Swan-labelled

Textile services

Version 2.0

Background document for ecolabelling

16. March 2009 – Consultative proposal

Nordic Ecolabelling

Swan-labelled Textile Services – Background document for ecolabelling
075/2.0, 16. March 2009 – Consultative proposal

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1 Summary

Textile service providers rent out, launder and dry clean textiles for both private and public sector customers. To qualify as a Swan-labelled textile service provider, a number of strict environmental requirements must be met. These concentrate on the main environmental effects of the service in a life cycle perspective. Accordingly the criteria focus on the laundry's consumption of energy, chemicals and water as well as purchases of textiles, distribution and processing of waste etc. At the same time a Swan-labelled laundry must comply with the quality and working environment requirements imposed by the industry association in the country in which it operates. The following chapters discuss the background to all the requirements imposed in the criteria document.

The main changes to the revised criteria for textile services are:

- Textile services were previously covered by two sets of criteria: for laundries and for hand towel roll services
- The energy requirements have been made significantly stricter
- Changes in the requirements we make of the chemicals used – including the introduction of requirements applicable to e.g. proofing products
- The introduction of requirements applicable to textile distribution (training, maintenance and purchase of new vehicles)
- The introduction of a points system that encourages further improvements over and above our mandatory requirements – reductions in the effects on climate and the effects of chemicals.

2 About the criteria

What products and services are eligible for an ecolabel?
The criteria are the result of the amalgamation of the criteria for hand towel roll services and laundries.

The product group encompasses the whole range of textile services and a licence may be awarded to individual production units or to multiple units in a chain/group. If so, however, each individual unit must fulfil the requirements imposed in the criteria document.

It is also possible to obtain a Swan Label that applies only to parts of the output of the individual unit, although this will be possible only in the case of hand towel roll services. This is because we wish to continue the flexibility of the existing system while at the same time harmonising the requirements by merging the criteria.

Justification for Swan labelling
The main contributions that textile service providers make to environmental impact comes through their consumption of energy for steam, machinery and vehicles; their use of materials and water and the emission of substances to the aquatic environment. These are effects that may have consequences at global, regional and local levels.

There are major differences between the environmental effects of individual laundries and many laundries have considerable potential for environmental improvements by optimising for example their consumption of energy, water and chemicals.

The Swan Label scheme already makes a difference and provides a tool for businesses that have made an extra effort to document this effort to the market. There are numerous examples of textile service providers that have adapted to the Swan requirements in response to requests by their customers. In revising the criteria and for example significantly tightening up our requirements as to energy consumption, we still have scope for influencing the textile service industry in a positive direction.

The version and validity of the criteria

Version 1.0 of the criteria for hand towel services was adopted in March 1996 and amended criteria were introduced in December 2004. These have since been adjusted and extended. The current version, version 2.2, is valid until 30 June 2010.

Version 1.0 of the criteria for laundries was adopted by the Board of Nordic Ecolabelling in December 2001. Since then there have been a number of extensions and adjustments and the current document, version 1.5, is valid until 30 June 1010, making it the oldest current set of criteria within Nordic Ecolabelling.

The submitted criteria for textile services will continue the product group numbering used by the criteria for laundries and will accordingly be allotted version 2.0 and will be valid until 30 June 2013.

The Nordic market

A key feature of the industrial laundry industry in Europe and the Nordic countries over the last 35-40 years has been consolidation: laundry chains and – less typically – individual laundries have been bought up by major operators in the industry. This tendency is inter alia described in Arndt, 2002. Thus in 2005 in Europe 13 groups owned more than 10 production sites and the largest owned 70-80 sites each (Søgaard-Pedersen, 2006). Thus there has been a shift in the industry in the direction of fewer, larger and more specialised production units operating together in large groups (Søgaard-Pedersen, 2004).

The tendency in the Nordic countries has been the same, and major players such as UK company Davis Service Group and its Danish subsidiary Sophus Berendsen operate on both sides of the national borders in Denmark, Sweden, Norway and Finland, while Lindström of Finland (including Comforta) has operations in Finland and Sweden. These two major Nordic textile service businesses also operate outside the Nordic region.

In the Nordic countries (excluding Iceland) there are some 265 industrial laundry units split more or less equally between the four countries, with Sweden having a slight predominance (Søgaard-Pedersen, 2004).

A typical laundry unit in the West (Denmark) has a turnover of DKK 25 million per annum and approximately 40 production staff (Søgaard-Pedersen, 2004). This means that the approximate turnover in the Nordic countries (excluding Iceland) is estimated

to be in the region of DKK 6.6 billion. The industry has undergone extensive growth in recent years as a consequence of the economic upturn which has benefited more or less all industries and has had the effect of increasing the demand for textile laundering by professional laundries (Kronborg, 2006). Accordingly it is likely that overall turnover in the Nordic countries has also increased and is probably closer to DKK 7 billion or more.

In Denmark, the two largest operators (Berendsen Tekstil Service and De Forenede Dampvaskerier) account for half of the turnover in the market, although a number of smaller operators also have a solid foothold (ErhvervsBladet Research & Analyse, 2006). The operators of a number of previously publicly owned hospital laundries have been taken over by the two largest operators, the hospital laundries being operated as joint ventures.

Sweden has a total of approximately 525 laundries if one includes the 400 or so small dry cleaners/laundries (a dry cleaner is normally a business that uses organic solvents for cleaning the textile, whereas the laundry uses water with the addition of some chemicals) that primarily serve the ordinary consumer. The total turnover of the industry is some SEK 3 billion, the major share – approximately SEK 2.5 billion – being taken by the industrial laundries. Industrial laundries in Sweden employ some 3,500 people. Thus the average Swedish industrial laundry is slightly smaller in terms of both number of employees and turnover than the typical laundry unit in the West as described above. Over the last five years the industry has invested in modern technology, moving in the direction of a more automated process.

In Norway, there are approximately 50 laundries, 50 combined laundries/dry cleaners and 200 dry cleaners (Christensen, 2008). Total turnover in the industry in 2007 was approximately NOK 2 billion (Statistics Norway, 2008). There are two major chains in Norway - TekstilPartnerNor AS and NorTekstil with 12 and 18 industrial laundries, respectively (TekstilPartnerNor, 2008; NorTekstil, 2008). Both chains service the whole of the Norwegian market and offer textile laundering services within all categories. Berendsen Tekstil Service AS also operates on the Norwegian market and has 6 units providing laundry services for work clothes, mats, mops and hand towel rolls (Berendsen, 2008). In addition to the chains there are, as noted above, a number of independent laundries and dry cleaners as well as a number of hospital laundries (NRV, 2008).

The largest operator on the Finnish market is Lindström Oy (Helle, 2008; Lindström, 2008). Berendsen Textile Service also has a presence in Finland. In addition to the chains there are a large number of independent hospital laundries and other laundries – some of which cooperate in their marketing. Including dry cleaners and small laundries there are some 400 textile service providers in Finland with a total turnover of approximately € 250 million (Räsänen, 2008).

Where laundering is insufficient to clean a textile, many industrial laundries have now moved away from dry cleaning the textile themselves, preferring to use subcontractors. More textiles are now able to withstand washing with water than was the case previously, although there is still a small group of particularly delicate textiles that cannot withstand washing.

Other labelling schemes

Many laundries are certified to ISO 14001 or EMAS as well as meeting their industry association's requirements as to quality, environment and working environment. The Swan Label scheme imposes specific requirement levels on environmental impact, something that the environmental management systems do not do. Businesses that work with management systems will often find it easier to compile and document the necessary information for the Swan Label scheme.

3 About the revision

The goal of the revision

The goal of the evaluation has been to bring the requirements up to date, in amongst other ways by looking at the following areas that were raised during the evaluation process:

- Assess the feasibility of combining the criteria for hand towel rolls, laundries and dry cleaners – e.g. introduce a common set of basic criteria for all three groups with possible supplementary requirements for the individual group.
- Look at whether alternative dry cleaning techniques to perchloroethylene could be used by ecolabelled laundries, thus permitting all the operations of a laundry to be ecolabelled.
- Businesses that operate solely as dry cleaners should be subject to stricter requirements as regards their dry cleaning technology.
- Look at the possibility of increasing the stringency of the requirements applicable to water and energy consumption.
- Consider increasing the stringency of the requirements applicable to textiles – over and above Øko-Tex.
- Look at whether scope exists for simplifying the calculation of environmental impact and improving the coordination between the requirements applicable to textile detergents for professional users and the corresponding requirements for detergents used by laundries.
- Look at the requirement applicable to quality control of laundries.
- Rewarding efficiency at lower washing temperatures should be considered.
- Look at the possibility of introducing points requirements as a supplement to the mandatory requirements.
- Consider whether it would be relevant to impose transport requirements.
- Look at the possibility of reducing the quantity of chlorine in use.
- Take a closer look at the division/definition of the degree of soiling of textiles.

About this revision

The criteria were revised by a Nordic project group during the period between September 2008 and June 2009. The revision was based on an evaluation of the existing criteria and by compiling information and data from the industry.

During the revision process the project participants maintained a close dialogue with the industry which involved, amongst other things, compiling key environmental figures from no fewer than 80 laundries across the Nordic region. This provides a sound basis for setting strict but realistic environmental requirements for Swan-labelled textile services.

The background document and criteria are circulated for consultation.

The Project Group has comprised:

- Arne Godal (Norway), Project Manager
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- Lena Axelsson (Sweden)
- Terhi Uusitalo (Finland)
- Eline Olsborg Hansen (Norway)

The Nordic Area Coordinator for the project was Anders Moberg (Sveden).

4 Justification for the requirements

Several life cycle assessments of textile services (Erberle & Möller, 2006; Frederiksen, 2004; Hansen & Holst, 2002; Frydendal, 2001; Schmidt, 2000; Frydendal, 1998; Kalliala, 1997) show that the primary environmental impact of the life cycle is connected to the operational phase – more specifically the laundries' processing of the textiles, with a general emphasis on washing and drying.

This is because the textiles are handled multiple times by the laundries (typically up to about 100 wash cycles). The long useful life measured in terms of the number of wash cycles means that the significance of textile production in the life cycle is reduced in comparison to for example everyday and fashion clothing.

Key environmental issues from a life cycle perspective include energy consumption and the associated environmental effects such as global warming, acidification, eutrofication etc. and the consumption of chemicals which contributes to, e.g., toxicity for humans and the environment, eutrofication etc. Water consumption may also be a major factor, particularly in regions with few available fresh water reserves.

Water consumption
With regard to water consumption, however, it is remarkable that it is not the laundry's use of water that dominates. This is because a high proportion of the textiles consist of cotton, cultivation of which requires a great deal of water. Approximately 50% of the world's cotton fields are irrigated (Frydendal, 1998). Water consumption in the irrigation of cotton amounts to more than 7,000 litres per kg of cotton as a global average even if one includes the fields that are not irrigated (Frydendal, 1998). By way of comparison, a laundry uses on average 10 litres of water per kg laundered, which with 100 washes over the life of the textile makes for water consumption of the order of 1,000 litres of water per kg – in other words – somewhat less than in cotton cultivation. It should be noted, however, that not all the textiles handled by a laundry are made of cotton.

In the case of water consumption it would not be feasible to impose requirements on the water consumed in the cultivation of cotton. Cotton is produced by local farmers in numerous regions around the world and is traded on large exchanges. The cotton

found in a single piece of textile might typically derive from a wide range of different farmers in several different regions.

