About Nordic Swan Ecolabelled

Rechargeable batteries and portable chargers

Version 5.4

Background to ecolabelling
15 June 2018 – 28 February 2027

Nordic Ecolabelling

Contents

030 Rechargeable batteries and portable chargers , version 5.4, 07 January 2025

Contact information

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

Denmark
Ecolabelling Denmark
info@ecolabel.dk
www.svanemaerket.dk

Finland
Ecolabelling Finland
joutsen@ecolabel.fi
www.joutsenmerkki.fi

Sweden
Ecolabelling Sweden
info@svanen.se
www.svanen.se

Iceland
Ecolabelling Iceland
svanurinn@ust.is
www.svanurinn.is

Norway
Ecolabelling Norway
info@svanemerket.no
www.svanemerket.no

What are Nordic Swan Ecolabel rechargeable batteries and portable chargers?

Nordic Swan Ecolabel rechargeable batteries and portable chargers live up to recognised quality and safety standards, placing them among the best in the market. Strict requirements apply to the information provided to the consumer. Both of these aspects are intended to ensure that the battery or portable charger will need to be replaced less frequently, thereby "saving" the environment the burden of more batteries than necessary. Portable chargers are designed in such a way that dismantling is possible. The content of lead, cadmium and mercury is lower than the levels stipulated by the authorities in their requirements. The plastic and metals used in the casings of both battery chargers and portable chargers must fulfil strict requirements regarding chlorinated plastic, flame-retardants and types of metals.

Producers of batteries and portable chargers must demonstrate good corporate social responsibility regarding the sourcing of conflict minerals, as well as critical raw materials and working conditions.

Nordic Swan Ecolabel rechargeable batteries and portable chargers:

- Meet stringent requirements for both battery capacity and durability – to ensure a long lifetime for the battery and portable charger.
- Live up to recognised quality and safety standards – to ensure good and safe consumer properties.
- Have a low content of mercury, cadmium and lead – to reduce the spreading and use of metals.
- Meet a CSR policy – to ensure responsible use and sourcing of limited raw materials and "conflict-free minerals.

Why choose the Nordic Swan Ecolabel?

- Licence holders may use the Nordic Swan Ecolabel trademark for marketing. The Nordic Swan Ecolabel is a very well-known and well-reputed trademark in the Nordic region.
- The Nordic Swan Ecolabel is a simple way of communicating environmental work and commitment to customers.
- The Nordic Swan Ecolabel clarifies the most important environmental impacts and thus shows how a company can cut emissions, resource consumption and waste management.
- Environmentally suitable operations prepare rechargeable batteries and portable chargers for future environmental legislation.
- Nordic Ecolabelling can be seen as providing a business with guidance on the work of environmental improvements.
- The Nordic Swan Ecolabel not only covers environmental issues, but also quality requirements, since the environment and quality often go hand in hand. This means that a Nordic Swan Ecolabel licence can also be seen as a mark of quality.

What can carry the Nordic Swan Ecolabel?

The product group comprises the following products:

Portable rechargeable batteries

Portable batteries that are rechargeable in accordance with the definition provided in the European Union's Battery Directive, 2006/66/EC.

Rechargeable batteries sold together with, or as accessories/parts for, electrical appliances, e.g. cordless power tools, can also be Nordic Swan Ecolabel (only the batteries). However, the battery must be designed to be replaced and charged in a separate charger. The Nordic Swan Ecolabel can´t be used on the packaging of the combination products (e.g. power tool + batteries). Use of the Nordic Swan Ecolabel, see requirement O14.

Rechargeable batteries sold in combination packs with external battery chargers are also eligible for a Nordic Swan Ecolabel. It must be made clear to the purchaser of combination packs of this type that the Nordic Swan Ecolabel applies solely to the batteries and not to the charger, or to other elements of the package.

The following batteries and electrical appliances cannot be Nordic Swan Ecolabel according to these criteria:

- Car batteries and industrial batteries.
- Primary (non-rechargeable) batteries, for which separate criteria exist.
- Batteries that are built into or form a permanent part of electronic products and where replacement of the batteries is not possible. Portable chargers (portable power banks) are exempt from this requirement, see below.
- Batteries that are built into or form a permanent part of electronic products and where the entire product is placed in a charger.
- Chargers sold for rechargeable batteries alone.

Portable chargers

A portable charger or "portable power bank" is defined as any portable energy storage device containing secondary batteries with charging circuitry, and which is used to charge portable consumer electronic devices via DC output. Portable chargers with built-in solar panels can also be Nordic Swan Ecolabel.

The following products do not fall within the above definition of portable chargers: products with AC input, products with jump starter functions, higher-capacity power packs intended for charging high-power industrial devices, and Uninterruptible Power Supply (UPS) systems.

Summary

The overall aim of this revision is to ensure that the Nordic Ecolabelling criteria continue to ensure positive environmental benefits via ecolabelling and that the criteria are viable and clear for the industry.

The revision has considered the areas that were apparent on the evaluation of the criteria. It has also focused on expanding the product group to make it possible for portable chargers (known as power banks) to be Nordic Swan Ecolabel.

Product group message

Nordic Swan Ecolabel rechargeable batteries and portable chargers live up to recognised quality and safety standards, placing them among the best in the market. Strict requirements apply to the information provided to the consumer.

Both of these aspects are intended to ensure that the battery or portable charger will need to be replaced less frequently, thereby “saving” the environment the burden of more batteries than necessary. Portable chargers are designed in such a way that dismantling is possible. The content of lead, cadmium and mercury is lower than the levels stipulated by the authorities in their requirements. The plastic and metals used in the casings of both battery chargers and portable chargers must fulfil strict requirements regarding chlorinated plastic, flame retardants and types of metals.

Producers of batteries and portable chargers must demonstrate good corporate social responsibility regarding sourcing of conflict minerals, as well as critical raw materials and working conditions.

Nordic Swan Ecolabel rechargeable batteries and portable chargers:

- Meet stringent requirements for both battery capacity and durability – to ensure a long lifetime for the battery and portable charger.
- Live up to recognised quality and safety standards – to ensure good and safe consumer properties.
- Have a low content of mercury, cadmium and lead – to reduce the spreading and use of metals.
- Meet a CSR policy – to ensure responsible use and sourcing of limited raw materials and “conflict-free minerals.

<u>MECO and RPS analyses</u>

To obtain an overview of the key environmental impacts in the products' life cycles, an environmental assessment of the product group was performed, as a qualitative MECO analysis for each of the four product areas. MECO stands for the assessment of Materials, Energy, Chemicals and Other 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 product group as a whole. RPS stands for Relevance, Potential and Steerability and the analysis identifies the most relevant environmental impacts that the Nordic Swan Ecolabel has the greatest possibility of steering towards a lower environmental impact. RPS was found for the following:

- The spreading and use of metals, especially heavy metals, from the batteries.
- The quality and safety of the rechargeable batteries and portable chargers.

- Overuse of batteries: due to the use of rechargeable batteries and portable chargers for an electrical application that drains the batteries or does not charge optimally.
- Incorrect handling of used batteries in the waste flow.

Market description

A brief review of the Nordic market shows that the use of both rechargeable batteries and portable chargers is developing positively. The sale of rechargeable NiMH batteries in the Nordic countries (2015 to 2016) increased by 16% on average.

The same development is seen in the market for Lithium-ion batteries, both as the sale of "normal" batteries (e.g. AA or AAA) and of batteries for power tools, but in particular as a built-in energy source in portable chargers. The description of the market also shows that environmental statements used in marketing by brand owners focus on rechargeability compared to disposable batteries.

Changes in the revised version

Based on the assessment, the MECO and RPS analyses and the market description, the main changes in the revision focus on:

- Expanding the criteria to include portable chargers.
- Adjustment of the requirements of capacity, durability and testing methods for both rechargeable batteries and portable chargers. There is also a new requirement concerning leakage during testing.
- New safety requirements for batteries and portable chargers.
- New requirements for corporate social responsibility regarding the sourcing of conflict minerals and critical raw materials.
- Adjustment of the consumer information requirements regarding safety and recycling.
- New requirement for the recyclable design of portable chargers.

All changes and amendments to the requirements are listed in Chapter 6. Further details of the changes to the requirements and new requirements can be found in Chapter 5.

1 Basic facts about the criteria

Version and validity of the criteria

The Nordic Ecolabelling Board adopted generation 2 of the Nordic Ecolabel criteria document for rechargeable batteries on 15 March 1996. Generation 2 of the criteria was valid until 14 September 2003.

Generation 3 was adopted by the Nordic Ecolabelling Board on 17 December 2002. Generation 3 of the criteria was extended several times and was therefore valid until 30 June 2012.

Generation 4 of the criteria document was adopted on 7 December 2010. A number of adjustments were agreed on at the management meeting on 16 February 2012, and the criteria were thus changed to version 4.1. The criteria document has subsequently been extended 5 times. Version 4.6 is valid until 31 December 2019.

Nordic Swan Ecolabel licences in the Nordic Market

Table 1: Overview of licences in the Nordic market.

Licensees	Country	Nordic marked	Battery technology
Energizer Trading Limited	Sweden	Sweden and Denmark	NiMH

2 Market analysis

Type of batteries

The technology used in commercial batteries has not changed drastically: they consist of an electrolyte and two electrodes (the anode and the cathode). The chemical reaction that takes place at the electrodes and the nature of the electrolyte influence the efficiency of a battery. The inactive components – steel casings, seals and separators – ensure the normal functioning of a battery cell. The active components comprise different chemical compounds which define the main attributes of a battery. Some of these may have a significant environmental impact if they are disposed of inappropriately (cadmium (Cd), lead (Pb) and mercury (Hg) and, to a lesser degree, – copper (Cu), nickel (Ni), lithium (Li), silver (Ag), and zinc (Zn)).

The EU Battery Directive distinguishes between three types of batteries: portable, industrial and automotive batteries. See table 2 below. Portable batteries are sealed, can be hand-carried and are neither industrial nor automotive batteries. Only portable batteries are covered by these Nordic Swan Ecolabel criteria. According to European Commission[1], approximately 75% of all portable batteries in the EU are non-rechargeable – for the "general purpose" use, leaving the rest of the market – 25%– to rechargeable batteries. Industrial batteries comprise batteries designed for professional application, often at the manufacturing level. Here, lead-acid batteries prevail in the market, at 96%, while the remaining 4% is divided equally between NiCd and other batteries. Finally, automotive batteries are used for vehicle starting, lighting and ignition systems (so-called "SLI" batteries).

NiCd batteries for use in consumer products are prohibited, except for emergency and alarm systems and medical devices. NiMH batteries provide more than twice the operating time compared to similar NiCd batteries and are a technical and environmental alternative to NiCd batteries. Most rechargeable batteries for AA and AAA sizes are NiMH and Li-ion.

[1] European Commission (2014). Frequently Asked Questions on Directive 2006/66/EU on Batteries and Accumulators and Waste Batteries and Accumulators. Commission Services document – not legally binding. http://ec.europa.eu/environment/waste/batteries/legislation.htm (visited 8/11-2017).

Table 2: Battery types, based on their application and the chemistries used

Portable		Industrial	Automotive (SLI)
Non-rechargeable	Rechargeable		
Zink-Carbon Alkaline-manganese Lithium-Oxide	Nickel-Cadmium Nickel metal hydride Lithium-ion Lead-acid	Lead-acid Nickel-Cadmium other	Lead-acid

Portable chargers

The increasing use of smartphones and tablets, technological advances, and power outages in certain countries, are driving the growth of the overall market.

The power bank market was valued at USD 7.77 billion in 2016 and is expected to grow at a Compound Annual Growth Rate (CAGR) of 21.2% between 2017 and 2022[2]. Table 3 below gives an overview of the important properties of a portable charger from a consumer viewpoint. For an overview of the most common cathode/anode materials used in Lithium-ion batteries today, see appendix 2 in this document.

Table 3: The most important characteristics of the power bank market (based on capacity range, number of USB ports, energy source, battery type and application).

By capacity range	500–3499 mAh 3500–6499 mAh 6500–9499 mAh 9500–12499 mAh 12500–15499 mAh Above 15500 mAh
By number of USB ports	One USB port Two USB ports More than two USB ports
By energy source	Electric Solar
By battery type	Lithium ion batteries Lithium polymer Batteries
By application	Smartphones Tablets Portable Media Devices Digital Cameras Laptops Others (Handheld Gaming Devices, Global Positioning System (GPS) Navigators, E-Readers, and Smartwatches)

2.1 The market development

The trend in the marked for rechargeable batteries is moving towards fully charged batteries (when purchased in the store), which are ready to be used when removed from the packaging.

[2] http://www.marketsandmarkets.com/Market-Reports/power-bank-market-127595596.html (visited 08-11-2017).

NiMH batteries are the largest category for consumers within the area in which the consumer takes out the batteries of the product and puts them in a charger, e.g. batteries for game consoles, remote controls, etc. Although it is possible to use rechargeable batteries in such products, the consumer often tends to use primary batteries for such purposes. According to data from battery manufacturers, there is a trend towards using more rechargeable batteries in high-drain applications such as game consoles and cameras. Primary batteries are primarily used in low- and medium-drain applications. The Nordic market (no data from Iceland) for rechargeable batteries is developing positively. Tables 4 and 5 below show sales of rechargeable NiMH batteries (types AA, AAA and others) in the Nordic countries in 2015 and 2016, and that sales have increased in all the countries.

Table 4: Sales of rechargeable NiMH batteries (types AA, AAA and others) in the Nordic countries in 2016, stated in units and weight[3]

Country	AA, pcs	Weight in kg	AAA, pcs	Weight in kg	Others, pcs	Others, weight in kg
Denmark	977,438	27,360	477,142	6,123	19,435	1,112
Finland	275,403	8,052	144,516	1,852	13,422	713
Sweden	1,505,728	44,900	638,388	8,506	93,717	5,005
Norway	285,360	8,526	283,431	3,692	0	0

Table 5: Total sales of rechargeable NiMH batteries (types AA, AAA and others) in the Nordic countries in 2016 and 2015, stated in units[4]

Country	2015 pcs	2016 pcs	%
Denmark	1,224,027	1,474,015	20.42%
Finland	394,682	433,341	9.79%
Sweden	1,950,258	2,237,833	14.75%
Norway	485,273	568,791	17.21%
Total	4,054,240	4,713,980	16.27%

Since the 1990s, when Sony commercialised Li-ion batteries, they have rapidly replaced their nickel-based predecessors[5]. In 1996, the total production of batteries for mobile phones was 4.9 million units; the Li-ion, NiMH and NiCd batteries shared the market at 22%, 39%, and 39%, respectively. Later, in 2005, phone production reached 177 million units, but 79% were equipped with Li-ion batteries (and 17% with Li-polymer batteries). For laptops, the situation is similar: in 1995, 1.8 million laptops were equipped with Li-ion (45%) and NiMH batteries (55%), but in 2005, Li-ion batteries led the laptop market at 92% (with total production of 3.3 million units). This was due to the specific advantages of Li-ion batteries[6]:

- Higher energy density.
- A higher number of charge cycles without “memory effect” and high energy density; as a result, battery lifetime is extended.

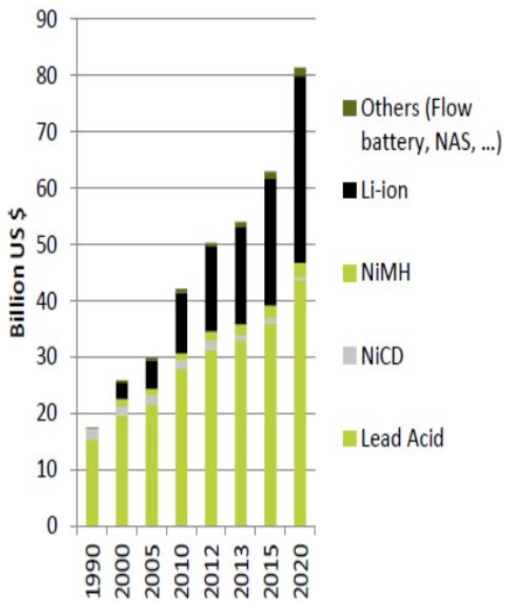
[3] Data from EPBA (6/11-2017).
[4] Data from EPBA (6/11-2017).
[5] Buchmann, I.: Batteries in a Portable World: A Handbook on Rechargeable Batteries for Non-Engineers. Richmond, British Columbia: Cadex Electronics Inc. The fourth edition, 2016.
[6] Wang, X. (2014). Managing End-of-Life Lithium-ion Batteries: an Environmental and Economic Assessment.Thesis. Rochester Institute of Technology.

- Just 5% loss of charge per month due to self-discharge (NiMH loses 30%).
- A wide variety of design factors, lightweight:
- A better environmental profile.

While the NiMH batteries have a few advantages (lower cost, high current and no need for processor-controlled protection circuits), the Li-ion batteries became dominant in the market for both portable devices and EVs. Factory giants (e.g. Tesla's and Panasonic's Gigafactory, LG Chem, Foxconn, BYD and Boston Power) are going to triple Li-ion battery production, reaching up to 125 GWh capacity by 2020, which will enhance the leading role of Li-ion battery technology.

