About Swan-labelled

Pellets

Version 2.0

Background for eco-labelling

Date 20-06-2007

Nordic Eco-labelling

Appendices

1 Summary

Swan labelling can be used for pellets manufactured from biofuel. One primary reason for recommending that biofuel be used is that the carbon dioxide generated by combustion can be offset by the carbon dioxide absorbed by the tree during its growth process. One successful argument for persuading the customer is that they will have a fuel that is easy to use and the user and environment will not be exposed to health hazards.

One important parameter to consider is that the **energy consumption for production** of pellets is in reasonable proportion to the energy density and the ultimate system efficiency. We feel that it is justified to set limits for energy consumption in the production of pellets. As a first step, we suggest a limit of 12,000 kWh per ton of pellets.

Similarly, **emissions of carbon dioxide from the production process** must be of a limited scope, so that from a system perspective it does not actually have any impact on the climate. Biofuel is used to a great extent for drying pellets and the choice of fuel does not have such a far-reaching impact from a system perspective, but a limit value of 100 kg CO_{2eq}/ton pellets for drying is proposed, in order to move towards production without fossil fuels.

Another important environmental aspect is that the grade of the pellets must be such that they can withstand the handling required prior to combustion. Good-quality pellets mean low emissions of health-endangering particles. The **quality specification** agreed on in the first version of the criteria is working and we see no reason to propose any change, except for the fact that a limit value for nitrogen content is compulsory. A limit value of this nature will help to restrict nitrogen emissions.

Demand for raw material has increased and the price is approaching the same level as the price for pulpwood, which indicates the possibility of timber being considered as a raw material. In such circumstances it is essential to consider whether requirements for **certified wood** are relevant to introduce into the criteria. The criteria proposal includes a requirement of this type.

2 Basic data about the criteria

2.1 Products that can be labelled

Raw material for pellets for Swan labelling must, in principle, be pure wood. The criteria include requirements for production, transport and storage. The aim is to single out optimal quality from a combustion perspective.

Pellets intended primarily for private use in small to medium-sized systems can be Swan-labelled. Such boilers and stoves are often used in densely-populated areas. In order to ensure that the emissions have as little impact as possible on the environment and health, combustion must be optimal. This means that the pellets must be of a lasting and uniform grade and be suitable for the burner in terms of size. The physical properties such as density, size and moisture content should vary as little as possible, and the customer will generally use the same grade of pellets.

This first revision also introduces a more in-depth review of energy requirements for production. This has resulted in a limit value for production of pellets being proposed.

2.2 Motive for Swan labelling

One general reason for promoting biofuel for heating is to reduce the contribution to the greenhouse effect. However, this must be as efficient as possible in order to avoid suboptimisation.

For market forces to steer customers towards use of renewable fuels, customers must feel that **the fuel is easy to use.** A stable grade without a tendency to absorb moisture or create a lot of dust is a prerequisite.

Combustion of biofuel generates flue gas emissions with a higher particle content than other methods of heating. Particle emissions have various different types of health effects, and reduced content is essential, particularly in densely-populated areas. This is achieved primarily by Swan-labelling and marketing boilers and stoves employing good technology. The Swan labelling system has several licences within these product groups. But one requirement is that such burners be fired using a **stable-grade** fuel, to ensure favourable combustion.

Biofuel can take the form of wood used in local boilers and stoves, or chips used in district heating plants. In light of this, one might question whether it is reasonable to eco-label a biofuel that requires energy in the production stage and also contributes to local particle emissions to a greater extent than use of heat pumps or boilers for liquid or gaseous fuel would, for example. The role of eco-labelling is not to single out specific technology or fuels for the customer, but to highlight a means of heating that yields a lower environmental impact than other more conventional means, regardless of technology or fuel. To ensure that this is the case, however, it must employ an **efficient** method and have a reduced impact on health. This results in limited energy consumption for production and the grade of the pellets being such that combustion is optimal.

If demand for pellets leads to a move from waste shavings being used as raw material to timber beginning to be used, it will be necessary to reconsider the need to introduce **requirements for wood selection**.

2.3 Version and validity of the criteria

The criteria were initially established on 10 June 2005 and are applicable up to 10 June 2007. At the secretariat management meeting on 16 November 2005, a change to energy requirements, version 1.1, was decided on. The secretariat management meeting on 3 May 2006 decided to extend the period of validity of the criteria by 6 months, up to 31 December 2007, version 1.2. On 8 December 2006, it was decided to extend the criteria up to 31 December 2008, version 1.3.

2.4 The Nordic market

One licence has been granted: Norwegian manufacturer Norsk Pellets Vestmarka, which sells on the Norwegian, Swedish and Danish markets. The manufacturer is very pleased and is experiencing a significant increase in sales thanks to the Swan labelling. The manufacturer is planning to continue with the Swan labelling. Dealers are extremely interested and have been in contact and would like help with marketing material in Sweden. Sales of pellets in the Nordic region have increased and there is currently a shortage of wood shavings.

Denmark: Figures from Force in thousands of tons. Figures for 2006 are provisional.

Table 1: Statistics for Denmark

(tons, thousands)	2004	2005	2006
Pellet production	187.5	200	200 ?
Import	540	630	670 ?
Export	0	0	0

Sizable volumes of pellets are used for district heating production in Denmark. Approximately 310,000 tons are used in small households.

Finland: Figures from Pelletscentre in thousands of tons and Vapo.

