About Nordic Ecolabelled

Candles

Version 2.10

Background to Nordic Ecolabelling
07 January 2025

Nordic Ecolabelling

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

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1 Summary

The overall aim of this revision is to ensure that the Nordic Ecolabelling criteria secure a positive environmental benefit via ecolabelling and that the criteria are viable and clear for the industry. The revision has considered the areas that were apparent on the evaluation of the criteria. This revision has also focused on expanding the product group to include the Nordic Swan Ecolabelling of oil candles that comprise one or more wicks, surrounded by a material that is liquid at room temperature (20°C – 27°C), generally known as oil candles or oil lamps.

Product group message
Nordic Swan Ecolabelled candles are required to contain a large proportion of renewable raw materials, to have traceability and control of vegetable raw materials and a ban agenst use of raw materials from palm- and soya oil. There is also a ban on the use of biocide-tolerant and insect-resistant genetically modified agricultural products (GM crops) in the raw materials.

Candles carry a high risk of exposure via inhalation of particles, volatile organic compounds, PAH, etc. The criteria therefore set stringent requirements concerning the soot index, and chemical requirements in the form of requirements for the classification of chemical products, and the limitation of VOC, heavy metals, halogenated organic solvents and aroma compounds.

The criteria for Nordic Swan Ecolabelled candles set requirements for good quality and fire safety.

MECO and RPS analyses
In order to gain an overview of the key environmental impacts in the products' life cycle, environmental assessment of the product group has been performed as a qualitative MECO analysis for each of the four product areas. MECO stands for the assessment of **M**aterials, **E**nergy, **C**hemicals and **O**ther characteristics, and describes the principal environmental impacts during the product group's life cycle phases. This was followed by an overall RPS analysis for the overall product group.

RPS was found for the following:

- Setting requirements that encourage the use of a greater proportion of renewable raw materials.
- Setting requirements concerning the use of certified raw materials and traceability standards that ensure sustainable raw materials.
- Placing a ban on the use of biocide-tolerant and insect-resistant genetically modified agricultural products (GM crops) in the raw materials for Nordic Swan Ecolabelled candles.
- Setting requirements for the proportion of renewable/recycled raw material in the material that encases the candle.
- Setting requirements for a low soot index, which steers towards optimal material composition (wax + wick), and thus also the quality of the individual candle.

- Setting requirements for the classification of chemical products and the classification of constituent substances. In addition, there is a high RPS to exclude or reduce specific problematic substances such as VOC, heavy metals, halogenated organic solvents, preservatives and aroma compounds.
- Expanding the product group definition to include oil candles/oil lamps, comprising 100% renewable raw materials.

Market description
A brief Nordic market description has been prepared that shows that distribution and sales (in large volumes) take place via the grocery sector, wholesalers, builder's merchants, furniture stores, home/lifestyle stores and the hotel and restaurant industry. Consumer preferences when purchasing candles are primarily design, price, function/environment and quality. The market description also shows that environmental statements used in marketing by retailers focus on the use of sustainable and carbon neutral raw materials.

Changes compared with previous version
Based on the assessment, the MECO and RPS analyses and the market description, the biggest changes in the revision concentrate on tightening the requirements for the soot index, materials and chemical requirements, and expanding the criteria to include new requirements for oil candles/oil lamps comprising 100% renewable raw materials. Chapter 7 gives a list of all the changes to the requirements. More detailed descriptions of requirement changes and new requirements are given in Chapter 6.

Input from the public hearing
Several stakeholders commented that oil candles/-lamps are not covered by the EN standards for candles e.g. EN 15493, and therefore should be excluded from the product group. Nordic Ecolabelling estimated that the function for a candle, which consists of solid/semi-solid material at room temperature and an Oil lights/oil lamp, is the same: to provide light. The combustible material (whether it is solid/semi-solid or liquid) can also be used in both traditional solid/semi-solid candles and Oil lights/oil lamps. Nordic Ecolabelling therefore considers that the Oil lights/oil lamps belong in this product group.

Based on comments received in the public hearing, the requirement to soot index has been tightened and differentiated by types of candles. A differentiated requirement to soot index by type of candle ensures that all Swan-labelled candles have low emissions of particulates. There has also been introduced a new requirement for testing of fine/ultrafine particles from burning candles. The requirement is a so-called information requirement i.e. there is no fixed limit. The requirement is set to gather information for a future requirement for emissions of particulate matter from candles, with a fixed limit. The requirement for testing of particles has however, subsequently been removed in version 2.1, because the test method were not standardized and contained several ambiguities.

2 Basic facts about the criteria

2.1 Products that may be Nordic Swan Ecolabelled

The product group comprises candles made up of one or more wicks surrounded by a solid or liquid material. These two areas are detailed below:

Solid material: Candles comprising one or more wicks, surrounded by a material that is solid/semi-solid at room temperature (20°C – 27°C). The candle is to comprise at least 90% renewable materials by weight. Paraffin is by definition not a renewable raw material (see O2) and therefore candles that contain a high proportion of paraffin cannot be Nordic Swan Ecolabelled. Scented candles and aromatherapy candles can also not be Nordic Ecolabelled, since requirement O17 does not permit aroma compounds, as they are potentially allergenic.

Liquid material: Candles comprising one or more wicks, surrounded by a material that is liquid at room temperature (20°C – 27°C), generally known as oil candles/oil lamps. The liquid material (the oil) must be made from 100% renewable raw materials by weight. The oil's flash point must be at least 65°C. The oil candle must be in a single-use container such that it cannot be refilled. The wick must not be adjustable.

It is thus possible to Nordic Swan Ecolabel taper candles, pillar candles, tea light candles, graveyard candles, garden candles, candles for decoration and oil candles/-lamps.

Background to product group delimitation: The requirement concerning candles comprising one or more wicks, surrounded by a material that is solid/semi-solid at room temperature (20°C – 27°C) remains unchanged in this version of the criteria. The requirement follows the definition in EN 15493 Candles – Specification for Fire Safety, EN 15426 Candles – Specification for sooting behaviour and EN 15494 Candles – Product safety labels. All three standards are currently under revision by CEN/TC 369. A description of how a candle works can be found in Appendix 3.

The requirement that the proportion of renewable materials must be a minimum of 90% by weight remains unchanged in version 2 of the criteria. Renewable raw material is here defined as a biological material which is reproduced in nature. It includes the degradable part of products, waste and residues from agriculture (both vegetable and animal), sustainable forestry and similar industries and the biodegradable fraction of industrial waste and municipal waste. Paraffin is by definition a synthetic petroleum product and is therefore never renewable.

Both biomass (vegetable raw materials) and fossil fuels release CO_2 during burning, and thus contribute to the greenhouse effect. The benefit of burning biomass is that it does not contribute additional CO_2 to the atmosphere, as is the case with fossil fuels, on condition that the biomass comes from sustainable sources. When you look at biomass genesis and transport, it leaves a marginal CO_2 footprint, which is lower than the CO_2 footprint that for example fossil oil leaves. This is the conclusion in an IPCC report[1] that focus on the total emission from all energy sources.

[1] http://www.danskenergi.dk/~/media/Biomasse/SummaryForPolicymakers.ashx, 2015-03-31

Biomass removes CO_2 from the air as it grows. When wood, for example, is then burned or decays, it releases the CO_2 again and it can them be absorbed by other trees. The benefit for the climate comes when the wood is burned instead of being left to decay, since it is possible to use the energy in the wood and avoid taking energy and carbon from the Earth in the form of coal, oil and gas. This then avoids adding atmospheric CO_2 that is not already part of the plants' CO_2 ecocycle. The fundamental condition for the carbon neutrality of wood is that the size of the forest is maintained, and more trees are not harvested than can be counterbalanced by ongoing growth. CO_2 from biofuels is also absorbed much more quickly than from fossil sources. Biomass therefore has a relatively short impact on the climate compared with fossil CO_2, Where the effect lasts for several thousands of years[2].

It is currently possible to produce certain types of candle from 100% renewable materials with the help of certain production techniques. This applies in particular to white taper candles with no over-dipping. When it comes to pillar and ball candles, it is often necessary to add a small amount of paraffin for quality reasons. This is to ensure that the candle does not split/crack during setting. Paraffin is also often used to ensure that stearin candles release from their mould, since stearin has a tendency to stick.

Paraffin is also used in the dyes generally used for the over-dipping of candles. This paraffin typically has a higher melting point (70–75°C) than stearin (60–62°C) and thus makes sure that the candle will not bend in sunlight, for example[3]. The paraffin also gives a smooth, uniform surface and smooth, round edges. The over-dipping is around 1 mm. Paraffin also tends to be used in the dyes used for colouring a whole candle. Nordic Ecolabelling would like it to continue being possible to Nordic Swan Ecolabel several types of candles (tea lights, ball and pillar candles, taper candles, etc.) and in different colours, which is why it will remain possible to use a small amount of paraffin in a candle. Conversations with licensees show that a requirement limit of 90% renewable raw materials by weight remains relevant.

There is a proposal to expand the product definition to include candles comprising one or more wicks, surrounded by a material that is liquid at room temperature (20°C-27°C), generally known as oil candles/oil lamps. The liquid material (the oil) must be made from 100% renewable raw materials by weight. The increasingly dominant lamp oil that is available on today's market is based on petroleum (n-paraffin), i.e. it has been developed from fossil fuels. This type of oil is classified as R65/H304 (harmful to health), particularly on inhalation, and is therefore subject to separate rules for the labelling of the oil[4]. The requirement that the liquid material must have a flash point of at least 65°C ensures that liquid materials classified as flammable are not used in a Nordic Swan Ecolabelled oil candle. Data from producers of oil candles based on 100% vegetable oil indicates good burning properties (cf. test for soot index), compared with traditional fossil-based lamp oil and candles made from solid wax. The oil candle must be in a single-use container such that it cannot be refilled. This ensures steerability of the product, i.e. that it is not refilled with a type of lamp oil other than the one used in the soot test. The wick must also not be adjustable, which ensures that the oil candle burns in the same way as at the time of testing. Oil candles must comply with EN 14059:2002 (Decorative oil lamps – Safety requirements and test methods), see O19.

[2] http://www.cicero.uio.no/fulltext/index_e.aspx?id=8878
[3] Dr. M. Matthäi, Dr. N. Petereit:"The quality candle", European Candle Institut, 2004
[4] http://mst.dk/virksomhed-myndighed/kemikalier/regulering-og-regler/faktaark-om-kemikaliereglerne/lampeolier/

2.2 Criteria history

The criteria for candles were first approved on 13 December 2007 and remained valid until 31 March 2017 generation 1.

On 5 November 2015, the revised criteria generation 2 were approved.

2.3 Justification for Nordic Ecolabelling

In developing version 1 of the criteria for candles, an RPS study[5] was conducted, describing relevant environmental parameters and potential for improvements in the product's life cycle. The requirements concerning this still remain valid and appear in the following areas:

- Minimising the use of petrochemical raw materials in the production of candles. This supports Nordic Ecolabelling's goal of promoting the use of renewable resources over the use of non-renewable resources (fossil fuels).
- Requirements concerning additives in the production of candles to prevent unnecessary distribution of environmental toxins and to improve burning.
- Emissions to air are limited through limit values set for emissions of particles that are harmful to health and the environment (soot index requirement) and requirements regarding the use of additives.
- The quality of the candle (impurities, shape, burning, etc.) has an impact on soot formation and on emissions of substances that are harmful to the environment and health, which is why requirements in this area are relevant. The same is true of the requirements concerning fire safety.

3 RPS summary

In order to gain an overview of the key environmental impacts in the products' life cycle, an environmental assessment of the product group and a qualitative MECO analysis were performed for candles comprising one or more wicks, surrounded by a material that is solid/semi-solid at room temperature. MECO stands for the assessment of Materials, Energy, Chemicals and Other characteristics and describes the principal environmental impacts during the product's life cycle phases. The MECO analyses are based on LCA studies, datasets from generic databases and scientific reports.

An overall RPS (Relevance, Potential and Steerability) analysis was then conducted for the candles for which high environmental relevance (high R) was identified in the MECO analysis. The RPS analysis is a tool for prioritising ecolabelling requirements and assessing where to focus the requirements in order to achieve the maximum environmental benefit. The overall RPS analysis is available in Danish and can be obtained by contacting Nordic Ecolabelling.

Section 3.1 below outlines the key areas of the RPS analyses. Areas with an overall high RPS will trigger a requirement in the criteria. Areas with a medium RPS may trigger a requirement or may be subject to a requirement in a future version of the criteria. Areas

[5] Baggrundsdokument til Nordisk Miljømærknings kriterier for levende lys, version 1.

with an overall low RPS will not trigger a requirement in the criteria. More detailed reasons for the individual requirements are given in Chapter 6.

3.1 RPS analysis of candles

Raw materials phase
The product group includes many different types of products, as can be seen in Appendix 2, which gives an overview of products and materials. Candles may contain non-renewable raw materials such as paraffin from crude oil, and renewable raw materials such as stearin (which derives from vegetable and animal fats and oils), soya, beeswax and other vegetable oils. The container that encases the candle may be made from plastic, glass, metal or other materials.

Both renewable raw materials and fossil fuels release CO_2 during burning, and thus contribute to the greenhouse effect. The benefit of burning renewables is that they do not contribute additional CO_2 to the atmosphere, as is the case with fossil fuels, on condition that the biomass, for example, comes from sustainable sources. CO_2 from biomass is also absorbed much more quickly than from fossil sources.

Biomass therefore has a relatively short impact on the climate compared with fossil CO_2, where the effect lasts for several thousands of years[6]. Requirements aimed at raising the proportion of renewable raw material in the candle therefore have high relevance (R) for the climate.

LCA reports show that biomass is associated with both positive and negative effects[7,8]. Even if renewable, the use of biomass is not by definition good for the environment. Stearic acid and fatty acids used to make stearin derive from animal and vegetable oils, with palm oil being the most common type of raw material. Soya is used for soya candles. Palm oil comes from oil palm plantations in South East Asia, which are often established at the cost of valuable rainforest. Soya beans are grown on land that is often established in the place of forest and forest savannah in South America (R).

In this area, sustainability standards are an important tool in ensuring that renewable raw materials such as palm and soya oil are also sustainable. Soya production, for example, is also subject to a ban on genetically modified organisms (GMO) in production. As the major debate about GMO continues, there remains a lack of knowledge about their long-term effects on both health and the environment (R), (P) and (S).

Conclusion – The raw materials phase is important in the production of candles. Nordic Ecolabelling requires that a minimum of 90% of the raw material must be renewable (R). Requirements concerning sustainable production of renewable raw materials are therefore highly relevant (R) and can be ensured by setting requirements for the use of sustainability standards (P). Requirements for the use of certified raw materials and traceability standards will also strengthen the traceability (S) of renewable raw materials that are used in Nordic Swan Ecolabelled candles. The same is true when it comes to ensuring that GMO raw materials are not used in Nordic Swan Ecolabelled candles.

[6] http://www.cicero.uio.no/fulltext/index_e.aspx?id=8878
[7] Baggrundsdokument, Svanemærkning af biobrændstof til transport, version 2, december 2011
[8] Rettenmaier N: LCA of biodiesel from jatropha, palmoil and soya beans, IFEU, November 2011

Production phase
Production of the actual candle takes place either through dipping or pressing (only possible with a high paraffin content).

The heating/melting of stearin and paraffin or the pressing of paraffin powder takes place with the help of fossil fuels (as declared by licensees). In this evaluation report, it has not been possible to obtain energy data for the two production forms. A future revision should consider whether Nordic Ecolabelling should set requirements for information on energy use and energy sources in relation to the quantity of candles produced. The product group is very heterogeneous and not all of the product types have clearly defined functional units, so that it would be difficult to set a requirement level. Controllability is therefore also low.

The Danish Environmental Protection Agency[9] has conducted a study into the constituent substances in candles sold in retail stores. The study found several substances that are harmful to health (heavy metals, lacquers, azo dyes, azo lacquers, phthalates, solvents (VOC), PAH, halogenated organic substances, allergens and aroma compounds). The environmental and health impacts of these substances are relevant (R) in terms of both the production of the products and the use phase. There is therefore potential to ensure that toxic, harmful and CMR (carcinogenic, mutagenic and reprotoxic) substances are not used as constituent substances in the production of candles (P).

This will ensure that these substances do not lead to a poor working environment and are not discharged to water or air during production, as well as avoiding any environmental and health problems in the use phase. The applicant must be able to document the constituent substances in the chemical products used and there is thus steerability (S) for such a requirement.

Conclusion – A high RPS is found for the requirements on classification of chemical products and classification of constituent substances.

The type of candle most widely sold is the candle in an aluminium single-use container (tea light). Nordic Ecolabelling has previously drawn up a material report and RPS analysis for aluminium[10], which states that the energy consumed in the production of aluminium and the raw materials used in its manufacture cause a significant environmental impact (R). This, coupled with the lack of traceability in waste sorting, means that Nordic Ecolabelling wishes to retain the requirement banning aluminium containers for candles.

There is considered to be an RPS for the use of a greater proportion of recycled plastic in candle containers. The critical factor is, however, whether it is post-consumer recycled plastic or post-industry recycled plastic, as defined in the standard ISO 14021, since pre-consumer, due to its often better quality, is easier to sell on the market for plastic granules than post-consumer. There is thus greater security in using recycled post-consumer plastic, although it does not result in the lower use of virgin plastic globally. Nordic Ecolabelling therefore believes it is not possible to equate the environmental benefits of using pre-consumer recycled plastic with the environmental benefits of post-consumer recycled plastic. On using recycled plastic, the use of fossil raw materials and energy consumption are reduced (R), (P). Applicants must be able to document the

[9] Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen", Miljøstyrelsen
[10] Materialerapport til kriteriedokumenter for Svanemærkning af gulv, vinduer og holdbart træ, 2012

proportion of post-consumer plastic and there is thus steerability (S) for such a requirement.

Nordic Ecolabelling has received many enquiries from candle producers that are considering replacing aluminium with bioplastic containers for their tea lights. There is relevance (R) and potential (P) in using plastic made from renewable raw materials, as previously described. The steerability (S) of documenting that the plastic is made from renewable materials is also judged to be good.

Conclusion – There is an RPS in setting requirements for the proportion of recycled or renewable raw material in the material that encases the candle, since the burned-out candle + container will, in most cases, end up as household waste. There is similarly an RPS for promoting containers that can be used several times for the same purpose. This does not, however, apply to oil candles, due to the lack of steerability over the type of lamp oil with which the container may later be refilled.

Use phase
Burning candles causes air pollution. This pollution is due in part to the substances contained in the candles before burning and in part to substances that form while the candles are burning. The main source of the air pollution is the uncombusted gases (CH4, tars, PAH, etc.), soot, particles and condensed tars (R).

Nordic Ecolabelling sets requirements for a low soot index, which is an expression of clean burning and thus also the quality of the individual candle. The choice of materials (purity of the materials) and optimum balance between materials, design and choice of wick (material, thickness, etc.) are critical in achieving a low soot index (R), (P). Having an independent test laboratory test the soot index to EN 15426:2018 ensures a high degree of steerability (S).

