About Nordic Ecolabelled

Candles



Version 2.0

Background to ecolabelling
20 November 2014
Version 2, 2014-11-20 until 2015-01-23
Consultation proposal

Nordic Ecolabelling

Content

1	**Summary**	**4**
2	**Basic facts about the criteria**	**5**
2.1	Products that may be Nordic Ecolabelled	5
2.2	The version and validity of the criteria	7
2.3	Justification for Nordic Ecolabelling	7
3	**RPS summary**	**8**
3.1	RPS analysis of candles	8
4	**Market description**	**12**
4.1	The Nordic market	12
4.2	Nordic Ecolabelling licences	15
4.3	Regulatory requirements and instruments	15
4.4	Other labelling schemes and controls	16
5	**About the criteria revision**	**17**
6	**Justification of the requirements**	**18**
6.1	Environmental requirements	19
6.2	Use and quality requirements	42
6.3	Quality and regulatory requirements	46
Terms and definitions		**50**

Appendix 1	Measurement results for soot index for Nordic Ecolabelled and non-Nordic Ecolabelled candles
Appendix 2	Raw materials for the production of candles
Appendix 3	How does a candle work?
Appendix 4	Waste or residues
Appendix 5	Raw material traceability
Appendix 6	GMO

088 Candles, version 2.0, 20 November 2014

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

Addresses

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

Denmark
Ecolabelling Denmark
Danish Standards Foundation
Portland Towers
Göteborg Plads 1
DK-2150 NORDHAVN
Tel: +45 72 300 450
Fax: +45 72 300 451
info@ecolabel.dk
www.ecolabel.dk

Norway
Miljømerking
Henrik Ibsens gate 20
NO-0255 OSLO
Tel: +47 24 14 46 00
Fax: +47 24 14 46 01
info@svanemerket.no
www.svanemerket.no

Finland
Ecolabelling Finland
Box 489
FI-00101 HELSINKI
Tel +358 424 2811
Fax +358 9 6122 5199
joutsen@ecolabel.fi
www.ecolabel.fi

Sweden
Ecolabelling Sweden
Box 38114
SE-100 64 STOCKHOLM
Tel: +46 8 55 55 24 00
Fax: +46 8 55 55 24 01
svanen@ecolabel.se
www.ecolabel.se

Iceland
Ecolabelling Iceland
Umhverfisstofnun
Suðurlandsbraut 24
IS-108 REYKJAVIK
Tel: +354 591 20 00
Fax: +354 591 20 20
svanurinn@ust.is
www.svanurinn.is

This document may only be copied in its entirety and without any type of change. It may be quoted from provided that Nordic Ecolabelling is stated as the source.

1 Summary

The overall aim of this revision is to ensure that the Nordic Ecolabelling criteria secure a positive environmental benefit via ecolabelling and also 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 Ecolabelling of 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.

Product group message
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.

Nordic Ecolabelled candles are required to contain a large proportion of renewable raw materials and all materials from palm and soya oil must be sustainability certified, plus there is a ban on the use of biocide-tolerant and insect-resistant genetically modified agricultural products (GM crops) in the raw materials.

The criteria for Nordic 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 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, 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 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.

2 Basic facts about the criteria

2.1 Products that may be Nordic 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 Ecolabelled. Scented candles and aromatherapy candles can also not be Nordic Ecolabelled, since requirement O20 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. 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 Ecolabel taper candles, pillar candles, tea lights, graveyard candles, garden candles and candles for decoration.

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. 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. 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[1].

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.

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 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[2]. 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 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. The liquid material (the oil) must be made from 100% renewable raw materials by weight. The increasingly dominant lamp oil that is available

[1] http://www.cicero.uio.no/fulltext/index_e.aspx?id=8878
[2] Dr. M. Matthäi, Dr. N. Petereit:"The quality candle", European Candle Institut, 2004

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[3]. 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 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 O23.

2.2 The version and validity of the criteria

The criteria for candles were first approved on 13 December 2007 and remained valid until 31 December 2011, version 1.0.

An amendment to requirement R17 (product and transport packaging) was adopted at the secretariat management meeting of 16 September 2009. The change led to version 1.1 of the criteria.

At the secretariat management meeting of 9 November 2010 the decision was taken to extend the validity of the criteria until 31 December 2013. This version was called 1.2.

At the secretariat management meeting of 15 November 2012, the decision was taken to extend the validity of the criteria until 30 December 2015. The new version was called 1.3.

2.3 Justification for Nordic Ecolabelling

In developing version 1 of the criteria for candles, an RPS study[4] 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

[3] http://mst.dk/virksomhed-myndighed/kemikalier/regulering-og-regler/faktaark-om-kemikaliereglerne/lampeolier/
[4] Baggrundsdokument til Nordisk Miljømærknings kriterier for levende lys, version 1.

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 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[5]. 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[6,7]. 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,

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

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 Ecolabelled candles. The same is true when it comes to ensuring that GMO raw materials are not used in Nordic Ecolabelled candles.

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[8] 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

[8] Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen", Miljøstyrelsen

analysis for aluminium[9], 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 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 15426:2007 ensures a high degree of steerability (S).

Data from licensees, after version 1 (see Appendix 1), and soot index testing of other non-Nordic Ecolabelled candles show great potential for tightening the requirement concerning the soot index, in accordance with EN 15426:2007. Soot index testing of oil candles (made from 100% renewables) to the same standard shows a soot index (Si/h) of

[9] Materialerapport til kriteriedokumenter for Svanemærkning af gulv, vinduer og holdbart træ, 2012

0.07[10]. 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.

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 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, comprising 100% renewable raw materials.

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

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[11]

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
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[12]. 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[13]. 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

[11] European Candle Association ASBL
[12] Interview med Kenneth Dådring, Delsbo, april 2013
[13] Statistisk Sentralbyrå (SSB) Norge 2010. www.ssb.no

same period[14]. 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[15].

Table 2 Candle production for 2000 and 2011 in selected European countries[16]

Country	Production (tonnes) 2000[17]	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
France	18,500	8,117
Italy	40,000	11,560
Estonia	-	9,445

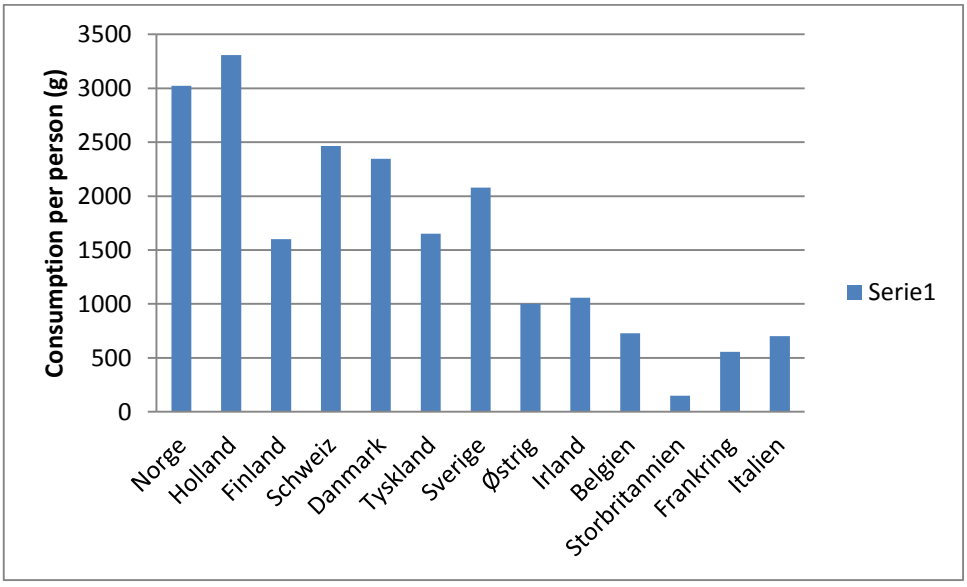


Figure 1: Average candle consumption per capita (grams) in a selection of European countries in the year 2000.

[14] Interviea med Maria Laaksonheimo og Petteri Viklman, Havi, april 2013
[15] Interview med Thomas Olesen (Diana lys), april 2013
[16] Eurostat-april 2013
[17] The British Candlemakers Federation, http://www.britishcandles.org/ (hentet I baggrundsdokumentet 2007)

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[18]. 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

[18] http://fdb.dk/analyse/vi-elsker-stearinlys

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 Ecolabelled candles indicate that the Nordic Ecolabel logo is generally used on all Nordic Ecolabelled candles (packaging), on the manufacturers' websites and in sales catalogues. The Nordic Ecolabel is the only ecolabel for candles. The quality label RAL[19], which focuses on the quality aspects of the candle (safety, burning time, etc.), is widely used by the industry.

4.2 Nordic Ecolabelling licences

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

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

Licensee	Reg. in DK	Reg. in S	Reg. in N	Reg. in Fin
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

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

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[20] 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:

- 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[21] 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

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

- 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.

5 About the criteria revision

Aims of the revision

Evaluation of version 1 of the criteria for the Nordic 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 (with liquid oil). The current criteria, version 1, relate only to solid wax.
- To tighten the current requirement level for the soot index. Data from licensees and data from corresponding testing of non-Nordic Ecolabelled candles indicate substantial scope to tighten the requirement level for the soot index
- To investigate the possibility of setting requirements for emissions of small and ultrafine particles from candles.
- To 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 15426:2007 (Candles – Specification for sooting behaviour), EN 15493:2007 (Candles – Specification for fire safety) and EN 15494:2007 (Candles – Product safety labels)).
- To investigate requirements for test methods for oil candles, since this product type has become included in the product definition.