Table 2: Statistics for Finland

(tons, thousands)	2004		2006
Pellet production	190		350
Import			
Export	250		250
consumption	41		100
stocks	61		

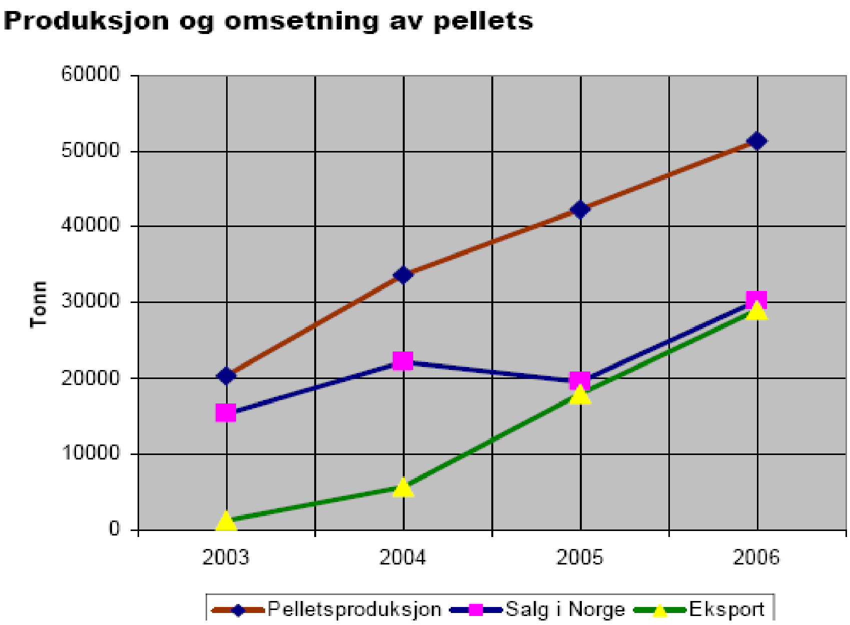
Use of pellets in Finland is sparse, but is increasing.

Norway: Figures from the Norwegian trade association for pellets.

Table 3: Statistics for Norway

(tons, thousands)	2004	2005	2006
Pellet production	34	42	51
Import	0.2	0.2	0
Export	6	18	29
consumption	22	19	30
stocks	7	12	4

Diagram 1: Production in Norway



Sweden: Figures from SveBio

Table 4: Statistics for Sweden

(tons, thousands)	2004	2005	2006
Pellet production	915	1,287	1,458
Import	341	330	356
Export	20	144	129
Consumption, total	1,237	1,473	1,679
Consumption, houses	345	458	609

The reason that we do not have more licences is believed to be due to the fact that the price of pellets is not yet high enough to bear the costs of Swan labelling, according to the information we have received. Several manufacturers have recently invested. We also understand that there are manufacturers who are selling the finer-quality pellets to Germany and Austria, which have higher quality requirements than stipulated by the Nordic countries and the European standard.

2.5 Other labelling

SP had launched a project to develop criteria for pellets. This project is not yet completed. The aim of the project has been primarily to include a quality specification.

In Germany and Austria, which have stringent requirements for low particle emissions, quality requirements similar to the Swan have been introduced.

3 About the revision

3.1 Objectives of the revision

3.1.1 Convenience for the customer

In order to promote greater use of biofuels, it is necessary for handling to be perceived as convenient for the user.
The benefit of using pellets instead of wood is that heating is possible even if the user is not able to actively supply fuel every day.

The quality requirements set by the criteria in the first version were intended to make this possible. This will be evaluated in this revision.

3.1.2 Health and environmental effects with local and regional impact

Local combustion of biofuel is less efficient and leads to greater particle emissions than other heating. Reduced carbon dioxide emissions can be achieved if heat production takes place instead in greater volumes or even better combined power and heating plants. However, it is not the role of eco-labelling to indicate which technology or which fuel should be used for heating. The essential aspect is to indicate what level of environmental impact is acceptable within the eco-labelling system and what the objective is, and to gradually steer manufacturers who view environmental thinking as a good tool for marketing towards achieving these goals.

Use of pellets gives slightly more efficient combustion depending on boiler and fuel. Nitrogen oxide emissions should be checked and the impact on particle emissions and hydrocarbons.

Pellet quality has an effect on the combustion situation in the long term. Any deposits or sintering in the burner affect the capability for good combustion.

3.1.3 Energy consumption and contribution to the greenhouse effect from production

An evaluation of energy consumption in production was simplified in the first version so that it only covered energy raw materials for drying. The requirements include quality assurance of energy use that only covers drying, and, moreover, fuel used and consumption of electricity for pelleting.

Oil may be used to start up the boilers, peat may be used for up to 35%; as for the rest, only biofuel may be used for the dryers.

The question of the possibility of using peat led to discussion before a decision was made. Several factories in Finland, and also Sweden, use peat for the actual drying process, despite peat’s substantial contribution to the greenhouse effect. Gas is also used in the drying process. However, use of gas is not accepted in the criteria. Whether peat can be classified as renewable or not is much debated, particularly in Sweden and Finland. Consequently, requirements were not formulated relative to the actual contribution to the greenhouse effect, but according to fuel type, with gas being regarded as negative and peat, to a certain extent, acceptable.

This revision included a system review. An evaluation was carried out based on the actual contribution to the greenhouse effect and system efficiency. A limit value was proposed for total energy use for production and for contribution to the greenhouse effect from drying.

There are various production processes and it is necessary to look at complete energy consumption for the production process. Evaluation of system efficiency was undertaken with examples from various production processes.
It is necessary to introduce a limit value for energy consumption in production of pellets. Compared with wood burning, system efficiency decreases when using pellets. Consequently, there is reason to challenge such extra energy use and to ensure that it is not greater than necessary.

Contribution to the greenhouse effect and energy use for production of pellets was a very important issue in the evaluation. It was also important in the revision. One central issue is perhaps whether it is acceptable to increase energy use in production of pellets in order to encourage increased use of biofuels and to reduce health hazards from heating using biofuel.

