

Socio-political factors influencing household electricity consumption: A comparison between Denmark and Belgium

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Abstract

This paper compares household electricity consumption in Denmark and Belgium on the basis of survey data and national statistics and it shows that there is a higher level of electricity consumption in Belgium. The first part of the paper focuses on background variables and shows that the Danish background variables can explain 30-40% of the variations in electricity consumption, whereas the Belgian data only explain 10-30% of the variations. Thus in both cases other more qualitative aspects explain most of the differences. The second part focuses on comparing the practices that generate electricity consumption. Analysis shows that it is the number and use of appliances more than energy efficiency that explain which households consume most electricity. Furthermore it is shown that electricity used for television, drying clothes and for providing a comfortable indoor temperature might be part of the explanation for the higher level of energy use in Belgium. Comparing attitudes to the environment, there is no reason to suggest that these would be part of the explanation; however, the general knowledge about energy seems to be higher in Denmark. The conclusion suggests that part of the explanation should be found in differences in energy policies, with more focus on saving in Danish energy policies than in Belgian. The paper however also points to factors with a huge impact on electricity consumption in households that are not included in the energy policy in neither Denmark nor Belgium, including the grow-

ing size of houses, the growing proportion of single-person households and the growing number of appliances.

Introduction

This paper compares residential electricity consumption (excluding heating) in Denmark and Belgium with a double focus: the practices at the household level and their social and cultural determinants. To elucidate the determinants of electricity consumption at the household level, the relevance and the importance of four groups of variables were assessed for both countries: household characteristics (composition, income, age of members), building characteristics (building type, area), electric appliance use and presence/absence of environmental concern. The purpose of this comparison was to understand which social, cultural and technical factors influence the level of household electricity consumption, and thus discuss to what extent energy policy in the two countries actually tries to influence these factors.

ELECTRICITY CONSUMPTION IN A CROSS-CULTURAL PERSPECTIVE

Previous studies on social and cultural aspects of energy consumption have typically focused on differences within a country, predominantly showing how higher social classes in a society use more than the lower classes (Kuehn, 1998; Pedersen and Broegaard, 1997). Others have extended the explanation of social classes to include studies of how technology and consumption practices in everyday life influence the level of energy consumption (Aune, 1997; Gram-Hanssen, 2004 and 2002). Furthermore there have been studies of how developments in technology and consump-

tion in general construct normality and through this strongly influence the level of energy consumption (Shove, 2003). In this paper we follow a slightly different line, as our interest was to compare two different countries to see in what ways differences in culture, social organisations or in energy policy between the countries influence energy consumption. The idea of comparing different cultures with respect to energy use has been successfully carried through in a study comparing Norway and Japan (Wilhite *et al.*, 1996); however, the cultural differences between Norway and Japan are presumably much greater than between Denmark and Belgium. Therefore, one of our main questions in this paper was to find out if energy consumption followed the same patterns in both countries and if it was associated with the same factors.

COMPARING ENERGY POLICY IN DENMARK AND IN BELGIUM

The objectives of Belgium's overall energy policy have not changed since the early 1970s¹ and priorities for a national energy policy are the following²: 1. To maintain the prices of energy at a competitive level by promoting efficient energy production and consumption with the least negative effect on the environment; 2. To let the whole population benefit from lower prices³; 3. To guarantee security of supply. In 1999 oil accounted for 41% of total primary energy supply, natural gas for 23%, nuclear power for 22%, coal for 13% and renewables for 1%⁴. "Because of this choice [of the nuclear energy], the country has constrained itself to a growing consumption and to a waste of energy, in order to reach an optimal return of the investments⁵." A progressive phasing-out of nuclear power was decided in 1999. Regions are responsible for energy-saving policies, but not much has been done in this matter with respect to households. Measures vary according to the region and there is no coordinating office.

The Danish energy policy has also been quite stable since the early 1970s with a focus on economy, security of supply and environment, though the balance between these three objectives has changed over the years towards more focus on the environment in the 1990s⁶. Energy efficiency in the households sector has been a part of this policy throughout the years and includes energy taxes, subsidies for insulation of houses and regular campaigns on energy saving (standby consumption, A-labels etc.). Since 1996 the organisation of these activities has been initiated partly by The Danish Electricity Savings Trust (www.elsparefonden.dk) with an annual budget of 12 million Euro and partly by the Public Service Obligations (PSO) of the (private) grid companies, which are obliged by law to promote energy savings with a

budget of approximately 25 million Euro a year, both financed by a tax on consumed electricity.

DATA AND METHODS OF THIS STUDY

Results presented in this paper are based on a Belgian research project SEREC – Socio-technical factors influencing Residential Energy Consumption. The idea of this project is that household energy consumption depended on two types of factors that were closely interconnected: housing's technical characteristics (area, insulation factor, characteristics of central heating boiler, electrical appliances etc.) and household members' socio-economic characteristics (family size, income group, environmental representations, etc.). For Belgium, neither the respective importance of these two types of factors nor their interactions have been estimated by causal statistical models, since there was no consistent database up to now that contained *both types of data* related to the *same* housing units. Thus this socio-technical study aims at offering an empirically based sociological contribution to a reappraisal of the socio-technical factors that explain effective changes and reluctance to change in household energy consumption⁷.

As a part of this project, in September 2004 we performed our own survey, called the SEREC Survey. It was a phone survey made with three random samples, one for each Belgian region (Brussels area, Flanders and Wallonia), as Belgian regional authorities govern a lot of aspects of energy policy. The total sample obtained was weighted to have correct distributions by region, income quartile and dwelling type. The weights for this procedure were calculated from the nationally representative sample survey of household budgets and consumption made in 2001.

