Suspecting standby? Domestic levels and the potential for household-level reductions in the UK

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1. AUTHORS' NOTE

This paper forms an abridged version of the MSc thesis: Vowles, J.C., (Summer 2000), *The Challenge of Domestic Standby Consumption: an evaluation of standby consumption levels within the UK domestic sector, and an assessment of the potential for household-level reductions.* Environmental Change Institute, University of Oxford, UK, supported by the Economic and Social Research Council.

2. SYNOPSIS

Empirical data is presented to estimate standby consumption levels in 32 UK households. User awareness of standby is investigated, and the scope for behavioural-induced reductions explored.

3. ABSTRACT

In situ measurements of electronic appliances in 32 households in the UK, coupled with a survey of appliance usage, provide evidence that standby consumption amounts to approximately 8% of total electricity consumption within the sample set. The subsequent adjustment of this data in line with national level energy consumption figures, indicates that this subsidiary, and often wasted, use of electricity may represent over 6% of total domestic sector consumption.

Discussions with householders, along with questionnaire responses received from a wider audience, reveal that, contrary to popular belief, there are strong indications that the level of standby consumption currently experienced within the UK is not the predominant result of a prevalent 'standby culture of convenience'. Rather, it is evident that a substantial proportion of householders are not aware of, and in fact opposed to, the levels of standby consumption within their home. Heightened awareness among householders is shown to provoke substantial behavioural-induced reductions in standby levels of up to 77% in individual cases, and 25% on average. However, the potential for further reductions is constrained by technological limitations, particularly the unavailability of power switches on appliances, and the need to retain programmed settings.

A dual approach to standby reduction is required: the expansion of current efforts to reduce standby demand levels of new appliances, together with the facilitation of awareness among individuals, in order to ensure that householders can support the market transformation process, and regulate domestic standby consumption from the 'bottom up'.

4. WHEN IS OFF, OFF? THE CASE OF STANDBY CONSUMPTION AND CONSUMER ELECTRONICS

With regard to household electronic goods, the term 'off' has increasingly become a relative one. Recent years have seen a proliferation of electronic goods, which continue to consume electricity even when they are not performing their primary function. In some cases, items continue to draw power even whilst ostensibly switched off using the power switch on the item. In other cases, items have no power switch and give the appearance of not consuming electricity, yet can only be switched off in absolute terms at the mains. However, of most significance is the increasing number of products that have a dormant or 'standby' mode, enabling them to respond to various signals, such as from a remote control to a television, or an incoming call to an answer machine. In order to perform standby functions these items demand a continuous power supply.

Whilst the standby consumption level of individual devices may be small, evidence reveals that standby can collectively form a substantial proportion of domestic sector baseload electricity demand. Investigations into domestic sector standby consumption began with the work of Meier (1993a, 1993b), Perez (1993) and Sandberg (1993). Since this time, field studies in a number of countries have attempted to quantify standby losses at a national level (see Table 1).

Table 1. Synopsis of country-specific domestic standby consumption studies[1]

Author	Date	Country	Proportion of domestic electricity consumption (%)	Standby demand per household (W)
EECA	1999	New Zealand	11	100
Harrington	2000	Australia	13	60
Meyer and Schaltegger	1999	Switzerland	3	37
Meier and Huber	1997	United States	5	50
Nakagami, Tanaka, Murakoshi and Litt	1997	Japan (Kanto and Kyushu regions)	10.7	60.5
Rainer, Greenberg and Meier	1996	United States	5	50
Rath, Hartmann, Praeffke and Mordzoil	1997	Germany	10	44
Siderius	1995	Netherlands	10	37
Sidler	2000	France	7	26.8

However, our knowledge of standby consumption is far from complete with studies being carried out in only a limited number of countries. Consequently, efforts to produce a wider estimate of standby consumption, at a European, OECD, or global level (see Lebot, Meier, and Anglade, 2000), have relied heavily on the extrapolation of existing data, and estimations based on gross assumptions of ownership and behaviour. One such dearth in the literature exists with regard to the UK. In fact, despite increasing attention to the need to reduce energy demand levels, particularly in order to meet international carbon dioxide emission reduction targets, the role of domestic standby consumption has been largely neglected. The work presented here aims to address this gap in knowledge, by providing the first *in situ* measurements of standby consumption for the UK.

