The University Of Sheffield.

Mini-project report

Carbon Case Development (CE Electric)

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Research Councils UK Energy For a Low Carbon Future

Introduction

The main purpose of this report is to establish a carbon case which focuses on investing in low carbon projects in order to reduce the overall carbon foot print of CE Electric in the UK. It is hoped that this case would manage to establish the UK best practice in the specific area it is targeting, which may have the potential to become the national standard. A new simple innovative approach will be taken to tackle the carbon issue and to secure a portion of the carbon network fund. Demand side management will be used as a technique in the lighting section to see if any room exists to reduce customer's electricity consumption.

Demand Side management

Demand side management or DMS can be defined in the electricity industry as activities done by the distribution companies to alter clients' electricity use patterns. These programs help promote practices that can save energy and electricity through new technologies for the individual households. Two main ways exist for United Kingdom or any other country around the world to meet their population's electricity requirement. This process can be done either through increasing the electricity generation or through reducing the demand.

1. Increasing electricity generation

Increasing the production through electricity generating companies involves enormous amount of money invested, it can be a time consuming process and increase carbon emission. One of the most important factors to consider when thinking of higher electricity generated are the drawbacks posed by environmental concerns mentioned earlier on. Electricity is produced in power plants which convert an energy format into electrical power. Electricity generation issues:

Energy format	Concerns
Fossil fuels	1. Emission of CO2 (for electricity production 10 billion tonnes CO2 emitted yearly), Ozone, Sulfur dioxide, NO2, Mercury Arsenic 2. None renewable
Nuclear power	Undesirable increase of the water temperature, Emission of radioactivity from a nuclear plant in abnormal or accidental operations, Mining uranium itself, costly and difficult to dispose waste, Nuclear proliferation
Tidal power	Tidal power plant ruthlessly disrupt the ecosystems by reducing or increasing the tidal swing
Biomass	Burning biomass still has emissions, Costly and timely to grow biomass
Wind power	Variant wind speed, Landscape and heritage issues, Bird and bat mortality
Geothermal power	Geothermal power plant emit hydrogen sulphide and CO2, Increased water temperature when returned to streams
Solar power	High production cost, Lack of sun light in the UK, Negative environmental impacts such as use of silicon and lead-acid batteries

Table 1

2. Reducing the electricity demand

An alternative way to meet the population's electricity requirement in the future, taking into account the government's pledge to cut carbon emissions by 80% by 2050 is reducing the demand through a new creative way that saves energy. One of the ways to reduce the electricity demand is through energy efficient home appliances which count up for the majority of the household CO2 emission. Persuading the customers to switch to new high technology energy saving appliances could potentially result to a major carbon emission cut back.

Lighting

Reducing the electricity demand in this carbon business case will be done through lighting and light bulbs will be used as the new high technology energy saving home appliance.

According to Paul Waide a senior policy analyst working for IEA (International Energy Agency) "Lighting is a major source of electricity consumption". He went on to say "Nineteen percent of global electricity generation is taken for lighting - that's more than is produced by hydro or nuclear stations, and about the same that's produced from natural gas,"

Based on the facts taken from dti and national statistics article called Energy Consumption in the United Kingdom, lighting counted for 23 per cent of the total amount of electricity consumed for lighting and appliances in the domestic sector. Smaller electrical appliances may be overlooked at times, but making sure households use energy efficient Compact Fluorescent bulb has the potential to save up to 4 times more energy than a standard light bulb. Further on lighting is also known to be a key component of peak demand in many countries and especially the UK making it more of a necessity to reduce demand in this sector. Lighting symbolizes a fifth of the electricity consumption of an individual household. The most efficient lighting technology can have four to five times more energy saving compared to the least efficient light bulb. This means an individual household's total energy consumption can reduce up to 15% if low efficient light bulbs were to be replaced by energy saving ones.

Incandescent lamp (GLS)

Incandescent light bulbs or GLS provide light through the process of heating up a metal filament wire up to a point that it glows.

Advantages	Disadvantages
Transparent glasses make them very bright	Very low energy efficiency (E,F or G-class)
complete compatibility with current luminaires	Risk associated to the high operating temperature
Completely dimmable on any dimmer	1000 hours life time (considered short)
Good quality light	

Table 2

Phasing-out Incandescent light bulbs in the EU

In 2007 the spring European Council encouraged the Commission to write proposals which facilitate increased energy efficiency requirements on GLS by 2009, with the support of the European Parliament. In 2008, the Council of energy ministers proposed to put an end to the sale of the worst energy efficient domestic light bulbs and products by 2010. This proposal took into account the following parameters:

- The risk of supply disruption in the internal market
- Functionality loss from the customer point of view
- Paying extra attention to the ecodesign review parameters (ie cost effectiveness)

The Commission also took other aspects such as the functionality of the product from the user's perspective was one of these features, so was user's health and safety and the industry competitiveness.

UK government's role

In September 2007 Environment Secretary Hilary Benn announced the plans to phase out and get rid of traditional light bulb by 2011. He announced "our aim is for traditional 150-watt light bulbs to be phased out by January next year, 100-watt bulbs the year after, 40-watt bulbs the year after that and all high-energy light bulbs by 2011." Mr. Benn's team estimated the above action would save approximately five million tonnes of CO2 a year and would help the UK achieve its 2050 targets of reducing carbon emission by 80%.

