windows-become-eco-friendly-insulation, 2024

h: https://arbetet.se/2022/01/10/var-finns-asbest-varning-for-fonster/ , 2024

i: https://www.boverket.se/sv/PBL-kunskapsbanken/teman/rivningsavfall/allmant-om-rivningsavfall-och-avfallshantering/kontrollplan/ , 2024

j: https://www.xn--fnsterrenoveringstockholm-yrc.nu/byta-eller-renovera-fonster, 2024

k: https://www.svenskfast.se/guider/energideklaration/ , 2024

l: https://glassforeurope.com/from-sand-to-flat-glass/ , 2024

m: LCA, ”Whole Life Analysis of timber, modified timber and aluminium-clad timber windows”, 2013, Dr. Gillian F. Menzies, Heriot Watt University

n: LCA, «The influence of durability and recycling on life cycle impacts of window frame assemblies», 2016, Stephanie Carlisle and Elizabeth Friedlander

o: «Analysing the environmental impact of windows: A review», 2019, Jean Souviron et.al. Building and Environment

p: Project report, «Moderne trevinduer – funksjonalitet, levetid og design», 2009, Heidi Arnesen et.al. SINTEF Byggforsk

q: The Nordic Swan Ecolabelling criteria for New Buildings, generation 4, 2023.

r: Metoder til fjernelse af miljøproblematiske stoffer – Udredning af teknologier til identifikation og fjernelse af miljøproblematiske stoffer og materialer fra bygninger til nedrivning eller renovering. Miljøprojekt nr. 1656, 2015. https://www2.mst.dk/Udgiv/publikationer/2015/03/978-87-93283-86-2.pdf

s: Boverket, Uppdrag att förbättra kunskapsnivån om hantering av asbest i byggnader, Rapportnummer: 2023:14

t: Kartlegging av isolerglasslim, 2023, Ruteretur, Kristin Runde (prosjektleder), Guro K. Milli-Solheim (kvalitetssikrer) og Sverre Valde

u: Materialeatlas. InnoBYG projekt fra 2016. https://www.innobyg.dk/media/75876/materialeatlas.pdf

v: Miljøkortlægning af miljøfarlige stoffer i bygningsdele, DMR, 2024, https://www.dmr.dk/miljoescreening-bygningsundersoegelse/miljoekortlaegning-miljoefarlige-stoffer/

3.2 Relevance, potential and steerability analysis

Nordic Ecolabelling sets requirements concerning the topics and processes in the life cycle that have a high environmental impact – also called hotspots. R represents the environmental relevance; P is the potential to reduce the environmental impact and S is the steerability on how compliance with a requirement can be documented and followed up. The criteria contain requirements in those areas in the life cycle that have been found to have high RPS, since there is potential to achieve positive environmental gains.

Table 1: Summary of results of the RPS analysis. The aspects assessed to have high or medium relevance are those covered by requirements in the criteria.

Area	RPS level (high/medium/low)	Comment
Recycling of float glass	R= High P= High S= High	The relevance and potential for recycling of float glass to new float glass is high. Large amounts of glass waste from the construction sector goes to landfill instead of being reused or recycled. The number vary from around 50% (Sweden)[20] to 70% (Norway)[21] up to 100% (Iceland)[22]. Climate calculations show that greenhouse gas emissions are reduced by as much as 50% and energy consumption is reduced by 30% if the float glass/window glass is recycled compared to if new raw materials are used in window production (which is standard practice in the industry). This is the case even though the

Area	RPS level (high/medium/low)	Comment
		collected glass in the case investigated is transported from Sweden to Germany by truck.[26] In addition, sand of sufficient quality for float glass production is estimated to only last for another 50 years which makes float glass very relevant to material recycle.[18][19] Almost no float glass is currently recycled into new float glass in the Nordics. The glass is instead sent for landfill, glass wool production or packaging material. The steerability is considered high as the delivery of the existing float glass to the production facilities of new float glass can be documented.
Energy efficiency in use phase	R= High P= High S= High	Old windows are often associated with high U-values and poor insulation. In older buildings with double-glazed windows, the U-value of the windows is usually around 3.0 W/m^{2}K. The U-value of a newer insulating glass window is around 1 W/m^{2}K or even lower[27]. Replacement will result in significant environmental benefits. High relevance and potential are identified. A minimum requirement on the U-value can be set and easily documented with high steerability. This is handles by setting requirements for a very high share of Nordic Swan Ecolabelled Windows and exterior doors.
Environmental survey/hazardous substances	R= High P= High S= Medium/High	PCB, asbestos, and other hazardous substances are highly problematic and are not handled correctly in many renovations (especially in private housings or minor renovation projects). For asbestos and PCB these substances can be present in many buildings built or renovated before 1980.[14] Window replacement projects that currently do not conduct a hazardous material survey have a high potential to improve and thereby secure correct handling and removal of the hazardous substances. Hazardous material surveys and waste management reports can document the presence of substances and the handling of these substances. Steerability is considered medium/high.
Performance and environmental impact of the new windows	R= High P= Medium S= Medium	The relevance and potential to require new float glass made of recycled materials is in theory high, and it would enhance all the above-mentioned environmental benefits with assuring recycling of float glass to new float glass. However, the recycling system is not yet up and running in a large scale[28], meaning that the steerability is currently higher at the end of life for old windows. Requirements for recycled float glass can currently not be set for production of new windows. It is relevant to impose criteria on wood raw material due to the environmental impact from loss of forest/biodiversity. Wood can be sustainably grown and can be sourced from areas where forestry is certified according to a certification system. Steerability is good through requirements for certification and traceability along the processing chain. RPS is considered high. These requirements are handled through the high degree of Nordic Swan Ecolabelled Windows required (80%) for windows with no special requirements. Non-renewable materials: The environmental impact from energy used for material extraction and production is relevant. But the use phase of the window has a much larger energy consumption seen in a lifecycle perspective. High RPS is found for energy performance of the new windows (U-value)