5. TOWARDS LOWER STANDBY CONSUMPTION

There are two routes to lower standby consumption: technological improvements and behavioural change. However, to date, efforts to reduce domestic standby demand levels have focused primarily on technological innovations to reduce standby consumption levels of new models, and thus future stock (see Huenges Wajer, 1996; Meier *et al*, 1998; Meier and Rosen, 1999; Siderius, 1998). Therefore, efforts have focused on stimulating the process of a manufacturer-driven market transformation towards more efficient goods (DECADE, 1997). In particular, through a voluntary agreement with manufacturers, the European Association of Consumer Electronics Manufacturers (EACEM) has been successful in prompting a reduction in mean standby consumption levels among signatories of new televisions (TVs) from an average of 6.18 W in 1996 to 3.98 W in 1999, and Video Cassette Recorders (VCRs) from 6.64 W to 4.90 W over the same period (Willems, 2000, page 4). It is now likely that similar agreements on external power supply units (transformers), audio equipment and Integrated Receiver Decoders (IRDs) will be forthcoming.

Despite these efforts, it is becoming increasingly apparent that technological improvements alone are proving insufficient, with several factors pointing to the likelihood for standby consumption levels to increase dramatically into the foreseeable future. This is particularly true for the UK. Firstly, the number of domestic electronic goods is set to rise in line with increasing numbers of both households and ownership levels (DECADE, 1995; Lower Carbon Futures, 2000; Market Transformation Programme (MTP) website, 2000). Secondly, goods which have been traditionally electro-mechanical, are becoming increasingly electronic in nature, with standby functions forming "key value enhancing features" (DECADE, 1997, page 35). Thirdly, increasing convergence of consumer electronics and information technology, enabling greater interaction between various electronic goods, means that more and more items may never be switched off completely (see Official Bluetooth Website, 2000).

Thus, it is apparent that more needs to be done. Indeed, there is greater scope for reductions in the standby demand of goods at the manufacturer level. However, the potential contribution to standby reductions from behavioural changes at the household level has been largely assumed to be minimal, or overlooked. This belief is based on the premise that the standby feature is desired by the consumer, typically owing to the convenience that it provides in the use of the product. The work presented here both investigates and challenges this assumption. Furthermore, through the investigation of user perception of standby functions and awareness of standby consumption, this paper provides necessary insight to inform future policy and invoke the necessary changes towards lower standby consumption.

6. DEFINING STANDBY

Standby consumption is the energy consumed by electronic items whilst they are not performing their primary function. This is further defined to encompass the following modes of operation:

- The waiting mode common in TVs, VCRs, hi-fis and answer-machines, which enables the device to perform its primary function in response to an internal or external signal. An example of the former is a timer function on a VCR, whereas an example of the latter is the remote control facility for a TV, or an incoming call to an answer-machine.
- Continuous display facilities and lighting which are subsidiary to the primary function (such as the clock display on a VCR or microwave oven, or LED (green and red light) power indicators).
- Memory retention facilities to maintain an environment beneficial to the user (such as to enable a TV to revert to the most recently viewed channel when switched on, or to retain programmed channel information).
- Inefficient linear power supplies/transformers that continue to use electricity despite the mechanical on/off switch on the appliance being set to off. In the case of rechargeable items, this includes chargers that continue to draw power despite the rechargeable item being fully charged, or unattached.
- User failure to switch the appliance to off/to standby when not in use, so that the device remains on, yet is not required or able to perform its primary function (hereafter denoted 'idle').

Clearly, defining standby is by no means a trivial task: definitions can vary considerably, and therefore it is important to take this in to consideration before comparing the findings of this study.

7. *IN SITU* MEASUREMENTS: THE FINDINGS

Standby consumption was estimated for 32 households, located within seven counties in the UK.