LG and Samsung have also scheduled the launch of Li-ion production in Europe – in 2018[7]. Figure 1 below presents the worldwide battery market in 1990-2020. Portable chargers are part of the "portable" category in the figure.

Moreover, the European Union has decided[8] to establish "a full value chain of batteries in Europe, with large-scale battery cell production, and the circular economy at the core". Europe's largest Li-ion factory, NorthVolt, is already being built in Sweden and the planned capacity of 32 GWh is expected to be reached by 2023[9]. The company assumes that there is "a long-term market for 100-150 factories of our size".



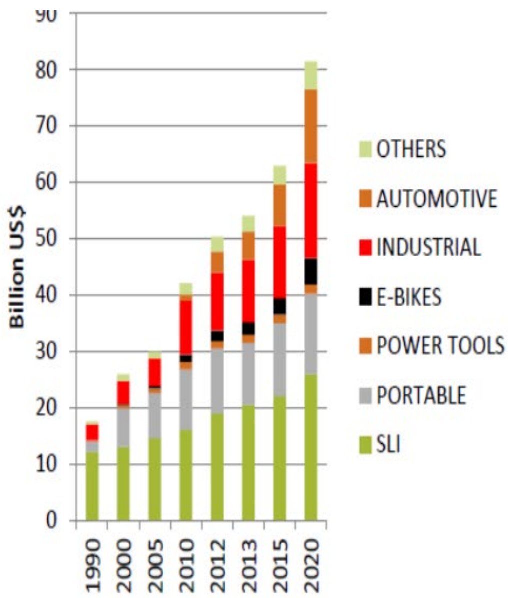


Figure 1: The worldwide battery market, 1990-2020[10]. ***SLI: start light and ignition batteries for cars, trucks, motors, boats, etc. Portables: consumer electronics (cellular (mobile phones, power banks), portable PCs, tablets, cameras, etc.). Automotive: hybrid electric vehicles (HEV), electric vehicles (VE). Others: medical - wheelchairs, medical devices, etc.***

[7] Dmytro Kapotia: Ecolabelling criteria development for rechargeable batteries in ICT products – Justifying a new generation of requirements for batteries based on state-of-the-art in the sector, IIIEE Thesis 2017:21.
[8] http://europa.eu/rapid/press-release_STATEMENT-17-3861_en.htm (visited 2017-11-10).
[9] http://northvolt.com (visited 2017-11-10).
[10] Avicenne Energy: presentation of the battery market – development for consumer electronics, automotive and industrial. Batteries 2014 September 24-26,2014 Nice, France.

2.2 Environment as a means of competition

Several battery manufacturers use “environmental/responsibility” in one way or another in their marketing. Energizer, for example, uses ”Energizer® EcoAdvanced®” for its rechargeable batteries, where 4% of the total weight of the battery consists of recycled batteries (which account for 10% of an important active ingredient in the battery)[11]. Panasonic names its rechargeable batteries as “ecological rechargeable batteries”[12].

This characteristic is also generally used as an environmental argument. GP, for example, uses the expression ReCyko ++ on one of its rechargeable battery types[13]. In general, producers emphasise that the batteries are rechargeable and that they replace x number of primary batteries. Varta writes that one rechargeable battery replaces 300 alkaline batteries in a camera[14]. Ikea highlights its new rechargeable batteries and points out that they are better for the environment than disposable batteries[15].

2.3 Stakeholders

RECHARGE (a non-profit organisation) was founded to promote the value of rechargeable batteries and represent the interests of all of its members in the chain of battery life. RECHARGE monitors the continuously changing regulatory and legislative environment for rechargeable batteries and is a recognised expertise centre for advanced portable and industrial rechargeable battery technologies. Members include suppliers of primary and secondary raw materials to the battery industry, rechargeable battery manufacturers, original equipment manufacturers, logistics partners and battery recyclers.
http://www.rechargebatteries.org/

The European Portable Battery Association (EPBA) represents the interests of primary and rechargeable portable battery manufacturers, industries using portable batteries in their products, and distributors of portable batteries active within the European Union, and beyond. www.epbaeurope.net

The European Battery Recycling Association (EBRA) represents the companies whose main activities are battery sorting and recycling. EBRA’s members are involved in the collection, sorting, treatment and recycling of used or waste batteries, whatever the technology or category – automotive, or Starting-Lighting-Igniting (SLI) batteries, industrial batteries, and consumer portable batteries (rechargeable and non-rechargeable). http://www.ebra-recycling.org/home

[11] http://www.energizer.com/ecoadvanced (visited 04.01.2017).
[12] http://www.panasonic-batteries.com/eu/products/product-ranges/rechargeable (visited 04.01.2017).
[13] http://www.gpbatteries.com/int_en/batteries/rechargeable-batteries/recyko/recykoaa-1 (visited 04.01.2017).
[14] http://www.varta-consumer.no/nb-NO/Products/Rechargeables.aspx (visited 04.01.2017).
[15] http://www.ikea.com/ms/no_NO/this-is-ikea/people-and-planet/sustainable-life-at-home/index.html (visited 04.01.2017).

3 Other labels

This chapter summarises the main regulatory requirements, controls and labelling schemes for rechargeable batteries, power banks and UPS systems.

3.1 Battery Directive (2006/66/EC)

The Battery Directive 2006/66/ EC[16] (2006) applies to all batteries and accumulators in the European Union market, unless, according to Article 2.2 of the Directive, they are used in equipment intended to protect essential national security interests and equipment designed to be sent into space. The Directive has two different purposes. One is to reduce the environmental impact of batteries and the other is to coordinate the rules throughout the EU.

The Directive reduces environmental impacts by limiting the use of batteries containing the heavy metals cadmium, mercury and lead, and by requiring the collection of batteries. The Directive also reduces the environmental impact of batteries by requiring the recovery of end-of-life batteries and prohibiting landfill deposits and incineration of untreated batteries. All of the Nordic countries have established collection arrangements for batteries, as provided by the Directive.

The EU Battery Directive is subject to revision[17]. The task is to minimise waste and maintain material flows within the economy for as long as possible, to achieve economic, social and environmental benefits. An area of special interest is to find economic and strategic incentives for material recovery. It is also planned to consider such issues as 1) business models for collection and recycling of negative-value waste streams; 2) recycling capacity; 3) recycling technologies for new chemistries; and 4) the legal framework for reuse (the second life). For more information concerning EU legislation, see appendix 1 in this document.

3.2 Type 1 ecolabels

Type 1 ecolabels, like the Nordic Swan Ecolabel, are voluntary, multiple-criteria based, third-party programmes which award a licence that authorises the use of environmental labels on products, so as to indicate the overall environmental preferability of a product within a specific product category, based on life-cycle considerations.

There are several type 1 ecolabelling organisations that ecolabel batteries, some of which have specific criteria for rechargeable batteries, while others have criteria for consumer electronic products (ICT products) that include rechargeable batteries. Some of the most relevant are described below. All of these ecolabels are type 1 and the organisations are members of GEN (Global Ecolabelling Network[18]).

[16] http://ec.europa.eu/environment/waste/batteries/legislation.htm (visited 6/11-2017).
[17] http://www.prba.org/wp-content/uploads/9.1-EU-Batteries-Directive-Review.pdf (visited 2/5-2017).
[18] https://globalecolabelling.net/ (visited November 2017)

Korea Ecolabel

Standard for rechargeable batteries[19]: The Korea Ecolabel requirements concern battery capacity, content of the heavy metals Cd, Pb and Hg, and that the packaging must be PVC-free. This limits the amount of lead (Pb) – 40 mg/kg or less; cadmium (Cd) – 10 mg/kg or less; and mercury (Hg) – 1 mg/kg or less. The Li-ion battery capacity must still be 80% of the nominal capacity after 400 charge cycles. No leakage may occur. Other criteria include requirements of consumer information (the reason that the ecolabelled battery performs better in terms of environmental impact); and safety, quality, and performance – based on the national and industrial standards. Nordic Swan Ecolabelling has chosen the same requirement level for the capacity and durability of the NiMH battery as the Korean Ecolabel.

Standard for mobile phones and for notebook computers[20]: sets restrictions concerning lead (Pb), mercury (Hg), and cadmium (Cd) in battery content, based on the Battery Directive.

In addition, there is the criterion for mobile phones concerning nickel emissions from the product and its elements, including the battery pack. The standard for mobile phones also sets the requirement for charging equipment: the product must have a structure whereby the recharging equipment may be used jointly with kindred model products with similar production times. The criterion regarding product design requires the option that the battery can be extracted and replaced. Customers must be provided with the relevant product- and service-related information.

Japan Environment Association – EcoMark

The criterion for energy consumption sets the standard energy consumption efficiency for battery-driven computers[21], based on their operational characteristics. The design criterion requires batteries to be replaceable and removable. EcoMark limits lead (Pb), mercury (Hg) and cadmium (Cd) in battery content, as well as hexavalent chromium, and specified brominated fire retardants (PBBs, PBDEs) – in accordance with the national Japanese standard. The product-related information (including the content information) and the information on battery replacement must be available via the website. The batteries are marked in accordance with national legislation on the promotion of effective utilisation of resources.

TCO Certified

TCO Certified[22] initiated the revision of the requirements for batteries in ICT products based on its own criteria, represented in the standards for smartphones, tablets and notebooks. The standards have shared requirements for batteries in portable electronics, with a minor difference between smartphones and tablets/notebooks.

---

[19] http://el.keiti.re.kr/enservice/enindex.do (visited 6/11-2017).
20 http://el.keiti.re.kr/enservice/enpage.do?mMenu=2&sMenu=1 (visited 6/11-2017).
[21] https://www.ecomark.jp/english/nintei.html (visited 6/11-2017).
[22] http://tcocertified.com/tco-certified/tco-certified-product-categories (visited 6/11-2017).

The limitation of hazardous substances is based on the Battery Directive: mercury (Hg), lead Pb) and cadmium (Cd) (section A.6 for all standards). Additional criteria consider such specific hazardous substances as polybrominated biphenyls (PBB), polybrominated diphenyl ether (PBDE) and hexabromocyclododecane (HBCDD) in all components, including batteries.

The battery must be rechargeable and replaceable. A producer must provide spare parts for tablets and notebooks – for 3 years following the end of production. Instructions for professionals on how to replace components must be available.

The Blue Angel

The Blue Angel has ecolabelling criteria for mobile phones[23]. Harmful substances in plastics have been minimised to promote precautionary health protection. A number of requirements have been included to ensure the longevity of the devices.

The battery, for example, must meet particularly high quality standards and must naturally be replaceable by the user without expert knowledge being required. A mobile phone has to travel a long way until it finally reaches the consumer. This is why the Basic Criteria for the Blue Angel also include requirements concerning the origin of raw materials, i.e. “conflict minerals” (tin, tantalum, tungsten and gold), as well as the production conditions. Compliance with fundamental social standards at the manufacturing plant is monitored on site by independent third parties. Nordic Swan Ecolabelling has chosen the same requirement level for the capacity and durability of the lithium battery as the Blue Angel.

The Blue Angel[24] has ecolabelling criteria for uninterruptible power supply (UPS) systems. Lead batteries are currently still being used in uninterruptible power supply systems. The environmental label ensures that these lead batteries deliver the greatest possible lifespan, in order to keep the useful value of this environmentally dangerous and unhealthy material as high as possible. The Blue Angel environmental label sets additional requirements concerning energy efficiency, quality and recycling-compatible construction.

3.3 Environmental Product Declarations (EPD)

In life cycle assessment, an Environmental Product Declaration (EPD) is a standardized way of quantifying the environmental impact of a product or system. While EPD do educate consumers about the product and its environmental impact, consumers should know that it is for disclosure purpose only, and does not mean that the product meets any environmental performance standards.

[23] https://www.blauer-engel.de/en/products/home-living/mobiltelefone-135 (visited 6/11-2017).
[24] https://www.blauer-engel.de/en/products/office/power-supply-systems (visited 6/11-2017).

EPDs are referred to as type 3 environmental declarations according to ISO 14024. No EPDs for batteries are found on the international EPD page, but it has been found that the Taiwan Battery Association has developed product category roles (PCR) for ”Lithium-ion Secondary Battery Pack for Consumer Electronics” as from 2014.

3.4 Product Environmental Footprint (PEF)

The European Commission, working closely with the Joint Research Centre, has developed a proposed methodology for the calculation of the environmental footprint of products[25]. The idea of the Product Environmental Footprint (PEF) initiative is to develop a harmonised methodology for the calculation of the environmental footprint of products, based on transparent methodology.

A pilot has been developed for high specific energy rechargeable batteries used in mobile application for the following three application fields:

- e-mobility (e.g., -bikes, EV, PHEV, cars, bus/trucks)
- ICT (e.g., tablets and phones, computers, cameras, games)
- Cordless power tools (e.g., drills, electric screwdrivers)

3.5 Purpose of the revision of the criteria

Evaluation of the current generation 4 of the criteria for the Nordic Swan Ecolabelling of rechargeable batteries (2014 and 2016) resulted in a proposal to revise the criteria, primarily by adjusting the product group definition in order to enable the Nordic Swan Ecolabelling of portable chargers (power banks) and possibly also UPS (energy storage) systems. In addition, to adjust the requirements of capacity, capacity testing methods, the overall quality of rechargeable batteries and the possibility of new requirements for metals.

Based on the recommendations in the evaluation report, the objectives of the revision have been to:

- Establish the product group definition to cover portable chargers and possibly UPS systems.
- Adjust the requirements of capacity and testing methods for both rechargeable batteries, portable chargers and, possibly, UPS systems.
- Map the types of metals and constituents found in today's battery types in order to adjust the requirements for the use of metals.
- Examine the possibility of developing a new requirement for metal extraction.
- Examine the possibility of developing new requirements for leakage, fire safety regarding batteries/chargers and consumer information about which applications the battery is suitable for.
- Generally update current requirements to ensure they are clear and relevant.
- Update background documents in line with the revision of requirements and conclusions from MECO and RPS made in this evaluation.

[25] http://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm (visited May 2018)

About this criteria revision

The revision was conducted by Thomas Christensen (DK, product group manager) and Ove Jansson (S, project adviser). Jakob Waidtløw (DK), Randi Rødseth (N), Ove Jansson (S) and Anna Sahlman (Fin) are the national product specialists (PS).

The revision was conducted as an internal Nordic Ecolabelling project, with an ongoing dialogue with international and national stakeholders.

4 Environmental impact of the product group

The product group rechargeable batteries and portable chargers comprises different materials and types of production, but with a uniform function: namely to store energy and provide a portable source of power to charge drained electronic devices. The main component by far in a portable charger is a rechargeable battery. This means that the overall life cycles are the same as for the rechargeable batteries included in today's criteria: production of raw materials, production of batteries, and the user-facing and end-of-life battery treatment. The differences in the types of products lie in the type of battery technology. Portable chargers also consist of a special electrical circuit that controls the power flow and a closed casing (plastic or metal) surrounding the battery and circuit.

Safety and quality requirements of batteries, battery chargers and portable chargers ensure safe, energy-effective and consumer-friendly, durable. The requirements of consumer information and the recyclable design of the portable charger must ensure a high degree of recycling of the products.

A MECO analysis was performed in conjunction with Nordic Ecolabelling's revision of the criteria in 2017[26]. MECO stands for the assessment of Materials, Energy, Chemicals and Other characteristics and describes the principal environmental impacts during the a product's life-cycle phases. The MECO analyses are based on LCA studies[27][28][29] and scientific reports[30][31]. Based on the MECO analysis, an RPS analysis was conducted to identify the relevance, steerability and potential of the various environmental aspects of rechargeable batteries.

---

[26] The separate MECO analysis for rechargeable batteries, portable chargers and UPS systems is written in Danish and is available on request from Nordic Ecolabelling: tc@ecolabel.dk.

[27] Giovanni Dolci et al.: Life cycle assessment of consumption choices: a comparison between disposable and rechargeable household batteries. The International Journal of Life Cycle Assessment (2016).

[28] Helgstand A.: AA batteries, disposable or rechargeable – A comparative Life Cycle Assessment of potential climate impact of rechargeable NiHM and alkaline disposable AA batteries. Linköping Universitet (2011).

[29] Mia Romare, Lisbeth Dahllöf (2017). The life cycle energy consumption and greenhouse gas emissions from Lithium-ion batteries, IVL Swedish Environmental Research Institute.

[30] Wang, X. (2014). Managing End-of-Life Lithium-ion Batteries: an Environmental and Economic Assessment. Thesis. Rochester Institute of Technology.

[31] Dmytro Kapotia: Ecolabelling Criteria development for rechargeable batteries in ICT products – Justifying a new generation of requirements to batteries based on state of the art in the sector, IIIEE Theses 2017:21.

Nordic Ecolabelling uses the RPS analysis to pinpoint the environmental issues that are most relevant (R) in the life cycle of the products and to assess the potential (P) which exists for reducing adverse effects on the environment in these areas. At the same time, it is important to examine how manufacturers in particular can make changes to the products (steerability = S) that will trigger the potential for environmental improvements. This section describes the key findings of the RPS analysis. The complete analysis is in Danish, but can be requested from Nordic Ecolabelling.

