

Electricity disclosure: The troubled birth of a new policy

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Abstract

As of October 2005, consumers in the EU15 have, in theory, become part of the decision-making process behind determining the national electricity generation mix in their countries. Under European liberalisation legislation, electricity suppliers within the EU are required to provide all customers, both domestic and non-domestic, with information about how their electricity has been generated and to make available details of the consequent environmental impacts. As part of a liberalised market, these ‘electricity labels’ will play an important role if consumers are to exert the power of choice. Analysis of a pan-European telephone survey involving 3000 participants across 10 countries identifies the potential impact of electricity disclosure. Evidence from the UK demonstrates the many pitfalls between theory and practice and the limited options consumers have at present to influence the generation mix.

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1. Introduction

The implementation of the European Directive 2003/54/EC on liberalisation of the European electricity market requires all Member States to open up their electricity markets to competition. To facilitate this competition, the Directive includes a provision for the ‘labelling’ of electricity, otherwise known as ‘electricity disclosure’. This requires electricity suppliers to provide all customers, both domestic and non-domestic, with information about how their electricity has been generated and to make available details of the consequent environmental impacts (carbon dioxide emissions and nuclear waste).

At the heart of disclosure lies the customer—the provision of information about the source and environmental impact of their electricity means that people will be able to choose a supplier on factors other than price, making an informed decision which reflects their environmental values. There is a substantial potential for consumers to shift the supply mix towards more sustainable sources of electricity. For this to happen, the relevant information has to be accessible to consumers, they have

to be concerned and then switch to a new supplier. A secondary, related effect of disclosure will be the way in which suppliers anticipate—and respond to—consumers’ actions and change their purchasing patterns. The full effect may take time and be difficult to isolate, as changes in the supply mix—and, therefore, the generation mix—reflect the varying company priorities, fossil fuel prices, regulatory environment, as well as any consumer pressures.

The process of disclosing the fuel mix (and environmental information) to consumers is also taking place in the USA and Switzerland (Markard and Holt, 2003) and in parts of Australia (Watt and Outhred, 2001), though few results have been established. In some cases, where the market has not been liberalised (e.g. several American States), the information is provided to enhance consumer awareness, as switching is not yet possible. In Australia, part of the motivation was to encourage the visibility, and, therefore, provision, of electricity from renewable sources (Watt and Outhred, 2001).

Prior to disclosure, customers had changed supplier primarily on the basis of the unit price of electricity. The UK has the highest number of customers who have switched supplier, partly due to the fact that the UK was one of the first to liberalise its electricity market (Table 1).

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Table 1
European electricity markets: liberalisation and switching estimates, 2003

	Declared market opening 2004 ^a (2003 ^b)(%)	Total switching estimates, since market opening ^a (1998–2001) ^c (%)		Annual switching estimates, 2003 ^a or (2002 ^b) (%)	
		Large eligible industrial users	Small commercial/domestic ^d	Large eligible industrial users	Small commercial/domestic ^d
Austria	100	22	3	7	1
Belgium	c.90	35	19	8	19
Denmark	100	> 50	5	22	5
Finland	100	> 50	(5–10)	16	4
France	70	22	–	(15)	–
Germany	100	35	6	(20)	(5)
Greece	62	0	–	0	–
Ireland	56	> 50	1	6	1
Italy	79	c.15	–	(15)	–
Luxembourg	57	10	–	(10)	–
Netherlands	100	30	35	(20)	Unknown
Portugal	100	9	1	7	1
Spain	100	18	0	5	0
Sweden	100	> 50	(10–20)	5	10
UK	100	> 50	> 50	(15)	22
Estonia	10	0	–	0	–
Latvia	76	0	–	0	–
Lithuania	(17)	17	–	17	–
Poland	52	10	–	7	–
Czech R	47	Unknown	–	Unknown	–
Slovakia	66	10	4	3	(6)
Hungary	67	24	–	19	–
Slovenia	75	10	–	10	–
Cyprus	35	0	–	0	–
Malta	0	0	–	0	–

^aEuropean Commission (2005b).

^bEuropean Commission (2004b).

^cEuropean Commission (2003).

^d– represents ‘not eligible’.

The percentage of customers who have switched tends to be highest for large industrial users in those countries which are fully liberalised, while the proportion of small commercial and domestic customers switching is far lower, apart from in the UK and the Netherlands. This is most likely a reflection of the staggered approach taken to liberalisation, with residential customers being the last to be brought into the market. The annual switching rates show a similar pattern but with small commercial and domestic switching rates double those of large industrial users in Belgium and Sweden. The experience of switching, albeit on the basis of price, is a useful preparation for reacting to disclosure.

This paper examines the legal background of the Directive with reference to disclosure and then provides the results of a European survey into the consumer attitudes to indicate how they may respond to disclosure. The surveys were part of the **4CE (2003)** project (‘Consumer Choice and Carbon Consciousness for Electricity’, funded by the European Commission). The paper draws heavily on two substantive reports (Palmer et al., 2003; Boardman and Palmer, 2003). Finally, evidence from the first year of operation in the UK is presented.

The main focus is on electricity supply to the residential sector and of the effects on carbon dioxide emissions, rather than radioactive waste, as the latter is a straight multiplier of the amount of nuclear power used, whereas the former results from the mix of all fuels used to supply the electricity.