- To 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.
- To revise the requirement concerning the material that encases the candle.
- To 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.
- To assess the requirement concerning GMO in candles.
- To update the requirement concerning chemicals and classification under the CLP Regulation No 1272/2008.
- To 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.
- To investigate the possibility of setting requirements for the proportion of renewable raw material in the material that encases the candle (e.g. tea lights).
- To investigate the possibility of introducing a ban on bleaching wicks.
- To 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 (S) as project adviser. Ingrid Elmedal (DK), Kristian Kruse (N), Björn Simons (S) and Sammi Karelahti (Fin) are the national contacts.

6 Justification of the requirements

O1 Description of the product

Requirement in the criteria document

The applicant must submit the following information about the product(s):

1. Brand/trading name

2. Description of product(s) included in the application. The candle is to be described (thickness, wick, height, coloured or non-coloured)

3. The raw materials in the candle/oil candle are to be described (stearin, paraffin, wax, oil, fat or other raw material), such that it is clear which raw materials have been used, where these materials come from and what percentage of the candle they account for.

4. The material in the wick (cotton, paper, plastic or other) and in the wick sustainer/holder (metal, plastic or other) must also be described.

5. Any other materials (e.g. cup/container encasing the candle) and packaging must also be described, if they form part of the product as sold.

6. Description of manufacturing process of the product. Suppliers must be described with the name of the company, production site, contact, and the production processes performed (such as candle dyes).

7. State a list of materials and chemical products used in the production of the candle/oil candle (see definition description in section 6.1) or other components included with the product. Safety data sheets for each chemical product must be included.

☒ Description of the points above. Appendix 1 may be used.

☒ Safety data sheet (less than three years old) for each chemical product

Background to requirement
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

O2 Amount of raw material produced from renewable raw materials

Candles made from raw materials that are solid at room temperature (20°C – 27°C):
The amount of raw materials in the candle produced from renewable raw materials must exceed 90% of the total weight of the candle.

Candles made from raw materials that are liquid at room temperature (20°C – 27°C):
The amount of raw materials in the candle produced from renewable raw materials must be 100% of the total weight of the candle.

Renewable raw materials are biological materials that are reproduced continuously in nature. This 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.

☒ Description from the manufacturer of the renewable raw material and declaration from the manufacturer of the candle/oil candle giving the percentages of raw materials in the candle. Appendix 1 may be used.

Background to requirement
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.

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. 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[22].

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 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 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.

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. 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 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 (at room temperature, 20°C – 27°C).

O3 Vegetable raw materials

100% of all vegetable raw materials from palm oil or soya oil used in Nordic Ecolabelled candles must be:

1. certified to a standard and certification scheme as set out in Appendix 2, which is approved by Nordic Ecolabelling,

or

2. certified as organically cultivated, or the cultivation may be in the process of being switched to organic production.

Certification must be performed by an independent third party.

The requirement does not cover residues or waste from the production of vegetable oil. For a definition of residues and waste, see Terms and definitions.

✉ It is to be verified by both the supplier of the material and the candle manufacturer that the purchased vegetable raw material is certified.

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

☒ Copy of relevant certificates that comply with the guidelines for certification and organic cultivation as set out in Appendix 2.

Background to requirement
Palm oil is the primary vegetable raw material in the production of stearin, while soya is used in soya candles.

The requirements concerning renewable raw materials (R4 Renewable raw materials and R5 Carbon dioxide balance when producing the vegetable raw materials) in version 1 of the criteria have been changed in this version, since the requirements were unclear and difficult to understand for the licensees and for the case officers within Nordic Ecolabelling.

In this revised version 2 of the criteria, Nordic Ecolabelling sets the requirement that 100% of the vegetable raw material that derives from palm oil or soya oil, and that is used in Nordic Ecolabelled candles, must be organically grown or certified to a standard approved by Nordic Ecolabelling. Vegetable raw material that can be defined as a waste or residue is not covered by this requirement. This revision has considered whether residual and waste products from the production chain for vegetable oils should be exempted from the requirement for traceability. Due to the difficulty in defining waste and residues, and in checking compliance with the requirement, waste and residues are not exempted from the requirement for traceability. For more information, see Appendix 4.

Consideration has been given as to whether vegetable materials from other raw materials – for example, oilseed plants such as rape and canola, rather than palm oil or soya oil – should be certified or organically cultivated, but it has been judged environmentally beneficial to manufacture stearin from such plants even without such a stipulation. Because oilseed plants are a good rotation crop in cereal-dominated crop rotation, they can generally reduce the need for plant protection products in the cultivation system. Oilseed crops are only grown organically to a limited extent, since they are sensitive to disease and pests, and are poorly equipped to outcompete weeds[25].

The requirements for certification systems and standards correspond to those set by Nordic Ecolabelling for forest certification. When Nordic Ecolabelling receives an application in which the vegetable raw material is certified under a particular standard (e.g. the Round Table on Sustainable Palm Oil (RSPO)), an assessment is made of whether the standard and certification system fulfil the requirements presented in Appendix 2 of the criteria.

<u>Palm oil</u>
Approximately 90% of all the palm oil produced and traded worldwide comes from Malaysia and Indonesia[26], [27]. Oil palms are primarily grown in areas that were originally rainforest. 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

[25] Fogelfors, 2001. Växtproduktion i jordbruket. Natur och kultur/LT i samarbete med Sveriges lantbruksuniv.
[26] WWF. 2013. Palm Oil Buyers' Scorecard 2013 – Measuring the Progress of Palm Oil Buyers.
[27] Thoenes 2006. Biofuels and Commodity Markets – Palm Oil Focus. FAO, Commodities and Trade Division.
[28] UNEP. 2009. Towards sustainable production and use of resources: Assessing biofuels.
http://www.unep.org/pdf/biofuels/Assessing_Biofuels_Full_Report.pdf

products can lead to major problems with soil erosion. The felling of the rainforests and cultivating peat beds releases large amounts of greenhouse gases.

Setting a requirement for sustainability certified palm oil means that Nordic Ecolabelled candles will be contributing a little towards demand for new oil palm plantations. Although the manufacture of Nordic Ecolabelled candles in the Nordic countries is not the driving factor, it is important that a Nordic Ecolabelled candle is not contributing towards unsustainable development.

Nordic Ecolabelling has not managed to obtain information on the amounts of palm oil used in candles in the Nordic countries because there are so many different suppliers. Palm oil is directly imported from South West Asia and also imported via Europe.

The Round Table on Sustainable Palm Oil (RSPO) is a global standard for sustainable production of palm oil. RSPO was founded in 2004 by stakeholders throughout the production chain from palm oil producers, purchasers, consumers and dealers to NGOs, including environmental organisations. 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 companies demand 100% certified palm oil with traceability at a minimum of mass balance level by 2015[29]. 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[30].

Soya oil

Oil from soya accounts for 28% of the world's consumption of vegetable oil. The USA, Brazil and Argentina produce 80% of the world's soya. Of the soya grown in these countries, the GMO proportion was 100% in Argentina, 93% in the USA and 93% in Brazil in 2013[31]. The use of GM soya has led to the development of herbicide-resistant weeds. There has been an increase in total use of plant protection products since GMO was introduced in Brazil, but it is not possible to distinguish increased use of plant protection products in the cultivation of GM soya compared with conventionally grown soya[32]. In Brazil use of herbicides in soya cultivation increased by 50% per hectare and use of fungicide increased by 70% between 2003 and 2008[33].

In addition to the rising use of plant protection products, ever increasing land use is also a challenge. In Brazil the most economically successful crops soya and sugar cane, together with cattle farming, are judged to account for 80% of the use of agricultural land. An increased demand for these leads to increased demand for land, which in the

[29] WWF. 2013. Palm Oil Buyers' Scorecard 2013. Measuring the Progress of Palm Oil Buyers.
[30] http://www.ikea.com/ms/sv_SE/pdf/reports-downloads/sustainability-strategy-people-and-planet-positive.pdf (hämtad 2014-09-10)
[31] Soy Stats. 2014. Soy Stats 2014. www.soystats.com. (2014-09-22)
[32] SwedWatch. 2012. Mera soja mindre mångfald – En granskning av sojaimporten från Brasilien. (More soya less diversity – an examination of soya imports from Brazil). Swedwatch follow-up report #48. Latin America groups.
[33] Meyer & Cederberg. 2010. Pesticide use and glyphosate resistant weeds – a case study of Brazilian soybean production. SIK report No 809. SIK. Gothenburg.

long run can lead to deforestation. Growing sugar cane and soya, and cattle farming also push less financially rewarding crops from the best land to the periphery, i.e. to the forested areas[34].

The total area used for soya beans in Brazil was approximately 24 million hectares in 2010/2011, but this is expected to increase to approximately 27 million hectares by 2019[35]. Developments in Brazil are not driven by the production of soya for use as a vegetable oil. A large proportion is used for domestic biodiesel production, but export of soya for feed to Europe is also considerable.

The Round Table on Responsible Soy (RTRS)[36] is an initiative from stakeholders throughout the soya production and distribution chain. It is also supported by environmental organisations, such as WWF. The first RTRS standard was adopted in 2010 and the first RTRS soya was produced in 2011. The RTRS standard contains, for example, requirements on improved production methods in agriculture, working conditions, reduced use of plant protection products, respect for local societies and protection of areas with high biodiversity. RTRS has been criticised because it is technology neutral, i.e. it allows both GMO and GMO-free soya and it does not ban dangerous plant protection products. Under RTRS it is not permitted to certify land which changed land use after May 2009.

