



Best Foot Forward

Bringing sustainability down to earth

Youthful Energy



A report for Centrica

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Cover picture: Solio solar powered charger.

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Youthful Energy

Brief

Centrica kindly commissioned Best Foot Forward to investigate the use of domestic electricity by British teenagers as part of Centrica's on-going commitment to improved energy efficiency and climate change mitigation.

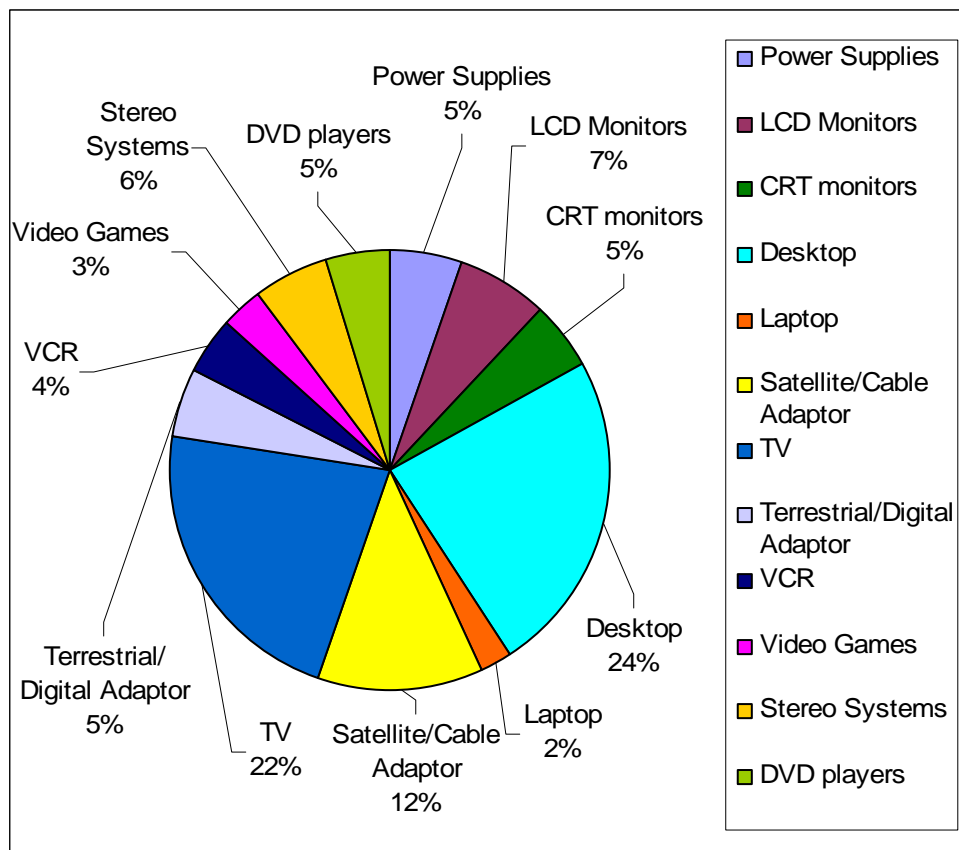
This report sets out the findings based on a combination of desk research and interviews with more than 350 13-19 year olds. A more detailed investigation was completed of the 16-19 age group. The use of 12 electrical devices was investigated with the results presented by usage mode (on, off and standby), gender of user, social class and region (Scotland, Wales, South England, North England and Midlands).

Summary findings

- Approximately 3.12 TWh of electricity per year is consumed in electronic appliances used by teenagers aged 13-19 in Great Britain each year. This is approximately 2.58% of domestic electricity consumption and 0.87% of total UK electricity consumption¹.
- This is equivalent to the energy that would be generated by 229 new offshore wind turbines, and just exceeds the amount of energy currently produced by all wind turbines in the UK.
- This electricity use gives rise to an extra 242 kg of CO₂ per teenager per year, a total of 1,295,273 tonnes of CO₂ overall. This is the equivalent of each teenager driving 1,300 kilometres per year in an average petrol car.
- Desktop computers, computer monitors, televisions and their associated adaptors (satellite, cable, terrestrial) use the most power – together making up more than 75% of the total energy use by teenagers. This is because they are in use for longer and draw more power both when on and in standby (see Figure 1 below).
- Turning all appliances off when not in use - instead of leaving them on standby - would save over 28% of the energy consumed (equivalent to each teenager driving 360 fewer kilometres each year).
- There are weak regional differences in consumption – individual teenagers in Scotland and in the North consume slightly more electricity than their counterparts in the Midlands, South and Wales, with figures for Wales being the lowest.
- There are gender differences: boys consume roughly 9% more than girls.

¹ DTI Electricity: Commodity balances (DUKES 5.1)
<http://www.dti.gov.uk/energy/statistics/source/electricity/page18527.html>

Figure 1. Total Annual Energy Consumption by 13-19 year olds, by type of device, Great Britain, 2006, %



Policy Context

The Kyoto treaty requires the UK to reduce its annual greenhouse gas emissions (predominantly made up of carbon dioxide, CO₂) by 2012 to 12.5% below 1990 levels. The UK Government has set itself the even tougher target of cutting emissions to 20% below 1990 levels by 2010.

This is proving extremely challenging to achieve. Emissions in 2004 rose 1.5% above those in 2003. In 2002 the UK was 14.4% below 1990 levels, and in 2003, 13.4% below. The provisional figures for 2004 show emissions are 12.6% below, just 0.1% underneath the Kyoto target, with eight years of potential growth still to come.

CO₂ emissions accumulate from the burning of fossil fuels such as gas, oil and coal. These fuels are either used directly, in a refined form, or converted to electricity. The alarming growth of emissions is due in part to rising domestic electricity use (see Figure 2). Since 1998 UK domestic electricity consumption has increased by 7%² - the development of new renewable power generators (for example, wind turbines) has been unable to outpace this growth in demand for energy.

One driver for this increased energy use is the substantial increase in the UK sales and ownership of electronic appliances. Steady increases in sales and ownership levels have been observed over the past 20-30 years. It is projected that further increases will take place in the UK in the next five years. Figure 3 (below) shows predictions of steep increases in the numbers of power supplies and set-top boxes, further steady increases in the number of TVs and a levelling out of the ownership of VCRs.

² DTI Electricity: Commodity balances (DUKES 5.1)
<http://www.dti.gov.uk/energy/statistics/source/electricity/page18527.html>

Reductions in energy consumption and CO₂ emissions can be achieved by improving technology and/or reducing energy demand.

