REVIEW OF DOMESTIC LIGHTING IN THE BUILDING REGULATIONS

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EXECUTIVE SUMMARY

This report examines the possible benefits and format of a requirement for energy efficient domestic lighting in the Building Regulations Part L. Domestic lighting is a significant energy consumer, around 17TWh of UK electricity consumption. There are potential energy benefits from replacing tungsten lighting in housing with compact fluorescent lamps (CFLs). These savings will be cost effective if the CFLs are installed in heavily used areas. Currently there are around 0.7 CFLs per home out of an average of 18.6 lighting outlets.

One way to encourage the uptake of CFLs would be to have a requirement in Part L for energy efficient domestic lighting in new housing. It is suggested that at least one third of the rooms should be fitted with fittings or outlets which can only be used with fluorescent lighting (compact or linear). Here rooms would include halls and landings as well as lounges, kitchens and bedrooms. Lighting in garages, lofts and outhouses would not count towards the number of fluorescent fittings.

To link in with such a measure, a promotional and educational campaign to convince householders of the merits of CFLs would be advisable. As a possible extra measure, external lighting in new housing could be required to be either by discharge (including CFL) lighting, or switched using a movement detector.

The safety aspects of householders changing the CFLs back to tungsten lighting should be investigated further, although these are not thought insurmountable. A proposal on lighting in new dwellings would complement existing and possible future schemes to encourage the uptake of CFLs in existing dwellings.
INTRODUCTION

DETR is currently reviewing the energy efficiency requirements contained in Part L of the Building Regulations. Following initial consultation, Oscar Faber have identified energy efficient lighting as an issue that should be addressed. Oscar Faber have therefore approached BRE to provide a technical assessment of the topic to help develop a revised Part L incorporating guidance on this issue. This Report concentrates on one of the areas to be addressed, namely domestic lighting.

Domestic lighting was estimated to account for 17.4TWh of UK electricity consumption in 1994 (ref 1). However it is not addressed by the current Part L of the Building Regulations (ref 2), which only cover non-domestic lighting. Nor does the SAP for housing include lighting.

The NHBC has a basic minimum level of provision (ref 3) for installed lighting in new homes, which cover the number of lighting outlets required. Builders may choose to exceed these standards to give added quality to their houses, for example in installing downlights in kitchens and bathrooms, or wall lighting instead of a single ceiling pendant.

POSSIBLE MEASURES

Tungsten lighting is still widely used in the domestic sector. It has the advantages of excellent colour rendering, warm colour appearance, ability to be dimmed by low cost equipment, lack of perceptible flicker, compact size, wide availability and especially low capital cost. The main drawback is its poor energy efficiency and therefore high running cost. Typical lamp efficacies average around 12 lumens per Watt.

Over the past 20 years a wide range of compact fluorescent lamps have become available with much higher luminous efficacies, around 50-60 lm/W on average. Uptake of CFLs is still patchy. It is estimated (ref 4) that the average house contains 18.6 light fittings suitable for tungsten or CFL lighting. Market research suggests that there were around 0.7 CFLs per home in 1997. These were unevenly distributed amongst the housing stock; only 23% of households had any CFLs (ref 4) and these households had an average of three each. There is therefore still considerable potential for increasing the uptake of CFLs.

Many of the current CFLs have been marketed as direct plug in replacements, fitting into standard tungsten lamp sockets. Paradoxically this flexibility is a disadvantage as far as the Building Regulations are concerned. For if a compact fluorescent lamp (CFL) can replace a tungsten lamp it follows that it is also easy to use a tungsten lamp to replace a CFL. Even if this type of CFL were provided in a new building the occupants would be tempted to replace it with a tungsten lamp at the end of its life (typically 10000 hours). In a Swedish study (ref 5) only 60% of failed CFLs were replaced with another CFL. 10000 hours is still a reasonable length of time in a domestic context where lamps may only be in use for three hours per night; at this level of usage the lamp may last ten years. However the occupants might change
the lamp a lot earlier if they wanted to use a smaller lampshade or incorporate dimming. Mills (ref 6) discusses this issue in more detail.

A potentially more permanent measure is to require the installation of dedicated CFL sockets or luminaires. These have a specialised lamp holder, which will accept only CFLs and not standard tungsten lamps. They have the added advantage that the control gear is contained within the luminaire housing. When the CFL does fail only the tube itself has to be replaced; the control gear can be reused with the new tube. Thus long term replacement costs should be lower. With the plug in replacement CFLs referred to above, both lamp and control gear have to be changed when the lamp fails.

A suitable measure could therefore be to require some dedicated CFL sockets within each new dwelling. This could take several forms:

1. A set number of sockets per dwelling, say three. However this does not take account of the wide variety of dwelling types. A one roomed bed sitting studio flat might only have three lamps in total while a five bedroomed detached house could have many more.

2. A specific percentage of the lamp sockets to be dedicated CFL types. The problem here is that builders usually only install a minimal number of lamp holders in new homes anyway. By installing even fewer outlets they could reduce the commitment to provide CFLs still further.

3. A specific proportion of the rooms to have CFL sockets, say one third. Here rooms could include halls and landings as well as lounges, kitchens and bedrooms. Table 1 could be used as a guide.

