How many people does it take to change a light bulb?

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Synopsis

An investigation into factors which explain the variation in lighting electricity consumption levels between different households.

Abstract

The behavioural aspects of domestic lighting, such as purchasing and usage patterns and perceptions of what constitutes a desirable level of lighting, are major determinants of consumption levels. This is probably more so for lighting than for any other appliance group.

This paper examines the UK domestic lighting sector, based on a comparative analysis of two current projects: the Billsavers project, managed by LEEP (Lothian and Edinburgh Environmental Partnership), and a SAVE project undertaken by the UK's Electricity Association.

Preliminary findings show large disparities in the quantity, quality and use of lighting in people's homes. For example, LEEP found light bulb ownership ranging from one to sixty light bulbs across income groups. Similarly, thirteen percent of low-income households have no portable light fittings, whereas all houses in the higher income groups have portable fittings. Regarding use, the Electricity Association found, on average, a continuous low level of lighting demand across their sample throughout the day and night. This may be due to security lighting or the existence of rooms which always require artificial light.

It is hoped that a better understanding of the factors underlying such differences in purchasing, installation and usage will provide a sound basis from which to evaluate policy options and assess potential energy savings for this important sector.

1. Introduction

There are many reasons for changing a light bulb: to replace a burnt out bulb, to make a room brighter, to create a more subdued atmosphere, to save energy. Householders may be interested in how they can improve their immediate environment to meet their requirements. Social scientists may be concerned with why people want a certain type of lighting. Policy makers might be interested in how to encourage more energy-efficient lighting. Bringing these different perspectives together is necessary to develop effective measures aimed at reducing lighting consumption.

The amount of electricity going into lighting a house is a function of three physical variables: the number of light bulbs, the wattage of these light bulbs and the length of time each bulb is used. All of these factors involve an element of human behaviour; from choosing how many fittings should be in the room and selecting the types of bulbs that go into the fittings to selecting which fittings to turn on. Lighting is more complex than other domestic appliance groups, reflected in the fact that lighting is probably the least understood sector within domestic lights and appliances. It is not simply a case of one or two appliances in the household which are renewed every

6 to 10 years. Instead, it is more like 20 different appliances, with different usage patterns and a range of power consumptions, most of which are renewed frequently.

Lighting is an important policy focus since it represents a substantial proportion of domestic electricity consumption and is present in practically every household. What is more, compact fluorescent light bulbs (CFLs), an existing technology, have the potential to bring about a substantial reduction in lighting electricity consumption. Such savings would be rapid compared with other appliance groups due to the high turnover of light bulbs in the stock. However, until domestic lighting is better understood, it is difficult to put realistic figures on what the actual level of savings might be. The danger at present is that money is being put into schemes which quote a high level of savings and a short pay back period based purely on an economic analysis. For example, the UK Regional Electricity Companies (RECs) are required by the Regulator under the Standards of Performance (SOPs) to invest in domestic energy efficiency. So far 91% of over 1.7 million approved measures involve installing compact fluorescent light bulbs in the domestic sector (Boardman 1997). The predicted savings for these schemes have been calculated without really understanding how people use lighting and how usage is affected by different bulb types, such as incandescents and CFLs. It could be that these measures are not as cost-effective as they appear once such behavioural factors have been taken into account.

Cultural factors also need to be considered when it comes to assessing policy options and energy savings. Lighting has strong cultural significance (Wilhite et al. 1995) which may differ between countries and possibly between regions within a country. The importance of lighting in creating an atmosphere in the home, which is not such a central issue in the workplace, may result in barriers to savings in the domestic sector. The resistance to change in any aspect of lighting due to these cultural elements may be very large; it is not simply a case of economics as it might be for, say, a refrigerator.

In the UK, lighting is estimated to account for 24% of domestic electricity consumption. This gives an average annual figure of 730 kWh per household (DECADE 1995), although there have been few studies within the UK to validate this figure. This level of consumption is almost double previous estimates, illustrating the uncertainty that exists in this sector.

