

# **A socio-economic comparison of green and conventional products (TV-sets, washing machines, textile services, bookshelves and copy paper)**

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**Abstract:** This paper presents an environmental and socio-economic comparison of functionally equivalent product pairs: a product (or service) complying with eco-labeling criteria towards a conventional product (or service) within the same product/service group. The comparison comprises product pairs within the categories of TV-sets, washing machines, textile services, bookshelves and copy paper. The study included development of a methodology for the environmental and socio-economic comparison as well as the application of the methodology on the selected product groups. The study was funded and published by the Danish Environmental Protection Agency 2009-2011 [1]. The definition of product pairs took offset in criteria for environmental labeling schemes as The EU Ecolabel and The Nordic Swan – label. The “green product” meets as a minimum requirement the standards for ecolabeling. The similar “conventional products” were “typical” representatives for the main part of the products on the actual market. This analysis comprises the entire life cycle from production, transportation, distribution to consumption and finally disposal where significant differences are identified for the alternatives.

## **1 Introduction**

This report is the result of a study for the Environmental Protection Agency 2009-2010 that aimed at developing and testing a method for the comparison of economic consequences of choosing “green products” rather than similar “conventional products”.

### **1.1.1 The objectives of the study**

The aim of the study was to contribute to the development of a methodological basis for an assessment of the economic value of buying a green product instead of a conventional one. The objectives are thus:

- To develop a method for assessment of economic benefits and costs from consuming a green product instead of a similar conventional variant of the same product. Focus is on the difference between the products, and therefore the gross economic impact in absolute terms has not been estimated.
- To do an actual analysis and assessment of economic benefits and costs of choosing specific green rather than conventional products. This analysis comprises the entire life cycle from production, transportation, distribution, consumption and finally disposal.

## **2 How are green and conventional products defined?**

As a starting point, green products are here defined as products that meet the environmental requirements of the EU and the Nordic ecolabels (the EU flower and the Nordic Swan) [2]. The idea was to compare these with conventional products, i.e. products that are the typical products in the market, and which do not meet the ecolabel criteria.

The main sources of information in Table 1 are beside the eco labeling schemes [2] the EcoInvent Database [6]. Beside these general sources were used product specific sources where the most important has been the EUP-program [3] for Television and washing machines, the ETSA surveys for textiles [4], the BREF notes for paper [5], and data from the Eco-Invent database for wood processing used for office shelves [6].

**Table 1: The most relevant information and major differences among the analyzed products**

<b>Product category:</b>	<b>Television</b>	<b>Washing machines</b>	<b>Textile service</b>	<b>Copy paper</b>	<b>Office shelves</b>
Product	32 "LCD flat screen TV	5 kg household model	Work-clothes to an employee in a year	1 Air Dried Ton copy paper	1 section, 5 shelves
Ecolabel-scheme	EU-flower and Nordic Swan	Nordic Swan	Nordic Swan	EU-flower and Nordic Swan	Nordic Swan
Essential Ecolabel criteria	Limited use of certain substances Ceiling over energy consumption	Energy and water consumption Centrifugation	Prohibition of certain substances in textiles Detergents degradability and toxicity Ceiling on energy and water consumption	Energy consumption Sustainable forestry Emissions of COD, AOX, NOx and CO2	Sustainable forestry Energy consumption Glue, varnish Durability
Main differences, green and conventional products.	Ceiling over energy consumption	Centrifugation Warm water intake	Ceiling over energy and water consumption Environmentally Optimized detergents	SO2, NOx and CO2	Durability/ longer lifetime
Differences in the manufacturing process 1)	Minor differences	Stronger construction Intake of both warm and cold water	Differences are not precisely identified	Minor differences as a result of ecolabel criteria spill-over	Lifetime extension reduces production costs
Differences regarding transportation	None	None	None	None	None

Product category:	Television	Washing machines	Textile service	Copy paper	Office shelves
Differences in the use of the products	Electricity savings	Electricity savings for drying and electricity consumption replaced by district heating	Suppliers consumption of energy, water and detergents	None	Longer lifetime
Differences at disposal	Insignificant	None	None	None	Lifetime extension reduces the amount of waste
Focus in the socio-economic comparison	Savings in use versus additional costs in the production process.	Savings in use versus additional costs in the production process.	Cost savings and positive environmental impacts	Cost savings and positive environmental impacts	Cost savings and positive environmental impacts

In some instances, it has proven more appropriate to compare products that meet selected, specific environmental requirements with corresponding products that do not, whether or not these requirements are part of the ecolabel criteria or not. The basis for the comparison of products may be established in different ways, and it will often be useful to start with a consideration of the availability of the required data in relation to the definition of green and conventional products to be compared. The availability of life-cycle-analyses may thus be a good criterion to secure the availability of satisfactory data and information on the two products to be compared.