Data from licensees, after version 1 (see Appendix 1), and soot index testing of other non-Nordic Swan Ecolabelled candles show great potential for tightening the requirement concerning the soot index, in accordance with EN 15426:2018. Soot index testing of oil candles (made from 100% renewables) to the same standard shows a soot index (Si/h) of 0.07[11]. This is a long way below Nordic Ecolabelling's current limit value for the soot index (Si/h) of 1.0. There is thus an RPS for expanding the product group to include oil candles, as the only difference between an oil candle and traditional candles is that the combustible mass is liquid rather than solid.

Conclusion – There is a high RPS for requirements for a low soot index, which steer towards optimal material composition (wax/oil + wick), which in turn has a bearing on the quality of the individual candle. There is a high RPS for expanding the product group definition to include oil candles made from 100% renewable raw materials, and requirements concerning certified palm oil, in order to ensure sustainable raw materials.

Waste phase
The level of material recovery in candles (burned stumps of candles) is very low. Over 95% of the candle disappears in the use phase and the remainder ends up as household waste, which is used in heat production via waste incineration.

[11] http://dk.waxilight.com/fakta.aspx

Conclusion – No overall high RPS is seen for specific requirements to motivate the recycling of materials from the product group's candle types.

As mentioned previously, there is, however, an RPS in setting requirements for the proportion of recycled or renewable raw material in the material that encases the candle, since the burned-out candle + container will, in most cases, end up as household waste.

RPS – overall conclusion
An RPS has been found for the following:

- Setting requirements that encourage the use of a greater proportion of renewable raw materials.
- Setting requirements concerning the use of certified raw materials and traceability standards that ensure sustainable raw materials.
- Placing a ban on the use of biocide-tolerant and insect-resistant genetically modified agricultural products (GM crops) in the raw materials for Nordic Swan Ecolabelled candles.
- Setting requirements for the proportion of renewable/recycled raw material in the material that encases the candle.
- Setting requirements for a low soot index, which steers towards optimal material composition (wax + wick), and thus also the quality of the individual candle.
- Setting requirements for the classification of chemical products and the classification of constituent substances. In addition, there is a high RPS to exclude or reduce specific problematic substances such as VOC, heavy metals, halogenated organic solvents, preservatives and aroma compounds.
- Expanding the product group definition to include oil candles/oil lamps, comprising 100% renewable raw materials.

4 Market description

This chapter gives a brief overview of the Nordic market for candles plus regulatory requirements and other labelling schemes that apply for this product group.

4.1 The Nordic market

The European market for candles (paraffin, stearin and wax candles) saw a general rise in production from 467,935 tonnes in 2005 to 610,384 tonnes in 2011, see Table 1. Over the same period, the quantity of candles imported from outside Europe fell from 197,489 tonnes in 2005 to 103,353 tonnes in 2011. For the period 2005–2011, there was an overall increase in the consumption of candles.

Table 1: The European market (EU-27) for candles[12].

Year	Production (tonnes)	Import (tonnes)	Export (tonnes)	Consumption (tonnes)	Consumption per person (kg)
2005	467,935	197,489	46,887	618,537	1.26
2006	461,165	186,928	50,234	597,860	1.21
2007	478,538	218,733	53,647	643,624	1.30

[12] European Candle Association ASBL

2008	486,641	174,310	50,391	610,559	1.23
2009	531,902	103,425	49,793	585,533	1.17
2010	595,020	113,584	57,917	650,687	1.30
2011	610,384	103,353	60,884	652,852	1.30

The Swedish market for candles is considered to be stable. The market is seeing a decline in the tonnage (tonnes) of candles sold, but growth in the number of candles sold[13]. The market is moving from the sale of large candles to the sale of small candles. Candle production in Sweden rose from 15,000 tonnes in 2000 to 20,437 tonnes in 2011, see Table 3. There are three major candle manufacturers in the Swedish market: Delsbo Candles (paraffin and stearin candles), Liljeholmen (stearin candles) and Skånska Sterarinljusfabrikken (specialist candles). In addition, there are around 10 large-scale importers of candles. Each person in Sweden consumes an average of approx. 2 kg candles (as of the year 2000). That is twice the European average of approx. 1 kg.

There are no major candle manufacturers in the Norwegian market, but a relatively large number of small-scale manufacturers. Candle production in Norway fell from 7,000 tonnes in 2000 to just over 1,800 tonnes in 2011, while imports rose from 10,500 tonnes to 22,500 tonnes in 2010[14].

Norway is one of the largest per capita consumers of candles in Europe, at around 3 kg per year in 2000, exceeded only by the Netherlands, see Figure 2.

There are two large-scale and a number of small-scale candle manufacturers in Finland. Finland's largest manufacturer is Havi (part of Suomen Kerta Oy), which has a market share of around 30% of the Finnish market. Candle production in Finland fell from 8,500 tonnes in 2000 to a little over 5,440 tonnes in 2011, while imports rose over the same period[15]. Taper candles are used to a much lesser extent than in Sweden, for example.

There are a number of major candle manufacturers in Denmark. Denmark's biggest manufacturer of stearin candles is Diana, which has a market share of 70% for stearin taper candles in Denmark. The other major manufacturers produce paraffin candles. Candle production in Denmark rose from 5,800 tonnes in 2000 to 19,117 tonnes in 2011, see Table 2. In Denmark it is estimated that 20–25% of the candle market comprises candles based on renewable raw materials[16].

Table 2: Candle production for 2000 and 2011 in selected European countries[17].

Country	Production (tonnes) 2000[18]	Production (tonnes) 2011
Denmark	5,800	19,117
Iceland		-
Finland	8,500	5,440
Norway	7,000	1,793
Sweden	15,500	20,437
Germany	117,400	131,454
Poland	-	232,010

[13] Interview med Kenneth Dådring, Delsbo, april 2013
[14] Statistisk Sentralbyrå (SSB) Norge 2010. www.ssb.no
[15] Interviea med Maria Laaksonheimo og Petteri Viklman, Havi, april 2013
[16] Interview med Thomas Olesen (Diana lys), april 2013
[17] Eurostat-april 2013
[18] The British Candlemakers Federation, http://www.britishcandles.org/ (hentet I baggrundsdokumentet 2007)

France	18,500	8,117
Italy	40,000	11,560
Estonia	-	9,445

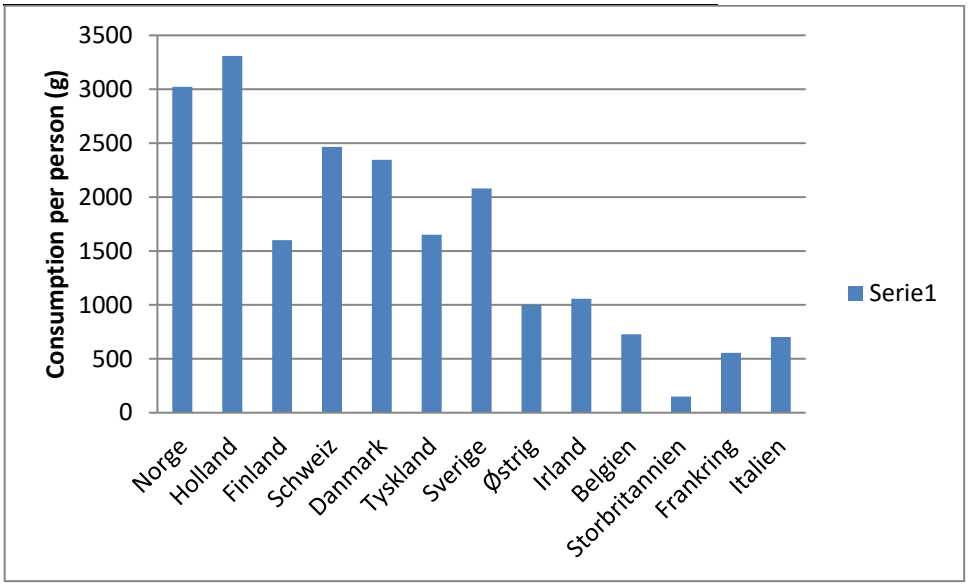


Figure 1: Average candle consumption per capita (grams) in a selection of European countries in the year 2000.

The industry can be summarised as follows:

- Distribution and sales (in large volumes) take place via the grocery sector, wholesalers, builder's merchants, furniture stores, home/lifestyle stores and the hotel and restaurant industry.
- IKEA is the biggest player and retailer of candles in the Nordic region and globally (large sales of tea lights).
- Candles are purchased almost entirely by women (95% according to a British survey).

Retailers and consumers

Many of the manufacturers produce candles for private labels, primarily for the grocery sector and furniture stores.

Many large manufacturers of candles also produce/offer other products for the "dining table", such as serviettes, tablecloths, plates and serving utensils, cups/glasses, cutlery and so on, and these are often sold through wholesalers. The feedback from the industry is that it is difficult to influence wholesalers with regard to the environment and Nordic Ecolabelling issues. The steering parameters in this context are price, quantity, range and quality. The environment as a parameter plays a greater role when it comes to retail sales.

An industry interview shows that consumer preferences when purchasing candles are primarily design, price, function/environment and quality. This is also backed up by a consumer survey conducted in 2011 by a retail chain in Denmark, which indicates that 3 out of 5 customers do not read the packaging before purchase, see below.

There is another major challenge in informing consumers about the difference between stearin candles and paraffin candles, and that all candles are referred to/marketed as stearin candles, irrespective of the material from which they are made. In this context, Nordic Ecolabelling has a major opportunity to guide the consumer.

In November 2011, the Danish Consumers Cooperative Society (FDB – now part of the Coop) surveyed 1,030 people about their candle use[19]. In the survey there was no differentiation between stearin candles and paraffin candles. The respondents were weighted by age, gender and geography, and the survey can be considered representative of the Danish population in the age group 15-74.

The results of the survey show that:

- Over a quarter of Danish adults (28%) light a stearin candle every day in autumn/winter. Three quarters (74%) light a candle at least once a week. Older people in particular (43%) light a candle every day, while middle-aged (29%) and young people (18%) are more restrained. Of those who light candles, just under a third (32%) light five candles at a time. And the candles are most likely to be tea lights, according to three out of five respondents (61%).
- The results also show that a third (35%) feel stearin candles may to some degree be harmful to the indoor climate, while over a quarter (30%) give the response "to a small degree". 14% believe that stearin candles damage the indoor climate to a high or very high degree. More women than men state that stearin candles can be harmful to the indoor climate, and young people are less sceptical than those aged over 34.
- Finally, the survey shows that just under three out of five (59%) do not check on the packaging to see what the candle is made of, before making a purchase. More of those with a medium (37%) or long education (39%) check the packaging, while the figure for those with a short education is a quarter (25 %).

The environment as a competitive tool
Environmental factors are used to a high degree in the industry as a sales argument for stearin candles. In marketing, there is a particularly active use of the argument that candles are produced from sustainable/renewable raw materials. In addition, there is an increased focus on the use of certified palm oil or soya oil. The argument that stearin candles produced from 100% stearin are carbon neutral is also used in marketing.

Interviews with manufacturers of Nordic Swan Ecolabelled candles indicate that the Nordic Ecolabel logo is generally used on all Nordic Swan Ecolabelled candles (packaging), on the manufacturers' websites and in sales catalogues. The Nordic Swan Ecolabel is the only ecolabel for candles. The quality label RAL[20], which focuses on the quality aspects of the candle (safety, burning time, etc.), is widely used by the industry.

[19] http://fdb.dk/analyse/vi-elsker-stearinlys
[20] http://www.kerzenguete.com/?sprach_id=en

4.2 Nordic Ecolabelling licences

Table 3 gives an overview of the licences for Nordic Swan Ecolabelled candles in the Nordic market. There are six producers that have Nordic Swan Ecolabelled over 100 types of candles.

Table 3: Overview of candle-related licences and registrations, 7 January 2014.

Licensee	Reg. in DK	Reg. in SE	Reg. in NO	Reg. in FI
Danish				
Baltic Candles Ltd.		x	x	x
Diana Lys A/S		x	x	x
Swedish				
Delsbo Candle AB	x		x	x
Liljeholmens Stearinfabrik AB				
Refillsystem i Oxelösund AB	x		x	x
Finnish				
Suomen Kerta Oy, Havin Kynttiloätehdas		x	x	

4.3 Regulatory requirements and instruments

4.3.1 Standards

Candles comprising one or more wicks, surrounded by a material that is solid/semi-solid at room temperature (20°C – 27°C) are covered by three standards: EN 15493 Candles – Specification for Fire Safety, EN 15426 Candles – Specification for sooting behaviour and EN 15494 Candles – Product safety labels. All three standards are currently under revision by CEN/TC 369.

Candles comprising one or more wicks, surrounded by a material that is liquid at room temperature (20°C – 27°C) have to comply with the standard EN 14059:2002 (Decorative oil lamps – Safety requirements and test methods). Oil candles are also regulated via EU Directive 76/769/EEC, which prohibits oil candles classified as R65 (Asp. Tox1 H304).

4.4 Other labelling schemes and controls

4.4.1 Environmental Choice Programme (Terrachoice in Canada)

The criteria document[21] was published in 1999, but it has not been revised since. There are currently no candles licensed according to the criteria document.

The criteria document requires compliance with US standard ASTM F2058 concerning fire safety for candles. In addition, the following substances must not be added to or be included in the manufacture of the ecolabelled candle:

[21] http://www.ecologo.org/en/seeourcriteria/details.asp?ccd_id=355

- Aromatic solvents
- Paraffin
- Halogenated organic solvents
- Lead, mercury, chromium VI, cadmium and their compounds
- Packaging

In contrast to the Nordic Ecolabelling criteria, the Canadian ecolabel requires that no paraffin is used in the candle. Only candles made from stearin, beeswax and hardened vegetable and animal oil/fat are thus covered by the criteria. The other requirements prohibiting the addition of certain additives and heavy metals are the same as the current Nordic Ecolabelling criteria. The criteria document contains no requirements relating to raw materials.

4.4.2 RAL Quality Mark Candles – Quality Assurance RAL-GZ 041

RAL Quality Mark Candles, Assurance RAL-GZ 041[22] is a quality standard developed in Germany for candles. The standard covers the following products: paraffin candles, stearin candles, wax candles, mixed candles and oil candles.

RAL-GZ 041/1 comprises specific quality requirements for traditional candles for indoor use. The requirements include testing of:

- the candle's burning properties
- the position of the wick when the candle is lit
- the "drip-fastness" of the candle, i.e. it must not run
- the soot index in line with EN 15426
- "afterglow of the wick" after the candle has been extinguished
- dimensions of the candle and the candle's burning time

RAL-GZ 041/2 contains specific quality requirements for tea lights, which are similar to those in RAL-GZ 041/1.

RAL-GZ 041/3 contains specific quality requirements for graveyard lights, which are similar to those in RAL-GZ 041/1. Oil candles are not covered by these quality requirements.

In addition, the standard sets a number of minimum requirements relating to raw materials and additives, covering paraffin wax, stearin, beeswax, vegetable/animal fats and oils, the wick's properties, dyes, lacquers and aroma compounds.

The RAL-GZ 041 standard sets a number of specific quality requirements that are not directly covered by Nordic Ecolabelling's current criteria (for example, wick position, drip-fastness and wick afterglow). The requirement concerning the soot index in line with EN 15426 (whereby the average soot index value from three tests must be less than 1.0 per hour) is identical to Nordic Ecolabelling's criteria.

[22] http://www.kerzenguete.com/?sprach_id=en

5 About the criteria revision

Aims of the revision

Evaluation of version 1 of the criteria for the Nordic Swan Ecolabelling of candles (autumn 2013) resulted in a proposal to revise the criteria, primarily by tightening the current requirement level for the soot index, updating the raw material requirements and expanding the product group to include oil candles.

Based on the recommendations in the evaluation report, the revision has had the following objectives to:

- expand the product group definition to include oil candles/oil lamps (with liquid oil). The current criteria, version 1, relate only to solid wax.
- tighten the current requirement level for the soot index. Data from licensees and data from corresponding testing of non-Nordic Swan Ecolabelled candles indicate substantial scope to tighten the requirement level for the soot index
- investigate the possibility of setting requirements for emissions of small and ultrafine particles from candles.
- assess the requirement concerning test methods to ensure that these are relevant and up to date. The European standards for candles are currently under review (European standards EN 15426:2018 (Candles – Specification for sooting behaviour), EN 15493:2019 (Candles – Specification for fire safety) and EN 15494:2019 (Candles – Product safety labels)).
- investigate requirements for test methods for oil candles, since this product type has become included in the product definition.
- introduce a new requirement for the proportion of certified renewable raw materials. An updated requirement for traceability and control of the renewable raw material and a requirement concerning the proportion of certified renewable material replace the current requirement on carbon dioxide balance (R5), which has been judged to be unclear. The requirement on renewable raw materials has been updated in line with similar requirements in other product groups.
- revise the requirement concerning the material that encases the candle.
- investigate residues (waste products) from the refining of vegetable oil, or used vegetable oils from the catering industry, more closely in relation to the requirement of traceability.
- assess the requirement concerning GMO in candles.
- update the requirement concerning chemicals and classification under the CLP Regulation No 1272/2008.
- more closely assess the requirement concerning constituent substances in dyes, and the possibility of setting requirements for the light-fastness of dyes (quality requirement for consumers). The German RAL standard (RAL-GZ 041) for stearin candles sets requirements for light-fastness testing, for example.
- investigate the possibility of setting requirements for the proportion of renewable raw material in the material that encases the candle (e.g. tea lights).
- investigate the possibility of introducing a ban on bleaching wicks.

- update the customer information requirement.

About this revision

The revision was conducted by Product Group Manager Thomas Christensen (DK) as project manager and Eva-Lotta Lindholm (SE) as project adviser. Ingrid Elmedal (DK), Kristian Kruse (NO), Björn Simons (SE) and Sammi Karelahti (FI) are the national contacts.

6 Justification of the requirements

Background to requirement O1 Description of the product

The requirement has been amended slightly, compared with the requirement in version 1 of the criteria. The intention of the requirement is to provide a sufficient picture of the life cycle of the product and any packaging: what raw materials and production processes are used, what coatings or additives are used, and so on. The requirement will thus produce an insight into the product(s) in the application, in order to ensure correct processing of the application.

6.1 Environmental requirements

6.1.1 Resources

Background to requirement O2 Amount of raw material produced from renewable raw materials

The requirement that the proportion of renewable materials in the candle must be a minimum of 90% by weight remains unchanged in version 2 of the criteria.

The requirement for solid candles follows the definition in EN 15493 Candles – Specification for Fire Safety, EN 15426 Candles – Specification for sooting behaviour and EN 15494 Candles – Product safety labels.

Background for the requirement for high proportion of renewable materials is previously described in section 2.1, products Swan label.

It is currently possible to produce some types of candle from 100% renewable materials with the help of certain production techniques. This applies in particular to white taper candles. When it comes to pillar and ball candles, it is often necessary to add a small amount of paraffin for quality reasons. This is to ensure that the candle does not split/crack during setting. Paraffin is also often used to ensure that stearin candles release from their mould, since stearin has a tendency to stick.