Standby demand

Standby demand (W) was measured for all household electronic items, using a Voltech PM1000 Wattmeter, sensitive to 0.01 W. In total, standby demand measurements were obtained for 282 items, covering 32 product types. A summary of the measurements by product type can be found in Table 2 below. The total number of standby appliances for all households is greater than the total measured, as in some cases appliances were mains wired or inaccessible. In such instances the mean of the other measured items in the product category has been taken, in order to later provide a reasonable estimate of household standby consumption. As it is inadvisable to disconnect digital IRDs, the measurement of the sole satellite digital IRD is estimated from Environmental Change Institute data. Owing to complexity of measurements and generic accessibility problems, computers,

heating and security devices are excluded from the study, and as such, estimates for household standby consumption levels are likely to form underestimations.

Table 2. Summary of standby demand measurements of household electronic goods (W, by product type)[2]

Product category/type	Number measured	Standby demand (W)			
		Minimum	Maximum	Mean	Standard deviation
Audio/Visual					
Amplifier (waiting)	2	2.18	2.30	2.24	-
Amplifier (idle)	2	6.91	19.78	13.35	-
DVD	1	-	-	4.45	-
Electric Keyboard	1	-	-	2.80	-
Games Console	3	0.85	1.81	1.28	0.49
Hi-fi (waiting)	31	0.85	25.15	7.54	6.82
Hi-fi (idle)	19	3.65	39.67	17.60	12.88
IRD (waiting)	10	7.48	16.39	11.93	3.11
IRD (idle)	9	7.88	23.26	14.16	5.34
Radio/Tuner	6	0.27	2.89	1.81	1.01
Record Player	3	0.00	1.02	0.34	0.59
Speaker	2	-	-	3.78	-
TV (waiting)	45	0.64	16.13	6.47	4.03
TV Booster	2	1.43	1.99	1.71	
TV Clock Radio	1	-	-	3.17	-
VCR (waiting)	36	3.12	17.51	8.04	3.68
VCR (idle)	33	7.89	35.55	14.34	5.37
Cold and Wet Goods					
Dishwasher	6	0.00	1.02	0.50	0.35
Freezer	12	0.00	4.63	0.88	1.28
Fridge	14	0.00	0.59	0.10	0.18
Fridge Freezer	19	0.00	20.65	2.21	4.93
Washing Machine	12	0.12	0.77	0.29	0.18
Cooking					
Cooker	4	1.63	6.03	4.40	1.97
Microwave	15	1.17	6.05	3.39	1.36
Teas Made	1	-	-	3.17	-
Telephony					
Amateur Radio Transceiver	1	-	-	1.84	-
Answer-machine	9	2.12	4.78	2.95	0.90
Cordless Phone	6	1.72	4.14	2.71	0.89
Cordless Telephone/Answer machine	4	2.53	3.39	2.93	0.43
Fax	1	-	-	7.83	-
Mobile Telephone Charger	12	0.52	5.88	1.60	1.75
Miscellaneous					
Battery Charger	1	-	-	2.53	-
Cordless Vacuum	4	1.93	2.79	2.54	0.40
Door Bell	1	-	-	2.69	-
Extension Lead (with light)	12	0.13	2.24	0.38	0.59
Hairdryer	5	0.00	0.13	0.10	0.06

Standby consumption

Combining data in Table 2 with user estimates for the time household electronic goods are left in standby mode, as summarised in Table 3, along with total household electricity consumption data, permits the calculation of standby consumption levels per household (both absolute and as a percentage of total consumption).

Table 3. Summary of user estimates of the standby time for household electronic goods (hours per day, by product type)

