About Nordic ecolabelled

Printing companies, printed matter, envelopes and other converted paper products

Version 5.0

Background for ecolabelling

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Nordic Ecolabelling

Nordic ecolabelled printing companies, printed matter, envelopes and converted paper products – Background for ecolabelling
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Abbreviations used in the criteria and background documents

AOX	Adsorbable Organic Halogen
BAT	Best Available Technology
BREF	BAT Reference Document
CLP	Classification, Labelling and Packaging
CO_2	Carbon dioxide
CTP	Computer to Plate
ECB	European Chemical Bureau
EF	European Communities
EMAS	Eco Management and Audit Scheme
EN	European Norm
EU	The European Union
FSC	Forest Stewardship Council
GA	Grafisk Arbejdsgiverforening (The Graphic Association of Denmark)
INGEDE	Internationale Forschungsgemeiscchaft Deinking-Technik (International Association of the De-inking Industry)
IPPC	Integrated Polution Prevention and Control
IPU	Institut for Produktudvikling, Danmarks Tekniske Universitet (The Institute for Product Development at the Technical University of Denmark)
ISO	International Standardisation Organisation
LCA	Life Cycle Assessment
NO_x	Nitrogen Oxides
PBT	Persistent Bioaccumulative Toxic
PVC	Polyvinyl chloride
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RPS	Relevance, Potential and Controlability
SETAC	Society of Environmental Toxicology and Chemistry
SFS	Svensk Författningssamling (Swedish Code of Statutes)
SIS	Swedish Standards Institute
SO_2	Sulphur Dioxide
UMIP	Udvikling af Miljøvenlige Industriprodukter (EDIP Environmental Design of Industrial Products)
VOC	Volatile Organic Compound
vPvB	Very persistent, very bioaccumulative

1 Summary

This background document contains a short description of the product group and its impact on health and the environment, overview of the market and the background to the requirements imposed in the fifth generation of the printing criteria. In addition, a quantitative overview of the environmental effects achieved and quantitative and qualitative assessments of the consequences of the criteria for the environment have been compiled.

The main problems for the environment and health associated with the life cycles of printing companies and printed matter are the high level of raw material consumption in the form of paper and board, high energy consumption and consumption of chemicals, waste generation and emissions of pollutants to the air and emissions of hazardous substances in waste water, which impose a burden on treatment plants and the aquatic environment.

The requirements address these problems from the perspective of the environmental targets defined in Nordic Ecolabelling's Environmental Philosophy. Requirements are also justified from the perspective of the potential environmental gains that might be achieved by ecolabelling printing companies and printed matter as well as the possibilities for verifying and documenting the requirements.

Printing companies that apply the most commonly used printing methods for printing on paper are encompassed by the criteria for printing companies and printed matter. Hence, the requirements restrict the use of chemicals that have harmful effects on health and the environment and promote the use of renewable resources. The requirements also promote the use of printing inks, varnishes and adhesives that do not give rise to problems in the recycling process.

Printing companies that use large quantities of paper produced at lower level of energy consumption and reduced emissions of pollutants than other paper are rewarded. The same applies to printing companies that have minimised waste quantities and printing companies that keep their energy consumption and waste paper at a low level.

Some of the main differences between criteria versions 4 and 5 are that the functional unit has been changed from the number of tonnes of paper purchased to tonnes of product. In addition, the overall points score has been tightened up considerably and there are new stricter requirements for the environmental profiles of inspected and ecolabelled paper. An energy parameter covering the overall energy consumption of the printing company has been introduced and the chemical requirements have been made stricter in that the list of particularly problematical substances has been extended considerably. In addition, the criteria applying to envelopes have been included in the printing company criteria to the effect that, for instance, envelope production now has its own points limit in the points system.

The amendments relative to the most recent version of the criteria for printing companies can be seen in Section 7 and the main changes are summarised in Section **Fejl! Henvisningskilde ikke fundet.**.

2 Introduction

Nordic Ecolabelling utilises well-known life cycle assessments and also conducts assessments of relevance, potential and controllability (RPC). The RPC assessment is described in Nordic Ecolabelling's Environmental Philosophy.

The requirements are, inter alia, based on eight of the environmental targets in Nordic Ecolabelling's Environmental Philosophy that are of particular relevance to the life cycle of printing:

- Climate change
- Acidification
- Photochemical ozone formation
- Water pollution and eutrophication
- Emissions of environmental toxins and heavy metals
- Emissions and effects of substances harmful to health
- Waste formation
- Biodiversity reduction
- Over-consumption of non-renewable resources.

In addition to these environmental targets, the Environmental Philosophy specifies a number of means of realising the vision of sustainability, for example by means of increased efficiency in resource consumption.

3 Environmental effects achieved

The criteria for the ecolabelling of printing companies have had a significant impact on the Nordic market and a large number of licences have been issued. Licences have also been issued in other European countries, including the Baltic states. As a consequence of the large number of licences issued, demand for inspected/ecolabelled paper and chemicals with a low environmental impact has increased. It is difficult to quantify the environmental effects that have accompanied this development, but it can be assumed that the large number of ecolabelled printing companies has given rise to improvements in other industries as well, such as paper and chemical production.

Environmental gains can generally be divided into qualitative and quantitative gains. According to the evaluation of the printing house criteria in 2008/09 for two parameters, the quantitative environmental gains have, overall, been at the level predicted by forecasts in connection with the adoption of the fourth generation of criteria in 2005. (Nordic Ecolabelling 2010a):

- In the case of paper, the saving calculated as a reduction in polluted waste water is calculated as a reduction in COD (Chemical Oxygen Demand) related to eutrophication and algal bloom. Here the reduction is in line with the forecast of 6,000 tonnes per annum relative to the situation that prevailed in the period prior to the adoption of the current criteria in 2005.
- In the case of waste paper the environmental gain appears to be of the order of 2,900 tonnes p.a. for all printing companies, which is in line with the forecast. This figure can be compared with the average annual paper consumption for licenced sheet fed offset printers being 941 tonnes, and for newspaper printers 14,315 tonnes (data from February 2009). In reality, the gain may be even greater since this figure was based on a market share for Nordic ecolabelled printing companies of 10 % of the overall market.
- For VOC the reduction is calculated at 9-12% compared with the early 90s. The forecast predicted a reduction of 26% (based on a reduction in alcohol consumption). This forecast was uncertain because of uncertainties attaching to the data and assumptions applied.

Figure: Algal bloom in the Baltic Sea, 11 July 2005 © NASA/SMHI.

As regards chemicals, almost 1,000 printing inks were reviewed, and approximately 3 % of these did not meet requirements – most because of their hazard

classification. A few printing inks do not meet the requirement regarding the EDTA content, which is restricted on the grounds that it is a particularly problematical substance.

One very important qualitative effect is that the Nordic ecolabel criteria function as a benchmark for how to proceed to get on board the "environmental bus". The Nordic ecolabel also demonstrates what technical solutions can feasibly be implemented. Accordingly, many operators use the criteria as a source of inspiration without submitting themselves or their products for ecolabelling. This applies in the case of printers, suppliers of paper, chemicals, pre-press and finishing services, as well as waste handlers. The criteria can also be used as a tool for setting objectives when establishing environmental management systems such as EMAS and ISO 14001 (Johnsen et al 2006) and as a source of inspiration in public and private sector procurement.

A survey commission by the UK Government and completed in 2008 considered nine areas, including 22-28 ecolabelled standards/criteria throughout the world in the area of paper pulp, paper and printing – but with a definite focus on paper (Environment, Food and Rural Affairs 2008). The conclusion was that FSC, Nordic Swan (*ecolabel*) and Environmental Choice New Zealand function as "*international best practice*" in the area of paper. The report also concluded that FSC must be viewed as a raw material label in that it does not take account of other environmental effects associated with paper production. The Nordic ecolabel is a standard that covers most environmental aspects.

4 Basic facts about the criteria

Eligible products

The product group encompasses printing companies, printed matter, envelopes and other converted paper products, such as post-it notes and note pads. This means that in addition to offering their customers Nordic ecolabelled printed matter, printing companies may also use the Nordic ecolabel in marketing themselves, thereby signalling their environmental commitment to the outside world.

In the criteria, Nordic Ecolabelling's definitions of printing companies and printed matter have been added. There are also definitions of other terms, such as envelopes.

Few end users use the Nordic Ecolabel as a guideline to environmentally friendly purchasing in the area of printed matter. Instead, a book, for example, will be purchased on the basis of its contents. On the other hand, the Nordic ecolabel represents a *signal value* indicating that in choosing a Nordic ecolabelled printing company the publisher/sender/author took environmental considerations into account.

One example of an exception to this would be envelopes, notepads and leaflets where the printed content, if any, cannot be linked specifically to a sender/ pub-

lisher. In the case of these products the Nordic ecolabel provides guidelines on environmentally friendly purchases.

To systematise the description of which products are eligible for labelling, Nordic Ecolabelling uses a division into 13 categories of all types of printed matter devised by Frank Romano, Professor Emeritus at Rochester Institute of Technology, USA. Nordic Ecolabelling has removed wall paper from the list in order to avoid confusion as these products often consist of plastic coated paper.

The purpose of Nordic ecolabelling

A consultants' report commissioned by Nordic Ecolabelling in 1995 concluded that potential existed for improvement, particularly within film production in the form of a reduction in emissions to the sewage system, minimising alcohol consumption in dampening solution, reducing and substituting washing agents and promoting the use of vegetable printing ink (Brodin et al).

Moreover, Nordic Ecolabelling concluded that consumers wanted more environmentally friendly printed matter. This also meant that there was a need for guidance for designers and orderers of printed matter so as to enable them to locate printing companies that were capable of supplying printed matter of this type. Furthermore, the industry also had a reputation for heavy chemical use and a poor working environment. The large number of operators in the market also meant that the prospects for a market-based system such as ecolabelling were good.

The purpose of ecolabelling printed matter was initially formulated in the revision of the third generation of the criteria. This definition was taken from the Danish Board of Technology's report on the use of chemicals in industry and represents a form of sustainability target, although without the social dimension. The criteria are designed to promote the development of printing companies that:

- use renewable rather than non-renewable resources
- do not use substances that are harmful to health or the environment
- involve better utilisation of resources
- contribute as little as possible to pollution and waste generation.

Since the criteria are revised every few years, each version of the criteria document represents a step in the direction of achieving the above goals. The goal of the current version of the criteria is to achieve further environmental gains, particularly in connection with energy-saving measures and continuing a low level of administration.

Version and validity of the criteria

The current criteria were adopted in December 2011 and will remain in force for five years. They were extended twice by a total of three years until 2013 and remained valid for just over seven years.

In 1990-91, Nordic Ecolabelling conducted a study into the graphic industry in the Nordic countries. In 1991, it was decided on the basis of the findings of this

study that ecolabelling criteria should be drawn up for converted fine paper products. In connection with the first revision of these criteria, they were extended to include printed products. When the document was adopted in 1996, the name of the product group was changed to Printed Matter.

The 1996 printed matter criteria have been evaluated three times with subsequent revisions. The evaluations took place in 1997/98, in 2000/01 and, most recently, in 2008/09. The first two revisions built on the concept defined in the first version of the criteria.

Since it is natural for many printing companies to use the Nordic ecolabel to attract customers, the obvious approach in connection with the 2003 revision was to permit entire printing companies to be ecolabelled and not solely the printed output. This option gives buyers of printed matter a guarantee that the printing company represents a good choice in environmental terms, even if the Nordic ecolabel does not appear on the printed matter itself.

The main reason for this change was to give buyers of printed matter better guidance when it came to choosing a printing company. In addition the following reasons apply:

- Printed matter is purchased by print buyers – not many end users buy a printed document because it is ecolabelled.
- The Nordic ecolabel must send a credible signal to buyers of printed matter at the moment of purchase.
- There will be less administration – the process is easier if several of the requirements involve the printing company as a whole (e.g. waste paper) rather than the individual item of printed matter (e.g. cutting waste).
- The environmental gains are bigger when several of the requirements relate to the printing company as a whole rather than to a few printed documents.

The revision of the third generation of the criteria focused considerably on reducing the overall administration required of licence holders. This was achieved by reducing the number of requirements and by locating the points system at “printer level” rather than at “order level”. In addition, the electronic guide to application in the Nordic Print Portal was compiled.

The portal has a direct connection to Nordic Ecolabelling’s database of assessed chemicals and paper and the electronic application aid enables printing companies to submit the entire application electronically.

The Nordic market

The 2003 evaluation estimated the value of the printed matter market in the Nordic countries to be just under 10 billion euro. This figure is based on Nordic industry statistics and includes the sale of anything printed on paper except envelopes, packaging goods, labels and publishing.

At the European level approximately two-thirds of printers have fewer than 10 employees, 15% have between 10 and 19 employees, 15% between 20 and 99, whereas only 2% have more than 100 employees (European IPPC Bureau 2005).

In addition to the graphic industry there is also an industry for converted paper products, such as envelopes, note pads and notebooks, and one for packaging production. Furthermore, some printers specialise in printing on other printing materials than paper.

The 2009 market survey showed a complex product group consisting of a number of different products and services, which are marketed in very different ways. Typically, this industry is more technology and production-orientated than focused on marketing and environmental communication (Nordic Ecolabelling 2010a).

The market is subject to growing competition from the internet and digital media, and a continuous decline in total printing volumes is to be expected. In addition, digital printing orders are experiencing considerable growth, currently accounting for some 10-15% of the total volume. By 2020 the figure may have increased to 60% (Romano 2008).

Nordic Ecolabel licences

By the spring of 2011 a total of approximately 450 licences had been granted. Most of these are to sheet-fed offset printers, but some licences have also been issued to newspaper and heatset printers. There has been an increase in the proportion of printers offering digital printing services only, and printers offering both sheet-fed offset and digital printing. In addition, a number of licences have been granted to operators outside the Nordic countries, particularly in the Baltic states

The evaluation in 2009 showed that the Nordic ecolabel still holds a strong position and is widely used in the market for several of the product categories included in the product group. A large number of operators in the market held a licence. Increasing focus in society on the environment and climate meant that new and “new-old” licence holders continued to join the scheme (Nordic Ecolabelling 2010).

Other ecolabelling schemes

Other labelling schemes for the graphic industry encompass other ecolabelling schemes, certified environmental management systems, industry labels, raw material labels, environmental declarations, environmental claims and climate labels as well as purchasing guidelines.

The market analysis in the 2009 Evaluation revealed an increasing focus on environmental issues throughout society. In addition to an increasing interest in the Nordic ecolabel other labels had also arrived on the scene such as e.g. the raw material labels FSC and PEFC. In addition, there were already a couple of different climate labels for the graphic industry and several more were on their way.

Ecolabelling schemes
Criteria for printing companies/printed matter have been established by several other ecolabelling organisations worldwide Criteria for printing and photocopying paper, packaging paper, stationery products, printing inks, etc. also exist.

In connection with the evaluation of the fourth generation criteria, Nordic Ecolabelling conducted a review of 15 current criteria for printing companies, printed matter and converted paper products from eight countries. None of the criteria considered were of such broad scope and imposed as extensive requirements as Nordic Ecolabelling's criteria.

The European ecolabelling scheme EU Ecolabel initiated a project to develop criteria for the ecolabelling of printed matter in 2003. The proposal for criteria was prepared concurrently with version 4 of the Nordic ecolabelling criteria, which means there are a number of similarities. However, the project was suspended because of disagreements in the Commission. In 2009 and 2010 work was resumed as the Commission is trying to incorporate requirements as to printed matter in the criteria for photocopying and printing paper. However, this proposal was withdrawn before the revised criteria for copying and printing paper were adopted. In 2011, the work was resumed once again with a view to adoption in 2012.

As part of assessing the EU ecolabel scheme's original proposal for criteria the Commission conducted an assessment of consequences. The Commission particularly mentioned the Nordic ecolabel's criteria as an example of a successful product group in the area of ecolabelling and emphasized the similarities in the wording of requirements in the proposal made by the EU ecolabel's scheme. However, the assessment pointed out that the EU ecolabel's proposal was less stringent, reflecting the balance that had to be struck amongst the member states (EU Commission 2007).

Certified environmental management systems
Many printing companies in the Nordic countries have certified environmental management systems, such as ISO14001 or EMAS. With a view to reducing the administrative burden, efforts were made in the process of formulating the criteria to take account of the environmental management systems that might already be in place at printing companies, inter alia by permitting the use of parts of the management system to document some of the requirements.

Industry schemes
Industry-owned environmental certification schemes have also been established outside the Nordic region. France has a label known as Imprim'Vert which is owned by AMIGRAF (L'Association des Métiers et Industries Graphiques pour la Formation Proffessionelle).

In the United States the graphic industry has developed a concept known as SGP Sustainable Green Printing Partnership. The criteria for certification consist of a detailed description of the structure of an environmental management system; (www.sgppartnership.org).

In Europe there is an association called Paper by Nature, which is a pan-European collaboration between some of the major paper suppliers and paper converters as represented by MECSEA (Manufacturers of Educational and Commercial Stationery Association) and FEPE (European Envelope Manufacturers Association).

The requirements are taken from EU Ecolabel's most recent draft criteria with some adjustments. For example, the minimum requirements as to the proportion of inspected paper are lower than in the proposal by EU Ecolabel. The recycling requirement in the EU Ecolabel's proposal has been removed entirely, and the points system has been amended in such a way that there is a greater emphasis on the choice of paper. In addition, different requirements are imposed as to points score depending on whether the product is made of paper or of board. In addition an option is available for scoring points for paper containing a high proportion of products from certified forestry operations.

Raw material schemes
Recently, third-party raw material schemes such as FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification schemes) have gained ground. FSC has its origin in the World Wide Fund for Nature and PEFC in the forestry industry. These schemes appear in different forms on printed matter and solely indicate that the paper used for the printed matter is either recycled or comes from sustainable forestry. These schemes do not tell you anything about the paper's overall environmental performance in a life cycle perspective.

Environmental claims and climate labels
Printed matter sometimes contains various environmental claims such as "vegetable printing ink" and "environmentally friendly paper".

There are also various climate labels relating to carbon dioxide emissions from printing companies and the supplier chain. GA (Grafisk Arbejdsgiverforening i Denmark) set up a climate label for the industry based on Intergraf's recommendations for climate calculations that can also be used outside Denmark. According to GA this tool is capable of calculating emissions for both graphic activities and the individual print item and follows Intergraph's recommendations in this area (www.ga.dk).

Environmental product declarations
Mostly used within paper. Many paper grades have what is termed a paper profile which can be accessed via the manufacturers' websites.

Purchasing guidelines and public procurement
The European organisation GPP (Green Public Procurement) has drafted purchasing guidelines for photocopying and printing paper (European Commission 2008). No guidelines have been created for printed matter or printing companies. However, in the Nordic countries advice is available on green purchasing, for example guidelines on printed matter (sheet offset) and copying services can be found at www.miljoevejledninger.dk. This includes references to, inter alia, the

Nordic ecolabel for sheet offset printed matter and photocopying and printing paper.

5 About the revision process

The goal of the revision process
The evaluation of the fourth generation of the criteria for printing companies arrived at a range of issues of relevance to the revision process (Nordic Ecolabelling 2010a). A number of these issues were made primary targets for the revision:

- Work on the energy consumption and carbon dioxide emission requirements, including the possibility of including transport
- Tightening up the total points score and assessing other areas that might be tightened up, for example the triviality thresholds for chemicals, the requirements applicable to VOC consumption etc.
- Work on updating the assessment of environmental gains achieved and drafting forecasts for future environmental gains.

About this criteria development/revision process
The work was performed by an internal Nordic Ecolabelling working group. Maria Enroth of MSG (Management System Group AB) was used as an external consultant.

The group comprised the following people:

Eline Olsborg Hansen, Norway
Harri Hotulainen, Finland
Ingela Hellström, Sweden
Jesper Gruvmark, Denmark

Karin Bergbom and Gun Nycander (who served as a substitute for a period) acted as Nordic area coordinators.

The work has taken the form of the drafting of technical studies, obtaining the basis for licence applications, contact with stakeholders, licence holders, pilot organisations and searches in the literature. The group has also sought aid from Maria Enroth in connection with the drafting of, inter alia, the energy requirements (Enroth 2010a).

The requirements have been tightened up on the basis of a thorough analysis of market data. Market data is available from an analysis of data on licence holders with the aid of the statistical tool in Nordic Print Portal and by compiling data from the literature and from pilot businesses.

Particular emphasis has been placed on coordinating this work with the work of the paper group, so that, for example, the method of calculating energy consumption will as far as possible be consistent for both product groups.

External anchoring has largely taken place in connection with the 60-day consultation process in the spring of 2011. In addition, industry meetings were held with key and relevant industry associations in several of the Nordic countries. Moreover, the working group continuously anchored proposals for changes and new requirements by means of contact with outside third parties during for example inspection visits and the like. In addition, Nordic ecolabelled printing companies have been supplied with information on the background to the energy requirements via the Nordic Print Portal.

6 The environmental impact of printing companies and printed matter

Although printers in the Nordic countries have for many years worked actively on environmental issues, scope still exists for improvement. This is true not least in light of the size of the industry. According to the European IPPC Bureau the printing industry is one of the biggest production industries in the European Union and features amongst the ten largest production industries in most countries (European IPPC Bureau 2005).

At a general level the environmental impact of the life cycle of printers and printed matter relates largely to the production of the printing material and to printing. Typically the environmental impacts relate to impact on biodiversity in connection with forestry, the greenhouse effect, eutrophication, photochemical ozone creation and acidification.

Normally, life cycle assessments do not cover the working environment, biodiversity (see however Tiedemann et al) and the idea of rewarding the use of renewable resources. However, this does not mean that Nordic Ecolabelling cannot impose requirements in these areas.

Paper
The most important item of consumption in the production of printed matter is the printing substrate – in this case it will typically be paper. It is customary to view the production of paper and paper pulp as the main environmental and resource-related burden in the life cycle of an item of printed matter. This is confirmed in most life cycle studies (Dalhielm et al 1995, Drivsholm et al 1996 and 1997, Tiedemann et al 2001, Larsen et al 2009).

Wood fibre and miscellaneous chemicals represent the most significant items consumed in the production of printing paper. Of the chemicals used, fillers and coatings, such as chalk and kaolin, are the most significant as regards resource consumption (Winell 1997). As regards environmental impact, a number of other chemicals are also used in the production of printing paper.

Biodiversity in forestry environments can typically be safeguarded by means of sustainable forestry operations. According to the life cycle study conducted by the German EPA, apart from climate impact forestry is the most important pa-

rameter in the life cycle of printed matter. As a consequence, the study concludes that the use of recycled paper will reduce the impact on forestry and by extension the loss of biodiversity (Tiedemann et al 2001).

In 2009, paper and board collection in Europe reached a level of approximately 72% relative to overall consumption of paper and board (CEPI Key Statistics 2009). However, there is considerable variation in the recycling percentage depending on the paper fractions in question. For example, in Europe 90% of all newspaper and corrugated board was collected in 2009, whereas only 10% of ordinary graphic paper was collected (CEPI Key Statistics 2009). In practice, virtually 100% of residual paper that occurs at a printing company or at subcontractors will be collected, since these fractions are so "clean" that collection offers genuine economic benefits. The number of paper fractions that are sorted will depend on the individual business and the scope for obtaining further payment for uniform fractions.

A second important area of resource consumption in the life cycle of printing companies and printed matter is energy. Energy consumption relates primarily to the production of paper pulp and paper. In addition, some energy is expended in the printing process and in connection with transport.

Energy consumption results in emissions to the atmosphere of the gases carbon dioxide (CO_2), nitrogen oxide (NO_x) sulphur dioxide (SO_2) and volatile organic compounds (VOC). According to the life cycle analyses consulted, emissions associated with energy production from paper represent by far the highest proportion of overall emissions of these types of gases in the life cycle of printed matter.

Other emissions during the production of pulp and paper include organic materials, measured as Chemical Oxygen Demand (COD). In Europe and the United States, waste water from industry and households accounts for the second highest contribution to eutrophication. The highest contribution comes from agriculture in the form of fertiliser containing nitrogen and phosphorous. One consequence of eutrophication is oxygen depletion which, inter alia, results in algal bloom, fish death and inferior bathing water.

Waste water from paper production also contains AOX and heavy metals. These chemicals will generally be treated in the paper mill's treatment plant. In the Nordic countries, where a large part of Europe's paper is produced, it is common for paper and pulp mills to have their own water treatment plants.

A recent Danish life cycle study concluded that the environmental impact of paper is significantly lower than the levels concluded in other studies. According to the report, the reason that paper has less significance is that human and eco toxicity are included in the study (Johnsen et al 2006 and Larsen et al 2009).

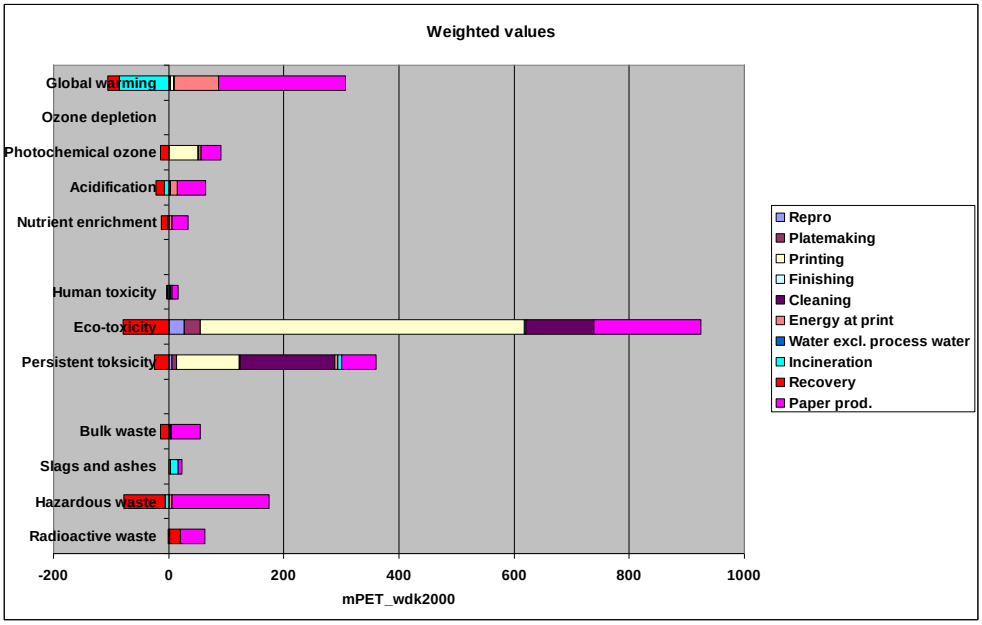

Figure **Fejl! Henvisningskilde ikke fundet.**. The diagram shows the environmental impact of an item of generic offset printed matter expressed in what are termed milli-person equivalents (Johnsen et al 2006). The impact of paper production is 31% of the overall environmental impact of the printed matter in the chosen scenario. As regards resource consumption, however, paper accounts for 88%. Reproduced with the kind permission of Grafisk Arbejdsgiverforening.

If toxicity associated with chemicals had not been included in the study, paper would have accounted for 67%, which corresponds to the 70-80% typically reported in other life cycle studies (Dalhielm et al 1995, Johansson 2002 and Drivsholm et al 1996 and 1997).

Printing

However, a recent Danish life cycle study attributes a relatively high proportion of the overall environmental impact to printing (Larsen et al 2009). This is because this study includes human and ecotoxicological effects for a number of chemicals that are mainly used by printers and in the production of pigments.

In an older study, the significance of printing including prepress varies between 10 and 30% of the overall environmental impact of the product (Dalhielm et al 1995). The more recent Danish study concludes that printing excluding film and printing form production accounts for 64% of the overall environmental impact of printed matter (41% printing, 17% washing and 6% energy consumption at the printing company). This figure is reduced slightly if it is not assumed that all paper that is not collected for recycling is incinerated (the calculation takes as its point of departure a European scenario for paper collection and a Danish scenario for waste incineration).

If instead the natural resources impact is considered (the filler kaolin in the paper is exempted), printing accounts for a total of 40% (printing 4%, washing at the printing company 3% and energy consumption at the printing company 33%).

According to a commission set up by the Danish Working Environment Council, the main working environment problems associated with printers and publishing businesses are noise levels leading to hearing damage, heavy lifting, repetitive work duties, physically challenging working positions, the psychological working environment, brain-damaging substances and allergies of the skin and respiratory system. (Danish Working Environment Council 2002).

Printing inks, toners and inks

As regards chemical use by printers, the consumption of printing inks constitutes the highest consumption. In Denmark, consumption of printing inks in 2003 totalled approximately 16,800 tonnes (GA 2004). This corresponds to approximately 84,000 tonnes in the Nordic region as a whole if it is assumed that Denmark accounts for one fifth of Nordic consumption. Consumption in Denmark has been increasing since 1996, at which time it stood at approximately 14,800 tonnes. In the European Union 987,000 tonnes of printing ink are used every year (Sahlén et al 2003).

A life cycle study found that printing ink contributes between 3 and 15% of total environmental impact, depending on the parameter considered. However, printing inks make a negligible contribution to the formation of photochemical ozone (Johansson 2002).

A recent Danish study found that printing inks contribute 34% of total environmental impact. According to this study, 16% derives from the production of printing ink and 18% from ink wasted during the printing process. According to this report, this can primarily be attributed to emissions of environmentally harmful substances to the aquatic environment (Larsen et al 2009).

Printing inks, toners and inks contain greater or smaller quantities of mineral oils, pigments and additives, depending on the type of product in question. All these substances may have long term effects in the aquatic environment and represent an important reason for the effect of printing inks on the overall environmental impact of printing companies and printed matter.

A study conducted in 2003 examined the chemical compounds emitted from printing ink on printed matter to which users are exposed during reading and storage (Hansen et al 2003). The conclusion was that based on the available data, ordinary consumers of printed matter have no grounds for concern about their health. However, it is by no means impossible that some of the substances may cause allergic reactions in sensitive consumers. Toluene received most attention, since this was the substance that was found to be released in the greatest quantities.

The study also assessed noxious smells and concluded that in some cases consumers might be able to smell e.g. toluene, oil, turpentine or simply “a smell of chemicals”. The “chemical smell” derived, inter alia, from aldehydes (propanal, pentanal, heptanal), toluene and the combination of terpenes and terpenoid substances.

Washing agents and organic solvents
Historically, problems associated with brain damage caused by solvents have been a very familiar problem in the graphic industry. In 1998, a study was conducted in Denmark into the use of washing agents and the scope that existed for substituting existing products with products that were less harmful to health. The report concluded that a number of organic solvents continued to be used even though many vegetable washing agents had become available on the market (GRAKU 1998).

Typically emissions of volatile organic compounds originate from the use of organic solvents and the use of alcohol in dampening solutions in the printing process in certain printing methods. Heatset inks contain mineral oils which are regarded as VOCs when they reach the afterburner, since this is where they become volatile.

In one study, washing agents and dampening solution, including IPA, contribute some 95% of the formation of photochemical ozone in an item of offset printed matter (Johansson 2002). In a second study, paper accounts for 50% or even more of the photochemical ozone in the life cycle of the printed matter (Drivsholm et al 1996 and 1997).

7 Justification for the requirements

Nordic Ecolabelling has drawn up a requirement structure containing mandatory requirements and a scope for scoring points: In addition to fulfilling the mandatory requirements, a certain score must also be obtained in order to be granted a licence. The requirement structure is:

- A points system in which more points will be scored, the better the environmental conditions are and the more environmental measures have been implemented.
- The points system applies to the entire printing company.
- All printing techniques and sub-processes are encompassed by the same points system, which, for instance, means that values are calculated in the same way for all printing methods.
- The number of requirements has been reduced – instead strict requirements are introduced with regard to the score required for the various printing methods in order to qualify for a licence.
- Templates have been created for use in fulfilling the requirements relating to the printers' routine procedures and instructions have been drafted as an aid to meeting the ecolabelling requirements.
- Special marketing requirements apply to printed matter that is to carry the ecolabel.

The working group emphasised that the requirements must be easy to document, while at the same time encouraging the printers to introduce environmental improvements or rewarding printers that have already done so. The number of op-

tions for scoring points is at a level ensuring applicants a reasonably high degree of flexibility.

Generally, the requirements have been selected on the basis of an assessment of the effects of printing on health and the environment during its life cycle. In addition, the approach has been taken that a potential environmental gain in one area must not have the effect of creating an environmental problem in a second area.