New electronic appliances offer the potential to be more energy efficient – but this potential is not always realised. For example, plasma screen TVs are typically less efficient than both the bulky old cathode ray tube (CRT) TVs they often replace and the alternative, newer liquid crystal display (LCD) models. Similarly, digital radios can use more power than their analogue counterparts.

Demand reduction is a more effective means of cutting CO₂ emissions. Turning devices off, reducing use or simply not buying them in the first place can deliver clear and immediate savings. Such behaviour change is, however, difficult to mandate.

Figure 2. Total UK domestic electricity consumption, 1998-2005, GWh

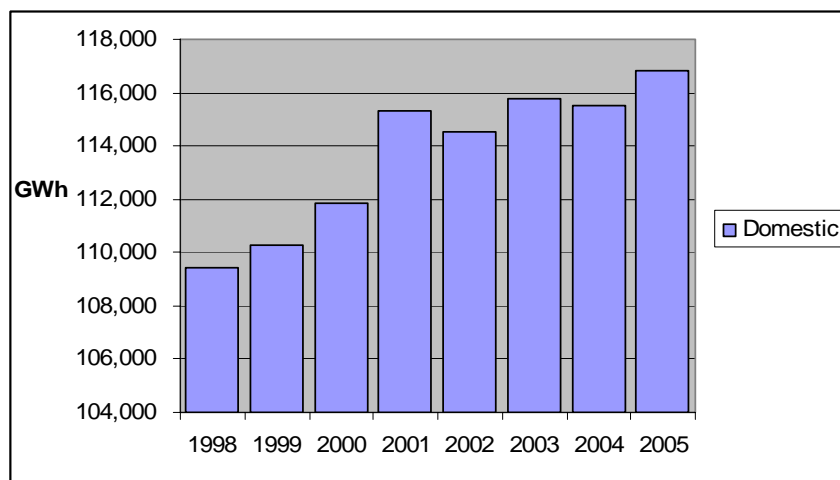
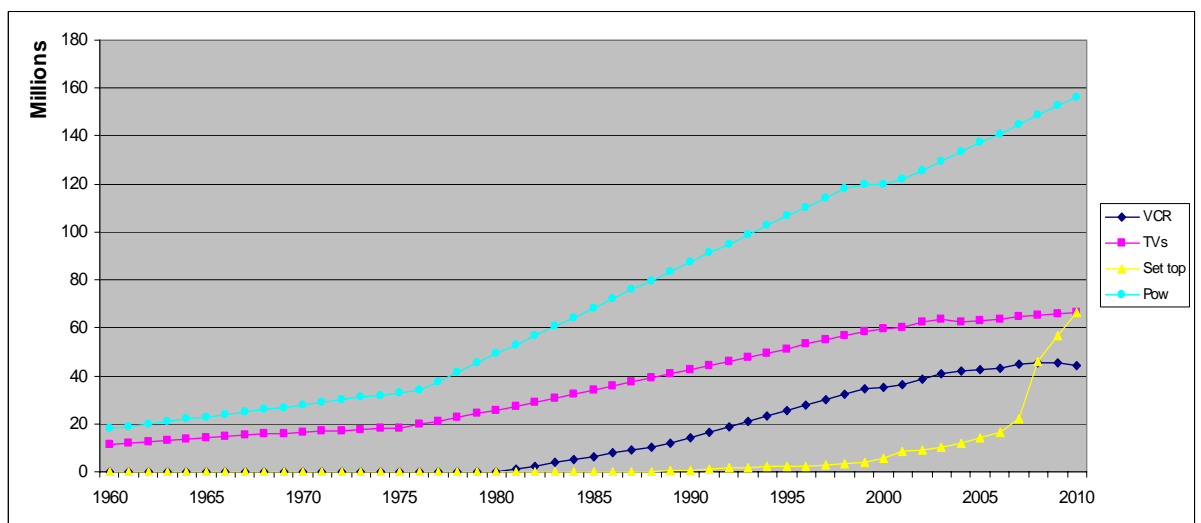


Figure 3. The stock of major electronic devices in the UK (TVs, VCR, Power Supplies, Set top boxes).



Source: What If? Market transformation programme, <http://whatif.mtprog.org>, 2006

Data Collection

For the purpose of addressing the current research question, 358 teenagers were surveyed about the electronic devices they regularly use. This information was then combined with secondary data sources on usage patterns and the electricity consumption of individual devices.

The data on the use of various devices by teenagers was gathered by the ACT2 market research company on behalf of Best Foot Forward. The questionnaire was designed by Best Foot Forward in collaboration with ACT2. Interviews were conducted over the telephone with respondents taken from the ACT2 Telephone Panel. This comprises of young people previously interviewed face-to-face by ACT2 and who had expressed a willingness to be contacted again.

Scope

All those interviewed were between 13 and 19 years old. Two interview sessions were conducted with overlapping groups of teenagers. One group comprised 323 16-19 year olds – the second group 81 13-19 year olds. The two sessions were necessary to ensure sufficient regional coverage.

Sample groups were balanced for gender and geography to represent Wales, Scotland, North of England, Midlands and South of England. Appendix A gives the makeup of these regions.

Electronic devices

Teenagers were asked about their domestic use of the following devices:

- | | |
|-------------------------------|---------------------------------|
| 1. Power Supplies/Chargers | 7. TVs |
| 2. LCD Monitors | 8. Terrestrial/Digital Adaptors |
| 3. CRT monitors | 9. VCRs |
| 4. Desktop Computers | 10. Video Games |
| 5. Laptop Computers | 11. Stereo Systems |
| 6. Satellite / Cable Adaptors | 12. DVD players |

The “power supplies/chargers” category includes devices such as mobile phone chargers, iPod / MP3 player chargers and camera chargers.

Methodology

The following formula was used to calculate total energy consumption associated with appliances used by teenagers in the North, Midlands, South of England, Wales and Scotland.

$$TEC_i = 365 * POP_i * \left(\sum_k O_i^k \left(\sum_l C_l^k * U_l^k \right) \right)$$

Where:

$k=1, \dots, K$ – the types of appliances;

$i=1, \dots, I$ – the regions (North, Midlands, South);

$l=1, \dots, L$ – modes (on, standby, off)

TEC_i - total energy consumption in i^{th} region (North, Midlands, South), W ;

POP_i - population of the 16-19 year olds in the i^{th} region;

O_i^k - ownership rate of devices of type k in the region i , %

C_l^k - consumption of energy of the device type k in on mode l , W

U_l^k - use of device k per day, hr

Data gaps

Due to data gaps and the variability in the energy consumption and usage patterns for these devices, some standard assumptions were required.