Regarding the Danish part of the data, Denmark has quite reliable registers of both persons and buildings and researchers are allowed to combine these registers with consumption data provided by the utilities. In this way a database with approximately 50 000 households from the second largest city in Denmark, Århus has been established. For each household it contains socio-economic and demographic data from the Danish personal data net (the Danish CPR register containing information on income, education, age, nationality etc. on every person living in Denmark), building data from the national building data net (the Danish BBR register containing information on the year the building was constructed, size and type etc. of all buildings in Denmark), combined with data on water, electricity and district heating delivered to the household⁸. From these data we removed housing with business activities, weekend cottages, electricity-heated houses and households with extreme electricity consumption (defined as less than

1. <http://www.iea.org/textbase/nppdf/free/2000/belgium2001.pdf> read on 8-3-2005.

2. http://www.plan.be/fr/bench/6_1.stm read on 8-3-2005.

3. "The energy price for the industry sector is relatively low in Belgium (...). The households however pay a relative high consumption price for electricity and have to pay high taxes on electricity", read on 8-3-2005 on http://www.plan.be/fr/bench/6_1.stm

4. <http://www.iea.org/textbase/nppdf/free/2000/belgium2001.pdf> read on 8-3-2005.

5. Knapen, 1997, p. 1.

6. <http://www.iea.org/textbase/nppdf/free/2000/denmark2002.pdf> read on 8-3-2005

7. The SEREC research project (Socio-technical factors influencing Residential Energy Consumption) is a 2-year project associating the Institute of Demography of the University of Louvain (UCL), the Flemish Institute for Technology (Vito) and the Danish Building Research Institute (SBI). The Belgian Science Policy Office finances this project.

8. The database and its results concerning electricity consumption are further described in (Gram-Hanssen, Kofod and Petersen 2004). The full detailed statistical analyses are described in a Danish report (Petersen and Gram-Hanssen 2005).

Table 1. Development in average electricity consumption per dwelling in Denmark and Belgium.

	Unit	1990	1995	2000
Denmark	kWh/dw	4 071	4 223	4 055
Belgium	kWh/dw	4 627	5 400	5 602

Sources: Odyssee (<http://www.odyssee-indicators.org/>)

Table 2. Distribution of dwellings in Denmark and Belgium according to their type (%).

	Denmark	Belgium
Detached house	46	32.4
Semi-detached house (3 facades)		20.1
Semi-detached house (2 facades)	13	23.8
Apartment	39	23.1
Other	2	(0.6)
Total	100	100

Sources: Denmark: Statistics Denmark 2005. Belgium: SEREC Survey (2004) and Survey on Consumption (2001). (As the SEREC survey was weighted according to official data on dwelling type (see the introduction for more details), the figures in Table 1 are quite close to official data: in the 2001 Belgian census, 75.4% of the dwellings are single-family houses (http://statbel.fgov.be/census/results4_fr.asp?q=1a – read on 12/1/5)

Note: Figures in parenthesis refer to a number in the sample smaller than 30 in the SEREC Survey

500 kWh or more than 16 000 kWh). This database was one of the primary inputs for the analysis of the Danish presentation in this paper. Another important input came from a study of 500 semi-detached houses in Albertslund, a suburb of Copenhagen. That study comprises analysis of a questionnaire containing many of the same questions as those used in the Belgian SEREC Survey and the study is further described in Gram-Hanssen (2002, 2003, 2004).

Background Variables

The idea of this paper is to compare residential electricity consumption in Denmark and Belgium. For this purpose we needed reliable and comparable data from both countries on energy consumption in households. Table 1 shows one example of available data for this purpose, which is from the European Odyssee project (www.odyssee-indicators.org/). As can be seen here, average electricity consumption in Belgian households is almost 30% higher than the Danish average and the Belgian level has increased over the last decade, whereas the Danish has been stable⁹.

Before concluding from these data that Belgian households consumes much more electricity than Danish, we need to compare some of the fundamental background variables in the two countries to see if average households electricity consumption is a relevant parameter to compare. We know from other studies that electricity consumption is strongly dependent on type and size of housing, as well as on household size (Gram-Hanssen, Kofod and Petersen 2004). Therefore we compare these background variables for the two countries to see if differences in these factors are the main explanation for the differences in electricity consumption. In the following two sections we first look at building characteristics and afterwards at household size. These sta-

tics are drawn either from national statistics or from specific surveys.

BUILDING CHARACTERISTICS

Dwelling type

In Denmark, nearly one dwelling out of two is a detached house compared with one out of three in Belgium (see Table 2). Furthermore, Belgium has more semi-detached houses (44%) than Denmark (13%), while the opposite is observed for apartments (39% in Denmark, 23% in Belgium). From the Danish data we know that detached houses on average consumes much more electricity than apartments and a little more than semi-detached houses. If the same holds true for the Belgian data, the differences in housing types between the two countries are probably not part of the explanation of the differences in electricity consumption. The reason being that the lower amount of detached houses in Belgium compared with Denmark is outweighed by a lower amount of apartments in Belgium compared with Denmark.