Nevertheless, water consumption at a laundry is controllable and even though this is not the major contributor to overall water consumption, this still represents consumption of a considerable order. Reducing the water consumption of the laundry can at the same time offer a number of other benefits, including reduced energy consumption, since less water will need to be heated and it will be easier to recycle the energy in the hot water.

We have therefore opted to impose requirements on the water consumption of the laundry in order to exclude laundries with a very high water consumption from the Swan-labelling scheme. Nevertheless, we do not view water consumption as the most significant environmental parameter for a laundry.

The amount of water required to wash clothing will depend to a large degree on the type of textile in question. With this in mind we have differentiated our requirements. The requirements as to the quality of the wash water in the case of mats will not be great and it will accordingly be easier to recycle the water, thereby achieving savings. However, a comforter, for example, has a large volume that takes up a great deal of space in the drum relative to other textiles, which in turn results in higher water consumption.

Experience has shown that there is no great need to tighten up the water consumption requirements relative to version 1 of the criteria, but that there is a need to make certain adjustments to the allocation between the water consumption permitted for various textile categories.

Table 1: Textile categories

Textile categories (see Appendix 1):	**F_{water} [l/kg]**
Work clothes, industrial/kitchen/butchering and kitchen whites	20.0
Work clothes, institution/retail/service	20.0
Hotels	10.0
Restaurants	18.0
Hospitals/nursing homes	15.0
Comforters and pillows	25.0
Mats and mops	8.0
Textile hand towel rolls	12.0
Industrial wiping cloths	12,0
Dry cleaning	0.0
Other	8.0

$$G_{water} = \sum \left[(Proportion)_i \cdot (F_{water})_i \right]$$

Requirement

$$A_{water} \leq G_{water}$$

G_{water} is the threshold value for water consumption at a laundry measured in litres of clean water per kg textile delivered.The weighted average of factor values provides the threshold value for a laundry.
(F_{water})i is the factor value for water in litres of clean water per kg of textile delivered for the individual textile category i. .
*$Proportion_i$ is the proportion of textile category i that is delivered. If a laundry e.g. launders 50% hotel textiles 50% mats, then $Proportion_{hotel}$ = 0.5 og $Proportion_{mats}$ 0.5 whereas for the other categories the figure is 0. Gwater for the example = (0.5*1.0)+(0.5*8.0) = 9.0 litre clean water per kg of textile delivered.*
A_{water} is the quantity of clean water used at the laundry in litres of clean water per kg textile delivered.

Water consumption covers the laundry's total consumption of fresh water (washing, steam, soaking, toilets etc.). Water consumption for for example washing vehicles can be deducted if a separate meter has been installed to document consumption.

Where a multiple unit chain applies for a common licence number, each individual unit must fulfil the requirement.

In determining the above requirement as to water consumption we compiled data from some 80 laundries throughout the Nordic region, both with and without current Swan licences. The figures are confidential and can therefore not be presented in their entirety in this background document. However, the figure below shows the relative deviations of the laundries from our requirements divided into ranges.

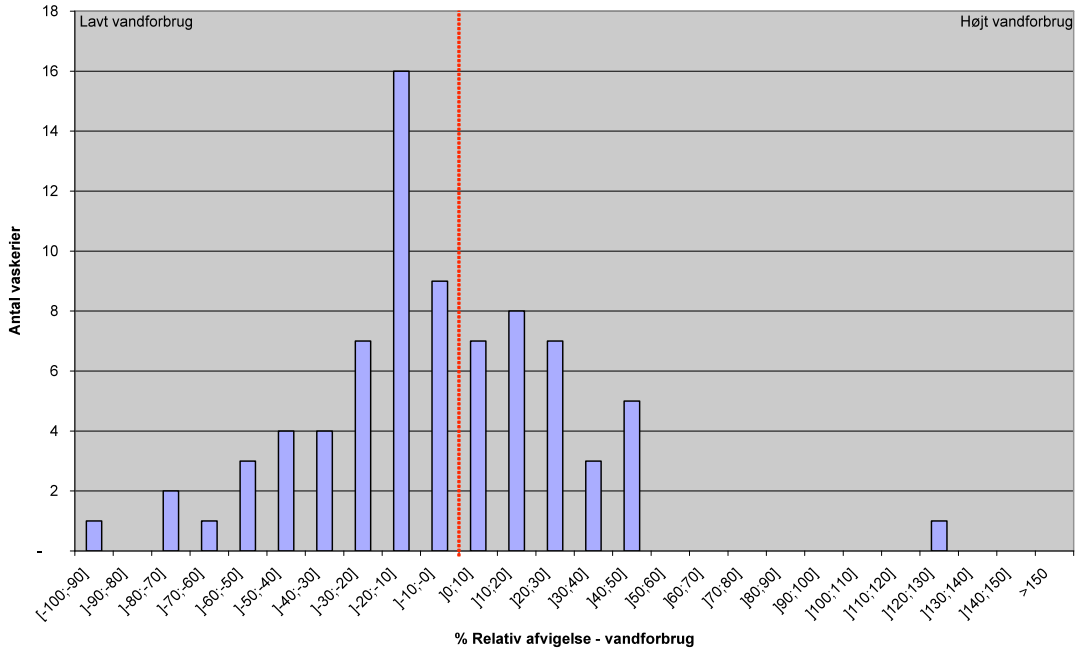

Figure 1. Relative deviations by Nordic laundries from our mandatory requirements for water consumption.

As will be seen from the figure, just under 60% of the laundries comply with our water consumption requirement. This reflects our objective for water consumption, cf. the comments above.

Energy consumption

Energy consumption contributes to a number of environmental effects and experience from numerous LCA studies reveal that it is the single most important parameter in the environmental impact of textile services.

Energy consumption during the operational phase (in other words, activities over which the laundry has a direct influence) is very high when compared with energy consumption during other parts of the life cycle (Erberle & Möller, 2006; Frederiksen, 2004; Hansen & Holst, 2002; Frydendal, 2001; Schmidt, 2000; Frydendal, 1998; Kalliala, 1997). Schmidt (2000), which examines hand towel rolls from a life cycle perspective, divides energy consumption up into three phases as follows: (Frydendal; Schmidt & Zeuthen, 2000):

- Production ~ 16%
- Use/operations (washing/drying/disposal) ~ 80%
- Distribution ~ 5%

Thus imposing a requirement on energy consumption during the operational phase is highly relevant and moreover energy consumption at a laundry is highly controllable. Investigations into the industry conducted by for example Erberle & Möller (2006), who looked at 32 European (including sites in Denmark and Finland) laundries' laundering of hand towel rolls revealed a wide variation (by a factor of 3) between the energy consumption of various laundries. In other words this means that there is considerable potential for improvement and that strict requirement should be imposed on energy consumption. However, some of the variation can be accounted for by the

differences between the use of thermo, termo-chemical or chemical disinfection by the laundries, since this affects the wash temperature and, accordingly, energy consumption.

If one examines the energy consumption of a laundry, it is apparent that there are differences in the amount of energy used to wash different types of textiles. For example, Hansen et al. (1998) found that the average oil/gas consumption of a linen laundry is 1.7 – 2.7 kWh/kg textiles, whereas the average for a clothing laundry is somewhat higher, 2.5 – 3.5 kWh/kg of textile.

An analysis conducted in 1998 of the energy consumption of a linen laundry shows that total energy consumption broke down as follows (Petersen & Mou, 1998):

- Wash ~ 25%
- Tumble drying ~ 39%
- Rolling ~ 23%
- Other* ~ 12%

It should be noted that this refers to a single laundry within a specific category and accordingly the energy consumption figures cannot be said to be general. Nevertheless, the study does provide a picture of how energy is consumed. In both the rolling and the tumble drying processes the energy used in evaporating water is dominant. Accordingly the amount of water held by the textiles after washing will have a direct effect on energy consumption – and thus the use of artificial fibres such as polyester, which does not absorb as much water, has a beneficial effect on environmental impact (Frydendal, 1998).

In the case of low temperature washing there is a widespread impression that lower temperatures mean lower energy consumption. However, this is not always the case, as is apparent from Hansen & Holst (2002), which shows that the extra chemical consumption entails that energy consumption from a life cycle perspective increases. The study also reveals that the costs of a laundry will be greater. It should be noted, however, that this conclusion is based on a single example involving work clothing where it is necessary to step up a great deal for the surfactant substances. This case cannot be said to be general, and with developments in low temperature processes in recent years it must be concluded that there is a significant energy saving potential in washing at lower temperatures. This is made clear in the confidential part of the Erberle & Möller (2006) study, which compares individual laundries in Europe on the laundering of hand towel rolls.

Since the wash energy as shown above makes up only approximately 25% of overall energy consumption by the laundry, significant - but not outstanding - energy savings can be achieved every time the temperature can be reduced by a few degrees. Replacing old boilers and direct gas fired tumblers and washing machines offer significant potential for reducing energy consumption. Here, however, we are typically talking about major investments that may be difficult to implement in an existing laundry.

* Heating buildings, hot water, trouser presses, loss from steam pipes etc.

As well as reducing the temperature, increasing the proportion of non-absorbent fibres in the textiles (e.g. polyester) may also represent an ”easy route” to reducing the energy consumption of the laundry (Frydendal, 1998).

In order to allow comparisons to be made between the figures for electricity consumption and fuel consumption as regards the consumption of primary energy, electricity consumption is multiplied by a factor of 2.5. This corresponds to the standard coefficient for electricity used in the EU (EU, 2006) and used by Nordic Ecolabelling in other criteria, e.g. for Swan-labelled fuel pellets. The value reflects the fact that because of losses of energy in production and distribution of electricity, the average efficiency is 40% (EU, 2006).

We have established the following factor values for energy (F_{energy}) for the various textile categories.

Table 2: Factor values for energy for different textiles

Textile categories (see Appendix 1).	**F_{energy} [kwh/kg]**
Work clothes, industrial/kitchen/butcher and kitchen whites	3.15
Work clothes, institutions/retail/service	2.85
Hotels	1.75
Restaurants	2.75
Hospitals/care homes	2.75
Comforters and pillows	3.00
Mats and mops	1.00
Cloth hand towel rolls	1.90
Industrial wiping cloths	2.95
Dry cleaning	0.00
Other	1.00

Grænseværdien for energi for vaskeriet udregnes som et vægtet gennemsnit af faktorværdierne i forhold til den type tekstiler vaskeriet leverer.

$$G_{energy} = \sum \left[(\text{Proportion})_i \cdot (F_{energy})_i \right]$$

Den anvendte energi på vaskeriet udregnes ved at lægge brænselsenergi og el sammen, idet der for el regnes med en faktor 2,5 som forklaret ovenfor.

$$Ay = 2{,}5 \cdot A_{el} + A_{fuel}$$

Kravet, der skal overholdes er, at den anvendte energi for vaskeriet skal ligge under grænseværdien.

$$A_{energy} \leq G_{energy}$$

G_{energy} is the threshold value for energy consumption at a laundry measured in kWh primary enery per kg textile delivered. The weighted average of the factor values provides the threshold value for a laundry.
$(F_{energy})i$ is the factor value for energy in kWh primary energy per kg textile delivered for the specified textile category i.
*$Proportion_i$ is the proportion of textile category i that is delivered. If e.g. a laundry launders 50% hotel textiles and 50% mats, then $Proportio_{hotel}$ = 0.5 og $Proportion_{mats}$ =0.5 whereas for the remaining categories the figure is 0. G_{energy} for the example= (0.5*1.00)+(0.5*1.75) = 1.375 kWh primary energy per kg of textile delivered.*
A_{el} is the quantity of delivered electricity used at the laundry in kWh per kg textile delivered.