Paraffin is also used in the dyes generally employed in the over-dipping of candles. This paraffin typically has a higher melting point (70–75°C) than stearin (60–62°C) and thus makes sure that the candle will not bend in sunlight, for example[23]. The paraffin also gives a smooth, uniform surface and smooth, round edges. The over-dipping is around 1 mm. Paraffin also tends to be used in the dyes used for colouring a whole candle. Nordic Ecolabelling would like it to continue being possible to Nordic Swan Ecolabel several types of candles (tea lights, ball and pillar candles, taper candles, etc.) and in

[23] Dr. M. Matthäi, Dr. N. Petereit: "The quality candle", European Candle Institut, 2004

different colours, which is why it will remain possible to use a small amount of paraffin in a candle.

The product definition is expanded to include candles comprising one or more wicks, surrounded by a material that is liquid at room temperature (20°C – 27°C), and generally known as oil candles/oil lamps. The liquid material (the oil) must be made from 100% renewable raw materials by weight. The increasingly dominant lamp oil that is available on today's market is based on petroleum (n-paraffin), i.e. it has been developed from fossil fuels. This type of oil is classified as R65/H304 (harmful to health), particularly on inhalation, and is therefore subject to separate rules for the labelling of the oil[24].

The requirement that the liquid material must have a flash point of at least 65°C ensures that liquid materials classified as flammable are not used in a Nordic Swan Ecolabelled oil candle/oil lamp. Data from producers of oil candles based on 100% vegetable oil indicates good burning properties (cf. test for soot index), compared with traditional fossil-based lamp oil and candles made from solid wax (at room temperature, 20°C – 27°C).

If raw materials of animal origin is used, name of production site(s) and approval number (EU Code) must be disclosed. Raw materials of animal origin is subjected to EU regulation 1774/2002 of 3 October 2002 concerning health rules concerning animal by-products, not intended for human consumption. The requirement ensures traceability to where waste and residue arise.

Background to requirement O3 Vegetable raw materials from palm- and soy oil
Palm oil is the primary vegetable raw material in the production of stearin or oil to oil-candles/oil lamps, while soy is used in soya candles. Both raw material are, however, associated with significant environmental and social problems in both the cultivation and the production phase. Nordic Ecolabel official position on the standards RSPO[25] and RTRS[26] found in Annex 6.

An expert group in the Nordic Ecolabelling has in the summer of 2015 evaluated in details both the standard for palm oil (Round Table on Sustainable Palm Oil, RSPO) and soy (Roundtable on Responsible Soy Association, RTRS).

The conclusion regarding both standards is that they currently do not meet the Nordic Ecolabel requirements for raw material schemes. This is mainly due to lack of absolute requirements to protection of important biological areas, and lack of requirements and compliance with basic international conventions. This means that renewable raw materials from palm- and soy oil are not allowed to be used in Swan labelled candles/oil candles. This also includes waste and residue as per the definition of renewable material in requirement O2.

Issues surrounding the production of palm oil:

As the consumption of vegetable oils has increased over the last 30 years, the cultivation of vegetable oil crops has increased faster than any other industrial crop during the last forty years[27]. The total area of oil palm plantations has since 1990 increased by almost 10

[24] http://mst.dk/virksomhed-myndighed/kemikalier/regulering-og-regler/faktaark-om-kemikaliereglerne/lampeolier/
[25] http://www.rspo.org/
[26] http://www.responsiblesoy.org/en/
[27] RSPO 2012. Promoting The Growth And Use Of Sustainable Palm Oil - Factsheet.

million hectares. The largest increases occurred in Malaysia and Indonesia. Palm oil may be separated in a number of different oils with different characteristics. Palm oil is used in products like cooking oils, margarine, liquid detergents, soaps, cosmetics, waxes and polishes and for livestock feed. In the early 1970s there was a drastic expansion of palm oil plantations in Malaysia and Indonesia. In 2000 the two countries accounted for just over half of the world's palm oil plantations, while Nigeria accounted for 30% of world production of palm oil.

The most important environmental problem associated with the production of palm oil is the conversion of natural areas for oil palm plantations, which is a critical threat to many endangered species, as their habitat disappears. The expansion of oil palm plantations in South West Asia is the largest cause of destruction of the rainforests or draining of peat beds[28].

This leads to fragmentation and reduction in habitats for biodiversity. When the natural ecosystem disappears, this also affects ecosystem services such as carbon storage, the production of clean water and barriers to soil erosion. The way palm oil is cultivated and the use of plant protection products can lead to major problems with soil erosion. The felling of the rainforests and cultivating peat beds releases large amounts of greenhouse gases. In addition, there may be environmental problems associated with the use of toxins in production, air pollution from burning forests, soil erosion and heavy sedimentation to rivers and streams, as well as the discharge of waste water from palm oil mills.

Large-scale palm oil production creates in addition to the natural and environmental problems also social problems in Southeast Asia. In the production there are risks of violations of labor rights, where the use of chemical and pesticide constitutes a health risk for plantation workers[29]. High unemployment in Indonesia and illegal work in Malaysia increases the risk of wages below the minimum wage, poor response to requests to participate in trade unions and unsafe working conditions. The expansion of palm oil plantations is also helping to displace locals. As a result of many disagreements about ownership of the land the plantation company is the most conflict-prone land-based sector in Indonesia and Malaysia.

Issues surrounding the production of soy oil:

The intensive production of soy in eg Argentina and Brazil have different environmental and natural consequences. Agricultural production of soy and exports from Argentina and Brazil affect the environment on both a local and global level. By deforestation, draining of wetlands and the establishment of monocultures such as soy bean fields, increases the risk of loss of biodiversity and habitat fragmentation. Worldwide over the last three decades there has in average beeb cleared about 13 million hectares of forest a year. When clearing forest you removes ecosystems, and conversion of natural areas for cultivation can separate the natural habitats of large area. Lack of pathways between natural habitats reduces the genetic flow between populations and increases the risk of species or their food resources to disappear. The environmental and natural consequences are in particular associated with conversion of natural or semi-natural areas

[28] UNEP. 2009. Towards sustainable production and use of resources: Assessing biofuels. http://www.unep.org/pdf/biofuels/Assessing_Biofuels_Full_Report.pdf
[29] OLSEN LJ, FENGER NA & GRAVERSEN J 2011a. Palmeolie - Danmarks rolle i forhold til den globale produktion af palmeolie. WWF Verdensnaturfonden Denmark.

to cultivation areas together with a specialization of culturing methods and use of pesticides.

The extent of pesticide use in e.q Argentina is so widespread in the soy production, that many Argentineans daily gets in to contact with toxins[30]. In addition to farmers and farm workers who handle sprays, are also locals who live near the soya fields.

Certification schemes for palm- and soy oil:

The Round Table on Sustainable Palm Oil (RSPO) is a global standard for sustainable production of palm oil. Stakeholders throughout the production chain from palm oil producers, purchasers, consumers and dealers to NGOs, including environmental organisations, founded RSPO in 2004[31].

The different stakeholders are reflected in RSPO's management structure by gathering together working parties in "roundtable" discussions in which each stakeholder group has equal rights. The aim is for different stakeholders and competing companies to work together towards a common goal and make decisions through consensus. The supply of RSPO certified palm oil has risen from 1.3 million tonnes in 2009 to 8.2 million tonnes in 2013. According to WWF, 15% of palm oil used globally is certified, but only half of that was bought in 2012. Today, many companies rely on certificate trading (Book and Claim) for the RSPO-certified palm oil. WWF recommends that company's demand 100% certified palm oil with traceability at a minimum of mass balance level by 2015[32]. IKEA has recently decided that by December 2015 all the palm oil currently used in its home furnishing products, such as candles, or as a food ingredient will either come from certified segregated sustainable sources, or be replaced by more sustainable ingredients[33].

Roundtable on Responsible Soy Association (RTRS)[34] was founded in Switzerland in 2006 and the movement is a market-oriented international organization that take the interests of those organizations that support production, processing and trade of responsibly produced soy. A wide range of companies and some NGOs are represented in the RTRS. The RTRS standard can be used for both conventionally grown, organically grown and GM crops, and the certification is in this context, technology neutral.

The principles and criteria behind the certification is based on five themes: Regulatory Compliance; Responsible labour practices; Responsible relationships with nearby; Environmental accountability and good agricultural practice.

Companies that want to buy RTRS certified soy, can do it by two models. The soy purchasers can buy RTRS certified soy, registered throughout the supply chain up to the final consumer, either as 'Fully Segregated', where the RTRS certified soy is kept separate from conventional soy or 'Mass Balance', where the RTRS certified soy is mixed with the conventional soya. In the final agreement, it is then declared, that a certain percentage of the soybeans is certified. The second model is based on the possibility for companies to

[30] Hermansen J. et all: Soja og Palmeolie, certificeringsordninger til dokumentation af bæredygtighed i produktionen, DCA rapport nr. 029, marts 2013
[31] DANWATCH 2011. Sojaproduktion i Argentina - Landbrugets ukendte giftskandale. DanWatch 1-15.
[32] WWF. 2013. Palm Oil Buyers' Scorecard 2013. Measuring the Progress of Palm Oil Buyers.
[33] http://www.ikea.com/ms/sv_SE/pdf/reports-downloads/sustainability-strategy-people-and-planet-positive.pdf (hämtad 2014-09-10)
[34] http://www.responsiblesoy.org/en/ (2015-05-18)

buy responsibly produced soy. The fundamentals of the system is the RTRS's certificate trading platform (CTP). As an addition, it is also possible to by non-GM soy.

The supply chain structure is the same for the 'Fully Segregated' and 'Mass Balance' models. It also ensures that non-genetically modified soy are mixed into the blends. The system of traceability is described in Annex 4.

Environmental groups are divided in their attitudes to the use of palm oil or soybean oil, and existing certification schemes for palm- and soy. Environmental organizations supporting RSPO fully are for example (WWF[35] and Rainforest Alliance[36]), while organizations as (Greenpeace[37], Regnskogsfondet[38] and Naturskyddsföreningen[39]) does not mean that the system is good enough. When it comes to soy, WWF supports the RTRS, while the world's forests[40] do not believe that the arrangements are good enough.

The main criticism of the certification schemes is that they do not adequately protect against the conversion of "secondary forest" to oil palm or soy plantations. Clearing this minor economic valuable forest type destroys habitats and release large amounts of greenhouse gases bound in trees and soil.

Background to requirement O4 Traceability and control of vegetable raw materials

Since use of land is also a relevant environmental parameter in this product group, requirements should be set concerning the areas from which the vegetable raw materials originate. The aim is to ensure that areas of high biological or social value are not used for cultivation.

For Nordic Swan Ecolabelled candles/oil candles/oil lamps made from renewable raw materials, it is therefore important to set requirements concerning the areas from which the raw materials are sourced. Most criteria documents do this by ensuring the origin of the raw material. Underpinning all the requirements placed on vegetable materials is a need for traceability. This traceability tells us where the raw material comes from and who produced it. Nordic Ecolabelling has long-standing traceability requirements in criteria that include timber raw materials.

These criteria additionally set requirements for the traceability of vegetable raw materials, following the same pattern as the criteria for the Nordic Swan Ecolabelling of biofuels. There must be a written policy in place for the purchase of raw materials that also ensures all raw materials come from legal sources.

The criteria therefore contain requirements that renewable raw materials must not be sourced from the following:

- protected areas or areas under preparation as protected areas
- areas where ownership or usage rights are unclear

35 http://wwf.panda.org/what_we_do/footprint/agriculture/palm_oil/solutions/roundtable_on_sustainable_palm_oil/rspoprinciplessummary/, 20150420
36 http://www.rainforest-alliance.org/work/agriculture/palm-oil, 20150420
37 http://www.greenpeace.org/international/en/publications/Campaign-reports/Forests-Reports/Certifying-Destruction/, 20150420
38 http://www.regnskog.no/no/bevisst-forbruker/palmeolje/Regnskogfondet+om+RSPO, 20150420
39 http://www.naturskyddsforeningen.se/nyheter/skovling-av-regnskog-trots-certifiering-av-palmoljan, 20150420
40 https://www.verdensskove.org/node/34731 20150420

- illegally harvested crops

If the vegetable raw material can be defined as a waste or residue, there must be traceability to the process from which the waste or residue derived by means of invoices.

Vegetable raw materials for candles/oil candles/oil lamps can be, for example coconut-, grape-, sunflower- or canola oil.

Background to requirement O5 Genetically modified plants
Nordic Ecolabelling has a ban on the use of biocide-tolerant and insect-resistant genetically modified agricultural products (GM crops) in the raw materials for Nordic Swan Ecolabelled candles. The decision to ban GM crops in renewable raw materials is rooted in the precautionary principle. GMO (genetically modified organisms) are a much debated topic and many countries have banned the cultivation of GM crops. The themes of the debate include food safety, land use, lack of scientific knowledge about the effects of GM crops under local agricultural/forestry conditions and the risk of negative impacts on health and the environment.

WHO defines the risk of GMO as follows[41]: the capability of the GMO to escape and potentially introduce the engineered genes into wild populations; the persistence of the gene after the GMO has been harvested; the susceptibility of non-target organisms (e.g. insects which are not pests) to the gene product; the stability of the gene; the reduction in the spectrum of other plants including loss of biodiversity; and increased use of chemicals in agriculture.

The use of GM crops has an influence on the sustainability of the raw material. Genetically modified organisms (GMO) can be defined as organisms whose properties are changed using gene technology rather than traditional methods of plant breeding. A plant can thus be given properties from another plant or organism through the transfer of new genetic material. The transferred properties may be a change in nutritional content or a better capacity to resist cold, insect attack, drought and so on. Most of the plants that have been developed so far are insect-resistant or herbicide-tolerant, or a combination of both[42]. Around 99% of the world's GM herbicide-tolerant products derive from different varieties of Monsanto's Roundup Ready, which can tolerate the herbicide glyphosate, for example[43].

If a plant that is genetically modified to tolerate a particular weed killer has a major capacity to spread and can cross into related wild species, this can lead to farmers eventually having greater problems managing weeds than they did before, according to the website of the Norwegian Biotechnology Advisory Board[44]. A farmer may then be forced to use more pesticide. For consumers, this can lead to more pesticide residues in food. For the environment, it is also important to assess whether genetically modified plants containing an insecticide can also be harmful to other insects and animals that do not harm the crops and that play an important role in the ecosystem.

[41] http://www.who.int/foodsafety/areas_work/food-technology/faq-geneically-modified-food/en/, september 2014
[42] GMO, hvad kan det bruges til? Vidensyntese fra Fødevareministeriet 2009
[43] Greenpeace 2011: Herbicide tolerance and GM crops, June 2011
[44] Den norske bioteknologinemdas nettside om "Genmodifiserte planter og mat"
http://www.bion.no/temaer/genmodifiserte-planter-og-mat/ (besøkt 20.06.2014)

There is also a risk of undesirable cross-breeding between genetically modified plants and related wild species, such that the new properties are transferred to the latter.

As the major debate about GMO continues, there remains a lack of knowledge about their long-term effects on both health and the environment. There is also a question about whether they contribute to sustainable development. To obtain more knowledge in this field, Nordic Ecolabelling commissioned the report "Genetically Modified Organisms – A Summary of Potential Adverse Effects Relevant to Sustainable Development" from Genøk. The report, which is published on Genøk's website, shows that there are potential undesirable effects of GMO along the whole value chain from the research and development of the plants, via cultivation, to storage, use and waste management. The report also describes a lack of scientific research in several of these phases and a lack of assessment of the overall picture. More information on GMO can be found in Appendix 5.

The requirement applies to the raw materials in the combustible material in the candle such as paraffin, wax, oils, fat, etc. The requirement does not apply to the wick in the candle. This is because GMO-free cotton only is available in limited quantity on the market and that the steerability to buy GMO-free cotton is low.

Background to requirement O6 Fossil raw materials (paraffin wax)
The requirement is new for this version of the criteria, version 2, and its aim is to ensure that only high quality paraffin is used in the candle.

The requirement for hydrogenated paraffin ensures that only fully purified paraffin is used in Nordic Swan Ecolabelled candles. The quality of the paraffin has a major effect on the burning process and emissions from this process.

Crude oil contains many different chemical compounds, made up primarily of carbon and hydrogen. In addition, crude oil always contains compounds of sulphur, nitrogen and trace elements. There are, in fact, several thousand different compounds. Most important of these in the production of crude oil products is the saturated hydrocarbons, a group known as alkanes. There are also olefins, naphthenes and aromatics, which are defined by their different carbon bonds.

The German quality standard for candles, Quality Assurance RAL-GZ 041, is a voluntary standard used by a large number of candle manufacturers in Europe[45].

The standard sets tough requirements concerning the quality of the paraffin, which matches the hydrogenated grade.

The candle manufacturer must document fulfilment of the requirement through invoices or similar documentation.

Background to requirement O7 Wick and wick sustainer
The wick: The requirement has been amended slightly, compared with version 1. Wicks are generally made from cotton and can have different thicknesses and shapes. Some wicks contain paper fibres to stiffen the wick. It used to be normal to stiffen the wick with a metal, such as lead, tin and zinc, but this is no longer standard practice. It may, however, still happen and there is therefore a ban on the use of metal in wicks[46]. All

[45] http://guetezeichen-kerzen.com/en/home/
[46] Miljøstyrelsen. Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen".

heavy metals are more or less toxic to people and the environment, and many are classified as potentially CMR substances.

The wick controls the melting, evaporation and burning of the candle material and transports the liquid wax from the melting area to the burning zone. To keep the wicks stiff and upright, they can be impregnated with various waxes or they can be interwoven with paper fibres. The stiffness of the wick is an important factor in avoiding bends in the wick, which will increase the level of sooting.

For stearin candles, it is necessary to impregnate the cotton wick, otherwise it will be "eaten away" by the acid in the stearin. This impregnation usually takes the form of inorganic potassium or sodium salts[47]. Nordic Ecolabelling's requirements concerning chemicals and additives do not exclude the use of impregnated wicks.

The production of a wick traditionally involves three steps[48]:

1. Washing the cotton to remove any impurities.
2. Bleaching the cotton wick. This has no effect on the burning properties of the wick, and is done entirely for cosmetic reasons (white wick).
3. Impregnating the wick to determine its strength, acid resistance and burning properties.

Nordic Ecolabelling considers bleaching the cotton wick to be an unnecessary process in environmental terms, if its purpose is purely cosmetic.

During bleaching of the wick, the coloured substances have to be broken down or transformed without the fibres being destroyed.

The chemicals used tend to be oxidisers (hydrogen peroxide), but reducing agents are also used (sulphur dioxide, sodium dithionite)[49]. Conversations with manufacturers and resellers (retail chains) of candles show, however, that consumers only want candles with white wicks. This is largely attributed to the fact that candles are also an interior design item used for decoration. Bleaching cotton wicks is therefore permitted in this version of the criteria, version 2.

Wick sustainer: The requirement has been amended slightly, compared with version 1. Wick sustainers are used primarily in tea lights to ensure that the wick does not collapse when the wax becomes liquid. The hot liquid wax requires that the wick sustainer shall withstand high temeperatuer why this is made of metal. The requirement relates to heavy metals that are particularly harmful to health and the environment, which is why their discharge must be limited as far as possible.