Studies to date have concentrated on the fixed fittings (hard-wired fittings) on the light circuit, ignoring portable light fittings on the ring circuit. In the UK, portable fittings are those fittings which have a switch either on the fitting itself or on the cable and can be plugged into a wall socket connected to the ring circuit. Fixed fittings are usually located on the ceiling or wall and are operated by a wall mounted switch connected to a separate light circuit. Until now, the only way of accounting for the electricity going into the portable fittings has been to classify it as “residual electricity” or to base the relative proportions for each circuit on estimates of usage. Stenberg (1995) found the balance of usage between fixed fittings and portable fittings in low-income households in Edinburgh to be 63:37. However, this ratio is particularly uncertain, since it is based on estimates, and so the significance of portable fittings in terms of total lighting consumption (consumption in fixed fittings on the lighting circuit and portable fittings on the ring circuit) has not been clear. This issue may not be of such importance for other countries since the way in which lighting is wired into domestic housing often differs, introducing definitional problems in addition to the cultural variation between countries.

This paper represents an interim analysis, identifying some of the key factors which determine the level of household lighting consumption. The results are based on an analysis of two current projects: the Billsavers project, managed by the community project LEEP (Lothian and Edinburgh Environmental Partnership), and a SAVE project undertaken by the UK’s Electricity Association (the major trade organisation of the electricity industry). Both these projects provide monitored lighting data which will enable a better estimate of UK domestic lighting electricity consumption. The EA project has monitored both the fixed fittings and the majority of portable fittings and so, for the first time, it will be possible to obtain the split in electricity consumption between these two end uses. In addition to the monitored data, household surveys were carried out providing information on household characteristics and participants’ attitudes to lighting in general.

2. Methodology

2.1 The Billsavers Project

The Billsavers project, managed by LEEP with funding from LIFE, is based in Edinburgh, Scotland. The project has monitored electricity consumption of domestic lights and appliances in two stages: Billsavers 1, which covered 100 low-income households (LEEP 1996), and Billsavers 2, looking at 100 higher income households.

Survey information was collected for the 200 monitored households. These surveys covered basic household characteristics and included a lighting schedule detailing the number and type of light bulbs and fittings in each room.

2.2 The Electricity Association Lighting Project

The UK's Electricity Association, with funding from SAVE and the UK Department of the Environment, is monitoring domestic lighting in households split almost equally between the South of England, the North of England and Scotland.

A self-completion questionnaire, covering basic household characteristics as well as more in depth questions examining people's attitudes towards lighting and related issues, was sent out to participants. The majority of households also filled out a detailed lighting schedule similar to the one used in the Billsavers project.

Table 2-1. Summary of the data available from the projects used in the analysis

	Billsavers 1	Billsavers 2	EA project
Relevant period	October 1993 - September 1994	October 1995 - September 1996	March - September 1996
Income distributions	Low-income	Mid to high-income	Range of incomes
Survey covering basic household characteristics	Yes	Yes	Yes
Lighting schedules	Yes	Yes	Yes
In-depth survey	No	No	Yes
Fixed fittings monitored	93 households	91 households	72 households
Portable fittings monitored	-	-	72 households

2.3 Data Processing

2.3.1 General

Where there were gaps in the consumption data, figures were adjusted pro-rata on the basis of the data available in the same period.

2.3.2 Linear Regr ession Analysis

Since the distribution of actual consumption was skewed, the log of consumption was used in all analyses to provide data with an approximately normal distribution.

Stepwise linear regression analysis was used to identify the factors which can account for the variation in lighting consumption while controlling for the number of bulbs in each household. Essentially this should indicate factors which determine different levels of usage in households with equivalent bulb ownership. However, as with all such methods, the analysis is limited to those factors on which information was available. Originally, CFL ownership was also controlled for, but it was not found to be significant and was therefore excluded from the models.

Due to differences in the data available, separate analyses were performed for each of the three samples. For the Billsavers 1 and Billsavers 2 samples, annual electricity consumption in the fixed fittings was considered. The factors entered into the regression analysis were: number of rooms, income, region, number of people, number of children (up to 15 years), number of pensioners (people over 65 years), ownership of CFLs.