It is obvious that a relevant definition of green products, like the ecolabel criteria, will change over time. Ecolabel criteria tend to develop into general requirements and product standards, which have given them a dynamic impact on the market and thereby make the continuous adjustment of the criteria necessary. The value and relevance of a definition of a green product as one, which meets the ecolabel criteria may therefore vary among product types, and they will further tend to decrease depending on the time elapsed since the latest adjustment of the criteria.

### 3 Economic and financial analysis

For each of the 5 products, the environmental effects of production, use and disposal of the green and the conventional products have been estimated on the basis of existing Life Cycle Assessments. Together with available economic costs of environmental impacts [7] [8] and other cost data [8], the economic costs and benefits of choosing a green rather than the corresponding conventional products have been estimated. In addition to that, a financial analysis of costs and benefits of this choice has been conducted. This is e.g. relevant for consumers, procurement officers etc.

Other differences are not included as a result of the limited importance or because of problems in estimating their size or economic value.

#### 3.1.1 Results of the economic analysis

The television set is an example of a green product where the green version providing significant energy savings that are clearly dominating the less significant additional production manufacturing costs.

**Table 0: Differences in direct impacts and economic value during the life cycles of a conventional and a green TV.**

Life cycle phase	Impact	Difference between green and conventional product	Economic value
Manufacturing phase	Manufacturing costs	-34 Dkr.	Dkr. -34
Transportation /distribution.	-		Dkr. 0
Use phase	Electricity	99kWh/year	Dkr. 425
	CO2 from fossil fuel	90,46 kg/year	Dkr. 131
	VOC ex. Methane	0,01 kg/year	Dkr. 0
	SO2	0,14 kg/year	Dkr. 98
	NO2	0,09 kg/year	Dkr. 40
	Small particles	0,004031 kg/year	Dkr. 3
	Mercury emission	0,0019 g/year	Dkr. 1
End of use phase			Dkr. 0
Total economic value, (NPV)			Dkr. 665

The green washing machine is characterized by significant additional manufacturing costs and economic savings as well as environmental benefits and economic savings during the consumption phase. The net result and hence the economic value of choosing the green product is however very close to zero.

**Table 0: Economic value by investment and use of an AAA-marked washing machine with fast spinning compared to conventional AAB-marked model.**

Life cycle phase	Impact	Unit	Reduced Cost & impact by Green product	Economic Value
Manufacturing	Cost	Dkr.	-750	Dkr. -750
Use	Electricity	kWh	157,5	Dkr. 677
	CO2 from fossil fuel	kg	29	Dkr. 42
	SO2	kg	0,075	Dkr. 52
	NOX/NO2	kg	0,054	Dkr. 24
	Small particles	kg	0,0162	Dkr. 14
	VOC ex. Methane	kg	0,0076	Dkr. 0
	Mercury emission	g	0,0016	Dkr. 1
Total economic value		Dkr.		Dkr. 60

**Table 4: Economic value by production of Ecolabeled copy paper compared to conventional copy paper.**

Life cycle phase	Impact	Unit	Reduced Cost & impact by Green product	Economic Value
Production phase	Costs of labeling	Dkr.	-16	Dkr. -16
Production	SO2	Kg	1,60	Dkr. 138
Production	NOX/NO2	Kg	0,80	Dkr. 44
Use & transportation			-	
End of use phase			-	
Total economic value				Dkr. 166

In case of copy paper, the choice of a green rather than a conventional product is also socio economically beneficial but in this case, the environmental impacts are the main components. The additional costs of the green products, if any, are very small and confined to ecolabel costs and possible up-front investments (sunk costs). One category of environmental benefits, namely the use of wood from sustainable forestry, is not quantified and included in the calculations.

As a service product, the green and the conventional textile services are defined as the functional unit of providing work clothes for a worker for a year. According to suppliers, the green products are not more expensive than the conventional ones except for minor ecolabel costs, and at the same time, there are clear benefits in terms of cost savings and environmental benefits. The results are positive economic net benefits from choosing a green product rather than the conventional one.