Floor Area

Table 3 shows the distribution of dwellings according to floor area in both countries. Although the categories are slightly different for both countries, Danish dwellings seem to be larger. The SEREC Survey data for Belgium overestimates the floor area quite a lot compared with the National CENSUS data, probably because the (fixed) phone-numbers sample, which we used, underestimates households made of young people living alone (see below) in a small dwelling seen as temporary (a mobile phone is then preferred.). In the SEREC Survey, the respondents estimated

9. The levels of consumption in these tables are higher than what we present later in this paper. The explanation is that the electricity consumption includes electricity-heated households, and for the Belgian data it includes the low-tension consumption of the professional sector (shops etc), whereas the Danish data distribute consumption from week-end cottages to permanent residences and furthermore include farms. These comments also illustrate how difficult international comparisons are in this field.

Table 3. Distribution of dwellings in Denmark and Belgium per floor area (%).

	Denmark	Belgium: CENSUS (2001)	Belgium: SEREC Survey
< 35 m ²		8.8	
35 m ² to 54 m ²		19.2	
< 50 m ²	13.1		(1.6)
< 60 m ²			
55 m ² to 84 m ²		27.5	
85 m ² to 104 m ²		21.9	
50 m ² to 99 m ²	37.5		17.9
60 m ² to 99 m ²			
100 m ² to 149 m ²		12.8	20.7
105 m ² to 124 m ²		9.8	
> 125 m ²	34.9		
100 m ² to 159 m ²			
150 m ² to 199 m ²	9.2		15.1
160 m ² to 199 m ²			
200 m ² to 249 m ²			12.9
> 249 m ²	5.4		10.8
> 200 m ²			
Does not know	-	-	21.1
Total	100		100.0

Sources: Denmark: Statistics Denmark (2005). Belgium: CENSUS (Socio-economic Survey) (2001) and SEREC Survey (2004)

Note: Figures in parenthesis refer to a number in the sample smaller than 30 in the SEREC Survey

Table 4. Mean household size in Denmark and Belgium according to dwelling type.

	Denmark		Belgium		
	Mean household size (Denmark)	Mean household size (Århus-data)	Mean household size	Income quartile distribution	
				% lowest quartile	% highest quartile
Detached house	2.63	2.83	2.85	11.9	36.3
Semi-detached house (3 facades)	1.99	2.5	3.09	18.8	14.6
Semi-detached house (2 facades)			3.01	22.0	37.3
Apartment	1.71	1.7	1.51	44.2	3.9
Total	2.18		2.71	21.4	26.3
N	5 222 584	53 804	453	453	

Sources: Denmark (Statistics Denmark 2005) and Århus data base (2000). Belgium: SEREC Survey (2004) and Survey on Consumption (2001). Note: Figures in parenthesis refer to a number in the sample smaller than 30

the floor area during the phone survey, but one respondent in five could not answer that question.

A larger floor area may permit a larger number of appliances and light and from the Danish studies we know that electricity consumption increases with the size of the home. As our data indicate that Danish homes are bigger than Belgian homes, we would expect electricity consumption to be higher in Denmark compared with Belgium.

HOUSEHOLD VARIABLES

In Denmark the mean household size is 2.18 persons, whereas in Belgium it is 2.36. In both countries these figures vary according to the dwelling type as shown in Table 4. However, the SEREC data clearly underestimated the single-person households, only 16.6% of the surveyed households being single-person households, whereas in official statistics 32.7% of all households are made up of single-person households¹⁰. As a consequence, the mean household

size in the SEREC Survey is 2.71, as opposed to 2.36 in the official statistics. In both countries, the highest-income households more often live in detached houses and the least affluent ones in apartments¹¹. By comparing household sizes in Denmark and Belgium, we found that more people live together in Belgium than in Denmark and from this fact alone one would expect electricity consumption to be lower in Denmark compared with Belgium.

Altogether we found when comparing Denmark and Belgium by simple background variables that by these factors alone one would expect Danes on average to consume less electricity per household than Belgians, as there are fewer

10. http://www.statbel.fgov.be/figures/d24_fr.asp read on 30-12-2004. These national figures are *de jure* (official registration) figures, whereas our survey is a *de facto* survey.

11. The average incomes (in DKK) according to the type of housing are the following: for an owner-occupied detached house: 566 562; for an owner-occupied apartment: 430 345; for a cooperative dwelling: 344 583; for a rented house: 335 780 and for a rented apartment, 275 237 DKK. (Source: Statistics Denmark 2005, consumption survey).

Table 5A. Mean electricity consumption per dwelling type: Denmark.

Type of dwelling	Number of Households	Ave. Elect. Cons. (kWh/year)	Standard Deviation	Ave. Elect. Cons. per person (kWh/year)	DK Ave. Elect. Cons. (kWh/year)
Detached houses	8 573	4 189	2 062	1 477.7	4 042
Semi-detached houses	4 950	3 114	1 523	1 227.1	
Apartments	40 281	1 720	865	1 038.6	1 934

Sources: The Danish average electricity consumption is calculated on the basis of Dansk Energi (2003), all other figures are based on the Århus data base (2000).

Table 5B. Mean electricity consumption per dwelling type: Belgium.

Type of dwelling	Number of Households	Ave. Elect. Cons. (kWh/year)	Standard Deviation	Ave. Elect. Cons. per Person* (kWh/year)
Detached houses	161	4 966.3	2 522.7	1 864 – 1 916
Semi-detached houses,3F	96	4 830.4	2 876.5	1 736 – 1 771
Semi-detached houses,2F	117	4 675.6	2 568.5	1 550 – 1 578
Apartments	76	2 636.6	2 590.9	1 790 – 1 816
Total	451	4 462.1	2 741.8	1 745 – 1 784

Source: SEREC Survey (2004)

* The two means of the range are obtained as follows: the first one is the average of the electricity consumption divided by the number of persons who are always part of that household; the second one is the electricity consumption divided by the number of persons who are always part of that household plus the number, divided by 3, of persons who are temporary members of that household.

persons in the households, and more electricity as they live in bigger homes.