Most of the energy consumption data was obtained from the UK Market Transformation Programme (MTP). However this did not cover all devices. Data gaps were filled by BFF. Based on direct measurement of several example systems, it was assumed that video games and stereo systems each consumed 11W in “on” mode and 4W in “standby” mode. Based on BFF estimates, the following average daily usage pattern was assumed for video games: “on” 0.5 hours, “off” 0.5 hours and “standby” for 23 hours. For stereo systems the pattern assumed was: “on” 1 hour, “off” 1 hour and “standby” for 22 hours per day on average. Usage patterns for other devices were assumed to follow the national average (MTP).

Limitations

The duration, scale and budget of this study placed certain constraints on the analysis. Although numbers of teenagers regularly using each device was determined by survey, national average figures were used for daily usage patterns and energy use. Therefore caution is advised when interpreting the results.

Furthermore, the average energy consumption data from the Market Transformation Programme was not provided with range data. This makes it difficult to assess the uncertainty in the final results.

Results

Results are first shown for the whole of Great Britain for all teenagers (13-19 year olds). A more in-depth analysis is then presented of 16-19 year olds (based on an expanded sample size) to explore regional, gender and social class difference.

Device ownership, usage and power ratings

Table 1 shows the regular usage rates for various electronic devices by teenagers aged 13-19 for the whole of Great Britain.

Table 1. Regular usage rates (%), ICT and Electronic Equipment, 13-19 year olds, National Average, 2006

Items	Total
Power Supplies	95
LCD Monitors	56
CRT monitors	17
Desktops	67
Laptops	38
Satellite/Cable Adaptors	43
TVs	90
Terrestrial/Digital Adaptors	41
VCRs	48
Video Games	58
Stereo Systems	86
DVD players	73

Source: ACT2, London, UK

The devices that the teenagers use can be grouped into four categories:

- 1) Widely used devices (80-100%): TVs, Power Supplies, Stereo Systems;
- 2) Moderately used devices (60-80%): DVD players, Desktops;
- 3) Less used devices (40-60%): Video Games, LCD monitors, VCRs, Satellite/Cable and Terrestrial/Digital Adaptors;
- 4) Rarely used devices (less than 40%): Laptops and CRT monitors.

Table 2 shows the usage patterns of electronic devices. It can be seen that all devices could be classified according their pattern of use into the following major categories:

- 1) Those that are “on” most of the day: Satellite/Cable Adaptors, Terrestrial/Digital Adaptors;
- 2) Those that are in “standby” mode most of the time: Power Supplies, VCRs and DVD players;
- 3) Those that are “off” most of the day: LCD monitors, CRT monitors, Desktops, Laptops.

TVs are in “standby” mode during half of the day, “off” for almost 8 hours and on for slightly over 4 hours, on average.

Table 2. Average Usage (hours) by item (on/standby/off), ICT and Electronic Equipment, 2006

	On	Standby	Off
Power Supplies	0	24	0
LCD Monitors	4.27	1.65	18.08
CRT monitors	4.27	1.65	18.08
Desktops	5.5	0.04	18.46
Laptops	2	4.3	17.7
Satellite/Cable Adaptors	17.00	7.00	0
TVs	4.13	11.91	7.96
Terrestrial/Digital Adaptors	16.73	7.26	0.01
VCRs	1.28	22.72	0
Video Games	0.5	23	0.5
Stereo Systems	1	22	1
DVD players	1.28	22.72	0

Sources: What If? Market Transformation Programme, <http://whatif.mtprog.org>, and BFF

Table 3 contains technical data on the energy consumption in several modes for all types of electronic devices covered in the study.

Table 3. Energy consumption (Watts) by item (on/standby/off), ICT and Electronic Equipment, 2006

	On	Standby	Off
Power Supplies		3.5	
LCD Monitors	37.67	2	1.3
CRT monitors	92	3.5	2.5
Desktops	91.14	16.03	2.7
Laptops	30.18	2.68	0.91
Satellite/Cable Adaptors	17.97	18.83	
TVs	82.52	3.1	
Terrestrial/Digital Adaptors	8.56	6.61	
VCRs	16.84	4.77	
Video Games	11	4	
Stereo Systems	11	4	
DVD players	9	3.81	

Source: What If? Market Transformation Programme, <http://whatif.mtprog.org> and BFF

All devices can be grouped into several categories according to energy consumption:

- 1) Most energy intensive devices: CRT monitors (92W), Desktops (91.1 W) and TVs (82.5W).
- 2) Moderately energy intensive devices: LCD monitors (37.7W), Laptops (30.18W).
- 3) Less energy intensive devices: Satellite/Cable Adaptors (18W), VCRs (16.8W),
- 4) Least energy intensive devices: Video Games (11W), Stereo Systems (11W), DVD players (9W), Terrestrial/Digital Adaptors (8.6W)

Note that all devices consume significant power in standby mode, which for Satellite/Cable Adaptors is higher than the amount of energy consumed when the devices are “on”.

Total Electricity Consumption

The total amount of energy attributed to the use of ICT and Electronic Appliances by teenagers aged 13-19 in Great Britain is approximately 3.12 TWh (see Figure 4), which is 2.58% of domestic electricity consumption and 0.87% of total UK electricity consumption. Of this, 68% is consumed when the appliances are on, 28% in standby and 4% when switched off (some electronic devices continue to draw power even when switched off).

Figure 4. Total Annual Energy Consumption (GWh) in “On”, “Standby” and “Off” Modes, ICT and Electronic Appliances, 13-19 year olds, Great Britain, 2006, GWh