With the EA project, regression analyses for the six months electricity consumption in both the fixed fittings and the majority of portable fittings, as well as in total, could be performed. The in-depth questionnaire provided factors in addition to those listed above, which were also included in the EA sample regression analysis: importance of security lighting (both internal and external), whether there are rooms which constantly require lighting and if there are other appliances wired into the light circuit.

3. Results

The results are divided into three sections. The first section gives descriptive statistics for all three samples.

The second section compares the variation in consumption across the year between the three samples and looks at the ratio of consumption in fixed and portable fittings for the EA sample.

The third section details the results of the regression analyses.

3.1 Summary Data

The following three tables summarise some of the basic characteristics of the samples.

The average number of rooms per household in Great Britain is 5.05, excluding small kitchens and bathrooms, (OPCS 1993) and the average room area for the UK is 84m^2 (Eurostat 1989). This gives a rough guide to the average floor area for each of the samples: 83 m^2 for the EA sample, 55 m^2 for Billsavers 1 and 96 m^2 for Billsavers 2.

All the samples are slightly higher than the UK average of 2.4 people per household (CSO 1995).

Income data was not collected for the Billsavers 1 sample. However, most households were in receipt of means tested benefit, hence their mean annual income is unlikely to be above £5000. Lower-income households are often made up of people who are retired, disabled, unemployed or single parents. Consequently, these people spend a large proportion of the day in their homes which may result in a high level of lighting usage, particularly during the winter. The EA sample is just below the 1994/5 UK national average of £19 800 (Social Trends 1997), whereas Billsavers 2 is slightly biased towards higher income households.

It is not valid to compare the consumption figures between the Billsavers sample and the EA project directly since the EA sample only has consumption for the six months during summer whereas the Billsavers data are annual figures.

Table 3-1. Summary of Billsavers 1 sample characteristics, UK 1993-5

	Sample mean	Sample standard deviation	Minimum	Maximum	Sample size
Total light bulbs	10.1	2.8	1	16	93
Total light fittings	10.1	2.8	1	16	93
Light bulbs in fixed fittings	7.5	2.0	1	12	93
Fixed fittings	7.5	2.0	1	12	93
CFL ownership	0	-	-	-	93
Fixed fitting consumption (kWh/year/household)	385	240	51	1314	93
# people per household	2.7	1.5	1	8	93
Household income (before tax)	NA	-	-	-	-
Rooms per household	3.3	0.9	2	5	93

Note: For a normal distribution, the standard deviation indicates the range either side of the mean within which roughly 68% of the sample lies. Approximately 95% of the sample lie within +/- two standard deviations of the mean. However, the majority of the distributions in the table are skewed.
NA - not available

Table 3-2. Summary of Billsavers 2 sample characteristics, UK 1995-6

	Sample mean	Sample standard deviation	Minimum	Maximum	Sample size
Total light bulbs	31.6	12.9	10	65	90
Total light fittings	25.1	9.8	9	55	90
Light bulbs in fixed fittings	20.9	10.3	6	52	90
Fixed fittings	15.0	7.0	5	43	90
CFL ownership	3.1	2.8	1	16	36
Fixed fitting consumption (kWh/year/household)	933	700	160	4263	90
# people per household	3.3	1.4	1	9	90
Household income (before tax)	£26 000	-	-	-	65
Rooms per household	5.7	2.1	2	13	90

Note: See note for Table 3-1

Table 3-3. Summary of Electricity Association sample characteristics, UK 1995-6

	Sample mean	Sample standard deviation	Minimum	Maximum	Sample size
Light bulbs	20.7	8.1	6	43	63
Light fittings	16.8	6.3	6	35	63
Light bulbs in fixed fittings	16.3	7.2	4	37	63
Fixed fittings	12.4	5.3	4	30	63
CFL ownership	2.8	1.8	1	6	11
Fixed fitting consumption* (kWh/household)	186	147	13	625	72
Portable fitting consumption* (kWh/household)	39	46	1	218	72
Total lighting consumption* (kWh/household)	225	159	26	811	72
# people per household	3.0	1.3	1	6	67
Household income (before tax)	£18 000	-	-	-	61
Rooms per household	5.0	1.8	2	11	68

* Summer six months

Note: See note for Table 3-1

Note: The number of rooms per household has been adjusted to make consistent with the Billsavers data (the EA definition included kitchens and bathrooms, whereas the Billsavers definition did not)

The low-income households in Billsavers 1 have far lower numbers of light bulbs and lighting consumption compared to the higher income households. The higher income households are more likely to have multiple bulb fittings which may explain the higher levels of consumption to an extent.