The manufacture of aluminium is also associated with high energy consumption and emissions of environmentally harmful substances, which is why its use is not permitted in containers for Nordic Swan Ecolabelling candles (e.g. tea lights). It is therefore relevant to ensure that any metal used in a candle's wick sustainer is free from the heavy metals lead (Pb), mercury (Hg), chromium VI (Cr^{VI}), cadmium (Cd), cobalt (Co), antimony (Sb),

[47] http://www.wedowick.de/home/
[48] http://www.technische-geflechte.de/site/english/about-the-wick/wick-treatment.html
[49] http://www.technische-geflechte.de/site/english/about-the-wick/wick-treatment.html

zinc (Zn,), copper (Cu), nickel (Ni) and aluminium (Al). The requirement does not apply to steel.

Lead
Lead is a toxic heavy metal that accumulates in nature and in human beings. This means that even small quantities of lead can be harmful to health. Children are particularly vulnerable. They are generally exposed to more lead than adults via food, soil and dust, while their gastrointestinal system absorbs lead far more effectively than adults. Lead affects the nervous system.

As a child's nervous system is still developing, they are particularly sensitive to these effects and American studies have shown that, even in small quantities, lead can affect children's learning ability and intelligence. Lead is also toxic for organisms in soil and water. If products containing lead are disposed of as waste, after incineration the lead will be present in slag and fly ash. A small amount is dispersed in smoke and dust from incineration plants.

Mercury
Mercury occurs as inorganic and organic chemical compounds, and is one of the most dangerous environmental toxins.

Mercury is a threat to the environment and to human health. The organic mercury compounds are particularly toxic. Mercury compounds are extremely toxic for aquatic organisms and for mammals. Mercury, even in small quantities, can cause three chronic toxic effects. Mercury can also cause kidney damage, foetal damage and lead to contact allergy.

Chromium
Chromium (III) and chromium (VI) are used for e.g. chrome plating, in dyes and in pigments. Chromium (III) is essential, since living organisms require chromium. The different types of chromium have different effects. All chromium compounds are toxic. Chromium (VI) has particularly harmful effects, as it is carcinogenic and allergenic. A number of chromate compounds are on the Danish Environmental Protection Agency's List of Undesirable Substances. It is therefore still relevant to include a ban on chromium in the criteria.

Cadmium
Cadmium and cadmium compounds are acutely and chronically toxic for human beings and animals. Most cadmium compounds are also carcinogenic. Cadmium is classified as very toxic by inhalation and as carcinogenic. Cadmium can also potentially be reprotoxic and cause foetal damage. Most cadmium compounds are extremely toxic for aquatic organisms, especially in fresh water, and acutely toxic for mammals. Cadmium also has chronic toxic effects on many organisms, even in very small concentrations. Cadmium is bioaccumulative in fish and mammals and has a long biological half life in mammals.

Cobalt
Cobalt has the same properties as those described for cadmium.

Antimony
Antimony compounds are generally harmful to health and the environment, but certain compounds also have other effects. On the list of dangerous substances, antimony compounds – with the exception of antimony tetroxide (Sb_2O_4), antimony pentoxide

(Sb_2O_5), antimony trisulfide (Sb_2S_3), antimony pentasulfide (Sb_2S_5) and compounds with separate classification – carry the classification: harmful to health with the risk phrase R20/22 (Harmful by inhalation and if swallowed) and harmful to the environment with the risk phrase R51/53 (Toxic to aquatic organisms; may cause long-term adverse effects in the aquatic environment). Antimony trioxide is classified by the EU as carcinogenic (category Carc3) with the risk phrase R40 (Limited evidence of a carcinogenic effect). The substance is undergoing environmental hazard classification and risk assessment in the EU.

Zinc
Zinc is an essential metal, since living organisms require zinc. In excessive quantities zinc can be toxic for organisms in the environment and can cause stomach cramps and vomiting, and anaemia after prolonged ingestion. It can also affect rats' ability to reproduce, but it is not known whether it also has this effect on human beings. Zinc is a finite resource with a supply horizon of 20 years.

Copper
Plants, animals and humans need very small quantities of copper to survive, but it becomes toxic in higher concentrations. The body uses copper in the red blood cells, in certain enzymes and in hormones.

Too much copper can cause nausea, vomiting and diarrhoea, and affect the cardiovascular system. Copper and copper compounds are listed as priority substances in the EU's Framework Directive and the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal. Copper is also included on the European Commission's EPER list.

Nickel
Nickel is one of the commonest reasons for contact allergy in Denmark. However, cases have declined since new rules were introduced in 1991 for a large number of consumer products that are intended for direct and prolonged contact with the skin. The rules apply to e.g. jewellery, spectacles, buttons and belts, while mobile phones and laptop computers must also comply with the nickel requirements. Yet the rules do not protect all consumers, since some people are more sensitive. Even though metal elements comply with the rules, this is not sufficient to prevent particularly sensitive people from developing a nickel allergy.

Aluminium
The key environmental impacts in the life cycle of aluminium are associated with land use and waste from the extraction of the primary raw material, bauxite, high energy consumption in the production of primary aluminium, and emissions of environmentally harmful substances in the production process.

Steel
The carbon content of steel is between 0.002% and 2.1% by weight for plain iron–carbon alloys.
These values vary depending on alloying elements such as manganese, chromium, nickel, iron, tungsten, carbon and so on[50]. Other materials are often added to the iron/carbon mixture to produce steel with desired properties. Stainless steel contains at least 11%

[50] Ashby, Michael F. & Jones, David R. H. (1992) [1986]. Engineering Materials 2 (revideret udg.). Oxford: Pergamon Press

chromium, often in combination with nickel, in order to resist corrosion. Some types of stainless steel, for example. ferritic, are magnetic, while others, for example. austenite, the non-magnetic.

6.1.2 Container encasing the candle

The requirements O8 to O10 applies to Swan-labeled candles/oil candles/oil lamps, sold with a container. Requirement O8 applies to containers intended only to be used once, while O9 applies to containers, which are intended to be used several times. Containers containing plastic must additionally also apply to requirement O10.

Background to requirement O8 Materials in the container encasing the candle/oil in the oil candle
The requirement has been changed compared with version 1. Nordic Ecolabelling wishes to make it possible to Nordic Swan Ecolabelled candles in single-use containers, since they are the biggest sellers. Thereby Nordic Ecolabelling has a good chance to influence the biggest market for candles in an environmentally positive way, by dealing with disposable containers.

Metal:
Nordic Ecolabelling does not wish to allow disposable containers in metal, as there are environmentally preferable alternatives such as plastics with a high share of recycled plastic. Aluminium is today the most widely used material for containers in tea lights. There is no basic reason why tea lights with aluminium containers should be treated as anything other than metal waste for recycling. The practical system of collecting the aluminium containers is, however, critical to the environmental impact in terms of the life cycle, since recycled aluminium considerably reduces the environmental impact. In practice, it is the case that the majority of the aluminium containers from tea lights are incinerated (as domestic waste), and so there is a substantial impact from tea lights in aluminium containers, compared with the alternatives. The steerability in setting requirements for waste sorting is thus very low.

The draft report to the EU BAT reference document (Best available techniques) for "Non-Ferrous Metals Industries"[51] describes, that it takes two tonnes of bauxite to a tonne of aluminium, which in turn gives 0.53 tonne of aluminium. It takes 0.4 to 0.45 tonnes of carbon and 7.6 to 11.7 GJ of energy per ton of aluminium produced. This together with the lack of traceability in the waste sorting process, makes Nordic Ecolabelling maintains the ban on aluminium containers for candles in this criteria version. Today there is used a small amount of recycled aluminium to extruded and rolled products and there is little traceability of the production chain in relation to the material's origin[52]. Nordic Ecolabelling is not familiar with recycled Al is used in container for tea lights today.

[51] European IPPC Bureau. Best Available Techniques (BAT) Reference Document for Non-Ferrous Metals Industries (Final draft). Joint Research Centre 2014. side 445 og . http://eippcb.jrc.ec.europa.eu/reference/ (11. April 2015)
[52] Nordisk Miljømerking. Om Svanenmärkta Nordisk miljømerking. Bakgrund till miljömärkning av Fönster och ytterdörrar versjon 4.1. Bilaga 4. Mars 2014 http://ecolabel.dk/da/blomsten-og-svanen/kriterier/vis-produktgruppe?produktgruppeid=62&projektgruppe=Svanen (hentet 11. april 2015)

Nordic Ecolabelling has previously drawn up a material report and RPS analysis for aluminium[53], which states that the energy consumed in the production of aluminium and the raw materials used in its manufacture cause a significant environmental impact. This, coupled with the lack of traceability in waste sorting, means that Nordic Ecolabelling wishes to retain the requirement banning aluminium containers for candles in the coming criteria.

In Norway, WWF holds an annual tea light campaign to increase the proportion of tea light containers that are recycled[54]. The tea light campaign has helped increase the number of Norwegians who sort tea lights as metal waste from 24% in 2011 to 45% in 2013. A third of Norwegians are aware of the tea light campaign (source: YouGov, Norstat).

The Norwegian campaign described above shows that it is possible to increase consumer awareness of recycling aluminium containers from candles. It must, however, still be assumed that the majority of the aluminium containers are incinerated as household waste.

Heavy metals impacts the environment, so their discharge must be limited as far as possible.

It is therefore relevant to ensure that any metal used in a candle's container is free from the heavy metals lead (Pb), mercury (Hg), chromium VI (Cr^{VI}), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn,), copper (Cu), nickel (Ni) and aluminium (Al) (read more about these under requirement O7).

Glass and ceramic:
Nordic Ecolabelling does not wish to promote Nordic Swan Ecolabelled candles in single-use containers made from glass and ceramic, known as filled glass or ceramic candles. Production of glass and ceramic is highly energy-intensive, and the product is relatively heavy in relation to the actual candle, and even with a long burning time (40 hours) the environmental impact remains considerable, if the container is discarded after use. This applies even if the glass is sent for recycling. The production of glass and ceramic is based primarily on raw materials that are in plentiful supply and that have no known serious effects on health and the environment. Nordic Ecolabelling therefore allows candles in glass and ceramic containers if they are designed to be used multiple times for the same purpose, i.e. a refill system. A refill system means that the glass or ceramic container is sold with several candles, such that the candles can be replaced. The exemption relates only to candles made up of one or more wicks surrounded by a solid/semi-solid material at room temperature. Oil candles should be in single-use containers, as stated previously under the product definition.

PVS and PVDC:
PVC is not known to be used in candle containers, but chlorinated polymers such as PVC (polyvinyl chloride) and PVDC (polyvinyldiklorid) is still explicitly prohibited. There are many problems regarding both the production of PVC and handling of waste PVC.

[53] Materialerapport til kriteriedokumenter for Svanemærkning af gulv, vinduer og holdbart træ, 2012
[54] WWF "Resirkulering av telys på timeplanen" http://www.wwf.no/?38985/www.telysjakten.no

For more information on PVC, see the Nordic Swan Ecolabelling criteria for flooring and windows and doors[55][56]. A specific problem regarding recycled PVC is the content of lead and cadmium, which earlier mainly was used, as stabilizers in PVC.

Plastic
The requirement concerns constituent substances added to master batches or compounds. The requirement does not concern the actual polymer production.

There is considered to be an RPS for the use of a greater proportion of recycled plastic in candle containers. The critical factor is, however, whether it is post-consumer recycled plastic or post-industry recycled plastic, as defined in the standard ISO 14021, since pre-consumer, due to its often better quality, is easier to sell on the market for plastic granules than post-consumer. There is thus greater security in using recycled post-consumer plastic, although it does not result in the lower use of virgin plastic globally. Nordic Ecolabelling therefore believes it is not possible to equate the environmental benefits of using pre-consumer recycled plastic with the environmental benefits of post-consumer recycled plastic. On using recycled plastic, the use of both fossil raw materials and energy consumption is reduced. Recycled materials often have low traceability in terms of additives, and there is thus a risk of a trade-off in relation to problematic chemicals in the recycled raw materials.

This applies especially if it is post-consumer, rather than post-industry, in which case it will also be far more difficult to document the constituent substances of the materials, due to low traceability. The requirement limit of 75% by weight post-consumer recycled raw material was set based on dialogue with the candle industry. See also O10.

Nordic Ecolabelling has received many enquiries from candle producers that are considering replacing aluminium with containers made from bioplastic for their tea lights. Preliminary testing of containers made from bioplastic shows that they do not yet meet the requirements for fire safety in line with standard EN 15493.

The lid on graveyard candles and Oil candle are exempted from the general prohibition on metal. However, the lid must not contain aluminium (Al), lead (Pb), mercury (Hg), chromium VI (Cr^{VI}), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn), copper (Cu) or nickel (Ni). The requirement does not apply to steel (see also O7).

Graveyard candles are designed to be used outside, why it is in most cases designed in a plastic container with a metal lid to withstand the elements. The lid must be able to withstand high temperatures and therefore often made out of metal (often steel coated with another metal coating). The oil candle must be in a single-use container en order to obtain the Swan label. In order to ensure that the container is leak proof, a special metal lid is used, which simultaneously also serves as wick sustainer that has to be able to withstand high temperatures.

[55] Nordisk miljømerking. Bakgrund till miljömärkning av Fönster och ytterdörrar versjon 4.1. Bilaga 4. Mars 2014 http://ecolabel.dk/da/blomsten-og-svanen/kriterier/vis-produktgruppe?produktgruppeid=62&projektgruppe=Svanen (hentet 11. april 2015)
[56] Nordisk Miljømerkin. Bakgrunndokument til kriteriene for gulv. Om Svanenmärkta Golv. Versjon 6, bilag 3. 2014. http://www.ecolabel.dk/kriteriedokumenter/029_6_0_Baggrundsdokument.pdf (hentet 12. april 2015)

Requirements for containers sold together with the candle, which is designed to be used multiple times for the same purpose, i.e. refilsystem.

Background to requirement O9 Materials in the container encasing the candle
See background to O8.

Fireproof glass is made of borosilicate or soda lime. Borosilicate glass can withstand more rapid temperature changes than soda-lime glass. Fireproof glass have a higher melting point compared to normal glass, and therefore cannot be recycled together with normal glass. A small proportion of fireproof glass can ruin a ton of glass packaging sent for recycling. If fireproof glass is uses in a container it must be referenced in the information requirements for the consumer (O20), that the glass may not be sorted in the waste phase together with regular glass.

Containers that are designed to be used multiple times for the same purpose, is to be sold/marketed together with the at least two Swan labelled candles (refills). It is not possible to Swan label containers alone. This ensures traceability on the candles used in the container.

There is an exception for banning the use of aluminum in containers that are designed to be used multiple times. It is allowed to use aluminum in the container, if the amount is less than 15% of the container's total weight. It has been found that it can be difficult to clean containers (e.g., glass cups) of stearic when used several times. Refills are available on the market, wherein the container consists of parts which are easy to dismantle in order to remedy the cleaning and waste in the end.

These refill sytemer consists of a base plate made of aluminum and the sides of either glass or plastic. Refill systems using plastic cups can not comply with the limit at 15% of the container's total weight. Refill systems which uses glass cups will be able to meet the requrement limit.

Silicone is not subject to the requirement saying that at least 50% of the plastic materials used, must be made of either bioplastics or post-human consumption recycled raw materials. Silicone is not currently re-used in the same manner as other plastics, but is considered as hazardous waste. Silicone consist of inorganic polymers of polysiloxanes in which the chain is built up of silicic and oxygen atoms.

Background to requirement O10 Additives in bio-, virgin-, and recycled plastic
Polycarbonate is produced from bisphenol A (BPA). Nordic Ecolabelling is aware that there may be small residues of BPA present in the plastic after the polymerisation (ppm) levels. We can live with this risk because the alternative is many actively added flame-retardants. People are only marginally exposed to this kind of product (container made from polycarbonate).

It is also possible to use other types of plastic as candle containers, but this would then require that the plastic is added flame-retardants. Flame-retardants function is mainly to protect the product in the use phase. Therefore, they are deliberately constructed so that they do not break easily, making the flame-retardants persistent if spread in the nature. The greatest attention is directed toward the brominated flame-retardants, partly because they are detected in breast milk and in blood. Because of this, halogenated flame-retardants must not actively be added in the plastic/plastic parts.

The requirement also includes recycled plastic. According to manufacturers of candle containers made from recycled polycarbonate, it is possible to produce containers from 100% recycled polycarbonate. In order to ensure a sufficiently strong and good quality of the plastic, they often used as a lower proportion (50-60%) recycled polycarbonate. The preferred plastic product to recycle polycarbonate from is CD/DVD disks and certain types of plastic bottles.

According to a report of the Nordic Council of Ministers in 2014[57], CDs is compiled a in its own recirculation fraction (waste fraction). CD is often coated with lacquer, pigment and may also contain several types of flame-retardants. The process for recycling polycarbonate consists of a series of "washing processes," which ends with a "clean" polycarbonate granules (compound). It is not necessary to add additives to the polycarbonate granules in order to produce candle containers. Because of this, a number of substances must not actively be added in the plastic/plastic parts (both bio-, virgin- and recycled plastic). The requirement includes constituents to master batches or compounds. The requirement does not concern the actual polymer production.

Recycled plastic granules must not contain halogenated flame-retardants. The manufacturer or supplier of the recycled plastic granules must therefore test/declare that recycled plastic granules do not contain halogenated flame-retardants in concentrations above 100 ppm. Test can be performed by the producer of the candle in accordance with specifications in Appendix 11. Non halogenated flame is not subject to the requirement.

Nordic Ecolabelling will consider the possibility of setting new requirements to flame retardants and other substances in the recycled plastic share, in the next revision of the criteria for candles.

Nordic Ecolabelling wishes to promote products that can be used multiple times rather than just once. Therefore, the requirement regarding the share of bioplastic or recycled plastic in container is differentiated between containers designed to be used only ones and multiple times.

Halogenated organic compounds include many substances that are harmful to the environment and health, highly toxic for aquatic organisms, carcinogenic or harmful to health in other ways. The halogenated organic compounds are degraded slowly in the environment, which also increases the risk of harmful effects from the substances. Halogenated organic compounds may, for example, appear as flame retardants in plastic.

Prohibition of pigments and substances based on aluminium (Al), lead (Pb), mercury (Hg), chromium VI (Cr^{VI}), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn), copper (Cu) or nickel (Ni) and their compounds. See under O8.

The background for the requirement to EU's Candidate List, see O14.

[57] Cowi. Plastic at Recycling Centres. Background report, phase 1. 2014. http://norden.diva-portal.org/smash/record.jsf?faces-redirect=true&aq2=%5B%5B%5D%5D&af=%5B%5D&searchType=SIMPLE&query=&language=no&pid=diva2%3A716370&aq=%5B%5B%5D%5D&sf=all&aqe=%5B%5D&sortOrder=author_sort_asc&onlyFullText=false&noOfRows=50&dswid=3326 (hentet 12. april 2015)

6.1.3 Product and transport packaging

Background to requirement O11 Product and transport packaging
The requirement has been changed compared with version 1. The requirement concerning the quantity of primary packaging in relation to the weight of the candle is deleted from version 2 of the criteria. The aim of the packaging requirement was to restrict excessive use of packaging in relation to the primary product, the candle. The effect was that it was difficult for candle packs sold with one or two candles (particularly taper candles) to meet the requirement. The primary packaging comprises paperboard, paper and plastic foil, the function of which is to protect the candles, present them (visual design) and allow space for consumer information. A review of candle products sold on the Nordic market shows that the manufacturers of candles are acutely aware of the use of packaging in relation to the product. This also applies to the sale of candle packs containing one or two candles. Nordic Ecolabelling judges that there is very little potential (P) in continuing with the requirement concerning the quantity of primary packaging in relation to the weight of the candle, and so the requirement has been deleted.