3.1.4 Requirements for certified wood

When developing the criteria, the expert group proposed setting requirements for forest stewardship in the form of requirements for **certified wood**. As a basis for the submission it was proposed that 20% of the raw material should be certified wood. Following further discussions, however, we found that this requirement would not produce any environmental gains so long as the raw material comprised wood shavings as a by-product from sawmills, etc. If, however, the raw material were to be newly-felled wood, it would be possible to effect environmental gains by setting requirements for certified wood, apart from that felled by storms. When establishing the criteria, it was ascertained, through information from manufacturers, that all raw material comprised by-products, and there was therefore no reason to include requirements for certified wood in the first edition of the criteria. However, such requirements would become reasonable at any time new timber begins to be used for pellet production.

The objective therefore is to investigate whether the market is beginning to use new timber for production of pellets and, if so, what proportion of certified wood would be appropriate.

3.2 About this revision

Revision of the criteria has been planned as an internal project with Marianne Pettersson as project manager and Karin Bergbom as area coordinator. Additional project participants are Harri Hotulainen, Finland, Randi Rödseth, Norway and Thomas Christensen, Denmark. The following persons have been consulted during the revision.

Table 5: External reference group

company		person	tel. no.	e-mail

Vestmarka	No	Hans Geritsen	+47 62 83 28 90	hans@norskpellets.no
Analysen AB	Sv	Lars Rosengren	+46 510 88 700	lars.rosengren@analysen.se
SP	Sv	Henrik Persson		
Swedish Energy Agency	Sv	Anders Odell		
VAPO	Fi	Jaakko Lehtovaara		jaakko.lehtovaara@vapo.fi
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4 Justification of requirements

4.1 Convenience for the customer

Storage and handling must be straightforward. Swan labelling therefore also includes advice on how to construct storage facilities and requirements for the manufacturer that deliveries be made in a way that ensures no crumbling of pellets. Similarly, the pellets must be sufficiently robust to withstand handling through to the burner without crumbling. Pellets with a high energy density and low moisture content are smaller in volume. Pellets must also endure storage without being prone to absorbing moisture. Similarly, the ash content must be low to reduce the need for servicing.

A follow-up in the Nordic countries where the Swan-labelled pellets are sold showed that dealers and customers have been very satisfied. In large urban areas in particular, they have been very willing to pay a slightly higher price. Once a customer has begun purchasing the Swan-labelled pellets, they have continued to do so because they see that the quality is uniform and the ash content is low and also that the pellets yield a higher level of efficiency.

The European standard was also established in connection with the Swan criteria being determined. In the final stage, an additional parameter was added to the standard, and this concerned the proportion of fines content. There are two categories, F1 and F2, which represent a limit of ≤ 1% and ≤ 2%. See the established standard for pellets in Europe. Please note that the standard does not include specification requirements, but is shown as an example of good pellet quality in Appendix 1.

Table 6: European standard for pellets TS14 961, Appendix 1: wood pellets

A.2 Wood pellets (selected from Table 5)

Origin:	1.2.1.1 Chemically untreated wood without bark
Moisture content:	M10
Mechanical durability:	DU97.5
Amount of fines:	F1.0 or F2.0
Dimensions:	D06 or D08
Ash content:	A0.7
Sulphur content:	S0.05
Additives:	< 2 w-% of dry basis. Only products from the primarily agricultural and forest biomass that are not chemically modified are approved to be added as a pressing aids. Type and amount of additive has to be stated.
Energy density:	E4.7 [kWh/kg] ($q_{p,net,ar}$ ≥ 4,7 kWh/kg = 16,9 MJ/kg)

The Swan specification states a limit value of 2% for fines content.

Naturally, the Swan requirements are stricter than the European standard. The Swan specification currently comprises several parameters, but stated limit values do not deviate much. Nordic Eco-labelling suspects that many pellet grades have difficulty fulfilling the requirements of the European standard and therefore sees no reason to further tighten up on the parameters included in the standard.

Conclusion:
Nordic Eco-labelling judges that the objective of convenience for the customer has been achieved with fulfilment of the requirements set in version 1 of the criteria.

4.2 Health effects

The first step towards reduced particle emissions is Swan labelling of boilers and stoves, and also offering customers good-quality pellets. Uniform and consistent quality allows precise adjustments to combustion conditions, leading to reduced emissions.

One parameter that has a direct bearing on the emissions is the nitrogen content in the fuel, which relates to the nitrogen oxide emissions in the flue gases. It is important to limit the emissions of nitrogen oxide. The current criteria only require the nitrogen content to be analysed if the raw material consists of waste products from wood processing involving use of adhesive. Tightening up of the criteria would involve introducing requirements for compulsory analysis of nitrogen in all cases.

Conclusion:
Nordic Eco-labelling judges the quality requirements in version 1 of the criteria to be adequate to facilitate good combustion with the lowest possible emissions, based on what can be influenced by quality requirements. However, compulsory checking of nitrogen in the pellets is recommended.

4.3 Energy requirements for production of pellets

4.3.1 The production process

An evaluation of energy consumption in production was simplified in the first version so that it only covered energy raw materials for drying. The requirements include quality assurance of energy use that only covers drying, and, moreover, fuel used and consumption of electricity for pelleting.

Oil may be used to start up the boilers, peat may be used for up to 35%; as for the rest, only biofuel may be used for the dryers. If excess heat could be utilised, there would be potential for allocation.

All stages should be included in a system review. The complete process comprises the following stages:

process stage	energy
barking	electricity
chipping	electricity
drying	fuel
grinding	electricity
boiling	fuel
compressing	electricity

cooling	electricity
sifting and packaging	

It is necessary to include two additional stages in the review for when new timber begins to be purchased for production of pellets. These stages are debarking and chipping. In addition to the actual process stages, energy is required for property maintenance and transport.

4.3.2 Estimate of energy consumption

The information for setting limit values for the production process was limited when the first edition of the criteria was being developed. The information has improved slightly, but is still limited. Consequently, there is reason to be fairly cautious when setting limit values.

Energy consumption is an important parameter in the production process. Energy is required for the dryers, which are generally fired using wood shavings, and for mills and presses, which are powered by electricity.
Use of waste products, which are dryer than new raw material, eliminates the need for drying the raw material. However, energy may be required to produce steam to moisten the shavings, and the presses may also require more energy. Since the demand for wood shavings exceeds the supply, use of timber as a raw material will probably be instituted. Additional energy will then be required for barking and chipping the timber.