Results

In the previous section we have shown that Belgian households use more electricity than Danish and we have presented differences in background variables. In the following we will use our data on Danish and Belgian households to explore and possibly explain the relation between these differences. In the first section we show the average electricity consumption for the different types of dwellings and for different sizes of households, and here we also compare survey data with other sources of electricity consumption to discuss the validity of our data. The next section concentrates on showing the importance and the correlation of all the relevant background variables for electricity consumption in each country. Then follows a section on ownership and practices regarding appliances in the two countries. The question we try to answer is whether ownership or use of appliances might explain the higher level of electricity consumption in Belgium compared with Denmark. Finally we also have a section concentrating on whether environmental concern or knowledge of energy saving might be part of the explanation for differences in electricity consumption in the two countries.

ELECTRICITY CONSUMPTION BY DWELLING TYPE AND HOUSEHOLD SIZE

In this section we compare electricity consumption in Belgium and Denmark for different types of dwellings and for different sizes of households. Furthermore we also compare our data on electricity consumption with other data sources of electricity consumption in households in order to discuss the validity of our data.

Average electricity consumption in Denmark is quite different for the three types of housing, which is the reason why we chose to analyse separately each type of housing. Table 5A also shows huge standard deviations showing that there are big variations in electricity consumption within each type of dwelling. Furthermore the average electricity consumption in our sample is quite comparable with national average numbers, though for apartments, the lower level in our sample is explained by a larger number of small apartments in Århus than the national mean. In Belgium, the mean electricity consumption is higher than in Denmark, for every dwelling type and in general, as shown by Table 5B. This difference may be partially explained by the underestimation of single-person households in the SEREC Survey, as electricity consumption correlated well with the household size ($R^2 = 0.24$).

However, when comparing the two countries per dwelling type and per person, as shown in Tables 6A and 6B, the electricity consumption per person is always higher in Belgium; this is especially true for apartments: one person in an apartment in Denmark consumes 1 400 kWh per year on average and a Belgian counterpart 2 100 kWh per year. There are more households living in apartments in Denmark (39%) than in Belgium (23%), with a higher mean number of persons (1.7 versus 1.5) as previously indicated by Tables 2 and 4. To give another perspective, it has been calculated in a Belgian region, Wallonia, that a “saving” household of one person consumes 1 575 kWh annually, while the corresponding figures are 2 200 kWh, 2 705 kWh or 3 150 kWh respectively¹², if there are 2, 3 or 4 persons. These values are between the means estimated for Danish semi-detached houses and apartments.

12. CwaPE, 2003.

Table 6A. Mean electricity consumption per household size: Denmark.

Household size	Detached houses		Semi-detached houses		Apartments	
	N	Est. Elect. Cons. (kWh/pers.)	N	Est. Elect. Cons. (kWh/pers.)	N	Est. Elect. Cons. (kWh/pers.)
1 person	1 114	2 762	1 139	2 112	20 566	1 433
2 persons	3 123	3 536	1 518	2 792	12 933	1 892
3 persons	1 545	4 310	889	3 472	3 293	2 351
4 persons	1 725	5 084	850	4 152	1 288	2 810
5 persons	619	5 858	248	4 832	300	3 269

Source: Estimations with simple regression models computed from the Århus database (2000)

Table 6B. Mean electricity consumption per household size: Belgium.

Household size	Detached houses		Semi-detached houses		Apartments	
	N	Ave. Elect. Cons. (kWh/pers.)	N	Ave. Elect. Cons. (kWh/pers.)	N	Ave. Elect. Cons. (kWh/pers.)
1 person	(17)	(3 325.0)	(14)	(2 954.4)	52	2 134.5
2 persons	71	4 241.0	88	3 380.4	35	2 962.3
3 persons	47	5 526.4	64	4 819.6	(8)	(3 957.6)
4 persons	39	5 358.7	39	5 787.7	(1)	(2 732.5)
5 persons +					-	-
Total	190	4 840.2	242	4 781.9	96	2 587.1

Source: SEREC Survey (2004)

Table 7A. Denmark: detached houses: multiple regression on electricity consumption.

Background Variables	Effect on Electricity Consumption kWh/year	Explanatory Power Change in R ² (%)	Sig.B
Per person in the household	541	27.6	0.000
Per 100 000 DKK in gross income	90	5.8	0.000
Per 10 sq. meter floor area	95	2.5	0.000
Per age square* of oldest person	-0.35	1.3	0.000
Per 0-6 years old child	-158		
Per 13-19 years old child	179	0.5	0.000
If long education compared with no education	-278	0.02	0.000

Based on analysis of the Århus database, n=8573

* In the multiple regression analysis the actual age, and not only the age square, is used, in order to follow "the hierarchical principle", the actual age however has no explanatory power.

Table 7B. Belgium: detached houses: multiple regression on electricity consumption.