2. The Directive

The European Directive 2003/54/EC on liberalisation of the European electricity market was adopted by the Commission in June 2003 with implementation by 1 July 2004. Under the Directive, the EU15 Member States are obliged to fully liberalise their electricity markets by 1 July 2007; the new EU10 Member States have until 1 January 2013 to be fully liberalised. The objective of liberalisation is to promote better services and lower prices through greater openness, competition, transparency and interconnection. By the end of 2005, liberalisation was progressing slowly across Europe. Seven Member States had not even transposed the Directive into country law and were being taken to the Court of Justice by the **European Commission (2005a, p. 29)**.

Disclosure is only effective if the market is sufficiently liberalised for customers to switch to an alternative supplier. With progress towards full market liberalisation, a growing number of customers are able to choose who they buy their electricity from. As part of this process, suppliers are required to provide improved consumer information on the electricity supplied—electricity disclosure. The objectives of this are fourfold (European Commission, 2004a):

- increase market transparency by providing open and easy access to relevant information,
- comply with the consumers' right to information regarding purchased products,
- enable consumers to make informed choices about suppliers based on the generation characteristics of the electricity they supply,
- educate consumers and stimulate electricity generation that contributes to a secure and sustainable electricity system.

The provision is detailed in Article 3 of the Directive:

- 6) Member States shall ensure that electricity suppliers specify in or with the bills and in promotional materials made available to final customers:
 - a) the contribution of each energy source to the overall fuel mix of the supplier over the preceding year;
 - b) at least the reference to existing reference sources, such as web-pages, where information on the environmental impact, in terms of at least emissions of CO₂ and the radioactive waste resulting from the electricity produced by the overall fuel mix of the supplier over the preceding year is publicly available.

...Member States shall take the necessary steps to ensure that the information provided by suppliers to their customers pursuant to this Article is reliable.

As it stands, the wording of the labelling provision in the Directive is weak, with no requirement for harmonisation between or even within Member States, though individual Member States could decide to implement a harmonised scheme within their own boundaries. This is in contrast to the approach taken under the Framework Directive 92/75/EC for labelling appliances in which a unified European scheme was developed. The car labelling Directive (1999/94/EC) required a uniform scheme within each Member State, but not uniformity between states initially, and provides the opportunity for harmonisation later, based on the experience of the different schemes. For electricity, consumers need information that is easy to compare across products in their own country: any trading between countries is likely to be by suppliers, not consumers. Thus, uniformity within each country should be the priority and consistency between States is of less importance.

The effectiveness of electricity disclosure ultimately depends on how the legislation is implemented in each of the Member States. The labelling provision in the Directive only outlines the requirements in very general terms. More specific, detailed guidance on interpretation of the Directive has been provided by the European Commission (European Commission, 2004a; Palmer et al., 2003). Although these recommendations are not legally binding, they represent an attempt by the Commission to identify the potential of the Directive. There is a possibility, however, that Member States will do the minimum necessary to comply with the Directive, potentially limiting the impact of disclosure.

The requirement in the Directive that the information supplied to consumers is 'reliable' does imply that an institution will be required in each Member State to monitor the calibre of information provided through disclosure.

The Directive does not provide a specific timeline in relation to disclosure, other than the general requirement that:

Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive not later than 1 July 2004.

If a full year for data collection is allowed, this implies that information on electricity should have been available to all consumers throughout the EU from July 2005 onwards. Information on the status of disclosure schemes amongst the Member States is limited—the first annual report from the Commission on implementation of the Directive concludes that the requirement of Article 3 (6) "has, as yet only been partially transposed and is not operational in many Member States" (European Commission, 2005a, p. 34). Nine of the EU15 members had made arrangements to implement labelling, by September 2005 (European Commission, 2005a, p. 35). Austria is the most advanced EU country in terms of compliance, having had a disclosure scheme in place since 2001.

2.1. What do European consumers want?

In order to investigate the possible response to disclosure, a pan-European survey involving 2000 domestic customers and 1000 Small and Medium Enterprises (SMEs) was conducted in 2003. The aim was to explore people's comprehension and knowledge of issues around electricity disclosure, the results representing a significant benchmark of understanding in this area. The survey was undertaken as part of the 4CE (2003) project carried out under the framework of the EU Altener programme, which studied the implementation of a European electricity disclosure scheme (Boardman and Palmer, 2003). Results from the survey presented here provide an insight into the choices that consumers might make and the possible implications for suppliers and policy-makers.

In 2003, the survey was conducted, by telephone, with a representative sample in 10 of the major European Member States or accession countries (as they were then). All the interviews were conducted by a native speaker of the appropriate language. Survey participants were asked a range of questions regarding electricity purchase, environmental concerns and knowledge, and electricity disclosure. A selection of the responses is presented here and full details of the survey can be found on the 4CE (2003) website (<http://www.electricitylabels.com>). Unless otherwise stated, percentages given relate to the whole sample (3000 respondents: 2000 households and 1000 SMEs). Detailed analysis is undertaken for households only.

2.2. Electricity and the environment

One of the aims of the survey was to investigate environmental concerns in relation to electricity. Respondents were asked to indicate their level of concern about four environmental impacts related to electricity usage: radioactive waste, CO₂ emissions, climate change and use of finite fuels. The first two groups of issues were investigated as they are identified for disclosure in the Directive. The other environmental impacts were surveyed to assess consumers' background knowledge. A Likert scale of 1 (low) to 10 (high) was used and scores of 7 or more were assumed to represent 'high concern'. In the results below, the χ^2 tests if there is a relationship, whereas tau-*b* indicates the strength of the relationship; in both cases the higher the number, the greater the strength of the association.