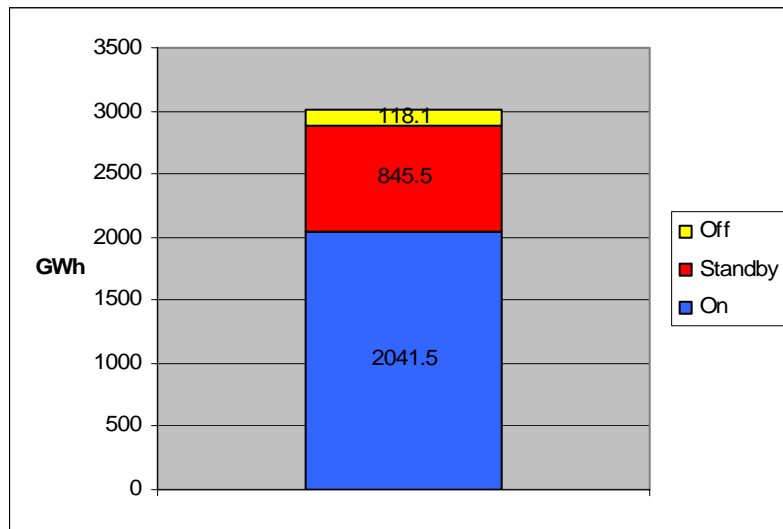
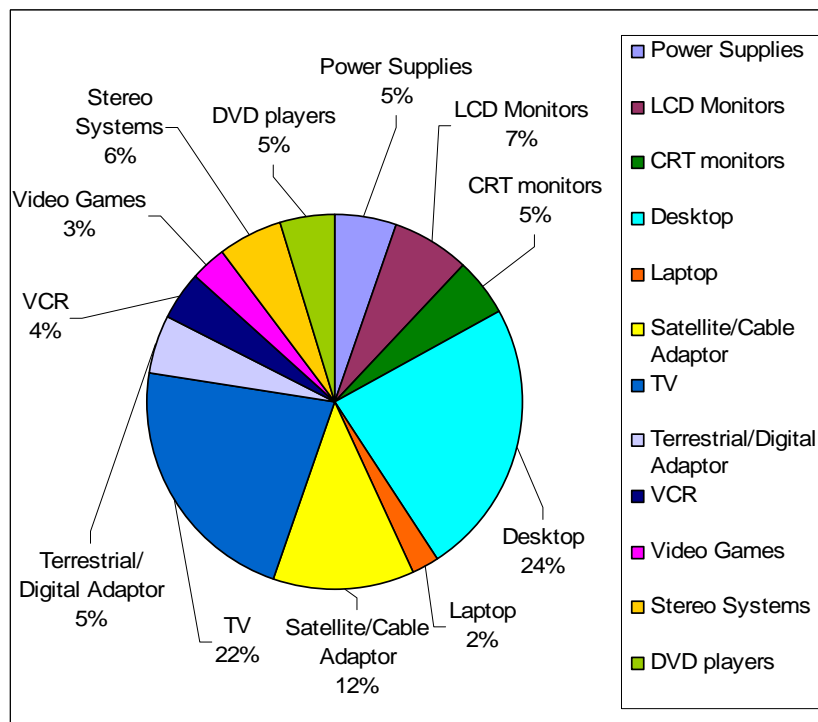


Figure 5. Total Annual Energy Consumption by 13-19 year olds, by type of device, Great Britain, 2006, %



Consumption by Device

On the whole, Desktop Computers and TVs are responsible for 24% and 22% of total energy consumed by 13-19 year olds using ICT and Electronic Appliances, while Satellite Cable Adaptors use 12%, LCD monitors use 7%, and Stereo Systems use 6% respectively. CRT monitors, Terrestrial/Digital Adaptors, Power Supplies and DVD players use 5% each, Video Recorders 4%, Video Games 3%, and Laptops 2% (see earlier Figure 1).

Computer processors and monitors, together with TVs and their associated set-top boxes (whether satellite, cable or terrestrial), make up more than 75% of total energy use.

Figure 6. Total Annual Energy Consumption by type of device in “On”, “Standby” and “Off” modes, ICT and Electronic Appliances, 13-19 year olds, Great Britain, 2006, GWh

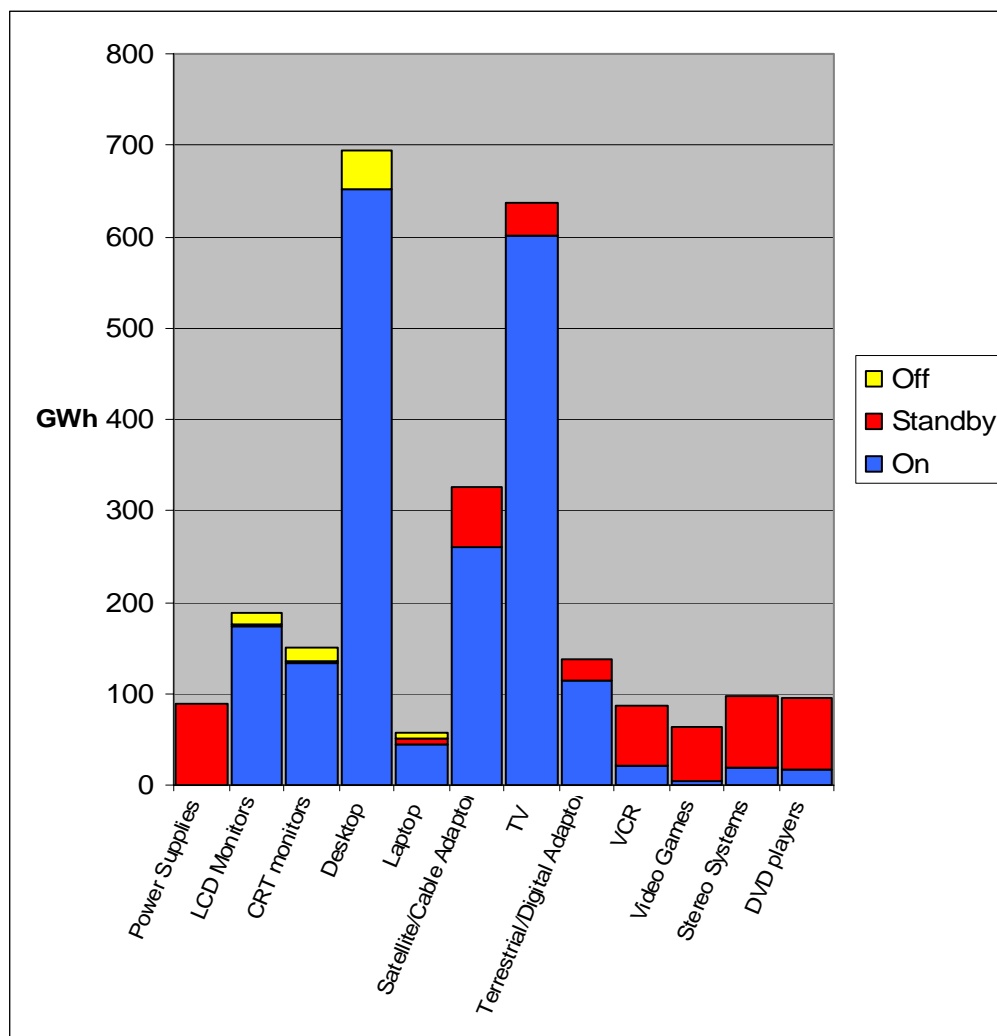
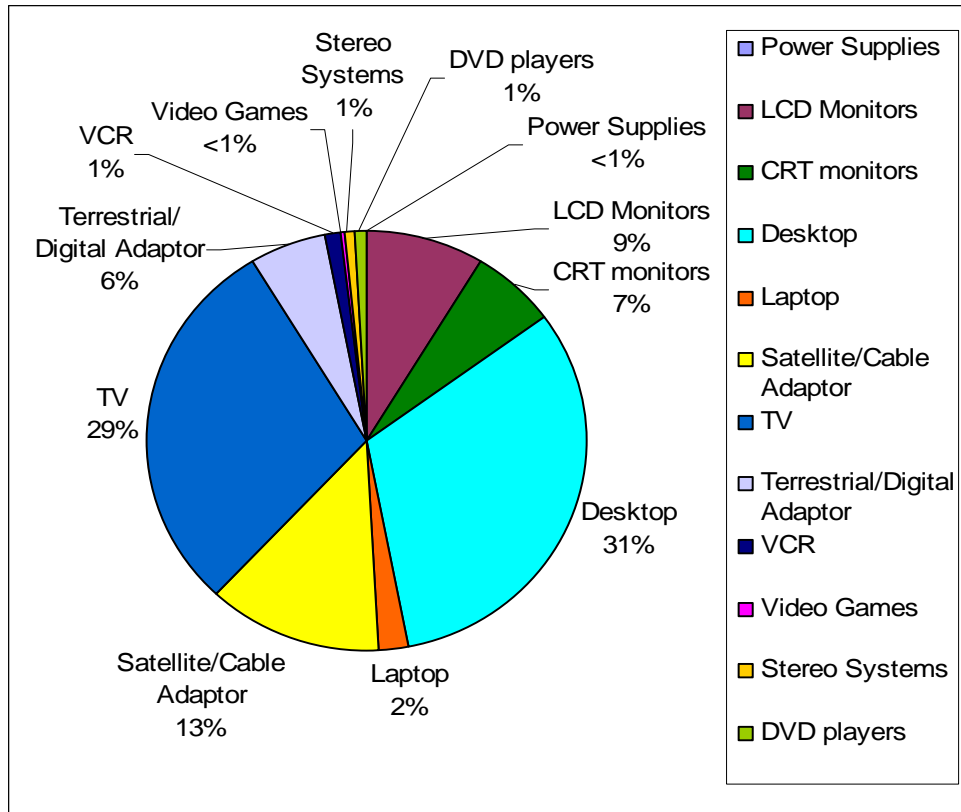