[26] Ökat Cirkulär Användning av Planglas, RISE Research Institute of Sweden, 2020. Vil samle inn flere ruter - Glass og Fasadeforeningen (glassportal.no),
[27] Energimyndigheten, Energieffektiva fönster och dörrar, https://www.energimyndigheten.se/energieffektivisering/husguiden---for-dig-som-vill-energieffektivisera-ditt/minska-behovet-av-varme-och-varmvatten/fonster-dorrar/
[28] Dialogue with industry expert from Saint-Gobain

Area	RPS level (high/medium/low)	Comment
		which is described in RPS for the "Energy efficiency in use phase". There is medium RPS for setting requirements for the materials used in the window production such as aluminium, PVC etc. These requirements are handled through the high degree of Nordic Swan Ecolabelled Windows required (80%). Thereby ensuring ambitious requirements for e.g. wood, steel aluminium and chemical products used in production of the windows.
Installation materials and chemical products	R= Medium P= Medium S= High	During installation of the new windows, different chemicals such as glue, paint, putty, and filler are used. In addition, different building materials of solid texture such as sealing strips, insulation material (glass wool for insulation between the window frames and the wall), windowsills and wooden interior lists are used. Due to the limited amounts, the relevance is considered medium. There is a medium potential to set requirements on problematic chemical substances on e.g. sealants and building foam. The steerability is high as the purchased products can be documented by the producers in question.
Quality of the installation	R= medium P= medium S= medium	Technical installation quality: Correct installation is essential to avoid moisture problems, achieve the right air tightness and longest possible life span. Systematic quality assessment of the installation has the potential to improve the quality. RPS is medium.[23] Control measurement: Good knowledge about construction is needed to avoid mistakes in measurements of new windows. For example, what is behind the frames and lining affects the size of the window. If customers do the measurements themselves, the risk of faulty production increases and you may even have to throw away newly produced windows. The RPS is medium. Ventilation: In properties with self-drafting, new airtight windows can affect the houses ventilation. The risk for moisture problems after a window replacement is much lower if the existing ventilation of the house is considered. This aspect should always be investigated beforehand to avoid unpleasant surprises such as mold and moisture damage. Medium RPS.[15]
Waste management	R= Low/medium P= Medium S= Medium	Non-hazardous waste from the existing building and waste from new installation materials can be better recycled if proper processes and systems for waste sorting is in place. Especially in smaller projects that generate small amounts of waste the materials can often end up as unsorted waste. However, only relatively small amounts of construction waste are generated meaning that the relevance and potential is limited low/medium. Steerability is medium when the paper trail is followed from source to handling of the waste.
The following aspects are not covered by requirements in the criteria due to low relevance or low steerability.		
Transportation within the scope of the service	R= Low P= medium S= Low	Installation of windows require transport in relation to customer meeting, transport of windows, transport of installation crew, transport of installation waste and old windows for waste management and glass recycling. This is typically associated with the use of conventional vehicles. There are alternatives to conventional means of transport, e.g. electrical vehicles, so a potential for improvement is present. However, the transportation in this product group is fragmented using different types of vehicles for the different stages. Old windows for recycling of glass are typically collected by the waste/recycling company and not delivered by the installation company, meaning a low steerability. Compared to the lifecycle of impact of a window the total impact of transport is limited.

Area	RPS level (high/medium/low)	Comment
		In total, it is found that there is low/medium steerability for setting requirements due a fragmented transport need, difficulties with long distances, lack of infrastructure for electrical vehicles in some areas and a limited total impact on the whole lifecycle.