The background for the prohibition of chlorinated plastic, see "background" to O8.

6.1.4 Chemicals

The requirements cover all chemical products used in the manufacture of candles/oil candle/oil lamps at the candle/oil candle/oil lamp factory/production centre or by suppliers.

The requirements apply to chemical products such as stearin, paraffin, wax, oil, fat, printing inks, dyes, lacquers, adhesives, pigments, hardeners and similar.

The requirements do not cover:

- Containers encasing the candle/oil, wicks and wick sustainers.
- Auxiliary chemicals used during manufacture, such as lubricants, cleaning chemicals and so on.
- The requirements also do not cover refining processes, i.e. refining of vegetable or fossil oil.
- Packaging such as printing inks and adhesived

Requirements in the Nordic Ecolabelling criteria are set e.g. for the classification of chemical products as well as ingoing substances in the chemical product.

Ingoing substances and impurities are defined below:

- **Ingoing substances:** All substances in the chemical product, including additives (e.g. preservatives and stabilisers) in the raw materials. Substances known to be released from ingoing substances (e.g. formaldehyde and arylamine) are also regarded as ingoing substances.
- **Impurities:** Residuals, pollutants, contaminants etc. from production, including production of raw materials that remain in the chemical product in concentrations less than 100 ppm (0.0100 w-%).

However, the following applies specifically to printing inks used to print on candle surface: Residuals, pollutants, contaminants etc. from production, including production of raw materials that remain in the chemical product in concentrations less than 1000 ppm (0.100 w-%).

Examples of impurities are residues of the following: residues or reagents including residues of monomers, catalysts, by-products, scavengers, and detergents for production equipment and carry-over from other or previous production lines.

This declaration is based on best knowledge at the time of application, based on the test and/or declarations from the manufacturer of raw materials. With reservations for developments and new scientific findings. If such new knowledge should be made available, the undersigned is required to submit an updated declaration to Nordic Ecolabelling.

Table 4: List of non-permitted classifications of the chemical products used in the manufacture of candles/oil candles, in accordance with CLP Regulation (EC) No 1272/2008, or later.

Signal words (Regulation (EC) No 1272/2008[a])	Hazard code (Regulation (EC) No 1272/2008)	Hazard class (Directive No 67/548/EEC[b])	Risk phrase (Directive No 67/548/EEC)
		Toxic to the environment	
Warning, Aquatic acute 1	H400	N	R50
Warning, Aquatic chronic 1	H410	N	R50/53
Aquatic chronic 2	H411	N	R51/53
Aquatic chronic 3	H412	-	R52/53
Aquatic chronic 4	H413	-	R53
Warning, Ozone	H420	N	R59
		Carcinogenic	
Danger, Carc. 1A or 1B	H350	T	R45 and/or
Danger, Carc. 1A or 1B		T	R49
Warning, Carc. 2	H351	Xn	R40
		Mutagenic	
Danger, Muta. 1A or 1B	H340	T	R46
Warning, Muta. 2	H341	Xn	R68
		Reprotoxic	
Danger, Repr. 1A or 1B	H360	T	R60
Danger, Repr. 1A or 1B	H360	T	R61
Warning, Repr. 2	H361	Xn	R62 and/or
Warning, Repr. 2	H361	Xn	R63
-	H362	-	R33
Lact.	H362	-	R64
		Very toxic	
Danger, Acute Tox. 1 or 2	H330	Tx	R26
Danger, Acute Tox. 1	H310	Tx	R27
Danger, Acute Tox. 2	H300	Tx	R28 and/or
Danger, STOT SE 1	H370	Tx	R39
		Toxic	
Danger, Acute Tox. 2 or 3	H330 or H331	T	R23
Danger, Acute Tox. 3	H331	T	R24
Danger, Acute Tox. 3	H301	T	R25
Danger, STOT SE 1	H370	T	R39 and/or
Danger, STOT RE 1	H372	T	R48
		Sensitising	
Hazardous, Resp. Sens. 1	H334	Xn	R42
Warning, Skin sens. 1	H317	Xi	R43
		Harmful	
Hazardous, Asp. Tox. 1	H304	Xn	R65

Background to requirement O12 Chemical products, classification
The requirement level for the classification of chemical products has been amended slightly in this revision, version 2. The requirement has been updated in line with the CLP which brings a new ban on chemical substances with the hazard code H330, H311, H301, H370, H372 (hazard class toxic, T), H330, H310, H300, H370 (hazard class very toxic, Tx), H400, H412, H413 (hazard class dangerous for the environment, N), H304 (hazard class harmful, Xn) and the wording of the requirement text has been made clearer. A review of chemical products in the current licences shows that the adjustment will not have any influence over the use of general chemical products such as stearin, paraffin, wax, oil, fat, dyes, lacquers, adhesives, pigments and hardeners. It is necessary to make an exception for paraffin, since this is classified as H412 and/or H350.

Nordic Ecolabelling seeks to ensure that the health and environmental impact of the products is as low as possible. Therefore, requirements are made for the prohibition of specific classifications of the products. The RPS analysis in Chapter 3 found a generally high RPS for strict chemical requirements for this product group. Chemical product requirements will not prevent a product from containing constituent substances with an undesirable classification. But in such a case, the classified substance will be in such a small quantity that the finished product will not be classified.

Table 5: List of non-permitted classifications for the constituent substances in the chemical products used in the manufacture of candles/oil candles, in accordance with CLP Regulation (EC) No 1272/2008, or later.

Signal words (Regulation (EC) No 1272/2008[a])	Hazard code (Regulation (EC) No 1272/2008[a])	Hazard class (Directive No 67/548/EEC[b])	Risk phrase (Directive No 67/548/EEC[b])
		Carcinogenic	
Danger, Carc. 1A or 1B	H350	T	R45 and/or
Danger, Carc. 1A or 1B		T	R49
Warning, Carc. 2	H351	Xn	R40
		Mutagenic	
Danger, Muta. 1A or 1B	H340	T	R46
Warning, Muta. 2	H341	Xn	R68
		Reprotoxic	
Danger, Repr. 1A or 1B	H360	T	R60
Danger, Repr. 1A or 1B	H360	T	R61
Warning, Repr. 2	H361	Xn	R62 and/or
Warning, Repr. 2	H361	Xn	R63
-	H362	-	R33
Lact.	H362	-	R64

Background to requirement O13 Classification of constituent substances
The requirement was also included in the previous version of the criteria, version 1. There is a requirement that constituent substances with a serious effect on health must not be included in the chemical products. This is to ensure that even small quantities of problematic substances are not contained in ecolabelled products. This applies to health effects where there is an actual classification, such as with CMR substances.

Two types of colouring are used in candles: pigments (organic and inorganic) and dyes. Pigments are used primarily for over-dipped candles and are generally more colourfast than dyes. The pigments are not greatly flammable and do not dissolve in the wax – the pigments remain as particles in the solid material of the candle. Pigments are filtered out by the wick and remain at the foot of the wick. Large quantities of pigment produce a

smaller flame, since the wick becomes slightly clogged by the pigment. The dyes are related to aniline dyes and, in contrast to pigments, fully dissolve in the wax. Dyes are used primarily to colour the wax, and are thus sucked up by the wick and become part of the combustion process.

Both pigments and dyes may contain CMR classified substances, the use of which is not permitted in Nordic Swan Ecolabelled candles.

Stearic acid, the building block of stearin, contains a highly reactive group that readily reacts with dyes in the stearin. This means that the candle loses its colour, depending on the temperature.

The same applies on exposure to sunlight (UV rays). Dyes therefore have a UV stabiliser added to combat this effect.

UV stabilisers are sometimes classified as H412 (R51/53) and H317 (Xi, R43)[58]. Nordic Ecolabelling does not wish to exclude UV stabilizers from the requirement.

Background to requirement O14 Substances that must not be included in the candle/oil candle
The requirement has been amended slightly compared with the previous version of the criteria.

Substances on the EU's Candidate List:
This is a new requirement that introduces a ban on the use of substances on the Candidate List in chemical products. Article 57 of REACH defines the criteria used for assessing substances as Substances of Very High Concern (SVHC). These substances may be added to the Candidate List. There is no list of SVHC substances – only a set of criteria for assessing substances as SVHC. The mere addition of a substance to the Candidate List does not in itself have any regulatory consequence, but it indicates that the substance can be considered for inclusion on the Authorisation List (see below).

The Candidate List is published pursuant to REACH Article 59 on the Chemicals Agency (ECHA) website. The link to the list is here: echa.europa.eu/candidate-list-table

Aromatic organic solvents:
Volatile organic compounds in which one or several benzene rings are included are called volatile aromatic hydrocarbons (VAH), and are very stable.
The expression "aromatic compounds" among other things describes benzene, toluene, mixed xylenes, orthoxylene and paraxylene.

Polycyclical aromatic hydrocarbons (PAH) may be released from candles. Some aromatic solvents are natural components of paraffin due to its petrochemical origin.

It is therefore not possible to ban such solvents completely in the 10% of paraffin that is permitted in Nordic Swan Ecolabelled candles. A study has shown that these chemical substances are general released in very small quantities from candles of various kinds

[58] http://www.bekro.de/

(stearin, paraffin and beeswax), if they have not intentionally been added to the candle during production[59].

Phthalates:
The requirement was also included in the previous version of the criteria. Phthalates are found in some candles, including generally white taper candles without aroma compounds[60]. Many phthalate compounds have undesirable health and environmental impacts. Some phthalates are on the EU's Priority List of substances that require further investigation for endocrine-disrupting effects – and some have already been shown to have endocrine-disrupting effects. Phthalates also receive a good deal of attention in the media and may therefore be undesirable in ecolabelled products for many reasons.

Some phthalates are on the Danish List of Undesirable Substances. These are diethyl hexyl phthalate (DEHP), dibutyl phthalate (DBP), benzyl butyl phthalate (BBP), dimethoxyethyl phthalate (DMEP) and diisobutyl phthalate (DIBP) with the following justification: "All five phthalates have problematic properties according to the List of Harmonised Classification. In addition, DEHP, DBP and BBP are on the EU Priority List of substances requiring further investigation for endocrine-disrupting properties."

Halogenated organic solvents:
The requirement was also included in the previous version of the criteria. Halogenated organic compounds are organic substances that contain halogenated compounds such as chlorine, bromine, fluorine or iodine. Halogenated organic compounds include many substances that are harmful to the environment and health, they are highly toxic for aquatic organisms, and are carcinogenic or harmful to health in other ways. Halogenated organic compounds have very low degradability in the environment, which also increases the risk of harmful effects from the substances. The requirements require that halogenated flame retardants, chlorinated paraffins, perfluoralkyl compounds (such as PFOA and PFOS) and halogenated organic solvents must not be added.

Heavy metals:
The requirement was also included in the previous version of the criteria, version 1. Heavy metals may be used for example in pigments/dye production[61]. The substances in question are lead, mercury, chromium^{VI}, cadmium, cobalt, antimony, zinc, copper and nickel and their compounds. The requirement particularly concerns heavy metals that are harmful to health and the environment, as specified in the text. These are toxic to humans and other organisms. Heavy metals impact the environment, so their discharge must be limited as far as possible.

It is therefore relevant to ensure that substances added to the chemical products used in the manufacture of candles are free from the heavy metals: mercury, chromium^{VI}, lead, cadmium, cobalt, antimony, zinc, copper and nickel and their compounds. See also O7.

Background to requirement O15 Total amount of organic solvent
The requirement has been amended slightly, compared with the previous version of the criteria. Several organic solvents have effects that are harmful to health. Organic solvents

[59] The 2007 Ökometric study: http://candles.org/wp-content/uploads/2014/05/International-Study-Shows-All-Candle-Waxes-Burn-Alike.pdf
[60] Miljøstyrelsen. Kortlægning af kemiske stoffer i forbrugerprodukter nr. 75, 2006. "Samlet sundhedsmæssig vurdering af kemiske stoffer i indeklimaet fra udvalgte forbrugerprodukter":
[61] Miljøstyrelsen. Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen".

may be absorbed via the lungs and skin, and damage a number of organs. The damage may be acute or chronic.

Acute injury after inhaling gases presents as e.g. headache, tiredness, etc. Organic solvents may also irritate the mucous membranes in the eyes, nose and throat. Organic solvents dry out the skin and can lead to eczema. After longer exposure, organic solvents can lead to chronic damage to the brain and nervous system. Certain organic solvents lead to other irreparable damage such as cancer and damage to reproduction (foetal damage).

In addition, certain organic solvents contribute to the greenhouse effect, some to photochemical ozone formation and some to depletion of the ozone layer.

Organic solvents are generally harmful to health due to the CMR risk and/or the risk of dissolving human tissue, for example brain tissue. A limit value has therefore been set for the permitted level of organic solvents in candles (unchanged from version 1 of the criteria)[62]. The aforementioned study shows a very small emission of the organic solvents when candles are burning. There is a potential risk, however, and a limit value has therefore been set.

Table 6: List of aromatic amines.

Aromatic amines cleaved from azo dyes and azo lacquers	CAS number
4-aminodiphenyl	92-67-1
Benzidin	92-87-5
4-chlor-o-toluidin	95-69-2
2-naphthylamin	91-59-8
o-amino-azotoluen	97-56-3
2-amino-4-nitrotoluen	99-55-8
p-chloranilin	106-47-8
2,4-diaminoanisol	615-05-4
4,4´-diaminodiphenylmethan	101-77-9
3,3´-dichlorbenzidin	91-94-1
3,3´-dimethoxybenzidin	119-90-4
3,3´-dimethylbenzidin	119-93-7
3,3´-dimethyl-4,4´-diaminodiphenylmethan	838-88-0
p-cresidine	120-71-8
4,4'-oxydianiline	101-80-4
4,4'-thiodianiline	139-65-1
o-toluidine	95-53-4
2,4-diaminotoluene	95-80-7
2,4,5-trimethylaniline	137-17-7
4-aminoazobenzene	60-09-3
o-anisidine	90-04-0
2,4-Xylidine	95-68-1
2,6-Xylidine	87-62-7

[62] Lau, C. et al. 1997. "Levels of selected organic compounds in materials for candle production and human exposure to candle emissions". Chemosphere, Vol. 34, Nos 5-7, pp. 1623-1630.

Background to requirement O16 Azo dyes and azo lacquers
The requirement was also included in the previous version of the criteria. Azo dyes and lacquers that cleaves to a number of aromatic amines is banned to use in EU according to Directive 2002/61/EC, but is still allowed to use outside EU. Certain azo dyes and azo lacquers can cleave into aromatic amines, which may be carcinogenic, allergenic, irritant or toxic. There is a limit value on 30 ppm in the EU legislation and has been set because it cannot be avoided, that impurities and tracers gives a minimal content of the listed amines.

Background to requirement O17 Perfume, aromas, and other aroma compounds
The requirement was also included in the previous version of the criteria. The requirement has been made more specific to clarify those aromas and other aroma compounds are also excluded from use.

Nordic Swan Ecolabelled candles/oil candles must not contain perfumes, aromas or other aroma compounds. Aromas, flavourings, perfume, essential oils, plant oils and plant extracts often contain a number of allergens or carcinogenic substances. Many candles contain aroma compounds to make them attractive to consumers, and in some cases to conceal odours that occur when burning the other substances in the candle. Aroma compounds may also be used in candles/oil candles to irritate insects and keep them away from the area around the candle.

To avoid adverse health effects from this type of substance the use of aromas, flavourings, perfume and aroma compounds is prohibited.

As aromas, perfumes and other aroma compounds are not necessary and entail unnecessary use of chemicals, a prohibition has been included in the criteria.

6.2 Use and quality requirements

Candles with the same candlemass, wick and thickness, but which is found in many different colors, only need to test one colored candle according to O18 (soot-index), O19 (fire safety) and O20 (burning time).

Background to requirement O18 Soot index
The requirement also appeared in the previous version of the criteria, but the requirement is now tightened. The requirement now also differentiates between candles/oil candles/oil lamps for indoor and outdoor use.

On the basis of data from licensees, after version 1 (see Appendix 1) and soot index testing of other non-Nordic Swan Ecolabelled candles[63], the requirement concerning the soot index has been tightened from 1.0 to 0.3 per hour (in accordance with EN 15426:2018) regaring taper/dinner candles, from 1.0 to 0.2 per hour regarding piller candles and from 1.0 to 0.1 per hour regaring tea-light candles/oil candles/oil lamp. The requirement concerning the soot index for a single test has also been tightened.

The reason for providing a differentiated requirements for soot index by type of candle is that there is a correlation between how much raw material is burned per hour and soot index/amount of particles. A normal taper candles burn faster than the pillar candles and tea-light candles.

[63] http://www.bolius.dk/pas-paa-stearinlys-her-er-5-sundere-alternativer-24697/, 20150409

The faster a candle burns, the more particles will be emitted to the air per hour. One reason for this is that there are more air movement about a thin candle so that the particles can be torn free faster. Wick design and wax composition and purity are also very important for the combustion[64].

Candles/oil candles for outdoor use (such as garden candles, graveyard candles and oil candles) often need to burn more strongly than a candle for indoor use due to wind and the need for more light. The soot index requirement for outdoor candles has therefore not been changed in this criteria version 2, e.g. 1.0 per hour (in accordance with EN 15426:2018). The requirement concerning the soot index for a single test has also not been changed (2.0 per hour). The reason for setting requirements for soot index regarding candles/oil candles/oil lamps for outdoor use is that they are often used at dining tables and therfore relatively close to the consumer.

In Scandinavia, it is also normal to eat outdoors in the summertime under a canopy (covered terresse or conservatory), and int this "room" you may have a concentration of particles.

In the new criteria version 2, the product definition has been changed to include candles comprising a wick surrounded by a material that is liquid at room temperature, generally known as oil candles/oil lamps. This type of candle is not covered by the standard EN 15426:2018, which only applies for solid/semi-solid materials at room temperature. The method is, however, judged to be transferable to the analysis of sooting from oil candles, since the key aspect of the test standard is the height from the fuel to the collection plate. Oil candles/oil lamps must meet the requirements concerning dimensions and burning periods that currently apply to candles made from a solid/semi-solid material.

Burning candles causes air pollution. This pollution is due in part to the substances contained in the candles before burning and in part to substances that form while the candles are burning.

The smoke from candles primarily comprises gases and particles:

- Gases:
    a) Carbon dioxide CO_2
    b) Water vapour H20
    c) Uncombusted gases – CH4, volatile organic compounds, PAH, etc.
- Particles:
    a) Soot, aerosols
    b) Condensed tars
    c) Condensed salts

The main source of the air pollution is the uncombusted gases (CH4, tars, PAH, etc.), soot and condensed tars.