The low-income households do not own any CFLs, whereas ownership is at 40% for Billsavers 2. With both Billsavers 2 and the EA sample, those households that have CFLs have an average of two to three CFLs.

The large standard deviations, particularly in the consumption figures, indicate the wide variation that exists across the households.

3.1 Lighting Consumption

3.2.1 Annual Variation in Fixed Fitting Lighting Electricity Consumption

Figure 3-1 is a plot of the average fortnightly (a fortnight is two weeks) readings from the fixed fittings (in total) for the three samples. The data have been smoothed to highlight seasonal trends. The EA data falls between the two Billsavers projects which is in line with the sample characteristics. Average fortnightly consumption across the year for the Billsavers 2 households is over double that for Billsavers 1: 38 kWh compared with 15 kWh.

The lighting demand is seasonal, as would be expected. However, the peak demand in the winter months is more pronounced in the Billsavers 2 households than Billsavers 1. This is probably partly due to the fact that Billsavers 2 households are larger and have more light bulbs, and hence greater scope for varying usage between winter and summer, than in Billsavers 1. Also, as with heating, the low-income households may simply not be able to afford the extra cost of more lighting during the winter. Consequently, the low-income households may have to cope with a lower standard of lighting, particularly in winter.

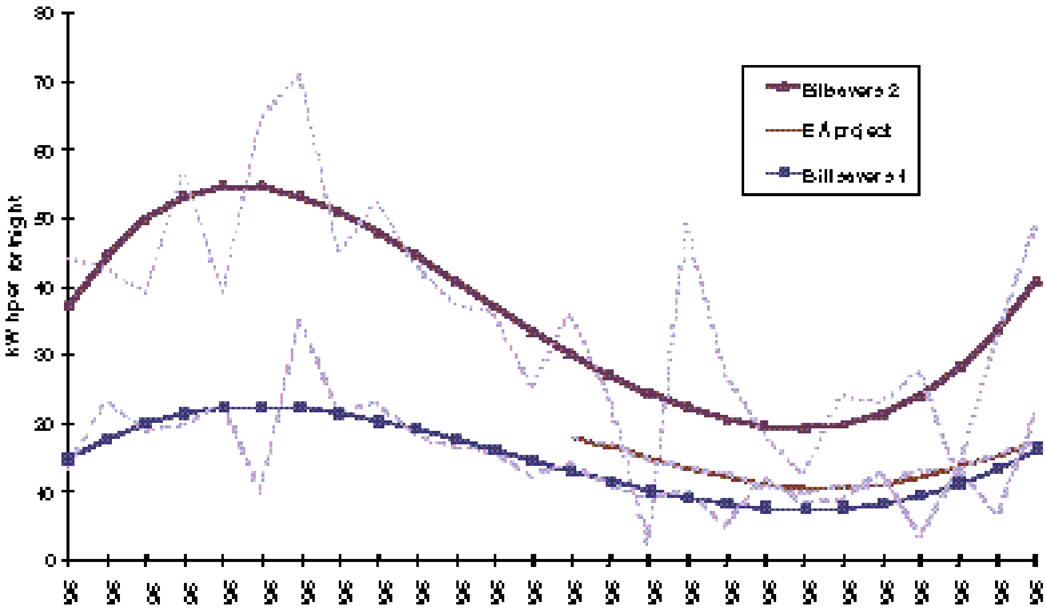

Figure 3-1. Raw and smoothed mean fortnightly fixed fitting electricity consumption for the Billsavers and EA projects Note: The Billsavers 1 data is for the period 10/10/93 to 25/09/94