Several of the requirements will make a positive contribution to the financial position of the printing company. For example, savings in operating costs can be made by printing companies that are successful in reducing their waste paper, printing ink spillage and refuse quantities. This makes for a close interplay between ecolabelling and EMA (Environmental Management Accounting).

Other important considerations have been the possibility of formulating clear criteria that are technically and financially possible to document and that offer a high degree of credibility. Where the Nordic authorities have legislation in place or have stated goals or attitudes in the area, this has also been taken into account as the ecolabelling requirements must be stricter than any legislation that may exist.

The requirements also follow the applicable legislation, including what is termed BAT. In the case of large printers within the European Union, the applicable legislation requires that an environmental permit be issued against the background of the business' emissions to air, water and the ground and the general waste generated by the business. The requirements in the permit must be based on best available technology (BAT) as described and detailed in what is termed a BAT reference document, abbreviated as BREF (European IPPC Bureau 2005).

The requirements are also formulated on the assumption that the printers will produce their own applications using the electronic application aid on the Nordic Print Portal, which Nordic Ecolabelling developed in connection with the fourth generation of the criteria. The application aid contains databases of inspected paper, chemicals, finishers and other Nordic ecolabelled printing companies and performs all calculations required, thus facilitating the documentation process for printers.

The functional unit
The functional unit used in the criteria is one tonne of finished product. Factors such as energy consumption and VOC consumption are related to this unit, reflecting the result that print buyers achieve when they order printed matter from a printing company. The printing company's output of printed matter is calculated by deducting the overall quantity of waste paper generated from the printer's total purchases/consumption of paper on an annual basis.

The selected weight-based functional unit may theoretically have the consequence that printing companies which mainly print on paper with lower grammage than other printing companies which mainly use higher grammage paper (but the same printing method), will find it more difficult to comply with these

requirements. However, most printers have a broad range of customers and their order portfolio will accordingly be fairly varied. This means that in practice there will be no significant difference between printers in this respect.

In the fourth generation of the criteria document, the functional unit was 1 tonne of paper purchased/used. This was because Nordic Ecolabelling was uncertain about the extent to which printers would be able to calculate the weight of waste paper. It transpired that in fact most printers were able to do so, and accordingly it was relevant that the requirement should be imposed from the fifth generation of the criteria onwards that the quantity of finished products should be calculated with the aid of waste paper.

Calculating the quantity of finished product in this way does not allow the weight of other elements in the printed matter to be included (e.g. printing ink, varnish, foil, adhesive, staples). This is less significant since by far the greatest proportion of the weight of printed matter consists of paper.

In future criteria documents Nordic Ecolabelling will consider changing the calculation to "area of finished product", since this provides an even better match with the actual purpose of submitting the information. This is why Nordic Ecolabelling is working to modify the Nordic Print Portal in order for it to be able to compute all relevant key figures in relation to the "area of finished product" in parallel with "tonnes of finished product".

7.1 Product group definition (What is eligible for the Nordic ecolabel?)

The product group encompasses printing companies and printed matter. A printing company is a business providing printing of printed matter as a substantial part of business. Printing is a process involving the processing of printing material to produce printed matter and encompassing printing on printing materials and/or finishing/converting. The processing consists in an image, pattern, text or the like being printed on paper or some other printing material. In other words, one of the primary functions of the printed matter is as an "information carrier".

In the fifth generation of the criteria the name of the product group was changed from "Printing companies" to "Printing companies, printed matter, envelopes and other converted paper products" in order to further stress that the criteria also focus on ensuring that the environmental profile of the individual item of Nordic ecolabelled printed matter, including envelopes and other converted paper products is satisfactory.

The products in question are ordinary printed matter, converted paper and paperboard products as well as packaging products made of paperboard. Ordinary printed matter encompasses for example newspapers, books, catalogues, brochures, pads, leaflets, posters as well as envelopes, folders, ring binders, packaging products and labels made of paper.

In the criteria, Nordic Ecolabelling's definitions of printing companies and printed matter have been added. There are also definitions of other terms, such as envelopes and newspapers.

Nordic Ecolabelling has made changes to the effect that it is now clear that licences to become a Nordic ecolabelled printing company cannot be issued to publishers and advertising agencies as their purpose is not to provide printing services.

For practical reasons licensed printing companies may also print on other printing materials than those based on paper fibre, provided that 75% of the total turnover of the printer derives from paper printed matter.

Printing companies producing these products using the printing methods sheet, heatset and coldset offset, gravure printing, flexographic printing and digital printing are eligible for a Nordic ecolabelling licence. Special points limits apply for variants of these methods in connection with the printing of newspapers, forms, envelopes (both offset printing of envelopes and envelope production using the flexographic method), and packaging.

In the fifth generation of the criteria Nordic Ecolabelling combined the envelope criteria with the printing company criteria and introduced in the printing company criteria a special points limit for offset printing of envelopes. Envelope production itself is performed on a flexographic printing machine which often prints on the inside of the envelope. As envelopes generate more waste paper than, for instance, notepads and leaflets, which are also printed using the flexographic method, Nordic Ecolabelling introduced its own points limit for envelope production (flexographic envelope production). Envelope producers must also select this category even if they produce envelopes that neither bear print on the inside or outside. As regards printing on the envelopes using offset technology the printer must use envelope offset. If the printer uses digital printing machines, then the ordinary digital printing method must be selected.

For other converted paper products without print, the "closest" method must be used. For printing a note pad with blank pages, the same printing method as that used for the cover must be used. A post-it note requires the same method as that used for the back cover.

The option of exempting test prints and certain printing methods if they accounted for only a small part of output was removed in the fifth generation of the criteria in order to avoid interpretation difficulties, and because most methods for test printing are by now covered by methods already encompassed by the criteria.

The fifth generation of the criteria also clarified the point that exemptions apply only to the production of security printing (bank notes, passports, lottery tickets). However, this does not apply if this production makes up a significant portion of the output of the printing company, and accordingly turnover from security printing combined with turnover from printed matter not based on paper must not exceed a maximum of 25% of total turnover from printing.

Besides these changes, screen-printing and letterpress printing were excluded in the fifth generation of the criteria. Nordic Ecolabelling did not have any licences for these methods. Letterpress is an old method which, in practice, has been replaced by offset. Screen printing is used extensively in connection with materials other than paper.

7.2 General requirements (O1)

A minimum of 75% of the printing company's printing must be on paper, calculated on the basis of financial turnover. This minimum requirement was introduced for reasons of credibility and represents a clarification of the requirements in relation to the last generation of criteria, which specified that printing should "chiefly" be on paper. The situation is that as at the present time Nordic Ecolabelling has not studied the environmental impact of printers that print large quantities of their output on other materials. It is possible, however, that the environmental impact of other printing materials will be studied during subsequent revisions of the criteria.

As from the fifth generation of the criteria it was specified that paper must be paper covered by the EU Ecolabel's or Nordic Ecolabelling's criteria for paper.

Based on a number of consultation comments, Nordic Ecolabelling specified that the 75% must be calculated on the basis of the printing company's turnover from printing. Consequently, turnover from other activities, such as layout work, web design, etc., does not count. This is because the criteria cover printing, for which reason it is not credible that a Nordic ecolabelled printing company markets other activities as Nordic ecolabelled. As a result Nordic Ecolabelling changed the documentation guidelines to the effect that it is now possible to declare that only paper is used for printing, if this is the case. In the case of printing companies that print on printing materials other than paper, the requirement must be documented against the background of financial turnover of paper and other printed matter, respectively.

In most cases the paper grades are supplied in a format suitable for the printing method in question. Information about which formats have been supplied to which printing company is typically held by paper wholesalers. In connection with the consultation process Nordic Ecolabelling was made aware that in certain cases some printing companies use paper in sheet-fed offset format which they cut up for use in a digital printing machine. In order to minimise the administrative burden, printing companies using both sheet fed offset and digital printing may cut up some of the sheet fed offset paper and use it for digital printing, and then the printing company may estimate the quantity of it.

7.3 Requirements applicable to suppliers of print services (O2)

At least 75 weight per cent of printing, including printing by subcontractors, must be Nordic ecolabelled printing companies. This requirement has been introduced for reasons of credibility. Previously the requirement was 50%.

The requirement is formulated in such a way that a printing company will not be eligible for a licence if a significant proportion of its output is produced externally by non-ecolabelled printers. The reason that 25% of printing output is nevertheless allowed to be of the non-inspected kind is to relieve the printing company of a too heavy administrative burden.

Some printing companies have multiple suppliers, and the number may moreover vary from year to year. Furthermore, it is by no means certain that the printer will have any great degree of influence on whether or not their suppliers are ecolabelled. However, the requirement is imposed so that all suppliers used for the production of Nordic ecolabelled printed matter must hold licences (see Section 7.27).

7.4 Requirements applicable to suppliers of finishing services (O3)

At least 90 weight per cent of all finishing involving adhesive, varnish, laminating or foil printing (what is termed "chemical finishing"), including corresponding finishing conducted by external finishes, must have been inspected and must comply with the requirements applicable to external finishing. This requirement has been introduced for reasons of credibility and is an obvious extension of existing requirements, since the criteria impose requirements on chemicals and materials used internally at the printing company.

The stringency of the requirement has been increased relative to the fourth generation of the criteria when the level imposed was 85% and most printers were very close to 100% (see the analysis in Appendix 1). The requirement entails that the use by external finishers of, for example, adhesives and varnishes that do not fulfil the chemical requirements has largely been ruled out. As a new addition to the fifth generation criteria, printing inks, toners and inks used in connection with address printing at finishers have also been included, as these chemicals are covered by the requirements applicable to chemicals at the printing company.
The pre-requisite for inspection and listing in the Nordic Print Portal is that finishers fulfil the following requirements:

- Chemicals and materials and the associated triviality thresholds. However, the requirement that there must be no more than 5% not inspected old chemicals does not apply to external finishers (7.8).
- PVC in packaging and laminating foil for paper print items (**Fejl! Henvisningskilde ikke fundet.**).
- The requirements applicable to pressure-sensitive adhesives (**Fejl! Henvisningskilde ikke fundet.**).

An additional requirement is that the use of PVC materials is banned in printed matter that is to be Nordic ecolabelled. In the fifth generation of the criteria Nordic Ecolabelling introduced a triviality threshold to avoid unnecessary administration. In other words, the requirement ceases to apply in its entirety if external chemical finishing is conducted on a maximum of 5 weight per cent calculated as purchased paper for orders for external chemical finishing in relation to total pa-

per consumption. To ease the administrative burden this can also be calculated using financial figures.

In the production of printed matter that will carry a Nordic ecolabel any use of external chemical finishing must be inspected (see section **Fejl! Henvisningskilde ikke fundet.**). In connection with the calculation of waste paper (see section **Fejl! Henvisningskilde ikke fundet.**) and energy consumption (see section **Fejl! Henvisningskilde ikke fundet.**) all finishers performing mechanical finishing must be included in addition to the chemical finishers.

With effect from the fifth generation, adhesives and varnishes used by finishers will also be included in the printing company's points for chemicals. In practice this will entail that inspected finishers will be awarded points based on the type of adhesive and varnish they use. To make it simple, these points are set as a worst case, meaning that the adhesive or varnish with the lowest points will represent the points awarded to finishers. These points can be found on the Nordic Print Portal (see section **Fejl! Henvisningskilde ikke fundet.**).

As a new addition to the fifth generation criteria, any printing inks, toners or inks used in connection with address printing are also covered by the chemical requirements applicable to finishers.

7.5 Requirement as to the minimum proportion of inspected/ecolabelled paper (O4)

The printing company must use a minimum of 25% inspected and ecolabelled paper calculated as a weighted proportion of various types of paper. In this calculation, Nordic ecolabelled paper must have a weight of 1, inspected paper 0.8 and EU ecolabelled paper 0.7. The weighting factors are based on different environmental performances for the different types of paper (see details of weighting in the following section). This is an increase in stringency relative to the last generation of the criteria in which there was no minimum limit. The requirement has been selected against the background of Nordic Ecolabelling's goals within the areas of climate change, acidification, water pollution and eutrophication, as well as emissions of environmental toxins and heavy metals, biodiversity reduction and enhanced efficiency in the exploitation of energy and materials.

The requirement must be viewed against the scope for scoring points for choice of paper, where points are scored depending on the quantity of inspected/ecolabelled paper that is used. The points are weighted according to the weighting factors. The background to this weighting is discussed in the next section.

The weighting means that if a printer has neither Nordic ecolabelled paper nor EU ecolabelled paper, and in addition to other paper exclusively has inspected paper, the printer will be awarded points if the proportion held is above approx. 31% (25/0.8). The corresponding figure for EU ecolabelled paper is approx. 36% (25/0.7).

On average most printing companies/printing methods have a considerably higher proportion of inspected/ecolabelled paper (see Appendix 1). However, this may be difficult for printing companies that print mainly on board, as typically there are not many of these grades that have been inspected. Moreover, there are as yet not many Nordic ecolabelled printing companies in this category. Nordic Ecolabelling expects increased interest in this type of printing companies and accordingly greater pressure on the paper industry in order for these paper grades to be inspected.

With this requirement, Nordic Ecolabelling wants to remove the possibility of Nordic ecolabelling a printing company, if the share of inspected/ecolabelled paper is very low. This also means that paper is generally given greater weight in the requirements, which is in line with the existing life cycle studies. Read more about this in the following section.

7.6 Points for choice of paper (P1)

The printing company may score up to 25 points, depending on how much of the weighted proportion of inspected and ecolabelled paper used by the printer exceeds the minimum threshold of 25%. This avenue for achieving points was included against the background of Nordic Ecolabelling's targets within the areas of climate change, acidification, water pollution and eutrophication, emissions of environmental toxins and heavy metals, biodiversity reduction and the efficient exploitation of energy and materials.

Nordic Ecolabelling has collected data and calculated a market average for the volume of waste paper for the weighted proportion of inspected and ecolabelled paper for each printing method (Appendix 1). The sum of the market average for this and other parameters, plus an overall points addition, constitutes a printing method's points limit for obtaining a licence (see Section 7.24). Based on the stricter requirements in the most recent version of the paper criteria document, Nordic Ecolabelling estimates that, in future, the prevailing paper in the market will be EU ecolabelled paper. Consequently, Nordic Ecolabelling has assumed that all inspected/ecolabelled paper used on average for the various printing methods carries the EU ecolabel, and the market average is calculated on the basis of this assumption.

The weighting of different types of paper
As from the fifth generation of the criteria, weighting is introduced to the effect that Nordic ecolabelled paper is weighted with a factor of 1 and what is termed inspected paper with a factor of 0.8. The weighting for EU ecolabelled paper is 0.7. If a paper type carries both marks, the highest weighting factor may be applied. The reason for the weighting is explained below.

The weighting factor for paper with the EU Ecolabel was changed after the consultation, as the weighting was formerly based on the consultation proposal for version 4 of Nordic ecolabelled copying and printing paper. These requirements, including the energy requirements, were eased slightly before version 4 was adopted, thus reducing the differences for EU ecolabelled paper.

In future, the requirements applicable to inspected paper differ from those applicable to Nordic ecolabelled paper. The requirements applicable to inspected paper are based on Nordic Ecolabelling's basic requirements for paper (second generation basic module for paper), supplemented by some relaxations stated below.

The requirements applicable to inspected paper are specified in Appendix 5 to the printing criteria and must be applied in applications for inspection of paper grades.

Thus in the case of inspected paper all the requirements of the basic module must be met, including the chemical module, version 2, subject to the following modifications:

- Requirement R11 applicable to carbon dioxide emissions during transportation does not apply
- The requirements applicable to special paper and niche products in the supplementary module for copying and printing paper version 4 (K4) also apply to inspected paper
- The documentation requirements for K1-K14 in the chemical module have been changed to the effect that documentation must instead be a list of all the chemicals used with brand names, classification and a declaration that the requirements in K2-K14 have been fulfilled
- Inspected paper grades must be designated with a unique trade name so that it is not possible to mix paper that has been inspected with non-inspected or Nordic ecolabelled paper
- The grammage encompassed by the inspection must be stated.

A combined assessment of the level of the requirements for new criteria for the Nordic Ecolabel and inspected paper as compared with paper carrying the EU Ecolabel indicates that the Nordic Ecolabel has considerably stricter requirements than the EU scheme. The comparison was conducted on the basis of the basic module and the chemical module version 2, as well as the supplementary module for Nordic ecolabelled photocopying and printing paper version 4, which were all adopted in June 2011, and the EU Ecolabel's criteria for printing paper version 2 were adopted in October 2010. In this connection it is assumed that the requirements also apply to newsprint although this type of paper is not encompassed by the EU Ecolabel's criteria.

The major differences in the level of the requirements can inter alia be found with respect to energy and carbon dioxide. Based on the evaluation of the differences in the environmental requirements an advantage in terms of points is awarded to paper with the strictest level of requirements through the various weightings.

The revision of the Nordic ecolabelling criteria for photocopying and printing paper has increased the stringency of the requirements applicable to energy consumption and carbon dioxide emissions significantly. The so-called energy score for licensed Nordic ecolabelled paper is 1.15 and for inspected paper 1.25 in the

case of both electricity and fuel. The corresponding energy score for the EU ecolabel is 1.5. In addition to this, the Nordic Ecolabel, unlike the EU Ecolabel, has raised the reference values for energy, i.e. the standard values with which energy consumption must be compared when points are calculated. Nordic Ecolabelling has assessed these distinctions in energy requirements quantitatively and they constitute the main contributory foundation for the various weightings.

To compare the requirement levels for energy requirements applicable to EU ecolabelled, Nordic ecolabelled and inspected paper, Nordic Ecolabelling has established the requirement levels in relation to the average energy consumption in European paper industry (CEPI key statistics 2009). Nordic Ecolabelling has calculated where the total energy consumption related to paper and pulp production is percentagewise in relation to the requirement limits in the various schemes. The results have then been lined up in relation to each other.

The comparison is made by multiplying the quantities of the various types of paper and pulp produced in CEPI with related reference values from the different schemes. In order to obtain the assessment of energy consumption, the result is multiplied with the requirement limits in the different schemes (e.g. 1.15 for Nordic ecolabelled paper). Moreover, the calculations take into account the Nordic ecolabel's way of relating the requirements to the fibre content by applying an overall average for non-fibre based material stated in the CEPI statistics, instead of relating them to the product as in a previous version of the paper criteria. It is also assumed that the quantity of bleached chemical pulp is as large as the unbleached pulp and that 1 tonne of collected recycled paper will become some 0.65 tonnes of recycled pulp.

The result of this comparison is that the requirement level for inspected paper is at 0.9 and at 0.6 for EU ecolabelled paper provided that the level for Nordic ecolabelled paper is put equal to 1. The comparison forms the basis here of the final weighting between the paper grades assessed by Nordic Ecolabelling. Inspected paper has been adjusted downwards to 0.8 because of the removal of the requirement regarding calculating the carbon dioxide emissions during transportation. Particularly for paper with the EU ecolabel there are differences in relation to the Nordic ecolabel when it comes to carbon dioxide emissions and chemicals; as a result, EU ecolabelled paper is assigned a weighting of 0.7.

In order for the CEPI statistics to be describable as a relevant market average, it is imperative that paper used in the European market is in fact manufactured in the CEPI countries. According to CEPI the organisation covers 95% of all pulp and paper production in Europe. The statistics state that in 2009 some 17% of all pulp used was imported from other parts of the world. The corresponding figure for paper is 6% (CEPI Statistics 2009, p. 3). This demonstrates that the CEPI statistics reflect the market very well.

The EU Ecolabel's carbon dioxide requirements are easier to fulfil than the requirements applicable to Nordic ecolabelled and inspected paper. In the Nordic ecolabel scheme, for example, the requirement limit for chemical pulp is 900 kg CO_2/tonne of paper, whereas the corresponding requirement in the EU ecolabel scheme is 1000-1100 kg CO_2/tonne of paper (for integrated and non-integrated

production, respectively). The EU ecolabel's value for mechanical pulp is the same as that for chemical pulp, and is thus stricter than the Nordic ecolabel requirements (1600 kg CO_2/tonne of paper), but in this case the EU ecolabel's criteria do not encompass newspaper (however, the EU Ecolabel's proposal for criteria for newsprint paper has set a requirement value of 1000-1100 kg CO_2/tonne of paper). Unlike the EU ecolabel scheme the Nordic ecolabel has also introduced a new requirement applicable to carbon dioxide emissions from transport in the case of Nordic ecolabelled paper. These requirements do not apply to inspected paper. However, stricter rules governing electricity factors apply to Nordic ecolabelled and inspected paper. According to the Nordic ecolabel energy guidelines the European electricity mix factor of 385 g CO_2/kWh must be applied to all purchased electricity, where the EU Ecolabel's value is 400. In return, the EU Ecolabel accepts that electricity from renewable electricity sources may be deducted.

In addition there is one important requirement that is stricter for Nordic ecolabelled and inspected paper than for EU ecolabelled paper. This applies to GMO in starch raw materials for paper production.

The EU ecolabel requirements as to certified fibre have been increased from 10 to 50%, but there are no minimum requirements as regards the forestry certification schemes, apart from a reference to PEFC, FSC or the like. The Nordic ecolabel requirements have been increased from 20% to 30% and contain detailed requirements as to what a forestry standard must contain in order for fibre from certified forestry operations to be counted. Thus not all forestry standards are accepted by Nordic Ecolabelling. For example, the assessment so far by Nordic Ecolabelling is that very few plantation and interim standards fulfil the requirements the Nordic ecolabel scheme imposes on forestry standards. Since the EU ecolabel scheme has no specified requirements as to which standards are acceptable, Nordic Ecolabelling finds that the Nordic ecolabel's requirements as to certified fibre are stricter than those of the EU Ecolabel, even though the percentage rate for the EU ecolabel is higher.

There are variations in the chemical requirements, as the EU ecolabel has an upper limit of 0.1 weight per cent of finished paper for substances and mixtures in the production process that are classified with risk sentences attached to the most hazardous health and environmental effects, including those for environmental hazard and CMR effects. In addition, the requirement also encompasses the so-called SVHC (substances of very high concern), including endocrine-disruptive substances in chemicals. The Nordic ecolabelling criteria include a ban on those chemicals in the production process that are classified as environmentally harmful, and on those with CMR effects. The Nordic ecolabel has not introduced a general ban on the high-risk chemicals at a general level, but on certain substances specified by name. Hence, the Nordic ecolabel prohibits the use of phthalates in dyes (typically endocrine disrupters) as well as alkyl phenol derivates in certain chemicals (typically endocrine disrupters).

Calculation of points

The below formula for calculating points means that, for instance, 25 points will be awarded if all paper used is Nordic ecolabelled, about 18 points if all paper used is inspected, and 15 points if all paper used is EU ecolabelled.

The formula for calculating points is:

score = 1/3 * weighted percentage share inspected/ecolabelled paper - 25/3 (however at least 0 points)

The formula is designed so that a maximum of 25 points can be obtained; in the case of 100% Nordic ecolabelled paper, 0 points is awarded, and in the case of 25% Nordic ecolabelled paper (or 0% inspected and 0% EU ecolabelled paper), a higher percentage share will be required before points will begin to be awarded for inspected and EU ecolabelled paper. This means that if a printer has neither Nordic ecolabelled paper nor EU ecolabelled paper, and in addition to other paper exclusively has inspected paper, the printer will only be awarded points if the proportion held is above approx. 31% (25/0.8). The corresponding figure for EU ecolabelled paper is approx. 36% (25/0.7). These levels correspond to the minimum levels stated in the mandatory requirements.

The formula implies that the relationship between the points varies for the various types of paper, depending on how much inspected/ecolabelled paper is held. If, for instance, a printer holds 100% EU ecolabelled paper, the relationship between the points is 0.6 compared with the points for 100% Nordic ecolabelled paper. If smaller quantities are held, the relationship will be even smaller. This means that the actual points do not reflect the weighting factors numerically. This is why Nordic Ecolabelling Board decided that the formula must be scrutinized at the next revision.

Based on the existing formula, the possibility of multiplying the calculation by a point correction for the percentage shares of the various paper grades in relation to the share of inspected/ecolabelled paper is now being examined.

Point correction = 1.0* percentage share Nordic ecolabelled +
1.2* percentage share inspected +
1.4* percentage share EU ecolabelled paper

This correction has the effect that points are begun to be awarded at the level representing the minimum level for each paper type. Furthermore, it entails an optimization of the relationship between points and weighting factors. This means that the relationship between the points for the different paper types precisely reflects the weighting factors when the percentage share for one of the paper types is in the middle of the interval in which points are gained, i.e. 62.5% (in between 25 and 100%). In the case of such a change of the formula, the points average for this parameter is to be recalculated and, consequently, the total points limit is also to be recalculated in accordance with Appendix 1.

A maximum of 25 points attainable for this area remains 25 points. This means that the total score attainable for paper or areas related to paper is 45 (including

10 for waste paper, 7 for recycling in relation to printing inks, and 3 for recycling in relation to adhesives).

The fourth generation of the criteria imposed an upper limit of 75% on the amount of inspected/ecolabelled paper required in order to score the maximum number of points available. This limit was removed in the fifth generation of criteria since, for example, newspaper presses often had levels in excess of this.

The option of using an average for the last three years instead of the proportion of inspected/ecolabelled paper used in the last year was removed in the fifth generation of the criteria, since Nordic Ecolabelling's experience was that no printers had taken advantage of this option.

Many printers have what are termed house grades and therefore have scope for influencing the grades on which products are printed. Appendix 1 shows how much inspected/ecolabelled paper on average is used for the different printing methods. For sheet-fed offset printing, for instance, it was just over 70%. From this it appears that there are major differences. These differences help to explain why different points scores are required for the various printing methods. Large printers sometimes have customers who wish to decide what paper is to be used and it may therefore be difficult for these printers to maintain a sufficient number of points for this parameter. On the other hand, large printing companies have greater scope than small printers for bringing about improvements in other areas and will thus nevertheless succeed in maintaining low environmental impact.

One of the reasons that the points for paper are not higher, as many life cycle studies would indicate, is in part that if this were the case it would be more difficult to create the motivation to bring about improvements. It may also be the case that in some cases the printer will be unable to control the choice of paper since large clients will wish to decide this themselves. Having said this, Nordic Ecolabelling's wish is that printers should attempt to influence their clients to choose environmentally-friendly designs for printed matter.

A second reason is that a recent life cycle study indicated that the significance of paper in the life cycle is less than 50% if the focus is environmental impact alone and if the impact of natural resources is excluded (Larsen et al 2009). This means that Nordic Ecolabelling's allocation of points for paper represents an acceptable balance.

Furthermore, it transpires that on some markets fewer inspected paper grades are available than is the case on the Scandinavian market. It is likely that this situation will also apply outside the EU. This makes it more difficult for some printers to score points and, as a result of this difference between markets, the controllability of this parameter is reduced.

The fifth generation of the criteria document introduces a mandatory minimum level of 25% for the calculated proportion of inspected/ecolabelled paper (see section **Fejl! Henvisningskilde ikke fundet.**). This requirement means that on an overall basis, paper will have a higher weighting than in the previous generations of the criteria document.

Recycled paper
The option of scoring points for recycled paper has been removed. Recycled paper is generally associated with a green profile. A Danish report produced by the Danish EPA concluded that the recycling of paper fibres is preferable to combustion if wood is regarded as a limited resource (Miljøstyrelsen 2005c). The German life cycle study also concludes that recycling is preferable to incineration.

Hence, in the fourth generation of criteria points could be scored for 100% recycled paper. This option was removed in the fifth generation of criteria as Nordic Ecolabelling prefers to look at the overall picture and not just the individual parameters, such as the content of recycled fibres. The requirement introduced by Nordic Ecolabelling and the EU ecolabel for copying and printing paper also covers paper made from recycled fibres.

7.7 Points for waste paper (P2)

Printing companies may score up to 10 points as regards the quantity of waste paper generated by the printing company on an annual basis. The scope for scoring points in this area has been introduced against the background of Nordic Ecolabelling's objective of reducing resource consumption and on the same basis as choice of paper.

There are no changes in the calculation of points for waste paper. On the other hand, there has been an increase in stringency with regard to the financial calculations that may be used for waste paper generated externally, since with effect from this generation of criteria, waste paper is used to calculate production quantity. Furthermore, the documentation requirements have been tightened to the effect that waste paper generated internally has to be stated on the basis of weighing – either as specified on the invoice from the collectors or by in-house weighing.

Nordic Ecolabelling has collected data and calculated a market average for the volume of waste paper for each printing method (Appendix 1). The sum of the market average for this and other parameters, plus an overall points addition, constitutes the points limit for obtaining a licence (see Section 7.24).

Points for waste paper
The formula for calculating waste paper points is:

Points = 10/35x(40 - waste paper percentage)
Max. 10 points

The formula has been adjusted slightly relative to the fourth generation criteria in order to make it more precise in mathematical terms.

The reason why waste paper gives 0 points at 40% is that waste paper at the printing company examined by Nordic Ecolabelling may account for as much as 40% (see information in Appendix 1). Nordic Ecolabelling has not seen any ex-

amples of printers with 0% waste paper and this is why a maximum score of 10% is achieved already at 5% waste paper.

The points scale is accordingly independent of the printing method used. For instance, it can seem strange and act as a disincentive to make improvements that a digital printer can obtain points for waste paper if, hypothetically, the printing company's waste paper should be above 20% when the average is just under 10% (see Appendix 1). If the totality is considered, however, a different picture emerges: a digital printer with significant deviations from the average will find it considerably more difficult to comply with the overall points limit for digital printing.

The maximum points to be scored are 10 for waste paper. This means that the total score attainable for paper or areas related to paper is 45 (of which 25 for choice of paper, 7 for recycling as regards printing inks and 3 for recycling with regard to adhesives). The reason that the waste paper score is not higher contrary to what life cycle studies indicate is that the combination of orders can be such that a printing company will often produce printed matter that contributes significantly to waste paper.

Waste paper at the printing company
Considerable quantities of waste paper can be generated at a printing company. Although this is paper that goes for recycling, it would still be an advantage to minimise the quantities. Nordic Ecolabelling has observed up to 30-40% waste paper at offset printers. In the 2009 evaluation the average for sheet fed offset printers, for instance, was 23%, whereas for newspaper presses it was 11% (see appendix 1). Since paper accounts for a major part of the cost of producing an item of printed matter, it is of major significance to both the environment and the economy. The difference in values is one of the reasons why Nordic Ecolabelling operates with different points for different printing methods. This gives an incentive to make improvements for each printing method.

Many people at the printers will exert influence: Salespersons, production planners, buyers, printers and book binders. In addition, the printing machines available and the customer will obviously influence the amount of waste paper generated. One area in which the printer will not be able to exert influence is the customers' disposal of printed matter for which they no longer have any use.

In addition to the waste paper occurring in connection with the production of an order, a small quantity in excess of the order is often printed so as to be certain that the customer gets the quantity ordered. This type of planned “overproduction” is necessary because some items will be lost in connection with, for example, the setting up of printing and finishing machinery.

One recent study measured “overproduction” on the basis of test printing of two standard jobs on three different digital printing machines at three different digital printers in Sweden and Denmark (Christensen 2010). Overproduction is the de facto measure of extra items received by the customer over and above the quantity ordered. The study found that overproduction in connection with the two specific jobs at the three printers on average was approximately 11% relative to the

paper consumed in the order and moreover that waste paper on average totalled approximately 6.5%. In other words "overproduction" often accounts for a greater proportion of waste than waste paper in digital printing production.

Calculation of waste paper

Waste paper occurs in many areas of printing and for a variety of reasons. Nordic Ecolabelling demands that waste paper is calculated on the basis of weight. The printer must either weigh the waste paper itself or obtain information about weight from those who collect the waste paper.

The printer need not add up waste paper for each printing method; calculating waste paper for the entire printing company will suffice. The Nordic Print Portal undertakes to distribute the waste paper on each printing method in relation to the market average (see the table below) for each method and makes all the calculations. The fourth generation of criteria permitted a theoretical calculation of waste paper on the basis of the order calculation, but this method was not used and was consequently abandoned.

Table **Fejl! Henvisningskilde ikke fundet.**. Average, rounded-off market values for waste paper (data from Appendix 1).