It is essential to assess energy consumption and relate it to the energy content and efficiency of ultimate production of heat. The assessment below does not include energy consumption for transport.

Energy raw material: Dryers in Sweden generally use wood shavings or powder, though some manufacturers use oil. Peat is used in both Sweden and Finland. The Baltic countries use gas, as does Russia. There are plans to use gas in Finland. Some manufacturers use oil to start up the dryers, others use wood shavings.

Electricity is used for most processes. The assessment of electricity production here has been calculated using a common European view with an electricity factor of 2.5 and a greenhouse effect contribution of 385 g/kWh electricity.

Moisture content in raw materials: The energy required by the dryers depends on the moisture content of the raw materials. This may vary from 8% for dry shavings to over 60% for new wood shavings. The energy requirement increases if the raw material consists of moist shavings. In Denmark, dry raw material is generally used. The heat from the actual pelleting process is then usually adequate for drying the shavings.

In addition, the criteria have a more stringent requirement with regard to moisture content in pellets than the standard. The requirement sets a limit of max. 9% moisture content in the finished pellets. The reason is that dry pellets offer better durability and stand up to transport better, thus providing better potential for good combustion and lower resultant emissions.

Energy consumption: In order to estimate the energy consumption from production, we have obtained information from various sources.

Table 6: Manufacturers of pellets with dry pellet raw material. (Ref. Basis for eco-labelling of pellets, ÅF-Process AB, Stockholm, January 2005

Manufacturer	fuel type	drying kWh/tons	electricity for presses kWh/tons
B1	wood powder	700	105
B2		-	80
B3		-	80
C2		-	90
C3		-	90
F1			90
		-	(80x2.5)---(100x2.5) ***200-250 kWh/ton pellets***

The manufacturers who use shavings with 8-12% moisture content use between 0 and 700 kWh per ton of pellets for drying. However, B1 must be an exception, or represent incorrect information.

Electricity consumption for the presses is between 75 and 110 kWh per ton of pellets. This is equivalent, with an electricity factor of 2.5, to energy consumption of **200 to 250 kWh per ton of pellets.** These figures may be representative of the processes of pressing, cooling and sifting.

However, it is difficult to limit the scope so that Swan-labelled pellets only include pellets from already dry raw material. Demand for wood shavings is so great that waste products from furniture industries are insufficient. It is likely that pellets will soon begin to be produced from newly-felled trees.

A thesis from the Swedish University of Agricultural Sciences. The various estimates of energy consumption are summarised below:

Table 7: Energy consumption in production (Ref. International comparison of production costs for pelleting, Mårten Zakrisson, 2002)

process stage	form of energy	primary energy kWh/ton
drying	fuel	520
grinding	electricity	21 x 2.5 = 53
compressing	electricity	56 x 2.5 = 140
cooling	electricity	4.3 x 2.5 = 11
sifting, packaging, etc.	electricity	8.5 x 2.5 = 21
Total (kWh energy/ton pellets)		*(745) 7**50***

The economic study of production of pellets estimates energy consumption in total to amount to 750 kWh per ton of pellets, which tallies with energy consumption from other references. The total for grinding, compressing, cooling and sifting in this study is 225 kWh per ton, which also tallies with the consumption in production using dry wood shavings, which is 200 to 300 kWh in the reference above.

When producing pellets from fresh wood shavings, the moisture content can be up to 60% and this is dried to around 10-12% before compressing. In some cases, the shavings are dried to 8% moisture content.

Table 7: Manufacturers using raw wood ((Ref. includes "Underlag för miljömärkning av pellets, ÅF-Process AB, Sth januari 2005" (Basis for eco-labelling of pellets, ÅF Process AB, Sth January 2005) A-F; Swan inquiries x)

Production	**Fuel type for drying**	**drying** kWh/ton	**electricity for presses** kWh electricity/ton	**Drying+press** kWh energy/ton
A*[1]	waste wood, peat	540	200	1,040
C1*[1]	wood powder (50%), E01(50%)	700	80-100	900-950
D*[1]	sawdust	1,000	140	1,350
E*[1]	wood powder	600	200	1,100
F2*[1]	bark, chips, shavings	600	100-110	860-870
	kWh primary	*550-1,000*	*250-400*	*900- 1400*
X1*[2]	Various fuels	950	230	1,520
X2*[2]	"	940	230	1,510
X3*[2]	Fuel and electricity	(235)	(470)	1,420
	kWh primary	*900-1,000*	*250*	*1400-1550*
total	***(kWh/ton pellets)***	***550 – 1,000***	(100x2.5)-(250x2.5) ***250-600***	***900-1,500***

*EO1 is a grade of light oil sold in Sweden.
*[1] These values represent energy use for drying and compressing.
*[2] These values represent probable total energy use at the factory.

Drying raw wood with a moisture content of just over 50% requires between 550 and 1,000 kWh of energy. Electricity consumption for the presses is between 80 and 200 kWh, which means 250 to 600 kWh energy with an electricity factor of 2.5. It is worth considering whether it requires less energy to compress drier shavings than to dry drier shavings. The figures indicate this.