Table 2
Level of concern about the consequences of electricity generation, households and SMEs

	All	Au	F	G	Gr	Hu	I	P	Sp	Sw	UK
Radioactive waste ^a	7.4	7.8	6.6	7.0	8.8	7.5	7.7	6.0	8.6	6.5	7.0
CO ₂ emissions ^b	6.9	6.7	5.7	6.4	7.9	7.3	7.4	6.1	7.8	6.8	6.8
Climate change ^c	7.0	6.6	6.0	6.7	7.7	7.5	7.4	5.9	7.9	6.9	6.8
Fuel will run out ^d	7.1	7.0	6.3	7.2	7.0	7.8	7.6	5.8	7.7	6.8	7.2

For total sample: (a) $N = 2863$, (b) $N = 2841$, (c) $N = 2906$, (d) $N = 2927$.
Note: Countries surveyed: Austria, France, Germany, Greece, Hungary, Italy, Poland, Spain, Sweden, UK.

Table 3
Relationship between levels of concern and socio-economic factors, households

	Radioactive waste				Climate change			
	χ^2	<i>p</i>	tau- <i>b</i>	<i>N</i>	χ^2	<i>p</i>	tau- <i>b</i>	<i>N</i>
Gender (df = 2)	15.93	<.001	.09 ^a	1885	18.60	<.001	.10 ^a	1914
Age (df = 10)	8.96	.536	–	1876	11.96	.288	–	1926
Income (df = 16)	26.26	.050	–	1260	19.75	.232	–	1269
Socio-economic group (df = 10)	11.60	.312	–	1827	12.95	.227	–	1853
Education (df = 6)	24.35	<.001	–.07	1802	3.00	.809	–	1831

^aValue of Cramer's *V* (tau-*b* equivalent for nominal measures).

Levels of concern for each of the impacts were similar, with around half the sample expressing high concern for all four impacts. Table 2 shows the mean scores for each impact, illustrating the strength of concern that exists in all sampled countries, with Spain being the highest and Poland the lowest aggregate score. There was a significant association between concern for radioactive waste and the other impacts: CO₂ emissions ($\chi^2 = 738.14$, df = 4, $p < .001$), climate change ($\chi^2 = 679.10$, df = 9, $p < .001$) and limited (i.e. fossil) fuel ($\chi^2 = 471.87$, df = 9, $p < .001$). Values of Kendall's tau-*b* were .43, .40 and .34, respectively, indicating a medium strength of association. Hence, it appears that respondents who are concerned about the fact that electricity generation produces radioactive waste are also likely to be concerned about the other environmental impacts of generation or of the risk of fuel shortages.

The Directive specifies that radioactive waste and carbon dioxide are the two environmental impacts that must be covered by disclosure. Focusing on concern about radioactive waste and climate change amongst householders, a significant association was only found with gender (for both impacts) and education (radioactive waste only), and only with a low level of association—indicated by Kendall's tau-*b* (and Cramer's *V* for gender, as a nominal variable) (Table 3). These results indicate that women are slightly more likely to express higher levels of concern than men and that levels of concern about radioactive waste drop slightly as education increases.

It is surprising that a stronger relationship between concern and some of the sample characteristics is not apparent since environmental concern has been shown to be associated with education, age and income in other studies (e.g. Jowell et al., 1997; Scientific Alliance, 2002; Tinch et al., 2004). In this dataset, concern about the environmental impacts of electricity generation is generally high with 50–60% of participants expressing strong concern, although there are no clear factors which explain the variation in responses.

Across the whole sample, concern was slightly higher for radioactive waste (56%) than for climate change (48%). On a country-by-country basis, the proportion of respondents indicating high concern ranged from 30% to over 80% (Fig. 1). Participants in Greece showed the highest

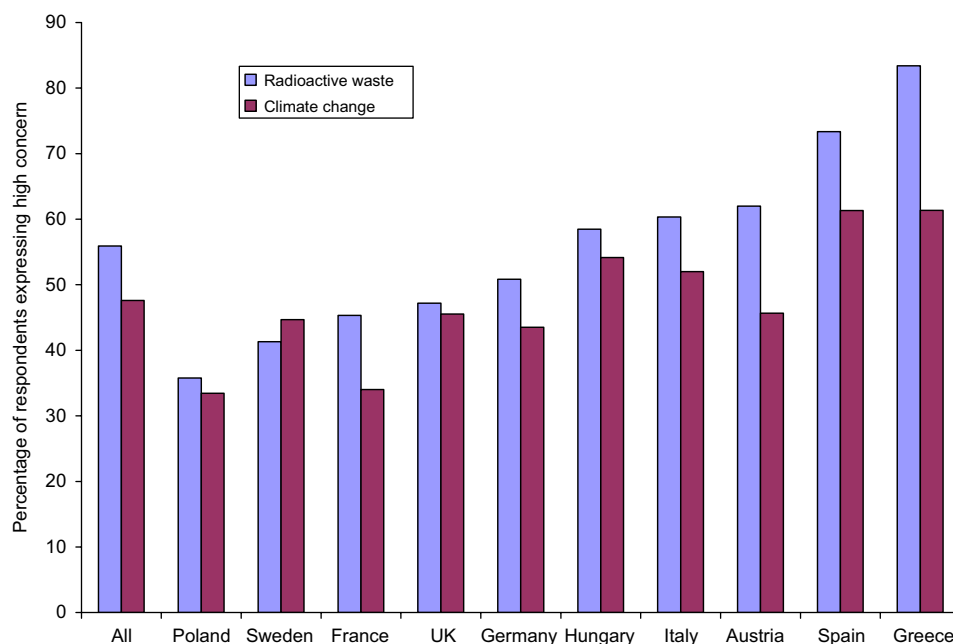


Fig. 1. Concern about the environmental impacts of electricity usage.