O4 Certified traceability and control of vegetable raw materials

Suppliers of palm and soya oil must be traceability certified (Chain of Custody – CoC), according to a certification system that meets the guidelines in Appendix 2.

Vegetable raw materials from palm oil and soya oil must be traceable back to the area of cultivation (i.e. full traceability).

✉ Copy of relevant Chain of Custody certificates.

Background to requirement

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). Many producers of palm oil are currently certified for full traceability, and as such are able to supply palm oil with full traceability[37]. Stearin is extracted to a large extent from palm oil, while oils from soya are used in soya candles.

Internationally there is a strong focus on ensuring that palm and soya oil originate from legal and sustainable sources. Nordic Ecolabelling judges that CoC certification is now so widespread, for example in RSPO and RTRS, that we can introduce a new requirement that suppliers of palm oil and soya oil must be CoC-certified.

The requirements and the CoC certification will help to ensure complete traceability of the palm and soya oil's origin. The certification system sets Chain of Custody requirements that ensure traceability, documentation and controls along the entire production chain. Certification must be carried out by an accredited and qualified third party.

[34] FOE Friends of the Earth. 2010. From forest to fork – The UK's contribution to deforestation in Brazil. Report.
[35] FOE Friends of the Earth. 2010. From forest to fork – The UK's contribution to deforestation in Brazil. Report.
[36] www.responsiblesoy.org (2012-02-21)
[37] http://www.rspo.org/content.php?lang=en&pagename=current_list_of_supply_chain_certification&phrase=&submit=Search&country=Malaysia&supply_options%5B%5D=SG

There are three different types of certified palm oil[38], see Appendix 5:

- Fully Segregated,
- Mass Balance and
- Book and Claim (GreenPalm)

Book and Claim is not available for certified soya oil.

"Fully Segregated" guarantees that the palm oil is cultivated on an RSPO certified plantation, and that along the entire value chain the palm oil is kept segregated from conventional palm oil. Once the oil has been pre-processed, the certification is approved by a third-party consultancy firm, and the oil can be labelled "RSPO-certified sustainable palm oil".

In the "Mass Balance" system, the certified palm oil is blended with conventional palm oil during transport and storage. Once at the refinery, the blended palm oil is assessed by an independent certification body. From a blend of e.g. 100 tonnes certified and 100 tonnes conventional palm oil, a business can sell 100 tonnes as RSPO certified palm oil. Mass Balance oil can carry the RSPO logo and be labelled as "mixed".

"Book and Claim" is administered through the certificate trading programme GreenPalm[39]. Under this system, palm oil from certified producers is handled together with conventional palm oil. Movements and transactions are not monitored along the production chain. Instead, the producers are rewarded for the use of responsible methods on their plantations by receiving one GreenPalm certificate for every tonne of certified palm oil they produce. The producers then sell their certificates at www.greenpalm.org to purchasers around the world, with the purchasers thus providing financial support for the responsibly produced palm oil.

O5 Traceability and control of vegetable raw materials

Vegetable raw materials other than palm oil and soya oil must meet the following requirements:

1. State name (Latin and a Nordic language) and geographical origin (country/state and region/province/municipality) and suppliers of the vegetable raw material used. Appendix 3 may be used.
2. There must also be a written procedure in place for the purchase of vegetable raw materials that also ensures all vegetable raw materials come from legal sources. The raw materials must not be sourced from:
    - protected areas or areas under preparation as protected areas
    - areas where ownership or usage rights are unclear
    - illegally harvested crops

Nordic Ecolabelling may require further documentation in the event of uncertainty about the raw material's origin.

If the vegetable raw material comprises waste or residues, there must be traceability to the production/process from which the waste or residue derived.

For a definition of residues and waste, see Terms and definitions at the back of the criteria.

[38] www.rspo.org
[39] http://www.greenpalm.org/

✉ Name (Latin and a Nordic language) and geographical origin (country/state and region/province/municipality) of the vegetable raw materials used. Appendix 3 can be used for documentation purposes.

✉ Description of the system for traceability of vegetable raw materials

✉ A written procedure from the producer/supplier of the vegetable raw material or the manufacturer of the candle, documenting how the requirement is fulfilled. A requirement for a Chain of Custody certificate from a supplier may be used as part of the procedure.

Background to requirement
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 Ecolabelled candles 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 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
- 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.

O6 Genetically modified plants

Raw materials from biocide-tolerant and insect-resistant genetically modified plants are not permitted in Nordic Ecolabelled candles.

✉ Declaration from the raw material supplier that the requirement concerning genetically modified plants is fulfilled. Appendix 4 may be used. Nordic Ecolabelling reserves the right to require further documentation in the event of uncertainty about fulfilment of the requirement.

Background to requirement
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 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[40]: 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[41]. 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[42].

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[43]. 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. 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 6.

O7 Fossil raw materials (paraffin wax)

All paraffins used in Nordic Ecolabelling candles must be fully refined (i.e. hydrogenated), or match the hydrogenated grade stated in the standard Quality Assurance RAL-GZ 041, January 2013 or later.

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

✉ Invoice or similar documentation from the manufacturer of the candle showing that the requirement is fulfilled.

Background to requirement
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 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[44]. 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.

O8 Wick

The wick must not contain any kind of metal.

The cotton in the wick must be Öko-Tex 100 certified. The use of alternative materials such as paper, flax or other vegetable fibre is permitted to stabilise or improve the burning properties of the wick.

✉ Copy of Öko-Tex 100 certificate.

✉ Declaration from the manufacturer of the wick that the requirement is fulfilled. Appendix 5 may be used.

Background to requirement
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[45]. All 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.

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

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[46]. 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[47]:

- Washing the cotton to remove any impurities.
- Bleaching the cotton wick. This has no effect on the burning properties of the wick, and is done entirely for cosmetic reasons (white wick).
- 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)[48]. 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.

O9 Wick sustainer

The following metals must not be actively added to the wick sustainer:

Lead (Pb), mercury (Hg), chromium IV (CrIV), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn,), copper (Cu), nickel (Ni) or aluminium (Al).

✉ Declaration from the manufacturer of the wick sustainer that the requirement is fulfilled. Appendix 6 may be used.

Background to requirement

Wick sustainers are used primarily in tea lights to ensure that the wick does not collapse when the wax becomes liquid. The material tends to be aluminium, since this is cheap compared with other metals. Nordic Ecolabelling does not permit the use of aluminium in containers, for example for tea lights. This requirement has now been expanded to include wick sustainers. Iron and steel may be used as alternatives to aluminium.

The requirement has been amended slightly, compared with version 1, so that it now includes aluminium. 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 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 IV (CrIV), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn,), copper (Cu), nickel (Ni) and aluminium (Al).

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

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.

6.1.2 Container encasing the candle

The requirement applies to candles comprising one or more wicks, surrounded by a material that is solid/semi-solid or liquid at room temperature (20°C – 27°C).

Requirements for containers sold together with the candle, and that are only intended to be used once

O10 Materials in the container encasing the candle

Containers that are sold together with the candle, and that are only intended to be used once, must not contain:

- glass or ceramic
- the following metals: Aluminium (Al), lead (Pb), mercury (Hg), chromium IV (CrIV), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn), copper (Cu) or nickel (Ni)

- if plastic is included in the container at least 50% by weight of the plastic materials used must be made from post-consumer recycled raw materials, as defined in ISO 14021

The following substances must not be present in the plastic (both virgin and recycled plastic):

- halogenated organic compounds in general (including chlorinated polymers, PVC, chlorinated paraffins, fluorinated compounds and flame retardants)

Unless otherwise stated, constituent substance covers all substances in the product, including additives to the raw materials (such as preservatives or stabilisers), but not impurities from raw material production.

Impurity limit:
Impurities include residues from raw material production which are found in dyes, lacquers, pigments, paints, solvents, impregnation agents and similar chemical products in concentrations below 100 ppm (0.0100 % by weight, 100 mg/kg), but not substances added to an ingredient or product deliberately and with a purpose, regardless of amount. However, impurities at the raw material level at concentrations of over 1.0% of the raw material will be regarded as a constituent substance. Substances known to be degradation products of the constituent substances are also themselves considered to be constituent substances.

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

☒ Overview of material composition with information on material types.

☒ Declaration from the manufacturer of the container, showing that the requirement is fulfilled. Appendix 7 may be used.

☒ Declaration from the manufacturer/supplier of the plastic that the requirement is fulfilled. Appendix 8 may be used.

Background to requirement
The requirement has been changed compared with version 1. Nordic Ecolabelling wishes to make it possible to Nordic Ecolabel candles in single-use containers, since they are the biggest sellers. 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.

Nordic Ecolabelling has previously drawn up a material report and RPS analysis for aluminium[49], 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[50]. 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

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

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.

Nordic Ecolabelling does not wish to promote Nordic 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.

Heavy metals impact 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 IV (CrIV), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn,), copper (Cu), nickel (Ni) and aluminium (Al) (read more about these under requirement O9).

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 50% by weight post-consumer recycled raw material was set on the basis of dialogue with the candle industry.