Table 8: Generalisations about energy consumption for production of pellets

Process stage	form of energy	Primary energy (kWh/ton pellets)				
reference		SLU	ÅF + Swan	generalisation		
				I	II	III
(barking)	electricity			100	50	50
(chipping)	electricity					
drying	fuel	520	550-1,000	800	750	600
grinding	electricity	50				
(boiling)	fuel					
compressing	electricity	60	200-250 250-600	600	350	200
cooling	electricity	50		100	50	50
Sifting, packaging, etc.	electricity					
Total excluding property maintenance and transport				1,600	1,200	900

I: energy guzzlers at present; II: first limit value for the Swan system; III: target for 6 years' time

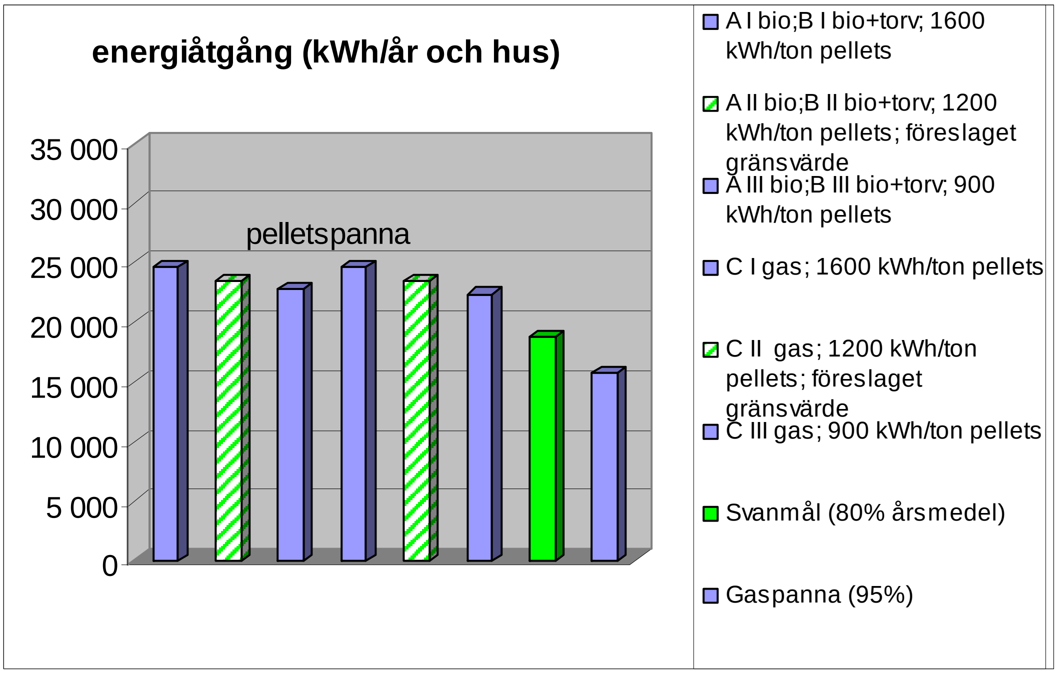
If generalising, an energy consumption total of 1,600 kWh per ton of pellets can be totalled at present. However, we do not have a reliable conception of how many manufacturers can manage a requirement of 1,200 kWh per ton of pellets. Should a limit value be set based on the data we have, it would be reasonable to propose 1,200 kWh of supplied energy per ton of pellets, which is equivalent to 24% of the energy density. In the long term, a reasonable target to aim for would be energy consumption of 900 kWh per ton of pellets. However, good quality and low emissions must always be balanced against any very tight restriction on energy use. Energy rationalisation is still necessary, particularly if new wood begins to be used. If so, energy would be required for drying out more moisture, and also for debarking and chipping. The raw wood would need to dry by itself more than at present before the actual production process commenced. The question then is whether a restriction of this kind is relevant for production of pellets and what level of system efficiency this would actually yield for final heat production. Let's take a look at this through a general evaluation of complete system efficiency.

Table 9: System limit value for heating using pellets with varying energy consumption in production. (The calculations can be found in the appendix.)

PRODUCTION OF PELLETS	HEATING WITH BOILER
Energy consumption (production)	Energy consumption (system efficiency)
Biofuel in drying furnace	
I: 1,600 kWh	61%
II: 1,200 kWh	62%
III: 900 kWh	64%
65% bio+35% peat in drying furnace	
I:	61%
II:	62%
III:	64%
100% natural gas in drying furnace	
I	62%
II	63%
III	64%

The finished pellets are burned in a pellet boiler with an average annual efficiency level of 75%. It is not a Swan-labelled pellet boiler but a medium-quality boiler new on the market that is fired without an accumulator tank, but is relatively efficient. It is compared with a gas boiler that is not Swan-labelled, but yields a good level of efficiency. In addition, a comparison is undertaken with an average annual efficiency level limit of 80%, which in several background documents has been formulated as a target for Swan labelling for heating. The building is assumed to have a heat requirement of 15,000 kWh per year.

Diagram 2: The scope of the effect of the production energy from a system perspective when heating using pellets. The heat requirement is assumed to be 15,000 kWh useable heat.



The first six columns represent energy consumption when heating using a pellet boiler. The variations are due to how the pellets have been manufactured. The first three columns solely used biofuel or biofuel in combination with peat for drying the shavings. With the next three columns, gas has been used for drying the shavings. The green column presents a target within the Swan system for an average annual value. In order to meet this kind of target, the boilers must be more efficient or equipped with solar collectors, and energy saving must be implemented in production of the pellets.

We see that heating using pellets employing any of the production options and fired in a normal pellet burner does not meet the Swan system target for efficiency of heating.

If, however, we produce pellets with a total energy consumption of 850 kWh per ton of pellets and fire these pellets in a boiler with an average annual efficiency level of 90%, we can meet the Swan system's target.

We assume that 200,000 houses in the Nordic region use pellet boilers (annual average efficiency level 75%) for heating and these houses have an average heat requirement of 15,000 kWh of useable heat and that everyone uses Swan-labelled pellets with an energy value of 5,000 kWh per ton of pellets.

One house like that would consume 15,000/0.75 = 20,000 kWh pellets, which is equivalent to 4 tons of pellets per year. All 200,000 houses would consume 4 x 200,000 = 800,000 tons of pellets per year.

Primary energy consumption varies depending on energy consumption in production.