Table 4

Relationship between type of electricity purchase and socio-economic factors, households

	Nuclear electricity				Renewable electricity			
	χ^2	<i>p</i>	tau- <i>b</i>	<i>N</i>	χ^2	<i>p</i>	tau- <i>b</i>	<i>N</i>
Gender (df = 2)	59.94	<.001	.18 ^a	1892	1.60	.448	–	1920
Age (df = 10)	5.85	.828	–	1882	22.56	<.05	–.08	1909
Income (df = 16)	64.65	<.001	.15	1256	26.75	<.05	.04	1274
Socio-economic group (df = 10)	33.28	<.001	–.10	1837	14.21	.164	–	1863
Education (df = 6)	25.23	<.001	.09	1807	20.72	<.01	.09	1832

^aValue of Cramer's *V* (tau-*b* equivalent for nominal measures).

level of concern regarding radioactive waste and climate change, with Polish citizens showing the lowest. Radioactive waste appears to be a greater concern in Italy, Austria, Spain and Greece, where there are no nuclear power stations, compared to countries with an active nuclear power programme. France and Sweden, with the highest proportion of nuclear-generated electricity in the national supply mix, at the time of the survey, at 78% and 51% respectively (IEA, 2004), show some of the lowest levels of concern amongst the 10 countries. This contrast may be explained by the fact that citizens in those countries with active nuclear power stations have adapted to the presence of this technology and perceive the issue of radioactive waste as slightly less of a threat.

2.3. Electricity purchase

When asked how likely they would be to buy electricity from nuclear and renewable sources, assuming equal cost, strong support for renewable sources was evident, with

76% of respondents stating they would be likely or extremely likely to buy renewable electricity. In contrast, 64% said they would be unlikely or extremely unlikely to purchase electricity from nuclear sources.

Women are less likely to buy nuclear electricity, although there was no significant difference between genders over purchase of renewable electricity (Table 4), possibly reflecting the emotive aspect of the nuclear debate. Preference for renewable electricity decreased slightly with age and increased with higher education and income levels. The likelihood of buying nuclear electricity also increased with income, education and socio-economic group. This could be due to a better understanding of the risks associated with nuclear electricity. The strength of these associations is still on the low side, but tends to be more marked in relation to nuclear electricity than renewable electricity.

Within the individual countries, there was a wide range in terms of who would be likely to buy nuclear electricity, from 3% in Austria to 55% in Sweden (Fig. 2). The pattern

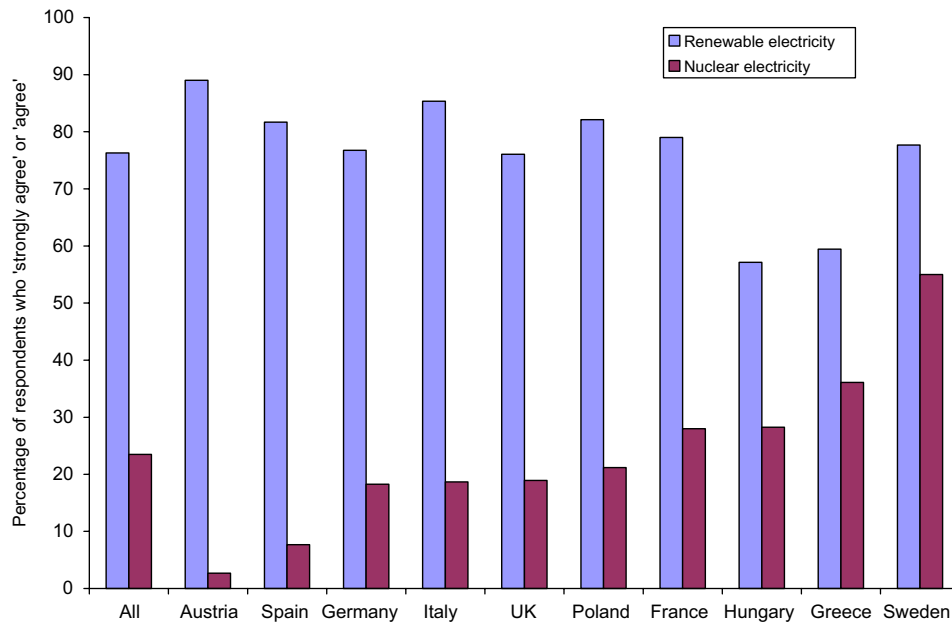


Fig. 2. Preference for type of electricity purchase.