Nordic Ecolabelling has received many enquiries from candle producers that are considering replacing aluminium with containers made from recycled plastic or 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. Therefor Nordic Ecolabelling does not set requirements for bioplastics in this criteria version.

The use of additives such as cadmium, lead and chromium has now largely been phased out. Plastic with halogenated flame retardants may, however, occur, particularly in electronic waste. There is thus a requirement that virgin and recycled plastic must not contain halogenated flame retardants. Impurities up to 100 ppm are permitted.

Halogenated organic compounds
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. See also O17.

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

O11 Materials in the container encasing the candle

Containers that are designed to be used multiple times for the same purpose, is to be sold together with the candle. It is not possible to Swan label containers alone.

If fireproof glass is used in the container then it must be referenced in the information requirements for the consumer (O24), that the glass may not be sorted in the waste phase with regular glass.

If plastic is included in the container at least 50% by weight of the plastic materials used must be made from post-consumer recycled raw materials, as defined in ISO 14021.

The following substances must not be present in the plastic (both virgin and recycled plastic):

- halogenated organic compounds in general (including chlorinated polymers, PVC, chlorinated paraffins, fluorinated compounds and flame retardants)

Unless otherwise stated, constituent substance covers all substances in the product, including additives to the raw materials (such as preservatives or stabilisers), but not impurities from raw material production.

Impurity limit:
Impurities include residues from raw material production which are found in dyes, lacquers, pigments, paints, solvents, impregnation agents and similar chemical products in concentrations below 100 ppm (0.0100 % by weight, 100 mg/kg), but not substances added to an ingredient or product deliberately and with a purpose, regardless of amount. However, impurities at the raw material level at concentrations of over 1.0% of the raw material will be regarded as a constituent substance. Substances known to be degradation products of the constituent substances are also themselves considered to be constituent substances.

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

✉ Overview of material composition with information on material types.

✉ Declaration from the manufacturer of the container, showing that the requirement is fulfilled. Appendix 7 may be used.

✉ Declaration from the manufacturer/supplier of the plastic that the requirement is fulfilled. Appendix 8 may be used.

Background to requirement
See background to O10.

> 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 can not 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 (O24), that the glass may not be sorted in the waste phase together with regular glass.

6.1.3 Product and transport packaging

O12 Product and transport packaging

Chlorine-based plastic must not be used in product and transport packaging.

✉ Description of the product and transport packaging

Background to requirement
The requirement has been changed compared with version 1. It is suggested that the requirement concerning the quantity of primary packaging in relation to the weight of the candle should be 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.

Version 1 of the criteria also contained a requirement banning chlorine-based plastics. PVC may be used as soft or hard PVC. In addition to the risk of phthalates in soft PVC, the waste treatment of PVC is particularly problematic. This is in part because incinerating 1 kg of PVC generates 0.4 to 1.7 kg flue gas cleaning residues, which are sent to landfill. The volume depends on the type of incineration process used[51]. It is highly likely that candle packaging will end up in household waste and will not be processed as specialist waste. It is therefore important to focus on not permitting packaging materials that may cause problems in the management of general household waste. In Denmark, for example, attempts have been made to develop methods to process these flue gas cleaning residues in order to recover the salts, particularly $CaCl_2$, but this has not proven financially viable, according to the Amager Resource Center in Denmark, which also reports that the hydrochloric acid that is formed on the combustion of the chlorine in PVC can corrode the installations and the chlorine can lead to the formation of dioxins and furans.

[51] Memo: Ole Hjelmar, DHI – Institut for Vand og Miljø, 2002 Memo on mass flows on incineration of PVC).

PVC may also contain softeners such as phthalates that may be reprotoxic or harmful to the environment. There are alternative softeners to phthalates, such as biobased softeners.

6.1.4 Chemicals

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

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

Several of the requirements are aimed at the constituent substances in the chemical products.

The requirements do not cover:

- Containers encasing the candle, 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.

Unless otherwise stated, constituent substance covers all substances in the product, including additives to the raw materials (such as preservatives or stabilisers), but not impurities from raw material production.

Impurity limit:
Impurities include residues from raw material production which are found in dyes, lacquers, pigments, paints, solvents, impregnation agents and similar chemical products in concentrations below 100 ppm (0.0100 % by weight, 100 mg/kg), but not substances added to an ingredient or product deliberately and with a purpose, regardless of amount. However, impurities at the raw material level at concentrations of over 1.0% of the raw material will be regarded as a constituent substance. Substances known to be degradation products of the constituent substances are also themselves considered to be constituent substances.

O13 Chemical products, classification

Chemical products used in the manufacture of candles must not be classified in any of the following hazard classes or with any of the associated hazard codes, as set out in Table 4 below.

Table 4: List of non-permitted classifications of the chemical products used in the manufacture of 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
Warning, Aquatic chronic 2	H411	N	R51/53
-, Aquatic chronic 3	H412	-	R52/53
-, Aquatic chronic 4	H413	-	R53
-, Ozone	H420	N	R59
		Carcinogenic	
Danger, Carc. 1A or 1B	H350	T	R45 and/or

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)
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
-	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

a) Applies from Dec 2010

b) Applies during period of transition to Regulation (EC) No 1272/2008 from Dec 2010 to June 2015

Paraffin classified as H412 is exempted from the requirement.

☒ Declaration from the manufacturer/supplier of the chemical product that the requirement has been fulfilled. Appendix 9 may be used.

☒ Safety data sheets for the chemical products used in the manufacture of the candle, in line with prevailing legislation.

Background to requirement

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, H331, 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.

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.

O14 Classification of constituent substances

Chemical products used in the manufacture of candles must not contain substances that are classified in any of the following hazard classes or with any of the associated hazard codes, as set out in Table 5 below.

Table 5: List of non-permitted classifications for the constituent substances in the chemical products used in the manufacture of 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
-	H362	-	R64

a) Applies from Dec 2010

b) Applies during period of transition to Regulation (EC) No 1272/2008 from Dec 2010 to June 2015

✉ Declaration from the chemical manufacturer/supplier that the requirement has been fulfilled. Appendix 10 may be used.

Background to requirement

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 Ecolabelling 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 classified as H412 (R51/53) and H317 (Xi, R43)[52]. Nordic Ecolabelling wishes to allow for ecolabelled coloured candles that are also resistant to sunlight (quality parameter).

Paraffin wax may contain several substances that are classified as dangerous to the environment (e.g. H411) or harmful to health. Nordic Ecolabelling permits a small quantity of paraffin in candles, which is why the hazard classes dangerous to the environment and harmful are not included in this requirement.

O15 Heavy metals

The following heavy metals, or compounds thereof, must not be included in the chemical products used to manufacture candles:

Lead (Pb), mercury (Hg), chromium IV (CrIV), cadmium (Cd), cobalt (Co), antimony (Sb).

✉ Declaration from the chemical manufacturer/supplier that the requirement is fulfilled. Appendix 10 may be used.

Background to requirement
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[53]. The substances in question are lead, mercury, chromium IV, cadmium, cobalt and antimony. 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 IV, lead, cadmium, cobalt and antimony.

O16 Volatile organic compounds (VOC)

Volatile organic compounds*, incl. volatile aromatic compounds, must not be included in the chemical products used to manufacture candles.

** Volatile organic compounds are here defined as:*
Organic compounds with a steam pressure exceeding 0.01kPa, at 20°C.

Exception
An exception is made for volatile aromatic compounds (VAH), if they are included in the permitted paraffin fraction or in organic pigments/dyes.

The content of organic solvents must not exceed 1.0% of the candle's total weight.

✉ Declaration from the chemical manufacturer/supplier of the VOC content in the chemical product. Appendix 10 may be used.

✉ Declaration from the candle manufacturer that the requirement concerning organic solvent content is fulfilled. Appendix 1 may be used.

[52] http://www.bekro.de/
[53] Miljøstyrelsen. Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen".

Background to requirement
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 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.

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 hydrocarbons" 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 Ecolabelled candles. A study has shown that these chemical substances are general released in very small quantities from candles of various kinds (stearin, paraffin and beeswax), if they have not intentionally been added to the candle during production[54].

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). 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.

O17 Halogenated organic solvents

Halogenated organic compounds must not be included in the chemical products used to manufacture candles.

✉ Declaration from the chemical manufacturer/supplier that the requirement is fulfilled. Appendix 10 may be used.

Background to requirement
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

[54] The 2007 Ökometric study: http://candles.org/wp-content/uploads/2014/05/International-Study-Shows-All-Candle-Waxes-Burn-Alike.pdf

halogenated flame retardants, chlorinated paraffins, perfluoralkyl compounds (such as PFOA and PFOS) and halogenated organic solvents must not be added.

O18 Substances on the Candidate List

None of the chemical products used in the manufacture of candles must be on the EU Candidate List pursuant to Article 59, Paragraph 10 of REACH, 1907/2006/EC, which is available on the ECHA website. The background text below contains a link to the list.

✉ Declaration from the chemical manufacturer/supplier that the requirement is fulfilled. Appendix 10 may be used.

Background to requirement

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

The ban on substances on the Candidate List is not considered a further tightening in relation to the other requirements concerning chemical products. Most of the Candidate List substances will also be covered by other requirements for the chemical products. The requirement is a way of taking account of REACH and the communications mode for substances in REACH.

O19 Phthalates

Phthalates must not be included in the chemical products used to manufacture candles.

✉ Declaration from the chemical manufacturer/supplier that the requirement is fulfilled. Appendix 10 may be used.

Background to requirement

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[55]. 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."