1. No limit value and all production consumes 1,600 kWh energy per ton of pellets.
   800,000 x 1,600 kWh = **1.28 TWh production energy per year.**

2. A limit value of 1,200 kWh per ton of pellets.
   800,000 x 1,200 kWh = **0.96 TWh production energy per year.**
   A saving of 240 GWh per year is possible with the Swan system's limit value, which is equivalent to the heat value of 48,000 tons of pellets or the heat requirement for 12,000 houses.

3. A limit value of 900 kWh per ton of pellets.
   800,000 x 900 kWh = **0.72 TWh production energy per year.**
   A saving of an additional 240 GWh per year or a total of 480 GWh per year compared with the first alternative.

For reasons of energy efficiency, energy consumption, and electricity consumption in particular, should be reduced. The assumptions for electricity are approximate and electricity consumption probably varies greatly between different manufacturers.

Conclusion:
With a limit of 1,200 kWh energy consumption for production of pellets, which covers the production processes but excludes transport, we ensure annual system efficiency of more than 60% when using a good pellet boiler with an average annual efficiency level of at least 75%.

If, however, we produce pellets with a total energy consumption of 850 kWh per ton of pellets and fire these pellets in a boiler with an average annual efficiency level of 90%, we can meet the Swan system's target of total system efficiency of 80% per year.

There are grounds for tightening up the requirements for energy consumption in production of pellets. This should be implemented gradually, and the first step would be to introduce a requirement of a maximum of 1,200 kWh per ton of pellets. Most manufacturers in the Nordic region could manage that, but the manufacturers with the highest energy consumption levels would not be able to achieve Swan labelling.

It will be necessary to examine the possibility of introducing tighter requirements in the next revision.

4.3.3 Possibilities for energy savings

A large percentage of the energy is consumed in drying and compressing the pellets. The varied moisture content in different raw materials affects energy consumption. Energy consumption will increase once new wood begins to be used for shavings.

The packaging process requires electricity and the limit value set for electricity consumption may exclude the actual packaging. There are no grounds for favouring just bulk pellets.

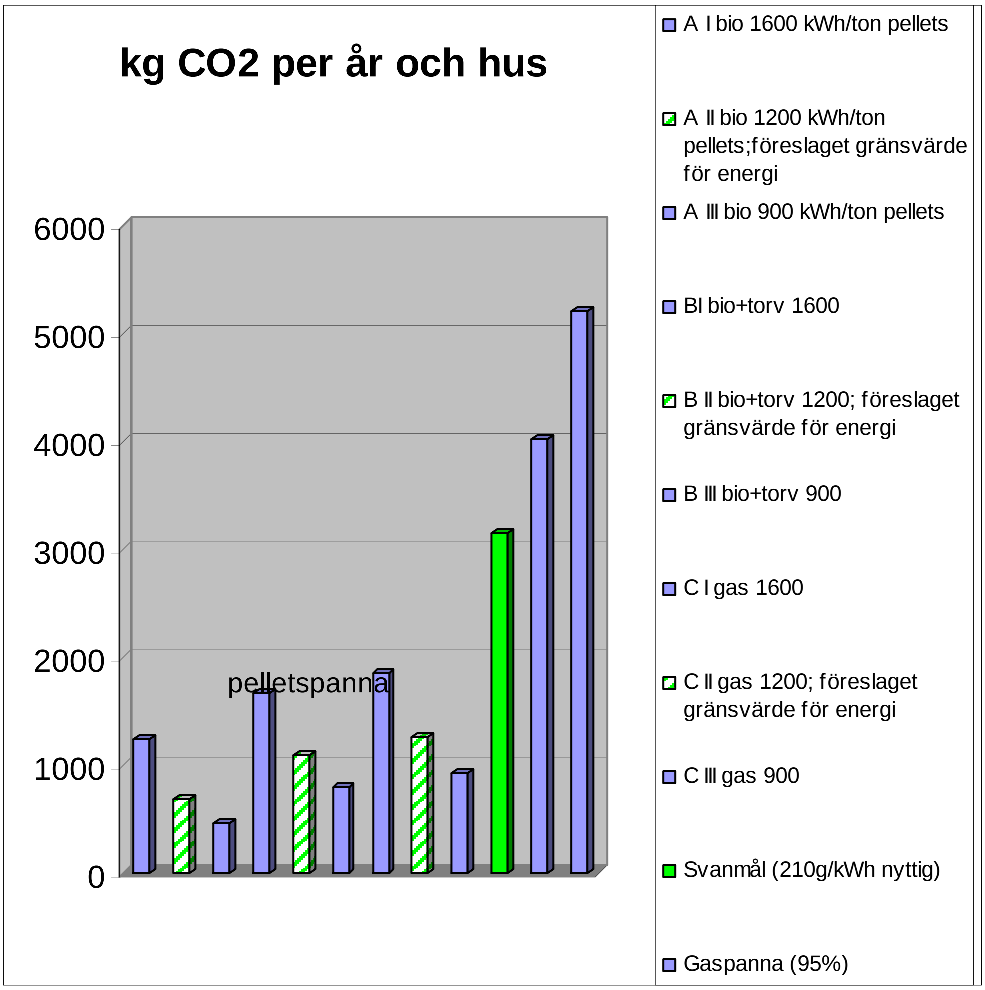
Possibilities for energy saving include locating a pellet factory close to another operation requiring steam or heat. Use shavings as dry as possible, but, above all, reduce electricity consumption. Choice of press and how the shavings are processed before pelleting has a bearing on energy consumption.

Due to a shortage of raw material for producing pellets, factories have ceased production while awaiting raw material. Erratic production means increased energy consumption per ton of pellets. Starting up boilers consumes more energy, as does the complete process altogether. Setting energy requirements means that a factory must have continuous production and should therefore expand access.

4.4 Contribution to the greenhouse effect from producing pellets

On the whole, not much fossil fuel is used for producing pellets. Oil may be used for starting up boilers. Peat and gas may be used for the dryers. The same example as above, but the contribution to the greenhouse effect is being judged instead. Electricity use affects the contribution to the greenhouse effect.