Printing method	**Average waste paper (%)**
Sheet fed offset (except packaging and offset printing of envelopes)	23
Coldset, newspapers	10
Coldset, forms	18
Coldset rotation (except newspaper and form printing)	19
Heatset rotation	21
Gravure printing	12
Flexographic printing (except envelope production)	11
Digital printing	10
Offset printing, envelopes	4
Envelope production with flexography	15
Offset, packaging	36

Waste paper includes shavings or cutting waste, waste from starting runs in the print works and the bindery (e.g. running-in in connection with folding, gluing, stitching), waste paper generated during printing and finising operations, waste paper from paper storage (discarded unprinted paper) and leftover paper in rolls or other unused paper for printing.

To ensure uniformity in figures, waste paper figures do not include packaging of the printing paper, rolls, or if the printing company carries out bookbinding activities for other printers. Furthermore, the fourth generation of criteria enabled an

exclusion of waste paper based on the customer's changes to the order placed. This possibility has been removed in the fifth generation of the criteria, as it does not make any difference from an environmental point of view. Also, the printer is expected to have a certain influence on the organisation of the production process in collaboration with the customer so that changes to the order placed can be incorporated before printing.

The option of deducting the start-up waste paper was removed in the fifth generation of criteria as new technology has provided better machines with less start-up waste paper and better machines for digital printing. Small printing companies have also proved often to be good at keeping the start-up waste paper at a low level, as small machines with fewer ink units do not necessarily generate as much start-up waste paper.

Waste paper generated by outside finishers
By contrast it may be difficult to determine the total amount of waste paper generated if an external finisher is used to finish the printed matter (mechanical finishing). It is a widely held view that little waste paper is generated by external finishers. However, detailed measurements at a major sheet fed offset printer with its own bookbinder indicate that on average half of the total waste paper generated occurs at the bookbinders (Skovlund 2005a).

A Danish study found that waste generated by bookbinders makes up some two-thirds or more of total waste paper. This was calculated on the basis of a number of standard jobs and is not based on actual measurements (Danish EPA 2000, pp. 10-20).

The recent Danish study referred to in the preceding paragraph measured waste paper from production in such detail that it is possible to see how much relates to printing and how much to finishing on two standard jobs produced by digital printers. The study found that 66% of waste paper is from finishing.

For Nordic ecolabelled printers with sheet fed offset only, an average of 26% of the paper purchased is sent to external finishing (mechanical), calculated on the basis of the overall quantities for printing companies according to data from February 2010. If waste paper generated externally had not been included, the average quantity of waste paper would have been 18% calculated on the basis of the total quantity of paper purchased and the total quantity of waste paper for these printers. The inclusion of waste paper generated externally pushes the figure up to 21%, if it is assumed that half of the waste paper is created at the bookbinder. If it is assumed that two-thirds is created at the bookbinder, the figure will be 22%, which indicates that it makes no great difference whether half or two-thirds of the waste paper is generated at the bookbinder.

Based on the above observations the criteria require waste paper generated at external bookbinders to be included in the calculation of the total waste paper. This is done by multiplying the waste paper from the *printing* of the part that goes to external bookbinders by a factor of 2 as a template value. If some other figure can be documented, then this may be used. For example, the point of departure could be a documented quantity of waste paper generated by a bookbind-

er (e.g. documented with the aid of invoices from transport providers), viewed in relation to the proportion the printers' turnover with the bookbinder represents in relation to the bookbinder's total turnover.

To illustrate the calculation of total waste paper by means of the "factor 2 principle", an example is given in the criteria in Appendix 7: The Nordic Print Portal makes these calculations for the printing companies, but from the example it can be seen that it would be sufficient to use:

- Total quantity of waste paper internally at the printing company (both from printing and internal finishing, if any)
- The quantity of paper purchased for the orders finished externally.

This latter quantity may be difficult to determine, but can be calculated with the aid of key financial figures if the precise quantities of paper that are used/purchased on orders finished externally cannot be found in the accounting system. The financial calculation must be based on overall payments to external providers of finishing services and must be related to 8% of the total turnover of the printing company and the total quantity of paper purchased.

The figure of 8% is based on the fact that finishing makes up a smaller portion of the cost of production. Typically it may be approximately 5% for internal finishing and 8-10% for external finishing. It should be noted, however, that a great deal will depend on the type of products the individual printer produces and the degree to which these products are processed, e.g. gluing. Costs will be a good deal higher in the case of laminating and UV varnishing. Accordingly the figure of 8% has been selected so that external waste paper does not account for too little in the printing company's overall calculations.

A printing company has expenses of DKK 500,000 for bookbinding and a turnover of its own of 20 million. If account is not taken of the fact that bookbinding makes up a smaller proportion of the costs, this would mean that 0.5/20= 2.5% of the purchased paper. The 8% rule means that the figure will instead be 0.5/(20*0.08) = 31.25%.

The example in Appendix 7 to the criteria document illustrates the situation in which one-quarter of the output is sent to an external bookbinder and the rest is finished at the printing company. Calculated according to the calculation method of the criteria document, total waste paper including internal and external finishing, will be 30% of paper purchased. If the printer does not include external finishing, the waste paper percentage will be only approximately 26%.

7.8 Requirements as to chemicals and materials (O5)

Printers are required to comply with a number of requirements relating to the main chemicals and materials that they use. The chemical requirement has been selected against the background of Nordic Ecolabelling's objective of reducing

the problems associated with chemicals in the aquatic environment and reducing health problems.

The requirements applicable to chemicals and materials are stricter now when compared with the latest generation of the criteria; for example many of the most problematical constituent substances have been prohibited on the basis of the REACH legislation. Moreover, the triviality thresholds have been increased, so that in practice almost all chemicals and materials must be inspected. This applies in particular to chemicals and materials which form part of the finished printed matter.

The requirement is divided into a general part applicable to all chemicals and to some extent also to materials, a specific part containing requirements as to individual categories of chemicals and materials, and an information section where the supplier must provide information underlying the various points scored under the points system of the criteria document. The general part encompasses requirements applicable to prohibited classifications and particularly problematical constituent substances. The specific part consists of selected requirements concerning certain categories. Exemptions are also specified, where necessary.

In general, only those chemicals and materials used in the greatest quantities in connection with prepress, printing and finishing are encompassed by the requirements. In the case of materials those that are encompassed must be materials other than paper and must form part of the finished item of printed matter.

Toners and inks used in pre-press are encompassed by the fifth generation requirements of the criteria, since test printing often involves the use of the same type of machines that are used for producing certain types of printed matter with high quality requirements. The option of exempting toners and inks used in connection with address printing has also been removed since they may contain problematical substances in the same way as other toners and inks; moreover in Nordic Ecolabelling's assessment the triviality thresholds provide sufficient scope for exempting small quantities.

As from the fifth generation, all chemicals for film and plate production are encompassed by the general chemical requirements (environmental hazard, health risk and particularly problematic substances). This applies typically to plate developer and finishing chemicals, but also chemicals for the production of plates for flexographic printing and rotogravure cylinders. In the case of these chemicals, VOC must also be specified, since organic solvents occur in some of these chemicals. The background to this tightening-up is the greater use of CTP technology, including non-chemical CTP, and the fact that film development is more or less a thing of the past. Points are still available if these chemicals are avoided under the points score for reprochemicals (see Section 7.12).

Chemicals used in ordinary cleaning are not encompassed by the requirement. As from the fifth generation criteria also washing agents used in bookbinding machines are encompassed by the requirements. A number of auxiliary chemicals, such as spray powder or anti-drying, are still not encompassed, as these are used in small quantities and do not normally have inherent properties associated with

health or environmental problems. In some of the requirements not all types of chemicals are encompassed. In these cases the exceptions are stated.

The chemical and material requirements are compiled in Appendix 1 to the criteria document. The reason for this is that these requirements are documented either by the supplier or by the manufacturer of the individual chemical, and not by the printing company. The Nordic Print Portal provides information to printing companies about which chemicals and materials are of the inspected type.

Triviality thresholds
In order to ensure that registration does not involve too great an administrative burden for printing companies, certain triviality thresholds have been introduced in each chemical/material category, to be calculated on the basis of annual consumption.

In addition to the triviality thresholds applicable to chemicals and materials purchased or received during the last year, the fifth generation of the criteria introduces a triviality threshold for non-inspected old chemicals and materials. This limit is 5% calculated in relation to purchased quantities during the course of the year within each category based on Nordic Ecolabelling's estimate of the quantity of old chemicals kept in stock at the printing companies. An old chemical/material is a chemical/material purchased before the latest reporting year. This means that from the fifth generation of the criteria onwards printers must know what quantities they have in stock of the various types of chemicals and materials.

The triviality thresholds were tightened up effective from the fifth generation of the criteria so that at least 99% by weight of all chemicals and materials purchased/received during the year and which form part of the finished item of printed matter must comply with the requirements. These are the so-called "product chemicals/materials": printing inks, toners, inks, varnish, glues, foils for foil printing and laminating foils. The reason that chemicals/materials "received" are included is that printing companies sometimes are presented with a few chemicals as gifts. This may be, for instance, in connection with the installation of a new printing machine.

The triviality threshold of 99% by weight corresponds on average to a maximum non-compliance of some 0.01 weight per cent of printing inks with the requirements calculated in relation to the annual output. Typically, printing inks is the chemical that is used the most, but for other chemicals and materials the threshold is expressed in weight per cent of output, for which reason it is even lower. (Based on Fred Larsen et al 2009.) Data from about the year 2000 cover 11 offset printers (7 sheet fed, 3 coldset news print, 1 heatset).

For practical reasons, an alternative triviality threshold of 10 kg for each category applies to printing inks, adhesives and varnish as in the previous generation of the criteria. The reason that the alternative triviality threshold does not apply to other product chemicals/materials is that these may be present in small quantities, or that it is not customary to alternate between different makes (toner and ink) and consequently these are not present at the printing company. The alternative

triviality threshold has been introduced to reduce the administrative burden for printing companies with many chemicals/materials in very small quantities.

Unlike in the previous generation of the criteria, printing inks, inks and toner may no longer be viewed as one category. With this tightening up of the criteria, Nordic Ecolabelling wishes to ensure that the digital printing techniques do use chemicals that live up to strict requirements.

The triviality thresholds have been tightened up against the background of a general wish to make the requirements stricter, where possible. Moreover, there is an expectation on the part of consumers that printed matter produced by Nordic ecolabelled printing companies, with or without a Nordic ecolabel logo, will be free of, or contain as little as possible of chemicals and materials that fail to fulfil the requirements.

Other chemicals can be categorised as process chemicals, these being washing agents and dampening solution additives as well as algecides and other chemicals for film and printing form production. Requirements as to chemicals in film and printing form production are new in this generation of criteria; together with algecides they are considered one overall category. In the case of washing agents and dampening solution additives the triviality threshold for each is still 5% of what was purchased/received during the year. The triviality threshold of 5% has also been chosen for the category consisting of the group of chemicals for film and printing form production, including algecides.

The 5% level has been set based on experience from previous criteria. Before the criteria were extended to cover the entire printing company, there was a triviality threshold of 2% for washing agents in relation to the total quantity of washing agents. When Nordic Ecolabelling changed the criteria to apply to the entire printing company, it was no longer equally easy to exempt certain parts of production. This is why a higher triviality threshold of 5% for each of the process chemicals was introduced.

In the case of washing agents and dampening solution additives the absolute triviality threshold of 10 kg in the previous generation of the criteria was amended to 0.1 kg per tonne of product for each category. This threshold was also introduced for chemicals in the film and printing form production, including algecides. The background to the threshold of 0.1 kg per tonne of product is experience derived from the licensing process in which printers that reduce both their consumption of non-inspected washing agents and the overall quantity of washing agents are in some cases penalised. In one example from the licensing process a printing company reduced its absolute quantities of non-inspected washing agents by some 60%, whereas the non-inspected *proportion* increased from 4 to 7% because the overall quantity of washing agents had also been reduced. This problem is avoided by relating one of the triviality thresholds to tonnes of product.

The level has been set at 0.1 kg per tonne of product on the basis of observations of licensing data. The average quantity of non-inspected washing agents for printers with sheet offset only is 0.15 kg/tonne of paper. This figure is based exclusively on printing companies that use washing agents which do not meet the

requirements. If the threshold of 0.1 kg/tonne of paper consumption is converted to kg/tonne of product with the aid of average waste paper quantities for sheet offset, a figure of 0.13 is reached. This is rounded off to 0.1. The corresponding figure for dampening solution additives is 0.06 kg/tonne. Chemicals in film and printing form production, including algecides, is at the same level as dampening solution additives (Larsen et al 2009). Non-inspected process chemicals do not occur in the same quantities in other printing methods.

The licensing process revealed that the reason a printing company has used the triviality threshold is often that the chemical is absent from the data base rather than the fact that it does not fulfil the requirements. In the case of washing agents, however, a number of chemicals have been used that have not met the environmental hazard classification requirement. In future generations of the criteria it may become relevant to assess a lower percentage limit also for process chemicals.

Classification
Nordic Ecolabelling's classification requirements lean heavily on the official rules for classification with the aim of excluding the worst chemicals used by printers and with some exceptions - which are discussed below - have not been changed since the last generation of the criteria. In the criteria chemicals are defined as products used by the printing company (either substances or mixtures) and not on the basis of constituent substances contained in the products. Accordingly the classification regulations determine how much of the individual classified substances the products may contain before the products themselves are subject to classification. In future criteria Nordic Ecolabelling will consider whether the classification requirements can be changed so that they apply at substance level.

The rules in question are the "old" directives 67/548/EEC (the Dangerous Substances Directive) and 99/45/EC (the Dangerous Preparations Directive) with subsequent amendments and adjustments and/or the new CLP Regulation 1272/2008/EC. The old and the new regulations are both encompassed by the requirements since the new provisions come into force for pure substances during a transition period between 2010 and 2015. In the case of mixtures the rules do not come into force until 2015.

In accordance with its environmental toxins policy, Nordic Ecolabelling wishes to exclude the worst hazard phrases (Nordic Ecolabelling 2007). These are the same as can be found in the EU ecolabel's "environmental toxins policy" in article 6 subsection 6 of the EU ecolabel regulation (European Parliament and Council 2010). In order to maintain consistency with this policy, the following risk and hazard phrases for "other toxicological effects" have been added effective from the fifth generation of criteria.

Table **Fejl! Henvisningskilde ikke fundet.**b. New prohibited R phrases and hazard phrases in the fifth generation of the criteria

Prohibited R phrases	**Wording R phrase**	**CLP hazard phrase**
R64 in combination with other R phrases	May cause harm to breast-fed babies	H362

R33 in combination with other R phrases	Danger of cumulative effects in the body after repeated use	H373
R29 in combination with other R phrases	Develops toxic gas in contact with water	EUH 029
R31 in combination with other R phrases	Develops toxic gas in contact with acid	EUH 031
R32 in combination with other R phrases	Develops very toxic gas in contact with acid	EUH 032

Also added is R65 "Harmful: May cause lung damage if swallowed" (H304 "May be fatal if swallowed and enters airways") and the combination phrase R39-41 (CLP: EUH 070) "Toxic by eye contact" as a consequence of the environmental toxins policy. For further information on R65 and exemptions, see the section below on other health-related effects. For the present the combination phrase R39-41 is found only on three substances on the list of hazardous substances which are all classified with this combination (European Chemicals Bureau 2007).

In addition to the risk and hazard phrases that are excluded against the background of the environmental toxins policy, phrases relating to sensitising effects (allergenic effects), R42 or R43 (CLP: H334 or H317), are also excluded, however with the exception of certain types of chemicals. For further information see the section below on Allergies.

Classification and environmental hazard
The requirement that chemicals must not be classified as an environmental hazard has not been changed since the fourth generation of the criteria. The reason that exemptions apply in the case of environmental hazard classification for algecides is that Nordic Ecolabelling wishes to avoid the risk that the environmental problems are shifted, for example that the requirement results in an increase in the transportation of water in diluted chemicals. Accordingly, an exemption applies in the case of algecides since these typically contain substances classified as environmental hazards. Nevertheless, the algecides must not be so toxic that the recommended solution for use could not be classified as an environmental hazard.

Printing inks, varnishes, inks and toners that are curable by radiation are also exempted since some of these are classified as environmental hazards in the uncured state. In the cured state these will not represent a hazard to the aquatic environment.

Classification and health risk
The requirement that chemicals labelled as harmful to health must be limited has largely not been changed since the last generation of the criteria and typically applies to substances that are to be allocated risk phrases by the European Union or in accordance with regulations are to indicate that the chemicals have mortal/seriously harmful effects, or chronic effects, for example that they are carcinogenic, mutagenic or reprotoxic (termed the CMR effects). The few changes involved are summarised above in the section on classification.

Classification with regard to CMR effects

As regards the CMR effects, all R phrases are excluded irrespective of whether the CMR effect is category 1, 2 or 3. In addition to the safety offered to end users, the exclusion of chemicals that are classified as harmful to health will safeguard a good chemical working environment. The requirement will, inter alia, exclude the use of chemicals containing more than 0.1% benzene, since benzene is classified as carcinogenic.

Toluene is inter alia classified as R63 Cat 3 (Possible risk of harm to the unborn child) and R48/20 (Danger of serious damage to health by prolonged exposure by inhalation). These hazard phrases are both prohibited under the classification requirements. However, toluene is permitted in printing inks and washing agents for gravure printing since no substitutes are available. Experiments with water based gravure printing have been carried out, but these entailed increasing problems with de-inking in the recycling process (Hofman 2001, p. 6). To compensate for this exemption, Nordic Ecolabelling has introduced a new requirement to the effect that a minimum share of all toluene used must be recycled (see section 7.14).

In connection with the manufacture of rotogravure cylinders, chemicals containing copper sulphate are used to build up a copper layer on the cylinder in which to engrave the image. The chemicals containing copper sulphate are classified as R50/53 (Very toxic to aquatic organisms; May cause long-term adverse effects in the aquatic environment). This copper process is a central part of the manufacture of the rotogravure printing form and cannot be substituted. This is the reason why these chemicals are exempted.

To obtain a hard and durable surface on the rotogravure cylinder, on which large print runs can be performed without replacement, chromium plating is made in connection with the manufacture of the cylinder. Chemicals containing chromium trioxide to be used for the chromium plating are classified as R62 Rep 3 (Possible risk of impaired fertility), R45 Carc 1 (May cause cancer), R46 Mut 2 (May cause heritable generic damage), R24/25 (Toxic in contact with skin and if swallowed), R48/23 (danger of serious damage to health by prolonged exposure through inhalation) and R42/43 (May cause sensitisation by inhalation and skin contact). Chemicals containing chromium trioxide in the cylinder production are exempted from the classification requirement as these are central to the printing of very large runs and cannot be substituted.

To compensate for the exemptions regarding copper sulphate and chromium trioxide Nordic Ecolabelling has introduced a requirement setting a maximum limit for emissions of copper and chromium to the drainage system, and a maximum limit for chromium emissions to air. The requirement originates in the EU ecolabel's criteria for printed matter (see section 7.14).

According to Statistics Norway some 300 tonnes of CMR substances were used in Norway in 2003 (Aasestad 2005). Most of these were developing fluids for film development. The substances in such developing fluids are difficult to substitute (see the background document to the Nordic Ecolabelling criteria for photographic development). Moreover, in Nordic Ecolabelling's assessment the consumption of developing fluids by printing companies is decreasingly significant-

ly in line with the introduction of CTP technology. It is not entirely clear whether the figure of 300 tonnes also encompasses other use than use by printers.

According to the study only 4% "other products" (i.e. other products than developing fluids) with a CMR effect are used. Statistics Norway also reports that acutely toxic chemicals and chemicals with other chronic effects than CMR are in limited use. Nordic Ecolabelling accordingly does not expect this requirement to have major effects. The requirement should therefore be viewed as more of a catch-all requirement.

Classification and allergy
With effect from the fifth generation of the criteria Nordic Ecolabelling introduced a general ban on allergenic chemicals with risk phrases R42 or R43 (CLP: H334 or H317). According to the study discussed above, the consumption of allergenic chemicals is almost as great as the consumption of chemicals with CMR effects. The study does not specify precisely which chemicals are involved, but states generally that the chemicals with harmful effects on health that are most widely used are printing inks, dampening solution additives and developing fluids.

There are however a number of chemicals that are typically classified as allergenic because of their properties. Accordingly substitution is not possible at present, and the following substances have therefore been exempted:

- Energy curing UV printing inks/toners/inks and varnishes
- 2-component adhesives (e.g. PUR)
- Algecides and dampening solution additives that according to the recommended dosage of the manufacturer must be diluted so much that the solution used should not be classifiable.

Exempting allergenic 2-component adhesives or UV-curing printing inks/toners/inks and varnishes is relevant because they are cured in the production process and accordingly will no longer have an allergenic effect provided that the curing process proceeds in accordance with the manufacturer's recommendations and the rules of working environment authorities.

Algecides and dampening solution additives typically contain preservatives/biocides which in addition to being allergenic are often also classified as environmental hazards (e.g. Kathon). These biocides are essential to the performance of these products and cannot readily be substituted. If the solution used is diluted to the point at which it would not be classifiable had it been encompassed by the rules, there is very little risk of an allergy hazard at the printing company.

As far as Nordic Ecolabelling is aware, large quantities of other chemicals with allergenic properties do not occur at printers and accordingly the requirement should be viewed as a general requirement put in place to prevent newly developed chemicals from being classified as allergenic.

Classification and other health-related effects
With effect from the fifth generation of the criteria R65 is prohibited (CLP: H304 "May be fatal if swallowed and enters airways", see discussion under classifica-

tion. Mineral oil based washing agents frequently carry the R65 phrase. Although printing inks contain large quantities of mineral oils, printing inks labelled R65 are not widely used since there must be over 10% and at the same time the product must flow freely (have low viscosity). Although the industry has worked for several years to introduce vegetable washing agents, this has proved to be difficult since the use of vegetable washing agents leaves too much of a greasy film. As a consequence Nordic Ecolabelling has temporarily exempted washing agents from the R65 requirement.

Particularly problematic constituent substances
As a supplement to the requirements concerning prohibited classifications there are a number of chemical substances that must not be added to the chemicals. With effect from the fifth generation of the criteria document the requirement will also apply to chemical substances added to the materials. Products or materials used by the printer may contain substances that have not been added intentionally, for example pollutants or traces from the production process. These are not encompassed by the requirement, even though they may have properties that Nordic Ecolabelling wishes to prohibit.

The requirement applicable to particularly problematical constituent substances is divided into one part containing named substances or substance groups and, effective from the fifth generation of the criteria, one part concerning substances defined on the basis of certain particularly problematical properties.

A newer Germany study examined the migration of mineral oils, including aromatic compounds, from printed food packaging made of cardboard to foods. Mainly dry foods with large specific surfaces containing fat and with long shelf life are at risk. It is suspected that the source, being mineral oil, contains these aromatic compounds and when used in printing inks they end up in a food carton made from recycled paper. Consequently, it would be relevant to limit the use of mineral oils with an aromatic fraction in the paper product cycle (Vollmer et al 2011).

To guarantee a certain quality level, suppliers of printing inks to the graphics industry use specifications/guidelines for mineral oils published by CEPE (European Council of the Paint, Printing Ink and Artist's Colours), based on negative lists of carcinogenic impurities (Møller 2011).

Suppliers also use specifications of carbon black pigment, restricting the extractable fraction of toluene to 0.15% and the contents of benzo(α)pyrene to 250 ppb for printing inks intended for food packaging (Møller 2011).

Nordic Ecolabelling will consider requirements in the future revisions to minimise the risk that problematic aromatic compounds may end up in materials made from recycled paper.

Alkyl phenol ethoxylates
The requirement contains a prohibition against alkyl phenol ethoxylates or derivatives thereof. Examples of these substances are found in adhesives and washing agents, and they also occur in printing inks used in water-based flexography

(Fred Larsen et al 2002). Since there is a widespread wish in the Nordic countries (for example on the Danish list of prohibited substances) that these substances should be removed from the cycle it has been decided, as in earlier generation of the criteria, that these substances should generally be prohibited. Some of these substances are recorded on the European Union's list of substances that cause endocrine disruption: nonylphenol ethoxylate, CAS: 9016-45-9, nonylphenol diethoxylate, CAS: 20427-84-3 and nonylphenol nonaethoxylate, CAS: 14409-72-4 (DHI-study).

The list also contains alkyl phenolethoxilates on which there is as yet insufficient data for hormone classification, e.g. octylphenol ethoxylate (CAS: 1322-97-0). Nordic Ecolabelling has therefore opted to retain a general prohibition on the basis of an analogous consideration.

EDTA
EDTA can mobilise heavy metals from sediment because of its strong complexing properties (Danish EPA 1989). EDTA is found in a few heatset printing inks to prevent the formation of lime deposits and as a consequence poor printing quality. However, it is possible to find substitutes for this complexing agent. EDTA is also found in washing agents for water based flexography (Fred Larsen et al 2002).

The EU's risk assessment of the substance focuses on EDTA in paper production. Commission communication 2006/C 90/04 proposes that EDTA should be addressed in ecolabelling criteria for paper products. The reason given is that there are concerns about the environmental effects of the substance, inter alia as a result of exposure during paper production and emissions in connection with the recycling of waste containing EDTA.

Sodium and calcium hypochlorite
Sodium and calcium hypochlorite are on the Danish list of prohibited substances because of the risk of the formation of organo-chlorine compounds (Danish EPA 2010). In the past hypochlorite has been found in washing agents used in screen printing (Fred Larsen 1998). Although this printing method is no longer covered by the criteria, Nordic Ecolabelling is maintaining the prohibition since this is a very widely used cleaning agent which could also be used by other printers.

Poly and perflourinated alkylated compounds - PFAS
In the fifth generation of the criteria the term PFOS-related substances was modified to "PFAS – poly and perflourinated alkylated compounds" in order to cover a broader group of this type of problematical compounds. The most widely studied and best known PFOS and PFOS-related compounds are now prohibited and no longer produced (Astrup Jensen et al 2008). Nordic Ecolabelling's definition of this group of substances deviates from the definition used by the OECD, Nordic Ecolabelling's definition being somewhat broader (Nordic Ecolabelling 2010b).

PFAS compounds break down into the very stable PFOS (perfluorooctane sulphonate compounds) and PFOA (perfluorooctane sulphonic acid compounds) and related substances. These substances are found everywhere on the planet,

from the great oceans to the Arctic regions. PFOS has been found in polar bears, birds and fish and in their eggs. The substances are persistent and easily absorbed in the body. Moreover, the substances in the substance group influence the biological processes of the body and are suspected not only of endocrine disruption, but also of carcinogenic properties (Danish EPA 2005a).

One known example of the occurrence of perfluorinated substances or PFOS-related substances is in grease-proof additives in paper bags used for microwave popcorn (Astrup Jensen et al 2008, s. 98). An example has also occurred of the use of fluorinated wax (CAS 9002-84-0) in printing inks to protect the surface and make it more even. According to the Danish EPA's study of alternatives to PFOS, replacements have been found within the area of paints and varnishes (Danish EPA 2005a). PFOA and PFOS are on the Danish and Norwegian lists of prohibited substances (Danish Epa 2010 and *Miljøstatus* 2011). In a recent study of 74 samples of paper and board for packaging of rye bread, cakes, popcorn, sandwiches, müsli, frozen food, fast food, etc. there were polyfluorinated surface-active substances (PFS) in 57% of the samples (Trier 2011). According to the very same study there are, in fact, alternatives to these substances to be found in the market.

Previously PFOS was regulated in the Limitations Directive for Dangerous Substances and Preparations (76/769/EEC); however, this directive ceased to apply as from June 1, 2009. The restrictions on PFOS previously found in the Directive are now instead found in Annex XVII entry 53 to the Reach Directive (1907/2006). PFOS (perfluorooctane sulphonate) must not be used in the market in semi-manufactures of products or goods or parts thereof if the concentration of PFOS is equal to or greater than 0.1 by weight, although a number of exceptions apply, for example light-sensitive coatings for film, paper or printing plates.

Substances that have been removed from the list of particularly problematical substances

NTA was on the Danish list of carcinogenic substances (Danish Working Environment Service 2002). With effect from the fifth generation of the criteria the requirement relating to particularly problematical substances was extended to apply to all CMR substances and accordingly NTA was removed from the requirement as an independent substance, since the substance was classified as Carc3 (Danish EPA 2010).

Effective from the fifth generation of the criteria LAS has been removed from the prohibition in the criteria against particularly problematical substances. In fact the substance has been removed from the list of prohibited substances because changes in consumption patterns meant that it no longer constituted as great a problem in the waste cycle. Moreover data had been produced to show that the substance was not as problematical as had previously been assumed. In Norway, however, attention is still focused on the substance and it is on the list of substances that have been reviewed in a report by the Norwegian Committee on Environmental Poisons (Miljøgiftsutvalget 2010) on how to restrict the use of environmental toxins posing a threat to health and the environment.

Substances of very high concern (SVHC) and CMR substances

As has already been noted, with effect from the fifth generation of the criteria, a prohibition has been introduced against substances with particularly problematical properties, i.e. the prohibition applies in general to all constituent substances with these properties. This increase in the stringency of the requirement is based on what are termed Substances of Very High Concern (SVHC) in EU chemical legislation (REACH Directive 1907/2006/EC).

Nordic Ecolabelling's assessment is that the major suppliers have for many years avoided this type of substance by using substitutes and that, consequently, the requirement should be regarded primarily as a general requirement. For example, the European printing ink-related industry has for a number of years been working on what is termed EuPIA Exclusion List, which inter alia prohibits CMR-substances in category 1 and 2 (EuPIA 2007).

More specifically, the prohibition against SVHC substances involves substances that fulfil the criteria of Article 57 of the REACH Directive with the single modification that Nordic Ecolabelling extends the criteria so that the requirements encompass more substances than those categorised in REACH as Substances of Very High Concern. Moreover, Nordic Ecolabelling refers to official lists of substances that fulfil the criteria in order to facilitate the assessment of whether the requirement is fulfilled:

1) Carcinogenic/mutagenic/reprotoxic (CMR) substances in category 1 or 2. CMR substances in category 3 are also included, even though they are not regarded as SVHC substances.

2) PBT substances (persistent, bioaccumulative and toxic) and/or vPvB substances (very persistent and very bioaccumulative) in accordance with the criteria in Annex XIII to REACH (Directive 1907/2006/EC).

3) Substances regarded as endocrine disrupters or potential endocrine disrupters in accordance with EU reports and lists on endocrine disruptive substances.

4) Substances recorded on the EU's Candidate List and not meeting the criteria requirements in points 1-3 above.

The lists specified here may be amended during the term of validity of the criteria document. Toluene is exempted from the requirement regarding particularly problematical substances for the same reason that toluene-based washing agents and printing inks are exempted from the classification requirement. It is also for this reason that chromium trioxide is exempted from the requirement regarding particularly problematical substances. However, to compensate for these exemptions, please see the requirements regarding limitation of emissions (Section 7.14).

The substances to which restrictions apply are those that have or should be allocated a risk phrase indicating that the chemical is carcinogenic, mutagenic or toxic to reproduction (termed 'CMR effects') according to EU classification legis-

lation. All chemicals with CMR R phrases are excluded, irrespective of whether they cover Category 1, 2 or 3 CMR effects.

CMR category 3 according to the old chemical legislation has also been included, even though it is not considered to be a substance of "Very High Concern". It is based on the strict policy of Nordic Ecolabelling on environmentally toxic chemicals (*Miljøgiftspolicy for Nordisk Miljømerking, Behandlet av NMN juni 2007*). the assessment that these substances is already mostly avoided in chemicals and materials at printing companies. Furthermore, it provides guidelines of which substances chemicals suppliers are to avoid when formulating new products.

The exclusion of substances that are harmful to health will minimise possible health issues related to the use of the product, but will also improve the chemical working environment during the manufacturing of the product.

To facilitate the use of the criteria for manufacturers of chemicals and materials supplied to printing companies, Nordic Ecolabelling added a link to the European Chemical Bureau's database. This database contains legally binding and recommended classifications of substances in the EU:

http://ecb.jrc.it/esis/index.php?PGM=cla

An example of a CMR substance used in printing inks is Hydroquinone. Hydroquinone is used as antioxidant in oxidising printing inks and is classified as R40 (Cat 2) among other R-phrases. The substance has been a known carcinogen for some time and substitutes have been available.