The RPS analysis for rechargeable batteries and portable chargers shows that RPS has been found in a life cycle for the following areas:

- The spreading and use of metals, especially heavy metals, from the batteries.
- The quality and safety of the rechargeable batteries and portable chargers.
- Overuse of batteries: due to the use of rechargeable batteries and portable chargers for an electrical application that does not drain or optimally charge the batteries.
- Incorrect handling of used batteries in the waste flow.

The spreading and use of metals, especially heavy metals, from the batteries

When it comes to the spreading and use of metals, there are differences in which substances the batteries in the market today contain, and at which concentrations. There is thus relevance (R) and potential (P) to distinguish between more or less environmentally hazardous types of batteries. The Battery Directive, 2006/66/ EC, already regulates the content of mercury (Hg), cadmium (Cd) and lead (Pb) in batteries.

The potential (P) for a stricter requirement concerning the use of mercury, cadmium and lead is therefore limited, but would, however, ensure that the raw materials used in a Nordic Swan Ecolabel battery/portable charger have a high purity, which has an impact on the quality (R) of the battery. The steerability (S) of the Hg, Cd and Pb content in the batteries is increased by requiring relevant test analyses.

Mining and refining of materials used in batteries is by far the biggest environmental impact across the life cycle of batteries. According to LCA studies,[23] almost 80% of environmental impacts across the life cycle of these batteries were found to occur during the mining and refining of materials. There is thus high relevance (R) and potential (P) for reducing the environmental impacts from mining and refining. The steerability (S) is however very low at the moment, but new legislation and new initiatives to verify and trace minerals from mines through the supply chain, is coming forward. New requirements of the use of conflict and critical raw minerals in battery production ensure that battery manufacturers have an active policy for the purchase and use of metals. Conflict minerals such as tin, tantalum, tungsten, gold and cobalt are often mined in conflict- or high-risk areas such as the Democratic Republic of Congo region. Critical raw materials are considered critical to our society and our well-being.

By requiring information concerning the content of the battery/portable chargers, Nordic Ecolabelling can collect evidence in order to assess how we will set requirements of the battery content in the future. Requirements of consumer information and the recyclable design of the portable charger will ensure a high degree of recycling of the products.

The quality/safety of rechargeable batteries and portable chargers

Materials composition and production methods vary between the individual product types of rechargeable batteries and portable chargers. This has a major impact on the quality of the products. It is therefore highly relevant (R) to ensure that the quality of rechargeable batteries and portable chargers is good. This can be ensured by requirements to apply quality standards (P). The steerability (S) of the quality of the rechargeable battery and portable charger is increased by requiring relevant quality parameters to be tested by independent, qualified third parties.

Imposing stringent requirements of the quality of rechargeable batteries and portable chargers not only ensures good energy efficiency, but also increases the lifetime of the battery. A long battery lifetime also leads to a smaller amount of batteries in the commercial and waste stream.

Overuse of batteries: due to the use of rechargeable batteries and portable chargers for an electrical application that drains or does not optimally charge the batteries

Nordic Ecolabelling is of the view that the most important parameter for the environmental impact of batteries is the overuse of batteries. The fewer batteries that are used, the lower the overall environmental impact of batteries. Accordingly, it is important to ensure that Nordic Ecolabel licences are awarded only to batteries that offer the longest operating time

For the consumer, there are economic and environmental benefits from choosing the right battery or portable charger with the best capacity for the electronic application, thereby ensuring a long and optimised battery life.

As stated above, there is a high RPS from ensuring that the quality of the rechargeable batteries and portable chargers is good. Requiring information on the packaging concerning which applications the battery/ portable charger is suitable for also ensures a long and optimised battery life.

5 Justification of the requirements

This chapter presents proposals for new and revised requirements, and explains the background to the requirements, the chosen requirement levels and any changes compared with generation 4.

5.1 Definition of the product group

The product group comprises the following products:

Portable rechargeable batteries

Portable batteries that are rechargeable in accordance with the definition given in the European Union’s Battery Directive, 2006/66/EC.

Rechargeable batteries sold together with, or as accessories/parts for, electrical appliances, e.g. cordless power tools, can also be Nordic Swan Ecolabel (only the batteries). However, the battery must be designed to be replaced and charged in a separate charger. The Nordic Swan Ecolabel can´t be used on the packaging of the combination products (e.g. power tool + batteries). Use of the Nordic Swan Ecolabel, see requirement O14.

Rechargeable batteries sold in combination packs with external battery chargers are also eligible for a Nordic Swan Ecolabel. It must be made clear to the purchaser of combination packs of this type that the Nordic Swan Ecolabel applies solely to the batteries and not to the charger, or to other elements of the package.

The following batteries and electrical appliances cannot be Swan Ecolabel according to these criteria:

- Car batteries and industrial batteries.
- Primary (non-rechargeable) batteries, for which separate criteria exist.
- Batteries that are built into or form a permanent part of electronic products and where replacement of the batteries is not possible. Portable chargers (portable power banks) are exempt from this requirement, see below.
- Batteries that are built into or form a permanent part of electronic products and where the entire product is placed in a charger.
- Chargers sold for rechargeable batteries alone.

Portable chargers

A portable charger or “portable power bank” is defined as any portable energy-storage device containing secondary batteries with charging circuitry that is used to charge portable consumer electronic devices via DC output. Portable chargers with built-in solar panels can also be Nordic Swan Ecolabel.

The following products do not fall within the aforementioned definition of portable chargers: products with AC input, products with jump starter functions, higher-capacity power packs intended for charging high-power industrial devices, and uninterruptible power supply (UPS) systems.

Background

As in the criteria for generation 4, the product group includes portable batteries that are rechargeable in accordance with the definition provided in the European Union’s Battery Directive, 2006/66/EC. In this generation of the criteria, the product group has been expanded with portable chargers, often referred to as power banks.

The main component by far in a portable charger is a rechargeable battery. This means that the overall life cycles are the same as for the rechargeable batteries included in today's criteria: production of raw materials, production of batteries, the user interface and end-of-life battery treatment. The difference in the types of products lies in the type of battery technology. Portable chargers also consist of a special electrical circuit that controls the power flow and a closed casing (plastic or metal) surrounding the battery and circuit.

According to Directive 2006/66/EC, a rechargeable battery is:

Any source of electrical energy generated by direct conversion of chemical energy and consisting of one or more secondary battery cells (rechargeable). Portable batteries are confined to: any battery or button cell, or any battery pack or accumulator, that is sealed, can be hand-carried and is neither an industrial battery nor an accumulator, nor an automotive battery or accumulator.

The term "sealed" applies to most - if not all - types of batteries: lead-acid, Nickel-Cadmium (Ni-Cd), Lithium-Primary, Lithium-Ion (Li-ion), Zinc Alkaline, etc. The battery is sealed during normal use in order to avoid spillage of the electrolyte out of the battery, but also to protect the battery from the introduction of air inside the battery. Both the spillage and the air inlet would reduce the service life of the battery.

The marked for power- and garden tools is going towards electrical appliance systems, all powered by one battery system[32]. When rechargeable batteries are sold in combination packs together with an electrical application, there is a risk that consumer perceives that the entire product (electrical application + rechargeable battery) is Nordic Swan Ecolabel. Therefore, the Nordic Swan Ecolabel must be used in a way so there is no doubt that that the Nordic Swan Ecolabel applies solely to the batteries and not to the electrical appliances or to other elements of the package.

If a Swan-labelled battery is sold as an individual item (accessories/parts for, electrical appliances), the Nordic Swan Ecolabel logo can be used on the product and outer packaging

Nordic Swan Ecolabelling has chosen to exclude batteries that are built into or form a fixed part of electrical products and that accordingly cannot be replaced. Many tools, for example, such as cheaper screwdrivers and drills, beauty products or toys, have rechargeable batteries that cannot be replaced when they get old and cannot be recharged at all. Nordic Swan Ecolabelling believes that it is an unnecessary waste of resources to have to discard an electrical appliance simply because the battery no longer functions optimally.

[32] Power tools are tools that consumers and professionals use for turning, milling, sanding, grinding, sawing, cutting, shearing, drilling, making holes, punching, hammering, riveting, screwing, polishing or the similar processing of wood, metal and other materials, as well as for mowing, cutting and other gardening activities.

Nordic Swan Ecolabelling has also chosen to exclude electronic products which contain a rechargeable battery, but where the entire product is placed in a charger, e.g. mobile telephones, portable computers, toys and household appliances such as electric toothbrushes, razors and hand-held vacuum cleaners. This is because Nordic Swan Ecolabelling does not impose further requirements on the electrical appliances into which the battery is built and it would therefore not be possible to ensure that the overall product is environmentally-friendly.

The charger plays a major role in the useful life and performance of a rechargeable battery. For this reason, Nordic Swan Ecolabelling has chosen to impose special quality requirements on chargers sold in combination with Nordic Swan Ecolabel rechargeable batteries. Rechargeable batteries sold in combination packs with external battery chargers are also eligible for a Nordic Swan Ecolabel. It must be made clear to the purchaser of combination packs of this type that the Nordic Swan Ecolabel applies solely to the batteries and not to the charger, or to other elements of the package.

A different Nordic Swan Ecolabelling criteria document allows primary batteries to be ecolabelled. Nordic Swan Ecolabelling has not combined rechargeable batteries and disposable batteries in the same criteria document, since there is an essential difference which, in most cases, will mean that rechargeable batteries represent a better choice from an environmental perspective: one of the products is a disposable product. When it runs out, it is discarded. The second product is reusable. When it runs out, it is recharged and re-used. Furthermore, primary batteries and rechargeable batteries have differing chemical compositions.

In most cases, rechargeable batteries will represent a better choice in environmental terms than primary batteries, a fact that is *inter alia* confirmed by different LCA analyses of various batteries[33][34], and Nordic Swan Ecolabelling's preference is that as many consumers as possible should use rechargeable batteries.

Portable chargers

In this criteria generation 5, it is also possible to label portable chargers. A portable charger or "portable power bank" is defined as any portable energy-storage device containing secondary batteries with charging circuitry (a PCB with voltage conversion and power management system and USP ports), which is used to charge portable consumer electronic devices via DC output. Portable chargers with built-in solar panels can also be Nordic Swan Ecolabel.

Most portable chargers (power banks) in the market have 5 volt (V) output, due to the USB power standard[35].

---

[33] Giovanni Dolci et al.: Life cycle assessment of consumption choices: a comparison between disposable and rechargeable household batteries. The International Journal of Life Cycle Assessment (2016).
[34] Helgstand A.: AA batteries, disposable or rechargeable – A comparative Life Cycle Assessment of potential climate impact of rechargeable NiHM and alkaline disposable AA batteries. Linköping Universitet (2011).
[35] https://en.wikipedia.org/wiki/USB (visited 10-11-2017).

Nordic Swan Ecolabelling has, however, decided not to set a 5-volt limit to the DC output, due to the development in the market, especially for charging laptops. The trend for power banks intended for charging laptops is for devices with 16V to 20V DC outputs[36].

It is not possible to label portable chargers with an AC input (direct integrated plug to power outlet), since these are designed for "stationary" charging and are therefore not portable. Portable chargers with a jump-start function are not designed for continuous charging of electronic products, and are therefore not part of these criteria. Higher-capacity portable chargers intended for charging high-power industrial devices are not included in the product group, since these products are not intended for consumer electronic devices. Uninterruptible power supply (UPS) systems are designed for "stationary" power supply/charging and are therefore not portable.

5.2 Production and product description

O1 Description of the product

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

- Brand and trading name(s).
- Name and contact details of production location(s) for the manufacture and brand owner(s) of batteries and/or portable chargers.
- Description of the product(s) (detailing all constituent substances present in the battery; metals, other solid substances and liquid chemical substances) in the application (weight %).
- Description of raw materials used in the casing of the battery charger or the portable charger.
- Description of materials used in the primary packaging. Primary packaging: refers to the purchase packaging for the consumer, e.g. the packaging that holds 4 batteries or one portable charger, and which the consumer encounters in sales.
- Description of the manufacturing process for the product. Nordic Ecolabelling wants a general description of the battery/portable charger manufacturing process and which technology that is being used to produce the batteries/portable chargers. A flow chart is recommended to explain the production process.

✉ Description of the above points. Appendix 1 may be used. A flow chart is recommended to explain the production process.

Background to requirement O1

The requirement of the description of the product has been adjusted to include portable chargers in generation 5 of the criteria.

The intention of the requirement is to provide an adequate picture of the manufacturing process and the life cycle of the product and any packaging: which raw materials and production processes are used, which metals, other solid substances and liquid chemical substances are used in the battery, and so on. Details of all constituent substances present in the battery and portable charger must be given in weight-%.

[36] http://www.tespack.com/7-facts-dont-know-power-banks/ (visited 10-11-2017).

The requirement will thus give an insight into the product(s) in the application, in order to ensure that the application is processed correctly.

O2 Metal content of batteries

The metal content of the battery may not exceed the following limits:

Metal	Content
Mercury	< 0.1 ppm
Cadmium	< 5.0 ppm
Lead	< 5.0 ppm

It should be noted that the EU's Battery Directive 2006/66/EC permits a maximum cadmium content of 20 ppm and a maximum mercury content of 5 ppm. The test laboratory may need special equipment in order to test batteries for a mercury content of < 0.1 ppm.

At least four examples of the product in question must be analysed and all four must meet the requirement.

The metal content of the batteries must be analysed in accordance with "Battery Industry Standard Analytical Method. For the determination of Mercury, Cadmium and Lead in Alkaline Manganese Cells Using AAS, ICP-AES and "Cold Vapour". European Portable Battery Association (EPBA), Battery Association of Japan (BAJ), and National Electrical Manufacturers Association (NEMA; USA). April 1998".

Similar test methods may be approved if assessed and adjudged to be equivalent to the recommended method by an independent third party.

✉ Report from the analysis body showing the metal content of the batteries.

✉ Declaration confirming that the institution performing the analysis is impartial and fulfils the general requirements applicable to test laboratories, as described in the requirements applicable to the analysis laboratory/test institutions in appendix 5.

Background to requirement O2

The requirement of the metal content of batteries has been changed in generation 5 of the criteria. Comments from stakeholders show that test methods cannot be used for testing for arsenic. Nordic Swan Ecolabelling has therefore decided to remove the requirement for content of arsenic in criteria generation 5.

As noted above, Nordic Swan Ecolabelling is aware that substances that are harmful to the environment are used in rechargeable batteries and that some of these substances are known to offer direct technical benefits. Unfortunately, at the present time we do not have sufficient knowledge of how these harmful metals might be limited without reducing the performance of the battery. On the other hand, we have known for many years that certain harmful metals can be limited without detrimental effect for battery performance:

- Mercury, which is very hazardous to health and the environment, accumulates in the body and is known to be highly volatile.
- Cadmium, which accumulates in the body, particularly the kidneys, and is known to be hazardous to health and the environment and in certain connections is carcinogenic, mutagenic or toxic for reproduction.

- Lead, which is known to be toxic for reproduction, environmentally harmful and has negative effects on the nervous system[37].
- Arsenic, which can occur in large quantities in rechargeable batteries. Arsenic is classified as toxic (H330 or H331/H301) and hazardous to the environment (H410).

The EU's Battery Directive 2006/66/EC (2006) requires batteries to be labelled if they contain concentrations of one or more of the three metals: mercury (max 5 ppm), cadmium (max 20 ppm) and lead (max 40 ppm). In addition, the Directive prohibits the marketing of ordinary consumer batteries with a mercury content in excess of 5 ppm and a cadmium content in excess of 20 ppm. At these levels, legislation has ensured that these three heavy metals may not be added to portable batteries deliberately. Even so, pollutants may nevertheless occur.

A German test study from 2013[38], which examined around 300 batteries, taken from stores, discovered that in some batteries, represented in the market, these metals may exceed the permitted EU limit, yet this is an exception: strict control in this sector will make it possible to completely erase commercial batteries with a prohibited level of such metals. Nevertheless, according to the same study, Li-ion batteries possess a significantly better chemical profile: the level of heavy metals is much lower than is allowed under the Directive.

As far back as in generation 3 of the criteria, Nordic Swan Ecolabelling opted to introduce stricter requirements than those of the authorities in this respect, in order to ensure that only the best constituent substances with very low concentrations of pollutants of the above metals may be used in Nordic Swan Ecolabel batteries.

The requirement refers to a test method for determining the content of the above metals, which was developed for use on Alkaline Manganese (AlMg) batteries. Nordic Swan Ecolabelling is aware that applications may be submitted for ecolabels for other types of rechargeable batteries, and Nordic Swan Ecolabelling is aware that the specified test method is old. Similar test methods may therefore be approved if assessed and adjudged to be equivalent to the recommended method by an independent third party.

O3 Requirements applicable to plastic and metal in the casing of the battery charger and in the outer casing/container that encircles the batteries/cells in the portable charger

The requirement solely applies to plastic and metal in the casing of the battery charger and the outer casing that encircles the batteries/cells in the portable charger. The requirement does not apply to the battery, the casing encircling the battery/cell itself, circuit/PCBs, wires or USB/charge ports.