Product category/type	Number of items	Standby time (hours per day)		
		Minimum	Maximum	Mean
Audio/Visual				
Amplifier (waiting)	2	23.0	23.7	22.8
Amplifier (idle)	2	0.0	0.0	0.0
DVD	1	-	-	23.7
Electric Keyboard	1	-	-	23.5
Games Console	3	22.0	23.7	22.9
Hi-fi (waiting)	31	0.0	23.9	17.9
Hi-fi (idle)	31	0.0	6.0	0.2
IRD (waiting)	10	0.0	23.9	17.9
IRD (idle)	10	0.0	23.0	4.0
Radio/Tuner	6	18.0	24.0	21.7
Record Player	3	0.0	23.9	8.0
Speaker	27	23.5	23.5	23.5
TV (waiting)	45	0.0	23.8	8.9
TV Booster	2	16.0	22.0	19.0
TV Clock Radio	1	-	-	24.0
VCR (waiting)	36	0.0	24.0	20.1
VCR (idle)	36	0.0	5.0	0.1
Cold and Wet Goods				
Dishwasher	9	16.0	23.7	22.5
Freezer	-	-	-	7.9*
Fridge	-	-	-	7.9*
Fridge Freezer	-	-	-	7.9*
Washing Machine	26	0.0	23.7	17.1
Cooking				
Cooker	22	0.0	23.5	19.8
Microwave	19	0.0	24.0	20.1
Teas Made	1	-	-	23.8
Telephony				
Amateur Radio Transceiver	1	-	-	23.0
Answer-machine	-	-	-	23.9*
Cordless Phone	-	-	-	23.5*
Cordless Telephone/Answer machine	-	-	-	23.5*
Fax	-	-	-	23.9*
Mobile Telephone Charger	12	2.0	23.0	16.9
Miscellaneous				
Battery Charger	1	-	-	22.0
Cordless Vacuum	-	-	-	23.5*
Door Bell	20	23.9	23.9	23.9
Extension Lead (with light)	12	15.0	24.0	21.7
Hairdryer	5	23.9	23.9	23.9

** assumed standby times, based on best information available.*

For cases where it was difficult for householders to estimate standby times, estimates are based on the best information available. In particular:

- Cordless telephones and vacuums are assumed to be in standby mode 23.5 hours per day, allowing 30 minutes for recharging. For cordless vacuums, all respondents confirmed that the item remained attached to the charger when not in use, and therefore the measurement was taken in this state. For cordless telephones, usage was more erratic, and consequently the measurement of the charger was taken without the telephone attached.
- Answer-machines and faxes are assumed to be in standby-mode 23 hours and 55 minutes per day (based on user-estimates of messages received per day).
- For 'cold' appliances it proved impossible to estimate standby times. Therefore, this study has drawn upon a report by Sidler (1996), whereby data is presented to show that fridge freezers operate on average 66.7% of the time (and hence are in standby mode 33.3% of the time). Here, it is assumed that all cold appliances operate in this manner.

The mean annual standby consumption for the sample households is calculated as 277 kWh, which represents a mean standby demand per household of 31.6 W. However, the level of annual standby consumption varies considerably among the households, with estimates ranging from 28 to 620 kWh per year. In relative terms, standby consumption also varies, accounting for between 1 and 22% of total consumption among the sample set. Assuming that the sample population forms a normal distribution, we can calculate the 95% confidence interval for the true population mean to be between 211 and 343 kWh (or between 6 and 10 % of annual household electricity demand).

In order to gain further insight, data was scaled up to provide an indication of the possible level of national domestic sector standby consumption. It is acknowledged that the results presented are not necessarily representative of the UK as a whole. However, given that these figures are derived from the first standby consumption dataset for the UK to be based on *in situ* measurements, such calculations provide additional context for the reassessment of earlier estimates for UK domestic sector standby consumption.

By comparing the product of the mean standby consumption figures per household, and the estimated 24.7 million households in the UK (Lower Carbon Futures, 2000), with the total domestic sector electricity consumption of 110,408 GWh (given for 1999; DTI, 2000: page 123), it is possible to obtain an estimate of the proportion of total domestic electricity consumption which is attributable to standby. Hence, standby as a percentage of total domestic sector consumption is calculated to be 6.2%. Whilst this figure is lower than that calculated for the household sample, this is likely to be due to the mean total electricity consumption within the sample households being less than the national average (owing to the exclusion of space heating from the annual electricity bills). Therefore, it is arguable that the national level figure is a more reliable estimate of the proportion of total domestic sector electricity consumption which is attributable to appliances in standby-mode. However, it must also be borne in mind, that due to the exclusion of several product types from the survey (see below), the figure is also likely to be an underestimation of the true value. Nevertheless, these findings unequivocally confirm that a significant proportion of UK domestic sector electricity demand is attributable to electronic appliances which are in standby mode.