A_{fuel} is the quantity of used at the laundry in kWh per kg textile delivered calculated on the basis of energy consumption and the energy factors in Appendix 2.
A_{energy} is the quantity of primary energy used at the laundry in kWh per kg textile delivered.

If the above laundry uses on average 0.10 kg fuel oil and 0.22 kWh electricity per kg textile, then

$$A_{energy} = 2.5 \frac{\text{kWh}}{\text{kWh}_{\text{delivered}}} \cdot 0.22 \frac{\text{kWh}_{\text{delivered}}}{\text{kg}} + 0.10 \frac{\text{kg}_{\text{fueloil}}}{\text{kg}} \cdot 11.29 \frac{\text{kWh}}{\text{kgfueloil}} = 1.679 \frac{kWh}{kg}$$

This is more than the laundry's threshold value for energy (G_{energy}) of 1.375 $\frac{kWh}{kg}$, which means that the laundry fails the Swan requirements for energy.

This requirement must be fulfilled by the individual Swan-labelled units in a chain.

If the laundry is able to separate out the following consumption with the aid of meters, then these factors will not be included in the calculation of A_{energy}:

- ventilation
- heating of buildings
- internal treatment plants
- 25% of energy consumption for VOC afterburners for laundries that launder industrial wiping cloths

The intention is to place all laundries on as equal a footing as possible, irrespective of the climate zone in which they are located and regardless of the environmental and working environment requirements to which they are subject, e.g. requirements as to ventilation and waste water processing imposed by the authorities.

Some laundries that wash industrial wiping cloths use a process whereby the air in the entire laundry is extracted and combusted in an afterburner to ensure that VOCs that enter the laundry with the polluted wiping cloths are not released into the environment. This is an energy-intensive process. Nevertheless, waste heat generated in this process can be used for heating washing water and tumble dryers. To take account of this, laundries that launder industrial wiping cloths and that are able to document energy consumption in the afterburner using a separate meter may deduct 25% of the energy consumption of the afterburner.

In setting the above energy consumption requirement we collected data from some 80 laundries throughout the Nordic region, some with and some without current Swan licences. These figures are confidential and can therefore not be presented individually in this background document. However, the conclusion with regard to energy was unambiguous. The industry as a whole has significantly reduced its energy consumption per kilo of textiles since version 1 of the criteria was adopted, which taken in combination with the increased focus on climate-related requirements in our criteria documents means that a considerable need existed for tightening up the existing energy requirements.

Based on the compiled data, we can see – as is clear from the figure below – that only some 40% of laundries in the Nordic region will be capable of fulfilling the energy requirement. In view of the fact that this is just one of our parameters, this is a relatively high figure and as we have heard represents a sharp increase in stringency. However, since the energy consumption of laundries has been the main focus of attention in this revision, the level is reasonable. Moreover, we are encouraging the laundries to further reduce their energy consumption and climate impact through our points requirements which are discussed at the end of this chapter.

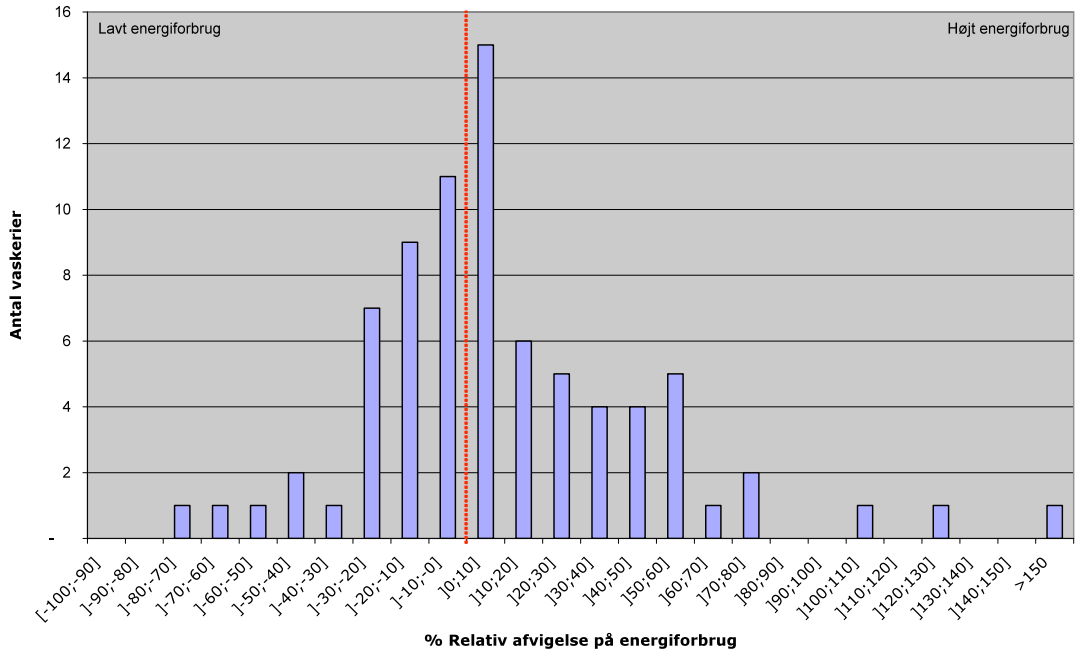

Figure 2. Nordic laundries' relative deviation from our mandatory requirements for energy consumption.

Transport

Distribution between laundry and customer has less significance in environmental terms than many people might think. A life cycle assessment of hand towel rolls (Schmidt, 2004) shows for example that energy consumption for distribution makes up only 5% of total energy consumption in the life cycle, whereas energy consumption at the laundry makes up 80% (Frydendal, Schmidt & Zeuthen, 2000). One reason for this is that the capacity of the vehicles is typically exploited efficiently because the vehicles are never empty since they carry soiled textiles with them when they return from customers. Nevertheless, transport is of some significance, especially when laundries become more specialised and relocate further away from their customers. However, experience from Denmark has shown that the environmental savings that can be achieved by laundries as a result of specialisation far exceeds the increased environmental impact that comes with having to transport the textiles further between customer and laundry.

Although transport does not represent the greatest environmental impact, it is controllable and very visible to the laundry's customers. At the same time, transport in general represents an increasing problem for society in terms of its impact on health and the environment.

We have therefore opted to impose a number of requirements on the distribution process between laundry/dry cleaner and customer, even though this is not the primary focus of this criteria document.

Several laundries have outsourced distribution to external carriers (Green, 2000). We have taken account of this when imposing our requirements.

One of these requirements is that all drivers (both in-house and external) driving for the licence-holder must undergo a course in ecodriving. Newly employed drivers must undergo a course of this nature within six months of their employment.

Ecodriving can on average provide fuel savings of between 5 and 10% (Ecodriven, 2006) as well as bringing down emissions of for example CO_2.

When new vehicles are purchased and/or new leasing agreements are signed (both internally and with external transporters) we impose the requirement that the vehicles must as a minimum fulfil the latest EURO norm. At the time of writing this means EURO norm 5 for trucks and EURO norm 4 for goods vehicles and cars (DieselNet, 2008; Wikipedia, 2008). Since new vehicles are required to meet the European Union's most recently adopted norm, the requirement will in practice have been fulfilled as long as new vehicles are purchased. Purchases of second-hand vehicles generally require documentation of compliance with the most recent Euronorm.

Purchases of textiles
Industrial laundries usually offer their customers the option of renting textiles. This means that in practice the laundry purchases and owns many of the textiles that the laundry handles and the customer uses. The rest of the textiles are owned by the customers.

Life cycle studies performed on textile services (e.g. Frydendal, 2001) reveal that the contribution made by textile production to environmental impact is limited, when compared with the laundry's consumption of energy and chemicals. Nevertheless, it is not insignificant and with the transfer of textile production to the Far East working conditions and similar ethical issues have increased in significance.

We have therefore chosen to impose a number of requirements on the purchase of textiles by laundries. We have focused exclusively on the textiles that the laundries own themselves, since imposing requirements on the textiles purchased by the laundry's customers would not be controllable.

The first requirement concerns the business' purchasing policy when buying textiles. On this point the Swan wishes to play a part in reducing the risk of workers in the textile industry, especially in third world countries, working under unfavourable conditions. Businesses are therefore required to have a code of conduct in place in relation to textile purchases under which suppliers of textiles and textile manufacturers must respect and comply with the ten principles of the UN Global Compact.

The ten principles of the UN's Global Compact (United Nations, 2008) are:

Principle 1: Businesses should support and respect the protection of internationally proclaimed human rights; and
Principle 2: make sure that they are not complicit in human rights abuses.

Labour Standards

Principle 3: Businesses should uphold the freedom of association and the effective recognition of the right to collective bargaining;
Principle 4: the elimination of all forms of forced and compulsory labour;
Principle 5: the effective abolition of child labour; and
Principle 6: the elimination of discrimination in respect of employment and occupation.

Environment

Principle 7: Businesses should support a precautionary approach to environmental challenges;
Principle 8: undertake initiatives to promote greater environmental responsibility; and
Principle 9: encourage the development and diffusion of environmentally friendly technologies.

Anti-Corruption

Principle 10: Businesses should work against corruption in all its forms, including extortion and bribery.))

The requirement is not controllable to any great degree, but does send out a clear signal to textile manufacturers.
A second requirement concerns the environmental and health properties of the textiles. There are major differences between the various textile categories in terms of the availability of ecolabelled and health-labelled products. The requirement is therefore related to newly purchased work clothes and linen requiring rolling, since the proportion of products available on the market that can document compliance with ecolabelling criteria or Økotex 100 is somewhat higher than for other categories. However, to offer some benefits in purchasing environmentally and health-friendly textiles – including in other areas – all purchases that comply with the standards, may be included in the calculation. Since ecolabelled textiles are subject to stricter requirements than Økotex, the purchase of ecolabelled textiles will carry a higher weight (by a factor of 2.5). The ecolabelling criteria are life cycle based and in addition contain the same type of health and quality requirements as to the end product as Økotex 100.

By ecolabelled textiles we mean textiles that are labelled with either the Swan or the Flower Label. Bra Miljöval also have criteria for textiles, but they are divided up and cover various aspects of the life cycle of the products. These are fibre production – ”good fibre” – and textile production – ”good preparation” (SNF, 2008). For the labelling to be life cycled-based, the product must be labelled both as ”good fibre” and ”good preparation” and we have therefore decided against crediting this ecolabel for textiles. The situation is different in the case of laundry chemicals.

On an annual basis Swan-labelled textile services must meet the following requirements:

$$\frac{\text{Quantity}_{\text{ecolabelled}} \cdot 2{,}5 + \text{Quantity}_{\text{Økotex100}}}{\text{Quantity}_{\text{workclothes}} + \text{Quantity}_{\text{linen}}} \geq 75\%$$

$Quantity_{ecolabelled}$ is the purchased volume (NOK or kg) of ecolabelled products (Flower or Swan)
$Quantity_{Økotex}100$ is the purchased volume (NOK or kg) of products that meet the Økotex100 standard
$Quantity_{work\ clothes}$ is the purchased volume (NOK or kg) of work clothes
$Quantity_{linen}$ is the purchased volume(NOK or kg) of linen requiring rolling (e.g. bedclothes, tableware, hand towel rolls etc.) etc.)