Figure 6 shows total energy consumption by teenagers for each device. It is notable that some devices (LCD monitors, CRT monitors, Desktops, Laptops, Satellite/Cable Adaptors, TV, Terrestrial/Digital Adaptors) are using much more energy when on (blue, lower bar) while others (Power Supplies, VCRs, Videogames, Stereo Systems, and DVD players) are consuming more in standby mode (red, middle bar). This relates to both the usage profile and power rating of the device; in particular the relationship between the power drain in on/standby and off modes (see Table 2).

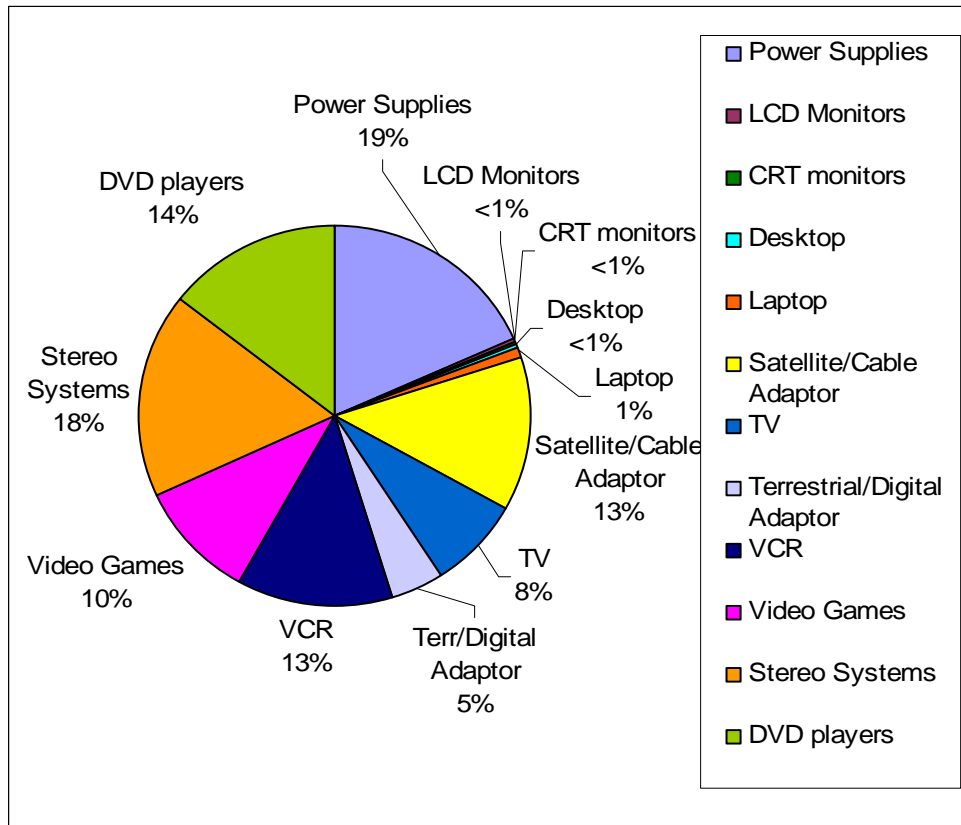
Switching off devices, rather than leaving them in standby, would save between 20 and 30% of total youth electricity consumption (about 840 GWh of the 3.12 TWh identified).

Figure 7. The shares of total annual energy consumption by ICT and Electronic Appliances, 13-19 year olds, “on” mode, Great Britain, 2006, %



As can be seen from Figure 7, the largest proportion of the energy used in ‘on’ mode can be attributed to the use of desktop computers (31%) and TVs (29%), followed by Satellite/Cable Adaptors at 13%, LCD monitors at 9%, CRT monitors at 7% and Terrestrial/Digital Adaptors at 6% each. Laptops are responsible for 2% each, DVD players, Video Recorders and Stereo Systems 1% each, Power Supplies and Video Games consume less than 1% each. The top five devices consume 89% of the ‘on’ mode energy.

Figure 8. Total annual standby energy consumption in Great Britain, ICT and Electronic Appliances, 13-19 year olds, “standby”-mode, Great Britain, 2006, %



74% of the energy consumed in standby mode (see Figure 9) is used by devices which are relatively infrequently used: Power Supplies (19%), Stereo Systems (18%), DVD players (14%), VCRs (13%) and Video Games (10%).