PBT and vPvB substances
Substances which fulfil, or substances which form other substances which fulfil, the PBT or vPvB criteria can be found on the website of the European Chemical Bureau:

http://ecb.jrc.it/esis/index.php?PGM=pbt

In 2010 this list contained more than 60 substances concluded not to fulfil the criteria for PBT or vPvB and more than 20 substances under evaluation. This indicates that many substances that originally were suspected PBT or vPvB-substances turned out not to have those properties after finished evaluation. Therefore only substances fulfilling the criteria for PBT and/or vPvB substances are included in the requirement. Substances that have been deferred or substances that are subject to an evaluation are therefore not considered to have PBT or vPvB properties.

Most of the chemicals satisfying the criteria for PBT or vPvB substances will also be classified as dangerous to the environment. But the PBT and vPvB criteria go beyond the classification criteria. If the long-term toxicity (NOEC, no effect concentration) is very high, the substance may qualify for PBT classification.

There are for example a number of pigments that are suspected of being PBT or vPvB substances (Pedersen 2004). The charted substances have subsequently proved not to be PBT or vPvB in accordance with the ECB: (Pigment yellow 83, Pigment yellow 14, Pigment yellow 13, Pigment orange 13 and C9-C12-iso-alkanes).

Endocrine disrupters
The requirement regarding endocrine disrupters is based on the EU implementation of a Community strategy for endocrine disrupters. The strategy covers a range of substances suspected of interfering with the hormone systems of humans and wildlife. On rare occasions some washing agents have contained phthalates which are endocrine disrupters. Typical examples of phthalates that are hormone disruptive substances are DEHP, BBP, DBP, DINP and DNOP.

The prohibition against hormone-disruptive phthalates was extended with effect from the fifth generation of the criteria onwards to apply to all endocrine disrupters provided for on the EU's lists, and not solely phthalates.

The EU has what is termed a priority list containing substances that have been subject to an assessment for endocrine disruptive effects and which forms the basis for Nordic Ecolabelling's requirements. The list is the result of a number of earlier studies and is from September 2007. The updated priority list from 2007 contains 428 substances and is included in list L in the "Final Report of the DHI-Study" on the EU Endocrine Disrupters website. The list is available at the website of the EU Endocrine Disrupters:

http://ec.europa.eu/environment/endocrine/strategy/substances_en.htm

The list includes substances with evidence of endocrine disruption (194), substances considered to be potential endocrine disrupters (125) and substances originally under suspicion. The list is open to change. As new information becomes available, chemicals may either be removed from or added to the list.

Nordic Ecolabelling excludes substances in category 1 and 2. These are categories that display endocrine disruptive effects or potential endocrine disruptive effects. Category 3a substances are not prohibited, since according to the studies underlying the candidate list they do not have endocrine disruptive effects (23 substances on the list). 86 substances are in category 3b, where as yet there are no scientific grounds or suspicions that the substance has endocrine disruptive effects. Should these substances prove to be endocrine disrupters and are allocated category 1 or 2 then the substances must not be present in chemicals and materials for use by Nordic ecolabelled printing companies.

Laminating film and foils for foilprinting
Laminating film and foils for foilprinting are subject to the requirement of a maximum of 100 ppm of heavy metals, as are printing inks, and with effect from the fifth generation of the criteria the requirement concerning particularly problematical constituent substances/additives is also subject to this. In the first generations of the criteria metal foils were not encompassed by the heavy metal requirement.

Any adhesives on a laminating film and on foils for foilprinting are subjected to the chemical requirements on a par with other adhesives used by the printer. However, for practical reasons these adhesives will be inspected together with the laminating film and are not counted as separate adhesives in the points score.

In the fifth generation of the criteria a prohibition was introduced against halogenated plastic (e.g. PVC) in laminates for paper printed matter, good alternatives to for example PP (polypropylene) are available. The background to this prohibition can be found in Section 10. Nordic Ecolabelling has found that Nordic ecolabelled printing companies have replaced their PVC laminates by other materials without any resulting higher costs, even though previously this requirement merely applied to Nordic ecolabelled printed matter. It has also turned out that certain types of PVC laminating film may contain more than 100 ppm of the prohibited heavy metals.

Specific requirements applicable to heavy metals and aromatic amines
Although the new requirements relating to particularly problematical constituent substances will probably encompass many of the problematical heavy metals and aromatic amines, the requirement applicable to these substance groups has been retained. The reason for this is that the requirements applicable to heavy metals and aromatic amines also encompass any pollutants and substances shedding less stable constituent substances.

Heavy metals that occur in pigments are usually harmful and should therefore in so far as possible be excluded from the substance cycle. Accordingly, as in previous versions of the criteria, pollutants from the worst heavy metals (lead, cadmium, mercury and chromium oxidisation stage 6) have been strongly reduced in that a limit of a maximum content of 100 ppm is set for printing inks, including metal inks in inks and toners. Nordic Ecolabelling's assessment is that these heavy metals have already been phased out and the requirement should accordingly be seen as a general requirement.

This requirement minimises the possibility that these heavy metals will occur in the waste cycle. They originate in the packaging directive 94/62/EF and entered into force in 2001. In the directive the requirement applies to packaging materials or components, and the limit value encompasses the total content of the aforementioned metals.

The requirement imposing a maximum permitted content of aromatic amines in printing inks, toner and ink was introduced in the last generation of criteria against the background of a Norwegian study in which aromatic amines in printing inks are suspected of being associated with a higher risk of bladder cancer amongst print workers (Bye 2005). Aromatic amines may be shed by certain less stable azo compounds. Azo compounds are used in azocolourants, which include both dyestuffs and azo pigments. Aromatic amines may also occur as traces from the production of dyestuffs. A Danish official environmental guide for azocolourants states that azo dyes are used in the form of azo pigments in printing inks. According to the guideline these substances are stable and do not come into con-

tact with skin. Accordingly they are not encompassed by the issues relating to for example azo dyes in textiles (Danish EPA 2005b).

The requirement was nevertheless introduced on the basis of the precautionary principle and is based on European guidelines issued by the Council of Europe. This is intended to safeguard health when dyestuffs are used in plastic materials that come into contact with foodstuffs (Council of Europe 1989). According to these guidelines, the requirement level has been set so that in case migration should occur during normal use of these substances in foods, this would not be toxicologically significant.

In the Commission's directive concerning plastic materials and objects intended to come into contact with foodstuffs (2002/72/ECF), the limit value has not been set in relation to the content of aromatic amines in the dyestuff itself, but rather in relation to the content of aromatic amines in the foodstuff that has come into contact with dyestuffs used for the plastic material. There is a limit of 0.02 mg/kg foodstuffs for primary aromatic amines.

In REACH, azocolourants shedding 22 specified aromatic amines are listed in the Restricted Substances List RSL (in Annex XVII). The restriction applies to contents exceeding 30 ppm of these amines in the finished goods or in dyed components in textile and leather goods that come into contact with skin. The REACH restrictions replace the previous Azocolourants directive (2002/61/EC).

7.9 Requirements as to pressure sensitive adhesives (O6)

The printer must have documentation that pressure-sensitive adhesive will not damage the recycling process. This requirement was introduced in the fifth generation of the criteria and was chosen against the background of Nordic Ecolabelling's aim of reducing resource requirements through recycling.

The requirement was included in earlier versions of the criteria for envelopes and inclusion in the printing criteria is therefore relevant, given that the envelope criteria have been combined with these present criteria. Accordingly a general requirement has been introduced with regard to pressure-sensitive adhesive to the effect that these adhesives do not harm the recycling process. This was a requirement that was included in the former envelope criteria.

In the fifth generation of the printing criteria, the testing requirements have been specified, so that now this must be demonstrated in accordance with the INGEDE Method 12 "Assessing the Recyclability of Printed Products - Testing of Fragmentation Behaviour of Adhesive Applications", as from June 2009 or later versions. Nordic Ecolabelling requires a result of least 51 points in accordance with European Recovered Paper Council ERPC's points system. Moreover, the test must be performed on a typical type of envelope. Test methods which can be confirmed by a competent and independent third party as being similar to those of INGEDE and ERCP may also be used.

According to Putz et al 2004 there are examples of pressure sensitive adhesives that do no cause problems in the recycling process and which fulfil the requirements of INGEDE.

Pressure sensitive adhesives used only for laminating film, for mounting, or on labels or stickers, are not encompassed by the requirement. Printed matter for which laminating film has been used cannot be recycled after all, but is removed in the mechanical sorting in the recycling process. Signs to which an image/text has been fastened with the aid of mounting rarely or never end up in the recycling process since they are usually made of other materials than paper (plastic, wood, metal). Labels and stickers are not collected for the purpose of recycling, but may be present on printed matter sent for recycling. These can be removed mechanically in the same way as printed matter containing laminating film.

PSA or pressure sensitive adhesives adhere under very little pressure and accordingly neither water, solvent nor heat is needed. PSAs are used in for example self-adhesive labels, tape and self-adhesive envelopes.

PSAs cause problems since they form what are known as “stickies” in the recycling process. The term stickies is used to refer to different groups of pollutants that form sticky deposits. Stickies cause quality problems in the finished paper in the form of holes, stains and reductions in mechanical surface strength, as well as process problems in the form of long interruptions. Read more about recycling in the following section.

7.10 Requirements as to plastic packaging and mounting film (O7)

The requirement that packaging must not contain PVC has been extended to apply to all printed matter at the printing company. A new requirement has been introduced that laminating foils used for printed paper matter must not contain PVC. The requirements restricting PVC have been selected against the background of Nordic Ecolabelling’s goal of minimising problems in the waste cycle.

Previously the requirement that materials in the packaging for Nordic ecolabelled printed matter must not consist of chlorinated plastic (PVC) applied only to Nordic ecolabelled printed matter, but has now been extended to encompass all plastic packaging used by the printing company to package its printed matter and for laminating film used for printed matter made of paper at the printing company. This because viable alternatives are available. The requirement does not apply to printed matter for use in especially demanding environments, such as for outdoor use or for manuals in car workshops, since in these cases it is difficult to find a substitute for PVC. However, these exceptions do not apply to printed matter for which Nordic ecolabelling has been applied for (see section 7.27).

PVC plastic contains unwanted substances that may have an adverse effect on both health and the environment when they reach the waste cycle. A particular source of this problem is halogen such as Cl (chlorine). This substance requires extensive treatment technology during incineration and causes large quantities of residual products that go to land fill. Many additives contained in PVC are asso-

ciated with environmental and health problems. These include compounds based on the metals lead (Pb), cadmium (Cd), tin (Sn), mercury (Hg) and phthalates. The production of PVC also represents a problem since it involves the emission of environmentally harmful substances during production and during the incineration of waste containing PVC. The processing of PVC as waste also represents a problem since the incineration of PVC generates large quantities of problematical residual waste. For this reason Denmark regards PVC as an unwanted material for the purposes of waste incineration (the Danish Ministry of the Environment 1999).

7.11 Points for types of chemicals (P3-P6)

The printer can score up to 20 points for using different types of chemicals on the basis of the inherent properties of the chemicals such as suitability for recycling, whether they are water-based or vegetable-based etc. If several different types are used, the points scored will be a weighted portion of the types used based on the quantities purchased.

Since the last version of the criteria changes have been made with respect to certain points for recycling, for example dry toner gets the same points for recycling as ordinary printing inks. On the other hand, wet toner, ink and water-based printing ink score fewer points for recycling than previously.

Nordic Ecolabelling has collected data and calculated a market average for points in relation to the various parameters under points for type of chemical for each printing method (Appendix 1). The sum of the market average for these and other parameters, plus an overall points addition, constitutes a printing method's points limit for obtaining a licence (see Section 7.24).

The chemicals used by the printer have a major impact on the life cycle of the printed matter in terms of both health and the environment (see Section 6) and for this reason Nordic Ecolabelling has introduced points based on the chemicals chosen in order to signal that better alternative choices in terms of health and the environment are available. The choice of chemicals is also an area in which printers are able to exercise influence. See also Section 7.8 on requirements as to chemicals.

Printing inks, varnishes, toners and inks (P3)
Up to 12 points are available depending on a combination of several factors, i.e. whether the printing ink, varnish, toner or ink:

- is vegetable or mineral oil/solvent based
- is water-based or not
- may pose problems in the recycling process of the printed matter.

The points available for these factors have been combined in accordance with the table below. In the Nordic Print Portal points for vegetable/water-based/recycling have been combined with points for metals as siccatives.

Table 7.11a Points for the various types of printing inks, varnishes, toners and inks. *) UV-inks, varnishes etc. can only obtain points for being water-based if they are not classified as environmentally harmful.

Types	**Vegetable printing inks and varnishes**	**Water-based printing inks and varnishes**	**Recy-cling**	**Sum** **Points**
No printing ink, varnish, toner or ink				12
Non-UV/EB-curing printing inks, varnishes, toners and inks				
Vegetable printing inks, varnishes and inks that are documented not to create problems in the recycling process (does not, however, apply to metallic inks and fluorescent printing inks)	5	0	7	12
Water-based printing inks and varnishes that are documented not to create problems in the recycling process	0	5	7	12
Other vegetable printing inks, varnishes and inks	5	0	5	10
Other water-based printing inks and inks	0	5	0	5
Other water-based varnishes	0	5	7	12
Mineral oil based printing inks, varnishes and inks	0	0	7	7
Metallic printing inks and fluorescent printing inks	0-5	0	2	2-7
Dry toner	5		7	12
Wet toners that are documented not to create problems in the recycling process in accordance with the test methods in Appendix 1	0-5	0	7	7-12
Other wet toners	0-5	0	0	0-5
UV/EB-curing printing inks, varnishes and inks				
Water-based (e.g. UV printing inks/varnishes/inks) and non-water-based (e.g. hybrid printing inks) documented not to create problems in the recycling process	0-5	0-5*	7	7-12
Other water-based printing inks (e.g. UV printing inks/varnishes/inks)	0	0-5*	1	1-6
Other non-water-based printing inks (e.g. hybrid printing inks)	0-5	0	1	1-6
Not inspected printing inks, varnishes, toners and inks				

All				0

Unlike in the previous generation of the criteria, points are no longer given for metals as siccatives. The reason is that cobalt siccatives have carcinogenic properties (Pilemand et al 2004) and are possible candidates for the REACH approval scheme (Hansen et al 2011). Hence, based on the prohibition against SVHC substances in this version of the criteria it is no longer relevant to operate with special points for printing inks without cobalt siccatives.

As in the fourth generation of the criteria Nordic Ecolabelling has allocated one point for UV printing inks, UV varnishes and UV inks. According to INGEDE, better results may be obtained by developing new types that could be removed in the alkaline part of the de-inking process and subsequently removed by flotation (INGEDE 2008a). By not giving 0 points Nordic Ecolabelling indicates that there are certain possibilities of recycling these types of ink and toner.

In the fourth generation of the criteria, dry toner was also awarded 1 point for recycling against the background of the above sources. In 2008, INGEDE made a compilation of facts concerning the recycling of printed matter, in which dry toner was described as "generally easy to de-ink without any problems". Accordingly, the recycling points for dry toner in the fifth generation have been changed to 7 (INGEDE 2008a).

In the fourth generation wet toner got the same number of points as dry toner, i.e. 1 point for recycling. But, according to INGEDE, the problems related to removing this type of toner are so large, even if the quantity of the printed matter is small, that the points awarded for wet toner have been changed to 0. This also applies to ink and water-based printing inks (typically flexographic), which in the fourth generation got four points for recycling (INGEDE 2008a).

Nordic Ecolabelling does not expect water-based varnish to pose any problems in the recycling process as it is dissolved in the recycling pulp and thus gets 7 points for recycling from the fifth generation of criteria as against the previous four.

Technically, metallic printing inks and fluorescent printing inks are difficult to handle in the recycling process and they may cause waste from the process to become toxic sludge. But since they are used so rarely they do not cause any problems in the recycling process (Grafiske Miljørådet 2000 and 2008). Even so, Nordic Ecolabelling wishes to signal that these types of printing ink may create problems when they occur in large quantities, and accordingly in the fifth generation of the criteria the score has been reduced to 2 points for recycling. In previous generations of the criteria these printing inks were not differentiated from vegetable/mineral oil based printing inks in terms of points.

Inks and toners in the fourth generation of the criteria were not encompassed by points for water-based or vegetable inks or for metals as siccatives. This has been changed with the fifth generation in order to make the awarding of points more uniform and to avoid sending wrong signals regarding water-based/oil-based printing inks now that many printing companies are using both types.

Since some pads, booklets and envelopes are produced without printing, the option was introduced effective from the fifth generation onwards of scoring 12 points for whatever part of a printer's output does not involve the use of printing inks, varnish, toner or inks, in the same way as for adhesives.

Since it is not unusual for printers to use external finishers which use varnish, the fifth generation of the criteria require the inclusion of external varnishing with the various types of varnish used for the purposes of allocating points (this might for example be UV varnishing, which is weighted with a lower score than water-based varnishing. The printing company is not required to register varnishes used externally in its list of chemicals, but must on the other hand weight points for internal and external varnishing by means of the paper quantity purchased for printed matter which is varnished externally and internally, respectively. This is done by registering the individual finisher on the Nordic Print Portal using a weighted average score based on quantities and types of chemicals (see Section **Fejl! Henvisningskilde ikke fundet.**).

It is not relevant to require that external printing be included in the calculation of points, as it is rare for printers to systematically buy parts of the printing of an order externally. When printing is purchased externally it will generally be for entire orders. External production of this nature is inspected through the requirement concerning print suppliers (see Section **Fejl! Henvisningskilde ikke fundet.**).

Vegetable printing inks and varnishes
As far back as in previous generations of the criteria vegetable printing inks and varnishes were pointed out as possible areas for the achievement of points, against the background of Nordic Ecolabelling's goal of rewarding the use of renewable resources, the large quantities used relative to other chemicals used by printers and the major focus amongst consumers themselves on vegetable printing inks. Shares of vegetable printing inks are also accounted for in the EMAS reports of some printing companies. Vegetable printing inks are also recommended in the Nordic Council of Ministers' BAT report (Nordic Council of Ministers 1998).

As Nordic Ecolabelling wants to encourage the use of renewable resources, 5 points are thus awarded for vegetable oil in printing ink and 0 points for mineral oil. For practical reasons there is a triviality threshold of up to 2.0 weight per cent of mineral oil-based oil/solvent in a vegetable printing ink.

No points are awarded specifically for *vegetable* washing agents. Washing agents are not used in nearly the same quantities as printing inks. Nevertheless, vegetable washing agents are rewarded indirectly through points given for washing agents, as they have a low vapour pressure. In addition, vegetable washing agents have an advantage in that they have a low vapour pressure and are accordingly not counted in in respect of VOC points.

Water-based printing inks and varnishes

Previously water-based printing inks and varnishes were singled out as possible areas for the achievement of points, against the background of Nordic Ecolabelling's goal of rewarding the use of renewable resources, the large quantities used relative to other chemicals used by printing companies and the major focus amongst consumers themselves on water-based printing inks and varnishes. The use of water-based printing inks allows solvents to be avoided, and this is beneficial to both health and the environment. Obviously, water-based printing inks and varnishes are also rewarded in terms of points for VOC.

UV/EB-curing printing inks and varnishes (e.g. UV printing inks and varnishes) are often water-based. These types of ink and varnish are used for printed matter with special customer requests, such as long durability, and special requirements as to gloss and colour reproduction. Nordic Ecolabelling has decided that to score maximum points these printing inks and varnishes must not be classified as environmentally harmful. This is because products are available both with and without hazard classification.

Nordic Ecolabelling does not have sufficient knowledge of the functional differences between those classified as environmentally harmful in the uncured state and those not classified as environmentally harmful in the uncured state, to be able to prohibit one of the categories. Moreover, Nordic Ecolabelling will only achieve limited environmental gains as these printing inks and varnishes are cured in such a manner that the environmentally harmful substances are stabilised in the hard varnish and thus cease to present the same danger to the environment as the uncured ink. A wide variety of factors are involved in assessing the environmental and health-related aspects of UV printing inks and there are no unambiguous solutions (Silfverberg & al 1998).

Recycling of printing inks, varnishes, toners and inks
The impact of chemicals on suitability of printed matter for recycling has been nominated as an area in which points may be scored. This is based on Nordic Ecolabelling's desire to reduce resource requirements and lessen the environmental impact from paper production by promoting the best possible conditions for the recycling process. According to various studies (including Tiedemann et al 2001) it is in fact an advantage for paper from printed matter to be recycled as either new paper or for other paper products (e.g. egg cartons).

Christensen 2004 and Grafiska Miljörådet 2000 (Graphic Council of Environment, Health and Safety) describe the recycling of printed matter and the problems associated with this in detail. Whether or not printing ink and varnish can be removed from paper will depend on a number of factors, including the type of printing inks/varnishes used, the printing technology and printing conditions and the surface of the paper.

The effect of lamination is that during the recycling phase paper bunches up around the plastic in the laminating film. Since these lumps are relatively large, they are easily removed during the de-inking process. However, laminated paper cannot be recycled.

Wax is used for coating various types of paper, board and similar products in order to give them greater wet strength. Any waxed material will cause the same type of sticky substances as adhesive and will have the same properties in the recycling process as a hot melt glue (Grafiska Miljörådet 2000).

Existing de-inking technologies are based on removing solvent-based offset and rotogravure printing inks. Water-based printing inks (e.g. water-based flexographic printing ink and water-based ink for inkjet) dissolve in the recycling process and may accordingly discolour the pulp.

Vegetable printing inks harden more quickly than mineral printing inks and are therefore more difficult to remove from the paper fibres in the recycling process without the use of more energy and a higher rate of fibre loss. Accordingly, because of the problems involved in the recycling process, vegetable printing inks score fewer points for recycling than mineral oil-based printing inks. However, where the recyclability has been tested to the effect that the printing ink in question does not cause problems for recycling, vegetable printing inks may score maximum points for recycling.

This must be tested in accordance with INGEDE's test method no. 11: Assessment of Print Product Recyclability – Deinkability test, from January 2007 or later versions. Testing must be performed on uncoated, coated and surface-sized paper. If a type of printing ink is only sold for one or two specific types of paper, it is sufficient to test the paper type(s) in question. Nordic Ecolabelling requires a result of least 51 points in accordance with European Recovered Paper Council ERPC's points system. In total, vegetable printing inks may score up to 12 points.

Testing has revealed that some formulae for vegetable offset printing inks display better properties in connection with the de-inking process (AIR 1997). It is accordingly relevant to indicate a difference in terms of points in relation to water based printing inks. For this reason vegetable printing inks score 5 points and water based printing inks 4 points in connection with recycling.

UV is what is known as a UV/EB-curing printing ink, which hardens with the aid of ultraviolet light. There are also UV/EB-curing printing inks that harden with the aid of an electronic beam (EB). Hybrid printing inks are a mixture of traditional offset printing ink and UV ink. Hybrid printing ink can be used in combination with UV varnish, allowing printing and varnishing to take place in a single step.

According to Grafiska Miljörådet 2002 and Christensen 2004 UV printing inks and varnishes and wet toners are the inks that cause the greatest problems in the de-inking process. According to INGEDE this also applies to UV ink/inkjet (INGEDE 2008a).

Silfverberg and Tauby Sørensen have also examined the problematical effects of UV printing inks and varnishes on the recycling process. The reason for the less favourable properties of UV printing inks is that more energy is required in the de-inking plant to remove the printing ink from the paper and moreover the quality of the new paper is poorer in traditional de-inking plants. UV printing inks

and varnishes are used for printed matter with special customer requests, such as long durability, and special requirements as to gloss and colour reproduction.

UV printing inks adhere very firmly to the paper fibres making them very difficult to remove. Typically UV printing inks cover the entire print item and may accordingly result in a considerable loss of materials. A further property of UV printing inks is that they may form flakes with a certain particle size that are difficult to remove in the recycling process. The result can be what is termed specklings on the finished paper.

INGEDE has compiled a number of test methods for documenting the recyclability of printed matter. INGEDE has modified their test method No. 11 for de-inking to make it easier to use and to allow it to be performed in laboratories using less sophisticated equipment (INGEDE 2007). In 2008 the method was supplemented by a points system in order to obtain a more unambiguous result from the individual measurements (European Recovered Paper Council 2009). Nordic Ecolabelling requires a result of least 51 points in accordance with ERPC's points system. This corresponds to “Good” or “Fair” de-inking.

In order to assess the recyclability of glued printed matter INGEDE has developed test method no. 12 (INGEDE 2001). This method has been supplemented by a points system from ERPC, which is similar to the one applying to printing inks (European Recovered Paper Council 2011), in which Nordic Ecolabelling also requires at least 51 points corresponding to “Good" or “Fair” removal of glue. The test must have been performed on a type of printed matter representative of the glue in question.

Adhesives (P4)
Here up to 2 points may be scored depending on the effect of the adhesive on the suitability on the print item for recycling (see the section on recycling above) and 3 points for print items that are not glued. As some printers use outside finishers for gluing processes there is a requirement that the external gluing processes must be included for the purpose of the points allocation. The printing company is not required to register adhesives used externally in its list of chemicals, but must on the other hand weight points for internal and external gluing by means of the paper quantity purchased for printed matter which is glued externally and internally, respectively. This is done by registering the individual finisher on the Nordic Print Portal using a weighted average score based on quantities and types of chemicals (see Section 7.4).

The ideal situation would be if there were no adhesive at all in collected paper and only staples had been used. Accordingly three points may be scored if no adhesive is used or if test results can be presented showing that the adhesive does not create problems during the recycling process. Non-inspected adhesives are given 0 points.

Hot melt adhesives can be made liquid at high temperatures and hard at room temperature. This can be done repeatedly. These adhesives form rather very large particles in the recycling process and are not as critical in relation to INGEDE's requirements as pressure-sensitive adhesives (Putz et al 2004). PUR or polyure-

thane glue is supplied as a single or double component glue and is a variant of hot melt glue which hardens permanently by means of a chemical reaction with, inter alia, isocyanates. Some PUR adhesives are classified as R40 (carcinogenic in category 3), but there are some PUR adhesives without this classification. PUR adhesives form even bigger particles than traditional hot melt adhesives and are accordingly relatively easy to remove.

Water-soluble adhesives cause problems in the recycling process because they dissolve and cannot be strained out. In the closed water circulation systems widely used in the paper industry today, there is a risk that the concentration of water-soluble adhesives can build up and ultimately cause problems.

Washing agents (P5)
Printing companies may score up to 2.5 points for washing agents based on the vapour pressure of the washing agent and 3 points if the printer does not use washing agents at all. This option for scoring points has been selected against the background of Nordic Ecolabelling's goal of reducing effects on health. The points provide a measure of the chemical effects of washing agents on the working environment. The chemical working environment represents an important part of the overall health effect of printed matter (see Section **Fejl! Henvisningskilde ikke fundet.**).

The score for washing agents depends on the vapour pressure of the individual washing agent and the quantities used. The type numbers are Nordic Ecolabelling's own development of the results of the SUBSPRINT projects (SUBstitution of organic Solvents in the PRINTing industry), which were part of the EU's SPRINT programme (Strategic Programme for Innovation and technology Transfer) in 1992-1996.

In their 2003 report Jepsen and Tebert refer to the various classes into which washing agents were categorised. The two classes with the highest vapour pressure contain washing agents with vapour pressures in excess of 0.3 kPa, equivalent to a flash point of over 21ºC for the washing agent. All washing agents that score less than 2.5 points are VOCs or contain VOC.

Table **Fejl! Henvisningskilde ikke fundet.**b Scores for washing agents

Washing agent type	Points
Use of washing agents that are not volatile (vapour pressure < 0.01 kPa):	2.5 points
Use of volatile washing agents (vapour pressure 0.01 - 0.05 kPa):	2 points
Use of volatile washing agents (vapour pressure 0.05 - 0.2 kPa):	1.5 points
Use of volatile washing agents (vapour pressure 0.2 - 0.3 kPa):	1 point
Use of volatile washing agents (vapour pressure 0.3 - 5 kPa):	0.5 points
Use of volatile washing agents (vapour pressure > 5 kPa):	0 points
Use of washing agents that are not inspected (max. 5%)	0 points

Vapour pressure has a major impact on the working environment since it provides a measure of how much of the solution evaporates, thereby representing a chemical working environment problem. A similar principle is also used by the working environment authorities in connection with the labelling of chemicals. In Denmark, for example, MAL codes are used. This possibility of achieving points based on vapour pressure represents an easy way of expressing part of the chemical impact of the washing process on the working environment. Generally, washing is the process in which personnel at the printers come into closest contact with chemicals. Moreover, Nordic ecolabelled washing agent types are well established in the industry, having been in use for many years.

A maximum of 2.5 points can be achieved if washing agents are used. This can for example be achieved by using vegetable washing agents, which have a low vapour pressure. The reason for the choice of 2.5 points is that the old washing scores went up to 2.5 points (the most volatile). If no washing agents are used whatsoever (e.g. in the case of digital printing), slightly higher points are awarded, i.e. 3 points. The number of points is low, but signals that the working environment too is important in the life cycle of printed matter.

Dampening solution additives (P6)
The printer may score up to one point for using non-allergenic dampening solution additives and two points for not using dampening solution additives at all. This option for scoring points has been selected against the background of Nordic Ecolabelling's objective of reducing effects on health. The number of points is low, but signals that the working environment too is important in the life cycle of printed matter.

Since many dampening solution additives, including softeners for dampening solutions, may be allergenic, it is now possible to gain points if the finished dampening solution has been diluted to the extent that it would not be classified as allergenic. The supplier of the dampening solution additive must document the recommended dosage and whether the solution used can be regarded as allergenic or not. This option has been introduced so as to avoid that ecolabelling induces licence holders to dilute the dampening solution additive simply in order to meet the requirements, thus contributing to a higher environmental impact because of increased transport requirements.

It is important to bear in mind that it may be necessary for the dampening solution to contain a small quantity of biocides in order to avoid allergy problems caused by biological sources. Thus the scope for points must be viewed as a signal to avoid over-consumption of biocides in the dampening solution.

7.12 Points for printing form production (P7)

The printing company may score up to 3 points for various technologies in printing form production. This option for scoring points has been selected against the background of Nordic Ecolabelling's objective of reducing emissions of ecotoxins to the aquatic environment. These points options also contribute to a reduction in the transport requirement since fewer consumables will need to be transported. Compared to the latest generation of the criteria the points available for

this area have been reduced, as a result of which the overall weighting in the points system is lower.

A maximum of 3 points may be scored for printing form production depending on how much paper is used for orders produced using the various repro technologies. Life cycle assessments show that the environmental impact of these processes often makes up less than 5% of the overall environmental impact (see inter alia Fred Larsen et al 2009). Points are achieved for the various technologies applicable to printing form production irrespective of whether orders are produced in-house or by external suppliers. The number of points has been weighted more or less in relation to the findings of various life cycle analyses. The term printing form covers all forms of printing forms (e.g. offset plates, flexographic blocks, and rotogravure cylinders).

Nordic Ecolabelling has estimated a market average for points related to printing form production for each printing method in Appendix 1. The sum of the market average for this and other parameters, plus an overall points addition, constitutes a printing method's points limit for obtaining a licence (see Section 7.24).

The number of points that can be achieved will depend on the process technology in question. The maximum 3 points can be scored on technology that requires neither film nor printing form (e.g. computer to press). This means that there is no need for printing forms (e.g. aluminium plates) or chemicals (e.g. developing fluids). In other words, the information to be printed is transferred directly to the printing press.

In the fourth generation of the criteria, 3 points were awarded for not using film (e.g. CTP: computer to plate). In the fifth generation of the criteria document the requirement has been made stricter so that 3 points will be available if neither film nor printing form is used (Computer to Press).

To achieve 2 points the printing form production must neither involve the use of film, chemicals (e.g. algaecides, developers, finishers) or rinsing water or recirculating rinsing water). This means that no liquid waste is produced. Equipment used in proofreading is not regarded as part of the production process. This type of CTP is typically called process-free CTP. "Process-free CTP" in which the plates are developed in the printing press does not release 2 points, as the developing process merely takes place in the printing press, which means that liquid waste may thus be emitted via the dampening solution instead (Christiansen 2011). This 2 point category also contains the so-called inkjet CTP, in which the image is transferred to/printed on the metal plate by means of inkjet technology.

The fifth generation of the criteria introduced an option of scoring 1 point if the generation of waste chemistry (e.g. used developer, finisher or rinsing water) is limited to 1.0 litre of used process chemicals per tonne of product annually for disposal. This type of CTP encompasses conventional CTP (chemically processed/conventional CTP), reduced chemistry and chemical/chemistry free CTP.