If a business chooses only to ecolabel its hand towel roll service, the purchased quantity of hand towel rolls must meet the requirement – in other words for example at least 75% of the purchased hand towel rolls must fulfil the requirements of Økotex 100.

Since data on purchases will typically be found in the accounting systems of businesses and will not always specify weight, the calculation may be performed on the basis of weight or economic purchase volume, at the discretion of the applicant.

Consumption of chemicals
It is often a cause of surprise that a laundry will typically purchase a large quantity of laundry chemicals in relation to the quantity of textiles. Thus in 2000, the Sophus Berendsen Group purchased approximately 1,800 tons of textiles, whereas total purchases of laundry chemicals were of the order of 4,300 tons (Berendsen, 2001). Clearly the numbers say nothing directly about environmental relevance, but on the other hand they do indicate that the requirements applicable to the chemicals used by the laundry should carry some weight. *

An industrial laundry uses a variety of different types of chemicals for various purposes (Grüttner, 2008):

- Surfactants
- Complexing agents
- Bleaches
- Rinsing agents
- Other substances, including e.g.
    - Alkalies
    - Enzymes
    - Optical brighteners
    - Fragrance
    - Etc.

Many businesses in the laundry industry have focused attention on phasing out a number of the worst substances – an effort that is supported by amongst others the European industry organisation E.T.S.A. (European Textile Services Association), which has introduced a number of environmental principles, one of which is that: ”Only detergents which have a minimum impact on the environment should be used” (Grüttner, 2008).

In addition to laundry chemicals, laundries may use a wide range of other chemicals such as stain treatment agents and proofing agents, as well as smaller quantities of chemicals that do not come into direct contact with textiles. These might for example

be chemicals for cleaning and, if applicable, disinfecting linen trolleys, boiler chemicals, salt and other chemicals for textile soaking equipment as well as lubricants and other substances for maintaining machinery.

However, the process chemicals are far and away the most significant group and as has already been noted, from a life cycle perspective far more process chemicals (in kilo incl. water) are purchased than textiles. Our requirements accordingly apply exclusively to process chemicals, which we define as chemicals that come into contact with the textiles both before, during and after the wash process. This includes for example stain removal agents, detergents and bleaches, starch, fabric conditioners, proofing agents etc.

The requirements imposed on the chemicals relate both to health and environmental aspects as well as requirements aimed at assuring that there is a low risk to the environment.

At the laundries most of the chemicals are handled in automatic dosing systems, where there is very little risk of direct contact with the chemical. Nevertheless, in the case of for example replacements of suction pipe sockets and manual dosing there is some possibility of exposure.

The requirement is therefore imposed that none of the products used must contain substances classified in the following way:

Classification	**Hazard classes and risk phrases**
Sensitising	Xn with R42 – applies only to aerosol products*
Carcinogenic	T with 45 and/or R49 (Carc1 or Carc2) or Xn with R40 (Carc3)
Mutagenic	T with R46 (Mut1 or Mut2) or Xn with R68 (Mut3)
Toxic for reproduction	T with R60, R61, R64 and/or R33 (Rep1 or Rep2) 0r Xn with R62, R63, R64 and/or R33 (Rep3)

** E.g. stain removal chemicals used in pretreating stains directly on the textiles may for example contain enzymes that may cause allergies upon inhalation of dust and aerosols. The requirement is therefore imposed that aerosol products must not contain substances classified as Xn, R42.*

At the same time, none of the products used must be classified as:

Classification	**Hazard classes and risk phrases**
Ecotoxic *	N with R50, R50/53 or R51/53. R52, R53 or R52/53 without N
Acute toxicity	T+ with R26, R27, R28 and/or R39
Toxic	T with R23, R24, R25, R39 and/or R48
Harmful for health **	Xn with R20, R21, R48, R65 and/or R68
Sensitising	Xn with R42*** and/or Xi with R43
Carcinogenic	T with R45 and/or R49 (Carc1 or Carc2) or Xn with R40 (Carc3)
Mutagenic	T with R46 (Mut1 or Mut2) or Xn with R68 (Mut3)
Toxic for reproduction	T with R60, R61, R64 and/or R33 (Rep1 or Rep2) or Xn with R62, R63, R64 and/or R33 (Rep3)

** The requirement applies only to 95% (w/w) of the laundry chemicals used.*
*** Exempted are products where the classification is due to the content of oxalic acid (CAS 144-62-7) or per acetic acid (CAS 79-21-0).*
**** The exception is stain pre-treatment agents with enzymes since these often contain more than 1% enzymes and will accordingly be classified. The use of stain pre-treatment agents directly on stains is considered to be sensible in environmental terms, and accordingly this classification exemption has been included.*

R20 Harmful by inhalation
R21 Harmful in contact with skin
R23 Toxic by inhalation
R24 Toxic in contact with skin
R25 Toxic if swallowed
R26 Very toxic by inhalation
R27 Very toxic in contact with skin
R28 Very toxic if swallowed
R33 Danger of cumulative effects
R39 Danger of very serious irreversible effects
R40 Limited evidence of carcinogenic effect
R42 May cause sensitisation by inhalation
R43 May cause sensitisation by skin contact
R45 May cause cancer
R46 May cause heritable genetic damage
R48 Danger of serious damage to health by prolonged exposure
R49 May cause cancer by inhalation
R50 Very toxic to aquatic organisms
R51 Toxic to aquatic organisms
R52 Harmful to aquatic organisms
R53 May cause long-term adverse effects in the aquatic environment
R60 May impair fertility
R61 May cause harm to the unborn child
R62 Possible risk of impaired fertility
R63 Possible risk of harm to the unborn child
R64 May cause harm to breast-fed babies
R65 Harmful: May cause lung damage if swallowed
R68 Possible risk of irreversible effects

Oxalic acid (Xn; R21/22) is used in laundries to remove for example rust stains which are often found on the textiles and cannot be removed in the ordinary washing process. There are no obvious alternatives to oxalic acid (Köcher, 2008), and accordingly this substance has been exempted from the health hazard classification. Were oxalic acid to be prohibited, the quantity of textiles that would have to be disposed of would increase significantly, which is not good for the environment.

Peracetic acid (R10 - O; R7 - Xn; R20/21/22 - C; R35 - N; R50) is produced from a mixture of acetic acid and hydrogen peroxide, is highly reactive and offers the benefit that it bleaches and disinfects at a far lower temperature than hydrogen peroxide alone. Accordingly, in processes using peracetic acid the wash temperature can be reduced, thereby achieving significant energy savings. In order not to reduce the scope of Swan-labelled laundries for achieving increased energy savings, we have opted to exempt this substance from the classification requirement.

It will be noted that we have not excluded products that are classified only as harmful to health with R22 (harmful if swallowed). This is because the substances are only used professionally at laundries where there are no children present. At the same time, most of the dosages are applied with the aid of automatic dosage systems, as a result of which the risk of exposure by swallowing is minimal.

As regards laundry chemicals classified as environmentally harmful, we have not prohibited them entirely, but accept that only 95% (w/w) of the products must not be classified as environmentally harmful (N). This acceptance of products that are classified as environmentally harmful is in part due to the fact that only a small portion of the products that are used are classified in this way and cannot readily be substituted, but is primarily due to the fact that the key issue as regards laundries is not the classification of the products but rather the total quantity of environmentally harmful substances released per kilo of laundry. If we imposed a total ban on products classified as environmentally harmful, the outcome might be that chemical manufacturers would supply less concentrated products in order to evade classification, which in turn would simply mean that the impact of transport would be increased.

Accordingly the environmental problems associated with laundry chemicals are primarily handled by imposing requirements restricting certain constituent substances, requirements applicable to the critical dilution volume and by prohibiting a number of problematical substances.

The following substances are accordingly restricted in the chemicals used:

- Substances that are toxic to the environment and at the same time are not readily degradable (R50/53, R51/53 and R52/53) represent a potential problem to the aquatic environment.

- Phosphorus contributes to an increase in nutrient loading in the environment which can contribute to for example algal bloom followed by oxygen deficit.

- Non-anaerobically degradable substances are organic substances that under anaerobic conditions fail to break down in the environment and where there is a risk of accumulation.

- Various substances contribute in different ways to potential environmental impact. In order to ensure an overall reduction in impact, we impose requirements on the total Critical Dilution Volume per kilo of textile. Put simply, the critical dilution volume is a concept which calculates the quantity of dilution with clean water required in order for there to be no toxic effects in the environment. However, this is a theoretical value which weights the fate and toxicity of the substances in the environment.

We impose the requirement that all surfactants must be aerobically and anaerobically degradable and also prohibit the following substances:

- Alkylphenol ethoxylates (APEO) and/or alkylphenol derivates (APD) are a group of surfactants that have been proved to cause endocrine disruption. As a result of legislative requirements, the substances have been phased out of most products, although we occasionally encounter them in raw materials, for which reason they are explicitly prohibited in this criteria document.
- LAS (linear alkylbenzene sulphonates) are a group of surfactants that are not anaerobically degradable and therefore proscribed. The substances are

proscribed in the surfactant requirement, but for the sake of clarity we have explicitly excluded them.

- DADMAC (dialkyldimethyl ammonium chloride) are a group of substances with very high ecotoxicity, for which reason the substance is frequently used during the summer by laundries in the final rinse to protect textiles against mildew. Our view is that better production planning would rule out the need to use this type of environmentally harmful substances.
- Perfluorinated and polyfluorinated alkylated compounds (PFAS) are used for example in connection with the proofing of textiles in or after the wash process. The substances are persistent and are easily discovered in the body (Jensen, Poulsen & Bossi, 2006). The chemical substances in the group affect biological processes in the body and are suspected of both endocrine disruption and carcinogenic properties (Jensen, Poulsen & Bossi, 2006).
- Boric acid and borates. Borates are used in detergents and bleaching agents, and a number of these substances as well as boric acid are in the process of being classified as toxic for reproduction (EU, 2008).
- Optical brighteners make the textiles artificially whiter by lodging in the fibres and reflecting more blue light, so that the textiles look whiter. Experiences from the laundry industry has revealed that optical brighteners are not necessary and that it is only where customers hold textiles laundered with and without optical brightener directly up against each other that they will see that products without optical brightener do not appear quite as white. Optical brighteners must therefore be viewed as unnecessary, and even though in recent years more environmentally-friendly substances have been developed for use as optical brighteners we see no reason to permit the use in Swan-labelled textile services.
- NTA and its salts are a complexing agent that is in the process of being classified as carcinogenic in the first amendment to the ClaP Directive (implementation of the Global Harmonisation System i Europe). In order to ensure that the substances are not used in products by Swan-labelled laundries until the new classification enters into force, the substance is explicitly prohibited.
- Fragrances may contain substances that have effects on both the environment and health. At the same time, the use of fragrance in the washing process may result in involuntary exposure for the end users of the textiles. Accordingly the use of fragrance in products that come into contact with the textiles is prohibited.
- Nanometals, nanocarbon compounds and/or nanofluoride compounds must not be actively added. For this purpose nanoparticles are regarded as microscopic particles where at least one of the dimensions is less than 100 nm. Examples of nanometals include nanosilver, nanogold and nanocopper. Nanometals such as nanosilver and nanocopper are under particularly close observation since they are found in a wide range of products – ranging from socks to refrigerators - in order to achieve an antibacterial effect. Substances such as nanosilver are viewed as biocides by the US Environmental Protection Agency. There is particular concern that emissions of nanosilver to waste water and other distribution of nanosilver may eliminate wanted bacteria and cause bacterial resistance.