The ‘on’ and ‘standby’ mode figures suggest two complementary strategies for reducing energy demand; switch off high power, high usage devices (computers, TVs, monitors etc.) when they are not in use and avoid leaving infrequently used devices (power supplies, music systems, video games etc.) on standby.

Regional and Demographic Variation

The results of the study show that there is little regional difference in the profile of regular use of devices (see Table 2), but more energy in total is used in the South because of the higher population of teenagers (see Figure 5). Individual teenagers in Scotland and in the North consume slightly more electricity than their counterparts in the Midlands, South and Wales, with figures for Wales being the lowest (see Figure 6).

Figure 9. Total Annual Energy Consumption in “On”, “Standby” and “Off” Modes, ICT and Electronic Appliances, 16-19 year olds by Region, Great Britain, 2006, GWh

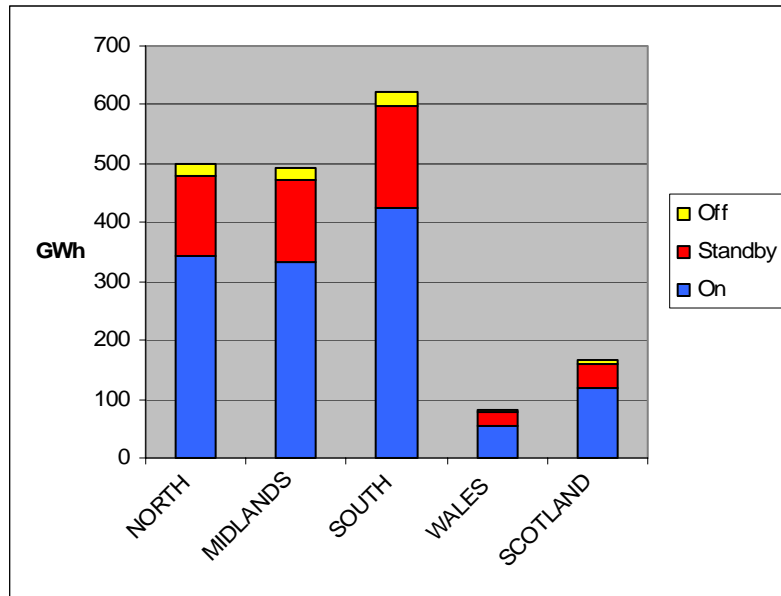
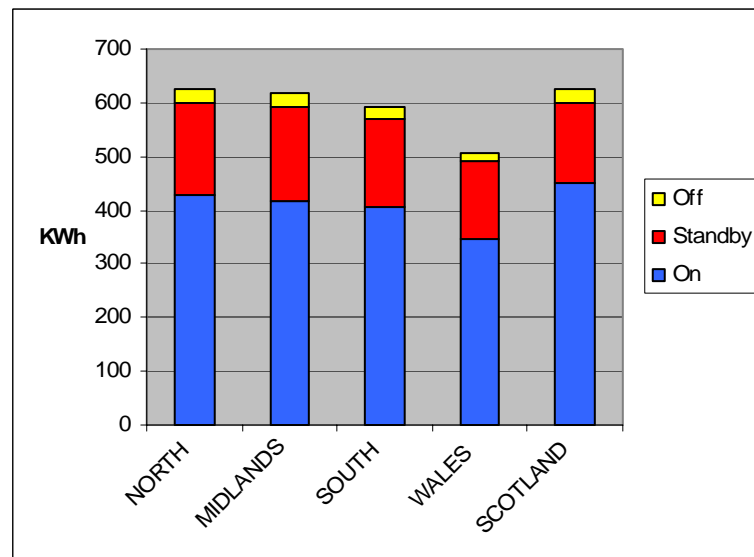


Figure 10. Total Per Teenager Annual Energy Consumption in “On”, “Standby” and “Off” modes, ICT and Electronic Appliances, 16-19 year olds by region, Great Britain, 2006, KWh



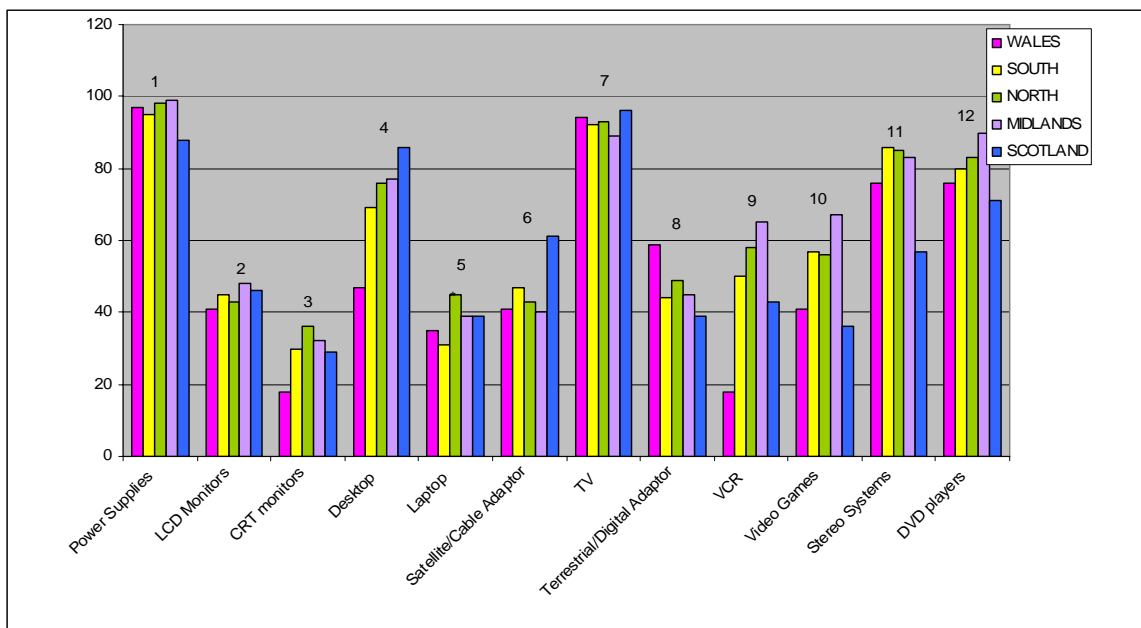
The survey highlighted the regional, gender, income and age differences in the patterns of active use of ICT and electronic appliances by 16-19 year olds. The differences significant at 90% confidence level are highlighted on the diagrams. It appears that there are no significant regional differences in the active use pattern of TVs and LCD monitors,

but there are greater variations seen in Desktop computers, VCRs and video games. (See Figure 11.)