The plastic or metal in the casing of the battery charger and the outer casing that encircles the batteries/cells in the portable charger must fulfil the following requirements:

[37] http://mst.dk/kemi/kemikalier/fokus-paa-saerlige-stoffer/
[38] https://www.umweltbundesamt.de/en/press/pressinformation/batteries-put-to-the-test-too-many-heavy-metals (visited May 2015).

Plastic:

- Plastic parts covering a surface > 200 mm² in the casing must be labelled in accordance with ISO 11469.
- The plastic may not be chlorinated plastic.
- Cadmium and lead must not be actively added to the plastic in the casing.
- Chloro-paraffins must not be actively added to the plastic in the casing.
- The following flame retardants must not be added to the plastic in the casing:
  a) Hexabromocyclodecane (HBCDD), tetrabromobisphenol A (TBBP-A) and tris(2-chloroethyl)phosphate (TCEP).
  b) Other halogenated organic flame retardants and flame retardants that have been given one or several of the following risk phrases may not be added:
     - H350
     - H350i
     - H340
     - H360D
     - H360F
     - H360Df
     - H360Fd

Metal:

The following metals may not be actively added to the casing in the battery charger and the outer casing that encircles the batteries/cells in the portable charger:

Lead (Pb), mercury (Hg), chromium VI (CrVI), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn,), copper (Cu) or nickel (Ni).

Exception: Steel is allowed to be used in the base panel that holds the USB/charge ports in portable chargers, but only if the steel is coated/laminated or covered with e.g. plastic.

✉ Documentation showing that the casing is labelled in accordance with ISO 11469.

✉ Declaration from the manufacturer of the battery charger or portable charger that the requirement is fulfilled. Appendix 2 may be used.

Background to requirement O3

In generation 5 of the criteria, the requirement of the plastic in the casing of the battery charger has been adjusted to include portable chargers. The requirement of flame retardants has also been adjusted so as to correspond to other Nordic Swan Ecolabel product groups containing electronic products.

The requirement of metal in the casing of the battery charger and the outer casing that encircles the batteries/cells in the portable charger is new in generation 5 of the criteria.

The requirement solely applies to the plastic and metal in the casing of the battery charger and the outer casing that encircles the batteries/cells of the portable charger. This is because the consumer only has direct contact with the outer casing. It is also difficult for the manufacturer to have full traceability of materials that are part of small plastic pieces and electronics.

The requirement does not apply to the battery, the casing encircling the cell itself, the circuit/PCB, wires or USB/charge ports, since some of these metals are essential in the circuit/PCB, wires, USB/charge ports, etc.

Plastic

Plastic parts covering a surface > 200 mm^2 in the casing must be labelled in accordance with ISO 11469. It is almost impossible to mark small pieces of plastic and therfore a limit of >200 mm^2 is set. The same limit exists in other Nordic Swan Ecolabelling criteria, e.g. PC and imaging products.

The presence of chlorine atoms in materials affords a number of technically desirable properties, but there are adverse environmental impacts coupled to the disposal of PVC plastics, as they usually contain additives with undesirable health effects. When PVC ends up in the waste stream for incineration, this effectively means more chlorine in the waste stream. Chlorine is a prerequisite for the formation of highly toxic dioxins in the flue gas, but since there are several other sources of chlorine than PVC, the increased incineration of PVC will not necessarily lead to an increased amount of dioxin, as chlorine is not the limiting factor for the formation of dioxins in incinerators[39][40]. The extra amount of PVC will, however, increase the formation of acidic gases and will consequently increase the need for gas cleaning with gas cleaning equipment.

Combustion of 1 kg of PVC produces up to 1.7 kg of salt in flue gas cleaning. In practice, this means that more waste is generated than the amount of waste that was sent into the incinerator. This is due to the neutralising process carried out in order to avoid hydrochloric acid being formed and creating a corrosive environment in the incinerator. Not all waste incineration facilities are able to incinerate PVC products in the Nordic region. Old fractions of PVC have a high probability of containing hazardous additives, such as lead and cadmium, creating residual materials that need to be taken care of. In the case of incinerators that cannot incinerate such PVC waste, the stream is usually landfilled. In the case of incinerators that can incinerate such PVC waste, the residual products (the fly ash and bottom slag) are treated specially; the fly ash is landfilled in special landfills, and the bottom slag is also landfilled, or used as a construction material for landfills.

PC/ABS is often used in electrical products because of its thermoplastic properties. PC/ABS (Polycarbonate/Acrylonitrile Butadiene Styrene) is a blend of PC and ABS providing unique combination of the high processability of ABS with the excellent mechanical properties, impact and heat resistance of PC. Flame retardant additives are commonly used in polymers where they can be either reactive flame-retardants, which are chemically built inside the polymer, or additive flame-retardants that are not covalently bound to it. If flame-retardants is added to the PC/ABC plastic these has to comply with the requirement.

[39] Hjelmar, 2002: Forbrænding af PVC: Påvirkning af massestrømmene gennem et forbrændingsanlæg. DHI – Institut for Vand og Miljø.
[40] http://www.esa.chalmers.se/education/I1/text_files/pvc.pdf (report from Chalmers University of Technology, Sweden).

Flame retardants

All electrical and electronic products involve a risk of fire. Various flame retardants are used to minimise this risk. The choice of flame retardants is determined by a number of factors, such as which material is to be flame proofed, the fire protection requirements and the price. Furthermore, the flame retardant may not impair the intended technical functions of the product.

The intention of flame retardants is to provide protection throughout a product's use phase.

This is why they are deliberately manufactured so as not to degrade easily, which means that these substances can be difficult to degrade when they emerge into the environment. Most attention has been paid to *brominated* flame retardants, partly because their presence has been detected in breastmilk and blood. Of the non-brominated flame retardants, the most common are metal compounds, organic phosphorus and nitrogen compounds, and inorganic salts.

There are approximately 70 brominated flame retardants on the market, and knowledge of their properties as being hazardous to health and the environment varies. The five brominated flame retardants which have been used most and for which a lot of knowledge exists are[41]:

- Pentabromodiphenyl ether
- Octabromodiphenyl ether
- Decabromodiphenyl ether
- Hexabromocyclododecane (HBCDD)
- Tetrabromobisphenol-A (TBBP-A)

The first three form part of the group of polybrominated diphenyl ethers (PBDEs). Due to the EU Directive on Restriction of Hazardous Substances (RoHS), polybrominated diphenyl ethers and polybrominated biphenyls (PBB) have been prohibited in new electrical and electronic devices since July 2006.

The Commission decided in October 2005 that the flame retardant decaBDE[42] would generally be exempted from the prohibition laid down in the RoHS Directive. On 1 April 2008, the European Court of Justice decided that decisions of the Commission on such exemptions are not valid. Consequently, decaBDE is also prohibited in electrical and electronic products as from 1 July 2008. Flame retardants incorporated later into the RoHS Directive were the brominated flame retardants HBCDD and TBBPA.

Sweden reported on the risk assessment of HBCDD within the EC's existing substance programme. The conclusions of the report are that this substance is persistent, bioaccumulative and very toxic to aquatic organisms, and may cause harmful long-term effects in the aquatic environment. In animal experiments, HBCDD has been proved to affect the liver and thyroid, and to be reprotoxic.

[41] Information from the Swedish Chemicals Agency website, sww.kemi.se (visited 28-10-2017).
[42] Pentabromodiphenyl, octabromodiphenyl and decabromodiphenyl ethers belong to the same chemical substances, polybrominated diphenyl ethers (abbreviated PBDE). These have different numbers of bromine atoms in their structures. All three are poorly degradable, persistent substances, while their bioaccumulation and toxicity differ.

The risk assessment of HBCDD is complete within the EU. HBCDD has been identified as a particularly hazardous substance, SVHC (Substance of Very High Concern), and it is included on the candidate list (REACH). HBCDD is also included in the authorisation list, Annex XIV, in REACH.

TBBP-A has also undergone risk assessment within the EU's existing substance programme. This substance is classified as very toxic to aquatic organisms and may cause harmful long-term effects in the aquatic environment. TBBP-A is considered to be poorly degradable and bioaccumulative. Alternatives to TBBP-A with flame retardant effects have been developed and are being used more widely.

TBBP-A is the most widely used brominated flame retardant in the world. It is used mostly in printed circuit boards. As it is chemically bound to the material in the printed circuit board, and hence is not spread so readily to the surrounding environment, the EU has deemed that it does not pose a risk to human health in this application. It is currently not possible to make printed circuit boards without TBBP-A, so that printed circuit boards are exempt from the prohibition of TBBP-A.

Chloroparaffins, which can also be used as flame retardants, are stable, poorly degradable compounds which may bioaccumulate in the environment. Highly-chlorinated short-chain and medium-chain chloroparaffins are very toxic to aquatic organisms and may cause harmful long-term effects in the aquatic environment. Highly-chlorinated short-chain chloroparaffins have been identified as particularly hazardous substances, SVHC, in REACH and are included on the candidate list. For this reason, Nordic Ecolabelling wishes to prohibit the use of these substances in plastic chargers for use with Nordic Swan Ecolabel rechargeable batteries or in portable chargers.

Table 6: Summary of flame retardants, their risks and usage restrictions.

Flame retardant	Rule	Risk assessment	Nordic Ecolabelling stipulation
Polybrominated biphenyls (PBB)	Banned in new electrical and electronic equipment since July 2006 under the RoHS Directive	PBB was the first brominated flame retardant that proved to be harmful. The substance has been well studied and as far as we know PBB is no longer made.	Must not be present
Polybrominated diphenyl ethers (PBDE)	Banned in new electrical and electronic equipment since July 2006 under the RoHS Directive (since July 2008 for decaBDE)	pentaBDE: persistent, harmful to health and the environment. POP substance (UNEP) octaBDE: endocrine disruptor, persistent and bioaccumulating. POP substance decaBDE: suspected to be harmful, but risk assessment is pending.	Must not be present
Hexabromocyclod odecane (HBCDD)	Use permitted	Classed as SVHC. Included on Candidate List.	Must not be present
Tetrabromobisphenol A (TBBP-A)	Use permitted	Highly toxic to aquatic organisms. May cause damaging long-term effects in an aquatic environment.	Must not be present

Against this background, particularly the credible risk assessment, the requirement of flame retardants has been adjusted so that it corresponds to other Nordic Swan Ecolabel product groups containing electronic products.

TCO-certified[43] have similar requirements for specific hazardous substances such as polybrominated biphenyls (PBB), polybrominated diphenyl ether (PBDE), and hexabromocyclododecane (HBCDD) in all components, including batteries.

Metal

A review of the market for portable chargers shows that there is great variety in the choice of materials and designs in the outer casing. In addition to plastic, metal is a preferred material.

The manufacture of the heavy metals zinc and nickel is associated with high energy consumption and emissions of environmentally harmful substances, which is why their use is not permitted in the casing of battery chargers and the outer casing that encircles the batteries/cells in the portable charger. It is therefore relevant to ensure that any metal used in the casing of battery chargers and the outer casing that encircles the batteries/cells in the portable charger is free of the heavy metals lead (Pb), mercury (Hg), chromium VI (CrVI), cadmium (Cd), cobalt (Co), antimony (Sb), zinc (Zn,), copper (Cu) and nickel (Ni).

Steel

The carbon content of steel is between 0.002% and 2.1% by weight for plain iron-carbon alloys. These values vary depending on the alloying elements such as manganese, chromium, nickel, iron, tungsten, carbon and so on[44]. Other materials are often added to the iron/carbon mixture to produce steel with desired properties. Stainless steel contains at least 11% chromium, often in combination with nickel, in order to resist corrosion. Some types of stainless steel, for example ferritic, are magnetic, while others, for example, austenite, are non-magnetic.

Nordic Ecolabelling recognizes the need for using steel/stainless steel in the base panel that holds the USB/charge ports in portable chargers for quality reasons. However, as mentioned a bow, steel contains different kinds of heavy metals, which besides being environmentally hazardous also poses a risk of developing allergy, e.g. nickel or chromium allergy. Portable chargers are product types that are in direct contact with the users hands and therefore poses a risk of exposure to allergenic metals. Nordic Ecolabelling has made an exception to the ban on the use of nine metals. Steel is allowed to be used in the base panel that holds the USB/charge ports in portable chargers, but only if the steel is coated/laminated or covered with e.g. plastic (avoiding direct skin contact).

[43] http://tcocertified.com/?s=all+in+on+PC (visited 6-11-2017).
[44] Ashby, Michael F. & Jones, David R. H. (1992) [1986]. Engineering Materials 2 ((edited edition) Oxford: Pergamon Press.

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 classifications: R20/22, H411 and H351. 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 most common 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.

O4 Battery charger, battery sizes

This requirement applies solely to chargers for rechargeable batteries of the following sizes: AAA: HR03, AA: HR6, C:HR14, D: HR20, 9V:HR 22.

If the rechargeable batteries are sold together with a charger, the charger must be suitable for use with a minimum of two battery sizes.

✉ Declaration from the licensee that the charger can be used for charging a minimum of two battery sizes. Appendix 2 may be used.

✉ A description/documentation of the charger confirming this must be attached.

Background to requirement O4

The requirement of the battery charger (battery sizes) remains unchanged in generation 5 of the criteria.

In order to ensure that consumers do not need to buy as many chargers as they have various battery sizes, thereby increasing the environmental impact as a consequence of increased charger production, Nordic Swan Ecolabelling's preference is that chargers that are sold together with ecolabelled rechargeable batteries should permit multiple battery sizes to be charged. As the present volume of chargers that charge three types of batteries is reduced – since few, if any, exist at all – this was changed in version 4.1 of the criteria to two battery sizes.

This requirement solely applies to chargers for rechargeable batteries for ordinary household batteries, size: AAA: HR03, AA: HR6, C:HR14, D: HR20, 9V:HR 22. Batteries for power tools (typically NiCd, NiMH and Li-ion) are normally not divided into the same battery sizes as ordinary household batteries, and are therefore not subject to the requirement. A battery for a power tool often comes with a charger of the relevant power tool. The charger can only handle one specific shape/size of battery, but the manufacturer of the power tool has ensured that the same shape/size of the battery/charger fits several of its power-tool products

5.3 Corporate Social Responsibility

O5 Sourcing of “conflict-free” minerals

The licensee must:

- Have a supply chain policy for responsible mineral sourcing that can be considered to cover tin, tantalum, tungsten, gold and cobalt. The policy must be both public and communicated to the supply chain.
- Have a process to identify smelters and refiners of tin, tantalum, tungsten, gold and cobalt.
- Be a part of an established multi-stakeholder program that works at supporting responsible sourcing programs for tin, tantalum, tungsten, gold and cobalt.

The background document contains recommendations (verification guidelines) to what can be included in the documentation of the three points.

✉ The most recent version of the public policy and a description of how it is communicated to the supply chain.

✉ A description of the licensees structured work on identifying risk areas in their supply chain.

✉ Proof of participation in an approved multi-stakeholder program.

Background to the requirement

This is a new requirement in generation 5 of the criteria. The European Commission has agreed on a framework to stop the financing of armed groups through trade in conflict minerals[45][46], after negotiations between the Commission, Council and Parliament. It aims for EU companies to source tin, tantalum, tungsten and gold responsibly. These minerals are typically used in everyday products such as mobile phones, electronic products, cars and jewellery.

The regulation will be enforced in 2021. Conflict minerals are often mined in conflict or high-risk areas such as the Democratic Republic of Congo (DRC) region, Afghanistan, Colombia, the Central African Republic and Myanmar[47]. In many cases, armed groups control mineral extraction activities in order to finance their operations[48]. This illicit trade contributes to violent conflicts and severe human rights violations.

Cobalt is primarily used in Lithium-ion and NiMH- batteries in the cathode chemistries and in battery cans (Nickel Cobalt Plated Steel). Cobalt is not on the list in the EU Regulation on conflict minerals. However, more than half of the cobalt on the world market is extracted in DRC under hazardous working conditions, where child labor is used, among other things[49][50]. No legal system in the world currently requires companies in the cobalt supply chain to carry out due diligence or disclose their efforts, despite limited legislation calling for disclosure of information on other minerals coming from the DRC and neighboring countries. However, with this new requirement Nordic Ecolabelling wish to affect the licensee to develop and support the development of a common understanding of supply chain due diligence in the cobalt supply chains.

The licensee's policy is an essential statement. It reflects the licensee´s commitment toward responsibly sourcing minerals and the expectations of their raw material suppliers regarding the use of these minerals.

Involvement in multi-company coordinated action that supports the development of responsible sourcing initiatives within the conflict-affected and high-risk areas is essential, since they help suppliers meet due diligence requirements, maintain trade and benefit local mining communities, whose livelihoods depend on a legitimate mining trade.

As documentation for the requirement, the licensee shall describe their due diligence activities along the supply chain for the five minerals identified.