Compact Fluorescent Lamp

CFL is a type of fluorescent lamp which gives the same amount of visible light but uses less power and has a higher life cycle compared to general service incandescent lamps. CFL light efficiency depends highly on the ballast these bulbs need to operate (electronic, magnetic or it can be a hybrid of the two) and the longer length and smaller diameter tubes. CFL's have ten times the lifetime of

incandescent bulbs, further on narrow diameter used in CFLs making it possible to use high-quality phosphors, this gives customers better efficiency and colour rendering. Tests and research done by Pedersen and Warentest have proven that quality electronic ballasted products are rarely affected by the frequent switching (Pedersen 1997, Stiftung Warentest 1995) making the CFLs even more attractive.

Economics

The most significant motive to use CFLs is the energy and running cost savings. Further on a 75% decrease in wattage achievable through CFL and can last ten times longer than GLS. CFLs have initial high cost 10-20 times more expensive than an incandescent bulb, but this amount can be reimbursed through the electricity saved and also using CFLs you avoid the cost to replace incandescent bulbs. If a 20W CFL were to be replace a 60W incandescent bulb used for 3.5 hours, and if we assume the average price for a CFL is 14ecu, 0.7 ecu for incandescent bulb and 0.12 ecu/kWh for electricity, the reimbursement period would be 2 years.

Concerns and future Improvements of CFLs

1. Mercury and disposal

Mercury emitted from the fossil fuel electricity generated for incandescent lights is three times the ones produced for CFLs. Mercury emitted from electricity generating power plants is not recyclable disparate the mercury used in CFLs. Another important factor worth mentioning here is that additional decrease in mercury pollution is possible by using higher efficient ballasts that have the ability to extend CFL life (Mills 1993, Begley and Linderson 1991, Gydesen and Maimann 1991). Environmentally friendly systems should be designed giving general public an easy way to dispose their light bulbs. (ie World's biggest bulb collection infrastructure 'Osram' Germany 1993 (Mills and Borg 1993))

2. Harmonic distortion effect

The majority of the ballasts are more efficient containing high power factors which results in low total harmonic distortion. Research shows that CFLs in reality have insignificant undesirable effects on the quality of power in the supply network and have the ability to even reduce voltage distortion (Gothelf 1997).

3. Improvements in technology

Technology has enabled the electronic ballast CFLs to be developed. Electronic ballasts CFLs are weighed 75% lighter and have reduced their volume by 50%, they are more efficient and having light of superior quality (DEFU 1996). Customers don't know the difference between magnetic ballasts and electronic ones, many people bought magnetic ballast CFLs because they were the first and oldest CFLs to be widely available in the market and may have a very bad impression of such technology.

Another difficulty exists with the availability of cheap electronic ballast CFLs with poor quality light and relatively small lifetime, which has ruined the image and perception of quality CFLs. Appropriate planning should be at place to advice and guide customers to pick and choose the best possible product. (ie Denmark and Sweden through labelling and providing customers with recommendation list of good quality CFLs.)

4. CFL Technology Mis-application

In some case even if customers purchase high quality CFLs satisfaction from these products may not be assured, integral ballast CFLs are not meant to be used in fixtures intended for GLS lights (ie. cases where bright focused beam of light needed). In order to achieve the best possible performance from CFLs factors such as operating temperature and light orientation should also be considered.

Conclusion

Demand side management in its variety of structures is an essential tool that can enable more efficient use of the energy resources which are available in a country. As presented in this case development,

demand side management will be useful if the appropriate technology is at place. Lighting was used as the element to implement DSMs theory and it should not be seen as a small section given the fact that nineteen percent of global electricity generation is taken for lighting. DSM through consumer electricity reduction is achievable with CFLs, which can provide the electricity distribution cut backs in their carbon emission and save individual households money spent on electricity through decreasing their consumption needs. For example a 75% reduction in wattage is achievable using this product which also last ten times longer than the traditional light bulbs, thus DSM can offer significant economic and environmental benefits. The cost-effectiveness analysis done for CFLs show that, despite the high energy and cost savings these products also have a fast payback period which is less than two years, making CFLs a very attractive investment. Mercury disposal was also discussed alongside three other concerns related to CFLs. As mentioned in the case development, mercury emitted from CFLs are can be dealt with and recycled and is far smaller amount in comparison to GLS lights and should not be considered a major concern. The other concern was over the harmonic distortion but given that the majority of the ballasts in CFLs have become more efficient containing higher power factors, the total harmonic distortion is lower than expected. Improvements in technology and awareness of the mis-application of such product have also been discussed and as a result the concerns over the above to factors are not that serious as explained in the main text. CFLs have the ability to reduce customer electricity consumption and electrical distribution companies can potentially benefit from such small product that can easily be overlooked. But with technology improving alongside the government support and small awareness programs (ie recommendation list of good quality CFLs) that can target end users, carbon emission can be reduced.

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