Males aged 16-19 use more Video Games than females, but females use more VCRs, DVD players and stereo systems (Figure 12). More affluent teenagers use more laptops and are more likely to be connected to the Satellite/Cable TV than less affluent, however less affluent teenagers are more likely to use a TV set, a VCR and Terrestrial/Digital TV (Figure 13).

It is interesting to observe how the technological change affects the patterns of energy use through the ownership and active use rates. Teenagers aged 16-17 are more likely to use LCD monitors than the 18-19 year-olds, and they also show significantly higher active use rates of Desktops and Terrestrial/Digital TV (Figure 14). Habits and lifestyle are manifested in the fact that the 16-17 year-olds are using more Video Games than the older ones.

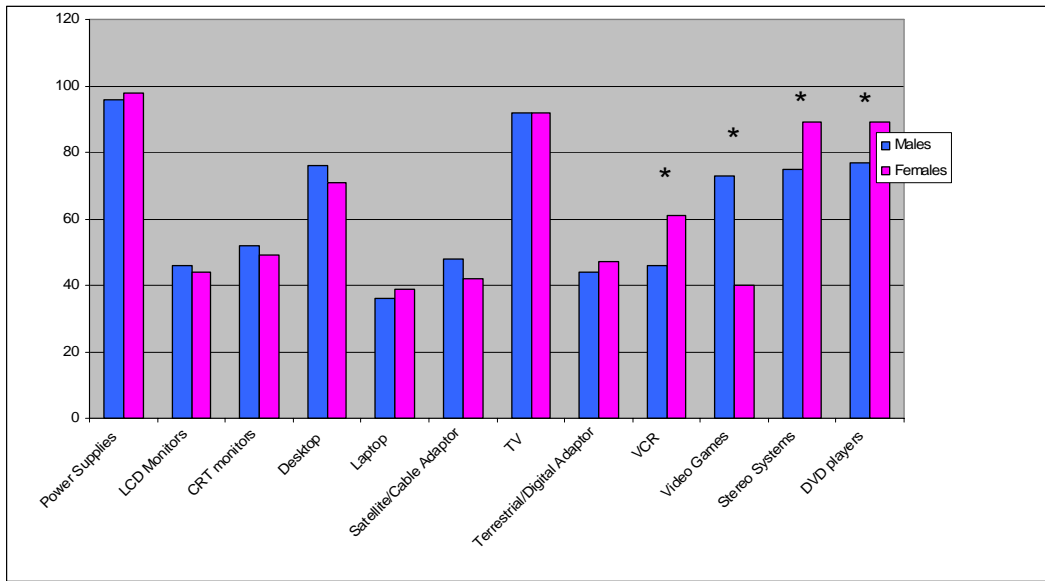
Figure 11. Difference in Active Use of ICT and Electronic Appliances by Males and Females, 16-19 year olds by region, Great Britain, 2006, %



Differences significant at 90% confidence level

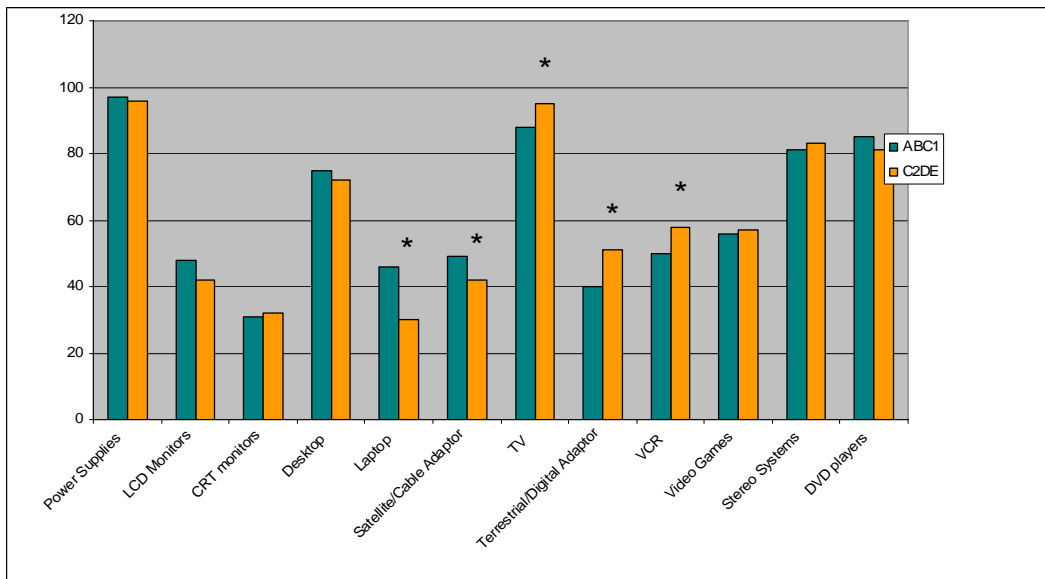
- 1- Power Suppliers: Midlands v South and Wales, North v Wales, Wales v Scotland
- 2 - LCD monitors: no significant differences
- 3 - CRT monitors: North v Wales
- 4 - Desktop computers: North v Wales, Midlands v South and Wales, South v Wales and Scotland, Wales v Scotland
- 5 - Laptop computers: North v South
- 6 - Satellite/Cable Adaptors: North and Midlands v Scotland
- 7 - TVs: no significant differences
- 8 - Terrestrial/Digital Adaptors: no significant differences
- 9 - VCRs: North v Wales and Scotland, Midlands v South, Wales, and Scotland, South v Scotland
- 10 - Video Games: North v Midlands and Scotland, Midlands v South, Wales, and Scotland, South v Wales, Wales v Scotland
- 11 - Stereo Systems: North, Midlands, South, Wales v Scotland
- 12 - DVD Players: North v Midlands and Scotland, Midlands v South, Wales, and Scotland

Figure 12. Difference in Active Use of ICT and Electronic Appliances by Males and Females, 16-19 year olds, Great Britain, 2006, %