Nordic Ecolabeling recommend that the supply chain policy for responsible minerals sourcing contains the following points:

---

[45] The EU Regulation on Conflict Minerals solely comprises tin, tantalum, tungsten and gold.
[46] http://www.consilium.europa.eu/en/press/press-releases/2016/06/16/conflict-minerals/# (visited 10-10-2017).
[47] Jaekel, T. "Far From Reality: How the EU Falls Short in Preventing the Illicit Trade of Conflict Minerals", Swedwatch, 2016.
[48] http://www.swedwatch.org/wp-content/uploads/2017/07/swedwatch_annual_progress_report_2016.pdf (visited 10-10-2017).
[49] Amnesty International, "This Is What We Die For, Human Rights Abuses in the Democratic Republic of the Congo Power the Global Trade in Cobalt", 2016.
[50] Nordic Ecolabelling (2017): Report on mining and traceability.

- That suppliers neither directly nor indirectly finance armed groups in conflict-affected regions.
- That suppliers neither tolerate nor contribute to human rights abuses that include forced labor, child labor and environmental degradation. This point is also included in the requirement O7 (working conditions).
- A commitment to supporting responsible sourcing from those regions in which specific mining operations may present risk.

Nordic Ecolabeling recommend that the describtion of the licensees structured work on identifying risk areas contains the following points:

- Identifying risk areas is a process that helps map the chain of custody of risk minerals down to the smelters and refiners within the supply chain. This is commonly done by a reporting template such as the “Conflict Mineral Reporting Template[51]” being systematically sent through the supply chain. This transfer of information facilitates the identification of high risk smelters and refiners.
- An list of smelters and refiners.

There are a number of initiatives to verify and trace minerals from mines through the supply chain:

- The OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas (“the Guidance”). Licence holders/brand owners require suppliers to disclose their sourcing origins for conflict minerals by using a questionnaire template such as the EICC “Conflict Minerals Reporting Template”, or similar, in order to prevent the potential use of conflict minerals.
- iTSCi - ITRI[52] represent tin producers and smelters. This programme is a supply chain initiative to verify and trace minerals from the mine to the smelter (traceability tagging). Although full membership is focused on upstream companies (Mining, Smelters, etc), an associate membership for downstream companies exists (manufacturers, etc,). Associate members contribute to the financing of the iTSCi programme and thereby stay informed on initiative activities and specific mining sites, while also supporting the development in Africa.
- The Conflict-Free Tin Initiative (CFTI): sources conflict-free tin from the South Kivu province of DRC that implements the ITRI Tin Supply Chain Initiative (iTSCi), and the due diligence and traceability system.
- The Public-Private Alliance for Responsible Minerals Trade[53] (PPA) is a multi-sector and multi-stakeholder initiative that provides funding and support for systems that trace and certify mineral supply chains in the DRC and Great Lakes Region.

[51] OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas[51]
[52] https://www.itri.co.uk/index.php?option=com_zoo&view=item&Itemid=191
[53] http://www.resolv.org/site-ppa/

- Other relevant in-region initiatives: initiatives not stated on the list, but which prove active commitment to an initiative aimed at increasing legitimately sourced minerals. Examples of other relevant initiatives that are approved:
  - Solutions for Hope (SfH); sources conflict-free tantalum from the Katanga province of DRC (incorporates the iTSCi process and CFS programme).
  - The Certified Trading Chains initiative (CTC) is a programme supported by the German government, which certifies mines to defined performance standards.
- Member of the EICC & GeSi Conflict-Free Sourcing Initiative (CFSI). Members contribute to a number of tools and resources, including the Conflict Minerals Reporting Template; supporting in-region sourcing schemes and the Conflict Free Smelter Programme (identification of Smelters and Refiners that source conflict-free minerals).
- Nordic Ecolabelling is aware of that currently no recognized due diligence program exist for cobalt, but several promising initiatives is on its way, e.g. https://www.sourceintelligence.com/cobalt-sourcing-due-diligence/[54]

Nordic Swan Ecolabelling requires the licensee to provide a copy of their conflict mineral policy. If the licensees use some of the aforementioned initiatives, this can be included in the documentation of the requirement.

O6 Sourcing of critical raw materials

The licensee must have a policy for the use of raw materials included in the EU's newest list of critical raw materials in batteries at the time of application. The EU 2017-list of critical raw materials can be found in appendix 3.

The policy must describe how the licensee works actively;

- to minimize and to phase out (in the long term) the use of critical raw materials in future.
- to recycle critical raw materials in the batteries.
- support recycling programs for collecting used batteries

✉ The licensee must submit a written policy that describes how the licensee work actively to phase out/recycle any critical raw materials in batteries, support recycling programs for collecting used batteries and minimizes the use of critical raw materials in the future.

Background to requirement O6

This is a new requirement in generation 5 of the criteria. The European Commission has listed 27 critical raw materials (CRMs) that are considered to be critical to our society and for well-being[55] (see appendix 3 in this document). The critical raw materials are chosen according to two important criteria: economic importance and access. The 27 critical raw materials are listed in table 7 below.

[54] https://www.sourceintelligence.com/cobalt-sourcing-due-diligence/ (visited May 2018)
[55] http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en (visited 5/11-2017).

Table 7: The European Commission´s list of critical raw materials (CRMs)

2017 CRMs			
Antimony	Fluorspar	LREEs*	Phosphorus
Baryte	Gallium	Magnesium	Scandium
Beryllium	Germanium	Natural graphite	Silicon metal
Bismuth	Hafnium	Natural rubber	Tantalum
Borate	Helium	Niobium	Tungsten
Cobalt	HREEs*	PGMs*	Vanadium
Coking coal	Indium	Phosphate rock	

*HREEs=heavy rare earth elements, LREEs=light rare earth elements, PGMs=platinum group metals

The assessment made by the EU shows that China is the most influential country in terms of global access to the 27 critical materials. The map below shows where in the world the 27 critical materials on the EU CRM list are available.

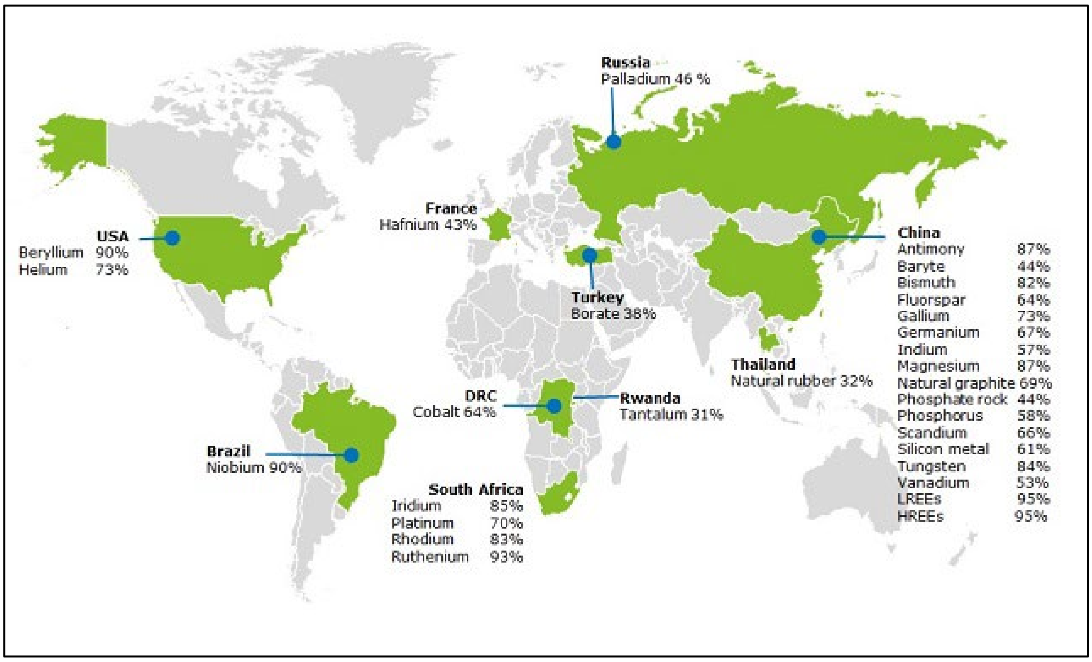


Figure 2: The major producers of the twenty EU-critical raw materials.

The economic aspects force battery producers to look for new chemical compounds, developing alternative battery technologies. The main reasons for this are: 1) to meet customers' expectations in terms of higher energy capacity and faster charging; and 2) to make the battery cheaper. Several of the 27 critical materials included on the EU list have e.g. very good conductive properties, supporting the customer's expectations in terms of a higher energy capacity. Cobalt, for example, is mainly used in Lithium-ion batteries for portable consumer electronics.

However, the market shows signs of gradually eliminating cobalt from cathode chemistries (to substitute cobalt in the battery content with nickel, manganese, and other materials[56]). Cobalt is the main contributor to the Li-ion battery price. Lithium is not among the 27 critical materials on the EU's list, but even this raw material is sourced from a narrow circle of areas: around 75% of lithium comes from the "Lithium Triangle": Argentina, Chile and Bolivia[57].

The list of raw materials produced by EU is based on the entire European market, not just the market for batteries. Therefore, some of the materials is not relevant for today's battery production, but it might change in the future. Nordic Ecolabel is aware that is not easy, simple or realistic to phase out some of the listed critical material in the nearest future. Therefore, the requirement is focusing on the license holder to address the concerns regarding the use of critical raw materials in the future. Nordic Ecolabelling requires the licence holders to address the concerns regarding the use of critical raw materials. In order to do so, the licensee must submit a written policy that describes how the licensee works actively:

- to phase out the use of critical raw materials in the long term
- to recycle any critical raw materials in the batteries
- support recycling programs for collecting used batteries
- minimize the use of critical raw materials in the future (in the long term).

O7 Working conditions

The licensee must have a written Code of Conduct that explains how the licensee ensures compliance with the following UN conventions and the UN Global Compact at component, battery, battery charger and portable charger suppliers:

- The UN Convention on the Rights of the Child, Article 32.
- The UN Declaration (61/295) on the Rights of Indigenous Peoples.

The UN's: Global Compact[58], which comprises the following ten principles:

1. Businesses should support and respect the protection of internationally proclaimed human rights.
2. Make sure that they are not complicit in human rights abuses.
3. Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining (ILO Conventions 87 and 98).
4. The elimination of all forms of forced and compulsory labour; (ILO Conventions 29 and 105).
5. The effective abolition of child labour (ILO Conventions 138 and 182).
6. the elimination of discrimination in respect of employment and occupation (ILO Conventions 100 and 111).
7. Businesses should support a precautionary approach to environmental challenges.
8. Undertake initiatives to promote greater environmental responsibility.

[56] Dmytro Kapotia: Ecolabelling Criteria development for rechargeable batteries in ICT products – Justifying a new generation of requirements to batteries based on state of the art in the sector, IIIEE Theses 2017:21.
[57] Nordic Ecolabelling (2017): Report on mining and traceability.
[58] http://www.unglobalcompact.org

9. Encourage the development and diffusion of environmentally friendly technologies.
10. Businesses should work against corruption in all its forms, including extortion and bribery.

The licensee must ensure that all suppliers are familiar with and comply with the Code of Conduct.

If components, batteries, battery chargers and portable chargers are produced in countries in which these conventions are incorporated as part of the requirements of the authorities, no further documentation will be required beyond the signed application form for a licence for Nordic Ecolabelling.

☒ Licensees must submit a written Code of Conduct that explains how the licensee ensures that its suppliers comply with the requirements of the UN conventions and the UN Global Compact.

☒ A description of how the licensee's Code of Conduct is communicated to all of its suppliers.

Background to requirement O7

The requirement concerning working conditions has been amended slightly, compared with generation 4. Generation 4 of the criteria required licensees to have a plan in place for compliance with the UN Global Compact[59] , of which the aim is to lay down international principles for human rights, labour, the environment and anti-corruption. Nordic Swan Ecolabelling has adopted a common requirement for working conditions which, in addition to compliance with the UN Global Compact, also includes compliance with the UN Convention on the Rights of the Child (Article 32) and the UN Declaration (61/295) on the Rights of Indigenous Peoples.

Nordic Swan Ecolabelling is aware that it may be difficult to ensure that the working environment of all suppliers in the Nordic Swan Ecolabel battery production chain is satisfactory. Nevertheless, Nordic Ecolabelling is convinced that as more component suppliers and battery producers are confronted with the requirement/signal from their customers that compliance with a Code of Conduct is required, the more likely it is to be achieved. Licensees must inform their suppliers about their Code of Conduct. However, the licensee is not required to guarantee that it will be complied with by its suppliers.

If component suppliers and battery producers operate in countries in which these conventions are incorporated as part of the authorities' requirements, no further documentation will be required beyond the signed application form for a licence for Nordic Swan Ecolabelling.

5.4 Packaging and information

Primary packaging: refers to the purchase packaging for the consumer, e.g. the packaging that holds four batteries or one portable charger, and which the consumer encounters in sales.

Secondary packaging: refers to the transport packaging and protects the packs of batteries and portable chargers during transport to stores and consumers.

[59] http://www.unglobalcompact.org

O8 Packaging

The total proportion of pre- and post-consumer* recycled material in the primary packaging for the batteries/portable charger must be at least 80% by weight.

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

The primary packaging must be designed in such a way that dismantling is possible for all individually parts for waste sorting (e.g. cardboard, paper, plastic, metal) without using any tools.

**Pre- and post-consumer material is defined in accordance with ISO 14021:*

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

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

✉ Description of the primary and secondary product packaging. Declaration from the manufacturer of the battery/portable charger or brand owner(s) showing that the requirement is fulfilled. Appendix 4 may be used.

✉ Documentation from packaging suppliers showing the proportion of post-consumer recycled material in their products.

✉ Statement from the manufacturer of the battery/portable charger showing that the total proportion of pre- and post-consumer recycled material in the primary packaging exceeds 80% weight. Appendix 4 may be used.

Background to requirement O8

The requirement to packaging has been adjusted to include portable chargers in generation 5 of the criteria.

The environmental impact of PVC is associated primarily with waste management, the use of additives, and dioxin emissions, for example in the production of PVC, plus the use of mercury in the production of chlorine. According to the report on "Hazardous substances in plastic materials"[60] published by the Norwegian Environment Agency in 2013, PVC may have over 50% plasticiser added, of which phthalates remain the most popular, since they are cheap and have solubility parameters that are very similar to the PVC polymer. PVC requires stabilisers to tolerate the temperatures needed to manufacture a PVC product (extrusion, injection moulding, etc). These stabilisers may be based on lead, metal mixtures (such as barium-zinc and calcium-zinc), tin or cadmium.

Overall, the environmental impact associated with the production, use and disposal of PVC is steadily declining, in part due to new knowledge and technical advances. However, there is every suggestion that problems associated with PVC remain. There is also inadequate control of PVC imported into the EU and the Nordic region from other parts of the world, which are not subject to the same restrictions.

---

[60] Norwegian Climate and Pollution Agency, Hazardous substances in plastic materials, Cowi, January 2013.

For Nordic Swan Ecolabel rechargeable batteries and portable chargers, there is therefore a ban on the use of PVC in the products and their packaging.

Nordic Ecolabelling has reviewed the proportion of recycled materials in the packaging of producers of Nordic Swan Ecolabel primary/rechargeable batteries and concluded that a figure of 80% for pre- and post-consumer recycled material in packaging is an ambitious, but attainable, level. The typical material in packaging is cardboard and PE plastic. An evaluation of primary packaging material used in portable charger banks shows that primarily the same materials as for batteries are used.

The requirement of at least 80% by weight for pre- and post-consumer recycled material applies to the total % by weight of the primary packaging.

The primary packaging must be designed in such a way that dismantling is possible for all individually parts for waste sorting (e.g. cardboard, paper, plastic, metal) without using any tools. The typical primary packaging for rechargeable batteries, battery chargers and portable chargers consist of cardboard/paper and plastic. The primary packaging must be designed so that it is easy to separate the individual material fractions for recycling.

5.5 Electrical testing

O9 Electrical testing

Nickel-metal hydride (NiMH) batteries and cells:

Battery capacity

The battery or cell capacity must be measured in accordance with paragraph 7.3.2 “Discharge performance at 20°C (rated capacity)” of IEC 61951-2:2017. The rated capacity (C) thereby determined must be at least as high as the nominal capacity (N) indicated on the battery and in the product documents.

The test must be carried out on a minimum of three batteries, in accordance with the sample size specified in IEC 61951-2:2017. All three tested batteries/cells must meet the requirements.

Endurance in cycles

The cell must be tested in accordance with paragraph 7.5.1 “Endurance in cycles” of IEC 61951-2:2017. The test must be carried out on a minimum of three batteries, in accordance with the sample size specified in IEC 61951-2:2017.

The total number of cycles obtained when the test is completed shall be ≥ 75% above the specific limit for cell types listed in paragraph 7.5.1 of IEC 61951-2. In table 8 below are listed examples of requirements for minimum number of cycles for cylindrical cells dimensionally interchangeable with primary batteries.

Table 8: Endurance in cycles for cylindrical cells dimensionally interchangeable with primary batteries.

Type of cell	Stated capacity	Total number of cycles
HR 03 AAA	< 800 mAh	≥ 350
HR 03 AAA	≥ 800 mAh	≥ 175
HR 06 AA	< 2100 mAh	≥ 350
HR 06 AA	≥ 2100 mAh	≥ 175
HR 14 C	-	≥ 350
HR 20 D	-	≥ 350

Leakage

During testing, no leakage may occur.