3.2.2 Fixed Fitting/Por table Fitting Split

The EA sample gives the mean ratio of electricity consumption in fixed fittings to electricity consumption in portable fittings as 83:17. There are two factors which should be taken into account when interpreting this ratio: (1) only the high use portable fittings were monitored and so consumption measured on the ring circuit will be a slight underestimate, (2) it is based on data for the summer months, March - September. It is possible that the data for winter will demonstrate a different relationship. However, applying this ratio to the average fixed fitting consumption in Table 2-1 and 2-2 gives total annual lighting consumption of 464 kWh for Billsavers 1 and 1198 kWh for Billsavers 2. This ratio can be assumed to be a minimum, indicating that DECADE is correct in doubling lighting electricity consumption figures.

3.3 Regression Analyses

The estimated parameters, discussed below, were all significant at the 95% level (t > 1.96).

3.3.1 Billsavers 1

Regression analysis identified two variables as being important in determining electricity consumption in the fixed fittings: total number of people and tenure. The adjusted R squared is 0.25 indicating that the regression explained 25% of the variation in the log of consumption.

3.3.2 Billsavers 2

Total number of people was the only significant variable in this regression analysis (adjusted R squared of 0.28).

3.3.3 EA Sample

Lighting consumption in fixed fittings: the regression analysis identified the total number of people as being the only significant variable (adjusted R squared of 0.22).

Lighting consumption in portable fittings: number of children and region were identified as important factors (adjusted R squared of 0.25).

Total lighting consumption (sum of lighting consumption in fixed and portable fittings): the significant variables were found to be total number of people, region and the presence of other appliances connected to the light circuit (such as infra-red heaters). The adjusted R squared was 0.32.

3.3.4 Discussion of the Regr ession Analyses

The regression analyses identified different combinations of five significant factors: total number of people, number of children, region, tenure and the presence of other appliances on the light circuit. The fact that there are differences between the models is not as important as the general conclusions that can be drawn from these analyses.

Floor area is usually assumed to be the major determinant of lighting consumption. However, the number of rooms in the house (as a surrogate for area) was not found to be a significant variable in any of the models. Instead it seems to be that people and the geographical location are more important.

Total number of people was significant in all models except for consumption in portable fittings, where the number of children was significant. The fact that these variables were identified as being significant is not that surprising, although it does indicate how much lighting consumption depends on behaviour. It is interesting that the presence of children was found to be important. This could be explained by two underlying social trends: (1) older children spending more time in their own rooms, rather than in the communal rooms of a house, and (2) the practise of “comfort lighting” for younger children where lights are left on overnight. Both these trends would lead to higher lighting usage and may be concentrated in portable rather than fixed fittings.

Region was found to be significant in the EA sample (this factor was not relevant to the Billsavers analysis since there was no regional difference within the sample, all the households being located in Scotland), with Scottish households having higher lighting consumption in portable fittings. Since Scotland is further north than the other households, it is understandable that this would be the case in winter since it is darker for longer during this period. However, data was for the summer months and so it could also be that there is some common characteristic of Scottish households that is important in determining lighting consumption but which it is not possible to identify in this analysis. There could be significant differences in usage or maybe even some cultural factor, similar to the importance of “cosiness” to Norwegians identified by Wilhite et al. (1995), which would account for the differences in lighting consumption. The Billsavers project may provide a means of investigating such cultural differences through the detailed knowledge and information on the households and their electricity use that has been gathered.

Owner occupation was identified in the Billsavers 1 sample as being a factor which can explain why some households have higher lighting consumption than those in rented accommodation. In this case, tenure may be acting as a surrogate variable for other factors, such as income (which could not be included in the Billsavers 1 analysis).

The significance of other appliances being connected to the lighting circuit implies that a certain amount of caution should be applied when interpreting the figures for electricity consumption in the fixed fittings in the EA sample. Unfortunately, it is not actually possible to identify how much of electricity is going into these appliances rather than lighting.