Table 5
Cross-tabulation of concern about radioactive waste and preference for nuclear electricity

			Likely to buy nuclear electricity			Total
			Unlikely	Neither	Likely	
Concern about radioactive waste	Low concern	Count	207	28	115	350
		% of total	7.6%	1.0%	4.2%	12.9%
	Medium concern	Count	448	75	229	752
		% of total	16.5%	2.8%	8.4%	27.7%
	High concern	Count	1173	105	336	1614
		% of total	43.2%	3.9%	12.4%	59.4%
Total	Count		1828	208	680	2716
	% of total		67.3%	7.7%	25.0%	100.0%

of responses may reflect the prevalence of nuclear power in each country—depending on how people interpreted the question; as some may have responded in the context of their national supply mix rather than a personal preference. For instance, the high figure for Sweden may be because Swedes are aware that a large proportion of their electricity is generated from nuclear sources and, therefore, know that this is what they would be buying. Given the history of citizen involvement with energy policy issues in Sweden, for instance the 1980 referendum on nuclear power (Viklund, 2004), a high level of awareness is likely. A recent European Commission survey demonstrated that, on average, European citizens had a good general awareness about the sources of electricity in their own countries (European Commission, 2002)—those in countries with nuclear power tended to be aware of this fact. However, even in countries without nuclear power, the majority of respondents still believed it to be a source of energy in their country (European Commission, 2002).

2.4. Electricity purchase and environmental concern

A more in-depth analysis of the link between environmental concern and electricity purchase revealed a significant association between concern about radioactive waste and preference for nuclear electricity (Table 5). Those expressing strong concern about nuclear waste were less likely to buy nuclear electricity ($\chi^2 = 54.01$ df = 4, $p < .001$). The opposite was true in relation to renewable electricity where a strong concern about nuclear waste is linked to the likelihood of purchasing renewable electricity ($\chi^2 = 10.48$, df = 4, $p < .05$). The strength of association was low in both cases (tau-b = $-.13$ and $.03$, respectively).

The relationship with concern about climate change was less clear: whilst there was a significant association with choice of nuclear electricity ($\chi^2 = 13.14$, df = 4, $p < .05$), with those respondents who were concerned about climate change being less likely to buy nuclear electricity, the association with purchase of renewable electricity was not

Table 6
Cross-tabulation of concern about climate change and preference for renewable electricity

			Likely to buy renewable electricity			Total
			Unlikely	Neither	Likely	
Concern about climate change	Low concern	Count	56	24	249	329
		% of total	2.0%	.9%	8.9%	11.8%
	Medium concern	Count	164	63	842	1069
		% of total	5.9%	2.3%	30.1%	38.3%
	High concern	Count	202	58	1136	1396
		% of total	7.2%	2.1%	40.7%	50.0%
Total	Count		422	145	2227	2794
	% of total		15.1%	5.2%	79.7%	100.0%

significant ($\chi^2 = 9.20$, $df = 4$, $p = .056$) (Table 6). Again, the strength of association was low for both ($\tau\text{-}b = -.06$ and $.04$, respectively). These findings highlight the complexity of people's views, as a concern for climate change and low carbon emissions would have been expected to be linked to a preparedness to purchase nuclear power.

Hence, it appears that whilst concern about radioactive waste may be a motivating factor in determining people's choice of electricity purchase, concern about climate change is less important when choosing renewable energy—the majority would prefer to buy renewable electricity, regardless of whether they are concerned about climate change. These survey results indicate that if consumers are given good, clear information through disclosure and choose to act, there could be substantial pressure on the electricity suppliers. The potential is there.

2.5. The UK as a case study

The UK had the highest annual switching rate amongst small commercial and domestic customers in 2003 at 22%, whereas the highest rate for industrial users was in Denmark, also at 22% (Table 1). The rate has declined slightly in the UK: over the period March 2005–February 2006, nearly 4m households (16%) switched, indicating that brand loyalty may be a chimera. In the next month (March 2006), as rising fuel prices focused consumer attention, the monthly rate of switching increased by 60% to over 535,000 (Ofgem, 2006a). This confirms that the UK has one of the most liberalised electricity markets, with consumers who are accustomed to switching, and thus it is an appropriate country in which to study the effects of disclosure.

The levels of switching on price may not be a good indicator of the likelihood of switching on environmental grounds, though they do indicate the extent to which switching has become an accepted activity. High levels of competition were reducing price differentials, until recent fuel price rises. However, the electricity companies might be relieved to reduce the focus on prices and, instead, compete on environmental factors.

A small proportion of switchers have been motivated by environmental concerns, with a total of 200,000 residential customers purchasing to 'green' tariffs—less than 1% of all UK households (Graham, 2006). Few utilities have promoted green electricity strongly and in the UK the price of green electricity rises with the general tariff. In these circumstances, the low level of sales of green electricity is less surprising. The need for an accreditation procedure, even if voluntary, has been discussed recently (Boardman et al., 2006; Graham, 2006), if consumers are to have confidence in the product offered.

Prior to this Directive, most consumers had no opportunity to identify the range in the environmental impacts of their electricity as the information was not made available by the companies. The lack of marketing of green electricity and its often higher price meant that it has not been easy for environmental consumers to follow their preferences without disclosure.

2.6. UK implementation

The responsibility of implementing the Directive in a way that reflects the spirit, as well as the letter, of the legislation, falls on each Member State's government; in particular, to see this as a way of informing consumers through the medium of reliable evidence. In the UK, implementation of the Directive is the responsibility of the Department of Trade and Industry for Great Britain, through a revision to the standard licence conditions (DTI, 2005b); different arrangements apply in Northern Ireland. The changes were developed through a consultation process with suppliers and other stakeholders, undertaken by the national regulator, Ofgem (2004a, b), DTI (2005a). No direct consultation with the public is identified; therefore, the 4CE (2003) survey provides the best indication to date of what it is that consumers themselves actually want.

The DTI has chosen to implement the minimum required by the Directive (DTI, 2005a) by allowing suppliers to choose their own way of presenting the information, with the option of providing the environmental information on a website, rather than with the bill, being left open.