[55] Miljøstyrelsen. Kortlægning af kemiske stoffer i forbrugerprodukter nr. 75, 2006. "Samlet sundhedsmæssig vurdering af kemiske stoffer i indeklimaet fra udvalgte forbrugerprodukter":

O20 Perfume, aromas and other aroma compounds

Perfume, aromas or other aroma compounds (e.g. essential oils, plant oils and plant extracts) may not be included in chemical products used to manufacture candles.

✉ Declaration from the raw material producer/supplier of all constituent raw materials, showing that the requirement has been fulfilled. Appendix 10 may be used.

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

Nordic Ecolabelled candles must not contain perfumes, aromas or other aroma compounds. Aromas, flavourings, perfume, essential oils and 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 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.

O21 Nanoparticles

Nanoparticles (from nanomaterial*) must not occur in the chemical products used to manufacture candles.

The following are exempt from the requirement:

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

** The definition of nanomaterials follows the European Commission's definition from 18 October 2011 (2011/696/EU):*
"A nanomaterial is a natural, incidental or purposely manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for at least 50% of the particles in the number size distribution, one or more external dimensions is in the size range 1–100 nm."
*** nano-titanium dioxide (nano-TiO_2) is not considered a pigment, and is thus not covered by the requirement.*
**** this applies to fillers covered by Annex V Point 7 of REACH.*

The following definition of "constituent substance" applies: Unless otherwise stated, the term constituent substance refers to all substances in the chemical product, including additives in the raw materials (such as preservatives and stabilisers) but does not include impurities from raw material production. Impurities are defined as residual products from the raw material production that can be found in the final product in concentrations below 100 ppm (0.01% by weight, 100 mg/kg), but not substances added to an ingredient or product deliberately and with a purpose, regardless of amount. Substances known to be degradation products of the constituent substances are also themselves considered to be constituent substances.

✉ Declaration from the chemical manufacturer/supplier that the raw material does not contain nanomaterials as defined by the requirement. Appendix 10 may be used.

Background to requirement
The requirement is new for version 2 of the criteria. Nanotechnology, which includes nanoparticles, is increasingly used in the construction and interior design industries. The greatest cause for concern is the use of nanoparticles that may be released and affect health and the environment. Nanoparticles may, for example, penetrate healthy cells and

then damage the cell or its core DNA. Nanoparticles are increasingly used in a number of consumer products, such as paints and coatings, to provide new and improved product properties. However, nanoparticles may pose an unforeseen risk to health and the environment. The particles can reach parts of the body and the environment that are otherwise protected[56] and their minute size can result in increased reactivity as small structures have a far larger available surface area than larger ones.

Research into the risk associated with nanomaterials has focused on health impacts and some cases of damage have been recorded[57]. It has certainly been shown that nanoparticles can penetrate cells and degrade them[58]. This does not mean that all nanoparticles cause damage, but at present, we lack sufficient knowledge of their effects on human health and the environment and of their long-term effects in particular[59]. Nordic Ecolabelling applies the precautionary principle on the use of nanoparticles and therefore do not allow the addition of nanoparticles in candles. It is, however, introduced an exception for pigments and filler in the claim. Both inorganic and organic pigments may consist of nano-sized particles, or contain a fraction of the nano-sized particles. The requirement is primarily relevant if surface treatment is used.

6.2 Use and quality requirements

6.2.1 Emissions from the candle

O22 Soot index

The requirement applies to candles comprising one or more wicks, surrounded by a material that is solid/semi-solid or liquid at room temperature (20°C – 27°C).

Candles for indoor use:
The average value for the soot index from 3 tests must be ≤ 0.3 per hour. No single test must exceed 0.6 per hour. Testing to EN 15426:2007.

Candles for outdoor use:
The average value for the soot index from 3 tests must be ≤ 0.8 per hour. No single test must exceed 1.6 per hour. Testing must be in line with EN 15426:2007.

Candles comprising a wick surrounded by a material that is liquid at room temperature (20°C – 27°C) must meet the requirements concerning dimensions and burning periods that currently apply to candles comprising a wick surrounded by a material that is solid/semi-solid at room temperature (20°C – 27°C).

The requirements concerning laboratories are stated in Appendix 11.

✉ Full report

Background to requirement
The requirement also appeared in the previous version of the criteria, but a tightening is proposed. The requirement now also differentiates between candles for indoor and outdoor use.

[56] Teknologirådet, 2008: Nanomaterialer, risiko og regulering, report 2008
[57] Teknologirådet, 2008: Nanomaterialer, risiko og regulering, report 2008
[58] Janne K. Folkmann, Lotte Risom, Nicklas R. Jacobsen, Håkan Wallin, Steffen Loft, Peter Møller: Oxidatively Damaged DNA in Rats Exposed by Oral Gavage to C60 Fullerenes and Single-Walled Carbon Nanotubes, Environ. Health Persp, 117(5), 2009
[59] Janne K. Folkmann, Lotte Risom, Nicklas R. Jacobsen, Håkan Wallin, Steffen Loft, Peter Møller: Oxidatively Damaged DNA in Rats Exposed by Oral Gavage to C60 Fullerenes and Single-Walled Carbon Nanotubes, Environ. Health Persp, 117(5), 2009

On the basis of data from licensees, after version 1 (see Appendix 1) and soot index testing of other non-Nordic Ecolabelled candles, the requirement concerning the soot index has been tightened from 1.0 to 0.3 per hour (in accordance with EN 15426:2007). The requirement concerning the soot index for a single test has also been tightened from 2.0 per hour to 0.6 per hour.

Nordic Ecolabelling wishes to make it possible for more types of candle to achieve a licence, which is why the soot index has been set at 0.3 per hour in the requirement. This requirement will be a particular challenge for taper candles since, as mentioned previously, these burn faster than the thicker pillar candles and tea lights. Consideration has been given to differentiating the soot index requirements according to candle type, but it was judged that this would cause problems in terms of communication and marketing.

Candles for outdoor use (such as garden candles and graveyard 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 been tightened from 1.0 to 0.8 per hour (in accordance with EN 15426:2007). The requirement concerning the soot index for a single test has also been tightened from 2.0 per hour to 1.6 per hour.

New for this version of the criteria, version 2, is the proposal to expand the product definition to include candles comprising a wick surrounded by a material that is liquid at room temperature, generally known as oil candles. This type of candle is not covered by the standard EN 15426:2007, 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 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:
- Carbon dioxide CO_2
- Water vapour H_20
- Uncombusted gases – CH4, volatile organic compounds, PAH, etc.
- Particles:
- Soot, aerosols
- Condensed tars
- 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. The particles come from various sources in the home, including candles, smoking, vacuuming, ironing and cooking.

A study[60] 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[61] 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.

There is a great deal of uncertainty about which types of particle (in terms of both size and chemical composition) have the greatest impact on health[62]. The international scientific literature does, however, show a clear correlation between concentrations of particles of less than 2.5 micrometres (PM2.5 expressed as mass) and early death, for example. The ultrafine particles are particularly harmful because they are so small that they are able to enter the bloodstream via the lungs. Ultrafine particles increase the risk of cardiovascular disease and can cause damage to DNA (genetic material), which causes an increased risk of cancer.

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[63] 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.

A normal height taper candle burns faster than the thicker pillar candles and tea lights. The faster a candle burns, the more particles are emitted per hour. One reason for this is that there is more air movement around a thinner candle, so the particles can be torn free more quickly. The shape of the wick and the composition and purity of the wax also have an impact on the burning[64].

In 2002[65] 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

[60] http://www.sbi.dk/indeklima/stov-og-partikler/kilder-til-partikler-i-bygninger/konklusion
[61] Bekö, Gabriel; Toftum, Jørn; Clausen, Geo, et al: Ultrafine Particles: Exposure and Source Apportionment in 56 Danish Home, Technical University of Denmark, 2013
[62] Brandt J. et al: Sundhedseffekter og relaterede eksterne omkostninger af luftforurening i København, DCE, Aahus universitet, 2013
[63] Tænk december 2006. "Pust partiklerne ud, laboratorietest".
[64] Bekö, Gabriel; Toftum, Jørn; Clausen, Geo, et al: Ultrafine Particles: Exposure and Source Apportionment in 56 Danish Home, Technical University of Denmark, 2013
[65] Danish Environmental Protection Agency. Kortlægning nr. 6, 2002: "Indholdsstoffer i levende lys der sælges i detailhandlen".

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[66] 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 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 15426:2007. 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.

O23 Fire safety

Candles comprising one or more wicks, surrounded by a material that is solid/semi-solid at room temperature (20°C – 27°C) have to comply with the standard EN 15493:2007 (Candles – Specification for Fire Safety).

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).

If other materials (see O10 and O11) accompany the candle, there must be documentation that such material does not pose a risk in terms of fire safety.

The requirements concerning laboratories are stated in Appendix 11.

✉ Test report from a technical service showing fulfilment of this requirement.

Background to requirement
The requirement also appeared in version 1 of the criteria, but has been expanded to include candles 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 15493:2007 or EN 14059:2002 on fire safety. There must also be documentation that any other materials (such as the container encasing the candle) do not pose a risk to fire safety.

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

O24 Consumer information

The following information must be included on the candle's label/packaging:

- The candle's burning time in grams (of material) per hour and its burning time expressed in hours of burning.