The finished pellets are burned in a pellet boiler with an average annual efficiency level of 75%. It is not a Swan-labelled pellet boiler but a medium-quality boiler new on the market that is fired without an accumulator tank, but is relatively efficient. It is compared with a gas boiler that is not Swan-labelled, but yields a good level of efficiency. In addition, a comparison is undertaken with a limit for contribution to the greenhouse effect from heating of 210 g/kWh of useable heat, which represents 3,150 kg per year. In several background documents this has been formulated as a target for Swan labelling for heating. The calculations can be found in the appendix.



The first nine columns represent variations due to differing production methods. With the first three columns, biofuel is used for drying in varying quantities. With the next three columns, bio + peat is used for 35%, and the final three columns use gas for drying. The pellets contribute between 30 and 110 g CO_2 to the greenhouse effect per useable kWh heat, depending on energy consumption and choice of fuel for production of the pellets. If peat up to 35% or gas up to 100% is used for drying, the impact is no greater from a system perspective. Even if peat up to 100% were to be used for drying, heating with pellets can manage the target set within the Swan system with regard to contribution to the greenhouse effect.

The contribution of the various production processes to the greenhouse effect is not of crucial significance to the environmental impact of the pellets from a system standpoint. However, limitation of the contribution to the greenhouse effect should naturally be implemented where possible. We therefore propose a continued restriction on possibilities for using fuel that adds to the greenhouse effect for drying on a par with the previous limit of 35% peat. In combination with the proposed limit of 1,200 kWh total energy consumption, there should be a margin of approximately 750 kWh fuel/ton pellets for drying, with a certain amount of flexibility. When using 35% peat or other fossil fuel, this means a limit value of 100 kg CO_{2eq}/ton pellets.

Summary: A limit value of 100 kg CO_{2eq}/ton pellets for drying is proposed.

4.5 Requirements for certified wood

When formulating the first criteria for pellets, the raw material consisted of wood shavings from sawmills and timber industries, e.g. furniture production. Demand for shavings has increased substantially.

K1 Origin of raw material for pellets

If new wood is used for production of pellets, the pellet manufacturer must ensure that the raw material does not come from forest environments with high biological and/or social protection values.

K2 Proportion of certified wood

On an annual basis, at least 10% of pellet raw material from new wood must come from certified forestry operations. Certified forestry operations are those that are conducted according to the standards that fulfil Nordic Eco-labelling requirements for sustainable forestry, see appendix 1.

Exemptions can be granted from this requirement if it can be documented by other reliable means that the raw material comes from a sustainable forestry operation and meets the same requirement level.

The following must be documented by the pellet manufacturer:

1. Information on deliveries of new wood and wood from certified forestry operations. Annual calculations of the proportion supplied from certified forestry operations. The system for traceability of raw material from certified forestry operations within the factory must be documented here.

2. Name (in Latin and a Nordic language) and geographic origin (country/federal state and region/province/municipality) of the species of wood used. Nordic Eco-labelling is entitled to demand additional documentation if there is any uncertainty as to whether the raw material comes from forest environments with high biological and/or social protection values.
3. Traceability of fibre raw material from felling location to timber processing company must be possible to confirm by an independent third-party check.
4. Copy of certificate signed and approved by the certification body and the body's final report. The name of the certification system must be shown. Copy of forest standard, name, address and telephone number of the organisation that formulated the standard.

5 Changes from previous version

5.1.1 Quality assurance of energy use

Requirement no. 13 in the first version of the criteria was formulated for the purpose of encouraging manufacturers to ensure good follow-up on energy use for drying and pelleting, thereby creating good scope for energy saving. The requirement is worded as follows:

K13 Follow-up on energy use

Energy use in drying must be summarised and documented annually. The different forms of energy are followed up separately and reported per ton of pellets.

Consumption of electricity for pelleting must be followed up annually, summarised, documented, and reported per ton of pellets produced.

A summary as per appendix 4 must be documented by the licence holder. The requirement is also checked on site.

Appendix 4 Basis for follow-up on energy use

The following energy raw material(s) is/are used:

		Energy raw material used per ton of pellets	*Energy content*	
			MJ/ton pellets	*kWh/ton pellets*
Own heat production	*Start-up of drying*			
	Drying			
	Other			
Heat from other process	*Drying*			
	Other			
Other combustion				
Total				

If excess energy is channelled from another production process, allocation can be implemented. This is implemented in a special report.

Nordic Eco-labelling proposes upgrading of reporting, as indicated below. All intermediate stages are defined, but it is possible to report an overall sum. The essential thing is to ensure measurements are recorded for the entire process.

Table 7: proposal for new report for energy consumption.

		Energy raw material used per ton of pellets	*Energy content*	
			MJ/ton pellets	*kWh/ton pellets*
Preliminary processing of raw material	*barking*	*…. kWh electricity x 2.5*		
	grinding	*…. kWh electricity x 2.5*		
Own heat production	*start-up of drying*			
	drying			
	boiling			
Heat from other process	*drying*			
	other			
Pelleting	*presses*	*kWh electricity x 2.5*		
	cooling	*kWh electricity x 2.5*		
	sifting	*kWh electricity x 2.5*		
	packaging	*kWh electricity x 2.5*		
Total				

5.1.2 Requirements for energy use

The energy requirement in the first version of the criteria was formulated as follows:

K12 Energy use in production

Only biofuel may be used as an energy raw material in production of pellets. The requirements apply to all internal processes and any external processes for production of heat/steam.

Electricity may not be used for the drying process.

An estimate of energy use must be prepared. Energy consumption per ton of pellets produced per year must be reported. Use of different energy raw materials is reported separately.

Exception:

Peat may be used as an energy raw material up to a maximum of 35% (MJ fuel) of the total fuel use per year.

Oil may be used for starting up the dryers.