Background Variables	Effect on Electricity Consumption kWh/year	Explanatory Power Change in R ² (%)	Sig. B
Per superior quartile in net income	668.5	7.7	0.000
Per person in the household	485.3	4.8	0.000
Per 50 sq. meter floor area	241.3	1.9	0.046
Per 0-9 years old child	-451.7	1.3	0.099
Per age square of respondent	0.204	0.9	0.170
Per education degree	52.7	0.0	0.801
Per 10-19 years old child	66.2	0.0	0.840

SEREC Survey, n=188. Adjusted R² =14%**ANALYSIS OF ALL BACKGROUND VARIABLES**

Results from multiple regression analyses for the three different types of housing are summarized in Tables 7, 8 and 9, where the 'explaining' variables are presented in descending order, which is the reason that the variables appear in different order in the different tables. The variables are written in bold if their additional effect is significant. In all tables, each new line represents an additional explanation where the effect of the above variables is accounted for. This means, for example, that Tables 7A shows the effect of a larger floor area when the effects from the number of persons and the income of the household are already taken into account.

For each type of housing in Denmark the number of persons living in the household is the single most significant explanation for electricity consumption. The more people living in the household, the more electricity is consumed. However as generally known and as can be calculated from Tables 6A and 6B, it is more efficient to live with more people in a household as the electricity consumption per person decreases with the number of people living in a household. The background variables with the second and third largest explanatory power in Denmark are the income of the family and the floor area – two variables that are strongly interrelated especially for detached and semi-detached houses. Together, the number of persons, income and floor area explain

Table 8A. Denmark: semi-detached houses: multiple regression on electricity consumption.

Background Variables	Effect on Electricity Consumption kWh/year	Explanatory Power Change in R ² (%)	Sig. B
Per person in the household	556	34.8	0.000
Per 10 000 DKK in gross income	100	4.1	0.000
Per 10 sq. meter floor area	99	2.1	0.000
Per age square of oldest person	-0.3	0.6	0.000
Per. 0-6 years old child	-211	1.0	0.000
Per 13-19 years old child	159		
If long education compared with no education	-247	0.3	0.000
If not Danish or Western citizenship	-797	0.3	0.000

Based on analysis of the Århus database, n=4950

Table 8B. Belgium: semi-detached houses: multiple regression on electricity consumption.

Background Variables	Effect on Electricity Consumption kWh/year	Explanatory Power Change in R ² (%)	Sig. B
Per person in the household	1 160.8	27.5	0.000
Per superior quartile in net income	769.8	6.6	0.000
Per age square of respondent	0.235	1.0	0.058
Per education degree	218.8	0.5	0.166
Per 0-9 years old child	189.8	0.2	0.353
Per 50 sq. meter floor area	64.8	0.2	0.456
Per 10-19 years old child	96.0	0.0	0.739

SERC Survey, n=241. Adjusted R²=36%**Table 9A. Denmark: apartments: multiple regression on electricity consumption.**

Background Variable	Effect on electricity Consumption kWh/year	Explanatory power Change in R ² (%)	Sig. B
Per person in the household	291	21.9	0.000
Per 100 000 DKK in gross income	20	1.3	0.000
Per 10 sq. meter floor area	119	7.2	0.000
Per age square of oldest person	-0.1	1.3	0.000
Per. 0-6 years old child	-76	0.3	0.000
Per 13-19 years old child	117		
If long education compared with no education	-63	0.1	0.000

Based on analysis of the Århus database, n=40 281

Table 9B. Belgium: apartments: multiple regression on electricity consumption.

Background Variables	Effect on Electricity Consumption kWh/year	Explanatory Power Change in R ² (%)	Sig. B
Per superior quartile in net income	569.5	6.5	0.012
Per person in the household	567.9	3.1	0.077
Per 0-9 years old child	-861.3	0.9	0.330
Per 50 sq. meter floor area	-104.7	0.8	0.370
Per 10-19 years old child	-544.3	0.8	0.383
Per education degree	-35.7	0.0	0.848
Per age square of respondent	0.02	0.0	0.897

SERC Survey, n=95. Adjusted R²=12%

between 30% and 40% of the total variation in electricity consumption in the three different types of housing, which also means that 60%-70% of the variation in electricity consumption in Denmark is unexplained by these variables.

For Belgium, the explanatory power of the models is much lower than for Denmark: the adjusted R² equals 14% for the detached houses, 12% for the apartments and surprisingly, it reaches 36% for the semi-detached houses. Fewer variables are significantly correlated with the electricity consumption in Belgium and the net-income quartile is the only variable to be always significant. The number of persons makes a significant difference both for the detached houses

and the semi-detached houses, while the floor area is only significant for detached houses.

These results also showed similarities between the two countries: the presence of one or more small children decreased the mean electricity consumption, except in semi-detached houses in Belgium; beside this (surprising) exception, the effect was higher in Belgium, especially for apartments. The presence of teenagers had the opposite effect in both countries and the increase was stronger in Denmark, whereas in Belgium for families living in apartments, the presence of teenager(s) meant a decrease (not significant though) of mean electricity consumption.

Table 10. Ownership of electric appliances, % households.