The burning time is to be measured at room temperature (20°C – 27°C) in accordance with EN 15426 point 2.2. Point 9.4 in EN 15493 regarding the test method for burning must also be followed. The candle is weighed before and after the test, and the burning time is calculated as the number of grams consumed divided by the number of hours that the candle has been lit. The test is conducted by the manufacturer.

Candles made up of one or more wicks, surrounded by a solid/semi-solid material at room temperature:

- safety information in accordance with EN 15494:2007 Annex A, figs. A1, A4 and A6, must also be provided, even though this is optional supplementary safety information in the standard.
- safety labelling and warnings in accordance with EN 15494:2007.

Candles made up of one or more wicks, surrounded by a liquid material at room temperature:

- safety information, labelling and warnings in accordance with EN 14059:2002.

✉ Copy of the candle's packaging text.

✉ Statement of the candle's burning time as set out in the requirement.

Background to requirement
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. The amount of material that burns (grams per hour) is a quality parameter for how well the candle burns.

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 15493 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.

New for this version of the criteria, version 2, is the proposal to expand the product definition to include candles comprising a wick surrounded by a material that is liquid at room temperature, generally known as oil candles. This type of candle is not covered by the standards EN 15426:2007 and EN 15493:2007, which only apply for solid/semi-solid materials at room temperature. The method is, however, judged to be transferable to the analysis of the oil candle's burning time, since the key aspect of the test standard is the height from the fuel to the collection plate. Oil candles must meet the requirements concerning dimensions and burning periods that currently apply to candles made from a solid/semi-solid material.

6.3 Quality and regulatory requirements

To ensure that the Nordic 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.

O25 Licence administrators

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

✉ Organisational chart showing who is responsible for the above.

O26 Documentation

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

🔑 On-site inspection.

O27 Product quality

The licensee must guarantee that the quality of the Nordic Ecolabelled candle is maintained throughout the validity period of the licence.

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

O28 Planned changes

Written notice of planned product and marketing changes that affect the Nordic Ecolabelling requirements must be given to Nordic Ecolabelling.

✉ Procedures detailing how planned product and marketing changes are dealt with.

O29 Unforeseen non-conformities

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

✉ Procedures showing how unforeseen non-conformities are handled.

O30 Traceability

The licensee must have a traceability system for the production of the Nordic Ecolabelled product.

✉ Description/procedures for how the requirement is to be met.

O31 Take-back system

Relevant national regulations, legislation and/or agreements within the sector regarding take-back systems for products and packaging shall be complied with in all the Nordic countries where the Nordic Ecolabelled candle is marketed.

✉ Description/procedures for how the requirement is to be met.

O32 Laws and regulations

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

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

O33 Marketing

The marketing of Nordic Ecolabelled candles must comply with "Rules on Nordic Ecolabelling" 22 June 2011 or later versions.

✉ Duly completed Appendix 12.

Background to requirement
Requirements O25 to O33 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 ENDAST REVIDERING

Table 6: 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 candles 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 candles 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	100% of all vegetable raw materials from palm oil or soya oil must be certified or organically cultivated.
O4	New requirement	Suppliers of palm and soya oil must be traceability certified (CoC certified). Requirement for full traceability.
O5	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.
O6	New requirement	Raw materials from biocide-tolerant and insect-resistant genetically modified plants are not permitted in Nordic Ecolabelled candles.
O7	New requirement	All paraffins used in Nordic Ecolabelled candles must be fully refined (i.e. hydrogenated), or match the hydrogenated grade stated in the standard RAL-GZ 041, January 2013 or later.
O8	R16	The wick requirement remains unchanged in version 2 of the criteria.
O9	R9	The requirement concerning wick sustainers also appeared in version 1. The requirement has been tightened to include a ban on the addition of aluminium.
O10	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 or a number of metals (including aluminium). Any plastic must comprise a minimum of 50% recycled plastic. Containers that are designed to be used multiple times are exempted from the requirement concerning glass and ceramic.
O11	New requirement	Applies to containers that are designed to be used multiple times. Requirement concerning additives in recycled and virgin plastic used in candle containers.
O12	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.

O13	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.
O14	R7	The requirement concerning constituent substances classified as CMR also appeared in version 1.
O15	R9	The requirement concerning heavy metals in constituent substances also appeared in version 1.
O16	R10/R12	The requirement concerning VAH and VOC has been amended to clearly show that it applies to chemical products.
O17	R11	Requirement concerning halogenated solvents. The requirement has been amended to clearly show that it applies to chemical products.
O18	New requirement	None of the constituent substances in the chemical mix must be on the EU's Candidate List in accordance with REACH.
O19	R14	The ban on phthalates also appeared in version 1.
O20	R13	The ban on perfume, aromas and other aroma substances also appeared in version 1.
O21	New requirement	New requirement concerning nanoparticles in chemical products.
O22	R6	The soot index requirement has been tightened and amended to include candles made from liquid materials at room temperature.
023	R19	The fire safety requirement also appeared in version 1. The requirement has been amended to include candles made from liquid materials at room temperature.
024	R18	The information requirement also appeared in version 1. The requirement has been amended to include candles made from liquid materials at room temperature.
O25–33	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 chemicals
- Requirement level for emissions, in the form of the soot index
- The possibility of setting requirements for emissions of small particles
- The health effects of different particle sizes

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	The definition of residues and waste is in line with the sustainability criteria and communi-cations from the European Commission relating to the Renewables Directive, and the Swedish implementation of the Renewables Directive: 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. Residues are divided into 1) production residues from agriculture, aquaculture, fisheries and forestry, and 2) processing residues[67]. Examples of residues from agriculture and forestry include straw, husks, branches and treetops. Waste is any substance or object which the holder discards or intends or is required to discard. Raw materials that have been

[67] 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).

Waste	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. Examples of waste include household waste, wastewater sludge, abattoir waste, food that is unfit for human consumption and used cooking oil.
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.

Appendix 1 Measurement results for soot index for Nordic Ecolabelled and non-Nordic 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 Ecolabelled candles. Candles no. 1–9 are pillar/ball candles, while 10–21 are taper candles.

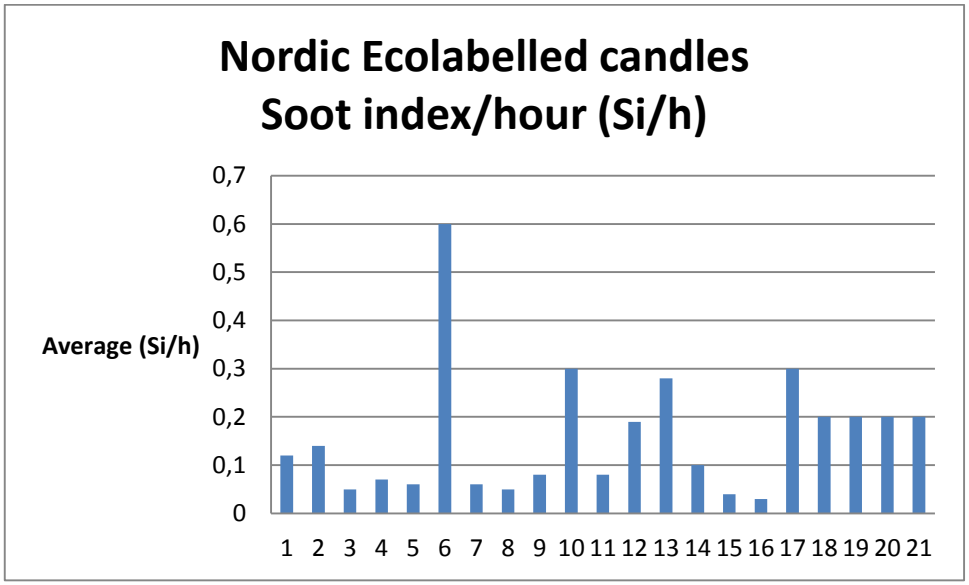


Figure 2 Measurement results from Nordic Ecolabelled candles. Nordic Ecolabelling's limit value for the soot index is 1.0 per hour (Si/h) in accordance with EN 15426:2007.

In December 2007, the Danish Information Centre for Environment and Health (IMS) conducted a test[68] 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.