**Table 5: Annual economic value per unit (Work wear)**

Life cycle phase	Impact	Unit	Reduced Cost & impact by Green product	Economic Value
Manufacturing phase			-	0
Transportation			-	0
Use				
	Electricity	kWh	7	Dkr. 4
	Gas oil *)	GJ**)	0,162	Dkr. 18
	Natural gas*)	Nm3***)	-2,16	Dkr. -7
	Detergent	Kg	0,50	Dkr. 18
	Water	Liter	100,00	Dkr. 5
	CO2 from fossil fuels	Kg	12,4	Dkr. 2
	SO2	Kg	0,028	Dkr. 2
	NOX/NO2	Kg	0,015	Dkr. 1
	Small particles	Kg	0,0018	Dkr. 0
	VOC ex. Methane	Kg	0,007	Dkr. 0
	Mercury emission	g	0,00038	Dkr. 0
End of life			-	0
Total economic value annually				Dkr. 43

Office shelves are a product without any significant environmental impact in the consumption phase. But there are differences in the manufacturing and disposal phases although they may be small. These differences may in particular be small in case of clearly defined, similar products. The office shelves like copy paper is an example of a product where the environmental aspect is dominated by the use of wood from sustainable forests. As this aspect apparently is the only obvious difference between green, ecolabeled and conventional products, and as other aspects have been considered difficult to measure and valuate, the green product has been defined as a product meeting another ecolabel criterion with a potential impact, namely the product durability, and this has been applied for the green product, namely the longer lifetime. This example shows how important the lifetime is for the economic value of a product.

**Table 0: Economic costs by investment and use of Green office shelves with long lifetime (10 instead of 5 years).**

Life cycle phase	Impact	Unit	Reduced Cost & impact by Green product	Economic Value
Manufacturing phase	Costs for labeling	Dkr.	-68	Dkr. -68
Production phase	Saved after year 6 (production of new shelves)	Dkr.	2700	Dkr. 2.116
	CO2 from fossil fuel in year 6	kg	33	Dkr. 5
	SO2 in year 6	kg	0,06	Dkr. 4
	NOX/NO2 in year 6	kg	0,05	Dkr. 2
	Small particles in year 6	kg	0,00	Dkr. 0
	VOC emission in year 6	kg	0,02	Dkr. 0
	Mercury emission in 6	g	0,004	Dkr. 0
	Transportation/Distribution			-
Use Phase			-	0
End of life phase			-	0
Total economic value		Dkr.		Dkr. 2.059



### **3.1.2 Method for cost-benefit calculation**

The primary aim of the cost-benefit calculations has been to develop a method for estimation of the economic effects of choosing green instead of conventional products, and the specific results of the calculations have not been a purpose by themselves. Still the results of the calculations lead to a few crosscutting conclusions and considerations.

Some limitations to the use of the model and for the calculation of economic effects of environmental impacts in general have been identified. In many cases, the lack of information on emissions and environmental impacts in the reference situation prevents the quantification of environmental effects. In such cases, it must be concluded that there are other potential effects that shall be taken into consideration for an overall economic assessment. In other cases, the lack of information on the specific environmental effects and the involved substances makes it impossible to translate the environmental effects into monetary values.

Secondly, it is seen from the calculations that energy savings and related environmental effects are dominating in the estimates of economic values of choosing a green product. Other environmental effects often disappear in the comparison. This may be due to the difficulties in quantifying, and in many cases environmental effects are eliminated when the results of an effective disposal or recycling system has been taken into account. Therefore, the energy consumption will often be left as the only tangible effect. In addition, energy savings are often a key ecolabel criterion, and in many cases, energy is therefore relatively dominating in the definition of a green product.

Some important environmental effects do not appear from the calculations because the use of them is assumed to be the same for the green and the conventional products. A good example is transport and distribution, where it is often assumed that the transport pattern is the same for the two products. Therefore, transport will not be seen as an environmental effect despite the fact that transport may be the most important environmental effect of using both products.

The net effect of choosing a green product is often very limited and other factors than the choice of a green product may be much more important for the environmental impact. In the case of a washing machine it was seen how the value of the green product depends on how water is heated in the specific household where the washing machine is installed. Similarly, the value of lower residual moisture depends on the energy efficiency of the dryer. The most environmentally

friendly solution is a combination of a conventional washing machine and the drying of clothes outside.

Another parameter of a more general character, which is often more important than the choice of a green instead of a conventional product, is the lifetime the consumer accept before replacing the product with a new version. The method, which has been developed and applied for the above mentioned calculations, may also be used for the further analysis of changes in manufacturing and consumption behavior. It may e.g. be used for the comparison of similar products with different lifetimes. This is done in the case of the office shelves, where it is seen that a simple extension of the life time of a product may have considerable economic effects, when, compared to other parameters, constituting the definition of a green product.

#### 4 References

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