8. THE UTILISATION OF STANDBY FUNCTIONS: INVESTIGATION INTO USER BEHAVIOUR AND AWARENESS

The analysis of 120 questionnaire responses provides insight into the underlying factors which determine levels of domestic standby consumption in the UK. Such information is vital to the establishment of effective strategies to address this issue.

In summary, usage of standby functions can be divided into three broad strategies among householders:

1. *Minimised standby function usage* – standby functions are not used, as the item is always switched off when not in use
2. *Intermediate standby function usage* – standby functions are utilised, although not on a continual basis
3. *Maximised standby function usage* – items are constantly either in standby- or on-mode

The proportion of responses falling into each category can be seen in Table 4 below:

Table 4. Use of standby function by items owned (percentage of respondents)

Product Type	Percentage of respondents (%)		
	Minimised	Intermediate	Maximised
Cooker	18	4	78
Hi-fi	34	8	58
IRD	0	0	100*
Microwave	12	2	86
TV	40	29	31
VCR	16	5	79

**includes two IRDs which were constantly on (idle)*

Firstly, Table 4 shows that the proportion of respondents falling into each category is not consistent for each product type, and therefore the use of standby facilities is not uniform for all products. Hence, it is apparent that householders adopt different strategies when using different household electronic goods. Secondly, there is a strong polarisation between those who always and those who never switch off appliances. Only in the case of TVs do a significant number of respondents jointly utilise both the off and standby functions. This is largely a result of the standby function being used when the TV is in frequent use, whereas it is more likely to be switched off when it is not intended to be used for a longer duration, particularly overnight.

Of particular interest are the large proportion of respondents (in the case of IRDs this is all respondents) who claim never to switch off electronic items. Further investigation of why users choose to leave items in standby mode will provide further insight.

Reasons for leaving items in standby

Questionnaire respondents were asked "if the item is not switched off when not in use, why?" Answers are categorised according to their main themes within Table 5 below:

Table 5. Percentage distribution of responses to the question: "if the item is not switched off when not in use, why?"

Product Type	Percentage of respondents (%)					Total Responses
	Convenience	Lose Settings	Use Clock	No Option	Miscellaneous	
Cooker	22	41	29	6	2	49
Hi-fi	37	17	4	37	5	75
IRD	30	10	n/a	60	0	11
Microwave	21	34	19	6	20	47
TV	88	n/a	n/a	11	1	82
VCR	28	43	7	15	7	107

The large number of respondents asserting that household electronic items are left in standby-mode purely for purposes of convenience, supports claims to the existence of a so-called 'standby culture'. This is shown to be particularly the case with televisions, with over 80% of respondents citing 'convenience' as the prime motive for utilising the standby-mode. Whilst many respondents readily acknowledged that since the advent of remote control facilities they had become "*lazy*", others stated that the function now forms an essential component of their lifestyle. However, a large proportion of respondents also refuted convenience as a motive for leaving items in standby mode, providing a variety of alternative explanations of which technological constraints and lack of awareness proved dominant.

A large percentage of respondents commented that they would be inclined to reduce the time spent in standby for certain items if this did not mean losing programmed settings. For instance, one questionnaire respondent (male, 25-34), who claimed to have a VCR, hi-fi, cooker and radio alarm clock left in standby-mode when not in use, commented: *"I am concerned about the waste of electricity involved in leaving the item on standby, but the inconvenience of losing the programmed information is too great."* In addition, a significant number of

respondents, particularly with regard to cookers and microwaves, stated that items were left in standby mode in order to maintain the clock facility.
However, investigations found that when respondents were asked directly whether they would switch items off more frequently if settings were maintained, the majority of respondents answered *"yes"*. In fact, for VCRs, hi-fis, cookers and microwaves, this proportion of respondents was 64, 56, 51 and 42% respectively.