Chemical/chemistry-free means that no traditional developing chemicals are used and that very few other chemicals are used. Developer-free CTP is a variant of chemistry-free CTP.

According to a study from Fujifilm and Kodak chemical/chemistry-free means that only very small quantities of chemicals are used and no or very little rinsing water, which on an overall basis is much less than conventional CTP. In between there is reduced chemistry CTP in which more chemicals and water are used on an overall basis than in chemical free-CTP, but less than in the case of conventional CTP (Zarwan 2009).

For all these categories there are sub-categories related to how the image is transferred (thermal/infrared light or visible light, including violet light) or how the water is handled (recirculation or not) or whether the plate needs baking in the oven or not in order to obtain greater strength. The option of scoring points for recycling of rinsing water has been removed in the fifth generation of the criteria document.

According to the study by Fujifilm and Kodak the energy consumption for process-free CTP is lower than for the other types of CTP. On the other hand the energy consumption in the case of chemical free CTP is on a level with reduced chemistry and conventional CTP. The quantity of waste chemistry is closely related to how much chemistry and water is used in the process (Zarwan 2009).

The level of 1.0 litre of process chemicals is based on information on typical consumption from the life cycle assessment of Johnsen et al (Johnsen et al 2006, p 45, part 2). This study specifies an average for plate development of 1.22 (0.094-3.5) and for gumming of 0.030 (0.0052-0.055) in kilos per tonne of product. The study also specifies water consumption of on average 31 litres per tonne of finished print item. However, most CTP systems today manage without any particular consumption of rinsing water as many recirculate water and the necessary rinsing can take place in the printing machine by means of the dampening solution. See also the option of scoring points for low water consumption in Section **Fejl! Henvisningskilde ikke fundet.**.

7.13 Points for emission of volatile organic compounds – VOC (P8)

The printing company is awarded up to 20 points depending on how much VOC (Volatile Organic Compounds) in kilos is emitted per tonne of finished printed matter up to a level of 9 kilos/tonne of product. The scope for scoring points in this area has been introduced against the background of Nordic Ecolabelling's objective of reducing photochemical ozone formation and goals regarding health, including working environment.

This option for scoring points has been given a high weighting and allows up to 20 points to be achieved. In the fourth generation of the criteria up to 30 points could be achieved. However, in the fifth generation of the criteria, energy has been given higher weighting so that a total of 15 points are awarded for energy, which amounts to 10 points more than previously. On the other hand, with the

fifth generation a requirement has been introduced to the effect that there must be air extraction if the VOC consumption is high (see above section). Against the background of the maximum 20 points instead of the 30 points, the points formula as from the fifth generation of the criteria is:

2*(10 – VOC used)

In connection with the development of the fourth generation of criteria Nordic Ecolabelling observed values of up to almost 10 kg per tonne of paper for sheet fed offset printing companies. Accordingly this has been set as the limit as to from where points may be scored. In connection with developing the fifth generation of the criteria Nordic Ecolabelling observed a handful of printers whose VOC consumption/emission was in excess of 10 kg per tonne of paper. For practical reasons Nordic Ecolabelling has chosen not to convert the 10 kilos to per tonne of product. This means that the interval in which points can be obtained from VOC counted per tonne of product is slightly narrower than in the fourth generation of the criteria.

Nordic Ecolabelling has collected data and calculated a market average for the volume of VOC consumption/emission for each printing method (Appendix 1). The sum of the market average for this and other parameters, plus an overall points addition, constitutes a printing method's points limit for obtaining a licence (see Section 7.24).

The option of calculating VOC consumption by means of the so-called unit contact area was removed in the fifth generation of the criteria, as no printing companies had chosen to use this method.

Potential
This is an area in which printing companies have considerable scope for making a difference and where there is major potential for improvement. A number of printers have entirely abandoned the use of alcohol as an additive in dampening solutions, and many printers use washing agents that are not VOCs. VOC emissions can also be reduced by using BAT technology that either destroys or recycles VOCs. Please refer to examples of gravure, heatset offset and flexographic printing in the European BREF-document: Best Available Technology reference document (European Commission 2007).

The normal quantity of alcohol in the dampening solution used by offset printers is in the region of 9-12%. With care this can be reduced to 8% and even further if the water input and ceramic rollers are carefully managed (Danish EPA 1999). Nordic Ecolabelling has seen examples of printing companies with wet offset that previously used alcohol and where the alcohol has been removed entirely.

It should be noted in particular that the VOC rules in the IPPC Directive (2008/1/EC) exclusively restrict emissions of solvents from certain printing methods, e.g. heatset. On the other hand, normal sheet fed offset printing is not covered by the VOC Directive, even though the emissions involved in the use of this method may be as much as 20 tonnes of VOC per year according to the ob-

servations of Nordic Ecolabelling. This quantity of solvent exceeds the limit value in the VOC Directive for several other printing methods.

VOC content in printing chemicals
VOC emissions occur primarily in connection with the consumption of:

- Washing agents
- Dampening solutions and dampening solution additives
- Printing inks

Sheet fed offset printing inks and coldset printing inks do not contribute VOC emissions since they dry through absorption by the printing substrate and subsequent chemical curing. The solvents used in these printing inks have a high boiling point and accordingly a low vapour pressure. This means that these printing inks are not volatile when used in sheet offset and coldset printing. Nor do UV printing inks generally release VOC. On the other hand, heatset inks dry when heated to 190-250 °C in an oven, resulting in oils becoming volatile.

Dry offset is a variant of the sheet-fed offset method in which no alcohol is used. Studies conducted by Framkom consultants, however, found that the environmental benefits are not as great when viewed from an overall perspective since dry offset, for example, uses more printing ink and requires a more extensive running-in process (Johansson 2002). Nevertheless, the use of dry offset is rewarded indirectly with points, since dry offset uses considerably smaller quantities of solvent. A Danish report compared the technical, financial and environmental aspects of the two technologies. According to the report emissions of solvents by an average sheet fed offset printer can be reduced by half by using water-free offset (Danish EPA 1999).

To be able to calculate VOC, sheet offset and cold offset printing companies must know the content of solvents in dampening solution additives and washing agents. Heatset printers must also know the content of oil in the printing inks since these become volatile (VOCs) in the heatset oven. Information is available from the Nordic Print Portal.

To ease the administrative burden, Nordic Ecolabelling has set a worst case standard value for VOC content in heatset printing inks of 50% based on the assumption that heatset printing inks typically contain 30-50% mineral oil (Constantine 1991). Since many suppliers of printing inks state oil quantities in their product data sheets, these values can also be used.

Definitions and calculations of VOC emissions
The criteria document defines VOCs in the same way as the authorities do in the VOC Directive on the limitation of emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations (1999/13/EC). The option of scoring points on VOCs entails that the printer will derive a benefit from going further than the requirement imposed by the authorities.

According to the VOC Directive, volatile organic compounds are defined as compounds which at 293.15 K have a vapour pressure of 0.01 kPa or more, or which have a corresponding volatility under particular conditions of use. Calculating the vapour pressure of a mixture on the basis of the vapour pressure of the individual components is not straightforward. The vapour pressure of a combined product of this nature may be both higher and lower than the vapour pressure of the individual components of the product. However, for the sake of simplicity for the purpose of the criteria the vapour pressure of a mixture is calculated on the basis of the vapour pressures of the individual components.

The VOC calculations in the criteria document are based on the recommendations of the authorities with regard to mass balance calculations and provide a picture of diffuse emissions of VOC to air. The point of departure is the printer's purchase of chemicals containing VOC and adjustments may be made for chemicals in stock. Thus only VOC introduced in the process from the outside will be included. VOC that is sold, destroyed or removed under controlled conditions may be subtracted in the calculation. One example of VOC destruction is an afterburner installed at the heatset printing company.

In the case of, for example, gravure printing, toluene is recycled internally; some of it is sold on and the rest is used to dilute purchased printing inks. Some sheetfed offset printers have their own evaporators for recycling washing agents. The use of wet toners in digital printing presses enables printers to reduce purchases significantly by recycling wet toner in the machine and thereby scoring higher VOC points. Wet toner and other chemicals used in digital printing with wet toner are in liquid form at room temperature and can therefore be removed under controlled conditions and subtracted in the calculation. A printing company can thus have low internal and external VOC emissions even if its consumption of solvents is high.

Nordic Ecolabelling has drawn up specific instructions for how the calculations for heatset and gravure printing companies are conducted – see below. However, other printing companies that destroy or remove VOC under controlled conditions will also be eligible for subtraction. This applies in the case of, for example, digital printers using Indigo machines.

Heatset
To make the system easier to use, standard values were introduced in the fourth generation of the criteria, which specify the deductions that may be made from heatset depending on the afterburner technology used to destroy VOC. The fifth generation of the criteria introduced additional calculation modifications as a result of which the total quantity of VOC purchased/received by the printing company is included in the form of:

- standard deductions for destroyed VOC from printing inks (100% for integrated afterburners and 90% for non-integrated afterburners). The calculation must assume that 85% of the mineral oils in heatset printing inks are converted to VOC in the heatset oven

- standard deductions for destroyed VOC from dampening solution additives (10%), VOC in washing agents for automatic washing (15%) and VOC in washing agents used in manual washing (5%)
- standard deductions for VOC that is removed in cloths and rags (0.75% of the total quantity introduced)
- addition for measured VOC released from the flue, based on measurement reports.

The standard values for dampening solution additives and washing agents have not been amended and encompass the quantity of VOC drawn into the afterburner. These values have been taken from Jepsen and Tebert's 2003 background report on BAT in the graphic industry from 2003. Literature contains several examples of higher values, but Jepsen and Tebert have applied a worst case situation (Enroth 2010b).

The standard value for deductions of VOC that is collected in cloths and rags for inspected removal is also taken from Jepsen and Tebert. They estimate that approximately 1.5% of VOC introduced in the process ends up in cloths and rags and that approximately 50% of this is released into the atmosphere (2003, p. 21). The rest, i.e. approximately 0.75% is retained in the cloths and rags and this is the value that the printers may deduct. However, one precondition is that the printer must store these cloths and rags in sealed containers after use. As discussed above, the fifth generation of the criteria also introduces the requirement that emissions of VOC from local sources must be included in the calculation.

Only 80-90 of the mineral oils in printing ink evaporate in the drying oven (European Commission 2007). This does not mean that all mineral oil becomes VOCs. Accordingly, Nordic Ecolabelling has specified in the criteria that 85% of the mineral oils in heatset printing ink are assumed to be converted to VOC in the oven unless some other figure can be documented.

Afterburning is the most widely used flue gas treatment for heatset. Alternative technologies, such as condensation, are less efficient (90%) and biological flue gas treatment does not function with this application (European Commission 2007). Some afterburners are integrated in heatset oven and others are located after the oven. The various types require the addition of greater or lesser amounts of fuel in order to function. Some use heat exchange to reduce energy consumption.

For the sake of simplicity, integrated afterburning qualifies for a 100% deduction. The integrated afterburner ensures that the entire process stops if the treatment is not operating. According to Jepsen and Tebert and the European BREF document, afterburner technologies are 99% efficient.

If afterburning is not integrated, the standard deduction has been set at an estimated 90% since there is a risk that the average cleaning effect will be reduced if the afterburner does not function optimally or flue gases are led past the afterburner in the event of breakdown. To ensure that the requirements are fulfilled,

Nordic Ecolabelling may carry out inspection visits to check that the after-burner has been operating.

Effective from the fifth generation of the criteria, Nordic Ecolabelling introduced the requirement that allowance must also be made for point source emissions in VOC calculations for heatset. VOC quantities from point source emissions are based on:

- measurements of NMVOC (Non Methane Volatile Organic Compounds) in mg C/Nm3 flue-gas after each treatment unit – as required by the authorities for heatset printing companies of a certain size
- information on annual gas flow with the aid of gas flow during operations (in Nm3/h) and the annual number of operating hours for each treatment unit.

If measurements of NMVOC are not available, the European threshold value of 20 mg C/Nm3 may be used as a standard value. To simplify the conversion to VOC, the printing company must assume the presence of what is termed Magie oil which consists of hydrocarbons with a typical chain length of C9-C20. This means that 1 g of VOC on average corresponds to 0.85 g C (Enroth 2010b).

In the so-called virtual plant in the European BREF document, with 20,000 tonnes of purchased paper (and 2,800 tonnes waste paper), the gas flow is approximately 7,200 Nm3/h for each of the two ovens (European Commission 2007, p. 29-31). The gas is channelled to an afterburner and there are a total of approximately 4,700 production hours during the course of a year where the treatment efficiency is 99%. Applying the European threshold value, this gives 1,592 kg of VOC per year or approximately 0.1 kg per tonne of product or just under 1% in relation to the total quantity of VOC released which in the virtual plant is just over 11 kg of VOC/tonne of product: (203-(50+1)*0.15-3*0.15-2*1)*1000/17.200.

0.1 kg of VOC/tonne of product corresponds to approximately 0.3 points in the point system used in the criteria document. Nordic Ecolabelling's assessment is that the average for the market is 2 kg per tonne of product for heatset printing companies (see Appendix 1). Given these figures, VOC from local emissions represents approximately 5% of VOC emissions.

However, according to Nordic Ecolabelling's observations, this degree of treatment efficiency may fluctuate considerably from one printing company to the other and the measurement requirement should therefore be viewed as an opportunity to encompass plants with poor performance or plants that are too small to be encompassed by the official regulations. In February 2010, 10 out of 29 Nordic ecolabelled printing companies using heatset as their main method of printing had a paper tonnage that was below the threshold based on the VOC directive's threshold value of 15 tonnes VOC per plant. This is calculated against the background of the average VOC consumption of heatset printing companies as observed by Nordic Ecolabelling (see Appendix 1).

Rotogravure printing

In rotogravure printing, the treatment technology is based on recycling VOC (toluene) and therefore a mass balance between input toluene less sold toluene provides an accurate measure of the degree of efficiency of recycling and accordingly of emissions of toluene by the printing company. The most significant VOC emission from rotogravure printing companies according to the European BREF document relates to evaporation from the products and represents some 2-3% of input toluene for printing companies with an effective toluene recycling system (European Commission 2007) or up to several litres per tonne of product (Hofman 2001, p. 2).

Printing companies with a high degree of treatment efficiency and internal storage/de-aeration of vacuum extraction of finished print items can accordingly reduce their VOC emissions to a low level. However, according to the European BREF document, the higher the degree of treatment, the more energy will be required.

The fifth generation of the criteria document clarifies the calculation of VOC by means of the introduction of standard values permitting a deduction 0.3% of all purchased VOC/toluene that is "captured" in cloths and rags and 0.3% of purchased VOC/toluene on condition that cloths and rags and printing ink waste are stored in sealed containers at the printing company and removed/handled under controlled conditions (Enroth 2010b). The values are based on the information contained in Jepsen and Tebert (2003, p. 52).

Danish working environment requirements of maximum evaporation of 300 mg toluene per kg of product (Danish Working Environment Authority 1995), have, for example, meant that Roto Smeets of Deventer in the Netherlands have had to introduce these deaeration technologies in order to sell their products on the Danish market, despite the considerable costs related to the methods (Hofman 2001, p. 5).

The Danish EPA's charting of chemical substances in consumer products studied chemical compounds emitted from print items and to which users are exposed during reading and storage (Hansen et al 2003).

Although the study concluded "that there are no grounds for consumers to be concerned about their health on the basis of the available data" adding that sensitive consumers may have allergic reactions, evaporation of up to 545 mg of toluene per kg of print item per hour was registered shortly after printing. Measurements on the following day recorded a figure of 431 mg and on the third day 272 mg – i.e. high levels of exposure for personnel at the printing company. If print items printed using rotogravure are circulated to consumers after a short space of time, there will be further grounds for concern.

The Danish Working Environment Authority has issued a circular which expands upon the more generally formulated working environment regulations. The circular stipulates a maximum limit for the evaporation of toluene from advertising print items (excluding catalogues and magazines) of 300 mg/kg print items during the course of an hour in connection with sorting and manual processing (Danish Working Environment Authority 1995).

In the case of imported printed matter, measurements are conducted when the print items arrive in Denmark, i.e. the regulations apply only in Denmark. According to the information in the circular, residual toluene may be expected to have a half-life of approximately 24 hours just after printing, but the half-life is increased later in the distribution chain to 3-4 days if the printed matter is stored in well-ventilated, heated premises.

7.14 Requirements as to emissions to air and water from gravure printers (08)

Gravure printing companies must observe the maximum requirements as to emissions of chromium (Cr-tot) and copper (Cu) to water, and a maximum requirement as to emissions of chromium-6 (Cr^{6+}) to air. Furthermore, gravure printing companies must observe a minimum requirement regarding recirculation toluene.

The reason that Nordic Ecolabelling has introduced these requirements with the fifth generation of the criteria is that gravure printers use toluene, chromium trioxide and copper sulphate in their production process. These cannot be substituted and thus need to be exempted from the chemical requirements (see section 7.8). Hence, for credibility reasons Nordic Ecolabelling aims to restrict the emission of these chemicals by means of limit values, which are based on the requirements imposed by the authorities on these, but which are 10% below the official requirements. The authorities to some extent regulate these emissions, but for reasons of credibility, Nordic Ecolabelling requests documentary proof of minimum emissions in connection with the granting of licences. Please also refer to the requirements regarding the submission of approvals from authorities in connection with the other requirements in section 7.26.

The regulation of metal emissions is based on a permit to emit a maximum amount of chromium and copper to water in accordance with legislation concerning an approval scheme for particularly polluting industries (Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008 concerning integrated pollution prevention and control, commonly referred to as IPPC directive).

An impact assessment of the IPPC rules has been performed in which the Commission reports of i.e. considerable shortfalls. It appears that member states use the best available technology to an insufficient degree. Moreover, the observance and enforcement of the rules is inadequate (EU Commission 2007).

Instead of basing the requirements on mg per litres of water, as the official limit values do, Nordic Ecolabelling relates the requirements to tonnes of products manufactured, just like other requirements in the document. Nordic Ecolabelling has converted the official limit values on the basis of production conditions typical of small rotogravure printers consuming less than 140,000 tonnes of paper per year. The reason for basing the conversion on data from small gravure printers is that it is more difficult to meet the requirements for gravure printers whose print runs are typically smaller, if the requirement is expressed as “per tonnes of product”. This is because the quantity of emitted copper and chromium is related

to the number of cylinders produced and because the larger quantities produced with one single cylinder, the less copper and chromium is emitted per tonne of printed matter produced.

The official limit values for emissions to water are 0.5 mg Cr-tot and 1.0 mg Cu per litre. Converted into tonnes of product the values will be in the region of 30 mg Cr-tot and 300 mg Cu. As Nordic Ecolabelling wants stricter requirements than the official limit values, the level for chromium has been set 10% below the projected value and rounded off, resulting in a final requirement value of 25 mg Cr-tot per tonne of paper. For copper the requirement value has been set on the basis of observations in the market at modern gravure printing companies and the final requirement value is thus 90 mg Cu per tonne of paper.

An alternative would have been to calculate the limit values in relation to the cylinder area in terms of square metres. The requirement would thus have been neutral in relation to the size of a typical print run. Nordic Ecolabelling believes it best to calculate on the basis of per tonne of product, as there may otherwise be a risk of the environmental impact from the printing form production in gravure printing being hidden.

Nordic Ecolabelling's limit value of 5 mg krom-6 (Cr^{6+}) per tonne of product is based on information from its previous criteria for printed matter (the third generation of criteria). The value of these criteria was 15 mg krom-6 per tonne of paper and has thus been converted into tonnes of product, the level being set lower because of technological developments.

The official requirements as to VOC emissions have been expressed as a limit value for the concentration of VOC in air released from gravure printing companies (see section 7.13). Instead Nordic Ecolabelling prefers to base the requirement on the effectiveness of treatment at the printing company. The degree of treatment of 92 % for gravure printers is based on information on ordinary levels for existing plants in Europe as it appears in the BAT reference document for printing (European Commission 2007).

7.15 Requirements as to maximum energy consumption (O9)

A new requirement has been introduced, limiting a printing method's energy consumption (purchased energy) to a maximum of 3,500 kWh/tonne of product. The requirement has been introduced against the background of Nordic Ecolabelling's objective of making energy consumption more effective and thus counteracting climate change.

The printer need not calculate energy consumption for each printing method; calculating the energy consumed for the entire printing company will suffice. The Nordic Print Portal undertakes to distribute the energy consumption on each printing method in relation to the market average (see the table below) for each method and makes all the calculations. The calculation is based on the assumption that the distribution of energy consumed at the individual printing company is the same as the distribution of the average market values.

Table 7.7. Average market values for energy consumption (data from Appendix 1).

Printing method	Average energy consumption (kWh/tonne of product)
Sheet fed offset (except packaging and offset printing of envelopes)	1253
Coldset, news print	365
Coldset, forms	997
Coldset rotation (except news print and form printing)	825
Heatset rotation	965
Rotogravure printing	864
Flexographic printing (except envelope production)	486
Digital printing	2799
Offset printing, envelopes	436
Envelope production with flexography	552
Offset, packaging	1564

The energy parameter covers all of the printing company's purchased energy in kWh per tonne of product. In other words, the printer must report purchased fuels for stationary combustion plant and purchased energy in the form of electricity, district heating/cooling etc. This parameter does not include fuel, if any, used for the printer's own vehicles. This means that energy produced in-house from e.g. sun, wind and thermal heating will not be included, since it has not been purchased. On the other hand, electricity purchased to power a heat pump will of course be included.

In principle, all energy should ideally be encompassed by the accounts. The reason that Nordic Ecolabelling imposes requirements on purchased energy only is that energy produced in-house may be complicated to calculate. As this is the first time requirements are introduced on the calculation of energy, Nordic Ecolabelling has aimed at not making the requirement too complicated. If a printer sells excess heat (e.g. a heatset printer) this heat can be deducted.

Furthermore, energy consumption during paper production is not included in this parameter. The energy consumed in the production of paper carries a high weighting in the life cycle of printed matter (see i.a. Fred Larsen et al 2009, Drivsholm et al 1996 and 1997, Dalhielm et al 1995), and on this basis it would theoretically be best to create an energy parameter that includes energy consumption both during paper production and during printing. However, energy consumption during paper production is already subject to indirect requirements through a mandatory minimum mandatory requirement and points requirements concerning the use of inspected/ecolabelled paper.

Nordic Ecolabelling's revised criteria for photocopying and printing paper contain strict requirements in the energy area. This means that printers will have greater scope for influencing energy consumption during paper production by selecting inspected/ecolabelled paper. It is better that printing companies choose

paper on the basis of an overall assessment instead of simply from the perspective of energy since, in addition to energy, the paper criteria also emphasise other parameters such as chemical consumption and emissions. Printing companies will also have greater control over their own energy consumption than over developments at paper mills and, accordingly, it makes most sense for a printer to focus on its own circumstances.

The threshold value of 3500 kWh/tonne per product is based on data compiled from literature (Enroth 2010a) as well as application data from/enquiries to Swan-labelled printing companies and data from other pilot businesses. The stringency of the requirement is such that it will be beyond the reach of the worst of the printing companies. This also means that energy consumption overall is given greater weight in the requirements than what the maximum points score indicates, which is in line with the existing life cycle studies. For further information on this, see Appendix 2 on life cycle studies.

Figure **Fejl! Henvisningskilde ikke fundet.**a provides an illustration of average values and the distribution of energy consumption data collected from printing companies using a variety of printing methods. The figures encompass data from most printing methods covered by the criteria. Nordic Ecolabelling compiled credible electricity data for 68 printers: of these 36 used electricity for heating and 10 had their own electricity and heating data. The primary reason that more printers did not have their own heating data is that they are in-house printers, i.e. they operate from leased premises where heating is included in the rent.

The figures reveal broad variation in energy consumption. It will be seen that a small number of printing companies record a very high energy consumption, which is supported by the fact that the median value is 1093 kWh/tonne of product, whereas the average is 1524. Five outliers were removed from the data set because they influenced the outcome to a relatively high extent. In the case of some of the outliers, uncertainty attached to the correctness of the figures since energy consumption was either very high or very low. It might, for example be the case that an in-house printing company has reported electricity consumption for the building as a whole without pointing out that they are an in-house printer.

Nordic Ecolabelling has also calculated the average value of electricity consumption and heat consumption and it is clear that consumption of electricity, primarily for the operation of the printing business, is higher than energy consumed for heating purposes. This is in line with figures provided by the Danish and Swedish graphic industries where electricity consumption makes up 55% and 75% respectively, of overall energy consumption. (GA and DDFF 2002, SCB 2010). Since printing presses largely run on electricity, it is logical that the electricity consumption of printing companies should be high.

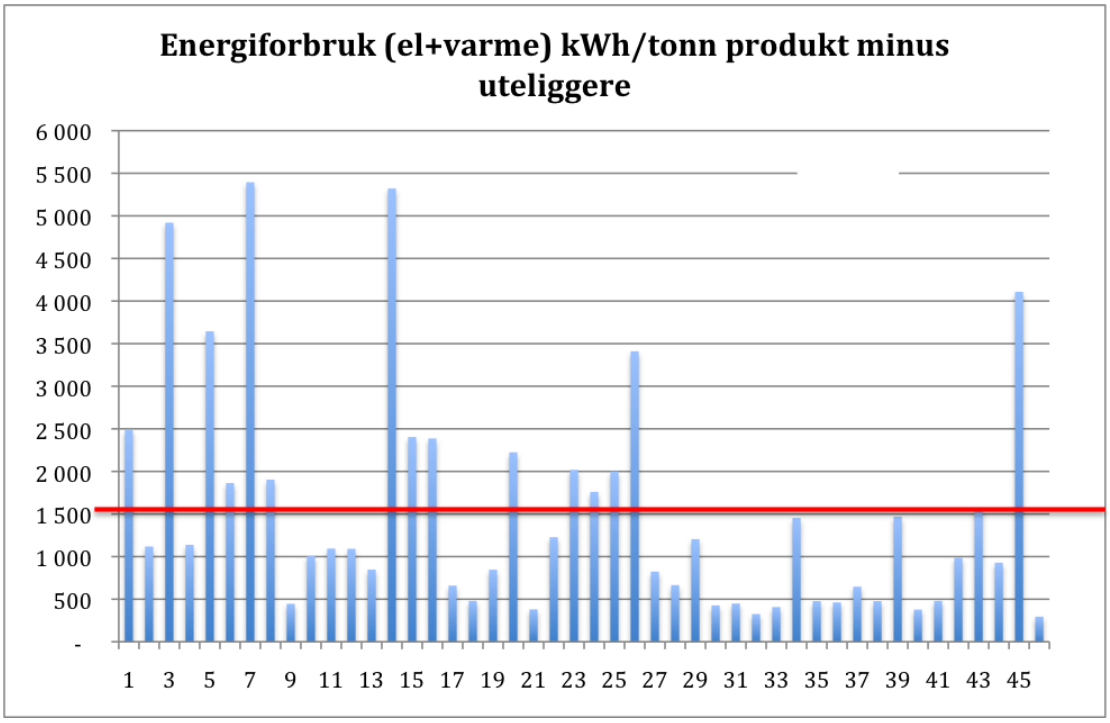

Figure **Fejl! Henvisningskilde ikke fundet.**a: Energy consumption (electricity + heating) in kWh/tonne of product minus outliers (n = 46). The red line indicates the average figure. Data primarily from Swan-labelled printers with their own electricity and heating data, autumn 2010 (printers using electricity for heating purposes are also included).

Average figures based on data compiled from licensed printers as well as information compiled from the literature, allocated by printing method, are shown in Appendix 1. Nordic Ecolabelling has calculated average values for the various printing methods by weighting energy consumption on the basis of the number of enterprises encompassed by the value. In this way, the average value from studies/data of most enterprises be more significant when the weighted average value is calculated.

Unfortunately, in the case of some of the printing methods little data is available. However, generally the figures show that digital printers have a higher consumption of energy per tonne of print item than other printing methods. Digital printing is followed by sheet-fed offset printing. The printing method with the lowest energy consumption is coldset, including coldset with newspaper printing.

Consequently, a threshold value of 3500 kWh/tonne of product will largely impact on digital printers with high energy consumption. Based on the data compiled from licensed printers and pilot printers in the autumn of 2010, the proportion of printers that will fail to measure up to the requirement, based on all compiled data, will be between 10 and 15 % depending on whether outliers are included are not. Of these, approximately 80% will be digital printers or digital printers in combination with some other printing technology.

However, the wide variation in energy consumption shows that this threshold value may also exclude other printing methods. Nordic Ecolabelling does not wish to exclude any particular printing method with this threshold value. The

requirement has been set in order to exclude printers with very high energy consumptions. Nordic Ecolabelling has relatively few data on digital printing companies, but the data compiled in Table **Fejl! Henvisningskilde ikke fundet.**a shows the broad spread in energy consumption amongst the digital printers on which Nordic Ecolabelling has information. This indicates that potential exists for digital printing companies to bring down their energy consumption.

Table **Fejl! Henvisningskilde ikke fundet.**a Energy data in kWh/tonne of product for digital printing companies that are not in-house printers.

Printing company	**Electricity consumption**	**Heat consumption**	**Total**
1	2487	(electric heating)	2487
2	803	316	1119
3	2785	1323	4108
4	3029	616	3645
5	1278	585	1863
6	1453	(electric heating)	1453
7	4920	(electric heating)	4920
Average			**2799**

Since there is adequately wide variation in energy consumption per tonne of product between the various printing methods, it would be more natural to set a threshold value for each individual printing method. This would ensure that the worst printing companies within each printing method would not be able to comply with the requirement. There were several reasons that this approach was not adopted. Firstly, Nordic Ecolabelling has insufficient data available to impose a mandatory requirement that would be fair for all printing methods. In the case of some printing methods where data is available in both the literature and from licensed printers, it might be possible to set a uniform threshold value. However, in the case of a number of other printing methods, including digital printing, flexographic printing, form and envelope production, limited data is available.

Introducing a mandatory threshold value according to printing method would represent a breach with the principle that the same requirements should apply to all printing methods. The guiding idea in the criteria document is that different requirement levels should apply only in the case of central requirements that determine whether or not a licence will be awarded. These requirements are the requirements as to total points score (see Section **Fejl! Henvisningskilde ikke fundet.**). This principle also applies to the requirement as to extraction in the event of a certain quantity of VOC (Section **Fejl! Henvisningskilde ikke fundet.**), a minimum quantity of inspected/ecolabelled paper (Section **Fejl! Henvisningskilde ikke fundet.**) and the triviality thresholds for chemicals (Section **Fejl! Henvisningskilde ikke fundet.**).

Activities included in energy consumption
As a general point of departure, it is the energy consumption of the entire printing company (kWh / tonne of product) that is encompassed by the energy parameter. This encompasses the entire production process in the form of pre-press, printing and finishing, as well as other sub processes/functions at the printing company, such as chemical stores, paper and product stores, ventilation, lighting,

internal treatment of water and emissions as well as support functions, such as offices, toilets and other shared areas.

If the printer also performs activities that are not related to the printing business, these may be deducted subject to an assessment by Nordic Ecolabelling. For this to apply, the printing company must be able to measure these activities separately, or qualified estimates/assessments must have been made which can be approved by Nordic Ecolabelling.

In connection with Nordic Ecolabelling's compilation of data on energy consumption in the autumn of 2010, information was also requested on what activities were included in energy consumption. A great many printers found it difficult to answer this question, so data are scarce. It has thus not proved possible to identify any connection between the number of activities included and the size of the energy consumption. However, the table below shows the average distribution of electricity consumption for various final uses at the printing company.

Table **Fejl! Henvisningskilde ikke fundet.**b Distribution of electricity consumption between mainly newspaper, book and offset printers (GA and DDFF 2002). Reproduced with the kind permission of the Graphic Association of Denmark.

Activity	**Distribution**
Drying	0
Lighting	15
Pumping	1
Cooling/freezing	5
Ventilation and fans	20
Compressed air and process air	5
Other electrical motors	35
Computers and electronics	15
Heating	4
Total	**100**

The table shows that most electricity is used for operating the printing presses (35%), while lighting, ventilation and computers and electronics use somewhat less electricity. All printers will have some consumption relating to these activities. To some extent the size of the various departments such as office activities and stores will reflect the size of the printing company as measured in number of tonnes of paper. Since energy consumption is calculated on the basis of tonnes of paper at the printing company, there will be a relationship between the size of the various departments at a printing company and its paper consumption. Furthermore, storage facilities will be an area that does not require a great deal of heating. This will further reduce the likelihood that these activities will be decisive as regards the overall energy consumption of the printing company.