Indoor air may contain surprisingly high concentrations of ultrafine particles (less than 0.1 μm), which are suspected of being harmful to health.

[64] Bekö, Gabriel; Toftum, Jørn; Clausen, Geo, et al: Ultrafine Particles: Exposure and Source Apportionment in 56 Danish Home, Technical University of Denmark, 2013

The particles come from various sources in the home, including candles, smoking, vacuuming, ironing and cooking.

A study[65] from 2006 on the formation of ultrafine particles in the home shows that burning candles produces the highest concentration of ultrafine particles. The concentration was around 240,000 particles/cm^3 for candles, compared with 213,300 particles/cm^3 for cigarettes, for example. There is no specification of what type of candle (wax type and size of candle) was used in the study.

A more recent study[66] from 2013 examined which types of candle produced the highest quantity of the problematic ultrafine particles, based on different materials such as paraffin, stearin and wax, plus the design of the candles. Of the candles used in the study, those made from soya wax generally fared better. According to the study, stearin candles are not as clean as many people believe.

They emit two thirds the amount of particles that a paraffin candle of the same design emits, and a candle made from pure stearin emits a third of the amount of a paraffin candle. The study also shows that the faster a candle burns, the more ultrafine particles it emits.

Soot-index is however an imprecise visual test, which does not say anything about either particle concentration or particle size. Soot particles are typically larger than the fine (PM 2.5) and ultrafine particles (PM 0.1 or <100 nm), which is assumed to be the most harmful. A study has shown that the number of ultrafine particles (20-30 nm in diameter) emitted was higher when the candle burned normal than during sooting burn. During the sooting burn the highest concentration of emitted particulates were about 10 times larger in size (270 nm diameter)[67].

The use of candles is one of the largest sources of particle pollution indoor and often the main source of exposure of ultrafine particles indoors[68],[69]. In test of burning candles, the highest concentration of particles was observed having a diameter in the range of 20-35 nm and a concentration of up to nearly 1 million particles/cm^3 was measured.

Even though the data for the potential health effects of particles in the indoor environment is uncertain, and not possible to compare directly with the health effects found from the traffic generated particles, there is however much to suggest that exposure to especially fine and ultrafine particles (PM2.5) can be a problem[70]. Ultrafine particles can penetrate the finest branches of the lungs, where the excretion is very slow, and where they potentially can penetrate into the bloodstream. A number of indoor

[65] http://www.sbi.dk/indeklima/stov-og-partikler/kilder-til-partikler-i-bygninger/konklusion
[66] Bekö, Gabriel; Toftum, Jørn; Clausen, Geo, et al: Ultrafine Particles: Exposure and Source Apportionment in 56 Danish Home, Technical University of Denmark, 2013
[67] Pagels et al. (2009). Chemical composition and mass emission factors of candle smoke particles. Aerosol Sci. 40, 193-208.
[68] Afshari,A., Matson,U., Ekberg,L.E., (2005). Characterization of indoor sources of fine and ultrafine particles: a study conducted in a full-scale chamber. Indoor Air Vol.15, Issue 2, pp. 141–150.
[69] Bekö et al. (2013). Ultrafine particles: Exposure and source apportionment in 56 Danish Homes. Env Sci Tech 47, 10240-10248.
[70] Brandt J. et al: Sundhedseffekter og relaterede eksterne omkostninger af luftforurening i København, DCE, Aahus universitet, 2013

sources of ultrafine particles have been identified, but the health effects of indoor ultrafine particle exposures remain largely unexplored[71].

The potential respiratory effects of such exposures seem most concerning because these particles are known to cause oxidative stress and inflammation in the lungs.

Subsequently, indoor ultrafine particle exposures may contribute to the exacerbation of asthma symptoms in susceptible individuals. Results from recent studies suggest that the amount of emitted particles from the candles can have a negative effect on lung function and systemic inflammation[72]. There is reason to be aware of the potentially harmful effects of particle emissions from candles, especially among sensitive groups of the population. The science is, however, currently unable to draw a quantitative distinction between the health effects of particles of different sizes and chemical compositions.

The Danish Information Centre for Environment and Health[73] studied the formation of particles (aerosols) and sooting in candles of different designs. The tests showed that the quantity of particles emitted when burning candles depends on the shape of the candle. The 6 taper candles tested emitted 110–360 micrograms of particles per hour. The 5 tea lights emitted less than 30 micrograms, while the 5 pillar candles emitted up to 100 micrograms of particles per hour.

In 2002[74] the Danish Environmental Protection Agency studied the content of chemical substances in a number of types of selected candles, and which substances were formed when the candles burned. The study showed that the candles contained relatively small quantities of heavy metals, and that the greatest concentrations were found in the wick. Some metals will remain in the wick, but it must be expected that others will be emitted during burning. Estimates of expected maximum concentrations in a room where a candle is being burned show that the level of nickel and lead in particular is significant.

The study also showed that, of the emitted pollutants studied, aerosols dominated with emissions of between 200 and 1300 µg/hour. No significant quantities of aldehydes or PAH compounds were found. Overall emissions of volatile organic compounds (VOC) came in at between 2 and 7400 µg/hour.

In 2007, a German laboratory at the Bayreuth Institute of Environmental Research[75] conducted a major study of emissions from candles.

The study tested paraffin candles, soya candles, stearin candles, palm wax candles and beeswax candles in a specialist test chamber. The emitted gases were analysed for over 300 chemicals that are known or suspected to be toxic, harmful to health or an irritant to the airways. These chemical groups included dioxins and furans, polycyclic aromatic hydrocarbons, short-chain aldehydes and volatile organic compounds. The study found that all the wax types tested burned cleanly and safely, without any noticeable difference

[71] Weichenthal S, Dufresne A, Infante-Rivard C (2007). Indoor ultrafine particles and childhood astma: exploring a potential health concern. Indoor Air 17(2),81-91.
[72] Karrotki et al. (2014). Cardiovascular and lung function in relation to outdoor and indoor exposure to fine and ultrafine particulatematter in middle-aged subjects Environment International 73 (2014) 372–381
[73] Tænk december 2006. "Pust partiklerne ud, laboratorietest".
[74] Danish Environmental Protection Agency. Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen".

[75] www.candles.org/researchstudies.html

in burning performance. The by-products from burning the various candle types were almost identical in composition and quantity.

Nordic Ecolabelling requires that candles must have a low soot index in accordance with EN 15426:2018.

A low soot index is an expression of clean burning from the individual candle, in terms of both particles and other uncombusted gases such as PAH, etc. The soot index requirement is thus still considered a good method of assessing the risk to health and the environment, as well as the quality of the candle.

Nordic Ecolabelling introduced after the consultation a requirement for testing emissions of fine and ultrafine particles from burning candles.

The requirement was a so-called information requirements without specified requirement threshold, since there is no standardized test for particulate emissions for candles.

Nordic Ecolabel therefore developed a test method in cooperation with the Danish Technological Institute (TI) in Denmark and because the test was not standardized and only used for very short periode, there was not a basis for setting a requirement threshold. Nordic Ecolabelling has subsequently worked to clarify the requirements for this test, and has in this context been in contact with the TI, individual companies and the European Candle Association (ECA). This has led to a clarification that it is difficult to test when the test method is not standardized, and therefor appear with several ambiguities. The requirement for testing emissions of fine and ultrafine particles from burning candles has therefore been removed in criteria version 2.1. Nordic Ecolabelling will allocate funds for testing emissions of particulate matter from Swan-labelled candles in 2017. Test results will form the basis for a partial evaluation solely with a focus on being able to set a requirement to emissions of particle from burning candles.

Background to requirement O19 Fire safety
The requirement also appeared in version 1 of the criteria, but has been expanded to include oil candles/-lamps comprising one or more wicks, surrounded by a material that is liquid at room temperature (20°C – 27°C). Candles can cause accidental fires if they are not used correctly. The licensee must therefore follow standard EN 15493:2019, EN 14059:2002 or EN 17616 on fire safety. There must also be documentation that any other materials (such as the container encasing the candle/oil) do not pose a risk to fire safety.

The requirement for fire safety for candle surrounded by liquid material at room temperature (oil lamps) is adjusted so that they too must comply with EN 15493:2019 and not EN 14059:2002. EN 14059:2002 include oil lamps which is based on petroleum (n-paraffin), ie developed from fossil fuels. This type of oil is classified with R65/H304 (harmful) particularly if swallowed, and therefore subject to special rules for the labelling the oilproduct. Nordic Ecolabelling does not allow fossil oil in oil lamps, so the standard is not relevant.

Taper/dinner candles with the same candlemass, wick and thickness, but with varying length, only need to test one white and one colored candle (colored candles may have been dipped in paraffin).

Background to requirement O20 Consumer information
The requirement has been changed compared with version 1. The criteria require that consumers must be informed about the burning time for one candle and given instructions on quality and safety when burning candles.

Fireproof glass cannot be recycled together with the normal glass fraction. Fireproof glass has to be recycled according to national legislation.

Candles can emit soot particles and other substances that are harmful to health and environment, if they are not used correctly. The licensee must therefore follow standard EN 15494:2019 on product safety labelling and warnings. There is also a requirement to provide the chosen consumer information in Annex A of the standard, even though this is optional according to the standard. For candles used outdoor, the standard EN 17617 applies.

This requirement is derived on the basis of advice from retailers. In this version 2 annex A5 in EN 15494: 2007 has been added to the requirement. Annex A5 makes recommendations how to extinguish the candle with a tweezer or cone in order to minimize emissions of particles/smoke.

In this criteria version 2, the product definition is changed to include candles comprising a wick surrounded by a material that is liquid at room temperature, generally known as oil candles/-lamps.

This type of "candle" is not covered by the standards EN 15426:2018 and EN 15493:2019, which only apply for solid/semi-solid materials at room temperature. Oil candles/-lamps must meet the requirements in EN14059:2002 concerning safety-, labelling- and warning information.

Taper/dinner candles with a burn time of over 12 hours is excepted from the burn test in EN 15493:2019. The standard EN 15493: 2007 has been developed for traditional consumer candles with a burning time less than 12 hours.

For special candles, eg church candles which have a very long burning time, the test method will results in a very long testing period, which is not reasonable. After conversation with the manufacturers of candles it has been decided that taper/dinner candles, with a burning time of more than 12 hours, has to be tested 3 times 4 hour periods with a paurse of 1 hour between burning periods. The candle burning time is calculated as; (number of centimeter candle burned per. hour/candle length). Moreover, the EN 15493: 2007 has to be meet.

6.3 Quality and regulatory requirements

To ensure that the Nordic Swan Ecolabel requirements are met, the following procedures must be implemented.

If the manufacturer has a certified environmental management system in accordance with ISO 14 001 or EMAS in which the following procedures are implemented, it is sufficient for the accredited auditor to confirm that the requirements are being implemented.

Background to requirements
O21 Licence administrators
O22 Documentation
O23 Product quality
O24 Planned changes
O25 Unforeseen non-conformities
O26 Traceability
O27 Take-back system
O28 Laws and regulations
Requirements O21 to O28 are general quality assurance requirements for ensuring that the ecolabelled products fulfil the requirements and comply with legislation and regulations such that the products maintain the environmental quality which is the purpose of the requirements. Most of these requirements are general and apply to all production of ecolabelled products. Individual requirements are not justified in greater detail here.

7 Changes compared to previous version

Table 7: Overview of changes from Version 1 to Version 2.

Revised criteria (2.0)	Previous criteria (1.0)	Comment
General		The product group definition has been amended slightly, compared with version 1. It now also includes oil candles/-lamps comprising one or more wicks, surrounded by a material that is liquid at room temperature (20°C – 27°C).
O1	R1	The requirement has been amended slightly, compared with the previous version of the criteria.
O2	R3	The requirement concerning the amount of raw material produced from renewable raw materials remains unchanged at a minimum of 90%. The requirement has been expanded to include oil candles/-lamps made from liquid materials at room temperature. For these, the requirement concerning the amount of raw material produced from renewable raw materials is 100%.
O3	New requirement	Prohibition on the use of renewable raw materials from palm- and soya oil in Swan labelled candles.
O4	R4	Traceability and control of vegetable raw materials (other than palm and soya oil). The requirement specifies which areas the raw materials must not be sourced from. Requirement for written procedures that ensure fulfilment of the requirement.
O5	New requirement	Raw materials from biocide-tolerant and insect-resistant genetically modified plants are not permitted in Nordic Swan Ecolabelled candles.
O6	New requirement	All paraffins used in Nordic Swan Ecolabelled candles must be fully refined (i.e. hydrogenated), or match the hydrogenated grade stated in the standard RAL-GZ 041, September 2014 or later.
O7	R16	The wick requirement remains unchanged in version 2 of the criteria. The requirement concerning wick sustainers also appeared in version 1. The requirement has been tightened to include a ban on the addition of aluminium.
O8	R15	Applies to containers intended only to be used once. Requirement concerning the materials that encase the candle. Single-use containers must not contain glass, ceramic, PVC/PVDC or a number of metals (including aluminium). Any plastic must comprise a minimum of 75% bioplastic or post-consumer recycled plastic.
O9	New requirement	Applies to containers that are designed to be used multiple times. The containers must not contain PVC/PVDC or a number of metals. Any plastic must comprise a minimum of 50% bioplastic or post-consumer recycled plastic.

O10	New requirement	Various substances must not actively be added in the plastic/plastic parts (both bio-, virgin- and recycled plastic): halogenated organic compounds, flame retardants, phthalates and substances on EU's Candidate List. Recycled plastic granules must not contain halogenated flame retardants in concentrations above 100 ppm.
O11	R17	The product and transport packaging requirement has been amended, such that there is no longer a requirement for the quantity of packaging in relation to the candle's weight.
O12	R7	The chemical products requirement has been updated in line with the CLP, which brings a new ban on chemical substances with the hazard code (hazard class toxic, T) H330, H331, H301, H370, H372, (hazard class very toxic, Tx) H330, H310, H300, H370, (hazard class dangerous for the environment, N) H400, H412, H413 or (hazard class harmful, Xn) H304.
O13	R7	The requirement concerning constituent substances classified as CMR also appeared in version 1.
O14	R9, R10, R11 and R14	The requirement to substances that must not be included in the candle/oil candle is now combined in one requirement. The requirement has been tightened to include a ban on substances on EU's Candidate List.
O15	R12	The requirement to total amount of organic solvent also appeared in version 1.
O16	R8	The requirement to the use of azo dyes/lacquers has been tightened with 2 new amines.
O17	R13	The ban on perfume, aromas and other aroma substances also appeared in version 1.
O18	R6	The soot index requirement has been tightened and differentiated by type of candle. New requirement to oil candles made from liquid materials at room temperature.
019	New requirement	Candle/oilcandle has to be tested for emissions of fine and ultra-fine particles (particles of 5-150 nm). (this requirement is subsequently removed in version 2.1, see any. requirement O18).
020	R19	The fire safety requirement also appeared in version 1. The requirement has been amended to include oil candles made from liquid materials at room temperature.
021	R18	The information requirement also appeared in version 1. The requirement has been amended to include oil candles made from liquid materials at room temperature. New requirement to information regarding extinguish the candle with a tweezer or cone in order to minimize emissions of particles/smoke.
O22–29	R20–28	Updated to the Nordic Ecolabel's latest wording of these general quality and environmental management requirements.

8 New criteria

As part of any future evaluation of the criteria, it will be relevant to consider the following points:

- Requirements concerning renewable and fossil raw materials
- Requirements concerning substances in bio-, virgin- or recycled plastic
- Requirements concerning chemicals
- Requirement level for emissions, in the form of the soot index
- The possibility of setting requirements for emissions of small particles

Terms and definitions

Term	Explanation or definition
CO	Carbon monoxide.
OGC	Organic gaseous carbon.
PAH	Polycyclic aromatic hydrocarbons.
NOx	Nitrogen oxides.
VOC	Volatile organic compounds.
RPS	Relevance, Potential and Steerability: tool for analysing whether environmental problems are relevant, whether there is potential for improvement, and whether the licensee has the steerability to be able to achieve these environmental improvements.
PVC	Polyvinyl chloride.
CMR substances	CMR substances are substances that are known to be Carcinogenic, Mutagenic and/or Reprotoxic.
PM2.5	The limit value for fine particles.
PET	A thermoplastic product of the polyester family. The material is known for its great strength and rigidity, and being a good barrier against oxygen and carbon dioxide. It comes either transparent or opaque.
GMO	Genetically modified organisms.
Residues	A residue is something other than the end product that the manufacturing process directly seeks to produce. It is not the main purpose of the manufacturing process and the process has not intentionally been modified to produce it[76].
Waste	Waste is any substance or object which the holder discards or intends or is required to discard. Raw materials that have been intentionally modified to count as waste (e.g. by adding waste material to a material that was not waste) should not be considered as qualifying.
Primary packaging	Primary packaging is paperboard, paper and plastic foil, the function of which is to protect the candles, present them (visual design) and allow space for consumer information.
Transport packaging	Transport packaging refers to packaging for the handling and transport of a number of sales units or multipack consignments, e.g. pallets and boxes made from paperboard and corrugated board.

[76] Meddelande från kommissionen om det praktiska genomförandet av EU:s hållbarhetssystem för biodrivmedel och flytande biobränslen och om beräkningsregler för biodrivmedel (2010/C 160/02).

Appendix 1 Measurement results for soot index for Nordic Swan Ecolabelled and non-Nordic Swan Ecolabelled candles

The soot index requirement follows the standard EN 15426:2007, whereby the average soot index value from three tests must be less than 1.0 per hour. No single test must exceed 2.0 per hour. Figure 3 below shows the measurement results for current Nordic Swan Ecolabelled candles. Candles no. 1–9 are pillar/ball candles, while 10–21 are taper candles.

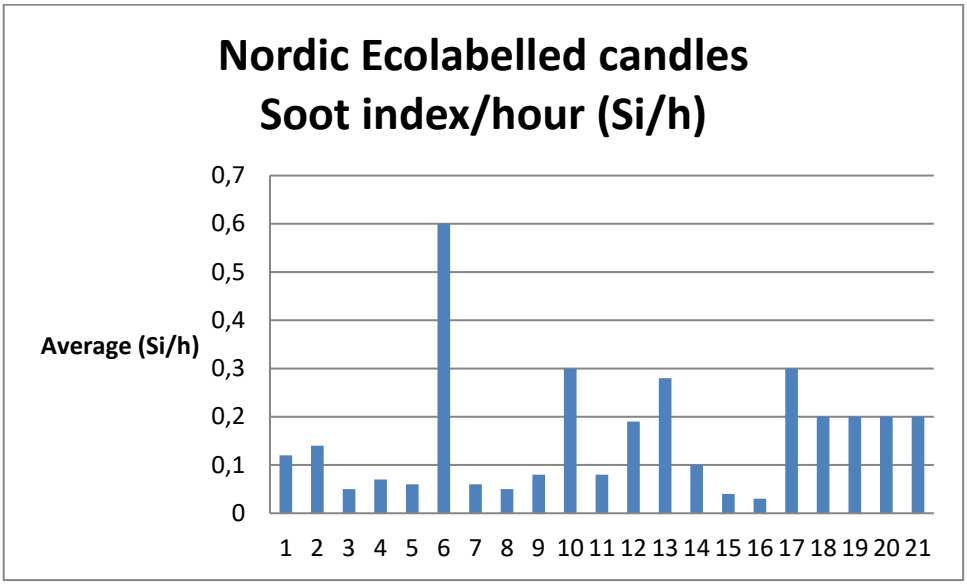


Figure 2 Measurement results from Nordic Swan Ecolabelled candles. Nordic Ecolabelling's limit value for the soot index is 1.0 per hour (Si/h) in accordance with EN 15426:2007.