Appliances	Denmark	Albertslund survey (DK)	Belgium	Appliances	Denmark	Albertslund survey (DK)	Belgium
Tumble dryer	48	43	65	Video	85		
Washing machine	76	92	95	DVD-player	54		85
Dishwasher	60	52	58	PC	81	78	71
Electric stove	88	100	64	Electric fan	(Not common)		38.3
Microwave oven	66	62	n.a.	Electric radiator	n.a.		29.2

Sources: Denmark (Statistics Denmark 2005) and Albertslund survey (2001). Belgium: SEREC Survey (2004)

Table 11. Ownership of a tumble dryer per group of electricity consumption (% households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh
Have a tumble dryer	21%	38%	68%
Do not have a tumble dryer	79%	62%	32%
N	163	167	174
Gamma (sig.)	0.597 (0.000)		
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year
Have a tumble dryer	50%	65%	84%
Do not have a tumble dryer	50%	35%	16%
N	177	175	177
Gamma (sig.)	0.475 (0.000)		

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

Table 12. Weekly tumble-dryer use per group of electricity consumption (% households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh
Once a week or less	53%	34%	21%
Several times a week	47%	66%	79%
N	32	59	108
Gamma (sig.)	0.334 (0.000)*		
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year
Once a week or less	50%	34%	24%
Several times a week	50%	66%	76%
N	90	111	148
Gamma (sig.)	0.311 (0.000)		

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

* These coefficients are calculated with the same variable with more categories: one use/week, 2, 3, 4, 5-25.

OWNERSHIP AND USE OF APPLIANCES

To explain the higher level of electricity consumption in Belgium compared with Denmark, we now turn to the practices that actually use electricity. The somewhat higher electricity consumption in Belgium compared with Denmark may be partially explained by a higher number of appliances. In Table 10 it is seen that more households in Belgium have tumble dryers, washing machines and electric fans. Even more interesting than comparing the ownership of appliances would be to compare the use of these appliances, which we do in the following section.

Data and Methods on ownership and use of appliances

The Danish data used in this section came from a study in Albertslund, where 500 households answered a questionnaire on energy consumption, ownership and use of appliances. The households lived in semi-detached houses and came from the middle and lower middle-classes in Denmark and thus they were not representative of the whole country.

These statistics therefore also had to be compared with national statistics on ownership of appliances.

In both countries the households studied were grouped into 3 classes of equal amplitude to make comparisons possible between the 'lower consumption group', the 'middle consumption group' and the 'higher consumption group'. Of course, the boundaries of the three groups varied in Denmark and in Belgium.

In Belgium, the lower-level group was made up of 40% of apartments and 37% of semi-detached houses, the middle group had only 7% of apartments, the rest was distributed evenly on detached and semi-detached houses, and the same pattern characterised the higher consumption group. The mean age of the respondent differed significantly between the 3 groups and it decreased from 54 years in the 'lower group', 49 years in the 'middle' group to 47 years in the 'higher group'. The mean household size followed an inverse pattern: 1.9 persons, 2.8 persons and 3.4 persons. As also indicated by the above results, net income was also as-

Table 13. Weekly washing-machine use per group of electricity consumption (% households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh
Once a week	24%	11%	3%
Several times a week	76%	89%	97%
N	139	166	170
Gamma (sig.)	0,462 (0,000)		
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year
Once a week or less	22%	6%	(4%)
Several times a week	78%	94%	96%
N	158	173	178
Gamma (sig.)	-0.427 (0.000)		

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

Table 14. Ownership of a dishwasher per group of electricity consumption (% households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh
Have a dishwasher	35%	53%	68%
Do not have a dishwasher	65%	47%	32%
N	164	173	175
Gamma (sig.)	0,419 (0,000)		
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 8 55 kWh/year	Higher 4 856 – 16 000 kWh/year
Have a dishwasher	35%	62%	88%
Do not have a dishwasher	65%	38%	12%
N	177	175	177
Gamma (sig.)	0.675 (0.000)		

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

sociated with the inclusion in one of these 3 groups: the ‘lower consumption group’ numbered 38% of households whose net income were situated in the first quartile, the ‘middle consumption group’ included 38% of households belonging to the third quartile of net income, while half of the households in the higher consumption group had the highest net income (fourth quartile). At a regional level, the Brussels area was over-represented in the ‘lower group’ and so was Wallonia, to a much lower degree though, while proportionally more households in the Flemish region were in the higher consumption category.

Washing and drying practices

Nearly all Belgian households in the SEREC study (95%) had a washing machine, which was generally used several times per week. The electricity consumption was significantly correlated with this usage frequency ($R^2 = 7.6\%$). Two thirds of the Belgian households had a dryer and used it a little less frequently than the washing machine. The correlation with the electricity consumption was still higher ($R^2 = 8.6\%$). In three households in five, the dryer was used as often¹³ as the washing machine; in total, 42.1% of the households surveyed used both the washing machine and the dryer several times a week and 9.2% every day. The use of both appliances was indeed highly correlated ($R^2 = 24.5\%$).

The usage frequency of the washing machine did not seem to differ between the 2 countries (Table 13). More households have a tumble dryer in Belgium than in Denmark and this held true both when comparing the SEREC

data with general statistic from Denmark and with the Albertslund data in each of the three ‘consumption groups’ (Tables 10 and 11). Frequency of both washing and drying seemed to be about the same in both countries (Tables 12 and 13).

Washing the dishes

Both in Belgium and in Denmark, three households in five have a dishwasher (Table 10). As expected, having a dishwasher or not correlated well with electricity consumption. Furthermore, its average use also strongly influenced it (not shown here).

Refrigerator

In Denmark, having a low-energy refrigerator or freezer is not significantly correlated with a low level of electricity consumption. It seems to be the same in Belgium (Table 15). In both countries, the number of refrigerators in the dwelling is highly correlated with electricity consumption (Table 15 for Belgium, Denmark is not shown here).