Nordic Ecolabelling has therefore chosen to impose requirements as to the energy consumption of the printing company in its entirety and not to permit deductions or, if applicable, supplements in energy consumption on the basis of various activities. However, two exceptions apply: newspaper printers with editorial offices; and external finishing.

Nordic Ecolabelling is of the view that the size of a newspaper editorial office will not necessarily be related to circulation measured in tonnes, but will rather be determined by the ambitions that apply to the contents of the newspaper. Fur-

thermore, a parallel can be drawn with other print items where the contents are created outside the walls of the printing company (e.g. the writing of a book). For this reason, this part of the production of a newspaper is not encompassed by the energy parameter.

Data from the literature shows that the energy consumption of newspaper printers with editorial offices is on average approximately 50% higher than that of newspaper printers without editorial offices (see the data in Appendix 1). For this reason, newspaper printers with editorial offices in the same building as printing operations may deduct the energy consumption related to editorial operations, if the energy consumption from printing operations can be measured or a qualified estimate the energy consumption from this can be made.

Finishing (both mechanical and chemical) is viewed as a natural part of the printing business. Some printing companies do a great deal of finishing in-house, whereas others do little and generally send print items out for finishing by an external supplier. Machines used in finishing consume energy and this energy must be included in the calculation of total energy consumption. In order that printers that finish their print items in-house are not penalised for doing so relative to printers that send their print items out for external finishing, printing companies that use external finishing services must add the energy consumption of their external finishes to their own energy consumption. To simplify this calculation, the printing company must use a standard value of 90kWh/per tonne of product, regardless of the finisher used by the printer.

For practical reasons, Nordic Ecolabelling has chosen to apply the same principle for energy consumption in finishing as is used for the purposes of waste paper in relation to internal and external finishing. The energy consumption to be added is related to the quantity of the paper purchased/used for orders sent for external finishing. This quantity is the same quantity that the printing company must use when calculating waste paper generated externally (see Section 7.7).

This means that a printing company generating a total of 30% waste paper and sending 200 tonnes to external finishing, has to add 90*200*(1-30/100)=12,600 kWh to the printing company’s internal energy consumption.

The standard value for energy consumption for external finishing is based on energy consumption figures for a bookbinder obtained by Nordic Ecolabelling during the energy compilation process. According to this information, energy consumption was 83 kWh/tonne of product at the bookbinder. The standard value has been rounded off to 90 kWh/tonne of product.

In-house printers
The term in-house refers to printers that do not have premises of their own but instead lease premises in a building in which other activities are also conducted. Digital printers are often typical in-house printers. Some of these printing companies do not have an overview of their own energy consumption. This is especially true of energy expended for heating, since this will often be included in the rent payable for the premises.

Moreover, three of the seven in-house digital printers on which Nordic Ecolabelling compiled data did not know how much electricity was consumed in operating the printing process itself. Nordic Ecolabelling has opted to introduce the requirement that in-house printers that do not know their own electricity consumption must install their own electricity meter, if applicable several meters, if there is no central supply. However, for practical reasons, the printer must as a minimum install electricity meters on all printing presses. If the printer does not install electricity meters for recording remaining electricity consumption, this must be calculated by multiplying electricity consumption relating to the machinery by a standard value of 2.86. The background to this value is that according to the information contained in Table **Fejl! Henvisningskilde ikke fundet.**b, approximately 35% of electricity consumption at a printing company derives from the printing presses (1/0.35=2.86).

To be able to control energy consumption levels it is necessary to know one's own energy consumption. If one knows how much one consumes, it will also be easier to make changes and then see the effect. Heating may be more difficult to measure with the aid of an individual meter as this may be supplied as, for instance, district heating. If electricity is used for heating purposes, the installation of an electricity meter will also provide figures of the amount consumed for heating. In the case of in-house printers where other sources of energy than electricity are used for heating and where there is no separate measurement of heat consumption, a figure for heating consumption must be added based on the heating consumption per square metre in the building in which the printer is located.

Nordic Ecolabelling compiled data on heat consumption per square metre in non-in-house printers in the autumn of 2010 and these data reveal an average value of 110 kWh/m^2 with a distribution between 43 and up to 261. This lies within the range typical for buildings of various sizes and ages, as shown in Table **Fejl! Henvisningskilde ikke fundet.**c.

Table **Fejl! Henvisningskilde ikke fundet.**c: Specific net heat consumption in buildings, depending on age and size (GA and DDFF 2002, p. 21).

Built or significantly refurbished in period	**Specific heat consumption in kWh/m2, year**		
	One storey	**Multiple storeys**	**Supplement in the event of small spaces**
Pre 1960	300	200	
1960-1977	150	100	
1978-1995	90	60	
Post 1995	70	50	
Supplement small spaces <300 m2			0,4
Supplement small spaces <250 m2			0,2

Nordic Ecolabelling has collected data on seven in-house digital printers where heating data is available for the building as a whole (non-electrical heating). The average heat consumption for these buildings is 110 kWh/m2 with data ranging from 3.6 (installed thermal heating) up to 252. The information is not extensive, but suggests that there are no major differences between heat consumption per

square metre in an in-house printing company and heat consumption for the building as a whole, when compared with the values for printers that are not in-house.

On the other hand it would appear that the variation is greater if the in-house printers' total heat consumption is calculated on the basis of the floor space of the printing company and this figure is related to tonnes of product. The average for the seven in-house digital printers discussed above is 3 105 kWh/tonne of product with a distribution ranging from 94 (installed thermal heating) all the way up to 11 144 kWh/tonne. This will be compared with digital printers that are not in-house where heat consumption on average was 710 (four digital printers that do not use electricity for heating purposes).

Nordic Ecolabelling also received data on the electricity consumption of four out of the aforementioned seven in-house printers. The data on these printers is shown in Table **Fejl! Henvisningskilde ikke fundet.**d. It will be seen from these data that none of the printers would be able to reach up to the threshold value of 3 500 kWh per tonne of product.

Table 7.15a Energy data in kWh/tonne of product for in-house digital printers with their own electricity data.

Printing company	Electricity consumption	Heat consumption (calculated)	Total
1	3.383	11.144	14.527
2	2.029	2.206	4.235
3	4.009	2.153	6.162
4*)	1367	776	2143
Average	**2.697**	**4.070**	**6.249**

*) Uncertain whether this represents own electricity data.

This difference from non-in-house digital printing companies may be due to too few and possibly inadequate data, but could also indicate that in-house printers often have bigger premises relative to the size of their output or that production capacity is not exploited to the same extent as in non-in-house printing companies. Inadequate data is often due to a mistake because data encompass the whole building and not just the printing house.

The reason that data are sometimes incoherent is also be related to the fact that many of the in-house printers do not pay an electricity or heating bill, they simply pay a fixed amount in rent. Nordic Ecolabelling's assessment is that there will typically be no difference between the printing machines used in in-house and non-in-house digital printing companies.

Against the background of the above information and the data provided by digital printers that are not in-house, Nordic Ecolabelling has concluded that considerable potential exists for in-house printers to save energy and that in doing so they could qualify for a Nordic ecolabel.

The energy consumption requirement does not take account of climatic differences. There are differences in the heating requirements in the various Nordic countries and within the individual country, but in the printing industry energy for operating printing equipment exceeds the energy used for heating purposes.

Based on the data compiled on energy consumption it is clear that major variations exist in energy consumption both between printing methods and within the individual printing method.

As a result of this wide variation it has not been possible to ascertain whether climatic zones have an impact on energy consumption. Since the mandatory threshold value is high, differences in energy consumption will be reflected in the flexible points parameter. It is unlikely that climatic zones will be decisive with regard to points scores achieved here. If Nordic Ecolabelling has access to more data in subsequent revisions of the document, it may be appropriate to adjust energy consumption on the basis of climatic zones.

Energy consumption and energy sources
The conversion factors presented in Table **Fejl! Henvisningskilde ikke fundet.**e must be used where sources of energy other than electricity are used. These are based on values for lower calorific value taken from Nordic Ecolabelling's criteria for paper, save as otherwise specified (Basic module, version 2).

Table **Fejl! Henvisningskilde ikke fundet.**e Energy factors based on lower calorific value.

Fuel	**Lower calorific value**	**Unit**
Light heating oil:	36.0	GJ/m^3
Heavy heating oil	38.7	GJ/m^3
LPG (gasol)	46.1	MJ/kg
Natural gas	38.9	MJ/m^3
Biogas	6.4	kWh/m^3
Pellets	10.0	GJ/m^3
Wood chips	3.5	GJ/m^3
Wood briquettes	10.0	GJ/m^3
Coal	26.5	MJ/kg
District heating		
Water based, 35°C cooling	40.8	kWh/m^3
Steam based, condensate at 100°C and normal air pressure	627	kWh/m^3

The values for lower calorific value are taken from the criteria for the ecolabelling of paper, except for biogas. The value for biogas is taken from the second generation of the criteria for textiles services. If more specific values are available from the supplier of fuel, e.g. own measured values, these values may be applied instead. In the case of fuels not included in the table, data provided by the supplier may be used (lower calorific value).

In some cases district heating is charged as m3 water or m3 condensate from district heating steam and the information stated if kWh is not specified on the bill. The data for district heating water is based on 35 degrees cooling, specific heat capacity for water of 4.2 J/kg* degrees (applies to water of between 0-120 degrees) and density 1 kg/l (applies to water between 0-100 degrees). As regards district heating condensate (district heating steam) the value is based on a specific evaporation enthalpy of 2 257 kJ/kg at 100 degrees and normal air pressure and a density = 1 kg/m3.

As a general rule, Nordic Ecolabelling would prefer to calculate energy consumption in terms of primary energy, i.e. that account would also be taken of the degree of efficiency of the various energy sources. A conversion of this nature would require electricity consumption, for example, to be multiplied by a factor of 2.5 and district heating by a different factor. This approach has not been followed in the fifth generation of the criteria, however. One of the reasons for this is the lack of detailed data. Conversion to primary energy requires information on energy consumption broken down into energy sources. Data compiled by Nordic Ecolabelling in the autumn of 2010 shows energy consumption broken down into energy sources, but data taken from the literature provides information only on overall energy consumption in kWh.

A further factor is that the scope for control, i.e. the possibility of switching energy source, is relatively small. The machinery used by a printer generally operates on electricity, and it will not be possible for the printer to replace electricity with some other source of energy. Having said this, however, there may be some scope for changing the energy sources used for heating purposes. This scope will however be limited, since it is by no means possible for district heating to be provided to all premises and moreover many printing companies are of a size that would make it uneconomical to invest in a stationary incineration plant. Less energy is consumed for heating purposes than for operating the printing business. Nordic Ecolabelling is therefore of the view that the printing has greater scope for saving energy than for switching heat source.

In introducing energy requirements in the fifth generation of the criteria Nordic Ecolabelling will gain additional information on electricity and fuel consumption allowing requirements based on primary energy to be imposed in subsequent versions of the criteria should Nordic Ecolabelling find this appropriate.

7.16 Points for energy (P9-P10)

Printers may score up to 20 points for energy: some for energy consumption calculated as energy purchased at the printing company and some for charting energy consumption at the printing company, as well as the use of renewable energy sources or the charting of carbon dioxide emissions in the supplier chain. Energy has been selected as an area in which points may be scored against the background of Nordic Ecolabelling's aim of achieving efficient energy use, thus counteracting climate change. A maximum of 18 points can be scored for energy consumption, and a maximum of 2 points for other measures taken. This means that points may be scored in the following areas only:

- Energy charting and planning
- Use of renewable energy sources
- Charting carbon dioxide emissions in the supplier chain

Nordic Ecolabelling has collected data and calculated a market average for the size of energy consumption and estimated the market average to be 0 for energy and carbon dioxide charting for each printing method in Appendix 1. The sum of the market average for these and other parameters, plus an overall points addi-

tion, constitutes a printing method's points limit for obtaining a licence (see Section 7.24).

All of the above requirements are new to the fifth generation of the criteria. In the fourth generation of the criteria 5 points only were available for requirements related to energy. However, since the focus on energy consumption and the greenhouse gas effect has grown more intense, energy has been given a higher weighting at the expense of points for VOC (10) and for waste (5) with effect from the fifth generation onwards. The scope for scoring points in the fourth generation related to various energy-saving measures, such as frequency-controlled compressors and pumps. These were difficult to verify and have been replaced with points for low energy consumption per tonne of paper. The option of scoring points for renewable energy sources for electricity and heating has been continued albeit modified.

Energy consumption (P9)
The criteria award up to 18 points depending on the amount of energy consumed in kWh per tonne of product, up to 3 500 kWh/tonne. The background to the delimitation and definition of the parameter is described in the preceding section. The values underlying the formulation of the parameter are based on data compiled from Nordic ecolabelled printers and data from the literature (see Appendix 1).

Points for energy consumption must be calculated using the following formula, where x is the energy consumption of the printer:

Points	= 18*3500/(3500-300) – 18*x/(3500-300) or = 18/3200x(3500 – energy consumption) in shorter form

The point of departure for the formula is that a value of 3 500 should quality for 0 points and a value of 300 should qualify for 18 points. The inter-relationship is linear. The reason that energy consumption qualifies for 0 points at 3 500 kWh/tonne of product is that it is a requirement that maximum energy consumption must be below this level (see Section **Fejl! Henvisningskilde ikke fundet.**). Since there are no cases of printers with an energy consumption of 0 kWh, a maximum of 18 points can be scored if a printer has a value of approximately 300 kWh per tonne of product annually. This level corresponds to the lowest observed level of energy consumption.

Energy charting (P10)
Printers can score 2 points if an energy review/charting exists that is less than five years old and contains proposals for measures, including savings potential and costs. Power consumption may be divided up according to the most power-intensive activities, such as printing presses, ventilation, dampening and electronic equipment/machines. This represents an expansion of the specifications for energy charting relative to the fourth generation of the criteria corresponding to the requirements in Nordic Ecolabelling's hotel criteria.

Renewable energy sources

The option for scoring points was lowered and tightened with effect from the fifth generation of the criteria, so that 2 points are awarded for electricity and 2 for heating, provided that the printing company has valid certificates/declarations of renewable electricity/heating for 100% of consumption. The reason for this is that it is difficult to demonstrate actual effects of such an option for scoring points; they are more likely to be describable as having a signalling value.

Nordic Ecolabelling's definition of renewable energy is based on the EU's definition in accordance with Directive 2001/77/EC, and the guidelines for Directive 2003/87/EC published in Decision 2004/156/EC. In the EU's Directive 2001/77/EF on the promotion of electricity produced from renewable energy sources in the internal market for electricity, renewable energy sources, including biofuels, are defined.

For Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading, there is a Commission Decision 2004/156/EC, in whose Chapter 8 peat is mentioned among solid fossil fuels.

Carbon dioxide emission (P10)
The printer is awarded 2 points if a CO_2 review has been conducted in accordance with Intergraf's recommendations on CO_2 calculations in the printing industry. This encompasses 13 parameters related to, inter alia, emissions during paper production, energy consumption, transport and production of chemicals. According to Intergraph, the parameters included will cover 95% of total CO_2 emissions from graphic production (Enroth 2010a).

During revision of the criteria document consideration was given to introducing requirements relating to emissions of CO_2 per tonne of product. However, it has not proved possible to set a quantitative requirement in this area. Detailed information on a large number of parameters is required in order for it to be possible to impose a requirement of this nature. Charting of emissions of CO_2 reveals that the production of paper, electricity consumption and the heating of premises represent the most important parameters in terms of greenhouse gas emissions (Enroth 2010a).

Nordic Ecolabelling already imposes requirements on the paper used by Nordic ecolabelled printing companies. Nordic ecolabelled and inspected paper grades fulfil strict requirements in terms of both consumption of energy and CO_2 emissions during production. Imposing requirements with regard to energy consumption and rewarding printers with low production would also indirectly lead to lower emissions of CO_2. The most important point for Nordic Ecolabelling is to impose requirements which reduce energy consumption. Thereafter it is important to stimulate the use of energy sources and other measures that may serve to reduce emissions of greenhouse gases.

Climate and emissions of greenhouse gases are matters of widespread concern in modern society and this is also reflected in the printing industry. However, Nordic Ecolabelling does not wish to stimulate an exaggerated focus on CO_2 emissions, since the key point is the overall environmental impact. Nevertheless, charting may have a positive effect in that it enables consumers to gain an over-

view of their own consumption and thereby to see the effects of any measures that are introduced. It can encourage improvements. Accordingly, scope for scoring points where charting of this nature is performed has been introduced, and Nordic Ecolabelling will review the relevance of introducing a quantitative carbon dioxide parameter in future generations of the criteria.

Unfortunately no internationally standardised method of performing CO_2 calculations exists, although work on a number of alternatives is under way. Work is inter alia being conducted on an ISO standard for "carbon footprint" for products (ISO 14067). Other examples include "Greenhouse Gas Protocol (GHG)", Clean Development Mechanism (CDM), CO_2 focus, Intergraf's recommendations, GA's (Graphic Association of Denmark) climate calculator and CEPI (Confederation of European Paper Industries) Framework for the development of Carbon Footprints for paper and board products. See Maria Enroth's description of these and other initiatives concerning carbon footprint (Enroth 2010a).

One example of an extensive carbon footprint study is the Finnish Leader Project (Viluksela et al 2010, Pihkola et al 2010 and Pihkola et al 2011). This project utilised carbon footprint guidelines issued by CEPI and the UK PAS 2050:2008 and performed calculations for a daily newspaper (coldset), magazine (heatset), book of photography (digital printing), an advertising print item (rotogravure) and a hard-cover book (sheet-fed offset) in order to identify the critical life cycle phases and processes in which carbon dioxide emissions might be reduced. Calculations were performed on the basis of an average of emissions over the last five years from Finnish energy production.

The reason for the choice of Intergraf's recommendations from 2010 is that they are extensive and detailed and cover almost the entire supplier chain; moreover Intergraph has developed guidelines specifically for the graphic industry in collaboration with industry organisations in Europe.

GA's climate calculator represents a practical example of the use of Intergraph's recommendations. The calculator can be used by printers to chart carbon dioxide emissions. A comparison of data produced by printing companies that have used the calculator reveals that paper accounts for the greatest carbon dioxide impact and represents 61% of carbon dioxide emissions in the supplier chain. This is followed by the printer's purchase of electricity (16%), the combustion of fuels in in-house incineration plants (8%), transportation of paper (5%) and the production of printing inks and varnish (5%). The data represents sheet fed offset, heatset and form printing (Enroth 2010a).

Nordic Ecolabelling will consider modifying the criteria at a later date so that charting that follows an adopted version of ISO 14067 may also grant points.

7.17 Requirements applicable to waste (O10)

The printing company must draw up a waste plan in order to facilitate the sorting of waste at source. This requirement has been selected against the background of Nordic Ecolabelling's goal of minimising waste formation. Waste is produced at

many points in the life cycle of print items, e.g. in connection with paper production. The waste requirement focuses on waste that the printer is able to control.

As in earlier versions of the criteria documents the practising company is required to produce a waste plan. This will help focus attention on the waste fractions. Recording waste quantities is voluntary. This will serve to further increase awareness of the quantities of waste that are formed and can be used as documentation of some of the measures for which points are awarded in the area of waste.

The waste plan requirement has been slightly corrected in version five of the criteria. The column in which to state the waste transport provider has been removed, and the waste fractions have been adjusted slightly so as to make them more up-to-date. In criteria version 5 the requirement has to be documented on the Nordic Print Portal instead of in a separate annex as previously. Appendix 2 to the criteria states which information is to be provided on the portal.

7.18 Points for waste (P11-P12)

Printing companies are awarded points for waste – up to 5 points for various waste minimising technologies and 5 points for the quantity of mixed waste in kg/tonnes of product up to 20 kg/tonnes of product. This option for scoring points has been introduced based on Nordic Ecolabelling's objective of reducing waste formation. Reductions in waste quantities will also contribute to fewer transports. Compared to the last generation of the criteria document the points available in this area have been changed from a total of 15 to a total of 5.

In Appendix 1, Nordic Ecolabelling has estimated that the market average for this parameter is 2 points for sheet fed offset, forms, envelopes and packaging offset and 5 points for other printing methods. Points for quantity of ungraded waste are estimated at 2.5 for all printing methods. The market average of these and other parameters plus a total points supplement constitute the points limit of a printing method for obtaining a licence (see 7.24).

Ink wastage has been selected as an area in which points may be scored based on Nordic Ecolabelling's objective of lowering consumption of materials and reducing ecotoxins in the aquatic environment. In addition to this option for scoring points there is a further requirement applicable to printing inks and their constituent substances, see Section **Fejl! Henvisningskilde ikke fundet.**.

A maximum of 5 points may be scored for technologies that minimise the flow of waste from printing companies. The fourth generation of the criteria offered the option of scoring up to 15 points in combination with points for mixed waste. However, it did not prove possible to achieve this level of points since not all technologies were relevant for all methods of printing. Waste is an area over which printing companies have a certain degree of control and where potential exists for improvements through the use of various technological solutions. In addition, up to 5 points may be scored for the quantity of mixed waste generated by the printing company. This can be viewed as a measure of the effectiveness of sorting waste at source.

For example, computer-controlled ink cartridges are available for offset printing machines which dose inks automatically into the ink fountain. These cartridges are designed in such a way that very little ink remains at the end of their useful life Johnsen et al reported a very wide range of ink wastage of between 2.4% and up to 45.9%. Jepsen and Tebert reported ink wastage of 1-3% for heat set printing companies. There is some uncertainty about whether the high figures registered by Johnsen et al indicate that other factors were included amongst the ink wastage fractions (e.g. the ink boxes).

The fourth generation of the criteria enabled points to be scored if the printing company could document low ink wastage by calculating percentage wastage. This option has been removed from the fifth generation of the criteria document since the calculations have proved to be very uncertain. Ink wastage is found in many different waste fractions, such as cloths and rags, used washing agent, traces in metal boxes etc. Nordic Ecolabelling has not observed any robust methods of calculating this waste.

According to Fred Larsen et al 2002, reusing washing agent solution/rinsing water for the purpose of diluting concentrated printing ink and using a chamber doctor in flexography can offer considerable environmental benefits. If the first litre of washing agent solution from the washing of printing blocks is used to dilute 15 litres of water, this only results in a dilution of 1%. According to Fred Larsen et al, dilution of between 1 8% is OK. According to Fred Larsen et al, there is a variety of ways in which waste can be minimised in flexographic printing.

Evaporation technology of various sizes is available for recycling washing agents, enabling the printing company to reduce the consumption of washing agents considerably, thereby also minimising washing agents to be disposed of (Jørgen Timm 2005). Filtration systems are also available capable of filtering the dampening solution with such effectiveness that it will not be necessary to dispose of it, it can simply be re-used repeatedly. The criteria refer to these systems as “extensive filtration” as distinguished from an ordinary textile filter which simply takes out the largest particles and which entail that dampening solution needs to be replaced on a regular basis.

In the fourth generation of the criteria, 2 points could be scored for an entirely closed system for film or printing form production, where the only waste requiring removal would be filters and sludge. This was most applicable to film production where for example rinsing water could be used for mixing a new fixer. This option has been removed from the fifth generation of the criteria, since traditional film production processes are no longer widely used.

It is no longer possible to score 1 point for a system in which rinsing water is recycled only, not necessarily reused in other parts of film or printing form production. From the fifth generation of the criteria onwards points will be scored only if chemicals are not released into the sewage system (e.g. rinsing water or developer) and less than 0.1 litres of used process chemicals per tonne of product produced per year requires removal. This means that points will be scored only if a very limited quantity of chemicals is used and at the same time these are col-

lected for controlled removal. For practical reasons, this option for scoring points has been moved to points for repro (Section 7.12).

Points can also be scored if the printing company can demonstrate that most of the waste produced is sorted on site. The scope for scoring points is reduced if consumer materials are not managed closely.

> Points = 5-x/4
> where x is the quantity of ungraded solid waste in kg per tonne of product

If the printing company has no more than 4 kg of ungraded waste, 4 points will be scored. In the fourth generation of the criteria, 3 points were scored if the quantity did not exceed 10 kg, and no other options for points existed. Ungraded waste is mixed waste that goes to landfill or to incineration. This level can be achieved by reusing or recycling waste either at the printing company or at an external waste processor. This might for example involve the recycling of materials (e.g. waste paper to recycled paper).

Nordic Ecolabelling has observed that many of the printing companies that have followed this option have values in the region of 5 kg or lower. In connection with the development of the fourth generation of the criteria Nordic Ecolabelling registered a relatively wide distribution, from approximately 5 kg up to approximately 100 kg per tonne of purchased printing paper amongst sheet fed, heatset and coldset offset printing companies. Accordingly the figure of 20 kg per tonne of product has been selected as a discretionary figure for the level at which points are no longer scored.

Points can be gathered from several different measures and printing companies that already think in terms of waste minimisation are rewarded, and a high degree of flexibility is offered to printing companies that wish to achieve a licence. The goal in the longer term is printing companies generating little or no waste. Minimising waste also has a positive impact on the operating finances of a printing company since costs are saved on raw materials and the removal of waste is costly.

7.19 Points for ecolabelled products and services (P13)

The use of various ecolabelled products and services allows up to 3 points to be scored. This option for scoring points has been introduced based on Nordic Ecolabelling's objective of reducing environmental impact in the life cycle of the printed matter. A second important reason is that ecolabelling increases awareness about the environment and green purchases in general. This option for scoring points has been adjusted relative to the last generation of the criteria so that a few points can now also be scored for products that are used in other areas than the production process.

Nordic Ecolabelling has gathered data and calculated a market average for number of points for this parameter for each individual printing method in Appendix

1. The market average of this and other parameters plus a total points supplement constitute the points limit of a printing method for obtaining a licence (see 7.24).

Ecolabelled products and services that score the highest points are initially products and services used in production and therefore expected to have some influence on the environmental impact of the life cycle of printed matter. From the fifth generation of the criteria onwards, however, the option has been introduced of achieving 0.5 points for purchasing a minimum of 90% ecolabelled consumables within two of the categories photocopying paper, toilet tissue, hand soap and detergents – i.e. items that are not directly related to production but are nevertheless purchased by printing companies. Similarly, points can be score for toner cartridges and office machines used at the printing company's office.

Other categories may be included subject to an assessment by Nordic Ecolabelling. Similarly, Nordic Ecolabelling will assess whether other product types in production than those specified should qualify for 1 point.

A minimum percentage limit of the quantity needed to qualify for points has been introduced in relation to the points options transferred from the criteria of previous generations (e.g. ecolabelled cloths and rags, working clothes, etc.).

From the fifth generation of the criteria, the points for Nordic ecolabelled adhesive were no longer available since it is no longer possible to ecolabel adhesives for graphic production. Points for Nordic ecolabelled or EU ecolabelled paper have been removed against the background of the new weighted calculation for paper below in connection with the mandatory requirement for a minimum proportion of environmentally-friendly paper and the option of scoring points for the choice of paper (7.5 and 7.6).

In order to score maximum points, points must be collected for several types of ecolabelled products or services.. Although only few points are awarded for each measure, this will serve to increase general attention on environmental issues. This is confirmed by Nordic Ecolabelling's experience of licences within the area of hotels and shops. Printing companies that have already been thinking along these lines will be rewarded and moreover, this system offers a high degree of flexibility since it encompasses many different measures.

7.20 Mandatory requirements for solvents (O11)

According to a new requirement, the printing company must install local extraction devices at the printing presses, if the VOC consumption exceeds 9 kg of VOC/tonne of product The reason for this requirement is Nordic Ecolabelling's objective of reducing health problems, including poor working environment.

The requirement comprises all printing plants on all printing machines with more than two printing plants/varnish units if the annual VOC consumption for the individual printing method is more than 9 kg per tonne of product (or approx. 7 kg per tonne of paper consumption) irrespective of printing method. Based on a proposal during the hearing, Nordic Ecolabelling introduced a method according to which the VOC consumption for each printing machine could be calculated.

As a result, extraction devices could be installed only on the machines with an excessively high VOC consumption. Moreover, Nordic Ecolabelling introduced the option of having only a central extraction device if the printing machine is incorporated as part of the design of the machine (e.g. certain digital printing machines).

This means that some 25% of typical sheet fed offset printing companies must either install an air extraction device or reduce VOC emissions in accordance with data from Nordic ecolabelled printing companies whose primary method was sheet fed offset printing in February 2010. Printing companies with only sheet fed offset printing of up to 1000 tonnes of paper annually had an average of 5.1 kg of VOC/tonne of paper consumption and those above that level had an average of 5.6. This means that large printing companies have approx. 9% higher average VOC consumption. See more about the reason for the requirement in 7.21, Points for working environment.

7.21 Points for working environment(P14)

Printing companies may now score up to 3 points for introducing measures to improve the working environment. This has been selected as an area in which points may be scored based on Nordic Ecolabelling's health objectives.

This points option was suggested based on work made at the Occupational Medicine Ward of St. Olafs Hospital in Norway, resulting in a guide to conducting risk assessments in relation to the working environment (Sivertsen et al 2004).

Nordic Ecolabelling has estimated the market average for points relating to this parameter to be 0 for all printing methods. The sum of the market average for this and other parameters, plus an overall points addition, constitutes a printing method’s points limit for obtaining a licence (see Section 7.24).

Besides the requirements that already contribute to an improved working environment such as points for washing agents and VOC extraction, it is possible to score points for conducting an external working environment review. The review must not be older than 3 years and must include a general assessment of:

- paper dust
- exposure to solvents
- noise
- ergonomics
- heavy lifting

and a special assessment of:

- washing of rubber blankets and rollers as well as cleaning of ink baths
- replacement of printing plates
- processing of printing plates (e.g. rubberising/cleaning)
- cleaning and maintenance of printing plants

In order to score points the review must also include a plan for follow-up measures. Documentation is a copy of the report as well as a description of planned and completed follow-up measures. Such an external working environment review can be conducted by the regulatory working environment authorities. If the company has an OHSAS 18001 certificate this can be used as documentation. However, it is a condition that the review encompasses the items referred to in the requirement. It is important that skilled persons within the individual area make the review and assessment. Irrespective of the authority used, the persons making the assessment must have qualifications within the specific area. No points can be scored by making a so-called workplace evaluation as it is the company itself that is responsible for making this review.

The hearing proposal also included several alternatives to points for working environment. After a new assessment and based on hearing comments some of these alternatives have now been removed. Points could also be scored for technologies reducing the amount of solvent vapours and technologies for dampening. The requirement for limiting paper dust and particles in the air has been maintained.

The reason why the items referred to were removed was that it is better to substitute chemicals by others less harmful to health. By granting points for local extraction to avoid VOC emissions, printing companies that are not inclined to replace their chemicals can still score points and thus potentially miss an opportunity to substitute chemicals with a high VOC content.

Most printing companies adjust air humidity. The primary reason is to avoid that the paper curls. As a result the potential for distinguishing between good and poor printing companies is too small.

7.22 Points for water consumption (P15)

As a new option printing companies may score up to 2 points for water consumption of up to 2000 litres/tonne of product. Water consumption has been selected as an area in which points may be scored against the background of Nordic Ecolabelling's goal of improving resource efficiency.

Nordic Ecolabelling has estimated a market average for points regarding this parameter for each printing method in Appendix 1. The market average total for this and other parameters, plus an overall points addition, constitutes a printing method's points limit for obtaining a licence (see Section 7.24).

The printing company may score up to 2 points depending of the water consumption per tonne of product. Points are connected to water consumption on a linear basis. The values are based on data collected from Nordic ecolabelled printing companies and data from the literature (see Appendix 1). Examples of points:

- 500 l/tonne 2 points
- 500 – 2000 l/tonne 1 point
- 2000 l/tonne and above 0 points

The reason why water consumption scores 0 points at or above 2000 l/tonne of product is that data for water consumption examined by Nordic Ecolabelling may total up to this level (see information in Appendix 1). If printing companies have other activities not related to the printing operations the water consumption from these activities may be deducted following an assessment by Nordic Ecolabelling. It is a condition that the printing company can measure the water consumption related to these activities.