The requirements concerning test laboratories and test instructions for capacity and endurance in cycles are stated in Appendix 5.

Li-ion/LiP batteries and cells:

Battery capacity

The battery capacity must be measured in accordance with paragraph 7.3 “Discharge performance at 20°C (rated capacity)” of IEC 61960-3:2017. The rated capacity (C) thus determined must be at least as high as the nominal capacity (N) indicated on the battery and in the product documents.

The test must be carried out on a minimum of three batteries, in accordance with the sample size specified in IEC 61960-3:2017. All three tested batteries/cells must meet the requirements.

Endurance in cycles

The battery or cell must be tested in accordance with paragraph 7.6 “Endurance in cycles” of IEC 61960-3:2017. The test must be carried out on a minimum of three batteries, in accordance with the sample size specified in IEC 61960-3:2017.

The total number of cycles obtained when the test is completed shall be≥ 75% above the specific limit for cell types listed in cells dimensionally paragraph 7.6 of IEC 61960-3:2017.

In table 9 below are listed examples of requirements for minimum number of cycles for secondary lithium cells and batteries.

Table 9: Endurance in cycles at a rate of 0,2 I_tA

Parameter	Reference paragraph	Number of cycles - cells	Number of cycles - batteries
Endurance in cycles at a rate of 0,2 I_tA	7.6.2	≥ 700	≥ 525

In order to accelerate the test, the following alternative procedures may be carried out; “Endurance in cycles at a rate of 0,5 ItA (accelerated test)”. The test instructions are stated in appendix 5.

The tested cells/batteries must meet the requirements stated in table 10.

Table 10: Endurance in cycles at a rate of 0,5 I_tA (accelerated test

Parameter	Reference paragraph	Number of cycles - cells	Number of cycles - batteries
Endurance in cycles at a rate of 0,5 I_tA (accelerated)	7.6.3	60% C_5 Ah	60% C_5 Ah

Leakage

During testing, no leakage may occur.

The requirements concerning test laboratories and test instructions for capacity and endurance in cycles are stated in Appendix 5.

☒ Complete test report, including information that no leakage has occurred during testing.

☒ Documentation showing that the test laboratory fulfil the requirement stated in Appendix 5.

Background to requirement O9

The requirement of electrical testing has been adjusted in generation 5 of the criteria, and a new requirement of leakage during testing has been added to the requirement.

The RPS analysis shows that the use phase is very important in an LCA perspective. A short-lived use stage for batteries results in a higher environmental impact. The lifespan of rechargeable batteries is significantly prolonged, since they can be used repeatedly – due to numerous charging and discharging cycles. This results in potential resource savings and decreasing waste, especially when compared with primary batteries[61].

<ins>The battery capacity</ins> is equivalent to the quantity of electricity (in ampere hours, Ah) declared by the manufacturer of the battery. Ah is the discharge current a battery can deliver over time.

The requirement of battery capacity for both NiMH batteries and Li-ion/LiP batteries is unchanged compared to the generation 4 criteria. Capacity testing is performed in order to ensure that the capacity of the batteries/cells corresponds to the actual discharge ability of fresh batteries/cells. The battery capacity for NiMH batteries shall be measured in accordance with paragraph 7.3.2 "Discharge performance at 20°C (rated capacity)" of IEC 61951-2:2017. The battery capacity for Li-ion/LiP batteries shall be measured in accordance with paragraph 7.3 "Discharge performance at 20°C (rated capacity) of IEC 61960-3:2017. For all batteries/cells the rated capacity (C) thus determined must be at least as high as the nominal capacity (N) indicated on the battery and in the product documents.

<ins>Endurance in cycles</ins>

Life cycle testing is performed in order to ensure that the batteries/cells have an appropriate number of charge/discharge cycles, offering an acceptable level of performance. There is a strong connection between the number of charge-discharge cycles and energy consumption, since shorter cycles lead to uncertainty concerning energy consumption during the use phase, thereby generating a greater impact on the battery. The improved cycle performance is the way to reduce the environmental impact[62].

NiMH cell/batteries: The requirement to endurance in cycle test has been adjusted according to the new IEC 61951-2:2017 standard, but the requirement to number of total cycles obtained in test has been adjusted. All types of NiMH cells must achieve a minimum of 75% number of circles above the specific limit for cell types listed in paragraph 7.5.1 of IEC 61951-2. E.g. an AAA battery (< 800mAh) must obtain at least 200 cycles according to IEC 61951-2:2017, while the requirement in Nordic Ecolabelling is at least 350 cycles.

---

[61] Yu, Y., Chen, B., Huang, K., Wang, X., & Wang, D. (2014). Environmental Impact Assessment and End-of-Life Treatment Policy Analysis for Li-Ion Batteries and Ni-MH Batteries. International Journal of Environmental Research and Public Health.
[62] Yu, Y., Chen, B., Huang, K., Wang, X., & Wang, D. (2014). Environmental Impact Assessment and End-of-Life Treatment Policy Analysis for Li-Ion Batteries and Ni-MH Batteries. International Journal of Environmental Research and Public Health.

Each test must include at least three batteries of each size and brand model. All three tested batteries/cells must meet the requirements.

Criteria generation 4 sets requirements for a specific number of charge cycles (between 300-500 cycles) within a specific period of 4 hours for different types of batteries. The requirement to endurance in cycles is however build around the old test in the IEC 61951-2:2003 standard (withdrawn) and therefore no longer relevant. E.g. The number of test circles, charge and discharge rates has been changed compared to the 2017 standard.

Li-ion/LiP batteries: The requirement to endurance in cycle test has been adjusted according to the new IEC 61960-3:2017 standard. All types of Lithium cells must achieve a minimum of 75% number of circles above the specific limit for cell types listed in paragraph 7.6.1 of IEC 61960-3:2017. This means that lithium cells must comply with a minimum of 700 number of cycles, while lithium batteries must comply with minimum 525 number of cycles. The requirement for lithium batteries is at the same requirement level as in the Blue Angel's criteria for mobile phones (RAL-UZ 106)[63]. In RAL-UZ 106 the Lithium battery must achieve a minimum of 500 full charge cycles.

Nordic Ecolabelling also accepts an alternative procedures for accelerated test according to "Endurance in cycles at a rate of 0,5 *I*tA (accelerated test)", 7.6.3 of IEC 61960-3:2017. The requirement is adapted to the minimum of 700 and 525 cycles.

Each test must include at least three batteries of each size and brand model. All three tested batteries/cells must meet the requirements.

Criteria generation 4 sets requirements for minimum 800 document charged cycles. The requirement to endurance in cycles is also build around the old test in the IEC 61960-3:2003 standard (withdrawn) and therefore no longer relevant.

A new requirement has been added that no leakage may occur doing testing. This requirement is the same as in the Koran Eco-label standard (EL764:2012) for batteries[64]. The requirement must ensure that the batteries meet high safety and quality requirements.

O10 Charged battery

The requirement solely applies to Nickel-metal hydride (NiMH batteries) and cells.

The battery must be fully charged when it leaves the production site.

Fully charged is defined as minimum 70% electrical stored capacity (SOC)

✉ A declaration confirming that the battery is fully charged when leaving the production site for delivery to customers/brand owners. Appendix 1 may be used.

[63] https://www.blauer-engel.de/en/products/home-living/mobiltelefone-135 (visited 6/11-2017).
[64] http://el.keiti.re.kr/enservice/enindex.do (visited 6/11-2017).

Background to requirement 010

The new requirement for fully charged Nickel-metal hydride (NiMH batteries) supports the trend in the market towards fully charged batteries (when purchased in the store), which are thereby ready to be used when taken out of the packaging. One of the reasons for the consumer's purchase of primary batteries is that these are ready for use right away. This requirement ensures that consumers have the same experience when purchasing rechargeable batteries. Fully charged is here defined as minimum 70% electrical stored capacity (SOC). This term refers to the percentage of the electrical stored capacity in a rechargeable cell or battery that is available for use. The limit of minimum 70% SOC is based on stakeholder input.

The international regulations applicable to air shipments of lithium batteries have changed[65]. Effective from 1 April 2016, all lithium ion batteries shipped by air without equipment must not exceed 30% SOC because of safety reasons. Although it does not apply if the batteries are transported by sea or road transport Nordic Ecolabelling has exempted Lithium batteries entirely from the requirement.

5.6 Safety

O11 Battery safety

The requirement applies to both batteries and batteries used in portable chargers.

NiMH batteries/cells:

The battery must fulfil the testing requirements in IEC 62133-1.

Lithium-ion/lithium polymer batteries/cells:

The batteries must fulfil the testing requirements in IEC 62133-2.

The requirements concerning test laboratories are stated in Appendix 5.

🖂 Complete test report.
🖂 Documentation showing that the test laboratory fulfil the requirement stated in Appendix 5.

Background to requirement O11

Batteries are an essential part of many of today's high-technology products. Together with the continuous development of battery technology and the increasing perfecting of manufacturing techniques, batteries are used more widely as a "green power" enabler for all kinds of applications, whether they are high-performance Lithium-ion (Li-ion) or the more conventional nickel metal hydride cell (NiMH). This is a new requirement in generation 5 of the criteria.

The use of Lithium-ion batteries/cells (Li-ion/Li polymer) has grown exponentially in recent years, see chapter 2. While Li-ion and NiMH batteries are widely used in consumer electronics, many users are not aware that these batteries are considered to be hazardous, especially due to the risk of overheating, fire and short circuiting.

When a Li-ion battery is being charged or is charging another device, it can overheat and cause a fire hazard.

[65] http://www.iata.org/whatwedo/cargo/dgr/Pages/lithium-batteries.aspx (visited 23.

This is referred to as thermal runaway. Even when not in use or being charged, the battery's internal temperature may rise, yielding destructive and dangerous results. The fires that result from these batteries are difficult to extinguish. Even when the number of batteries in use is compared to a relatively low failure rate, the degree of danger presented by a failure is the reason for strict standards and regulations. Well-publicised incidents have resulted in numerous product safety recalls[66].

The main hazards for both NiMH batteries and Li-ion batteries:
- Explosion
- Fire
- Overheating and fire danger

Primary causes:
- Improper charging
- Improper use
- Overheating
- Electrical abuse
    - Over-current
    - Over-voltage
    - Over-temperature
- Other abuses
    - Internal short-circuiting
    - Transportation
    - Miscellaneous

The batteries must fulfil the testing requirements in IEC 62133: "Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications – Part 1 regarding Nickel systems and Part 2: Lithium systems", as amended.

O12 Portable charger safety

Portable chargers (power banks) must be tested and comply with IEC 62368-1 (*Information technology equipment – Safety – Part 1: General requirements).*

The requirements concerning testing laboratories are stated in Appendix 5.

✉ Complete test report.
✉ Documentation showing that the test laboratory fulfil the requirement stated in Appendix 5.

Background to requirement O12

This is a new requirement in generation 5 of the criteria. Besides safety requirements for the battery itself listed in requirement O10, the portable charger must be tested and comply with IEC 62368-1 (Information technology equipment – Safety – Part 1: General requirements). The standard ensures that the portable charger is tested in order to reduce the risk of injury or damage due to the following: electric shock, energy-related hazards, fire, heat-related hazards, mechanical hazards, radiation and chemical hazards.

[66] http://www.rechargebatteries.org/knowledge-base/batteries/lithium-ion-cell-lilon/ (visited 10/10-2017).

O13 Quality of the battery charger

If the rechargeable batteries are sold together with a charger, the charger must fulfil the following requirements:

Testing of the charger: the quality of the charger must be tested by a testing laboratory that is impartial and fulfils the general requirements applicable to the test institutions provided for in the "Analysis laboratory/test institution" chapter in appendix 5.

C = The maximum capacity (expressed as mAh) specified on the batteries that the charger is sold with.

The reference charge is defined as a constant charge at 1C, cut off at $-\Delta V = 5$ mV/cell.

Discharge to the cut-off requirement of 1 V/cell.

The resting time is set at 20 minutes between each cycle of charge/discharge and discharge/charge.

Condition of battery and termination of charged capacity at 7 cycles:

Cycle 1	Residual Discharge	C/5
Cycle 2-5	Conditioning	1C
Cycle 6	Determining reference charge	1C
Cycle 7	Charging of battery in charger	

Cycles 1-6 to be performed in equipment for testing rechargeable batteries.

The charging phase is registered in cycles 6 and 7 to determine the charged capacity for the reference charger and the test charger.

After 7 cycles the average trickle charge and no-load current for the charger are measured.

The measurement must produce the following results:

- The charger must automatically stop charging when the battery is fully charged. Fully charged is defined as a reference charge with a cut-off of $-\Delta V = 5$ mV + 10%.
- The maximum trickle charge current must on average be < C/20, based on the lowest battery capacity that the charger is recommended to charge by the dealer.
- The maximum no-load current must on average be < C/50, based on the lowest battery capacity that the charger is recommended to charge by the dealer.

The requirements concerning test laboratories are stated in Appendix 5.

✉ Complete test report.
✉ Documentation showing that the test laboratory fulfil the requirement stated in Appendix 5.

Background to requirement O13

The requirement of the quality of the battery charger remains unchanged in generation 5 of the criteria.

The charger is a supplementary product to the main product, i.e. the rechargeable batteries. Battery producers purchase chargers from subcontractors, which limits their ability to manage, control or maintain an overview of the design and quality of the chargers. Even so, they should have scope to impose requirements concerning the charger if it is to be sold in a combination pack with the rechargeable batteries.

There are considerable differences in quality between chargers and, accordingly, in the amount of current they use and the amount of wear they cause for the batteries during charging[67].

A study of 40 different battery chargers on sale in the Nordic market found major differences in the energy consumption of the individual chargers[68]. This affects not only the environmental impact of the charger itself, but also the environmental profile of the rechargeable batteries, since this will be linked to the properties of the charger.

O14 Consumer information on the battery and portable charger

Battery:

The battery must be marked in accordance with IEC 61951-2 (NiMH) or IEC 61960-3 (Lithium).

The batteries must carry a clear indication of their capacity, in accordance with the requirements applicable to capacity labelling provided for in the EU's Battery Directive 2006/66/EC and regulation (EU) 1103/2010 on the capacity marking of portable rechargeable batteries.

"Clear indication" means that the capacity labelling shall be expressed in terms of a unit (mAh) and that other numerical markings on the battery must not be such that the customer is likely to be misled into thinking that they represent the capacity labelling.

Use of the Nordic Swan Ecolabel according to "guidelines for using the Nordic Swan Ecolabel"[69].

Use of the Nordic Swan Ecolabel on rechargeable batteries sold/marked together with electrical appliances, e.g. cordless power tools: The Nordic Swan Ecolabel must be used in a way so there is no doubt that the Nordic Swan Ecolabel applies solely to the batteries and not to the electrical appliances or to other elements of the package.

Portable charger:

Portable chargers must be supplied with the following safety information:

a) Minimum instructions for use as specified below:
   - The portable charger (power bank) will generate heat when charging. Always charge in a well-ventilated area. Do not charge under pillows, blankets or on flammable surfaces.
   - Keep the portable charger away from heat sources, direct sunlight, combustible gas, humidity, water or other liquids.
   - Do not dismantle, open, microwave, incinerate, paint or insert foreign objects into the portable charger.
   - Do not subject the power bank to mechanical shock such as crushing, bending, puncturing or shredding. Avoid dropping or placing heavy objects on the portable charger.
   - Do not short-circuit the portable charger or store it in a receptacle where it may be short-circuited by other metallic or conductive objects.
   - Do not operate the portable charger if it has been wet or otherwise damaged, so as to avoid electric shock, explosion and/or injury. Contact the dealer or authorised agent.

67 Forbrukerrapporten 07/2004.
68 Henrik V Ebne, Forbrugerrapporten 07/2004 "Plugg og lad".
69 http://www.nordic-ecolabel.org/certification/graphical-guidelines/ (visited March 2018)

- o Portable charger usage by children should be supervised.
- o Please read the operating instructions (including charging instructions and information on the minimum and maximum operating temperatures) supplied with this portable charger.

b) Instructions on how to charge the portable charger.
c) Information on the minimum and maximum operating temperatures for the portable charger.

☒ A sample of the information provided on the battery.
☒ Rechargeable batteries sold/marked together with electrical appliances: A sample of the battery in combination with the electrical appliances, showing that the use and placement of the logo assure that there is no doubt that the Nordic Swan Ecolabel applies solely to the battery.
☒ A sample of the safety information supplied with the portable charger.

Background to requirement O14

The requirement to consumer information/marking on batteries has been adjusted in generation 5 of the criteria. Batteries (battery packs) must be marked in accordance with IEC 61951-2 (NiMH) or IEC 61960 (Lithium). There are also new requirements for the information on portable chargers (power banks).

Both the IEC 61951-2 (NiMH) and IEC 61960 (Lithium) standards specify minimum information requirements for the battery, such as; rated capacity, nominal voltage, date on manufacture, etc. With this new requirement, Nordic Swan Ecolabelling ensures that the batteries are marked with relevant and accepted information for consumers.