Daily duration of housework

From time-use surveys (which are harmonised in Europe), it appears that Belgian women spend more time per day doing ‘household and family care’ chores than Danish women: of course, all these chores do not imply the use of appliances all the time but still, these surveys indicate that on average a Danish woman spends 3 hours and 20 minutes each day doing these tasks (3:13 for the employed), while her Belgian

13. At least within our categories of frequency.

Table 15. Characteristics of the refrigerator(s) per group of electricity consumption (% households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh
Have a low-energy refrigerator-freezer	53%	62%	49%
Do not have a low-energy refrigerator-freezer	47%	38%	51%
N	79	65	70
Gamma (sig.)	-0.055 (0.628)		
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year
Have at least one appliance of class A or B	60%	70%	70%
Have no appliance of class A or B	21%	18%	19%
Does not know	19%	13%	11%
N	175	175	177
Gamma (sig.)	-0.141 (0.040)		
Mean number of refrigerators	1.08	1.26	1.41
F (sig.)	25.3 (0.000)		
Mean age of main refrigerator	7.5	8.0	7.9
F (sig.)	0.2 (0.781)		

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

Table 16. Ownership of CFL lamps per group of electricity consumption (% households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh
< 25% CFL	74%	81%	73%
25% - 50% CFL	14%	11%	14%
> 50% CFL	12%	8%	13%
N	170	170	176
Gamma (sig.)	0.029 (0.727)		
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year
Have CFLs	63%	67%	70%
Do not have CFLs	38%	33%	30%
N	176	175	177
Gamma (sig.)	-0.096 (.203)		

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

Table 17. Ownership of TVs, videos and PCs per group of electricity consumption (% households).

Denmark	Lower	Middle	Higher	
Mean number of TVs +Video, DVDs	1.8	2.2	2.9	
N	148	158	162	
Mean number of PCs	0.62	0.99	1.37	
N	154	149	156	
Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year	Sig. of F
Mean number of TVs	1.27	1.45	1.72	0.000
Mean number of video/DVD	1.03	1.29	1.61	0.000
Mean number of PCs	0.59	1.01	1.33	0.000
N	177	175	178	

Sources: Denmark: Albertslund survey (2001); Belgium: SEREC Survey (2004)

counterpart spends nearly 4 hours (3:58; for the employed: 3:46). There are no differences for men (Eurostat, 2003, Aliaga & Winqvist, 2003). How the use of appliances – and sometimes the power decision to buy them – increases the domestic power in a rather unequal gender system has been discussed for Belgium (Bartiaux, 2003) and a comparison with Denmark would be interesting. From available statistics on time use and on labour force participation, Danish society seems to be more egalitarian than Belgium. Further research is needed to study whether (and how) this could have consequences for electricity consumption.

Lighting

Neither in Denmark nor in Belgium, a significant correlation appears between having CFL and the electricity consumption (Table 16). In Belgium, 25% of the 'lower group' reported that they always switched off the light when leaving a room for 5 minutes; so did 23% of the 'middle group' and 19% of the 'higher group'.

PC and TV

On average, Danish households have fewer TVs, videos and DVDs than Belgian households as shown in Table 17. Moreover, Danish people spend less time watching TV and video than Belgians do: 2 hours per day as opposed to 2:18. The

Table 18. Opinions per group of electricity consumption, Denmark (% of households).

Denmark	Lower 419-2 382 kWh	Middle 2 383-3 458 kWh	Higher 3 459-8 289 kWh	N
Very careful about energy saving	51%	30%	22%	181
Somehow careful about energy saving	45%	66%	66%	313
Normally not careful about energy saving	5%	5%	12%	38
N	177	178	177	
Gamma (sig.)	-0,400 (0.000)			

Sources: Denmark: Albertslund survey (2001)

Table 19. Representations and opinions per group of electricity consumption, Belgium (% of households).

Belgium	Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year	Sig. of F
I think I have done my best to save energy	2.45	2.68	2.99	0.000
[Energy saving] is not one of my priorities	4.07	3.78	3.70	0.036
[Energy saving] requires too much efforts	4.12	4.08	3.80	0.043
I don't want to loose in my comfort	3.32	3.62	3.50	0.156

Source: Belgium: SEREC Survey (2004)

Table 20. Main reason for saving energy per group of electricity consumption, Belgium (% of households).

Lower 500 – 2 949 kWh/year	Middle 2 950 – 4 855 kWh/year	Higher 4 856 – 16 000 kWh/year
To protect the environment (31%)	To protect the environment (29%)	To avoid wasting (36%)
To avoid wasting (23%)	To avoid wasting (28%)	To protect the environment (25%)
By sense of a collective responsibility (17%)	For economy reason (19%)	By sense of a collective responsibility (16%)

Source: Belgium: SEREC Survey (2004)

difference is mainly due to the unemployed persons (proportionally more numerous in Belgium), men and women aged 45 years and over with no children at home (Eurostat, 2003). However, in Denmark there are 10% more households with a PC than in Belgium (see Table 10) and as seen in Table 17 the mean number of PCs does correlate with the level of electricity consumption in both Denmark and Belgium.

In Belgium the number of TVs, videos or DVDs and the number of PCs used in the household were significantly correlated with the electricity consumption group. In addition, we tried to include some information in the survey about the stand-by consumption, but it appeared from the pre-tests that this notion was not clearly and equally understood. So we asked the following question: “Do you switch off the TV only from the remote control?” The proportions of the ‘never’ answers were 36% in the ‘lower consumption group’, 30% in the middle group and 21% in the higher group. In Denmark the survey showed strong significant correlation between a high number of appliances with standby normally on and the level of electricity consumption.