<table>
<thead>
<tr>
<th>Number of rooms</th>
<th>Required number of CFL sockets</th>
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</thead>
<tbody>
<tr>
<td>1-3</td>
<td>1</td>
</tr>
<tr>
<td>4-6</td>
<td>2</td>
</tr>
<tr>
<td>7-9</td>
<td>3</td>
</tr>
<tr>
<td>10-12</td>
<td>4</td>
</tr>
</tbody>
</table>

So in a three bedrooomed house with a hall and landing, lounge and kitchen the requirement would be for three CFL sockets. A one bedroomed flat with a lounge and kitchen, but no separate hall would need one socket. A five bedroomed detached house with two reception rooms, hall, landing, kitchen and utility room would need four sockets. Toilets and bathrooms would not be included in the list as they are less suitable locations for CFLs.
ISSUES TO BE ADDRESSED

Linear fluorescents

Linear fluorescent lamps can make a valuable contribution to energy efficiency in dwellings. Their energy efficiency is even better than for CFLs with circuit efficacies of 60 lm/W or more. For example an inexpensive standard 36W 1200mm fitting has a circuit efficacy of 63 lm/W and the lamps are cheap and easily replaced. In previous years linear fluorescents were fairly standard in kitchens and utility rooms, but anecdotal evidence suggests a recent trend to less efficient spot lighting in these areas. Including linear fluorescent luminaires in the requirement as alternatives to compact fluorescent could therefore be a valuable strategy.

Lamp locations

Some locations in the home are more suitable for CFLs than others. A CFL will give the best annual energy savings and most rapid payback in an area where it is most intensively used. Generally this implies living rooms and hallways and landings (ref 7). Bedrooms generally are lit for less of the time as are toilets and bathrooms. Two other factors are also important. CFLs cannot be dimmed using conventional dimmer switches; specialist, much more expensive equipment is needed. In the future it may be that the wider use of CFLs following measures like a Part L revision could encourage manufacturers to produce cheaper CFL dimmers. Currently, though, CFLs are less appropriate for bedrooms where lamp dimming may be required. Finally, frequent switching on and off, which could happen in toilets for example, will decrease lamp life and reduce the cost effectiveness of the CFL.

However it is probably not worth including all this advice in the Part L approved document. Reference should be made to other more detailed guidance, for example a BRECSU publication (ref 7). It could be worthwhile excluding lighting in built in garages from the Part L requirement. Fluorescent lighting may be used in garages anyway and the opportunity for energy savings there is small given the low occupancy times. Also mains frequency CFLs can give a stroboscopic effect with rotating machinery such as car engines.

Types of fittings

There are perceived aesthetic drawbacks with CFLs, with their unusual shape and larger size. In particular there is a lack of domestic fittings which are designed specifically for CFLs. Most of the current fittings are modifications of traditional lampshades originally intended for use with tungsten bulbs. As well as possible poor aesthetics, such fittings may have a poor light output ratio when used with CFLs because of the different output distribution of the lamp, and the lamp running too warm (ref 6). This will waste light and further reduce user satisfaction.

However inclusion of a CFL requirement in Part L ought to stimulate the market for low cost, attractive fittings for use with CFLs. An early announcement of a change to Part L might encourage manufacturers to start designing such fittings.
Lamp ranges

Typically 4 pin CFL sockets can take lamps by a range of manufacturers. However each socket type is limited to certain lamp wattages. Sockets might be able to use lamps of 10, 13 and 18 Watt ratings, roughly equivalent to 40, 60 and 75 Watt tungsten lamps. Sockets need to be suitable for lamps which are bright enough for the needs of the room.

External lighting

CFLs are suitable for external lighting, such as porch lighting, which is left on for periods during the evening or night. They are less suitable for lamps which only come on when a sensor detects movement. Such lamps are only on for a few minutes, and the frequent switching on and off can reduce lamp life substantially. Photoelectric switching, when the lamp comes on at dusk and off at dawn, is more suitable.

A range of outdoor luminaire types are available which are suitable for CFLs. Builders may install some external lighting in new homes either as bollards on drives or bulkhead fittings on walls or porches. Householders may be less resistant to external CFL lighting partly because the longer lamp life makes them easier to maintain.

How to include such lighting in the Regulations is not easy. A blanket requirement for all external lighting to be by CFL could give more financial incentive to builders not to provide such lighting and leave it to the householder. Allowing one or more of the required CFLs in Table 1 to be an external light could work, but it may act as a disincentive to PIR switched (motion sensing) lights which ought to be more energy efficient in most applications.

Regressing to tungsten

CFLs may not be perceived by householders to give as good lighting as tungsten lamps. This may be due to their slightly lower output, poorer colour rendering, unusual luminance distribution or, with some types, mains flicker. The size, shape and appearance of the CFL may also be frowned upon. The problem is that compared to other energy saving measures like improved insulation or condensing boilers, CFLs are highly visible.