In December 2007, the Danish Information Centre for Environment and Health (IMS) conducted a test[77] of 5 types of pillar candle and 5 types of taper candle from various retail chains in Denmark, see figure 4. The candles were made from a range of materials, such as paraffin, stearin and wax. In some cases, the material type was not listed on the packaging and the test therefore cannot be used to judge whether candles made from stearin or paraffin soot the least.

[77] http://www.forbrugerkemi.dk/tema/test-og-rad/testarkiv/test-af-sodning-fra-sorte-lys

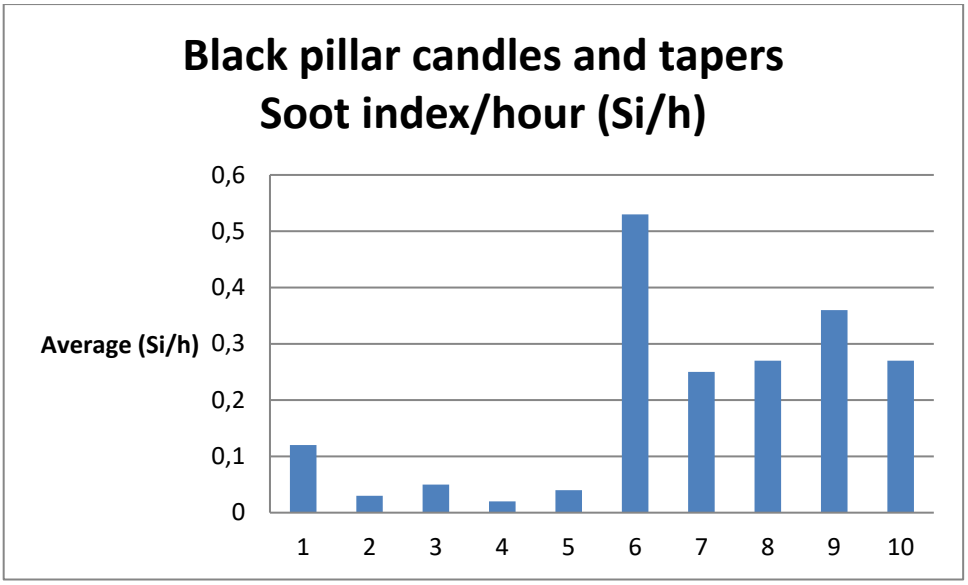


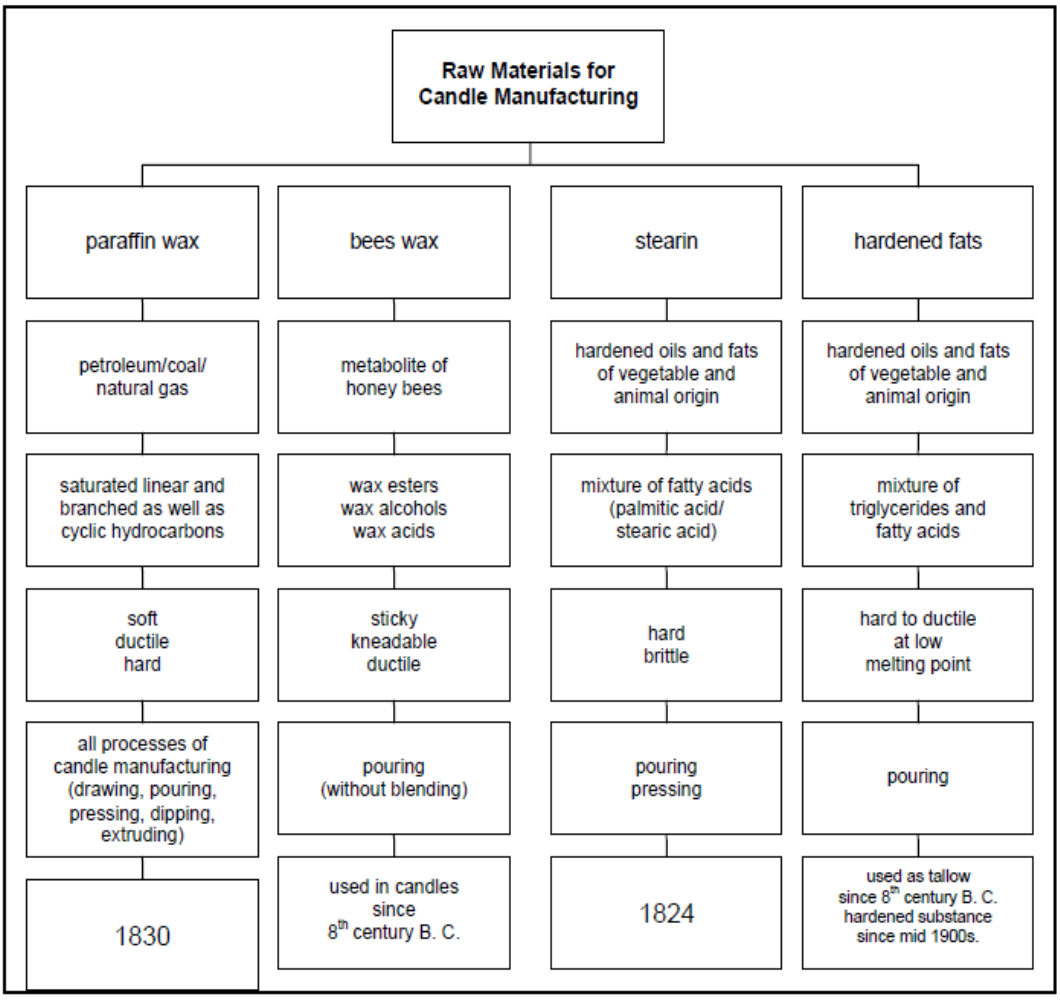
Figure 3 Measurement results from 5 black pillar candles (1-5) and 5 black taper candles (6-10) tested by the Danish Information Centre for Environment and Health in 2007

The results show that sooting from all 10 of the candles tested lies below the EU standard. The product that soots the most has an average soot index of 0.53 per hour. This is almost half what the standard and Nordic Ecolabelling permit. For the least sooting candle, the value comes in at 0.02 per hour. The test also reveals that pillar candles soot much less than taper candles. This is explained in part by the difference in shape. A normal height taper candle burns faster than the thicker tea lights and pillar candles. And the faster a candle burns, the more particles are emitted per hour. If one takes account of the fact that taper candles burn several grams more per hour than the other two types, the difference between the three types is minimised, but it does not disappear. If the choice is between taper candles and pillar candles, it would seem that the best choice is the pillar variant[78].

In December 2006, IMS tested the sooting of white candles. This time, the test showed that tea lights produce almost no soot, while taper candles are medium to strong sooters. Since the standard EN 15426:2007 was not in place at this time, the measurement method was slightly different in this case. The test results from 2006 are therefore not directly comparable with the latest test results for Nordic Swan Ecolabelled candles and the IMS test of black candles.

[78] Tænk december 2006."Pust partiklerne ud, laboratorietest".

Appendix 2 Raw materials for the production of candles[79]



Materials

A candle essentially comprises 2 components: a wax and a wick. Wax is a broad term. In this report it is used as a synonym for the flammable material that surrounds the wick in a candle. Wax is used as an umbrella term for a complex substance that is not chemically defined, but can be made from crude oil (synthetic wax, paraffin wax) or from materials of vegetable or animal origin. Wax as a substance is defined based on its physical-chemical properties. Wax must have a melting point above 40°C. Candles made from stearin wax may, for example, have a covering layer of paraffin wax to reduce the chance of the candle running or bending in the sun. This is because paraffin has a slightly higher melting point than stearin. The above diagram gives an overview of the different wax types, their composition and their physical properties.

[79] Dr. M.Matthäi, Dr. N.Petereit: "The quality candle", European Candle institute, 2004

Paraffin
Paraffin is currently the most widely used wax type for the manufacture of candles. Paraffin is made from crude oil, which generally comprises hydrocarbons, typically C22–C28 hydrocarbons. Refined paraffin is one of the main ingredients in the manufacture of candles. It is a blend of normal paraffins (unbranched chain of carbon atoms), isoparaffins (branched chain of carbon atoms) and cycloparaffins (naphthenes, ring of carbon atoms). The composition depends on the type of oil and the refining process. The melting point for refined paraffin is typically 52–56°C. Tea lights may also use paraffin with a lower carbon number, C18, which gives a lower melting point. To stop the candles bending in sunlight, the outer layer of a taper candle is generally coated in a paraffin with a higher melting point, typically around 70–75°C. Paraffin may contain residues of lighter aliphatic and aromatic hydrocarbons and other organic compounds[80].

Paraffin may be extracted from crude oil, oil-containing slate, brown coal and peat. Of these options, crude oil is the leading source. Technically prepared paraffin is a blend of 3 basic types of saturated hydrocarbons. The percentage distribution of such totally different components is determined by the composition of the crude oil and the preparation method used[81]. They are defined as follows:

Normal paraffins:
These paraffins comprise saturated linear chain hydrocarbons, i.e. with no branches or double bonds. At a well-defined temperature below the melting point, the molecular chains of normal paraffin will layer in a particular order, forming relatively large and regular crystals. During solidification, the chains of molecules pull together strongly, showing substantial contraction.

Iso-paraffin:
This is a saturated hydrocarbon that can display branches along the linear chain. The branches may be formed from different carbon atoms, and may also have different lengths. The regular chemical structure of iso-paraffin makes crystallisation more difficult during solidification. As a result, it forms smaller, more irregular crystals than normal paraffins. Because of the side chains, the molecules are not as tightly packed and the iso-paraffin therefore displays less contraction during solidification than is the case with normal paraffins.

Naphthenes:
Naphthenes are saturated ring compounds of one or more saturated side chains, with the same or different lengths and with branches of greater or lesser strength. The extremely irregular structure of the naphthenes largely prevents crystallisation during solidification. Below the melting point, the vast majority of material is "amorphous", i.e. a non-crystal-lised mass. The remaining quantity forms small, characteristically needle-shaped crystals.

There are also aromatics among the paraffins, although in structural terms these cannot strictly be considered paraffin hydrocarbons. They are also called cyclical hydrocarbons and are made up of benzene rings with substituted saturated side chains.

[80] Dr. M.Matthäi, Dr. N.Petereit: "The quality candle", European Candle institute, 2004
[81] http://cawatecnordic.dk/index.php/produkter-da/ct-menu-item-3/ct-menu-item-5/ct-menu-item-7

Production:
The paraffin component of the crude oil used is concentrated during distillation into different fractions of lubricating oil, depending on the boiling point.

To separate the paraffin, the majority of the lubricating oil is cooled to low temperatures (-30°C) with the help of solvents, and the paraffin that crystallises out is removed using large drum filters.

This paraffin-containing by-product, which still has a high oil content, is called crude paraffin (slack wax), and this is the basis for wax refining.

The paraffin wax producer now separates the different slack wax fractions that have not been extracted from the low boiling ingredients (up to approx. 400°C), but from the high boiling ones (from 350–550°C).

These different fractions that form during the distillation of paraffin are the paraffin manufacturer's feedstock. The fractions range from light lubricant oil to heavier lubricant oils and the residue known as Petrolatum. The relatively high oil content is in many cases unsuitable for consumers, since the level should ideally lie at around 0.5–1.5%.

The solvent extraction process tends to be used for the extraction of products with such a low oil content. The process can be performed in several different ways, all of which result in paraffin with a low oil content. The method described below is the method used in most cases, and one that can be used for the production of practically all slack wax types.

The liquid slack wax is sprayed from the top of a spray-tower and falls down as a fine powder with a particle size of approx. 0.1–1 mm. The cooling is achieved using a counterstream of atmospheric air. The powder is then mixed with a cold solvent (dichloroethane) in a mixing vessel. As this process is done cold, the paraffin wax particles are kept intact and only the oil is extracted due to the difference in specific gravity of the paraffin (approx. 0.78) and the solvent (approx. 1.26). The paraffin clumps are remixed with a solvent and extracted again after a specific time. The mix of paraffin and solvent is then placed in large centrifuges, where the majority of the solvent is extracted. The paraffin clumps are removed and, after a further reheating, the remaining solvents are removed. What remains is paraffin with a low oil content.

The result of this method is an almost oil-free paraffin or micro-wax that now can be further processed to meet special requirements. Hereafter the paraffin is filtered with an absorbent (bleaching agent) or refined with concentrated sulphuric acid, after which it is neutralised and treated with a bleaching agent and/or is hydro-finished.

In doing this, the coloured components are separated from the paraffin wax. Along with the refining residue, remaining reactive components such as compounds with aromatic rings or chains with reacting carbon atoms are extracted. The result is a refined product with great stability in light and heat. Resistance to oxidation can be further improved by adding stabilisers.

Stearin
Under normal conditions, stearin is a solid crystalline blend of the fatty acids stearic acid (C18 fatty acid) and palmitic acid (C16 fatty acid).

Stearin is used in its pure form or in blends to manufacture candles. The fatty acids used to make stearin derive from animal and vegetable fats and oils, with palm oil being the most common type of raw material. The various types of stearin can be differentiated according to their proportion of stearic acid and palmitic acid. The melting point typically lies at around 60–62°C[82].

Beeswax
Beeswax is the oldest known raw material for the production of candles. Beeswax is a blend of around 70% esters of long chain wax alcohols (C24–C24) with carboxylic acids (C16/C18), 15% hydrocarbons (C25–C35), 14% free wax fatty acids (C24–C32) and 1% free wax alcohols (C34–C36). The melting point of beeswax is around 65°C.

Natural fats and oils
Natural fats and oils comprise blends of triglycerides with various fatty acids. Depending on the length of the carbon atoms and the degree of saturation (saturated, monounsaturated or polyunsaturated), these fatty acids are either solid, semi-solid or oily substances. As mentioned previously, palm oil is the most widely used vegetable oil.

Wicks
Wicks are generally made from cotton and can have different thicknesses and shapes. The wick controls the melting, evaporation and burning of the candle material and transports the liquid wax from the melting area to the burning zone. To keep the wicks stiff and upright, they can be impregnated with various inorganic chemicals and waxes, or they can be interwoven with paper fibres. Impregnating the wick also prevents afterglow of the wick after the candle has been extinguished. It used to be common for wicks to have a metal thread embedded in them to keep the wick straight and stiff. This metal thread could be made of lead, zinc or tin[83].

The choice of wick and wax and the diameter of the candle need to be optimally balanced to ensure ideal burning of the candle.

Additives
In addition to wax and wicks, a number of other additives are used in the manufacture of candles. Dyes are generally organic synthetic substances that are soluble in wax. The dyes tend to belong to the group of aniline dyes or organic pigments. Aroma compounds added to scented candles are usually made from essential oils and plant extracts dissolved in an organic solvent. There is a ban on the use of aroma compounds in Nordic Ecolabelling's criteria for candles.

Other materials
Candles for outdoor use are often sold with a container (a cup or bowl) that encases the candle, so the candle can burn even in rain and wind. Such containers may be made from plastic, glass, metal or other materials. The same is also the case for tea lights that are used indoors, with aluminium often being used to encase the wax. This type of material is usually discarded along with normal household waste, with no waste sorting for recycling.

[82] Danish Environmental Protection Agency. Kortlægning nr. 6, 2002:"Indholdsstoffer i levende lys der sælges i detailhandlen".
[83] Dr. M.Matthäi, Dr. N.Petereit: "The quality candle", European Candle institute, 2004

In many countries, this waste is sent to landfill. The current Nordic Ecolabelling criteria therefore require that the material encasing the candle must be biodegradable. If this is not the case, the container must instead be reusable multiple times for the same purpose as it was originally used.

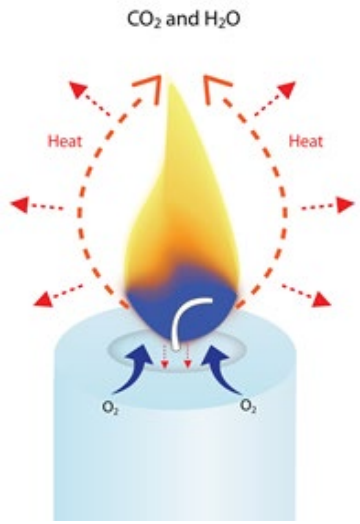
Packaging
Candles are often sold in packs of two or more. The packaging usually comprises paperboard plus a clear plastic foil (mostly PP). The packaging tends to end up in the general household waste.

Appendix 3 How does a candle work?

A candle essentially comprises 2 components: a wax and a wick. The wax is a solid substance at room temperature that melts on heating. Additives that may be added to the wax include dyes, various forms of aroma compound and "metallic" finishes that are in fact an organic material and not a metal. A wax has to be solid at room temperature and have a high enough melting point that the candle will not bend in sunlight. Since candles are typically burned indoors, it is always important that the wax does not contain too many impurities that could cause a pollution problem (soot) during burning.

The burning process can be split into the following phases[84]:

4. Melting the fuel (wax)
5. Transporting the fuel by capillary action via the wick
6. Converting the liquid fuel into gas
7. Thermally breaking down the fuel (pyrolysis)
8. Oxidising the products of the pyrolysis



Wax primarily comprises hydrocarbons (hydrogen and carbon atoms). When you light a candle, the heat from the flame melts the wax closest to the wick, and that wax is then drawn up the wick by capillary action. The heat from the flame vaporises the liquid wax, which begins to break the hydrocarbons down into molecules of hydrogen and carbon. These vaporised molecules are caught up in the flame, where they react with oxygen from the air and form heat, light, water vapour (H_2O) and carbon dioxide (CO_2).

It takes a couple of minutes from first lighting the candle until the combustion process stabilises. The flame may flicker or smoke a little to start with, but once the process has stabilised, the flame will burn cleanly and gently in a drop shape, emitting mainly carbon dioxide and water. If the flame becomes too large/small, or too much air or fuel is supplied, it will flicker and form unburned soot particles as a result of incomplete combustion. The ratio between the hydrogen and carbon in the wax also plays a key role in ensuring clean burning. Unsaturated hydrocarbons (e.g. aromatic compounds) that are present in unrefined/non-hydrogenated wax (slack wax) have a very high tendency to emit soot[85]. The design and composition of the wax also plays an important role in ensuring clean burning. Thicker wicks often give a higher soot index, since the oxygen finds it hard to penetrate fully to the core of the wick[86].

[84] http://www.candles.org/candlescience.html
[85] Dr. M.Matthäi, Dr. N.Petereit: "The quality candle", European Candle institute, 2004
[86] Telefonsamtale med Per Pedersen, Agowa, juli 2013.