ENERGY SAVING AND ENVIRONMENTAL CONCERN

In the Danish questionnaire, it was asked whether the households were careful about saving energy. The majority of the households thought that they were somehow or very careful about energy savings and this had a strong significant correlation with the households' level of electricity consumption (Table 18). The same turns out to be true in Belgium, to a minor degree, with the results to the question “Do you think that you have done your best to save energy?”: the answer was positive for 62.7% in the ‘lower group’,

55.2% in the ‘middle group’ and only 41% in the ‘higher group’ (see also Table 19). This could indicate that the people in Albertslund (Denmark) were more careful about saving energy. The reasons why some people are more careful than others may be diverse however.

For Belgium, Table 19 shows the average value for opinions on this topic. The value ‘1’ was given if the respondent fully agreed with the proposition and the value ‘5’ if s/he fully disagreed; ‘3’ was neutral. Many more persons in the lower consumption group reported that they had done their best to save energy and that they disagree with the ideas that energy saving was not one of their priorities or that it required too much effort. The association between energy saving and the idea of comfort did not yield significant differences between the three consumption groups.

In the Danish survey, a question was asked whether it was important to save natural resources for environmental reasons: 87% absolutely agreed with this and only 0.5% disagreed. It was further asked whether it was important to save natural resources for economy reasons and 79% absolutely agreed with this, while only 1,3% disagreed. None of these questions however correlated with the household level of electricity consumption.

Another question in the Belgian survey was: “What is, or what would be your main reason for saving energy?” Results are reported in Table 20. It is difficult to conclude from these figures that households with moderate electricity consumption valued the protection of the environment more than other households and it is even more hazardous to think that this environmental concern would drive their practices for lower electricity consumption.

Table 21. Opinions on environment (Source: Eurobarometer, 2002).

Which of these opinions comes closest to yours?				
	Human activity is currently in harmony with the environment	The deterioration of the environment can be halted by changing our way of life	Human activities can lead to irretrievable damage to the environment	Others and not answered
Denmark	5%	38%	52%	5%
Belgium	5%	55%	35%	6%
EU15 total	4%	45%	44%	6%
"Very" or "fairly well informed" on environmental questions (%)				
	Summary for 25 environmental questions	Climate	Consumption	Nuclear Power
Denmark	58%	65%	65%	48%
Belgium	38%	45%	37%	32%
EU15 total	43%	53%	46%	38%
Individual actions				
	The environment is an issue beyond my control as an individual	My actions can make a real difference to the environment	Others and not answered	
Denmark	42%	51%	7%	
Belgium	30%	52%	18%	
EU15 total	43%	43%	14%	

Another way of comparing attitudes on the environment in the two countries is through the Eurobarometer¹⁴. Approximately 1 000 inhabitants in each of the former 15 European countries, including Denmark and Belgium, were asked about their attitudes, concern and knowledge about the environment. As indicated in Table 21, it seemed as if Belgians were more optimistic in their view that lifestyle changes could help the environment, whereas more people in Denmark doubted that the environment was an issue that they could influence as individuals. People in Denmark however felt much better informed than in Belgium, especially on issues that related to electricity consumption such as climate, consumption, nuclear power (in Belgium, electricity is mostly produced so). But it remains to study whether and how information motivates behaviours or not in our societies: "the increase of social-actors reflexivity on themselves goes faster than their capacity of action" (Martuccelli, 2002, p.146). Overall it seems difficult to use attitudes to the environment as an explanation of the differences in electricity consumption between the two countries.

Conclusion

Household electricity consumption is lower in Denmark than in Belgium and this paper explores this difference. One part of it could be explained by the fact that the survey data used for Belgium underestimated single-person households and households living in small space, two factors correlated with low electricity consumption. When controlling by household size, the difference between the two countries remains and our results indicate that part of the explanation of the higher electricity consumption in Belgium could be the number and use of appliances. There are more TVs and videos per household and more time is spent watching them in Belgium. Tumble dryers are more widespread and so are electric fans and radiators (less than half of the surveyed

households had none of these two appliances). Probably more time is also devoted to preparing food and to cooking in Belgium. Time allocation for household chores, use of appliances and their implicit meanings should also be seen in the framework of gender systems that seem to be more egalitarian in Denmark. Factors that do not seem to explain the difference in electricity consumption include the use of energy efficient lamps and appliances. Based on a Eurobarometer survey, it has been hypothesised that attitudes and environmental concerns are probably not factors that can explain the differences observed in electricity consumption; information on environmental matters could play a role, but this needs to be further studied.

From a policy point of view it is interesting to know if these differences, which result in different levels of electricity consumption, are based on general cultural differences or if they are to some extent influenced by differences in energy policy, including public campaigns, taxes etc. The lack of weighty explanations for the large differences in electricity consumption between the two countries, combined with the fact that Danish electricity consumption has been stable for the last decades, whereas the Belgian consumption has grown, suggests however that the stronger focus on energy saving in the Danish energy policy compared with the Belgian policy actually has had a positive result. Results in this paper however also point to factors with a huge impact on electricity consumption, which neither in Denmark nor in Belgium are part of energy policy, including the (growing) size of houses, the growing portion of single-person households and the growing number of appliances in all households.

14. See The European Opinion Research Group (2002) available on http://europa.eu.int/comm/environment/barometer/barometer_2003_en.pdf read on 18/1/5

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