- Triclosan is an antibacterial disinfectant that is used in a wide range of products. There is some concern that the use of antibacterial and disinfectant substances such as triclosan may play a part in increasing the resistance of bacteria to antibiotics (Miljøstatus i Norge, 2008A). Triclosan is bioaccumulable and classified as environmentally harmful - N; R50/53 (Dye et al, 2007) and is on the Norwegian Pollution Control Authority's Priority List – a list of substances that the Norwegian authorities are seeking to bring about a significant reduction in the use of (Miljøstatus i Norge, 2008A) and on the Danish EPA's "Liste over uønskede stoffer " (List of proscribed substances) (EPA, 2004). Studies have been conducted that show that triclosan breaks down into harmful dioxins when it comes into contact with sunlight (Bakke, 2003). Triclosan has been found in a number of different locations – for example in sewage and in waste water from treatment plants (Dye et al, 2007), which indicates that the use of triclosan results in exposure in the environment.
- EDTA is a powerful complexing agent that is capable of binding metal ions and is therefore also suspected of being capable of mobilising heavy metals in the aquatic environment. However, the industry has questioned this latter property (Cefic, 2003). EDTA is not readily degradable and the European Union's risk assessment concludes that conditions in municipal treatment plants are such that EDTA will not break down or will break down only to a limited extent (Cefic, 2002). EDTA was permitted in previous criteria for professional textile detergents (version 1.2) and laundries (version 1.4) in Norway and in other areas where the use of phosphorus has been prohibited. However, more environmetally-friendly alternatives are now available that are degradable and can replace EDTA. These include MGDA (methylglycin diacetic), and for this reason we have chosen to entirely prohibit the use of EDTA.
- "Persistent, bioaccumulable and toxic (PBT) organic substances" and "very persistent and very bioaccumulable (vPvB) organic substances": The inherent properties of these substances should be kept out of the environment and are therefore excluded from the chemicals that may be used in Swan-labelled textile service operations. PBT and vPvB substances are defined in Annex XIII to REACH (Directive 1907/2006/EC). Substances that fulfil or substances that form other substances that fulfil the PBT or vPvB criteria can be found on the European Chemical Bureau website: http://ecb.jrc.it/esis/index.php?PGM=pbt. Substances that are "deferred" or substances "under evaluation" are not considered to have PBT or vPvB properties.
- Substances that cause endocrine disruption are substances that may affect the endocrine balance in humans and animals. Hormones control a number of the body's processes and are of particular importance in the growth and development of humans, animals and plants. Changes in the hormone/endocrine balance may have undesired effects and attention has in particular been focused on hormones that effect sexual development and reproduction. A number of studies have shown effects on animals which are assumed to have been caused by changes in the hormone balance. Emissions to the aquatic environment are one of the main sources of emissions and the spread of substances that cause endocrine disruption. (Miljøstatus i Norge, 2008B)

- Halogenated flame retardants encompass a range of substances harmful to health and the environment and highly toxic to organisms in water, carcinogenic or harmful to health in other ways. The substances do not break down readily in the environment, which increases the risk of harmful effects (Miljøvejledninger, 2008). Flame retardants may occur in the laundry since flame retardant proofed specialist textiles require frequent regeneration in order to retain their flame retardant properties. This regeneration process is performed by laundries (Glensvig et al., 2005).

Dyes
Dyes can aid in the correct identification of products in the laundries, thereby preventing errors that can result in environment and working environment-related problems. Dyestuffs are therefore permitted, but we impose the requirement that they be either approved for use in foodstuffs or not be bioaccumulable. Dyestuffs are regarded as not bioaccumulable if BCF < 100 or logKow < 3. If both values are available, the actual BCF value measured will be decisive.

Chlorine
In the past many laundries used large quantities of active chlorine compounds such as sodium hypochlorite. Although the level of consumption has now been reduced, our experience of the industry has shown us that many laundries still use bleach in situations in which it is unnecessary or use higher doses than necessary. Active chlorine compounds are in themselves toxic to the environment, but are reactive and accordingly break down. However, their reaction with organic substances can create chloro-organic substances that have undesirable environmental properties. On the other hand the use of bleach can in some cases entail that the quantity of textiles that would otherwise be discarded is reduced. This includes for example textiles with mildew stains that can only be removed by rewashing with chlorine. This is reflected in our threshold values for using chlorine for the various textile categories.

We have chosen to impose limits on the overall consumption of active chlorine per kilo of textile delivered instead of, as in the past, looking at the individual washing process and then permitting chlorine to be used only in washing and rewashing heavily soiled textiles. However, the requirements will be imposed in such a way that chlorine will in practice only be used where a genuine need exists – i.e. when washing and rewashing heavily soiled textiles.

The information base available for imposing requirements as to chlorine is not as detailed as in the case of energy and water. We have specific data for some 20 individual laundries and collective data from two major chains: Lindström and De Forenede Dampvaskerier. What we can see from the figures for the individual laundries is that there are major variations in bleach consumption, ranging from 0 mg/kg for laundries washing textiles that do not require the use of chlorine to over 1,000 mg active chlorine/kg of textile in other laundries. Generally we can say in the case of individual laundries on which we have data that those with a valid Swan Label use less chlorine than laundries that do not hold Swan licences. At Lindström's laundries the average consumption of active chlorine per kg of textile is 500 mg/kg (Lindström, 2008). At De Forenede Dampvaskerier approximately 6,1 g of chlorine is used per kg of textile (DFD, 2007), which if one assumes that the bleach essence

contains 13% of active chlorine is equivalent 800 mg/kg textile. Our assessment is accordingly that the following requirements represents a stringent level, at the same time as which the laundries have a realistic chance of compliance, without any significant increase in the quantity of textiles that need to be discarded.

Table 3: Factor values (F) for chlorine in various textile categories

Textile category (see Appendix 1):	**$F_{chlorine}$ [mg/kg]**
Work clothes, industrial/catering/butchering and kitchen whites	300.0
Work clothes, institutions/retail/service	50.0
Hotels	80.0
Restaurants	350.0
Hospitals/nursing homes	90.0
Comforters and pillows	0.0
Mats and mops	0.0
Textile hand towel rolls	25.0
Industrial wiping cloths	0.0
Dry cleaning	0.0
Other	0.0

$$G_{chlorine} = \sum \left[(Proportion)_i \cdot (F_{chlorine})_i \right]$$

Requirement

$$A_{chlorine} \leq G_{chlorine}$$

$G_{chlorine}$ is the threshold value for the consumption of active chlorine by a laundry measured in mg of active chlorine per kilo of textile delivered. The weighted average of factor values provides the threshold value for a laundry.
$(F_{chlorine})i$ is the factor value for active chlorine in mg per kg textile delivered for the individual textile category i.
*$Proportion_i$ is the proportion of textile category i that is delivered. If a laundry e.g. launders 50% hotel textiles and 50% mats, then $Proportion_{hotel}$ = 0.5 og $Proportion_{mats}$ 0.5 whereas for the other categories the figure is 0. $G_{Chlorine}$ for the example= (0.5*50.0)+(0.5*0.0) = 25.0 mg active chlorine per kg of textile delivered.*
$A_{chlorine}$ is the quantity of active chlorine used by the laundry in mg per kg of textile delivered.

CDV (critical dilution volume)

The critical dilution volume (CDV) of all chemicals that come into contact with the textiles must be calculated. This will include detergents, bleaches, starch, fabric conditioners, proofing agents and stain removal agents.

The critical dilution volume is a theoretical value that takes account of the toxicity and degradation in the environment of the individual substance. The method was developed for the EU Flower Scheme and replaces what was termed the TD calculation (Toxicity and Degradability) formerly used by Nordic Ecolabelling. Applicants have the choice of calculating either acute or chronic CDV, although there are differences between the level of requirements that will apply depending on the method chosen. Only one method may be chosen by each laundry and thus either acute or chronic SDV will be calculated for all laundry chemicals used by the laundry.

Table 4: Factor values for CDV in various textile categories

Textile categories (see Appendix 1):	**$F_{CDV\ acute}$ [litre/kg]**	**$F_{CDV\ chronic}$ [litre/kg]**
Work clothes, industrial/catering/butchering and kitchen whites	450.000	225.000
Work clothes, institutions/retail/service	350.000	175.000
Hotels	150.000	75.000
Restaurants	250.000	125.000
Hospitals/nursing homes	250.000	125.000
Comforters and pillows	150.000	75.000
Mats and mops	150.000	75.000
Textile hand towel rolls	150.000	75.000
Industrial wiping cloths	400.000	200.000
Dry cleaning	0	0
Other	150.000	75.000

$$G_{CDV} = \sum \left[(\text{Proportion})_i \cdot (F_{CDV})_i \right]$$

Requirements

$$A_{CDV} \leq G_{CDV}$$

G_{CDV} is the threshold value for the critical dilution volume of the chemical consumption calculated in litres per kilo of textile delivered. The weighted average of the factor values provides the threshold values for a laundry.
$(F_{CDV})i$ is the factor value for CDV in litres per kilo of textile delivered for the individual textile category i.
*$Proportion_i$ is the proportion of textile category i that is delivered. If a laundry e.g. launders 50% hotel textiles and 50% mats, then $Proportion_{hotel}$ = 0.5 og $Proportion_{mats}$ 0.5 whereas for the other categories the figure is 0. G_{CDV} for the example= (0.5*150,000)+(0.5*150,000) = 150.000 litres per kg of textile delivered.*
A_{CDV} is the critical dilution volume for the chemicals used in the laundry in litres per kilo of textile delivered.

Because of the degradation of the substances during the washing process, special rules apply to the calculation of the following three substances:

- Active chlorine such as sodium hypochlorite is not included in the calculation of CDV. The substance may well form problematical haloginated organic compounds in the process, and these may well be released into waste water but it would not be controllable to include them in the calculation, and moreover the use of active chlorine is already specifically restricted in other requirements of the criteria document precisely for this reason.
- Hydrogen peroxide – is not included in the calculation of CDV.
- Peracetic acid is included in the calculation as acetic acid.

Phosphorus

Phosphorus (P) released into the aquatic environment contributes to nutrient loading which may result in algal bloom and oxygen deficit. If waste water is processed in a treatment plant, some of the phosphorus will be precipitated in the waste water but some will slip through, and we have accordingly imposed the requirement that the use of phosphorus will be reduced.

Table 5: Factor values for phosphorus in the various textile categories

Textile categories (see Appendix 1):	**F_P [g/kg]**
Work clothes, industrial/catering/butchering and kitchen whites	1.75
Work clothes, institutions/retail/service	1.25
Hotels	0.50
Restaurants	1,00
Hospitals/nursing homes	0.75
Comforters and pillows	0.50
Mats and mops	0.50
Textile hand towel rolls	0.50
Industrial wiping cloths	1.50
Dry cleaning	0.00
Other	0.50

$$G_P = \sum \left[(\text{Proportion})_i \cdot (F_P)_i \right]$$

Requirements

$A_P \leq G_P$

G_P is the threshold value for the use of P by a laundry measured in g P per kg textile delivered. This is the weighted average of factor values, which provides the threshold value for a laundry.
$(F_P)i$ is the factor value for P in g per kg textile delivered for the stated textile category i.
*$Proportion_i$ is the proportion of textile category i that is delivered. If a laundry e.g. launders 50% restaurant textiles and 50% mats, then $Proportion_{restaurant}$ = 0.5 og $Proportion_{mats}$ 0.5 whereas for the other categories the figure is 0. GV_P for the example will be = (0.5*1.00)+(0.5*0.50) = ,75 g-P per kg of textile delivered.*
A_P is the quantity of P used by the laundry in g per kg of textile delivered.