7.23 Points for print quality (P16)

As a new option printing companies may now score 1 point if they have a certified system in place for print quality in accordance with the ISO12647 series or a standard based on ISO 12647. Credibility considerations underlie the scope for points in this area. The standard is an international standard for graphic production. An example of a standard based on ISO 12647 is Validation Printing System (VPS) from the Fogra research institute (Forschungsgesellschaft Druck e.V.). In order for a Fogra certificate to be awarded substrate colour, gloss, durability, light fasteners, fading, colour fastness and precision, homogeneity and evenness are assessed.

Previous generations of the criteria contained no quality requirements, since this can be a difficult area to define and there was a risk that the criteria would cause the printing companies some extra administrative work. Furthermore, Nordic Ecolabelling was of the opinion that the printing companies were already paying attention to this area.

One of the reasons why quality did not previously form part of the criteria was that, in general, it is not relevant to Nordic Ecolabelling to impose requirements regarding print quality. It should be up to the customer and the printing company to agree on this.

Nordic Ecolabelling has estimated the market average for points relating to this parameter to be 0 for all printing methods. The market average total for this and other parameters, plus an overall points addition, constitutes a printing method's points limit for obtaining a licence (see Section 7.24).

There are many different views on what constitutes print quality. In a report on quality in the daily press (Hallmén et al 2004) the authors point to a number of different views on quality: Satisfied customers, technical print quality, good service, speedy delivery. Other examples of quality requirements might be archiving requirements, protection against forgery, the surface of the printed matter, colour, the opacity of the paper etc.

The technical terms for quality used by newspaper presses, especially in Sweden, are based on ISO12647 – 3:2004 and/or IFRA[1] Track 3.0. In the industry, IFRA's guidelines are considered to be tougher than the ISO guidelines.

[1] Ifra is the world's leading association for the publishing industry. Ifra's name originates from "**I**NCA-**F**IEJ **R**esearch **A**ssociation". "INCA" is an abbreviation for "International Newspaper Colour Association" and "FIEJ" for "Fédération Internationale des Editeurs de Journaux". Today the name "Ifra" is used.

A second part of the quality concept might be the training received by print workers. In Sweden, the industry (Swedish Graphic Companies Federation, GFF, and the Swedish Media Publishers Association, TU) and the trade union (the Graphic Industries' Union, GF) have created an educational programme called Grafiska Utbildningsfonden. One feature of this programme is that it enables print workers to obtain certification as coldset and heatset printing companies.

ISO 12647 certification is not yet widespread amongst printing companies. However, there is increasing demand amongst buyers of printed matter for uniform quality irrespective of which printing company produces the printed items (Abildgaard Pedersen 2008). One point is scored if the printing company is certified.

7.24 Counting points (Section 5)

A system of points has been compiled in order to safeguard the greatest possible potential for product development and innovation and thus utility of the criteria, while at the same time ensuring low environmental impact. This means that if a printing company has made advances in one area it may be less well developed in other areas, provided that the overall environmental impact is low.

Industry average and level of requirements

A minimum points score based on observed or assessed industry averages must be achieved in order for a licence to be awarded. This score varies depending on the printing method used since Nordic Ecolabelling does not wish to promote any one method over others, but would rather stimulate improvements of the individual method. The methods fulfil different functions and customer wishes and the levels of points scored by the individual methods are accordingly not comparable.

The requirement as to total score is the most important requirement since it most clearly distinguishes the printing companies with the best environmental performance from the rest. Nordic Ecolabelling is of the view that considerable potential exists for improvements since there are wide variations in environmental performance and since the industry is developing quickly.

The level of the requirement has been set in such a way that a score must be achieved that lies 5 to10% above the score that would be achieved if a printing company had an average score for the market in each area in which points are available (see overview of scores in Appendix 1). In order to take account of the fact that a percentage addition would have greater consequences the higher the industry average, the 10% supplement applies to an industry average of 50 or below and 5% to an industry average of 100% or above. In between the scale is linear. This means that the percentage addition is equal to 15-x/10, where x is equal to the industry average in the range in question.

Nordic Ecolabelling has analysed licensing data in order to gain an overview of average market values for the individual parameters for all printing methods. In

order to verify these values a comparison has been performed with values from the literature where such values have been available. A large number of values have been reported in various studies reviewed by Nordic Ecolabelling. These are referenced in Appendix 1. Taken together with the large number of licences this entails that the expert group is of the view that they have gained a thorough picture of the average for the industry.

The information base provides an accurate picture of the levels of the printing companies since the calculation is based on sound data for each individual parameter within the individual printing method. Printing companies that have not provided information on waste paper are excluded from the calculations, and accordingly the average provides a relatively certain picture. This means that for this calculation Nordic Ecolabelling has a data set comprising 112 data, since each of the 8 printing methods has been analysed with respect to 14 parameters.

With the new parameters and printing methods there will be even more data (two new printing methods and four new parameters: energy consumption, working environment, water consumption, quality = > 2*(14+4)+8*4 = 68 items of data in total 170 data). In the case of the new parameters Nordic Ecolabelling has performed an assessment on a basis of experience and qualified estimates of the average level of the industry.

In order to illustrate developments, a theoretical score has been calculated on the basis of updated industry values recorded in February 2010 (Nordic Ecolabelling 2010). The calculation was conducted in the same way as when Nordic Ecolabelling set the level of the requirements in 2005, i.e. the level is 10% higher than the average for the market:

Table **Fejl! Henvisningskilde ikke fundet.**a. Comparison of market data for 2005 and for 2010, showing the number of points to be achieved if the requirements in the fourth generation of the criteria were to be based on market data from 2010 (see Appendix 1). The table also shows the tightening required for each individual printing method.

Printing method	**Points in version 4**	**Estimated points score using data from 2010**	**Compared to 2005 (%)**
Sheet fed offset	56	80	43
News print	89	100	12
Form print	56	83	48
Coldset rotation (except news print and form printing)	56	95	70
Heatset rotation	71	87	23
Rotogravure	60	96	60
Flexographic printing (except news print)	59	102	73
Digital printing and photocopying	84	99	18

The results of this analysis show how much the required points score for the various methods needed to be tightened if the requirements were not changed and if the updated industry values were applied instead. Such tightening would entail that almost 70% of the Nordic ecolabelled printing companies would lose their licence (Nordic Ecolabelling 2010a).

In the fifth generation of the criteria changes have been made in several cases in the way in which the parameters are calculated and new parameters have been added. Accordingly the points limits are not comparable to those applicable in the last generation of the criteria. In addition the maximum attainable score has been changed from 115 to 121. The following table shows the new points limits.

Table **Fejl! Henvisningskilde ikke fundet.**b. Points required in order to qualify for a licence in accordance with the requirements in the fifth generation of the criteria based on data observed in 2010 (see Appendix 1).

Printing method	**Industry average 2010**	**Required minimum score**
Sheet fed offset (excluding packaging and envelope)	54	63
News print with coldset	84	90
Coldset, forms	59	68
Coldset rotation (except news print and form printing)	70	78
Heatset rotation	59	68
Rotogravure	68	76
Flexographic printing (except envelope production)	77	85
Digital printing and photocopying	72	79
Envelope offset	68	76
Envelope production with flexography	72	80
Packaging offset	46	56

Overall this means that the level of the requirements is strict and that the printing company must be better than average based on an overall assessment. On average only 20-30% of printing companies will succeed in reaching the minimum score without altering their production.

This assessment is based on the total points score needed to gain a licence being the sum of an average of each parameter plus an addition. Most are good at some parameters and poor at others. As a result it is difficult to be good at all parameters.

In consequence, the figure of 20-30 % is an estimate. For practical reasons Nordic Ecolabelling cannot have a more precise picture of the number of points scored by each printing company based on the new requirements and thus calculate how many will actually meet the requirements. Although there may be other requirements than the points limit such as mandatory requirements for chemicals, minimum quantity inspected and ecolabelled paper as well as maximum energy consumption, Nordic Ecolabelling finds that the points limit is the controlling factor for being awarded a licence. Since the requirement for the points limit is strict very few printing companies can acquire enough points to get a licence if they are close to the mandatory values of e.g. VOC and energy consumption.

The mandatory requirements applicable to, inter alia, maximum energy consumption and local extraction in the event of high VOC levels provide extra security that the printing companies with the highest levels will not qualify for an ecolabelling licence.

Multiple printing methods in the same printing company
The option of adding together the total points limit for several printing methods was changed in the fifth generation of the criteria, as a result of which the requirements for each individual method must always be met.

Printing companies can total up parameters such as VOC consumption per tonne of product for each individual method without difficulty since the chemicals concerned will almost always be linked to a specific printing method. Paper quantity and the type of paper grades used in the various printing methods will also be relatively easy to manage. Nor is it a problem to total up what are termed technology points separately (e.g. points for recycling washing agents in the printing press).

There are some individual parameters, however, that for practical reasons can be totalled up for the printing operation as a whole, e.g. water consumption and the quantity of mixed waste, even if the printing company operates multiple printing methods. The requirements to be summarised for the entity as a whole are Type of printing company (O1), Print suppliers (O2), Suppliers of finishing services (O3), Pressure-sensitive adhesives (O6), Plastic packaging and laminates (O8), and Waste plan (O10).

Points options that can be summed up are Energy efficiency measures and carbon dioxide emissions (P10), Ungraded waste (P12), Ecolabelled products and services (P13) and Water consumption (P15). See also waste paper and energy consumption below.

Based on comments during the hearing concerning inappropriate administration it was decided to enter in the section on points options for type of chemicals that the printing company can add points for several printing methods if the same chemical is used in these printing methods. For adhesives (P4) it applies that the printing company can always count all points for the entire printing company since adhesives are not linked to a specific printing method.

For VOC where several different chemicals often contribute to the calculation it was decided that unless the printing company makes its own separate registrations, the quantities of a VOC chemical used in more than one printing method or in the finishing services must be distributed relative to the quantities of paper used in the printing methods.

By requiring separate statements for each individual printing method Nordic Ecolabelling avoids that Nordic ecolabelled printing companies have several printing methods where the environmental conditions are so poor in respect of one of the company's printing methods that the company would not be able to get a licence if it used this printing method alone. Thus one or more environmentally harmful printing methods could be balanced by a good printing method in the same printing company. This is also the reason why Nordic Ecolabelling has decided that it is no longer possible to calculate points for the quantity of inspected/ecolabelled paper for an entire group.

This approach may be a challenge with parameters which are not easily separated without the printing company being exposed to excessive administration, i.e. for waste paper and energy consumption. It does not make sense to distribute the waste paper equally between the printing methods due to the major differences depending on the printing methods in question.

Instead Nordic Ecolabelling has decided to make it possible to allocate the waste paper and energy consumption according to what is typical for the individual printing methods. Thus it is possible to use the market average values for waste paper/energy consumption for the printing methods and assume that the printing company is equally far from the average values of the individual printing methods.

If, for example, a printing company with both sheet fed (500 tonnes of paper) and digital (100 tonnes of paper) printing generates waste paper totalling 100 tonnes and the average waste paper percentage is 23% for sheet fed offset and 10% for digital printing (Appendix 1 to the background document), then 8 tonnes can be allocated to waste paper for digital printing and 92.0 tonnes to sheet fed offset because:

10/23 = (8.0/100)/(92.0/500) and
8.0+92.0 = 100

10/23	is the average waste paper ratio of digital printing to sheet fed offset in the market
y/z	is the waste paper ratio of digital printing to sheet fed offset in the individual printing company

Since conditions must be equal, y/z = 10/23. The total quantity of waste paper will be 100 tonnes, i.e. (y/100)*100 + (z/100)*500 = 100. For this to tally, y must be 8 and z must be 18.4.

The waste paper quantity for digital printing will be 8.0 tonnes and for sheet fed offset it will be 92.0 (18.4/100*500). If the printing company has data for each individual printing method, then this data can of course be used.

This change entails that in order to qualify for a licence, a printing company with multiple printing methods must satisfy the points limit for all methods. It would be damaging to credibility if there were some printing companies that had Nordic Ecolabels for part of their production but failed to fulfil the requirements in other parts of the production. For the same reason, there can be no threshold limit for the quantity of paper used determining if the printing method can be calculated separately.

Printing methods and types of printed matter
In the fifth generation of the criteria a separate point score was introduced for form printing. Previously, form printing had the same points limit as sheet fed offset.

In connection with the discontinuation of Nordic Ecolabelling's criteria for envelopes a new points limit was introduced in the fifth generation of the criteria of printing companies for printing using envelope offset. Special machines are used for offset printing of envelopes which do not require the products to be cut. If envelopes are printed digitally, the printing company in question should only use the points limit for digital printing. Envelope production itself takes place by means of flexography and accordingly this printing method must be used, even if nothing is printed on the envelope.

In addition, the fifth generation of the criteria introduced a points limit for packaging printing using offset on paperboard. Nordic Ecolabelling has compiled data on these methods, and these data provide the basis for the level of the requirements for total score. In some situations, for example in the case of energy, data has been lacking and has therefore been transferred from similar printing methods where Nordic Ecolabelling has been of the view that a comparison is possible (see Appendix 1). If the need arises and it proves relevant and practically possible, it may be appropriate to introduce additional categories.

For detailed descriptions of the various technologies and types of printed matter, Nordic Ecolabelling refers to Section 2.1.2 (divided into products) and 2.2.3 (divided into printing technologies) of the BAT reference document for printing (European Commission 2007) and Section 2 of the Nordic Council of Ministers' BAT report.

In addition to the necessary degree of flexibility, the points system used in the criteria can also compensate for differences between the printing companies which the companies themselves would have difficulty in influencing. This would include factors such as the printing company's size, customer base and customer requirements, differences between the Nordic countries etc.

In the first generations of the criteria the points system was organised at order level. This entailed a great deal of administration and for this reason the calculation of points was moved to process level. This means that it will not be necessary to perform points calculations for each order which is to carry the Nordic Ecolabel. Now it will be sufficient to perform the calculations at the time of application and thereafter at least once a year in order to ensure continuous compliance with the points limit.

Areas in which points may be scored
In the earlier generations of the criteria the points system was divided into sub-processes, and as a result there were points limits for film and printing form production, printing and finishing. In order to improve the clarity of the document relative to the earlier generations of the criteria, there is now a single points system encompassing all sub-processes. Points may be scored in the following areas:

Table **Fejl! Henvisningskilde ikke fundet.**c. Areas in which points may be scored. See the description of the individual areas in the preceding section.

1. Choice of paper
2. Waste paper

3. Type of chemicals
4. Film and printing form production
5. VOC (volatile organic compounds)
6. Energy (including energy consumption)
7. Waste minimisation
8. Ecolabelled products and services
9. Working environment
10. Water consumption
11. Quality

The relationship of the scores to life cycle assessments
The maximum numbers of points available have been selected in such a way that areas that are normally encompassed by known life cycle studies will at best offer 100 points. Areas that are not normally encompassed by life cycle studies but which are covered by the requirements such as quality, renewable resources, working environment and ecolabelled goods are not counted in the 100 points (see the overview of points in Appendix 1).

It is therefore possible to gain an impression of the percentage weighting of the various areas. This weighting is based on life cycle studies and a relevance, potential and controllability assessment (RPS). The RPS assessment is described in Nordic Ecolabelling's Environmental Philosophy. It is important to bear in mind that only the options for points will be counted in the points calculation. For example, chemical requirements are an important part of achieving a licence, but are not "weighted" in the points system. This means that the true weighting of the requirements in the criteria cannot be seen from the points system. For example, there are a number of chemical requirements in Appendix 1. These requirements accordingly increase the weight on chemicals if one looks to the totality and not simply to the points system.

7.25 Other areas that have been discussed

A number of requirements and options for points were discussed in the work process. Some of these were not included in the criteria. These are discussed below.

A printing method for corrugated cardboard flexography
Nordic Ecolabelling considered introducing corrugated board flexography as a printing method of its own. Corrugated board is made of paper materials constituting a very large part of the total paper production. However, it is not possible to introduce this printing method as long as the material (linerboard and corrugated medium) for producing corrugated board (containerboard/case material) is not governed by the Nordic or European paper criteria.

Production of corrugated board takes place by means of conversion, i.e. supporting two layers of cardboard with a medium layer of folded paper. This process comprises gluing in connection with the conversion and is therefore considered a sort of finishing service in the criteria of the printing companies although it typically takes place before printing.

Points for transportation of goods
Nordic Ecolabelling considered a number of approaches to awarding points for environmentally-friendly transportation of goods, but decided against incorporating this factor. The transportation of goods is a complex area, which in many cases would be very difficult for a printing company to control, since printing companies often do not have their own means of transport or purchase transport services themselves. Moreover, a long chain of carriers will often be involved.

Transport requirements and use vary considerably within the industry. According to Enroth, transport-related carbon dioxide emissions after the paper mill stage make up 4-35% of total emissions during the life cycle of a printed item (Enroth 2010a).

However, as a separate points option transport is included in the option for scoring points for a carbon dioxide report that follows Intergraf's recommendations (see Section 7.16). GA's climate calculator follows the Intergraph recommendation and includes the following forms of transportation:

- combustion of fuel in own or leased vehicles
- transport of paper and other substrates to the printing company
- transport of products to and from subcontractors
- transport of products to the printing company's customers
- staff transport to and from work

Other areas include upstream transportation of e.g. pulp to paper mills and paper to distribution centres.

Requirements applicable to nanomaterials
Nordic Ecolabelling considered prohibiting the use of nanomaterials by printing companies and in printed matter. The greatest cause of concern is the use of nanoparticles that might be released and thereby have an impact on health and the environment. Since nanoparticles are so small, they can easily penetrate healthy cells, as a result of which they may harm the cell or its DNA in the nucleus of the cell. However, considerable uncertainty attaches to the effects of nanomaterials on health and the environment. Since, however, Nordic Ecolabelling does not have information to indicate that this type of compounds occurs in print chemicals or materials used in the printing process, there are no grounds for imposing such a prohibition.

Toner powder normally has an average particle size of over 7 micrometres and is accordingly not nano size. Toner particles are pulverised and sieved in order to obtain the correct particle size in a mechanical process (Xerox 2006), but it may also be produced chemically. Xerox uses nanotechnology, including nano-sized polymers and pigments, to produce the toner for its EA (Emulsion Aggregation) toner technology. The technology is based on aggregation and according to Xerox allows the particle size to be controlled precisely to a range of 3 to 10 micrometres (Xerox 2006).

According to www.carbon-black.org, the carbon black products sold on the market (including pigments in toner powder) are agglomerates with diameters between 100 and 1000 nm and are accordingly not a nanomaterial.

Requirements as to perforation of plastic packaging
Nordic Ecolabelling discussed a requirement concerning perforation of plastic materials used to pack printed products individually. The idea was that this requirement should comprise advertising matter distributed to consumers and not envelopes packed in one package. The purpose was to ensure that these items of printed matter were better suited for recycling and thereby reduce resource utilisation since a part of these items end up unopened in the recycling plants. It is an advantage if paper from printed matter can be recycled to either new paper or other paper products.

The background were studies conducted by INGEDE and the German postal authorities. They were based on a relatively simple adjustment of the existing packaging machines to perforate packaging materials. The result showed that the printed matter will be available in the recycling process whereas previously it ended up as non-decomposed waste (INGEDE 2008b).

Based on hearing comments Nordic Ecolabelling however decided to remove the requirement. According to certain hearing authorities the recycling plants have equipment that tears up plastic automatically causing the paper to be available in the process even if the plastic is not perforated.

7.26 Other requirements (Section 6)

Other requirements encompass environmental management requirements, i.e. requirements that legislation is complied with, that the printing company has routines and instructions in place to ensure compliance with the ecolabelling requirements while the licence remains in force. There are also marketing requirements, requirements that the printing company has an organisation capable of ensuring that responsibility for these routines and instructions is allocated and has documentation evidencing compliance with the licensing conditions available for inspection. In version 5 of the criteria, the printing company has to write these routines and instructions itself and upload these to the Nordic Print Portal. Appendix 3 contains examples of routines and instructions meeting the requirements.

The requirements of the authorities as regards emissions of silver, copper and chromium in printing form production (M1)
Emissions of metals by large corporations is an area which, in Europe at least, is subject to the regulation of the authorities. So, understandably, it is a requirement that the regulations imposed by the authorities must be followed.

Gravure printing companies emit copper and chromium. The requirement for documentation of compliance with authorities' regulations is based on credibility considerations since these metals pose a hazard to health and the environment and there are exclusions to the chemical requirements for chemicals emitting those metals (see Section 7.8). There are also specific requirements to emissions

from gravure printing companies based on regulations laid down by the authorities (see Section 7.14).

Silver is used for the emulsion of films in the film production. As a result, it is not subject to the chemical requirements. The metal is very toxic for aquatic organisms. However films are rarely used since Computer-To-Plate technologies are more common. The introduction of this requirement is therefore based on credibility considerations and as an extra security.

Routines and instructions (M2-M7 and M13)
There are routines and instructions for:

- Documenting, processing and reporting of non-conformities, complaints and changes
- Traceability of printed matter to carry the Nordic Ecolabel (requirement M13)
- Record keeping and annual report
- Training

The criteria contain templates that provide help on what these routines and instructions should contain. The reason for the inclusion of these templates was that very many printing companies had difficulty in knowing which routines needed to be in place in order for the requirement to have been documented satisfactorily. Moreover consultants were drafting templates anyway, and Nordic Ecolabelling might therefore just as well produce them itself in order to ease the work of all parties.

In the fifth generation of the criteria the routine for record keeping was also extended to make it clearer that compliance with the requirements must be documented retrospectively against the background of last year's consumption. This means that in the event of the replacement of chemicals or paper grades actual consumption of both old and new must be included in the application/annual statement. One can only document compliance with requirements prospectively within a year against the background of actual measurements/ observations for a three-month period. When a licence is awarded any three-months period must have been completed and documented before a licence can be issued.

It transpired during the evaluation of the fourth generation of the criteria that many printing companies were not sufficiently familiar with the routines and instructions that had to be in place, according to the information contained in their applications. Effective from the fifth generation of the criteria Nordic Ecolabelling therefore opted to expand upon the requirements applicable to training and documentation of training by the printing company. From the fifth generation onwards the printing company must specify:

- how and when the printing company is to implement the first training the employees/staff functions involved
- how the printing company safeguards training in the event of staff changes

Moreover, Nordic Ecolabelling has specified that training must as a minimum comprise:

- General introduction to Nordic Ecolabelling
- Key score options and mandatory requirements concerning:
  - Energy
  - Paper
  - Chemicals
  - Waste paper
  - Organic solvents
  - Waste
- Procedures in the event of change of subcontractors
- Procedures in the event of changes in chemicals

The fifth generation of the criteria expands upon the routines applicable to non-conformity to clarify the typical situations in which a printing company will register non-conformity and accordingly will need to contact Nordic Ecolabelling and to draft a non-conformity report. This will occur if, for example, the printing company exceeds:

- a threshold limit (chemicals, finishers and suppliers of printing services)
- a total score limit
- a requirement limit (VOC requirement for installation of local extraction and energy requirements)

Record keeping routines were tightened in the fifth generation of the criteria. If a printing company with a licence records a non-conformity based on the above points and rectifies the situation, the printing company must submit documentation that the measures are working. In the fifth generation, routines were split up in two: one routine for record keeping and one for the annual statement.

Marketing (M8)
The marketing requirement is more or less the same as for other Nordic Ecolabelling product groups. In this product group, however, there is a requirement that the supplementary wording "printed matter" must always be used when marketing ecolabelled printed matter. This to avoid any confusion with ecolabelled paper. Moreover a number of special requirements apply to ecolabelled products (see below).

7.27 Special requirements applicable to ecolabelled products (Section 6.1)

The printing company must fulfil special requirements applicable to Nordic ecolabelled printed matter. These requirements have been selected from a credibility perspective and on the basis of the expectations that the reader/user has of Nordic ecolabelled printed matter. Here, Nordic Ecolabelling has focused on the most important aspect of the life cycle, i.e. the paper and the production of the printed

matter. In addition there are requirements based on specific consumer expectations such as products free of PVC and perfume.

Paper in printed matter (M9)
The requirement that the majority of paper printed matter must consist of paper that complies with the requirements applicable to inspected or ecolabelled paper is the same as in earlier versions of the criteria document. In spite of the many comments in the hearing, the requirement was not revised to version 4 of the criteria, i.e. the possibility of using paper with the EU Ecolabel for Nordic ecolabelled printed matter as well. The reasons why EU ecolabelled paper cannot be used for Nordic ecolabelled printed matter are the differences between the Nordic Ecolabelling and the EU Ecolabelling requirements and the wish that the paper must have at least one environmental performance on level with inspected paper. The differences are expressed with the weighting factors set by Nordic Ecolabelling based on the requirements of the various schemes (see Section 7.6). However, the Nordic Ecolabelling Board decided that paper with the EU Ecolabel can be used for Nordic ecolabelled printed matter until 30 June 2013. After that date, paper with the EU Ecolabel may only be used for Nordic ecolabelled printed matter if there is documentation to the effect that the paper also complies with the Nordic Ecolabelling requirements for inspected paper.

When it comes to products made from other materials than paper it is still not possible for such products to carry the Nordic Ecolabel. However, Nordic Ecolabelling may consider extending the criteria in future to the effect that products made from other materials can be Nordic ecolabelled.

In the case of the Nordic ecolabelling of printed matter comprising several different parts it would be unreasonable to require the entire product to consist of inspected/Nordic ecolabelled paper. Accordingly percentage limits have been introduced on the quantity of inspected/Nordic ecolabelled paper that a Nordic ecolabelled printed item must contain.

Printed items which - for functional reasons - need to have a thicker back or cover must consist of 80% inspected/Nordic ecolabelled paper. This will apply in the case of for example note pads, books etc. Other printed items must consist of 90% inspected paper. This means that there will be scope for specialist printed items comprising other materials such as plastic in the form of laminates. According to the Board of Technologies' 2000 report, 90 99% of the total weight of a printed item consists of paper. Envelopes are comprised by the category "other printed matter" and must therefore contain 90% inspected/Nordic ecolabelled paper.

This requirement is important in order to safeguard the credibility of ecolabelling, since customers/users of printed items have expected and will continue to expect the paper in a specific Nordic ecolabelled printed item to contain "environmentally-friendly paper". Thus it will not always be the overall environmental performance of the printing company that will be of most interest, but rather the signal that the individual printed item sends.

Against this background, the possibility of documenting compliance with the 90/80% requirement based on the annual production has been removed.

PVC in the printed matter and packaging (M10)
The requirement that the printed matter must not contain PVC has existed in all generations of the criteria. Effective from the fifth generation of the criteria the prohibition against PVC in packaging for Nordic ecolabelled printed matter has been amended so that it applies to all plastic packaging used by the printing company to package printed matter (see Section 7.10).

According to page 115 of the Nordic Council of Ministers' BAT report on printing companies, PVC is used as a print material for flexible outdoor foils used for example as streamers for cars. Apart from this it is not usual to use PVC in normal printed matter except sometimes in laminates.

Accordingly, from the fifth generation of the criteria onwards the use of PVC in laminates for all the printing company's paper items of printed matter is prohibited irrespective of whether they are to be Nordic ecolabelled or not (see Section 7.10).

The prohibition against PVC in Nordic ecolabelled printed matter therefore provides an extra degree of security since Nordic Ecolabelling's requirement that Nordic ecolabelled printed matter must contain 80/90% inspected/ecolabelled paper should not otherwise impose restrictions on other materials.

Fragrance (M11)
A new requirement has been introduced that the printing company may not use chemicals if scent has been added - e.g. scent varnishes - to Nordic ecolabelled printed matter.

Fragrance may contain substances which impact on both health and environment and are on the Danish list of unwanted substances (Danish EPA 2010). At the same time the use of fragrance in the production of printed matter may result in involuntary exposure on the part of the end users of, e.g., advertising material and may also have a negative effect on the quality of recycled paper. Moreover, fragrance does not contribute to any improvement in the performance of the printed matter and is therefore unnecessary. For this reason Nordic Ecolabelling does not permit printing companies to produce printed matter to which fragrance has been added intentionally.

Separate product samples attached to the printed matter and removable paper items from which fragrance is released if the surface is scratched are exempted.

Nordic Ecolabelling considered prohibiting intentional addition of fragrance to any of the printing company's printed items, irrespective of these carrying the Nordic Ecolabel or not. However, Nordic Ecolabelling found that it would be a giant step to introduce a total immediate prohibition and will instead consider introducing a total ban on or just a prohibition against printed matter aimed at children in the next revision.

Printing companies as suppliers (M12)
In order that buyers and end users of printed matter can always be confident that all printing companies involved in the production of Nordic ecolabelled printed matter comply with the requirements, all printing companies used as suppliers in the production of Nordic ecolabelled printed matter must also be Nordic ecolabelled. Effective from the fifth generation of the criteria the requirement also applies to the printing of covers. In the last generation of the criteria there was no requirement that the cover should be printed by a Nordic ecolabelled printing company so long as other paper in the printed matter made up 80/90 % of the weight of the printed matter.

Finishers as suppliers (M12)
In the fifth generation of the criteria Nordic Ecolabelling reintroduced a requirement from the third generation that so-called chemical finishing (finishing involving glue, varnish, laminates and mounting foil) of Nordic ecolabelled printed matter must be conducted by inspected finishers.

This applies even if the use of finishers is rare, i.e. even if total external finishing accounts for less than 5% calculated as purchased paper for orders for external chemical finishing (see Section 7.4). The requirement was reintroduced in light of the tightening of the threshold limits for chemicals in the fifth generation of the criteria (see Section 7.8).

Discontinued product requirements
The requirement restricting wet-strength in envelope paper was included in all generations of the envelope criteria. Wet-strength agents are detrimental to the recycling process. Since in Nordic Ecolabelling's experience it is very rare for envelopes to be produced from paper containing wet-strength agents, the requirement concerning wet-strength agents has not been transferred from the envelope criteria to the criteria of the printing companies.

7.28 Use of the Nordic Ecolabel

The instructions concerning use of the Nordic Ecolabel apply both to printing companies and to the printed matter itself and have not been amended since the last version of the criteria document. However, instructions has been made clearer in that they now specify that there should be no risk of confusion about what the Nordic Ecolabel applies to. This might in particular be applicable in the case of packaging and cardboard boxes.

Nordic Ecolabelling has transferred the requirement from the envelope criteria according to which Nordic ecolabelled envelopes must have the supplementary wording «envelope».

8 Key changes relative to previous versions of the criteria

In the fifth generation of the criteria the name of the product group was changed from "Printing companies" to "Printing companies and printed matter" in order

to further stress that the criteria also focus on ensuring that the environmental profile of the individual item of printed matter is satisfactory.

Silk screen and letterpress printing were left out of the fifth generation of the criteria since there was no interest in ecolabelling these methods of printing. Envelope production with flexographic printing, offset printing of envelopes and offset packaging printing have been added as new printing methods.

The work to formulate the fifth generation criteria included matters that were identified as important for the future when the fourth generation criteria and other areas were developed. The major changes and tightening in the fifth generation of criteria are:

- Requirements have been introduced for energy consumption in kWh/tonne of product, both in terms of points and a mandatory requirement.
- The points limit has been tightened – for sheet fed offset by 40%.
- A new functional unit has been introduced: environmental parameters must be calculated relative to tonnes of product produced instead of tonnes of paper purchased/used.
- The requirements must be calculated separately for each printing method. As a result, it is no longer possible to conceal a bad printing method with a good one.
- New ways of scoring points have been introduced: energy consumption in kWh/tonne of product, carbon dioxide charting, working environment technologies, consumption of chemicals in CTP, water consumption and print quality.
- The 5% threshold limit for chemicals and materials now only applies to chemicals used in the process (i.e. chemicals which do not end up in the printed matter). For chemicals and materials that end up in the printed matter, 99% must comply with the requirements.
- The list of prohibited especially problematical substances in chemicals and materials at the printing company has been extended to encompass all substances referred to in the European REACH legislation as Substances of Very High Concern (SVHC) and substances classified by CMR 3 categories according to the old chemicals legislation (not covered by the SVHC concept). However, there are certain exemptions for gravure.
- Allergenic chemicals at the printing company are prohibited. However, there are certain exemptions for chemicals being typically allergenic that cannot easily be substituted.
- There is an upper limit to the size of the printing company's stocks of old chemicals not listed in the Nordic Print Portal in relation to the quantity purchased in each chemicals category
- Chemicals for film and printing form production are now encompassed by the general chemical requirements (environmental hazard, health risk and particularly problematic substances) as well as the VOC requirement.
- A lower limit has been introduced specifying how large the portion of inspected/ecolabelled paper must be.