Appendix 4 Raw material traceability

Traceability states where the raw materials come from. In principle there are three different methods of documenting traceability: 1) physical separation at every stage ("Track and trace"), 2) mass balance (MB) and 3) certificate trading (Book and claim). In most traceability certification systems it is possible to use physical separation and mass balance. Certificate trading is not permitted in all systems, but is permitted in RSPO, for example, via an international system called GreenPalm.

Below is a more detailed description of the three traceability systems for raw materials:

1a) Traceability via physical separation at all facilities ("Track and trace") with what is known as Hard IP or Identity Preserved (IP) means that raw materials are kept separate throughout their life cycle (Figure 4). This means that it is possible to definitively state the precise origin of the raw materials of a product. The method is often used in the food industry, where organic labelling, for example, requires traceability at this level.

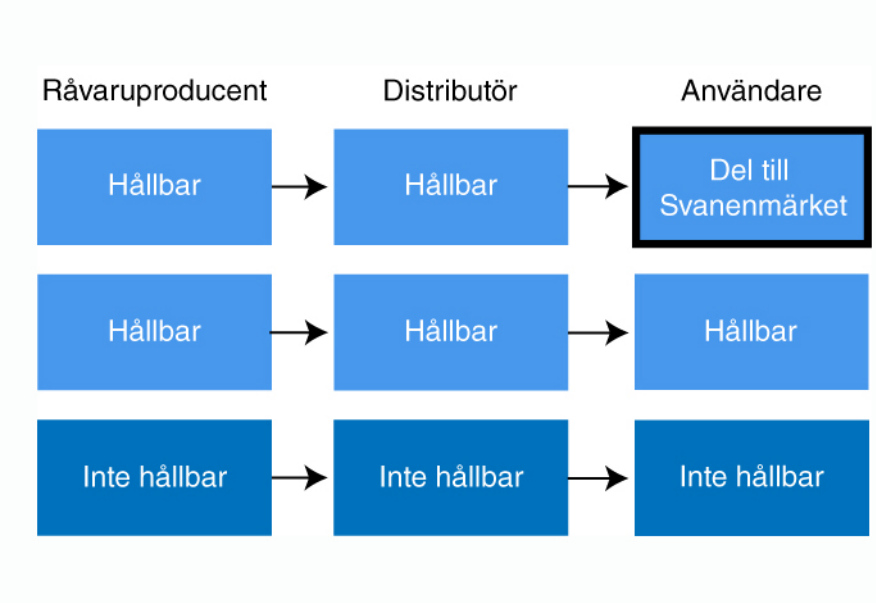


Figure 4: Traceability via physical separation at all facilities.

1b) Traceability via physical separation of sustainable and non-sustainable raw materials. ("Track and trace" with what is known as Soft IP) means that stock of raw materials is kept separate, but blending of different sustainable mixes is permitted (Figure 5).

The advantage of physical separation is that it is possible to follow the raw material all the way to the end customer. The system involves less administration but can be expensive and complicated for smaller flows.

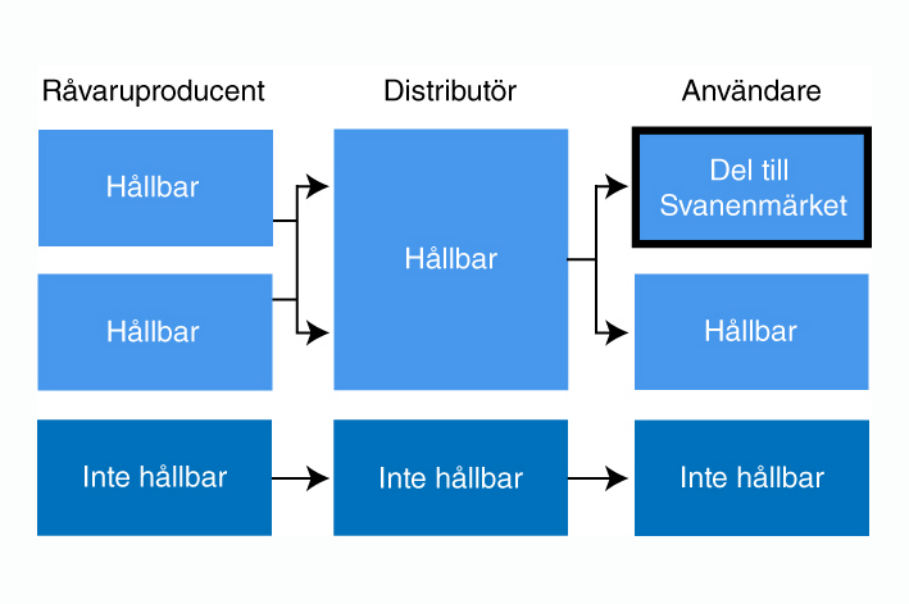


Figure 5: Traceability via physical separation of sustainable and non-sustainable raw materials.

2. Traceability via mass balance allows mixing of sustainable and non-sustainable raw materials (Figure 6). The requirement is that X% of sustainable raw materials in the mix is equal to X% of sustainable raw materials out of the mix. It is possible to use this method in traceability certification for food and in traceability certification for forest products (e.g. Forest Stewardship Council, FSC).

The advantage of mass balance is simplicity because no physical separation is necessary, making it easier and cheaper, particularly for trade with smaller flows. It requires a system for reporting mass balance.

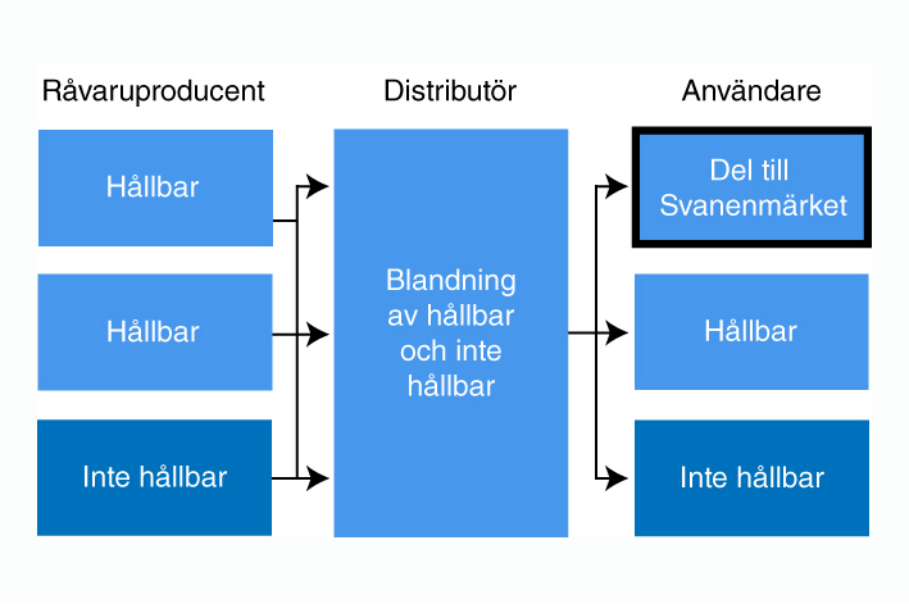


Figure 6: Traceability of mass balance of sustainable and non-sustainable elements.

3. Systems only based on certificate trading, known as "Book and Claim" (Figure 7). There is no physical connection between the product and the certificate. This is the method used by GreenPalm to buy RSPO certificates. The system must guarantee that the certified raw material/product is not sold more than once. The advantage of the system is simplicity because no physical separation is necessary, making it easier and cheaper, particularly for trade with smaller flows. The disadvantage is that it accepts trade in all sorts of palm oil, in other words it does not combat trade in non-certified palm oil.

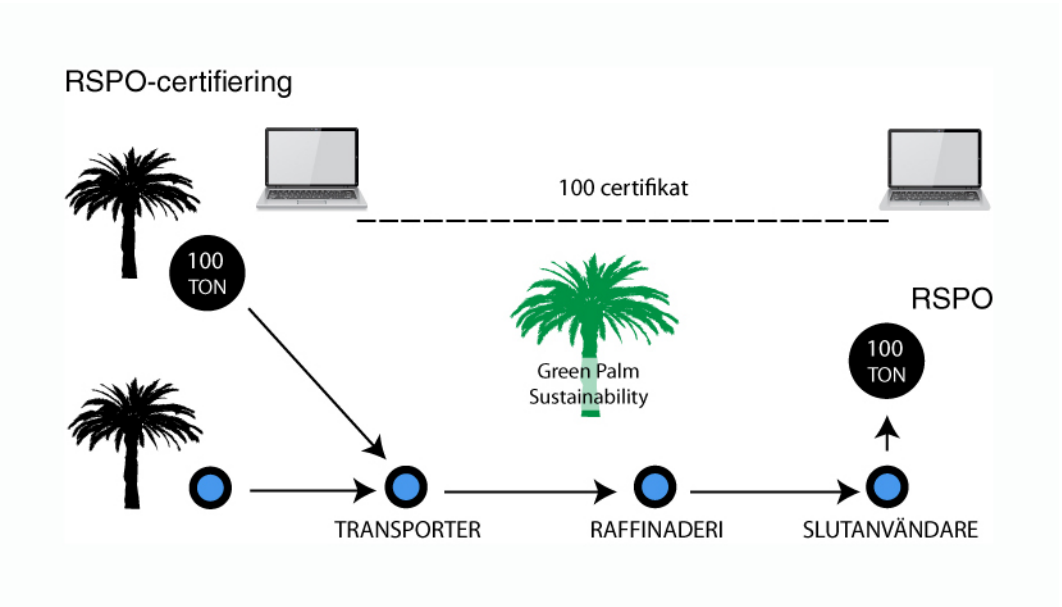


Figure 7: Traceability via certificate trading.

Appendix 5 GMO

The spread of GM plants

The commercial growing of genetically modified plants (GM plants) began in the early 1990s, and by 1996 GM crops covered 1.7 million hectares (ha) of farmland. The trend has continued to gain momentum, so that globally in 2011, around 160 million hectares were being grown. GM crop cultivation stood at around 148 million hectares in 2010 and 134 million in i 2009[87]. The figure of 160 million hectares in 2011 therefore represents a jump of 8.1% on the previous year.

GM crops were grown in 29 countries in 2011, a number that was unchanged compared with the year before. 19 of the 29 were developing countries, including: Brazil, Argentina, Pakistan and South Africa. Other countries, such as Sweden and Germany, relaunched the growing of Amflora potatoes after a ban was lifted. 90% of the farmed land for GM crops is concentrated in the USA, Brazil, Argentina, India and Canada. Other important growers are China, Paraguay, Pakistan and South Africa, with a total of over 11% of the farmed land (see Table 7 below). The USA, Brazil, Argentina, India and Canada are the most important GM crop growing countries in terms of the total size of the farmed land[88].

Table 8: Land with GM crops in the 17 leading growing countries, 2011.

Country	Land (mil. ha)	GM crops
USA	69.0	Maize, soya beans, cotton, rapeseed, sugar cane, alfalfa, papaya and courgette
Brazil	30.3	Soya beans, maize, cotton
Argentina	23.7	Soya beans, maize, cotton
India	10.6	Cotton
Canada	10.4	Rapeseed, maize, soya beans, sugar cane
China	3.9	Cotton, papaya, poplar trees, tomatoes, bell peppers
Paraguay	2.8	Soya beans
Pakistan	2.6	Cotton
South Africa	2.3	Maize, soya beans, cotton
Uruguay	1.3	Soya beans, maize
Bolivia	0.9	Soya beans
Australia	0.7	Cotton, rapeseed
Philippines	0.6	Maize
Burkina Faso	0.3	Cotton
Myanmar	0.3	Cotton
Mexico	0.2	Cotton, soya beans
Spain	0.1	Maize
Others (12 countries)	<0.1	Maize, potatoes, cotton, soya beans, rapeseed

[87] Gösta Kjellsson et al:Økologisk risikovurdering af genmodificerede planter i 2011, Videnskabelig rapport fra DCE, nr. 51, 2013

[88] Gösta Kjellsson et al:Økologisk risikovurdering af genmodificerede planter i 2011, Videnskabelig rapport fra DCE, nr. 51, 2013

In 2011, over 99% of the GM crops were: soya beans, cotton, maize and rapeseed. Over the past 10 years, there has been a clear trend towards greater cultivation and use of genetically modified crops. This is particularly true of soya beans and maize. It is now the case that a whole 75% of the world's soya bean crops and 32% of the maize has been genetically modified.

Development of herbicide-tolerant and insect-resistant plants
Globally, herbicide-tolerant plants make up a clear majority of the GM crops grown between 1997 and 2011 (Table 8). There was, however, an apparent trend for this to fall from 2005–2011. This was due to an increasing proportion of GM crops becoming both herbicide-tolerant and insect-resistant. As such, 26% of the GM crops in 2011 were both herbicide-tolerant and insect-resistant, compared with only 11% in 2005. The proportion of GM crops that are only insect-resistant fell slightly from 2005, but was much greater in 1997.

Table 9: Properties (%) of the globally grown GM crops over the period 1997–2011.

Property	1997	2005	2011
Herbicide tolerance (HT)	54	71	59
Insect resistance(IR)	31	18	15
HT + IR	<1	11	26
Virus resistance/other	14	<1	<1
Total	100	100	100

Steerability
The EU's Regulation (EC) No 1830/2003 requires traceability and labelling of genetically modified organisms in foodstuffs and feed. Every link in the chain of trade must inform the next link that the product contains or comprises GMO, along with information on which GMO is involved[89]. The regulation does, however, provide an exception from the above, if the content of materials that contain or are made from GMO does not exceed more 0.9% of the material in question. Candles are not a foodstuff or feed product, but the regulation supports the possibility of ensuring that GMO raw materials are not used in products such as candles.

Genetically modified products are defined differently in the EU and in the rest of the world. The EU defines a product as GM, if gene technology has been used in its production, even if the product is identical to a natural product. If such products are imported into the EU, they must be labelled as GMO in line with prevailing legislation. But this does not happen, if they are not labelled as GMO in the country of origin, such as the USA. It is currently difficult to check whether a starch, for example, that is imported into the EU is genetically modified.

The Round Table on Responsible Soy (RTRS) was formed in Switzerland in 2006 as a market-oriented international organisation that looks after some of the organisations that support the production, processing and trading of responsibly produced soya. The RTRS standard can be used for conventionally grown, organically grown and GM crops, making the certification technology-neutral in this context.

[89] GMO, hvad kan det bruges til? Videnssyntese fra Fødevareministeriet 2009

Businesses that wish to buy RTRS certified soya can do so according to two models. Soya bean purchasers can purchase RTRS certified soya that is registered along the whole supply chain to the end user, either via a "Fully Segregated" type, where the RTRS certified soya is kept separate from conventional soya, or via the "Mass Balance" type, where the RTRS certified soya is mixed with the conventional soya and then it is declared that a certain percentage of the soya in the product is certified. The other model is based on the businesses not directly purchasing certified soya, but providing support through their purchase of responsibly produced soya. The cornerstone of the system is RTRS's certificate trading platform (CTP). In addition, there is also the form non-GM soya. The supply chain structure is the same for the "Fully Segregated" and "Mass Balance" types, but at the same time it ensures that GM soya is not in the blends[90].

There are several different certification programmes whose purpose is to meet the demand for products with higher socio-economic and environmentally sustainable standards. ProTerra is one of these programmes, where the standards for certification are developed by Cert ID, which is based on the Basel criteria[91]. Cert ID is a third-party certification firm in the food industry, which has producers, resellers and agricultural producers as customers[92]. The standards behind the ProTerra certification are fundamentally based on social justice, economic viability and environmental concerns – including the fact that the product is GMO-free.

Imports to Europe of organic goods are generally subject to the production taking place and being certified according to the European guidelines for organic production, including separation from conventional products, and no use of pesticides, chemical fertilisers and GMO crops. The certification of organic products is in place in a large number of countries, including Brazil.

While organic certification and ProTerra certification are based on the purchaser being able to ensure that only the consignment of certified goods purchased is produced in the certified manner, the RTRS certification is primarily intended as a driver for more sustainable soya production. As mentioned, under RTRS it is thus possible to purchase certified soya products according to the mass balance method.

Nordic Ecolabelling requires that vegetable raw materials from palm oil and soya oil must be traceable back to the area of cultivation, i.e. full traceability (Fully Segregated). ProTerra, organic certification and RTRS "Fully Segregated" are judged by Nordic Ecolabelling to be systems that fulfil the GMO requirement.

[90] Hermansen J. et all: Soja og Palmeolie, certificeringsordninger til dokumentation af bæredygtighed i produktionen, DCA rapport nr. 029, marts 2013
[91] Coop and WWF, 2004;Cert ID, 2012
[92] www.cert-id.com (September 2013)

Appendix 6 Nordic Ecolabelling's position on RSPO and RTRS

Nordic Ecolabelling's raw materials group has weighed up the standards against the requirements that we set for single-issue labels and has reached the following conclusion:

At the current time, these two schemes do not fully meet Nordic Ecolabelling's requirements concerning sustainability labels.

8.1.1 The RSPO standard:

It is unclear whether this goes further than the legislation (striving to meet the international conventions in particular), there are absolute requirements, but with possibilities for exceptions, and the standard provides insufficient protection for key biological areas. There are no concrete requirements that some areas must be set aside for conservation (i.e. it appears to be more on a level with environmental management). Clearfelling is permitted and secondary forest is not protected. It is permitted to establish plantations on peat bogs, which are important carbon sinks.

8.1.2 The RTRS standard:

The generic standard is general, with some more specific requirements, for example 4.4 Expansion of soy cultivation which states in the sub-points that after 2009 soya plantations cannot expanded in to native habitat. However, there is possibility for exceptions here: "After May 2009 expansion for soy cultivation has not taken place on land cleared of native habitat except under the following conditions…" and "In areas that are not native forest, expansion into native habitat only occurs according to one of the following two options:…".

Reference is made only to local and national legislation and regulations, not international conventions. Compliance with all laws/regulations is required (1.1 There is awareness of, and compliance with, all applicable local and national legislation) and it must be clear who owns the land (1.2 Legal use rights to the land are clearly defined and demonstrable).

Apart from this, there are no specific requirements concerning preservation of protected areas, etc.

Since the production of these plant raw materials currently has major environmental consequences, Nordic Ecolabelling takes a strict line when it comes to these two raw materials and wants to set requirements that are as stringent as possible within the framework of the respective product groups.

In the product groups where there are alternative raw materials and there is good steerability to exclude these without experiencing any "Burden Shift" Nordic Ecolabelling wishes to exclude palm oil and soya oil from use in those products. (This is the case for Candles).

In product groups where there are no alternatives and/or no steerability to avoiding these raw materials, Nordic Ecolabelling wishes to set requirements that are as stringent as possible.

This is to ensure that the most eco-friendly alternative is used in Nordic Swan Ecolabelled products. In this case, Nordic Ecolabelling assess that RSPO and RTRS, plus their associated traceability systems, are the best tools available and will therefore be setting requirements relating to these. (This is the case for Sanitary products).

The RSPO and RTRS schemes are both moving in the right direction, and Nordic Ecolabelling will be monitoring their development, with a view to potentially approving and using them in all types of products at a later stage.