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

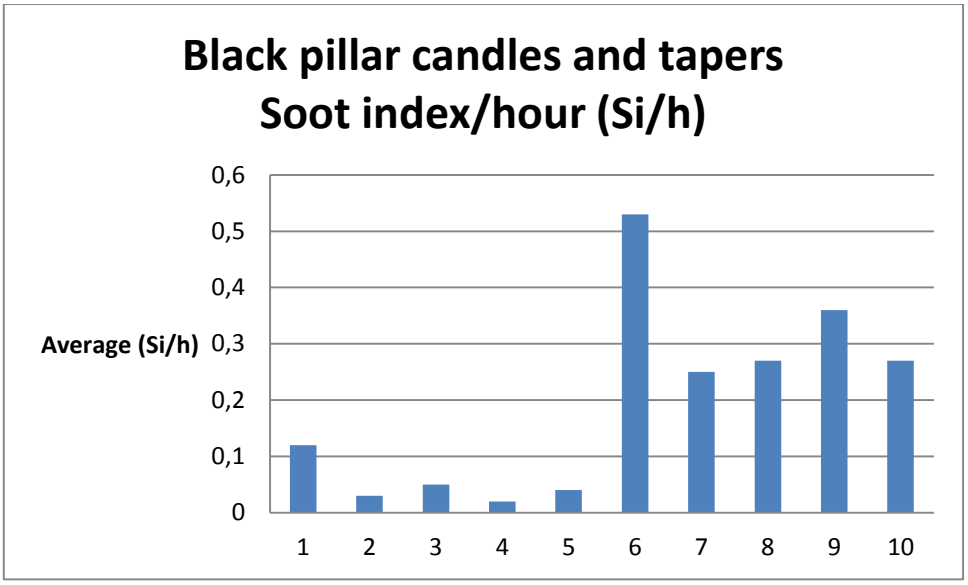


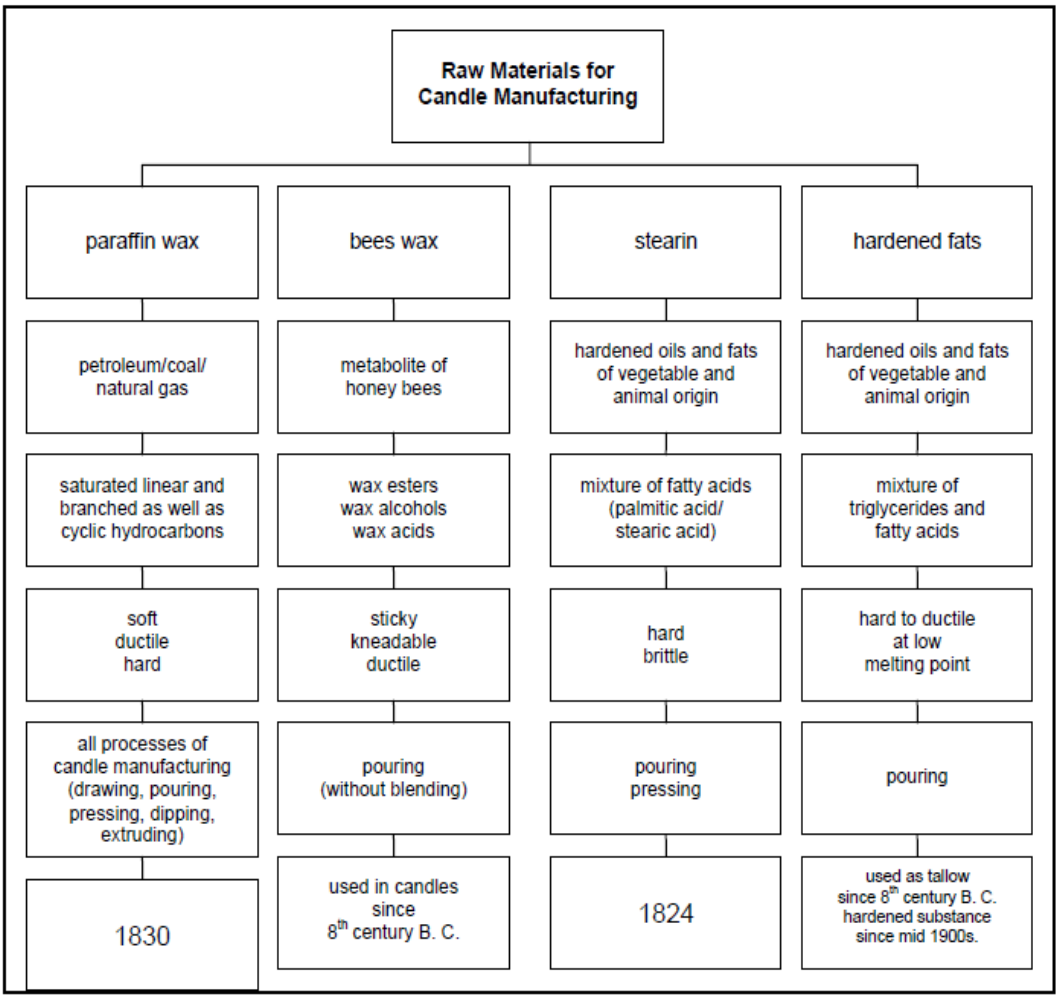
Figure 3 Measurement results from 5 black pillar candles (1-5) and 5 black taper candles (6-10) tested by the Danish Information Centre for Environment and Health in 2007

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[69].

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 Ecolabelled candles and the IMS test of black candles.

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

Appendix 2 Raw materials for the production of candles[70]



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.

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

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

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[71].

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[72]. 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.

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.

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

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[73].

[73] Danish Environmental Protection Agency. Kortlægning nr. 6, 2002:"Indholdsstoffer i levende lys der sælges i detailhandlen".

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[74].

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. 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.

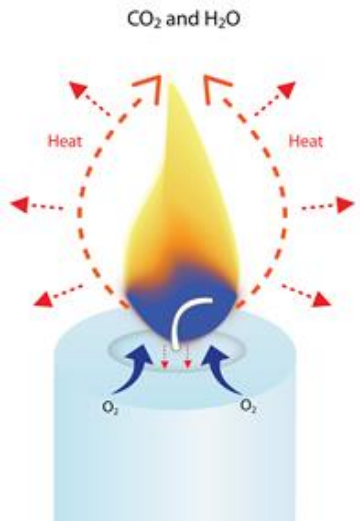
[74] Dr. M.Matthäi, Dr. N.Petereit: "The quality candle", European Candle institute, 2004

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[75]:

1. Melting the fuel (wax)
2. Transporting the fuel by capillary action via the wick
3. Converting the liquid fuel into gas
4. Thermally breaking down the fuel (pyrolysis)
5. 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[76]. 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[77].

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

Appendix 4 Waste or residues

Nordic Ecolabelling has been discussing the definition of residues for some time. The discussion has largely been focused around the criteria for fuels, but also in relation to palm oil in candles.

Key questions

Candles:

- How can a requirement that takes account of different grades of vegetable oil with a focus on palm oil be formulated for candles? Put another way, what traceability should we require for vegetable oils (pure palm/soya oil) and for residues from the palm oil production chain, i.e. full traceability, mass balance or certificate trading?
- If products of palm oil such as acid oils and fatty acid distillates can be considered residues, does this mean that they do not have to be certified?

The palm oil that can be used for the production of the raw material for stearin candles (palmitic acid and stearic acid) may derive from the end product in the refinement of RBD (refined bleached deodorised) palm oil, but also from residues that arise in different parts of the palm oil production chain. The raw material may be anything from a by-product of the refinement of the oil, known as acid oils, palm oil that does not meet supplier standards due to high levels of acid oils, and residues from palm oil pressing (poor palm oil fruits and already pressed palm oil fruits). According to suppliers, it is difficult for them to trace these types, in contrast to RBD. The acid oils and fatty acid distillates are around 4–5% of palm oil. The review of the criteria for candles revealed that licensees and importers of vegetable oils would like Nordic Ecolabelling to consider whether these can be classified as residues and thus not require traceability back to the oil palm plantation.

RSPO certified palm oil largely comes from major producers in South East Asia. According to suppliers, it is fully possible to require that products made from pure palm oil must be certified according to the Round Table of Sustainable Palm Oil (RSPO) scheme and have traceability via mass balance. Full traceability is also possible, but it favours the large producers over smaller producers. This is because the large producers have full control over the entire chain, since they own their own oil palm plantations. Traceability is more difficult for residues from the palm oil production chain, since they are usually not sold directly to traditional oil importers (small quantities). Instead, they are supplied to recycling companies. These specialist companies collect the acid oils from different oil refineries and store them in large tanks for resale.

Further information about the different traceability methods can be found in Appendix 5. RSPO has an electronic system to follow all trade (flows) of certified palm oil, RSPO eTrace, by monitoring all transactions[78].

Conclusion:
Palm oil and soya oil are highly controversial, particularly due to the conversion of forest and important ecological regions with high biodiversity into plantations and farmland. Soya cultivation is also controversial due to the high proportion of GMO. Nordic Ecolabelling proposes the requirement that vegetable raw materials from palm and soya oil in the candle criteria should be certified with full traceability.

Vegetable raw materials other than palm and soya oil
Under the EU's Renewables Directive and its sustainability criteria for biomass and liquid biofuels, system limits have been defined for the life cycle of the products. Nordic Ecolabelling has chosen to use these system limits for candles (although not for palm and soya oil). The Renewables Directive does not define what products are waste and residues, but gives guidance on how these are to be defined. In implementing the Renewables Directive, the Swedish Energy Agency has interpreted waste and residues in part according to a communication from the European Commission[79]. Under the sustainability criteria in the Renewables Directive, traceability is required back to the location where the waste or residue arises, in contrast to the main products, for which traceability is required back to the plantation.

Ahead of a revision of the sustainability criteria in the Renewables Directive, on 17 October 2012 the European Commission put forward a proposal to limit indirect land use change from biofuel production. The proposal defines a number of products that are to be promoted. In addition to algae, these include various waste products and residues, such as straw, palm oil mill effluent, empty palm fruit bunches, husks, bark, branches, sawdust and wood shavings[80].

The definition of residues is in line with the sustainability criteria and communications from the European Commission relating to the Renewables Directive, and the Swedish implementation of the Renewables Directive:

Residues: According to the Commission, 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. Residues are divided into 1) production residues from agriculture, aquaculture, fisheries and forestry, and 2) processing residues [81]. Examples of residues from agriculture and forestry include straw, husks, branches and treetops. Examples of industrial residues are crude glycerine, black liquor, sawdust, bark, acid oils and residues from wine fermentation[82].