The decision-making process for the criteria was dominated by a discussion of which **energy raw materials** should be accepted for drying pellets. In the end, a requirement for acceptance of using 35% peat for the drying process was proposed. Requirements were not established based on the actual environmental impact. Gas was excluded from the possibilities.

Prior to the revision, the previous methodology was abandoned and a requirement governing maximum contribution to the greenhouse effect was used as a basis instead. In connection with requirements for energy limitation being introduced, it is essential for manufacturers to rationalise using the best possible means for the specific facility, and for emissions of carbon dioxide to be kept to a very low level. Based on the stipulation that a maximum of 1,200 kWh may be used per ton of pellets, a limit of 200 kg CO_2 per ton of pellets is set.

An energy saving is necessary, and the target for production of pellets is 850 kWh energy per ton of pellets. As a first step, we suggest a limit value of 1,200 kWh of primary energy for production of pellets. Property maintenance, transport and packaging are excluded from the requirements.

A new formulation of the requirements is proposed, as follows.

K12 Energy use in production

Energy use for pellet production may not exceed 1,200 kWh of primary energy per ton of pellets. Transport, property maintenance and packaging are excluded.

Only fuel for which the climate impact does not exceed 200g CO_2 per ton of pellets may be used as energy raw material for production of pellets. Transport, property maintenance and packaging are excluded.

6 Future requirement areas

Example 1: Energy consumption in production of pellets

Pellets are produced using wood shavings from joinery operations and sawmills. Different production processes are used and compared. Transport and property maintenance are not included in the assessment. Electricity consumption is multiplied by 2.5 as a factor for electricity production. The pellets' heat value is set at 5,000 kWh per ton.

PRODUCTION OF PELLETS					HEATING WITH BOILER *(per kWh useable heat) 75%*	
pellet raw material		***Energy consumption**** [1] kWh/ton pellets			***Energy consumption*** (system efficiency)	
		electricity x 2.5	***drying***	***total***		
A. Biofuel in drying furnace						
A1	*1,600 kWh limit value*	800	800 [*2]	1600	0.32+1.33=1.65	61%
AII	*1,200 kWh limit value*	450	750	1200	0.24+1.33=1.57	64%
AIII	*900 kWh limit value*	300	600 [*3]	900	0.18+1.33=1.51	66%
B. 65% bio +35% peat in drying furnace [*3]						
BI	*(0.65x800)+(0.35x800)*	800	800	1600	0.32+1.33=1.65	61%
BII	*(0.65x750)+(0.35x750)*	450	750	1200	0.24+1.33=1.57	64%
BIII	*(0.65x600)+(0.35x600)*	300	600	900	0.18+1.33=1.51	66%
C. 100% natural gas in drying furnace* [4]						
CI		800	755	1555	0.31+1.33=1.64	61%
CII		450	708	1158	0.23+1.33=1.56	64%
CIII		300	567	867	0.17+1.33=1.50	67%

**1: System efficiency is calculated as follows:(1,600 /5,000)=0.32; 1/0.75=1.33; (0.32+1.33)=1.65;*

**2 When using 800 kWh supplied biofuel and with an efficiency level of 85% in the drying furnace, 680 kWh of useable energy is consumed.*

**3 When using peat, the same boiler efficiency level has been applied as for biofuel.*

**4 When using gas, an efficiency level of 90% has been applied.*

Example 2: The impact of production energy on primary energy from heating with pellets

The finished pellets are burned in a pellet boiler with an average annual efficiency level of 75%. It is not a Swan-labelled pellet boiler but a medium-quality boiler new on the market that is fired without an accumulator tank, but is relatively efficient. It is compared with a gas boiler that is not Swan-labelled, but yields a good level of efficiency. In addition, a comparison is undertaken with an average annual efficiency level limit of 80%, which in several background documents has been formulated as a target for Swan labelling for heating. The building is assumed to have a heat requirement of 15,000 kWh per year.

primary energy	**One house kWh per year**	**200,000 houses TWh per year**

A I	24,590	4,918
A II	23,437	4,687
A III	22,727	4,545
B I	24,590	4,918
B II	23,437	4,687
B III	22,727	4,545
CI	24,590	4,918
C II	23,437	4,687
C III	22,388	4,477
Swan system target	18,750	3,750
Gas boiler 95%	15,789	3,158

Example 3: Contribution to the greenhouse effect from producing pellets

In order to calculate the carbon dioxide emissions from production of pellets, the following data is used:

Table 12: Carbon dioxide emissions SOU 2002/100

fuel	**Energy density** (MJ/kg)	**Density** (kg/m^3)	**CO_2** (g/MJ fuel)	**CO_2** (g/kWh fuel)
EO1	42.7	840	75.3	271
natural gas	52	0.75	56.5	203
peat	11	370	107.3 *	386
powder	18	210	0	0
electricity				385

** other figures exist, such as 91-96 g/MJ for 6-50% moisture content. The Swedish National Environmental Protection Agency emission quotas state 106 g/MJ for peat.*

Electricity consumption is multiplied by a factor for carbon dioxide of 385 g/kWh electricity as a general factor for a European average.

PRODUCTION OF PELLETS					HEATING WITH BOILER ***1** *(per kWh useable heat) 75%*	
			CO_2 (kg/ton pellets)		***CO_2***	
	Fuel (kWh)	***Electricity (kWh)***		***CO_2tot***	***One house (kgCO_2/year)*** *(4 tons pellets/year)*	***All houses (thousand ton CO_2/year)*** *(200,000)*
AI (bio)	0	800	308	308	1,232	246
AII	0	450	173	173	692	138
AIII	0	300	116	116	464	93
BI (bio+peat)	0+(0.35x800)	800	108+308	416	1,664	333
BII	0+(0.35x750)	450	101+173	274	1,096	219
BIII	0+(0.35x600)	300	81+116	197	788	158
CI(gas)	755	800	153+308	461	1,844	369
CII	708	450	143+173	316	1,264	253
CIII	567	300	115+116	231	924	185