The lack of a requirement for harmonisation across suppliers in the legislation—although accepted in the European Commission guidance on implementation of the Directive—represents a missed opportunity. As such, the power of disclosure has been diluted and British consumers cannot easily compare across suppliers.

Non-binding guidance to encourage good practice by suppliers when complying with the new licence condition has been produced by *Ofgem* (2005). This proposes limited standardisation of certain aspects of the ‘fuel mix labels’, including a comparison with the national electricity mix, so consumers have some indication as to how their electricity company compares.

The obligation to provide disclosure information is placed on each supply licensee; therefore, companies are required to identify the mix of their total electricity supply. Where the source of the electricity is not known, for instance because the sales have been bought from a pool, the *DTI* (2006) specifies the residual fuel mix each year to be used. The net effect is, in Great Britain at least, that electricity customers are given information about the components of their fuel mix, probably in table format. The first electricity labels were due to appear from October 2005 onwards: each consumer must be given the disclosure information ‘on or with the bill’ at least once a year, including a reference to where the environmental information can be obtained. By September 2006 all 25 million residential customers should have had the fuel mix information at least once.

There appears to have been no survey of the six main providers of residential electricity to establish the format used to present the fuel mix on their bills, nor the general compliance with the guidance. At least one company, *npower*, is not complying as the UK average mix is not provided for comparison. Whatever has happened has been muted—no advertisements, no cold calls, as has been happening with great regularity in relation to fuel switching on the basis of price. This is despite the fact that the fuel mix information has to be provided in promotional materials. *Ofgem* is required to make sure the information is ‘reliable’, but will only prepare a report on the first year of disclosure in 2007 (*Ofgem*, 2006a, b).

One UK website has provided fuel mix information since July 2005 to enable consumers to compare across companies (<http://www.electricityinfo.org>) and others are becoming available (e.g. <http://www.energywatch.org>). From these, cross-checked with company websites, the information in Table 7 has been collated, showing what each individual supplier would provide to their residential and commercial customers. The six suppliers listed provide 99% of the electricity bought by UK households: British Energy, the nuclear generator, is the only other major electricity supplier and it provides the business market predominantly (*Cornwall and Buckley*, 2004, p. 22). The information provided for the current year refers to the electricity actually supplied during the previous 12 months, 1 April–31 March. The UK average for all electricity supplied via the grid is given for reference. The fuel mix of the six suppliers varies considerably:

coal forms	15–54%;
natural gas	30–58%;
nuclear	3–22%;
renewables	.2–8%.

This range indicates that there are a variety of factors influencing how companies decide their mix, which is beyond the scope of this paper to examine. However, it also indicates the potential for consumer influence. The range was not known before disclosure.

One of the issues that became clear in the first year of disclosure is that there is a considerable difference between the national fuel mix and the aggregate fuel mix sold to domestic customers. For instance, in 2005, none of the companies had more than the national proportion of nuclear in the residential fuel mix: British Gas was the highest with 16%, in comparison with the national average of 21%. This discrepancy occurs because the UK average figure covers all sales to all sectors, of which the residential sector accounts for just over a third (37–38%). In all probability, this difference between the sectors was not recognised at the time of the legislation and has only become visible with the introduction of disclosure.

Table 7
Fuel mix, main residential electricity suppliers, UK 2005–6

Company	Coal (%)	Natural gas (%)	Nuclear (%)	Renewables (%)	Other (%)	March 2006 sales % residential
British Gas/Centrica	15	58	22	3	2	22
EDF Energy	45	30	19	3	3	13
npower	41	36	15	5	3	15
PowerGen	54	36	8	.2	2.4	20
Scottish and Southern	39	45	5	8	3	16
Scottish Power	47	43	3	7	.8	13
UK residential	38	42	12	4	2	99
UK average	35	37	21	4	3	

Sources: See web addresses given in Table 9; RH column from *Ofgem* (2006a, b, p. 18).

The UK residential total in Table 7 was calculated from the information on individual companies and demonstrates the differences between the aggregate of what households are buying and the UK national average. For domestic consumers, the relevant information for their comparisons is the residential average. This would identify that three companies have an above average residential proportion of nuclear and three below. A switch to EDF energy or npower would, in reality, represent a switch to an above average nuclear power user for a residential consumer, although this is not apparent from the national average figures. Clearly, a large proportion of nuclear power is supplied through bilateral contracts, for instance between British Energy and large, individual, industrial customers. The information on the UK national average, provided on the label, does not provide a helpful comparison for residential consumers.

Four of the six companies have changed their mix of fuels substantially between 2004–05 and 2005–06 (Table 8). Some of the changes will have been motivated by the increasing price of natural gas. It is not clear how much, or whether, environmental impacts were a factor, though it seems unlikely to have been direct consumer pressure as a result of disclosure.

There is an additional complication about the declared fuel mixes, which occurs where the supplier sells more than one product, such as green electricity, as well as its standard portfolio. This is known as the product vs. portfolio debate (Boardman and Palmer, 2003, p. 37). The fuel mix disclosed to residential consumers represents the supplier's entire portfolio, whether this is comprised of just one or several products for the domestic sector. There is no requirement for the company supply mix to be adjusted to reflect this detail, which means that, for instance, electricity from renewables is counted twice in the supplier's declarations, once in the average of all of its sales and separately to green electricity tariff purchasers. This would clearly be misleading for consumers, but is not something they can identify. The amount of double counting could be significant: 1% of households are buying green electricity (Graham, 2006). If it is assumed that this is all 100% from renewable sources, this would represent a quarter of all the renewable electricity sold to residential customers (4% in Table 7). The average actually being bought by most householders would be only 3% from renewables, with the consequent increase in other sources and environmental impact. For this reason, the portfolio total per company is of reduced usefulness for the average consumer.