The EU's Battery Directive 2006/66/EC provides for rechargeable batteries to be labelled with their capacity in mAh. Regulation (EU) 1103/2010 governs the capacity-marking requirements for portable rechargeable batteries, including specific requirements related to their minimum size and location. The capacity label must include both the numeral and its units. The capacity label is a marking that must appear on either the battery label, the battery casing and/or the packaging.

However, the Sagentia Catella Report[70] notes that there are examples of this labelling "drowning" in other numerical values specified on the battery, which might be misinterpreted as representing the capacity of the battery. By imposing the requirement that the capacity must be clearly marked, Nordic Ecolabelling is seeking to ensure that the customer receives thorough information enabling him or her to purchase the right type of battery for their needs.

The marked for power- and garden tools is going towards electrical appliance systems, all powered by one battery system. When rechargeable batteries are sold in combination packs together with an electrical application, there is a risk that consumer perceives that the entire product (electrical application + rechargeable battery) is Nordic Swan Ecolabel.

[70] Annika Ahlberg Tidblad, Sagentia Catella, 11 July 2008, "Nordic Ecolabelling criteria for rechargeable batteries".

Therefore, the Nordic Swan Ecolabel must be used in a way so there is no doubt that that the Nordic Swan Ecolabel applies solely to the batteries and not to the electrical appliances or to other elements of the package.

If a Swan-labelled battery is sold as an individual item (accessories/parts for, electrical appliances), the Nordic Swan Ecolabel logo can be used on the product and outer packaging.

As written under requirements O10 and O11 (battery and portable charger safety) portable chargers are considered to be hazardous, due to the risk of overheating, fire and short-circuiting. Nordic Swan Ecolabel has therefore listed some minimum consumer safety instructions/information requirements that must be provided together with the portable charger. There is a strong connection between the Depth of Discharge (DoD) and the battery capacity retention of a Li-ion battery: deep DoD results in a shorter lifespan. Moreover, if the battery is constantly influenced by high voltage and temperature changes, this will enhance the degradation processes and aging. By following the basic recommendations for battery charging and the conditions for its use, it is possible to preserve the initial battery capacity, thereby extending the battery lifespan and product integrity.

O15 Recyclable design of the portable charger

The portable charger must be designed in such a way that dismantling is possible. The requirement consists of the following individual requirements:

- A qualified professional, working alone, must be able to dismantle the product.
- It must be possible to separate the substances, preparations and components listed in ANNEX VII of the WEEE Directive (2012/19/EU).
- It must be possible to remove the secondary batteries/cells for recycling purposes.
- The battery/cell chemicals must be prevented from leaking during the removal.

✉ Declaration from the manufacturer of the portable charger showing that the requirements are met. Appendix 2 may be used.

Background to requirement O15

This is a new requirement in generation 5 of the criteria. Besides safety and consumer information requirements for the portable charger itself listed in requirements O12 and O14, the portable charger must be designed to make recycling easier.

As stated under O12 and O14, portable chargers are considered hazardous, due to the risk of overheating, fire and short-circuiting. Therefore, portable chargers are not recommended to be dismantled or opened by the consumer (O14). In a life cycle perspective, however, it is essential to recycle the batteries and other materials in the product.

According to the Battery Directive (2006/66/EC), article 11, it should be possible, when needed, to remove batteries from appliances without delay or difficulty, and at a reasonable cost, using the instructions provided.

Article 11 solely applies to electrical or electronic equipment (EEE), as defined by Article 3(11) of the Battery Directive (2006/66/EC), i.e. any EEE as defined by Directive 2012/19/EU (WEEE Directive). Portable chargers are part of the WEEE Directive.

Article 11 of the Directive, as amended in 2013, contains a number of requirements in this respect. Its main objective is to ensure the removal of waste batteries and accumulators, thereby facilitating their recycling, and, by replacing them, extending the lifetime of the appliances in which they are used. This means that it should be possible to remove them without delay or difficulty and at a reasonable cost, when needed, using the instructions provided. If batteries or accumulators cannot be readily removed by end-users, it should always be possible to have them removed by “qualified professionals” (e.g. electronic repair shops or services) “independent of the manufacturer”.

The qualified professionals should be able to remove the batteries/cells from the portable charger without the risk of exposure to chemicals in the batteries/cells. Therefore, the battery and portable charger must be designed so as to ensure that there is no leakage from the battery/cell when removed.

The manufacturer of the portable charger must declare that the requirements are met.

5.7 Requirements of the authorities and quality requirements

To ensure that Nordic Ecolabelling requirements are fulfilled, the following procedures must be implemented.

O16 Responsible person and organisation

The company shall appoint individuals who are responsible for ensuring the fulfilment of the Nordic Ecolabelling requirements, for marketing and for finance, as well as a contact person for communication with Nordic Ecolabelling.

✉ Organisational chart showing who is responsible for the above.

O17 Documentation

The licensee must archive the documentation that is sent in with the application, or in a similar way maintain information in the Nordic Ecolabelling data system.

🔍 To be checked on site as necessary.

O18 Quality of rechargeable batteries and portable charger

The licensee must guarantee that the quality of the Nordic Swan Ecolabel product does not deteriorate during the term of validity of the licence.

✉ Procedures for archiving claims and, where necessary, dealing with claims and complaints regarding the quality of the Nordic Swan Ecolabel rechargeable batteries and portable chargers.

🔍 The claims archive is checked on site.

O19 Planned changes

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

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

O20 Unplanned nonconformities

Unplanned nonconformities that have a bearing on Nordic Ecolabelling requirements must be reported to Nordic Ecolabelling in writing and journalised.

🖂 Procedures detailing how unplanned nonconformities are handled.

O21 Traceability

The licensee must be able to trace the Nordic Swan Ecolabel rechargeable batteries and portable chargers in production.

🖂 Description of/procedures for the fulfilment of the requirement.

O22 Legislation and regulations

The licensee shall ensure compliance with all applicable local laws and provisions at all production facilities for the Nordic Swan Ecolabel product, e.g. with regard to safety, the working environment, environmental legislation and site-specific terms/permits.

🖂 Duly signed application form.

Background to the requirements

Requirements O16 to O22 are general quality assurance requirements to ensure that the Nordic Swan Ecolabel products fulfil the requirements and comply with legislation and regulations, so 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.

5.8 Areas without requirements

The following proposal for requirements was discussed and analysed during the review process. However, for the reasons explained below, Nordic Ecolabelling has decided that it will not be included in the criteria generation 5.

Nanotechnology

In the current criteria, generation 4, it is a requirement that nanoparticles may only be present in the electrodes (anode/cathode material) for the purpose of increasing the energy efficiency of the batteries. If nanoparticles are used in the batteries, the producer must publish information on how batteries containing nanoparticles are to be handled by battery recycling firms. This requirement is removed in the new generation 5.

An evaluation of the requirement concerning nanoparticles shows that the documentation of the requirement is very unclear. It is not described how the manufacturer should test potential increased capacity. General experience from dialogue/working with applications suggests that lithium batteries mix nanomaterials (from tests) into the electrolyte, which causes the nanoparticles to bind into the battery, and they are thus not released. In this case the requirement to publish information on nanoparticles for recycling is not relevant.

A review of Nordic Swan Ecolabel licences and dialogue with other producers of batteries shows that nano is only potentially relevant for the production of electrodes in lithium batteries, not NiHM batteries. Nobody uses nanotechnology in their batteries today, primarily due to lack of technology development and the price.

An LCA study[71] from 2013 concludes "that despite progress in research on and development of a single-walled carbon nanotube (SWCNT) anode technology and other nanomaterials, aimed to greatly expand the horizon of Li-ion battery energy, the energy intensity of SWCNT manufacturing process itself is too high, and usually diminishes the value of achieved improvement due to associated costs".

UPS systems

Nordic Swan Ecolabelling examined the possibility of involving uninterruptible power supply (UPS) systems in the product definition in generation 5 of the criteria. An UPS is a device that allows a computer to keep running for at least a short time when the primary power source is lost. A UPS contains a battery that "kicks in" when the device senses a loss of power from the primary source. The most common battery used today in UPS systems is lead batteries, but the trend is towards the use of Li-ion batteries.

UPS systems are not part of the European Union's Battery Directive 2006/66/EC, given that they are not portable. UPS comes with several technologies and therefore also consists of several electrical components. On this basis, Nordic Swan Ecolabelling has decided not to include UPS systems in this criteria document.

6 Changes compared to the previous version

The following are the key amendments compared with the previous generation 4.

Proposed requirement generation 5	Requirement generation 4	Same requirement	Change	New requirement	Comment
Products that may be Nordic Swan Ecolabel	Products that may be Nordic Swan Ecolabel		*		The product definition has been expanded to include portable chargers.
O1			*		Description of the product has been adjusted to include portable chargers. New requirement stating that batteries must be fully charged when they leave the production site.
O2			*		The limited content of arsenic has been removed.
O3	O5		*	*	The requirement for plastic in the casing in battery chargers has been adjusted to also include metals and casing in portable chargers.
O4	O6	*			Battery charger, battery sizes.
O5				*	New requirement: sourcing of conflict-free minerals.

[71] Amarakoon, S., Smith, J., & Segal, B. (2013): Application of LCA to Nanoscale Technology: Li-ion Batteries for Electric Vehicles. The U.S. Environmental Protection Agency's (EPA) Design for the Environment (DfE) Program.

O6				*	New requirement: sourcing of critical raw materials.
O7	O11		*		The requirement concerning working conditions has been amended slightly to also include the UN convention (art 32) and declaration (61/295).
O8	O7 and O8	*			The requirements for packaging have been merged into one requirement.
O9	O12		*		The requirement for electrical testing of the capacity and endurance in cycles of the battery has been adjusted regarding numbers of charged cycles. New requirement: during testing, no leakage may occur.
O10				*	New requirement: the NiMH battery must be fully charged when it leaves the production site.
O11				*	Battery safety NiMH must comply with IEC 62133-1 and Li-ion with IEC 62133-2.
O12				*	Portable charger safety Portable chargers must comply with IEC 60950-1:2005+A1:2009+A2:2013 part 1.
O13	O13	*			Quality of the battery charger.
O14	O10		*		Batteries must now be marked in accordance with IEC 61951-2 and IEC 61960. New safety information requirements for portable chargers.
O15				*	New requirement. The portable charger must be designed in such a way that dismantling is possible.
O16-O22	O14-21	*			Quality and official requirements.
Removed requirements					
	O3				Nanotechnology.
	O4				Information on batteries containing nanoparticles.
	O9				Collection systems for packaging and batteries.

History of the criteria

Nordic Ecolabelling adopted version 5.0 of the criteria for rechargeable batteries and portable chargers on 15 June 2018. The criteria are valid until 30 June 2023.

On 26 November 2019, the definition of "fully charged" in requirement O10 was changed from at least 85% to 70%. Also, it has been clarified that you can use both pre- and post-consumer recycled material in the primary packaging (O8). Finally, the requirement for sourcing of conflict-free minerals (O5) and critical raw materials (O6) has been aligned with the same wording as Nordic Swan Ecolabelling criteria for 001 primary batteries.

Nordic Ecolabelling decided on the 30 November 2021 to prolong the validity of the criteria with 18 months to the 31 December 2024. The new version is 5.2.

Nordic Ecolabelling decided on the 14 May 2024 to prolong the validity of the criteria with 14 months to the 28 February 2026. The new version is 5.3.

Nordic Ecolabelling decided on the 7 January 2025 to prolong the validity of the criteria with 12 months until 28 February 2027. The new version is 5.4.

New criteria

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

- The product definition – new types of rechargeable batteries.
- The possibility of imposing further requirements on constituent substances, particularly heavy metals and the use of solvents in the production of batteries.
- The possibility of imposing requirements concerning the sourcing of conflict-free minerals and critical raw materials.
- Requirements for electrical testing – battery capacity, durability of the battery and portable charger.
- Requirements concerning safety.

Terms and definitions

Term	Explanation or definition
AC input	Direct integrated plug to the power outlet. Designed for "stationary" charging and therefore not portable.
Conflict-affected and high-risk areas	Areas in a state of armed conflict, fragile post-conflict areas, as well as areas witnessing weak or non-existing governance and security, such as failed states. In these areas, there are often widespread and systematic violations of international law, including human rights abuses.
DC output	Direct current (DC) is the unidirectional flow of an electrical charge. A battery is a good example of a DC power supply.
DoD	Depth of Discharge.
EEE	Electrical and Electronic Equipment.
Li-ion	Lithium-ion.

mAh or Ah	Milliamp hours or amp hours: the amount of power expected over time. The higher the number, the greater the capacity. This is the electrical charge (current) that passes through a specific circuit in one hour.
NiMH	Nickel-metal hydride battery.
OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas	For more information: http://www.oecd.org/corporate/mne/mining.htm
PCB	Printed circuit board.
Primary packaging	Refers to the purchase packaging for the consumer, e.g. the packaging that holds 4 batteries or one portable charger, and what the consumer encounters in sales.
Secondary packaging	Refers to the transport packaging and protects the packs of batteries and portable chargers during transport to stores and consumers.
SLI batteries	Batteries used for vehicle starting, lighting and ignition systems.
SOC	SOC, short for electrical stored capacity in a rechargeable cell or battery,
SWCNT	Single-walled carbon nanotube.
UPS	Uninterruptible power supply (UPS) systems.
USB ports	A USB port is a standard cable connection interface for e.g. personal computers and consumer electronics devices. They can also supply electric power across the cable to devices that require it.
WEEE	Waste Electrical and Electronic Equipment.
Wh-Watt hours	A measure of electrical energy equivalent to power consumption of one watt for one hour. A simple way to determine the current delivered by the power bank is to divide the watts by the voltage rating of the device. Electrical power is measured in watts and power equals the voltage multiplied by the current (amp).

Appendix 1 European legislation

Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE) was recast on 24 July 2012 as Directive 2012/19/EU[72]

The Directive implements the principle of “extended producer responsibility” whereby electrical and electronic product manufacturers are responsible for the costs of collection, treatment, recovery and disposal of their own products, and hence for preventing such object products from entering municipal waste collection systems.

Furthermore, the Directive states that member states should encourage the design and production of electrical and electronic equipment that facilitates reuse, recycling and other forms of recovery of such waste in order to reduce it. Producers should not, through specific design features or manufacturing processes, prevent WEEE from being reused, unless such specific design features or manufacturing processes present overriding advantages, for example with regard to the protection of the environment and/or safety requirements.

The WEEE Directive applies to all electrical and electronic equipment, as listed in the categories below, which is dependent on electrical current or electromagnetic fields in order to work properly, and equipment for the generation, transfer and measurement of such currents and fields, designed for use with a voltage rating not exceeding 1000V for AC and 1500V for DC, provided that the equipment concerned is not part of another type of equipment that does not fall within the scope of the Directive (Annex I (covering the period from 14 August 2012 to 14 August 2018, of the WEEE Directive)):

- Large household appliances
- Small household appliances
- IT and telecommunications equipment
- Consumer equipment
- Lighting equipment
- Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
- Toys, leisure and sports equipment
- Medical devices (with the exception of all implanted and infected products)
- Monitoring and control instruments
- Automatic dispensers

From 15 August 2018, the WEEE Directive will apply to products covered by the categories outlined in Annex III of the Directive:

- Temperature exchange equipment
- Screens, monitors, and equipment containing screens having a surface greater than 100 cm^2
- Lamps

[72] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:197:0038:0071:en:PDF

- Large equipment (any external dimension greater than 50 cm), including, but not limited to:

  Household appliances; IT and telecommunication equipment; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electrical currents. This category does not include equipment included in categories 1 to 3.

- Small equipment (no external dimension greater than 50 cm), including, but not limited to:

  Household appliances; consumer equipment; luminaires; equipment reproducing sound or images, musical equipment; electrical and electronic tools; toys, leisure and sports equipment; medical devices; monitoring and control instruments; automatic dispensers; equipment for the generation of electric currents. This category does not include the equipment included in categories 1 to 3 and 6.

- Small IT and telecommunication equipment (no external dimension greater than 50 cm).

Directive 2002/95/EC on Restrictions of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment[73] (RoHS)

This Directive restricts the use of hazardous substances in electrical and electronic equipment, for the protection of human health. As from 1 July 2006, new products should not contain lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBBs) and polybrominated diphenyl ethers (PBDEs)[74]. This Directive covers electrical and electronic equipment as defined in the WEEE Directive. There are exemptions for some of these materials when used in certain products.

Batteries used within portable chargers are classed as hazardous waste[75].

1.4.1.3 Directive 2006/66/EC on batteries and accumulators and waste batteries and accumulators[76]

The Directive aims to reduce the impact on the environment of the manufacture, distribution, use, disposal and recovery of batteries (primary-single use, and secondary battery cells which are rechargeable, accumulators). The Directive introduces measures to prohibit the marketing of some batteries containing hazardous substances. It contains measures for establishing schemes aiming at a high level of collection and recycling of batteries with quantified collection and recycling targets.