The category entitled "no option" encompasses responses such as *"no on/off switch"* and *"can't reach plug"*[3]. Having no option was particularly important in determining the usage patterns of IRDs, hi-fis, and VCRs. One questionnaire respondent (male, 16-24) explained: *"many items do not have an on/off switch, so other than unplugging items, which isn't always convenient, there is no option other than to leave them on standby"*. It is also reasonable to assume that a lack of power switches on appliances, coupled with inaccessibility of mains switches, is largely responsible for the wasted standby consumption arising from continuous display items which, are not set up to display the correct time, yet are never switched off[4]. Further analysis of the questionnaire responses reveals that 24% of microwaves, and 16% of cookers are never switched off, despite the clock display not being set to the correct time (and therefore forming no service to the user). Six respondents asserted that there was *"no need"* to switch items off if they had a standby function, with one householder (male, 64+) qualifying this with the belief that in the standby mode the item is effectively *"switched off"*.

Householder awareness of standby consumption

In order to further gauge awareness of standby consumption, householders were asked if they thought their electronic items were consuming electricity when in standby-mode and off. Rather than using the terms 'standby' and 'off', these modes (if available) were demonstrated on the item in question.

Whilst the vast majority of respondents were able to identify items with a visible LED power indicator or continuous display to be consuming electricity whilst in standby mode, far fewer suspected items without any visible power indicator to be consuming electricity, or indeed to have a standby mode. In fact, only 27% of items without a visible power indicator were correctly identified to be consuming electricity. Moreover, even though almost all respondents acknowledged that items with a visible power indicator were consuming electricity in standby-mode, the levels of consumption in question were generally regarded as extremely low, being frequently referred to as *"minute"*, *"insignificant"* and *"too small to be relevant"* among the respondents.

Determining the impact of heightened awareness

Householders were presented with the findings of their individual household survey, with standby consumption for each measured item represented in the form of both kWh and estimated monetary cost per year, along with a total standby consumption figure, also presented as an estimated proportion of the yearly electricity bill. Over the subsequent three weeks, the householders' responses to the survey were monitored.

75% of respondents expressed surprise at the findings of the survey, and in 50% of households this was enough to provoke a reduction in standby consumption levels through modifications to the usage patterns of the electronic goods in question. In all cases, the initial changes made to the usage of items were still in place at the end of the three week period.

In total, the following list of items were no longer left in standby-mode: twelve TVs, ten hi-fis, six microwaves, seven mobile telephone chargers, two hairdryers, three IRDs, two radios, five VCRs, three washing machines, one calculator, one dishwasher, one games console, one timer, one laptop charger and one radio transceiver. In addition, one hi-fi had been reverted from 'demo' to power economising or 'eco' mode. If these behavioural changes were maintained, this would amount to savings of 2174 kWh per year, which is equivalent to a mean reduction in standby consumption per household of 68 kWh per year (from 277 to 209 kWh). This represents a 25% reduction in standby consumption among sample households. Of those households making changes, standby consumption was reduced by 40% on average, although in individual cases reductions up to 77 % were achieved. It is notable that householders were motivated to switch off items with relatively low standby consumption levels (less than 1 W). As one respondent commented (female, 45-54): *"small changes add up. If everyone did the same it would make a big difference"*.

Limitations to behavioural changes

Of the sixteen households for which it was stated that no changes had been made, nine of these comprised the households with the lowest measured level of standby consumption, and hence the scope for reductions there was limited. However, the remaining seven households displayed clear scope for a reduction in standby consumption. Of these, three household representatives explained that they were considering making changes in the future, whilst a further three asserted that they would not make any changes, as they enjoy the convenience of leaving items in standby mode.

Of those making changes, nine householders claimed that they had reduced their standby consumption as much as possible, but were restricted by the need to retain programmed settings, the unavailability of power switches and/or the inaccessibility of mains switches. This was summed up by one householder (female, 45-54) who stated: *"the changes made are the easy ones"*. Hence, it is arguable that whilst there is considerable scope for behavioural-induced reductions in standby consumption levels through heightened awareness, this is limited in practice due to technological and physical constraints.