Table 8
Main changes in UK residential fuel mix, 2004/5–2005/6

British Gas/Centrica	Nuclear	Increased from 16–22%
EDF Energy	Nuclear	Increased from 14–19%
Npower	Coal	Decreased from 46–41%
Scottish and Southern	Coal	Increased from 30–39%

Source: Comparisons derived from electricityinfo.org.

The additional environmental information on carbon dioxide emissions and radioactive waste is meant to be easily available, for instance on a website. A search for the information on the individual sites of the six main companies requires considerable determination. It is unlikely that members of the public would be able to access sufficient information to make comparisons, without the aid of sites like electricityinfo and energywatch. The search phrases to use are not self-evident; these and the resultant web addresses are listed in Table 9. Care is needed with phrases such as 'generation mix' as many of the suppliers are generators as well, so this could provide quite different information to the supply mix. There should be a consistent, common search phrase that would be both memorable and relevant to consumers, defined by the regulator and used by all suppliers, but there is currently no consistency.

When the information on the carbon dioxide emissions and radioactive waste can be compared, there is a substantial variation between the companies, reflecting the different fuel mixes. With carbon dioxide, there is a range from .37 to .64 kgCO₂/kWh (Table 10): an individual consumer could save 42% of the carbon emissions from electricity just by switching company. This demonstrates the potential environmental benefits of clear information—the rationale behind the legislation. In practice, if consumers were aware of the options, it would be interesting to see the extent to which they would switch to British Gas, to reduce the risk of climate change, despite

Table 9
Contacts for environmental information from six main UK domestic suppliers

Company	Search phrase	Website address
British Gas/Centrica	Fuel mix	http://britishgasbusiness.co.uk/bgb_website/?p=business/products/energy_efficiency/fuel_mix
EDF Energy	Fuel mix	http://www.edfenergy.com/edf-energy/showPage.do?name=ourfutures.til
npower	Fuel mix	http://www.npower.com/About_npower/Our_responsibility/Where_our_electricity_comes_from.html
PowerGen	Electricity source	http://www.powergen.co.uk/About-Us/About-Electricity-Source.htm
Scottish and Southern	Generation mix ^a	http://www.scottish-southern.co.uk/SSEInternet/WorkArea/showcontent.aspx?id=2798&LangType=1033
Scottish Power	Fuel mix ^b	http://www.scottishpower.co.uk/homeenergy/customerservices/fuelmix2.asp?section=homeenergy
All	Fuel mix	http://www.electricityinfo.org/ http://www.energywatch.org.uk/help_and_advice/green_tariffs/fuel_mix_disclosure.asp
UK national	Fuel mix	http://www.dti.gov.uk/energy/policy-strategy/consumer-policy/fuel-mix/page21629.html

^aDespite the confusing phrase, this is the supply mix in reality.

^bNB Scottishpower.co.uk, not Scottishpower.com.

Table 10
Carbon dioxide emissions by company and sector, UK

Company	2004–05 (kgCO ₂ /kWh)	2005–06 (kgCO ₂ /kWh)	% change
British Gas/Centrica	.37	.35	–3.3
EDF Energy	.56	.53	–5.1
npower	.56	.51	–9.5
PowerGen	.64	.62	–3.3
Scottish and Southern	.48	.52	+7.7
Scottish Power	.59	.58	–1.7
UK residential	.52	.51	–1.1
UK total	.46	.461	+ .2

its high proportion of nuclear power. The changes in fuel mix made by the individual companies have resulted in five of the six reducing the carbon dioxide emissions of their residential supply, in 1 year, by up to 10%. This is a rapid rate of change and demonstrates how consumers could have an additional effect, if they were also participating in influencing the market for environmental reasons.

The net effect for UK residents is that disclosure is a limited step forward. There is provision for the system to become more accurate after the first 2 years (Ofgem, 2005), so it is to be hoped that more detailed regulations are incorporated at the same time to deal with these anomalies.

3. Discussion

The advent of electricity disclosure has the potential to bring in a new era of citizen involvement in determining the national electricity generation mix. This is pertinent throughout the EU, with the current debate regarding the need for another generation of nuclear power plants. However, the impact of disclosure depends on how forceful the governments are in implementing a scheme that is effective at translating consumer choice into actual changes in the electricity supply system. And equally, how the utilities choose to approach the issue—rather than being another piece of legislation to fight against, some suppliers could view this as an opportunity to develop a stronger market position and a way of encouraging stronger brand loyalty amongst its customers, by providing them with a product that they want. Despite the heightened awareness of the urgency of climate change, the evidence is that electricity disclosure is not being given priority by either Member State governments, or most major utilities in the UK.

Disclosure represents a significant opportunity for suppliers to position themselves in the market to appeal to consumers' environmental concerns. British Energy, the generator which provides 90% of its electricity from nuclear power, but sells mainly to industrial customers, is promoting itself as an environmentally friendly company—according to the company's disclosure information (British Energy, 2005):

...British Energy is making the largest beneficial contribution to the UK's climate change programme of any single power utility.