73 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:201:0054:0057:EN:PDF
74 http://ec.europa.eu/environment/waste/rohs_eee/events_rohs1_en.htm
75 http://www.greenit.net/downloads/GreenIT-EnvIssues-Batteries.pdf
76 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:266:0001:0014:en:PDF

The Directive sets out minimum rules for producer responsibility and provisions with regard to the labelling of batteries and their removability from equipment.

The EU Battery Directive is under revision[77]. Continuously. The task is to minimise waste and to maintain material flows within the economy for as long as possible, in order to achieve economic, social and environmental benefits. Of special interest is finding economic and strategic incentives for material recovery. Preliminary Recommendations from the working group so far:

- Definitions of Portable/Automotive/Industrial: no change.
- Definitions of Re-use and Second use: to be added, explaining the impact on Extended Producer Responsibility (EPR) and definition of "producer".
- Placing on the Market (POM) definition/ harmonisation in transposition
- If needed, replace calculation for collection rate by "available for collection".
- Recycling efficiency: no change.
- Reporting (general): keep it simple, harmonise, improve data quality.
- Quality treatment of waste batteries in the event of export: "equivalent conditions" allowing the export of waste batteries as described in a certification scheme.
- Labelling and marking: coordination with the IEC standard is ongoing.

Registration, Evaluation, Authorisation and Restriction of Chemical substances (REACH) Regulation (EC) 1907/2006[78]

The REACH Regulation came into force on 1 June 2007 and deals with the Registration, Evaluation, Authorisation and restriction of Chemical substances. The aim of REACH is to improve the protection of human health and the environment through better and earlier identification of the intrinsic properties of chemical substances. At the same time, REACH aims to enhance the innovation and competitiveness of the EU chemicals industry.

REACH was introduced because many thousands of chemicals are used in the EU, some in very large quantities, but the risks to human health and to the environment from many of these are not widely understood. REACH contact information this by making manufacturers and importers of chemicals responsible for producing data to define the hazards and risks from around 30,000 substances that are manufactured or imported in quantities of one tonne or more per year within the EU[79].

Manufacturers are required to register the details of the properties of their chemical substances on a central database, which is run by the European Chemicals Agency in Helsinki. The Regulation also requires the most dangerous chemicals to be progressively replaced as suitable alternatives are developed.

77 http://www.prba.org/wp-content/uploads/9.1-EU-Batteries-Directive-Review.pdf (visited 2/5-2017)
78 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=oj:l:2006:396:0001:0849:en:pdf
79 http://www.element14.com/community/community/legislation/reach?CMP=KNC-EULEGREACH&s_kwcid=TC|21070|reach%20regulation||S||8299726988

Appendix 2 Design and materials used in batteries

Lithium-ion batteries

A Lithium-ion battery can be produced with several different combinations of lithium-based cathode and anode materials. There are a few electrode (anode and cathode) materials that currently dominate battery production. It is common to use a mix of cobalt, nickel and manganese oxides together with the lithium as the cathode, but it is also possible to use an iron phosphate[80]. This is coupled with an anode, most commonly graphite. It is, however, possible to combine the cathodes with other anodes, such as the lithium-based lithium titanate. Table 11 below gives an overview of the most common cathode materials used today, while table12 contains the anode choices[81].

Table 11: The table presents an overview of the most common battery cathode chemistries and their inherent advantages and disadvantages.

Cathode material	Abbr.	Use	Advantages	Disadvantages
$LiCoO_2$ Lithium cobalt oxide	LCO	Mainly in small-scale electronics	Performance, well understood	Safety, uses nickel and cobalt
$LiNi_{0.33}Mn_{0.33}Co_{0.33}O_2$ Lithium manganese cobalt oxide	NMC (333)	Common in EVs	Better safety and performance than LCO	Cost, nickel and cobalt
$LiFePO_4$ Lithium iron phosphate	LFP	High power option, potential choice for EVs	Excellent power, lifetime and safety, abundant materials	Low energy density
$LiMn_2O_4$ Lithium manganese oxide	LMO	Historically used in EVS, but now less common	Cheap, abundant, high power	Lifetime, low capacity means low energy density
$LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$ Lithium nickel cobalt aluminium oxide	NCA	Used in some EVs	High capacity and voltage, high power	Safety, cost, uses nickel and cobalt

When it comes to anode materials, there are fewer choices. Most common is to use a graphite anode, and this choice is by far the most common anode used in combination with the cathodes in the above table 11. A lithium-based alternative – lithium titanium oxide – is also possible. Table 12 shows the advantages and disadvantages of each type.

Table 12: The table presents an overview of the most common battery anode chemistries and their inherent advantages and disadvantages.

Anode material	Abbr.	Use	Advantages	Disadvantages
Graphite	Gr	Most common choice in EVs	Decent lifetime, well understood, abundant (because synthetic graphite can be used)	Inefficiency due to SEI formation
$Li_4Ti_5O_{12}$ Lithium titanium oxide	LTO	Possible to use in EVs	Excellent power and life cycle	Lower voltage means less energy, cost

[80] https://www.teknologisk.dk/ydelser/videncenter-for-batterier/teknologier/36314,2 (visited 14-11-2017).
[81] Romare M, Dahllhöf L. (2017): The Life Cycle Energy. Consumption and Greenhouse Gas Emissions from Lithium-Ion Batteries. A Study with Focus on Current Technology. IVL Swedish Environmental Research Institute.

Material content of Lithium-ion batteries

The relative weight of different pack components can help to give an understanding of the importance of different parts. Additionally, this can help to identify why the components contribute to the life cycle to different extents. In table 13 below, the typical composition of a pack is presented[82].

Table 13: The typical relative weight of different pack components is shown. The cell contributes a large part of the weight, but the pack supporting material also has an impact because it is often made from steel.

Cell component	Wt% of total battery pack
The active material in the cathode	20%
The active material in the anode	10%
Separator	1-3%
Aluminium substrate (cathode)	2-3%
Copper substrate (anode)	8-13%
Electrolyte	9-12%
Battery management system	3%
Cooling	4%
Packaging	30%

In this case, the packing contains the supporting material in the pack, often made of steel, or possibly aluminium. The choice of material for the casing naturally affects its relative contribution to the weight. The cells are the largest part of the pack and in total, the components in the pack contribute roughly 60% of the entire weight of the battery.

A German test study from 2013[83] which examined around 300 batteries, taken from stores, discovered that Li-ion batteries were in compliance with the EU Battery Directive, since the content of heavy metals was far lower than is allowed. Overall, together with alkaline manganese batteries, they had the lowest content of heavy metals.

Another study from 2013[84] conducted research into three types of Li-ion batteries and their metallic content. The test discovered that the following metals are present in high quantities:

- Aluminium (ranging from 51,800 to 341,000 mg/kg);
- Cobalt (58,000 to 278,000 mg/kg);
- Copper (54,100 to 152,000 mg/kg);
- Lithium (9,800 to 37,200 mg/kg).

[82] Romare M, Dahllhöf L. (2017): The Life Cycle Energy. Consumption and. Greenhouse Gas Emissions from Lithium-Ion Batteries. A Study with Focus on Current Technology. IVL Swedish Environmental Research Institute.
[83] https://www.umweltbundesamt.de/en/press/pressinformation/batteries-put-to-the-test-too-many-heavy-metals (visited May 2015).
[84] Kang, D. H., Chen, M., & Ogunseitan, O. A. (2013). Potential Environmental and Human Health Impacts of Rechargeable Lithium Batteries in Electronic Waste. Environmental Science & Technology.

In overall terms, these four metals represent up to 97% of all metals in the Li-ion battery content: lithium and cobalt are used for the production of cathodes; copper and aluminium – as current conductors. There are also barium, chromium, silver, thallium, vanadium, zinc, and lead, but their content is significantly lower. The analysis did not detect antimony, arsenic, beryllium, cadmium, mercury, molybdenum, and selenium in any of the Li-ion batteries analysed.

The same study also applied the Toxicity Characteristics Leaching Procedure (TCLP) to determine the metal content of discarded Li-ion batteries. The results of the assessments demonstrated:

- For all applied methods, cobalt, copper, and nickel contributed most to the total hazard potential.
- Except only three methods, where cobalt accounted for moderate hazard potential contribution, and it is often a main contributor to the total hazard potential.
- Copper demonstrated a mostly large to medium relative contribution to the total potential across all methods; exception – a minimal contribution to the human toxicity potential (HTP) from emission to water.
- Nickel is not the main contributor to any of the listed categories; but it is a nontrivial contributor to the total potential for all methods: from minimal to medium (the total HTP for the TRACI method), but across all methods.

Based on the simulated landfill situation whereby Co, Cu, Ni, and Pb would leach out in amounts that exceed allowable concentrations, the study demonstrates that this would negatively influence both the environment and human health, especially in regions that do not establish well-functioning waste collection, sorting and recycling infrastructure.

Appendix 3 List of critical raw materials[85]

Raw materials	Main global producers (average 2010-2014)	Main importers to the EU (average 2010-2014)	Import reliance rate*	Substitution indexes EI/SR**	End-of-life recycling input rate***
Antimony	China 87% Vietnam 11%	China 90% Vietnam 4%	100%	0.91/0,93	28%
Baryte	China 44% India 18% Morocco 10%	China 53% Morocco 37% Turkey 7%	80%	0,93/0,94	1%
Beryllium	USA 90% China 8%	n/a	n/a[86]	0.99/0,99	0%
Bismuth	China 82% Mexico 11% Japan 7%	China 84%	100%	0,96/0,94	1%
Borate	Turkey 38% USA 23% Argentina 12%	Turkey 98%	100%	1,0/1,0	0%
Cobalt	DRC 64% China 5% Canada 5%	Russia 91% DRC 7%	32%	1,0/1,0	0%
Coking coal	China 54% Australia 15% USA 7% Russia 7%	USA 39% Australia 36% Russia 9% Canada 8%	63%	0,92/0,92	0%
Fluorspar (Fluorite)	China 64% Mexico 16% Mongolia 5%	Mexico 38% China 17% South Africa 15% Namibia 12% Kenya 9%	70%	0.98/0,97	1%
Gallium[87]	China 85% Germany 7% Kazakhstan 5%	China 83% USA 11% Ukraine 9% South Korea 8%	34%	0,95/0,96	0%
Germanium	China 67% Finland 11% Canada 9% USA 9%	Chine 60% Russia 17% USA 16%	64%	1,0/1,0	2%
Hafnium	France 43% USA 41% Ukraine 8% Russia 8%	Canada 67% China 33%	9%	0,93/0,97	1%

[85] EU list of 27 CRMs was published in the communication on the list of critical raw materials 2017: http://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_en

[86] The EU import reliance cannot be calculated for the beryllium, as there is no production and trade for beryllium ores and concentrates in the EU.

[87] Gallium is a by-product; the best available data refer to production capacity, not to production as such.

Helium	USA 73% Qatar 12% Algeria 10%	USA 53% Algeria 29% Qatar 8% Russia 8%	96%	0,94/0,96	1%
Indium	China 57% South Korea 15% Japan 10%	China 41% Kazakhstan 19% South Korea11% Hong Kong 8%	0%	0,94/0,97	0%
Magnesium	China 87% USA 5%	China 94%	100%	0,91/0,91	9%
Natural graphite	China 69% India 12% Brazil 8%	China 63% Brazil 13% Norway 7%	99%	0,95/0,97	3%
Natural rubber	Thailand 32% Indonesia 26% Vietnam 8% India 8%	Indonesia 32% Malaysia 20% Thailand 17% Ivory Coast 12%	100%	0,92/0,92	1%
Niobium	Brazil 90% Canada 10%	Brazil 71% Canada 13%	100%	0,91/0,94	0,3%
Phosphate rock	China 44% Morocco 13% USA 13%	Morocco 31% Russia 18% Syria 12% Algeria 12%	88%	1,0/1,0	17%
Phosphorus	China 58% Vietnam 19% Kazakhstan 13% USA 11%	Kazakhstan 77% China 14% Vietnam 8%	100%	0,91/0,91	0%
Scandium	China 66% Russia 26% Ukraine 7%	Russia 67% Kazakhstan 33%	100%	0,91/0,95	0%
Silicon metal	China 61% Brazil 9% Norway 7% USA 6% France 5%	Norway 35% Brazil 18% China 18%	64%	0,99/0,99	0%
Tantalum[88]	Rwanda 31% DRC 19% Brazil 14%	Nigeria 81% Rwanda 14% China 5%	100%	0,94/0,95	1%
Tungsten[89]	China 84% Russia 4%	Russia 84% Bolivia 5% Vietnam 5%	44%	0,94/0,97	42%

[88] Tantalum is covered by the Conflict Minerals Regulation (Regulation (EU) 2017/821) establishing a Union system for supply chain due diligence to curtail opportunities for armed groups and security forces to trade in tin, tantalum and tungsten, and their ores, and gold.
[89] Tungsten is covered by the Conflict Minerals Regulation (Regulation (EU) 2017/821) establishing a Union system for supply chain due diligence to curtail opportunities for armed groups and security forces to trade in tin, tantalum and tungsten, and their ores, and gold.

Vanadium	China 53% South Africa 25% Russia 20%	Russia 71% China 13% South Africa	84%	0,91/0,94	44%
Platinum Group Metals	South Africa 83% -Iridium, platinum, rhodium, ruthenium	Switzerland 34% South Africa 31%	99,6%	0,93/0,98	14%
	Russia 46% -palladium	USA 21% Russia 8%			
Heavy Rare Earth Elements	China 95%	China 40% USA 34% Russia 25%	100%	0,96/0,89	8%
Light Rare Earth Elements	China 95%	China 40% USA 34% Russia 25%	100%	0,90/0,93	3%

Appendix 4 Analysis and testing laboratories

Testing of quality specifications must be performed by laboratories, which are accredited to the current standard and fulfil the general requirements in the standard EN ISO/IEC 17025 or have official GLP status. A non-accredited laboratory may perform tests if the laboratory has applied for accreditation according to the current testing method, but has not yet been granted approval, or if accreditation is not available for the technical specification or proposed standard. In such case, the laboratory must prove that it is an independent, competent laboratory.

The manufacturer's analysis laboratory/test procedure may be approved for analysis and testing if:

- Sampling and analysis are monitored by the authorities; or
- The manufacturer's quality assurance system covers analyses and sampling and is certified to ISO 9001; or
- The manufacturer can demonstrate agreement between a first-time test conducted at the manufacturer's own laboratory, and testing carried out in parallel at an independent test institute, and the manufacturer takes samples in accordance with a fixed sampling schedule.

Determination of battery endurance in cycles for NiMH batteries and cells

Preparation of the test

1. Determination of the rated capacity (C) in accordance with IEC 61951-2, paragraph 7.3.2 "Discharge performance at 20°C (rated capacity)" at an ambient temperature of 20 °C.
2. Determination or specification of the nominal capacity (N).
3. Prior to endurance in cycle test, the cell shall be discharged at a constant current of 0,2 I_tA, to a final voltage of 1,0 V.

Performance of the tests

1. Charge and discharge currents, ambient temperature and the respective periods of rest must be carried out in accordance with IEC 61951-2, paragraph 7.5.1 "Endurance in cycles".
2. The tests must carried out on a minimum of three batteries, in accordance with the sample size specified in IEC 61951-2. Each test must include at least three batteries of each size and brand model. The highest capacity value specified on the cell must be used for the purposes of testing.
3. All three batteries must meet the requirements listed therein.

Determination of endurance in cycles for Li-ion/LiP batteries and cells

Preparation of the test

1. Determination of the rated capacity (C) in accordance with IEC 61960-3, paragraph 7.3.1 "Discharge performance at 20°C (rated capacity)" at an ambient temperature of 20°C.
2. Determination or specification of the nominal capacity (N).
3. Prior to charging , the cell or battery shall be discharged at 20 °C ± 5° C at a constant current of 0,2 I_tA, down to a specified final voltage.

Performance of the tests

1. Charge and discharge currents, ambient temperature and the respective periods of rest must be carried out in accordance with IEC 61960-3, paragraph 7.6.2 "Endurance in cycles at a rate of 0.2 I_t A".
2. The tests must be performed on a minimum of three batteries in accordance with the sample size specified in IEC 61960-3. Each test must include at least 3 batteries of each size and brand model. The highest capacity value specified on the cell must be used for the purposes of testing
3. All three batteries must meet the requirements listed therein.

Endurance in cycles at a rate of 0,5 I_tA (accelerated test procedure)

In order to accelerate the test, the following alternative procedures may be carried out as an alternative to above test "Endurance in cycles at a rate of 0.2 I_t A".

Table 14

Cycle number [a]	Charge	Stand in charged condition h	Discharge
A: 700 or B: 525	Method declared by the manufacturer	0 to 1	0,5 I_tA to final voltage
[a] A: for cell, B: for batteries.			

The remaining capacity measured according to step 1 to step 3 of paragraph 7.3.1 "Discharge performance at 20°C" when the test is completed shall be no less than the requirement stated in table 15.

Table 15

Parameter	Reference paragraph	Amount of cycles - cells	Amount of cycles - batteries
Endurance in cycles (accelerated)	7.6.3	60% C_5 Ah	60% C_5 Ah