Although the number of bulbs in the house was controlled for in all the analyses, it was only found to be a significant factor in the Billsavers samples.

Ownership of CFLs was not found to be significant for either the Billsavers 2 sample or the EA project (no households in the Billsavers 1 sample owned CFLs). This could be for a variety of reasons. There may not be enough CFLs present in a house to have a significant effect on consumption, the CFLs may be placed in low use fittings, or it may be due to an element of “take back” (some of the energy savings being taken as an increase in service).

The regression analyses have identified some of the important factors underlying lighting consumption. Since the number of light bulbs was controlled for in the analyses, these factors indicate features which might explain the different patterns of lighting usage in different households.

4. Conclusions

The monitoring studies analysed in this paper have confirmed the need to revise the figures for UK domestic lighting electricity consumption, in line with DECADE estimates. These measurements emphasise the importance of domestic lighting as a policy focus. They also indicate that there are greater savings to be made in this sector than previously estimated. However, it is not simply a case of doubling the potential savings. These studies have also highlighted the wide variation that exists in lighting consumption levels across different households and the complex interaction with behaviour. In order to estimate *realistic* savings, the behavioural aspects of domestic lighting also need to be taken into account. This includes purchasing and usage of light bulbs and fittings as well as the cultural and social meanings of lighting.

So, how many people *does* it take to change a light bulb?

The ultimate decision to change to a CFL lies with the householder. In a single person household this is relatively straightforward. However, as soon as the number of people in the house increases, the more complex this decision becomes. Increasing number of people in the house is linked to higher levels of lighting usage. This factor is also important in determining the type of lighting installed in the house since people will have different requirements for lighting. These will be more difficult to resolve in the communal rooms, which are also likely to be the highest usage in terms of hours of lighting. However, it does appear that those households that have taken the step of changing to a CFL are more likely to change other bulbs too. Hence, it is the problem of getting the first CFL into a house that seems to be the crucial barrier. Policies should aim to make this action easy and accessible.

There are other people, besides the householder, who are involved in changing a light bulb. Retailers play a central role. The bulbs have to be available in the first place for consumers to be able to choose to buy them. Although consumer pressure is powerful in determining what retailers stock, unless consumers are aware of and demand a particular product, this pressure is not there. It may be that until sufficient consumer pressure builds up, retailers need to be encouraged in other ways to promote CFLs.

Manufacturers and designers of light bulbs are also crucial to the process. The technology needed to realise potential savings in domestic lighting already exists. The challenge lies in identifying how to adapt this technology to make it acceptable to the householder, involving an understanding of what significance lighting holds for people. The technology has vastly improved since the first magnetic CFLs, although people are not always aware of these improvements. The “early adopters” may well have been put off by problems with these first CFLs: too heavy, too much flicker, poor light quality and so on. As a result, they are no longer interested in buying CFLs. Re-education of consumers is needed to demonstrate that these problems are not an issue with the newest electronic CFLs. It is surprising that manufacturers are not more keen to promote the great advances they have made in this area. Could it be that they are reluctant to encourage people to buy CFLs because it would mean a drop in future sales volumes?

So, changing a bulb can be as simple and low cost as replacing an ordinary bulb with a CFL, with the support of retailers, manufacturers and designers. In every household, there will be some fittings for which it is this straightforward and which are suitable for CFLs. These will be the fittings which are used for long enough to give prompt pay back on the price of the bulb, can take a CFL in a technical sense, while still being aesthetically acceptable in appearance and for which the light output from a CFL is appropriate.

However, there will be other fittings which, while they are used for long enough to justify putting in a CFL, the householder will not change the bulb. This may be because the CFL protrudes from the lamp shade or does not look right in the fitting, the light distribution produced by the shade is wrong or the CFL does not actually fit into the bulb socket (for example, in recessed ceiling fittings). Thus more people are needed to change the light bulb: light fitting designers and manufacturers become involved. Fittings are needed which are specifically designed for CFLs to ensure a good light distribution. If these fittings are CFL specific (ie ordinary bulbs will not fit the socket), this would have the additional benefit of preventing people changing back to using ordinary bulbs. Increased availability of such fittings would, in turn, produce a demand for CFLs. It may be that, for certain households, a CFL specific fitting is the best way of encouraging people to change the first bulb. However, these light bulbs may be more difficult to change, since there is the additional cost of the new fitting associated with changing them.