- Paper requirements have been tightened. In future there are stricter requirements for Nordic ecolabelled paper than inspected paper. As a result, weighting has now been introduced to paper carrying the Nordic Ecolabel, inspected paper and paper carrying the EU Ecolabel.
- A requirement has been introduced for the installation of air extraction if the printing company has a high VOC emission level.

9 Expected environmental effects

The fifth generation of the criteria focused on introducing an energy parameter in the points system and on raising the general points level. Raising the general points level is accordingly expected to have a beneficial effect in relation to the parameters measured by Nordic Ecolabelling so far (see Section 3).

10 New criteria

In the future criteria, Nordic Ecolabelling will follow developments and tighten the requirement levels regarding total score in relation to the new market levels (see Section 7.24).

Moreover, Nordic Ecolabelling will evaluate the possibilities of introducing:

- A functional unit based on floor space (see Section 7)
- Requirements for other printing materials than paper (see Section 7.2)
- An adjustment of the points formula for inspected/ecolabelled paper so that the score better reflects the weighting factors for the various paper grades (see Section 7.6)
- A lower threshold limit for process chemicals (see Section 7.8)
- Requirements for classification of chemicals applicable at substance level (see Section 7.8)
- Requirements for printing inks to prevent problematic substances in materials manufactured from recycled paper (7.8)
- A quantitative CO2 parameter (see Section 7.15)
- A ban on fragrance in all items of printed matter or in printed matter aimed at children (see Section 7.27).

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Appendix 1 Overview of scores and observed values

Theoretical maximum scores

Printing method	Choice of paper	Waste paper	Type of chemicals [1]	Repro	VOC	Energy	Water	Waste	Ecolabelled products and services	Working environment	Quality	Total	LCA total [2]
Sheet fed offset (not envelopes/packaging)	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Coldset, news print	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Coldset, forms	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Coldset rotation (not news print/form printing)	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Heatset	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Gravure printing	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Flexographic printing (except envelope production)	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Digital printing and photocopying	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Offset printing, envelopes	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Offset printing, envelopes	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
Offset, packaging	25	10	5+7+3+3+2	3	20	20	2	10	3	3	1	117	100
										3			

1) Maximum points for type of chemicals encompass:Renewable resources (mineral or vegetable) or Watebased/not waterbased 5, Problems in the recycle process of printing inks 7and adhesives 3, Cleaning agents volatility as well as dampening solutions 2.

2) The LCA total is excluding points for chemicals based on renewable resources or water based chemicals 5, type points for chemicals related to working environment (cleaning agents 3 +dampening solutions 2), ecolabels 3, working environment technologies 5 and quality 1.

Reference points 4th generation of the criteria based on observed values 2010 (licence and literature data etc.)

Printing method	Choice of paper	Waste paper	Type of chemicals: (Renewable + Waterbased+Recycl. inks) + Cobolt + Adhesive +Cleaning agents + Dampenings solutions	Repro	VOC	Energy	Waste	Ecolabelling	Total	Percentage addition	Calculated level	Change compared to 2005 (%)
Sheet fed offset	23,7	4,6	14,2	2,7	15,3	3,3	7,2	1,0	72,0	7,8	80	43
News print	25,0	8,3	12,4	2,6	29,6	3,7	11,7	0,7	94,0	5,6	100	12
Form print	24,8	5,9	9,1	1,0	24,6	4,6	5,4	0,2	75,6	7,4	83	48
Coldset rotation (except news print and form printing)	23,9	5,7	12,3	3,0	29,2	3,7	9,6	1,3	88,7	6,1	95	70
Heatset	14,2	5,2	14,1	3,0	25,2	5,0	12,7	0,4	79,8	7,0	87	23
Gravure printing	17,3	8,5	14,1	3,0	27,3	5,0	12,5	2,5	90,2	6,0	96	60

Flexographic printing (except news print)	24,7	8,1	15,0	2,0	29,6	3,6	9,5	3,9	96,4	5,4	102	73
Digital printing and photocopying	25,0	8,3	8,6	5,0	29,3	3,0	9,9	4,0	93,1	5,7	99	18

Reference points 5th generation of the criteria based on observed values 2010 (licence and literature data etc.)

Printing method	**Choice of paper[3)]**	**Waste paper**	**Type of chemicals:**	**Repro**	**VOC**	**Energy[4)]**	**Waste[5)]**	**Eco-labelling**	**Water consumption**	**Working environment[1)]**	**Quality[2)]**	**Total**	**Percentage addition**	**Score requirements**
Sheet fed offset	8,3	4,7	13,7	1	7,2	12,6	4,5	1,0	1	0	0	53,7	9,6	63
Coldset, news print	17,1	8,6	10,4	1	19,7	17,6	7,5	0,7	1	0	0	83,6	6,6	90
Coldset, forms	9,1	6,1	7,1	1	15,6	14,1	4,5	0,2	1	0	0	58,7	9,1	68
Coldset rotation (except news print and form printing)	8,4	6,0	10,3	1	19,3	15,0	7,5	1,3	1	0	0	69,8	8,0	78
Heatset	1,6	5,4	12,1	1	16,0	14,3	7,5	0,4	1	0	0	59,3	9,1	68
Gravure printing	3,8	8,0	12,1	0	18,0	14,8	7,5	2,5	1	0	0	67,7	8,2	76
Flexographic printing (except envelope production)	9,0	8,4	9,0	1	19,7	17,0	7,5	3,9	2	0	0	77,5	7,2	85
Digital printing and photocopying	12,2	8,6	16,6	3	16,0	3,9	7,5	4,0	0	0	0	71,7	7,8	79
Envelope offset	8,3	10,0	13,7	1	11,6	17,2	4,5	1,0	1	0	0	68,3	7,3[6)]	76
Envelope production with flexography	9,0	7,5	9,0	1	19,7	16,6	7,5	1,0	1	0	0	72,3	7,8	80
Packaging offset	2,3	1,1	13,7	1	10,4	10,9	4,5	1,0	1	0	0	45,9	10,4	56

1) Working environment estimated at 0 point for all printing methods.

2) Points for quality estimated at 0 point for all printing methods.

3) Paper points estimated as a total weighting of 0. 7relative to most paper being inspected (gives a weighting of 0.8) and an increasing part is EU ecolabelled (weighting of 0.7). However, the weighting is 0.8 for news print and packaging offset since the EU Eco-label criteria do not comprise paper for these methods.

4) Energy efficiency and carbon dioxide review are estimated at 0 point. As a result, reference points for energy are equal to points for observed energy consumption.

5) Waste minimising technologies are estimated at 2 points for sheet fed offset, form printing, envelope printing and packaging offset and 5 points for other printing methods. Points for quantity of ungraded waste are estimated at 2.5 for all printing methods.

6) Additional points for envelope offset have been reduced since this area cannot get more waste points (the contribution to waste paper should have been 0.9 point).

Observed values and average assessment according to old parameters of primarily the Nordic and European markets

This table shows market average data used to set the score levels in the above table. The basis is both literature data and licence/pilot data. Nordic Ecolabelling wishes to keep data from licensees, applicants and pilot enterprises secret. This is the reason why these data are hidden. Licence/pilot data are based on average except for data sets which may have deviating values. In these cases the middle value has been used (quantity of inspected/ecolabelled paper and kg of VOC per tonne of paper). In respect of waste paper, printing companies that have not stated this information have been taken into consideration and have been removed from the average. Data have been extracted from the Nordic Print Portal in February 2010. Data are generated by the printing companies' data entries and represent data between 2006 and 2009. In case of more data sets the values are weighted based on the number of printing companies represented in the data set.

Printing method	**Nordic eco-labelled printing (av.)**	**Inspect-ed finishing (av.)**	**Choice of paper %[1)]**	**Waste paper %**	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Cobolt + Adhesive + Cleaning agents + Dampening solutions (points)[2)]**	**Repro**	**VOC kg/tonne of pur-chased paper**	**Energy**	**Waste**	**Eco-labelling**
Sheet fed offset										
Analysis licences spring 2010 (sheet fed offset "largest" method): 187 with only sheet fed offset										
Overall evaluation sheet fed offset 2010	99,6	98,0	71,2	23,4	14,2	2,7	4,9	3,3	7,2	1,0
Coldset rotation (not news print/form printing)										
Analysis licences spring 2010 (coldset the largest method), 9 only coldset										
Overall evaluation heatset 2010	99,9	100	71,9	19,1	12,3	3,0	0,28	3,7	9,6	1,3
Coldset, news print										
18 newspaper companies including editorial staff – data from 2008 in Sweden (MINT 2009).				9,8						
Analysis pilot companies spring 2011: 2 with only news print										
Analysis licences spring 2010 news print the largest method 34 only news print	99,4									
Overall evaluation news print 2010	99,4	100	95,3	9,8[7)]	12,4	2,6	0,14	3,7	11,7	0,65
Coldset, forms										
Analysis licences spring 2010 form printing the largest method 5 only form printing										
Overall evaluation form printing 2010	98,9	100	74,6	18,5	9,1	1,0	1,8	4,6	5,4	0,2
Heatset										

Printing method	**Nordic eco-labelled printing (av.)**	**Inspect-ed finishing (av.)**	**Choice of paper %**[1)]	**Waste paper %**	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Cobolt + Adhesive + Cleaning agents + Dampening solutions (points)**[2)]	**Repro**	**VOC kg/tonne of pur-chased paper**	**Energy**	**Waste**	**Eco-labelling**
Survey of leading European publication printing companies. Data for heatset 9 offset printing companies 2002: average 54,000 tonnes produced per plant (Enroth 2006). VOC calculated to per tonne of purchased paper.				17			2,5			
Estimated data for European average 15,000 tonnes of purchased paper web-offset plant with modern solvent recov-ery 2006 (Bjurstedt 2007). VOC calcu-lated to per tonne of purchased paper with Enroth data on waste paper.							1,25			
Selected German publication printing companies. Data for Schlott web-offset 2005: average 46,000 tonnes of paper purchased per plant (Bjurstedt 2007). VOC calculated to per ton purchased paper.				15			3,5			
Analysis licences spring 2010 (sheet fed offset "largest" method): *13 with only heatset. Average 33,400 tonnes*										
Analysis licences spring 2010: *8 with only heatset where the printing company has made a manual calcula-tion according to the criteria method (subset of above).*										
Overall evaluation heatset 2010	98,5	98,8	42,6	21 (ca. 17-24)[8)]	14,1	3,0	1,6 (ca. 1,25-1,9)[3)]	5,0	12,7	0,4
Gravure printing										
Good practise plant: Publication gravure approx. 90,000. European BAT Document. Survey from 1999.(European Commission 2007)				8,5			3,7 (VOC fugitive)			

Printing method	**Nordic eco-labelled printing (av.)**	**Inspect-ed finishing (av.)**	**Choice of paper %**[1)]	**Waste paper %**	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Cobolt + Adhesive + Cleaning agents + Dampening solutions (points)**[2)]	**Repro**	**VOC kg/tonne of pur-chased paper**	**Energy**	**Waste**	**Eco-labelling**
Survey of leading European publication printing companies. Data for gravure 2002 19 plants: average 140,000 tonnes produced per plant (Enroth 2006). VOC calculated to per tonne of purchased paper.				12			1,7			
Estimated data for average European 95,000 tonnes of purchased paper gravure plant with modern solvent recovery 2006 (Bjurstedt 2007). VOC calculated to per tonne of purchased paper with Enroth data on waste paper.							0,88			
Selected German publication printing companies (gravure + offset). Data for gravure 2005: Prinovis 224,420 and Schlott 76,940 tonnes of paper pur-chased per plant (Bjurstedt 2007). VOC calculated to per tonne of purchased paper.				6-8			0,09-0,11			
Analysis pilot companies spring 2010 *3 with only gravure printing*	[redacted]									
Overall evaluation gravure printing 2010	99,4	100	52,1	12 [5)]	14,1	3,0	0,9 (ca. 0,1-1,7)[4)]	5,0	12,5	2,5
Flexographic printing										
Analysis pilot companies spring 2010: *2 with only flexographic printing* *7 with flexographic printing as the largest method (4 with sheet fed also)*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Analysis pilot companies autumn 2010: *2 with only flexographic printing*							[redacted]			
Overall evaluation flexographic printing 2010	99,4	98,1	74,2	10,6	15,0	2,0	0,12	3,6	9,5	3,9
Envelope offset										
Analysis pilot companies 2010 *2 with only envelope offset*				[redacted]			[redacted]			

Printing method	**Nordic eco-labelled printing (av.)**	**Inspect-ed finishing (av.)**	**Choice of paper %[1)]**	**Waste paper %**	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Cobolt + Adhesive + Cleaning agents + Dampening solutions (points)[2)]**	**Repro**	**VOC kg/tonne of pur-chased paper**	**Energy**	**Waste**	**Eco-labelling**
Overall evaluation envelope offset 2010	99,6[6)]	98,0[6)]	71,2[6)]	4,18	14,2[6)]		4,05			1,0[6)]
Digital printing										
Analysis licences spring 2010 digital printing the largest method: 42 with only digital printing	[redacted]									
Overall evaluation digital printing 2010	98.5	99,8	87,9	9,8	8,6	5,0	0,25	3,0	9,9	4,0
Packaging printing with offset										
Analysis pilot companies spring 2010: 1 with only packaging offset				[redacted]			[redacted]			
Overall evaluation packaging 2010	99,6[6)]	98,0[6)]	40[10)]	36	14,2[6)]		2,8			1,0[6)]
Envelope production with flexog-raphy										
Analysis pilot companies spring 2010: 4 with envelope production and to a minor extent envelope offset				[redacted]						
Overall evaluation envelope production with flexographic printing 2010	99,4[9)]	98,1[9)]	74,2[9)]	15	15,0[9)]		0,12[9)]			1,0[6)]

Calculated as an average of each company. There is no weighted average.

2) Total calculated before rounding.

3) Calculated as the centre in interval including best European literature value and the most exact licensing data.

4) VOC gravure printing as the centre in interval including the most recent European literature values.

5) Waste paper gravure printing from Enroth as it is uncertain whether the other data comprise externally generated waste paper.

6) Values from sheet fed offset.

7) Value based on best literature values as many newspaper presses also print other printed items such as brochures, etc., in small numbers causing the waste paper percentage to rise.

8) Heatset waste paper calculated as approximate centre in interval including the most representative and recent literature and application data for European heatset printing companies.

9) Values from flexography.

10) Quantity of inspected/ecolabelled paper consumption estimated at 40% since the quantity of inspected cardboard is small.

Observed values and average assessment according to new/adjusted parameters of the Nordic and European markets

Printing method	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Adhesive +Cleaning agents + Dampening solutions (points)** [1]	**Repro**[9]	**VOC**[2] **(kg/tonne of product)**	**Total energy consumption kWh/tonne of produkt**[4]	**Water (kg/tonne of product)**
Sheet fed offset					
5 graphic arts firms (sheet fed offset). Data from 2001 (Enroth et al 2003). Values converted into tonnes of purchased paper.				1400	
11 firms (7 sheet fed offset, 1 heatset and 3 coldset, newsprint). Data from 1995-2002 (Johnsen et al 2006).				1210 (770-1620)	1160 (385-2690)
Special analysis licences spring 2010: 1 with almost only sheet fed offset (digital printing to a limited extent).				744 (845 inckl. transport)	
Analysis licences Nordic region spring 2010: 11 with just sheet fed offset with own both power and heating data (not electric heating)				816	
Data collection licences in Norway autumn 2010. 11 sheet fed printing companies (10 with only sheet fed offset) All printing companies use electric power for heating, of which a single company also uses oil.				1669 (481-5321)	
Overall evaluation sheet fed offset 2010	13,7	1	6,4	1253[5]	1160
Coldset rotation (not news print/form printing)					
Data collection licences Nordic countries autumn 2010: 4 with coldset (2 with only coldset, 1 with digital and 1 with barely 10% sheet fed) with both heating and power data.				825 (378-1469)	
Overall evaluation coldset 2010	10,3	1	0,35	825	1160[3]
Coldset, news print					
14 newspaper companies including editorial staff – data from 2001 (Enroth et al 2003).				730 (320-1410)	
4 newspaper companies including editorial staff – data from 2001: subset of the 14 companies in the above reference (Enroth et al 2003).				480	
18 newspaper companies including editorial staff – data from 2008 (MINT 2009).				530	

Printing method	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Adhesive +Cleaning agents + Dampening solutions (points)** [1)]	**Repro**[9)]	**VOC**[2)] **(kg/tonne of product)**	**Total energy consumption kWh/tonne of produkt**[4)]	**Water (kg/tonne of product)**
6 newspaper companies including editorial staff – data from 2008: subset of the 18 companies in the above reference (MINT 2009).				340	
Data collection licences Norway autumn 2010: *4 with only news print (3 uses electric power for heating, 1 supplements with oil and 1 has district heating).*				403 (326-450)	
Overall evaluation news print 2010	10,4	1	0,16	365[6)]	1160[3)]
Coldset, forms					
Analysis of licensing data from February 2010 and from data collection of licences in the Nordic region in the autumn of 2010 with both electric power and heating data: *4 with form printing (3 with only or very small quantity of other printing and 3 with form printing as the largest method and other print techniques such as sheet fed/flexographic printing).* *A single company uses electricity for heating.* *A single company is inhouse where kWh for district heating is allocated based on the assumption that the printing company uses slightly more per square metre than the rest of the building.*				[redacted]	
Overall evaluation form printing 2010	7,1	1	2,2	997	1160[3)]
Heatset					
Virtual plant: Heatset 20,000 tonnes. European BAT Document. Survey from 1999 (European Commission 2007).				1576	
Survey of leading European publication printing companies. Data for 9 heatset offset printing companies 2002: average 54,000 tonnes produced per plant (Enroth 2006).				610	
Selected German publication printing companies). Data for Schlott web-offset 2005: average 46,000 tonnes of paper purchased per plant (Bjurstedt 2007).				970	

Printing method	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Adhesive +Cleaning agents + Dampening solutions (points)** [1)]	**Repro**[9)]	**VOC**[2)] **(kg/tonne of product)**	**Total energy consumption kWh/tonne of produkt**[4)]	**Water (kg/tonne of product)**
Scholarly books heatset: 40 books for a college student. Data based on Finnish heatset printing companies (Kozak 2003).				2680	
Catalogues and magazines from heatset. Data from 2007 from Sweden and Norway: 2 companies (Viluksela 2008).				730	
Catalogues and magazines from heatset. Data from 2002-2007 from Finland: 6 companies (Viluksela 2009).				1220	
Data collection licences in Norway autumn 2010. 3 heatset printing companies (1 printing company uses electric power for heating and oil as well)				898 (666-1205)	
Overall evaluation heatset 2010	12,1	1	2,0	965[7)]	1160[3)]
Gravure printing					
Good practise plant: Publication gravure approx. 95,000 including pre-products. European BAT Document. Survey from 1999 (European Commission 2007)				781	1831
Survey of leading European publication printing companies. Data for 19 gravure printing companies 2002: average 140,000 tonnes produced per plant (Enroth 2006).				890	
Selected German publication printing companies (gravure + offset). Data for gravure 2005: Prinovis 224,420 and Schlott 76,940 tonnes of paper purchased per plant (Bjurstedt 2007). Values calculated to per tonne of purchased paper.				660 (620-700)	
Overall evaluation gravure printing 2010	12,1	0	1,0	864[7)]	1831
Flexographic printing					
Good practise plant flexible packaging flexo (paper). European BAT Document. Survey from 1999 (European Commission 2007). Solvents and water-based.				379	5420

Printing method	**Type of chemicals: (Renewable + Waterbased+Recycl. inks/varnish) + Adhesive +Cleaning agents + Dampening solutions (points)** [1)]	**Repro**[9)]	**VOC**[2)] **(kg/tonne of product)**	**Total energy consumption kWh/tonne of produkt**[4)]	**Water (kg/tonne of product)**
Data collection pilot company autumn 2010 (data from 2009): *1 with flexographic printing as the largest method (envelope production) and with a minor production of envelope offset.*					359
Analysis of licensing data from February and from data collection of licences in the Nordic region autumn 2010: *4 with flexographic printing as the largest method combined with sheet fed also.*				419 (295-534)	
Overall evaluation flexographic printing 2010	9,0	1	0,13	486	359
Envelope offset					
Overall evaluation envelope offset 2010	13,7		4,2	436[8)]	1160[3)]
Digital printing					
Analysis of licensing data from February and from data collection of licences in the Nordic region autumn 2010 and autumn 2011: *7 with only digital printing and which are not in-house printing companies with data for both electric power and heating of which 3 use electric power for heating.*				2799 (1119-4920)	
Data collection of licensees May 2010 in Sweden (1 with only digital printing). Average waste paper percentage for the method used for conversion.					3396
Overall evaluation digital printing 2010	16,6	3	2	2799	3396
Packaging printing with offset					
Analysis pilot companies spring 2010: *1 with only packaging offset*				1564	
Overall evaluation packaging 2010	13,7	1	4,8	1564	1160[3)]
Envelope production with flexography					
Analysis pilot companies spring 2010: *4 with envelope production and to a minor extent envelope offset*				552	
Overall evaluation envelope production with flexographic printing 2010	9,0	1	0,13	552	1160[3)]

*Adjusted for changes in applicable criteria. As an example, dry toner scores 7 points for recycling instead of one and water-based printing inks and inks score 0 instead of 4 in the last generation of the criteria. Ink (inkjet) is expected to become more widespread in the market in future (approx. 40% of the digital market will be ink (inkjet) of which a part will be wet toner: 40%*0+60%*7= approx. 4). For digital printing this is: (0-5-4)-2.6-3-2=16.6. Points are also adjusted for flexographic printing using water-based printing inks.*

In addition, toner and ink score 5 extra points for renewable raw material. In the last generation of the criteria they did not score points in these areas. The last change is the removal of points for metals as siccatives. As a result, 2 points have been removed for all printing methods except sheet fed offset, where 0.5 point attached to this parameter was reduced.

2) Calculated on the basis of average waste paper for current printing method. I.e. for sheet fed offset: VOC consumption 4.9 kg/tonne of paper consumption and waste paper 23.4% => 4.9/(1-23.4/100)= 6.4 kg/tonne of product. For digital printing the value is adjusted based on an assumption that 20% of the purchased paper in digital printing companies without any other printing methods will be printed with wet toner. The assumption is that printing with wet toner uses approx. 9-10 kg of VOC per tonne of product when using machines with recirculation and not using VOC for other printing.

3) Equal to corresponding value for sheet fed offset.

4) Weighted data with number of printing companies on which the average is based.

5) Sheet fed offset - only target data sets not involving other printing companies.

6) News print – only with new data and only data where the editorial staff are not included.

7) Heatset and gravure printing – data set with no indication of number of printing companies and weighted by 1.

8) Envelope offset – see estimate under energy data.

9) Adjusted to the fact that computer to press now gives 3 instead of 5, CTP without the use of chemistry gives 2 (previously same points as CTP, i.e. 3) and CTP with maximum amount of waste chemistry gives 1 (formerly same points as CTP, i.e. 3). Nordic Ecolabelling estimates that average repro-points for all printing methods except digital printing and gravure equal 1 as some printing companies have CTP without chemistry and some CTP where the volume of waste chemistry is so high that you do not get points. Digital printing gives 3 points and gravure gives 0.

Energy data (per tonne of product)[1)]

Printing method	**Electricity consumption kWh/tonne**	**Mixed fuels and heating kWh/tonne**	**District heating kWh/tonne**	**Fuel oil kWh/tonne**	**Natural gas/LPG kWh/tonne**	**Total energy[2)] kWh/tonne**	**Share of total energy consumption for printing companies without electricity for heating[3)] %**
Sheet fed offset							
5 graphic arts firms (sheet fed offset) Data from 2001 (Enroth et al 2003).						1400	
11 firms (7 sheet fed offset, 1 heatset and 3 coldset, newsprint). Data from 1995-2002 (Johnsen et al 2006).	705 (629-858)	-	176 (0-765)	243 (0- 486)	83,9 (0-304)	1210 (768-1620)	58
Special analysis licences spring 2010: *1 with almost only sheet fed offset (digital printing to a limited extent).*	633	-	-	111	-	744 (845 incl. transport)	85
Analysis licences Nordic region spring 2010: *11 with just sheet fed offset and with own both power and heating data (not electric heating)*	623	193	-	-	-	816	76

Printing method	**Electricity consumption kWh/tonne**	**Mixed fuels and heating kWh/tonne**	**District heating kWh/tonne**	**Fuel oil kWh/tonne**	**Natural gas/LPG kWh/tonne**	**Total energy[2] kWh/tonne**	**Share of total energy consumption for printing companies without electricity for heating[3] %**
Analysis licences spring 2010 (sheet fed offset "largest" method). Average waste paper percentage for the method used for conversion: *43 with only sheet fed offset* *2 with sheet fed offset and coldset/digital printing etc.* *29 with sheet fed offset and digital printing.* *All the above in the aggregate.*	1107 1030 1220 1149						
Data collection licences in Norway autumn 2010. *11 sheet fed printing companies (10 with only sheet fed offset)* *All printing companies use electric power for heating, of which a single company also uses oil.*						1669 (481-5321)	
Overall evaluation sheet fed offset 2010							
Coldset rotation (not news print/form printing)							
Analysis licences spring 2010 coldset the largest method. Average waste paper percentage for the method used for conversion: *2 only coldset* *1 coldset and sheet fed/digital* *1 coldset and heatset/sheet fed offset* *All the above in the aggregate.*	739 199 358 509						
Data collection licences Nordic countries autumn 2010: *4 with coldset (2 with only coldset, 1 with digital and 1 with barely 10% sheet fed) with bod heating and power data.*	579 (295-903)	246 (82-566)	-	-	-	825 (378-1469)	70
Overall evaluation coldset 2010							
Coldset, news print							
14 newspaper companies – data from 2001, average energy 70% electricity and 30% district heating (Enroth et al 2003).						730 (320-1410)	70
4 newspaper companies excluding editorial staff – data from 2001: subset of the 14 companies in the above reference (Enroth et al 2003).						480	
18 newspaper companies including editorial staff – data from 2008 (MINT 2009).						530	
6 newspaper companies excluding editorial staff – data from 2008: subset of the 18 companies in the above reference (MINT 2009).						340	

Printing method	**Electricity consumption kWh/tonne**	**Mixed fuels and heating kWh/tonne**	**District heating kWh/tonne**	**Fuel oil kWh/tonne**	**Natural gas/LPG kWh/tonne**	**Total energy[2] kWh/tonne**	**Share of total energy consumption for printing companies without electricity for heating[3] %**
Analysis licences spring 2010 news print the largest method *Average waste paper percentage for the method used for conversion:* *10 only news print* *3 news print and sheet fed/digital etc.* *All the above in the aggregate.*	303 478 344						
Data collection licences Norway autumn 2010: *4 with only news print (3 uses electric power for heating, 1 supplements with oil and 1 has district heating).* *Minimum value for heating stands for district heating where kWh is allocated based on the ratio of square meters of printing company to the total of the building as a whole.*	379 (317-450)	323 (91-450	-	-	-	403 (326-450)	
Overall evaluation news print 2010							
Coldset, forms							
Analysis of licensing data from February 2010 and from data collection of licences in the Nordic region in the autumn of 2010 with both electric power and heating data: *4 with form printing (3 with only or very small quantity of other printing and 3 with form printing as the largest method and other print techniques such as sheet fed/flexographic printing).* *A single company uses electricity for heating.* *A single company is inhouse where kWh for district heating is allocated based on the assumption that the printing company uses slightly more per square metre than the rest of the building.*	-	-	-	-	-	997 (446- 1904)	
Overall evaluation form printing 2010							
Heatset							
Virtual plant: Heatset 20,000 tonnes. European BAT Document. Survey from 1999 (European Commission 2007).	779	-	-	-	797	1576	49
Survey of leading European publication printing companies. Data for 9 heatset offset printing companies 2002: average 54,000 tonnes produced per plant (Enroth 2006).						610	
Selected German publication printing companies. Data for Schlott web-offset 2005: average 46,000 tonnes of paper purchased per plant (Bjurstedt 2007).						970	
Scholarly books heatset: 40 books for a student at college. Data based on Finnish heatset printing companies (Kozak 2003).						2680	
Catalogues and magazines from heatset. Data from 2007 from Sweden and Norway: 2 companies (Viluksela 2008).						730	

Printing method	**Electricity consumption kWh/tonne**	**Mixed fuels and heating kWh/tonne**	**District heating kWh/tonne**	**Fuel oil kWh/tonne**	**Natural gas/LPG kWh/tonne**	**Total energy[2] kWh/tonne**	**Share of total energy consumption for printing companies without electricity for heating[3] %**
Catalogues and magazines from heatset. Data from 2002-2007 from Finland: 6 companies (Viluksela 2009).						1220	
Analysis licences spring 2010 (heatset the largest method). Average waste paper percentage for the method used for conversion: *1with only heatset. Average 30,000 tonnes* *9 with heatset and sheet fed* *1 with heatset and coldset* *All the above in the aggregate (av. Heatset method 32,000 tonnes)*	[redacted]						
Data collection licences in Norway autumn 2010. *3 heatset printing companies (1 printing company uses electric power for heating and oil as well)*	[redacted]	[redacted]	-	-	-	[redacted]	[redacted]
Overall evaluation heatset 2010							
Gravure printing							
Good practise plant: Publication gravure approx. 95,000 including pre-products. European BAT Document. Survey from 1999 (European Commission 2007)	278	-	-	-	510	781	36
Survey of leading European publication printing companies. Data for 19 gravure printing companies 2002: average 140,000 tonnes produced per plant (Enroth 2006). Please note that min. value for energy is probably only electricity.						890 (210-1900)	
Selected German publication printing companies. Data for gravure 2005: Prinovis 224,420 and Schlott 76,940 tonnes of paper purchased per plant (Bjurstedt 2007).						660 (620-700)	
Analysis pilot companies spring 2010: *1with only gravure printing.*	[redacted]						
Overall evaluation gravure printing 2010							
Flexographic printing							
Good practise plant flexible packaging flexo (paper). European BAT Document. Survey from 1999 (European Commission 2007). Solvents and water-based.	342	-	-	-	36	379	90
Analysis licences spring 2010 with flexographic printing as the largest method (pads and booklets): *3 with flexo (some with sheet fed offset as well)*	[redacted]						
	[redacted]					[redacted]	

Printing method	**Electricity consumption kWh/tonne**	**Mixed fuels and heating kWh/tonne**	**District heating kWh/tonne**	**Fuel oil kWh/tonne**	**Natural gas/LPG kWh/tonne**	**Total energy[2] kWh/tonne**	**Share of total energy consumption for printing companies without electricity for heating[3] %**
Analysis of licensing data from February and from data collection of licences in the Nordic region autumn 2010: *4 with flexographic printing as the largest method combined with sheet fed also.*	[redacted]	[redacted]	-	-	-	[redacted]	[redacted]
Overall evaluation flexographic printing 2010							
Envelope offset							
Data collection licences Nordic countries autumn 2010: *3 with only envelope offset (1 inhouse).*	243 (182-324)						
Overall evaluation envelope offset 2010	243	193[4]				436[4]	
Digital printing							
Analysis licences spring 2010 digital printing the largest method: *9 with only digital printing*	[redacted]						
Analysis of licensing data from February and from data collection of licences in the Nordic region autumn 2010: *7 with only digital printing and which are not in-house printing companies with data for both electric power and heating of which 3 use electric power for heating.*						[redacted]	
Overall evaluation digital printing 2010							
Packaging printing with offset							
Analysis pilot companies spring 2010: *1 with only packaging offset*	[redacted]	[redacted]				[redacted]	[redacted]
Overall evaluation packaging 2010							
Envelope production with flexography							
Analysis pilot companies spring 2010: *4 with envelope production and to a minor extent envelope offset*	[redacted]		-	-	-	[redacted]	
Overall evaluation envelope production with flexographic printing 2010						552	

1) When needed calculated using annual waste paper data. Basically with waste paper data which belong to the data set. I.e. tonne of product = used paper – waste paper. This means that for instance the weight of printing ink and similar is not included in the calculation..

2) Total energy consumption in kWh is electricity consumption plus fuel / heat consumption in kWh.

3) Share of electricity consumption is calculated as electricity consumption divided by the total energy consumption.

4) Envelope offset - heating data estimated using data from 11 sheet fed offset printing companies from spring 2010. Total energy is electricity data from 3 envelope-offset printing companies plus estimated heating data.