Non-anaerobically degradable substances

We limit the content of organic substances in chemicals that are not anaerobically degradable in order to ensure that the substances released into the environment that are not immediately anaerobically degradable are minimised. The DID uses the term anNBO=Y for substances that are anaerobically degradable.

Table 6: Factor values for non-anaerobically degradable compounds in various textile categories

Textile categories (see Appendix 1):	**F_{IAN} [g/kg]**
Work clothes, industrial/catering/butchering and kitchen whites	1.75
Work clothes, institutions/retail/service	1.25
Hotels	0.50
Restaurants	1.00
Hospitals/nursing homes	0.75
Comforters and pillows	0.50
Mats and mops	0.50
Textile hand towel rolls	0.50
Industrial wiping cloths	1.50
Dry cleaning	0.00
Other	0.50

$$G_{IAN} = \sum\left[(\text{Proportion})_i \cdot (F_{IAN})_i\right]$$

Requirement

$$A_{IAN} \leq G_{IAN}$$

G_{IAN} is the threshold value for the consumption of non-anaerobically degradable organic substances in a laundry measured in g per kg of textile delivered. The weighted average of the factor values provides the threshold value for a laundry.
$(F_{IAN})i$ is the factor value for non-anaerobically degradable organic substances g per kg of textile delivered for the stated textile category i.

The DID provides information on the anearobic degradability of a number of substances. Substances for which there are no data on anaerobically degradability are as a general rule regarded as non-anaerobically degradable. However, substances that are not surfactants and are aerobically degradable (in accordance with OECD 301A-F or the equivalent), where there are no other data on anaerobical degradability and which fulfil at least one of the following criteria are not included amongst the anaerobically degradable substances:

- *have low adsorption (A < 25%) or high desorption (D > 75%) in accordance with OECD guideline no. 106, or*
- *are not bioaccumulable (bioconcentration factor (BCF) < 100 in accordance with OECD 305 A-E or where data on BCF are not available logKow < 3 in accordance with OECD guide 107, 117 or the equivalent).*

*$Proportion_i$ is the proportion of textile category i that is delivered. If for example a laundry launders 50% restaurant textiles and 40% mats, then $Proportion_{restaurant}$ = 0.,5 and $Proportion_{mats}$ 0.5 whereas for the other categories the figure will be 0. In this example G_{IAN} = (0.5*1.00)+(0.5*0.50) = 0.75 g non-anaerobically degradable organic substances per kg of textiles delivered.*
A_{IAN} is the applied quantity of non-aerobically degradable orgic substances in the laundry in g per kg of textiles delivered.

The content of environmentally harmful non-readily degradable substances in the chemicals

As well as limiting CDV, we wish to specifically limit the use of substances that are toxic to the aquatic environment and do not degrade readily in the aquatic environment – in other words substances with risk phrases R50/53, R51/53 and R52/53. Since R50/53 substances are more unwanted than substances with e.g. R52/53 classifications, we have included a factor that takes account of this. R50/53 substances may however have a significantly higher toxicity than expressed by the factor, but this will be very rare and is unlikely to apply to the substances that are typically used by a laundry today. The limit has been set on the basis of the limit in Version 1 of the criteria based on an equal distribution between R50/53, R12/53 and R52/53. In practice this means that the requirement has been tightened up for laundries that use a high proportion of the most environmentally harmful group (R50/53), but made less stringent for those with a low proportion of this group.

Requirement:

$$100 \cdot A_{R50/53} + 10 \cdot A_{R51/53} + A_{R52/53} \leq 1.3 \text{ g/kg textiles delivered}$$

$A_{R50/53}$ is the applied quantity of substances classified as R50/53in g per kg of textiles delivered
$A_{R51/53}$ is the applied quantity of substances classified as R51/53 in g per kg of textiles delivered
$A_{R52/53}$ is the applied quantity of substances classified as R52/53 in g per kg of textiles delivered

Waste water from laundries

As well as traces of laundry chemicals, waste water also contains soils from the laundered textiles. The content of e.g. heavy metals may have a major significance for the environmental impact of the laundry (Hansen & Holst, 2002).

It will not be controllable to impose requirements as to the content of soils in the textiles washed at customers, but is possible to impose requirements as to e.g. pollution of waste water by the laundries.

Experiences from the industry (Brynjolf, 1999) shows that the highest heavy metal impact is associated with the laundering of work clothes and that the heavy metal content of waste water at laundries that wash work clothes can be reduced by 70-95% by installing a small treatment plant at the laundries which treats the water before it is released to the public sewage system.

In 2001, Sophus Berendsen had pre-treatment plants in 4 out of 20 work clothes laundries, which for the Nordic countries corresponded to 27% af Berendsen's laundering of work clothes in Denmark and 38% in Sweden (Hansen & Holst, 2002). Pre-treatment entails that after treatment the waste water is released into the public waste water treatment plant (Hansen & Holst, 2002).

An analysis of the ecotoxicity of waste water conducted at the Technical University of Denmark before and after pre-treatment with biological treatment at Berendsen's work clothes laundry in Århus revealed a reduction in toxicity to algea of 99.3% and to daphnia of 100% (Hansen & Holst, 2002). No testing on fish was conducted.

The waste water from the laundering of industrial wiping cloths can contain many different problematical substances such a dyes, heavy metals, solvents and oil (Berendsen, 199x), making it inappropriate to release the waste water into the public sewage system (Brynjolf, 1999). Accordingly closed systems, e.g. involving evaporation, may be environmentally beneficial notwithstanding higher energy consumption on waste water treatment. This will depend however on how energy consumption is weighted in relation to water pollution.

Evaporation from solvents in wiping cloths can also constitute a problem in terms of health and the environment, which can be handled in various ways. E.g. the Alba laundry in Denmark collects oil from the cloths and filters it and burns it in its boiler, enabling energy to be used in the washing process (Sørensen, Husmer & Jensen, 2001). At Berendsen, oil and chemicals are micro-filtered and sent to an approved combustion facility (Berendsen, 199x). Here again the energy is used. The atmosphere at a laundry at which industrial wiping cloths are laundered can contain solvents which represent a problem in terms of working environment and safety. This can be resolved by constant extraction and to ensure that the solvents do not reach the environment, some laundries have installed after-burners which burn off the solvents allowing the heat to be recycled (Berendsen, 199x).

In this version of the criteria we impose the requirement that laundries which launder more than 5% industrial wiping cloths must install a treatment plant and that the sludge generated in the plant must be treated by an approved receptor station. We have decided against requiring waste water treatment for other laundries in this version, but will look at the possibility of regulating emission levels in the next revision.

At the present time we do not have sufficient information to define requirements specifically for laundries that launder work clothes since there are major differences between the content of soils in various types of work clothes – just as it may vary from customer to customer. At the same time the incidents of laundries that specialise in work clothes is limited.

Points for mapping textile loss
This is a point requirement that gives 2 points. The loss of textiles is an environmental problem in the sense that additional textiles need to be manufactured. Focusing the attention of laundries on this issue is beneficial. Many laundries are probably not aware of the actual scope of the loss. Some of this loss is unavoidable, but some losses can be minimised. The ecolabelling of printing companies gave a wake-up call to many companies as regards paper loss, which also represents an economic strain. We are hoping for a corresponding effect for laundries.

Requirements applicable to laundries
Most laundries have moved away from dry cleaning textiles, although some textiles that cannot be laundered are typically sent to subcontractors for dry cleaning. This is usually a very small proportion, and accordingly limited requirements are imposed as to the dry cleaning process. In the case of laundries that send a higher proportion (>5%) of the processed textiles for dry cleaning (total of dry cleaning internally and by subcontractors) the requirements applicable to alternative dry cleaning of textiles must be met.

If the proportion is less than this, then documentation must simply be provided that the dry cleaning process is performed without the use of haloginated organic dry cleaning chemicals such as perchloroethylene.

Laundries that use Swan-labelled subcontractors for dry cleaning have further scope for scoring points.

Waste
In order to ensure that the laundries maintain a focus on sorting and minimising their waste, they must have a written plan in place for waste sorting, which as a minimum covers paper, board, plastics, textiles and environmentally harmful waste.

All national rules, including legislation and industry agreements on recycling systems for products and packaging, must be fulfilled in the Nordic countries in which the Swan-labelled service is marketed.

In order to encourage reductions in plastic packaging and to ensure that recycling takes place, the laundry must offer to take back plastic packaging from its customers and to send it for recycling.

With regard to deliveries of laundry chemicals, all products delivered in quantities in excess of 100 kg must be supplied in returnable packaging, and smaller packaging must be reusable or combustible. Plastic materials must be labelled to ensure correct handling in the recycling process and chlorinated plastics such as PVC must not be present in packaging, including in labels.

Points requirements
In addition to the above mandatory requirements we require certain other measures to be performed. For this a given number of points can be scored within a range of

optional areas. The point system has been drafted in such a way that measures that provide the greatest environmental benefit score most points.

Energy & climate

Reduced energy consumption

Lower energy consumption is a key characteristic of the most environmentally-friendly laundries and our mandatory requirements are stringent. Nevertheless, even laundries that are on the borderline can achieve additional savings, and accordingly we reward laundries with an energy consumption that is significantly below the level of our requirements.

Points are awarded to laundries with lower energy consumption than our requirements.

A_{energy} is less than 50 % of G_{energy}	10 points
A_{energy} is less than 60 % of G_{energy}	8 points
A_{energy} is less than 70 % of G_{energy}	6 points
A_{energy} is less than 80 % of G_{energy}	4 points
A_{energy} is less than 90 % of G_{energy}	2 points
A_{energy} is less than 95 % of G_{energy}	1 point

Emissions of climate gases

In combination with the quantity of energy consumed the choice of energy source can have a significant effect on the impact of the textile service on the climate. Points are therefore awarded to laundries that are able to document low emissions of climate gases.

CO_2 from energy consumption/kg $\leq G_{energy}$ · 50 g/kg	10 points
G_{energy} · 50 g/kg < CO_2 from energy consumption/kg $\leq G_{energy}$ · 100 g/kg	8 points
G_{energy} · 100 g/kg < CO_2 from energy consumption/kg $\leq G_{energy}$ · 150 g/kg	6 points
G_{energy} · 150 g/kg < CO_2 from energy consumption/kg $\leq G_{energy}$ · 200 g/kg	4 points
G_{energy} · 200 g/kg < CO_2 from energy consumption/kg $\leq G_{energy}$ · 250 g/kg	2 points
CO_2 from energy consumption/kg > G_{energy} · 250 g/kg	0 point

The above principle entails for example that a laundry that is close to our limit for energy consumption and uses oil as its primary energy source will not score points. Thus fuel oil has a theoretical emission per kWh of approximately 280g CO_2.

G_{energy} is the threshold value for consumption of energy defined above under the mandatory energy requirement.

Only by switching to a more climate-friendly fuel and/or achieving significant reductions in energy consumption can climate-related points be scored.

The score is calculated using Appendix 2.

Chemicals

Ecolabelled laundry chemicals

Laundries that use a high proportion of ecolabelled laundry chemicals (Swan, Flower or Bra Miljöval).