For these reasons householders may disconnect and remove the CFL fittings and replace them with tungsten ones. This will be easier with some types of fitting than with others. For pendant fittings it is a simple DIY job to replace the CFL lampholder with a tungsten one. However it is not thought valuable to restrict this type of fitting in the Regulations because it is one of the standard and least expensive ways to introduce CFL lighting in the home.

If a Part L requirement for energy efficient lighting in new housing were introduced, a promotional campaign to convince householders of the merits of CFLs would be advisable. This could also be educational, showing people how to replace the lamps
with new CFLs when the old ones burnt out, the best types of lampshades to use, and not to try to dim the CFLs.

Health and safety issues

It is possible that people might try to connect a tungsten bulb across a CFL circuit. This could happen with a CFL pendant where the ballast was in the ceiling rose. People could then disconnect the CFL lamp holder and insert a tungsten one. Alternatively backstreet electrical manufacturers might try to sell adapters to convert CFL fittings for tungsten use. The safety aspects of this need to be considered.

For a ballast in use, the tungsten lamp would run at a lower voltage on the CFL circuit, because the ballast acts to step down the voltage. Thus the lamp would glow feebly and not give sufficient light. However problems could occur on starting. A fluorescent lamp requires a large initial voltage to start it. This could fail a tungsten lamp. There could be special problems with tungsten halogen lamps, which can fail actively (by implosion) under certain circumstances. The possibility of ballast failure and overheating should also be considered. Full electrical testing is recommended to check these possibilities.

Against this, there are significant safety advantages with CFL fittings. The lamps run cooler so fire risks are reduced. Also the design of the lamp holder can be electrically safer than a basic tungsten pendant lamp holder. With most dedicated CFL lamp holders the pin sockets are smaller and go dead when the lamp is removed. On the cheapest tungsten lamp holders the pins can remain live when the lamp is removed.

On site verification

Building control officers may have problems verifying whether CFL sockets have actually been installed in dwellings. Builders may tend to install them at the last minute, particularly because theft of small, high value items like CFLs and their sockets can be a problem on building sites. This may need to be further reviewed with BCOs.

INTERACTION WITH OTHER SCHEMES

There are a number of other existing and proposed schemes aimed at increasing the uptake of CFLs. The LEEP or Lighting Energy Efficiency Partnership scheme, organised by the Lighting Association, means domestic luminaire manufacturers can reclaim the full cost of converting new or existing products to energy saving lamps. However LEEP is aimed at portable fittings (table lamps or standard lamps) so it will tend to complement the impact of Part L, which would apply to lighting which was permanently fixed to the home.

DETR’s Climate Change consultation technical paper (ref 4) describes two different types of scheme, which have been implemented by the Energy Saving Trust. The first involves distributing free CFLs to lower income households. These would be of the plug in type. Such a scheme would tend to complement a change to Part L. If
low income families were occupying a new house (maybe as local authority or housing association tenants) they could use their plug in CFLs in the remaining tungsten lamp sockets in the home.

The second scheme involves subsidies to all households buying CFLs. A Part L measure would tend to decrease uptake among those who were occupying a new house which already had CFLs. But the two schemes would not seriously conflict.

An obvious drawback of the proposed Part L measure is that it applies only to new homes. In its current form it would be unreasonable to apply to existing housing; plug in compact fluorescents, rather than dedicated sockets, would be appropriate. The Part L proposal should therefore be considered alongside measures like those above to improve energy efficiency in the existing stock.

**COSTS AND SAVINGS**

Typical bulk costs for a CFL socket with integral electronic ballast are around £14 each, about £13 more than a tungsten bayonet socket. In addition there is the cost of the lamp at around £2.50 each. Lamps last around 10000 hours, sockets about five times this or 50000 hours.

In areas of high use, lamps can be in use for 1275 hours per year (ref 4). If a 13W CFL were used to replace a 60W tungsten lamp in one of these areas, annual energy savings would amount to 1275 x (60 –13*1.3) /1000 = 55 kWh. The extra factor of 1.3 arises because people tend to leave CFLs on for 30% longer than tungsten lamps (ref 1), due to the reduced running costs. The 55 kWh is worth around £3.60 at a marginal electricity cost of 6.51 p/kWh (ref 4), There is an additional 40p saving because the tungsten lamp will probably need replacing during this time. This gives an overall payback period of between three and four years.

However if the same CFL were installed in a ‘medium use’ fitting (500 hours per year) annual energy savings would be only around 22 kWh, worth £1.40. The payback period would be around ten years.

The figures above are for an electronically ballasted socket. CFL sockets with electromagnetic (wire wound ) ballasts are likely to be cheaper, but have slightly lower energy savings.

**CONCLUSION AND RECOMMENDATIONS**

Energy savings will occur if tungsten lighting in housing is replaced with compact fluorescent lamps (CFLs). These savings will be cost effective if the CFLs are installed in heavily used areas. One way to encourage the uptake of CFLs would be to have a requirement in Part L for energy efficient domestic lighting in new housing. It is suggested that at least one third of the rooms should be fitted with sockets which can only be used with fluorescent lighting (compact or linear). Here rooms
would include halls and landings as well as lounges, kitchens and bedrooms. Lighting in garages, lofts and outhouses would not count towards the number of fluorescent fittings.

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REFERENCES