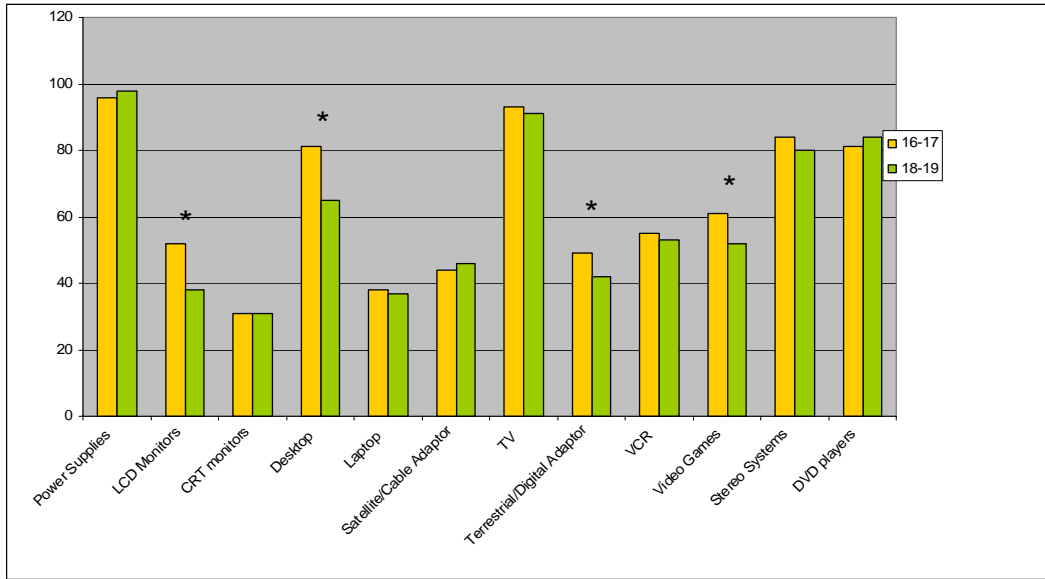
* Significantly different at 90% significance level.

Figure 13. Difference in Active Use of ICT and Electronic Appliances by teenagers of different social grades, 16-19 year olds, Great Britain, 2006, %



* Significantly different at 90% significance level.

Figure 14. Difference in Active Use of ICT and Electronic Appliances by teenagers aged 16-17 and 18-19, Great Britain, 2006, %



* Significantly different at 90% significance level.

CO₂ emissions

Taking the calculated energy consumption figures, it can be estimated that the electricity to power these items is responsible for CO₂ emissions of 1,295,273 tonnes per annum. This is equivalent to 242 kg of CO₂ per teenager. Of this, about 68 kg of this is attributable to items left in 'standby' mode.

Conclusions

2.58% of domestic electricity use in the UK³ – and 0.87% of total energy consumption – is attributable to teenagers' use of electronic appliances in the home. With the steady rise in the ownership of electronic devices, this figure is predicted to grow considerably (perhaps doubling) in the next decade.

Though this energy use may seem insignificant at a domestic level, when compared with the energy use of white goods, such as fridges, washing machines and dishwasher, the latter are already the subject of well-defined energy labelling schemes and their impact is being slowly addressed.

The use of devices by teenagers is – on the other hand – growing and the energy performance of the devices is less tightly regulated. This is partly because the diversity of the devices coupled with their relatively short design life makes such regulation more problematic.

When taken as a whole, the amount of electricity used (3.12 TWh) is clearly significant. This figure is almost certainly an under-estimate as not all devices were covered in this study. Nonetheless, 229 new offshore wind turbines would be required to produce this

³ Total Annual Electricity Consumption in the UK in 2003 was 369.96 TWh (International Energy Agency, Key World Energy Statistics, 2005, p. 56)

amount of renewable electricity. The energy used amounts to 104% of amounts of the currently installed wind capacity within the UK.

This electricity would result in, on average, the release of 1,295,273 tonnes of carbon dioxide (CO₂) per year the equivalent of 242 kg of CO₂ per teenager. This is the same as would be emitted from an average petrol car travelling a distance of 1,300 kilometres.

Although the survey sample size was too small to make definitive statements about geographical variations, a weak regional difference in consumption was found with teenagers in the North and Scotland appearing to consume more energy (per capita) than those in the South, Midlands and Wales.

Differences between genders were more pronounced with boys consuming about 9% more energy than girls. Age and social grade differences in the usage of certain devices was also evident.

The results of this research suggest four major options for reducing the CO₂ emissions from those electronic devices regularly used by teenagers:

1. **Turning off appliances instead of leaving them on standby.** This measure alone could yield CO₂ reductions of 20-30%. Permanently plugged in, but infrequently used, devices would seem to be the main culprits as these collectively account for 74% of standby power usage.
2. **Making sure high powered devices (TVs and computers) are only turned on when they are needed.** Computers, TVs and their associated devices (set-top boxes and monitors) make up the vast majority (more than 90%) of the 'on' power usage.
3. **Improving energy efficiency of devices.** Making electronic devices that use less energy is a key challenge for industry during the next few years. There are already examples of computers, for example, that require less than half the energy of a typical new model. Whereas there is already an incentive for manufacturers of mobile devices to ensure they are energy efficient (to improve their operational time), this incentive is not present for mains-powered appliances.
4. **Generating more electricity from renewable sources.** The Government is already committed to increasing the amount of renewable electricity fed into the national grid. The inherently low power demands of mobile devices present a further, exciting opportunity for them to be directly charged from solar energy. This could be from integrated solar panels (as has been the case with pocket calculators for some time) or from external plug-in devices (such as the fashionable 'Solio' solar charger already on the market).

In combination, these four measures could considerably reduce the energy consumption, and resulting CO₂ emissions, from the electronic devices used by teenagers by in excess of 50%.

Key Data Sources

Market Transformation Programme, What If? Tool, <http://whatif.mtprog.com>

Market Research: ACT2 Survey, 2006

Regional Population Data (UK Office of National Statistics (2006) Regional Trends, Chapter 3: Population and Migration. Table 3.2 Resident population by age and sex, 2006 www.statistics.gov.uk).

Appendix A: Regional characteristics of the population

(Regional Trends 2006, Chapter 3 Population and Migration, www.statistics.gov.uk)

Regions	Area	Population, (000) Total	Teenagers 13-19	Teenagers 16-19
North-East	8,573	2,545,100	242,855	141,200
North-West	14,106	6,827,200	661,410	374,900
Yorkshire and The Humber	15,408	5,038,800	486,215	277,700
NORTH	38,087	14,411,100	1,390,480	793,800
East Midlands	15,607	4,279,700	403,192	226,800
West Midlands	12,998	5,334,000	512,459	288,000
East of England	19,110	5,491,300	492,843	271,300
TOTAL EAST	47,715	15,105,000	1,408,494	786,100
London	1,572	7,429,200	628,114	365,700
South East	19,069	8,110,200	740,868	411,800
South West	23,837	5,038,200	454,771	254,000
TOTAL WEST	44,478	20,577,600	1,823,753	1,031,500
WALES	20779	2,952,500	279,900	158900
SCOTLAND	78772	5,084,400	458,300	264400
TOTAL	130,280	58,131,000	5,360,927	3,034,700

Source: Regional Trends, Office of National Statistics, UK, 2006