90 % (w/w) or higher	9 points
70 % (w/w) or higher	7 points
50 % (w/w) or higher	5 points
30 % (w/w) or higher	3 points
10 % (w/w) or higher	1 point

These proportions apply only to those chemicals on which we impose requirements, in other words all chemicals that come into contact with textiles.

Active chlorine
To further encourage a reduction in the use of chlorine we award points to laundries that have a chlorine consumption that lies considerably below our requirements.

$A_{chlorine}$ totals less than 50 % of $G_{chlorine}$	5 points
$A_{chlorine}$ totals less than 60 % of $G_{chlorine}$	4 points
$A_{chlorine}$ totals less than 70 % of $G_{chlorine}$	3 points
$A_{chlorine}$ totals less than 80 % of $G_{chlorine}$	2 points
$A_{chlorine}$ totals less than 90 % of $G_{chlorine}$	1 point

Laundries that exclusively launder textiles, where $C_{chlorine}$ is zero will automatically score 2 points in this category. This is because the laundries have no scope for achieving points here and should not be put in an unfavourable position for this reason.

Critical dilution volume CDV
Points are awarded to laundries with a significantly lower critical dilution volume than contained in our requirements.

A_{CDV} totals less than 50 % of G_{CDV}	5 points
A_{CDV} totals less than 60 % of G_{CDV}	4 points
A_{CDV} totals less than 70 % of G_{CDV}	3 points
A_{CDV} totals less than 80 % of G_{CDV}	2 points
A_{CDV} totals less than 90 % of G_{CDV}	1 point

Water
Laundries with a significantly reduced water consumption can score points on the basis of the following principle.

A_{water} totals less than 50 % of G_{water}	5 points
A_{water} totals less than 60 % of G_{water}	4 points
A_{water} totals less than 70 % of G_{water}	3 points
A_{water} totals less than 80 % of G_{water}	2 points
A_{water} totals less than 90 % of G_{water}	1 point

Distribution
Reduction of diesel particles
Diesel particles are harmful to health and are the cause of numerous deaths and hospital admissions every year (Sørensen, 2008; AMI, 2004; Sigsgaard, 2002). It is thought that the introduction of particle filters on all heavy diesel vehicles in Denmark

will reduce mortality in Denmark by 1,250 people per year (Sigsgaard, 2002). By awarding points for fitting particle filters to diesel vehicles we are encouraging reductions in emissions of particles in the traffic. Nevertheless, there are also other ways of reducing the impact of particles for which reason points are also awarded for the number of diesel vehicles that meet Euronorm 4 or 5 in terms of particles.

More than 90% of the diesel vehicles used in distribution are equipped with particle filters and/or meet Euronorms 4 or 5 for particle filters	3 points
More than 90% of the diesel vehicles used in distribution are equipped with particle filters and/or meet Euronorms 4 or 5 for particle filters	2 points
More than 90% of the diesel vehicles used in distribution are equipped with particle filters and/or meet Euronorms 4 or 5 for particle filters	1 point

At present, Euronorm 5 is the most recent emission standard for heavy diesel vehicles in the EU (EU, 1999). Euronorms 4 and 5 have the same emission limits for particles for heavy diesel vehicles – 0.02 g/kWh (Wikipedia, 2008; EU, 1999). As well as heavy diesel vehicles, other types of diesel vehicles may also be relevant in relation to this requirement, and here a minimum of Euronorm 4 must be fulfilled in order for points to be scored.

Swan-labelled fuel
Swan-labelled fuels may fulfil a number of requirements in relation to both e.g. climate and sustainability. Points are therefore awarded for the use of Swan-labelled fuels in distribution.

Swan-labelled fuels make up more than 15% of the fuel consumed in distribution	3 points
Swan-labelled fuels make up more than 10% of the fuel consumed in distribution	2 points
Swan-labelled fuels make up more than 5% of the fuel consumed in distribution	1 point

Textile purchases
Ecolabelled textiles
Points are awarded for purchases of textiles labelled with the Flower and Swan. Total purchases of ecolabelled textiles are compared with total purchases of work clothes and linen. This is because these are categories in which a reasonable proportion of ecolabelled products are available. Accordingly, in theory over 100% can be achieved in the following calculation formula.

$\frac{\text{Quantity}_{\text{ecolabelled}}}{\text{Quantity}_{\text{workclothes}} + \text{Quantity}_{\text{linen}}} > 50\ \%$	8 points
$50\% > \frac{\text{Quantity}_{\text{ecolabelled}}}{\text{Quantity}_{\text{workclothes}} + \text{Quantity}_{\text{linen}}} > 35\ \%$	6 points
$35\% > \frac{\text{Quantity}_{\text{ecolabelled}}}{\text{Quantity}_{\text{workclothes}} + \text{Quantity}_{\text{linen}}} > 20\ \%$	4 points
$20\% > \frac{\text{Quantity}_{\text{ecolabelled}}}{\text{Quantity}_{\text{workclothes}} + \text{Quantity}_{\text{linen}}} > 10\ \%$	2 points
$10\% > \frac{\text{Quantity}_{\text{ecolabelled}}}{\text{Quantity}_{\text{workclothes}} + \text{Quantity}_{\text{linen}}} > 5\ \%$	1 point

$\text{Quantity}_{\text{ecolabelled}}$ is the purchased volume (NOK or kg) of ecolabelled products (Flower or Swan Label)
$\text{Quantity}_{\text{work clothes}}$ is the purchased quantity (NOK or kg) of work clothes
$\text{Quantity}_{\text{linen}}$ is the purchased quantity (NOK or kg) of linen requiring rolling (e.g. bed linen, table linen, hand towel rolls etc.)

Statement of textile flows
A thorough overview over the various textile flows at the laundry provides a sound basis for putting in place measures that will increase the useful life of the laundry's textiles. Accordingly 2 points are awarded to businesses that are able to document their textile flows using the following principles.

As a minimum a specification must be provided of: quantity (kg) and type of textiles purchased, how much is lost from the production cycle as a result of for example loss of fibres in the laundering and drying process, loss at customers, textiles sent to waste processing firms and textile sent for recycling.

Dry cleaners
Swan-labelled dry cleaners are required to fulfil a number of strict environmental requirements and points are therefore awarded to laundries with less than 5% dry cleaning as follows:

- 1 point if >70% of dry cleaning is handled by a Swan-labelled dry cleaner
- 2 points if 100% of dry cleaning is handled by a Swan-labelled dry cleaner or if no clothing is sent out for dry cleaning

Environmental management and quality

In order to secure a reasonable level of quality and a satisfactory working environment that exceeds our chemical requirements for the laundry, laundries must as a minimum live up to the quality and working environment requirements of their industry association. In future criteria we will look at the possibility of introducing additional specific quality requirements.

The laundry must as a minimum have an environmental policy with goals for its environmental work signed by the chief executive officer. Laundries with a certified environmental managemement system such as ISO 14001 or EMAS will automatically fulfil the environmental policy requirement. An environmental policy

helps to secure a focus on environmental improvements with the backing of the management of the business.

An organisation scheme must be submitted on which the central functions are shown and which specifies who has responsibility for the Swan Label, environmental work, marketing, information, quality and purchasing. This will help ensure that one single person is responsible for m most primary areas and that Nordic Ecolabelling will know whom to contact in connection with e.g. follow-up inspections of compliance with the Swan requirements in various areas.

As is the case for all other product groups within the Swan system, planned changes that impact on the Swan requirements must be reported to and where necessary approved by Nordic Ecolabelling before the change is implemented. Unforeseen deviations in relation to the Swan requirements must always be reported to Nordic Ecolabelling.

Al employees and suppliers that in day-to-day operations have a role to play in relation to compliance with the Swan requirements must be informed of the requirements that concern them in order to ensure compliance with the requirements.

In order to safeguard compliance with the Swan requirements applicable to purchasing procedures/purchasing policy must be drafted showing that purchases of goods (e.g. textiles, distribution vehicles and chemicals) and service provision (e.g. external transport services and the leasing of vehicles) must comply with the Swan requirements.

5 Changes relative to the previous version

Since the last version we have, inter alia:

- Tightened up the energy requirements by a significant amount
- Amended our requirements to the chemicals used – including the introduction of requirements as to chemicals such as proofing agents where no requirements existed previously
- Introduced requirements as to textile distribution (training, maintenance and purchase of new vehicles)
- Introduced a point system that will encourage further improvements over and above our mandatory requirements – reduction of climate and chemical effects

6 New criteria

In future criteria, as well as updating the requirements applicable to energy, chemicals and water, we also wish to:

- Consider the possibility of imposing requirements as to treatment plants and/or the release of heavy metals and oils etc from laundries that wash heavily-soiled work clothes and the like.

- Consider whether specific quality requirements can be imposed on laundries that launder textiles for hospitals (tighter infection hygiene requirements, e.g. DS 2451-8) and requirements that reflective properties on "warning clothing" remain intact after laundering, see e.g. EN 471, as well as similar specific and relevant quality requirements.
- Increase the required number of points.
- Consider the possibility of increasing the stringency of the requirements applicable to packaging for transporting linen in.

7 Referencer

AMI (2008): **Dieselpartikler sluges og skader de indre organer.** Ny forskning fra ami 10. Arbejdsmiljøinstituttet.

Arndt, B. (2002): **Danske vaskerier i det 20. århundrede.** Foreningen af Danske Vaskerier.

Bakke, H. (2003): **Solskinn kan omdanne desinfiserende triclosan til dioksiner.** Bellona.

Berendsen (199x): **Verdens mest miljøvenlige fabrik til vask af miljøklude**. Berendsen Miljøservice A/S

Berendsen (2001): **Environmental Profile.** Sophus Berendsen A/S

Berendsen (2008): **Information på www.berendsen.no den 3. december 2008.**

Brynjolf, M. (1999): **Heavy metals in wastewater.** Sophus Berendsen A/S.

Christensen, M.J. (2008): **Personlig dialog med Michael J. Christensen fra NRV (Norsk Renseri-og vaskeriforening).**

DFD (2007): **Ren Besked – om miljø, arbejdsmiljø, kvalitet og hygiejne.** De Forenede Dampvaskerier A/S.

DieselNet (2008): **Emission Standards Europe.** http://www.dieselnet.com/standards/eu/ og underliggende sider den 18. December 2008.

Dye, C.; Schlabach, M.; Green, J.;Remberger, M.; Palm-Cousins, A. & Brorström-Lundén (2007): **Bronopol, Recorcinol, m-Cresol and Triclosan in the Nordic Environment.** TemaNord 2007:585 Nordisk Ministerråd.

Ecodriven (2006): **What is ecodriving?** Ecodrive.org. http://www.ecodrive.org/What-is-ecodriving.228.0.html

Energistyrelsen (2008): **Energistatistik 2007.** Energistyrelsen.

ErhvervsBladet Research & Analyse (2006): **Brancheanalyse af vaskerier.** På internettet: http://www.erhvervsbladet.dk/assets/pdf/EB47745987.PDF

EU (1999): **Europa-Parlamentets og Rådets direktiv 1999/96/EF af 13. december 1999 om indbyrdes tilnærmelse af medlemsstaternes lovgivninger om foranstaltninger mod emission af forurenende luftarter og partikler fra motorer med kompressionstænding til fremdrift af køretøjer og emission af forurenende luftarter fra køretøjsmotorer med styret tænding, som benytter naturgas eller autogas (LPG) som brændstof, og om ændring af Rådets direktiv 88/77/EØF.** Europæiske Unions Tidende.