Whilst ensuring that manufacturers and retailers promote CFL specific fittings is likely to be effective for portable fittings, it is necessary to go yet another step back in the decision chain when considering fixed fittings. Unlike portable fittings, fixed fittings are not easy to change or replace; most people will not change them very often, if at all. This requires intervention at the stage of designing and building houses. Hence, architects, builders and electricians become involved. Architects could maximise the use of natural light to create the right atmosphere, rather than relying on ever-increasing numbers of lights in peoples' homes. After all, it is natural light that light bulbs attempt to mimic. Requirements for builders and electricians to install CFL specific fixed fittings in new homes could be a way of overcoming that hurdle of getting the first CFL into people's houses.

Policy makers can act at almost every link in the chain of people involved in the decision to change a light bulb. There are a range of policies which can be implemented at each stage of the decision process. Financial incentives for bulbs will encourage sales for those fittings in the house that will take CFLs. Procurement could be an effective market pull to get CFL specific fittings onto the market. Both of these initiatives should be supported by education (retailer and consumer) and information campaigns to dispel the myths surrounding CFLs. Building regulations could be an effective way of ensuring that there is sufficient day-lighting in new houses. These could also be used to specify a minimum of one CFL specific fixed fitting in a high usage room in every new home.

Careful targeting of such policies will enhance their effectiveness. For example, elderly people are likely to want to bulbs which do not require frequent changing and so may be more receptive to CFLs. Targeting children, through schools and the media, can be a good way of introducing CFLs into the home. One scheme under the UK Energy Efficiency Standards of Performance distributed CFLs through schools. A high percentage of these bulbs were placed in the children's bedrooms because they looked upon the bulbs as their own.

Targeting is also needed to ensure that certain groups are not excluded from policies. For instance, procurement of CFL specific portable fittings would not benefit the thirteen percent of low-income households in the Billsavers 1 sample who had no portable fittings. These households are often rented and so the householders are unlikely to be able to alter the building fabric and are perhaps limited by the number of sockets available for portable fittings. They are also very unlikely to be able to change the fixed fittings. The most effective way of tackling these problems would be through retrofits and new build if lighting standards are incorporated into building regulations.

It is actually low-income households that would benefit most from changing to CFLs. Since these households have, on average, far fewer light fittings in total, their lighting usage will be concentrated in a very few bulbs. Installing CFLs will have a far greater impact on the electricity bills of these households since lighting represents a higher proportion of the bill compared to higher income homes (Stenberg 1995). The reduced running costs may enable the low-income households to afford warmer homes or other such necessities. Of course, there is likely to be an element of "take back", where households will use the lights more because they can afford to do so. This may be more significant for low-income households if under-lit and should be accounted for when calculating potential savings.

The discussion so far has focused on purchasing decisions since these appear more accessible to policy than usage. However, the way in which people use the lights they have is a key element in determining consumption levels. It requires an understanding of the social meanings of light in order to be able identify what aspects of behaviour can be modified (Moezzi 1996).

The use of portable fittings may have such cultural significance. Portable fittings are far more flexible than fixed fittings as a light source, since they are easy to move or change. It may be that they are more important in creating a warm and "cosy" atmosphere. In the EA sample, Scottish households had significantly higher consumption in the portable fittings than the English households. This regional difference may reflect the importance of creating a certain atmosphere through lighting. The presence of children in the house is associated with higher use of portable fittings, possibly for similar reasons. It remains to be seen whether the proportion of electricity used in portable fittings in all households will increase to make homes more "cosy" in the winter.

The number of people it takes to change a light bulb covers a range of people, depending on whether the focus is the bulb or the fitting, change in the short or long-term. Monitored studies can help identify who should be targeted, but an understanding of behaviour is essential to focus policy on what will encourage people to make the change.

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