9. CONCLUSIONS

Towards lower domestic standby consumption: the challenge

This study has provided the first investigation into standby consumption levels in the UK, based exclusively on empirical evidence. In summary, it has been shown that, of the households sampled, 8% of total electricity consumption (excluding space heating) is attributable to items in standby-mode. When extrapolated to the national level, this indicates that electronic items in standby-mode may account for over 6% of total domestic sector electricity demand. As the standby consumption from computers, heating and security devices were excluded from this study, the true level of domestic sector standby consumption is likely to be even higher. Furthermore, there is evidence that, if unchecked, standby consumption levels are likely to increase into the foreseeable future.

The challenge is thus to curb the trend towards increasing levels of standby consumption, and ultimately to reduce standby consumption to its lowest practicable level. This acknowledges that, whilst it has been shown that standby consumption is often synonymous with 'wasted watts', in many cases, standby consumption forms a necessary requirement of products, and therefore cannot be eradicated entirely.

Facing the challenge of domestic standby consumption

Whilst major achievements at the manufacturer level in the bid to reduce standby demand levels of electronic goods have been widely reported, less attention has been given to role of actions by individuals to reduce standby consumption. However, this study has shown that heightened awareness of standby consumption levels, and the standby demand of various household goods, has prompted a 'bottom-up' change resulting in a rapid and significant reduction of standby consumption. This indicates that in many cases, householders were not conscious of standby consumption, and were actually opposed to it. This is in strict contrast with the widespread assumption that there is little scope for reduction at the household level, due to the required trade-off between convenience and energy savings. These behavioural-induced standby savings could go even further, but are constrained by technological limitations, particularly the lack of (absolute) on/off switches and the need to retain programmed settings, which ultimately act to support the convenience of the standby function.

However, awareness of standby consumption at the individual level appears to be low. This is an issue which needs to be addressed, if the potential standby energy reductions through awareness-induced changes at the individual level are to be realised. Furthermore, such awareness is necessary to ensure that changes made to reduce standby consumption at the manufacturer level are realised as new products penetrate the stock (i.e. through activation of power save features), and to ensure that manufacturer efforts are both rewarded and stimulated through consumer demand for lower standby consuming goods.

Efforts to reduce standby demand at both the manufacturer and individual levels should be seen as complementary goals. The need for this dual approach is further evident if it is considered that owing to the dynamic nature of the consumer electronics industry (resulting in a high rate of new product entry into the

market), keeping check of standby demand levels through policy and voluntary agreements may prove to be a somewhat arduous task.

Recommendations

The following recommendations have been given based on the major findings of this study. It is acknowledged that further research is necessary to extend the sample size on which these recommendations are made, and to increase the confidence with which estimates for standby consumption levels (ranging from individual product types to national domestic sector consumption) can be made.

A dual approach to a reduction in domestic standby consumption should be adopted, encompassing the following recommendations at both the manufacturer and individual level:

1. Current efforts to reduce the standby demand of products at the manufacturer level should continue, and be extended to cover further product types (including new market product types), and to encompass the entire spectrum of standby-modes of operation (particularly the 'idle' status of audio/visual goods). This need has been affirmed by evidence of the limitations to behavioural change and by the need for certain items to remain permanently energised in order to operate effectively.
2. Increased attention should be given to raising awareness at the householder level, in order to provoke the necessary changes to ensure that standby consumption levels are regulated from the 'bottom-up'. This is based on indications that inadequate levels of awareness among householders currently acts to stifle the potential for significant behavioural-induced reductions in domestic standby consumption.
3. Attention is required to the increasing omission of absolute power switches on some electronic goods. Evidence presented within this report suggests that this may have profound implications for current and future levels of standby consumption, and consequently may need to be addressed through policy or voluntary action on the behalf of manufacturers.

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11. ENDNOTES

[1] This table is not exhaustive; the studies presented have been selected on the basis that estimated standby consumption levels per household are presented

[2] Measurements include items for which standby consumption was recorded as zero.

[3] It is assumed that the comment "can't reach plug" implies that it is not possible to switch the device off, other than at the mains

[4] This excludes memory retaining product types, such as VCRs.