EU (2006): **EUROPA-PARLAMENTETS OG RÅDETS DIREKTIV 2006/32/EF af 5. april 2006 om energieffektivitet i slutanvendelserne og om energitjenester samt om ophævelse af Rådets direktiv 93/76/EØF.** Europæiske Unions Tidende.

EU (2008): **COMMISSION DIRECTIVE 2008/58/EC of 21 August 2008 amending, for the purpose of its adaptation to technical progress, for the 30th time, Council Directive 67/548/EEC on the approximation of the laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances.** Europæiske Unions Tidende.

Forenede Nationer (2008): **About the Global Compact – The ten principles**. United Nations. http://www.unglobalcompact.org/AboutTheGC/TheTenPrinciples/index.html

Frydendal, J. (1998): **Life Cycle Comparison of Table Linen.** Sophus Berendsen

Frydendal, J; Schmidt, A. & Zeuthen, J. (2000): **Towel rolls in a life cycle perspective.** Sophus Berendsen A/S & dk-TEKNIK ENERGY & ENVIRONMENT.

Frydendal, J. (2001): **Life Cycle Assessment – Berendsen Care Bed Pads (1st ed.).** Sophus Berendsen

Frederiksen, R. H. (2004): **Livscyklusvurdering på dækketøj.** dk-TEKNIK ENERGI & MILJØ & Foreningen af Danske Vaskerier

Glensvig, D.; Buck, C.; Abildgaard, A. og Stuer-Lauridsen, F. (2005): **Eksponering af kemiske stoffer i imprægneringsmidler.** Miljøstyrelsen.

Green, T. (2000): **Tvätt- och Textilservice för bättre miljö – Del 1 och 2.** Berendsen Textil Service AB.

Grüttner (2008): **Environmental Assessment of Laundry Detergents.** European Textile Services Association. On the internet: http://www.eco-forum.dk/detergents/

Hansen et al. (1998): **Renere teknologier i vaskeribranchen – Hovedrapport.** Energistyrelsen

Hansen, M. S. & Holst, J. K. (2002): **Life Cycle Assessment – Berendsen Profile Workwear – Focus on chemicals (1st ed.).** Sophus Berendsen

Helle, R. (2008): **Personlig dialog med Riita Helle fra Lindström Oy.**

Jensen, A.A., Poulsen P.B. og Bossi, R. (2006): **Kemi, anvendelse, forekomst og effekter af perfluoralkylsyrer (PFOS, PFOA etc.) – en ny type miljøgifte.** I Miljø og Sundhed, nr. 30 april 2006. Indenrigs- og Sundhedsministeriets Miljømedicinske Forskningscenter.

Kalliala, E. (1997): **The Ecology of Textiles and Textile Services – A Life Cycle Assessment Study on Best Available Applications and Technologies for Hotel Textile Production and Services.** Tampere University of Technology.

Kronborg, M. (2006): **Erhvervsvaskerier tromler derudaf.** Erhvervsbladet.

Köcher, C. (2008): **Personlig dialog med Christian Köcher fra Ecolab Aps.**

Lindström (2008): **Sustainability Report 2007.** Lindström Oy.

Miljøstatus i Norge (2008A): **Prioritetslisten.**
http://www.miljostatus.no/Tema/Kjemikalier/Kjemikalielister/Prioritetslisten/ 3.december 2008.

Miljøstatus i Norge (2008B):**Hormonforstyrrende Stoffer.**
http://www.miljostatus.no/Tema/Kjemikalier/Noen-farlige-kjemikalier/Hormonforstyrrende-stoffer/#D den 3. december 2008.

Miljøstyrelsen (2004): **Listen over uønskede stoffer 2004.** Orientering fra Miljøstyrelsen nr. 8, 2004.

Miljøvejledninger (2008): **Halogenerede organiske forbindelser.** http://www.miljoevejledninger.dk/index.aspx?articleid=+787+787 den 3. december 2008.

Nordisk Miljømærkning (2007): **Om Svanmärkta Pellets - Version 2.0 - Bakgrund för miljömärkning.** Nordisk Miljømærkning.

Nordisk Miljømærkning (2008): **Baggrund for miljømærkning af kemiske byggeprodukter.** Nordisk Miljømærkning.

NorTekstil (2008): **Information på www.nortekstil.no den 3. december 2008.**

NRV (2008): **Information på www.nrv.no den 3. december 2008.**

Nyqvist-Kuusola, L. (2001): **Baggrundsdokument för Miljömärkning av Vattentvätterier.** Nordisk Miljømærkning.

Petersen, P.M. & Mou, C. (1998): **Kortlægning af energi- og vandforbrug.** COWI

Räsänen, L. (2008): **Personlig dialog med Lassi Räsänen fra Tekstiilihuoltoliitto ry.**

Schmidt, A. (2000): **Life cycle assessment of towel rolls (3rd ed.).** dk-TEKNIK ENERGY & ENVIRONMENT

Sigsgaard, T.I. (2002): **Partikler og dødelighed.** Ugeskrift for Læger 2002;164(34):3935

Statistisk Sentralbyrå (2008): **Information på www.ssb.no/tjenester/ den 3. december 2008.**

Søgaard-Pedersen, S. (2004): **Vaskeridrift.** Foreningen af Danske Vaskerier.

Sørensen, B.K. (2008): **Partikler er det nye bly.** Ingeniøren fredag den 27. juni 2008 http://ing.dk/artikel/89352

TekstilPartnerNor (2008): **Information på www.tekstilpartnernor.no den 3. december 2008.**

Wikipedia (2008): **European emission standards.** http://en.wikipedia.org/wiki/European_emission_standards 24/11-2008

Appendix 1 – Definition of textile categories
Textile categories

1	Work clothes industrial/kitchen/ butchering and equivalent use. Kitchen textiles (cloths and towels)	Clothing, such as work clothes for mechanical industrial work, the foodstuffs industry, the medical industry and the like, as well as clothing for butchers, cooks and the like. Kitchen cloths, floor cloths, cooks whites, kitchen towels and the like for restaurants and institutional kitchens etc. These textiles are often characterised by their heavy degree of soiling and may be difficult to clean.
2	Work clothes, institutions/retail/service	Clothing for use in service industries, retail outlets, hotels, hospitals, nursing homes and other institutions. This will usually be work clothes with a somewhat smaller degree of soiling than in the previous category.
3	Hotels	Bed clothes and towelling from hotels and other overnight accommodation. Often this will involve lightly soiled textiles since they will often have been in limited use before being sent off for laundering.
4	Restaurants	Tablecloths, napkins and the like for use in restaurants, industrial kitchens etc. This will often be textiles with a medium degree of soiling. Although the stains in question may frequently require relaundering.
5	Hospitals/nursing homes	Textiles from hospitals and nursing homes and similar institutions including bedclothes, contour sheets, surgical scrubs, barrier sheets and patient clothing, but excluding the work wear of personnel and the category “comforters and pillows”. Although there will be a wider degree of variation in soiling, on average it can be viewed as of medium intensity.
6	Comforters and pillows	Comforters, pillows, sleeping bags and mattress toppers from for example hospitals, nursing homes, hotels, summer houses, ski lodges and the like. The volume per kilo of these textiles will often be high, which makes for a lower degree of filling. Moreover, it is difficult to remove water from these textiles before drying, which in turn means that the tumble drying process consumes more energy.
7	Mats and mops	Mats for entrance ways and the like for capturing dirt, as well as mops for cleaning. Often heavily soiled, but do not need to be completely clean. Frequently treated after laundering in order to secure enhanced soil retention properties.

8	Textile hand towel rolls	Cotton cloth hand towel rolls for hand drying in toilets and the like.
9	Industrial wiping cloths	Textile cloths for drying in for example the graphic and mechanical industries. Will often be heavily polluted cloths containing traces of printers ink, oils, metal filings etc.
10	Dry cleaning	All textiles that are dry-cleaned internally and/or externally including private clothing. These will typically be delicate textiles not capable of withstanding washing.
11	Other	Textiles that are not encompassed by the above categories and that generally make up a small proportion of the textiles laundered by the laundries.

Appendix 2 – Energy and CO_2 factors

Fuel	Energy factor	Unit	CO2 factor	Unit
Natural gas *	**11.00**	**kWh/m_3-N**	**2248**	**g/m_3-N**
Fuel oil *	**11.29**	**kWh/kg**	**3171**	**g/kg**
LPG*	**12.78**	**kWh/kg**	**2990**	**g/kg**
Petroleum coke*	**8.72**	**kWh/kg**	**2889**	**g/kg**
Coke*	**8.14**	**kWh/kg**	**3164**	**g/kg**
Brown coal briquettes *	**5.08**	**kWh/kg**	**1731**	**g/kg**
Straw*	**4.03**	**kWh/kg**	**0**	**g/kg**
Pellets (wooden pellets)*	**4.86**	**kWh/kg**	**0**	**g/kg**
Wood offcuts*	**4.08**	**kWh/kg**	**0**	**g/kg**
Wood chipping*	**0.78**	**kWh/m^3**	**0**	**g/m^3**
Biogas*	**6.39**	**kWh/m^3**	**0**	**g/m^3**
Electricity			**385**	**g/kWh$_{levert}$**

* If more specific data are available from the fuel supplier, data from the supplier may be utilised instead.
Source: Danish Energy Agency (2008).
** 385g/kWh is applied for electricity irrespective of source – cf. the principles described in Nordic Ecolabelling, 2007.

Example
A laundry that only washes hospital textiles (G_{energy} = 2.75 kWh per kg of textiles) and with an average energy consumption per kg of textiles of 0.15 kWh electricity and 0.20 kg fuel oil can calculate the following:

$$A_{eneryi} = 2.5 \frac{\text{kWh}}{\text{kWh}_{\text{delivered}}} \cdot 0.15 \frac{\text{kWh}_{\text{delivered}}}{\text{kg}} + 0.20 \frac{\text{kg}_{\text{fueloil}}}{\text{kg}} \cdot 11.29 \frac{\text{kWh}}{\text{kg}_{\text{fueloil}}} = 2.633 \frac{kWh}{kg}$$

, which entails that the laundry fulfils the Swan Label's mandatory requirements for energy, since: $2.633 \frac{kWh}{kg} = A_{eneryi} \leq \text{G}_{\text{energy}} = 2.75 \frac{kWh}{kg}$.

A_{energy} *makes up approximately 96% of* G_{energy}, which means that the laundry will not score points for lower energy consumption since points are only awarded if energy consumption is less than 95% of the threshold value for energy.

In order to determine whether the laundry can score points for reduced emissions of climate gases, the CO_2 *generated by energy consumption per kg of textiles can be calculated as follows:*

$$CO_2 \text{ from energy consumption} = 0.15 \frac{\text{kWh}_{\text{delivered}}}{\text{kg}} \cdot 385 \frac{\text{g}}{\text{kWh}_{\text{delivered}}} + 0.20 \frac{\text{kg}_{\text{fueloil}}}{\text{kg}} \cdot 3171 \frac{g}{kg_{f\,uelolie}} = 2.633 \frac{kWh}{kg} = 692 \frac{g}{kg}$$

In order to score points for further reductions in CO_2, CO_2 *from energy consumption/kg* $\leq G_{energy} \cdot 250$ *g/kg*
Since $G_{energy.} \cdot 250$ *g/kg is equal to 687.5 g/kg the laundry in the example will score no points for further reductions in climate effects.*

Nordic Ecolabelling has developed a spreadsheet for use in calculating both compliance with mandatory requirements and in relation to the number of points scored. This will be published together with the final criteria document.