---

[78] http://www.rspo.org/en/rspo_etrace (2014-08-21)
[79] 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).
[80] Proposal for a Directive amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EC and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources [COM(2012) 595]
[81] 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).
[82] Energimyndigheten. 2011. Vägledning till regelverket om hållbarhetskriterier för biodrivmedel och flytande biobränslen (Version 2.0 ER 2011:23).

Waste: According to the European Commission, 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. Examples of waste include household waste, wastewater sludge, abattoir waste, food that is unfit for human consumption and used cooking oil[83].

Co-products are defined as a flow that constitutes an important outcome of the process (in terms of quantity and financial value) and this material is used for purposes other than energy, and thus both materials should be co-products. Examples include feed protein in the form of rapeseed cake or soya meal as co-products with vegetable oil when pressing oilseed crops, and the dry feed draff, which is a co-product when producing bioethanol. However, the processes are usually optimised in favour of the vegetable oil and ethanol respectively. Products from industrial processes that do not meet certain quality standards are not be defined as residues according to the Swedish Energy Agency[84].

According to the definitions above, the following products from the vegetable oil production chain can be considered residues and waste products: bad fruit/seeds, pressed fruit/seeds.

[83] Energimyndigheten. 2011. Vägledning till regelverket om hållbarhetskriterier för biodrivmedel och flytande biobränslen (Version 2.0 ER 2011:23).
[84] Emmi Jozsa, Energimyndigheten i Sverige. Muntligt meddeland 2014-09-03.

Appendix 5 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 5). 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.

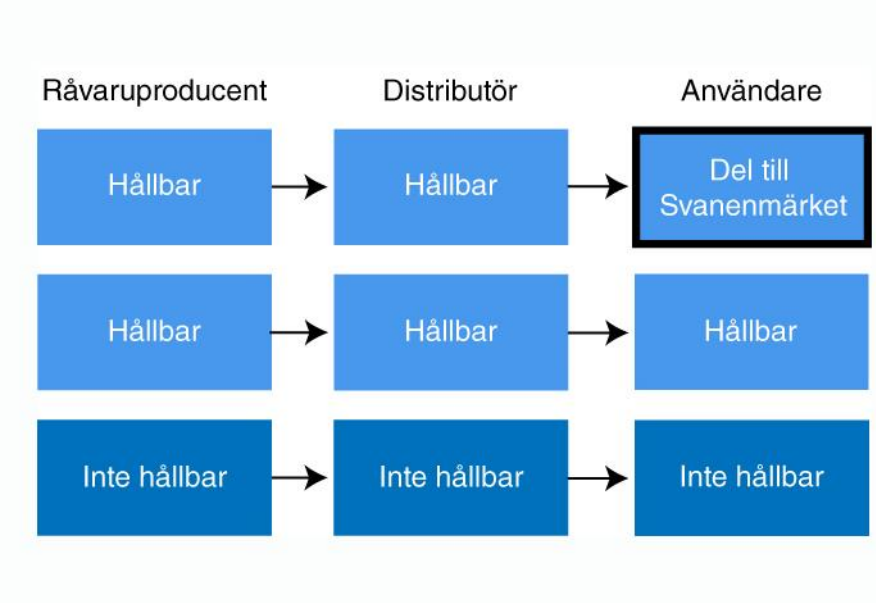


Figure 4: Traceability via physical separation at all facilities.

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 6).

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.

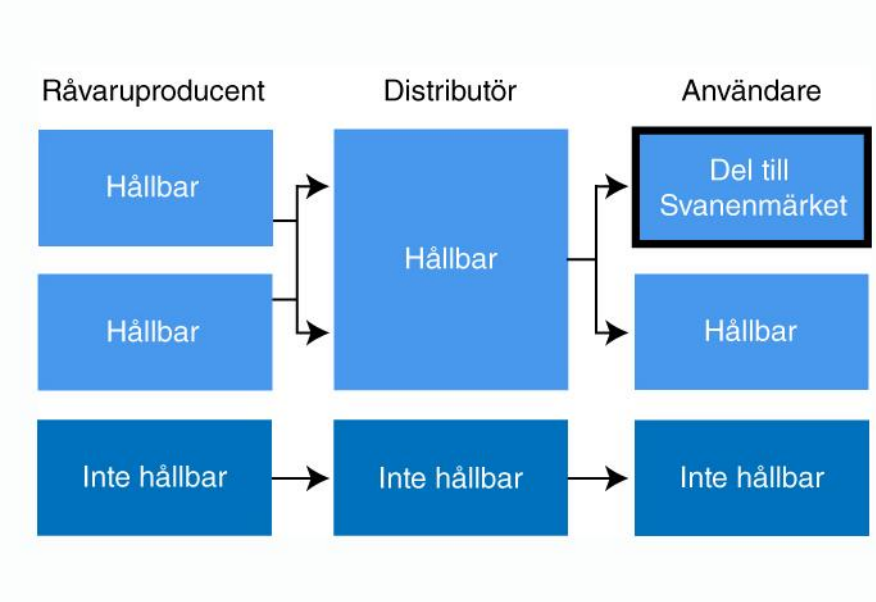


Figure 5: Traceability via physical separation of sustainable and non-sustainable raw materials.

2. Traceability via mass balance allows mixing of sustainable and non-sustainable raw materials (Figure 7). 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.

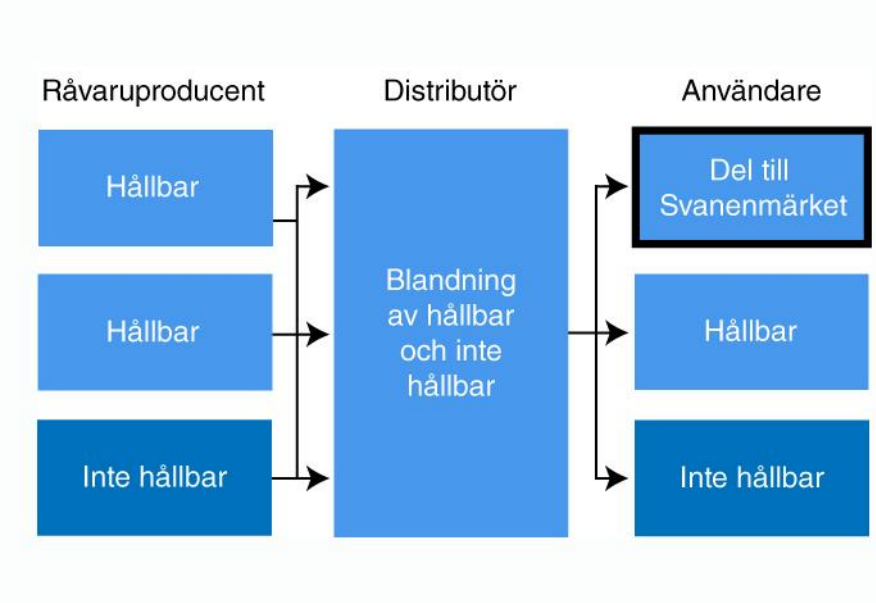


Figure 6: Traceability of mass balance of sustainable and non-sustainable elements.

3. Systems only based on certificate trading, known as "Book and Claim" (Figure 8). 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.

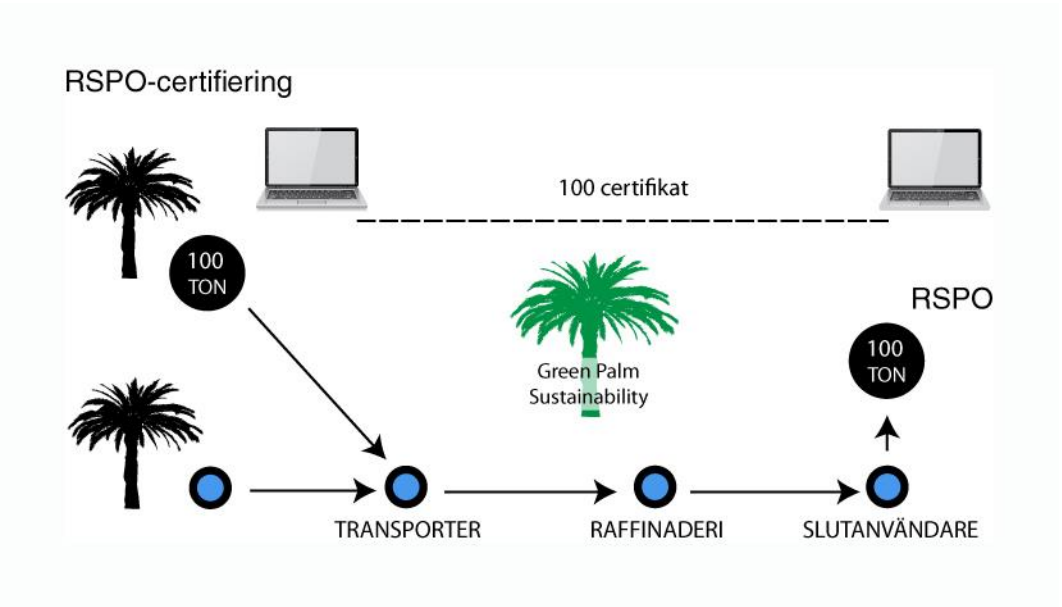


Figure 7: Traceability via certificate trading.

Appendix 6 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[85]. 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[86].

Table 7: 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

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

[86] 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 8: 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[87]. 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.

[87] GMO, hvad kan det bruges til? Vidensyntese 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[88].

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[89]. Cert ID is a third-party certification firm in the food industry, which has producers, resellers and agricultural producers as customers[90]. 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.

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