Whether or not customers notice the disclosure information depends on how suppliers choose to present it—given that bills are already viewed as being confusing and complex by many consumers (Boardman and Palmer, 2003, p. 22), it would be easy to lose the disclosure information in amongst what is there already. The provision of prominent, clear and easy to understand information is crucial to the success of disclosure (Markard and Holt, 2003). In the UK, the utilities do not have a standard format for the information 'on or with' the bill and appear to depend on websites to display environmental information, so that the potential is not being realised.

Reliability of the data is also key, particularly given low levels of trust in information provided by suppliers amongst consumers (Boardman and Palmer, 2003). A disclosure scheme with poor data undermines the credibility of the system in the eyes of the customers and renders it ineffective. A high degree of accuracy and transparency in how the figures are calculated is important in avoiding such an occurrence, with careful policing to ensure compliance. The anomalies outlined in the paper in relation to both the national average fuel mix and the use of the portfolio fuel mix by the suppliers are examples that could easily result in consumers becoming disillusioned.

There was, of course, no guarantee that governments and suppliers would take a pro-active approach to disclosure. Certainly the action of the UK's DTI and Ofgem so far is not encouraging and the suppliers appear to be adopting a similar, minimalist approach. There is a role for consumer groups and other NGOs to take the lead and raise awareness about disclosure, putting pressure on suppliers and the governments and ensuring all consumers have access to the information they need. Independent websites provide people with a 'one-stop shop' where they can see how the suppliers compare on environmental grounds. Consumers in the USA and Switzerland have consistently identified the ability to make comparisons as important (Markard and Holt, 2003) as well as those throughout the EU (Boardman and Palmer, 2003). If consumers are to make use of electricity disclosure, compare companies and use the information as a basis for switching, then the whole process has to be made considerably more visible and consumer friendly.

There is the wider question of how the European citizens themselves will respond to this information. What is clear from the results of the 4CE (2003) survey is that there are high levels of concern regarding the environmental impact of electricity and a strong preference for renewable sources of energy. These trends appear fairly consistent across all 10 countries surveyed and between householders and SMEs. However, it is well known that people often overstate what they would do in reality and possibly respond in the way that they view as being 'right' or socially

acceptable. Many surveys have demonstrated high concern for the environment and strong support for renewable sources of electricity, but the slow uptake of, for example green electricity implies that people do not always act on these views. Whatever the reason, the provision of the necessary information, as required by the Directive, is the first essential step.

The link between environmental concern and the type of electricity purchased may not be crucial—the analysis presented here indicates that even people who did not express high levels of environmental concern would still favour renewable electricity and are against nuclear power. This has potential implications for the way in which the suppliers choose to market their products—people know what they want and are looking for the simple message that their electricity supply is renewable and is, therefore, protecting the environment. When disclosure is functioning properly, it will be possible to establish the relative priorities that consumers actually give to climate change and nuclear power: will they buy nuclear power because of its low carbon emissions, or not?

Disclosure has the potential to be a useful means of raising awareness about the implications of electricity use. Providing customers with information on the environmental impacts of their electricity is one step further towards encouraging ‘energy citizenship’. An increasing number of products available on the market place are being labelled in terms of their carbon impact, for instance both cars and buildings within Europe. Electricity is another one to add to this list, although somewhat diluted by the fact that the carbon content is not yet required specifically on the bill. If the environmental information is available only on a website, this excludes the substantial proportion of the population without internet access.

4. Conclusion

The introduction of electricity disclosure is a unique opportunity for greater transparency and consumer choice within the electricity industry throughout Europe. The European Commission has initiated the first step by requiring the provision of disclosure information. It is now the responsibility of the national governments, power companies, consumer groups and NGOs to ensure that this information is readily accessible and provided in a way in which people are able to use it effectively. The disclosure schemes need to be carefully designed and strictly monitored to ensure reliability and credibility of the system. Strong marketing and promotion is required to make certain that people notice and can act on this information, in a liberalised market. In the absence of strong brand loyalty, utilities now have the chance to differentiate themselves on factors other than price, with third parties playing an important role in providing an independent and impartial perspective.

One of the key questions is how consumers will choose to act on this new information. With strong support for

renewables and a shift towards greater carbon awareness and energy citizenship, electricity disclosure could be the start of a radical transformation of the electricity market. The utilities and governments need to be prepared to listen to what consumers want and act accordingly.

If used well, disclosure is a powerful tool, enabling consultation with the public through the use of market forces and representing the chance for citizens of Europe to exercise their power in deciding how electricity is generated in Europe.

The early evidence from the UK is that the scheme is being poorly implemented, to the detriment of the environment. The data being provided by UK companies demonstrates, for the first time, the wide range of fuel mixes being supplied by the six major companies: householders could reduce their carbon dioxide emissions from electricity by 42% just by switching supplier. This information was not available prior to disclosure, although it is not easily accessible now in order to make the comparisons.

The use of the national average fuel mix for comparison is misleading, because of the higher proportion of coal and natural gas, and lower proportion of nuclear power, in the residential mix. The emphasis on the fuel mix of the company’s entire portfolio, without excluding, for instance, green electricity tariffs could be resulting in up to a quarter of the renewable electricity being double counted. The most accurate comparison, for householders, is between the fuel mix they are actually purchasing and the average for the whole residential sector. The substantial extent to which suppliers are changing their fuel mix already, between one year and the next, demonstrates that there could be powerful synergies with consumer pressure, if disclosure can be made effective.

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