Standby losses caused by low voltage lighting

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1. SYNOPSIS

New technology can reduce standby losses from low voltage transformers by factor 1000 resulting in an estimated annual energy saving within EU of 10 TWh.

2. ABSTRACT

Often-neglected sources of standby losses are those caused by low voltage lighting powered by plug-in transformers. Within the European Community there is an existing stock of more than 300 million low-voltage light fittings. These fittings are used in lamps such as bedside lamps, office tabletop lamps, decorative lights and many other applications. More than 100 million fittings are produced annually of which 30 per cent are exported to the European countries.

Low voltage lighting has a considerable energy saving potential. This sector has, however, not been included in the standby discussions that covered consumer electronics and recently also white goods. A Swedish innovation can lead the way for considerably reduced standby losses in low voltage lighting by also in other sectors.

The European Commission presented a paper to the European Council and to the European Parliament on *Policy Instruments to Reduce Standby losses of Consumer Electronic Equipment, COM (1999) 120 final.* In this paper, the consumption of consumer electronic equipment in standby mode has been estimated to be around 36 TWh and it is predicted to increase to 62 TWh by year 2010. That figure was excluding the standby loss from low power lighting, which by year 2010 is estimated to 10 TWh. The energy saving potential from the electronic equipments is estimated to 39 TWh if the Community and Member States adopt adequate policies and programs.

3. BACKGROUND

A guidance document produced by the European Commission noted that 32.4% of the CO_2 emissions were related to electricity consumption. Successful programs such as Energy Star and energy labelling of white goods have resulted in energy efficient electronic equipment and energy efficient appliances. The market forces have gradually improved electricity efficiency within certain sectors. However, the electricity demand continues to increase. There still remains a large potential for further improvement and new electricity consuming areas must be identified.

During the ECEEE 1993 summer study, Eje Sandberg, ESAN Energi AB, presented a study that brought standby losses into focus. He had studied 300 domestic electronic items for sale in Swedish stores. The power demand was measured when the items were in “turned-off” position and in “standby” position. The average energy demand for these items was between 4 and as much as 90 kWh/year/item. He also studied the standby power losses in an ordinary Swedish home. This study showed that approximately 475 kWh per year were consumed when electronic equipment was not in use but connected. Studies from other countries came up with similar results.

IEA initiated two workshops of which one was organised jointly with the European Commission on January 2000. A third workshop took place in Tokyo on February this year. The IEA has put in place three Task Forces the result of which is a report that will facilitate an international collaboration to improve the energy efficiency in the standby power mode of electrical equipment.
Most of the work has been concentrated on electronic equipment. An area with a substantial energy saving potential has been neglected. This paper covers that area.

Definitions

Recent consumer electronic equipment and other domestic and commercial appliances consume electricity also when they are not in use, unless they have been unplugged. The Task Force I has defined a terminology for that: Standby.

Several other types of electronic equipment do not have the on-off switch. The equipment is always connected to the grid and few components are always powered, therefore the equipment is consuming a few Watts also when the equipment seems to be off. Particularly within the industry, there are still many hidden Watts lost every year. For example robots within the industry that often are in a standby position waiting for material. This is also an area that in the future needs to be examined closely.

In this paper, however, we are presenting energy losses from low voltage lamps. These lamps are not in a real standby position but they leak electricity through their plug-in transformers. Introduction of a new word in this matter could create confusion and therefore we call also this energy loss for standby loss where a more accurate word should be *idling losses.*

4. ENERGY LOSSES FROM CONSUMER ELECTRONIC EQUIPMENT IN STANDBY POSITION

Standby power consumption is increasing along with increased living standard and increased range of products with “fast reaction” for stressed consumers. How big the standby loss is varies from country to country depending on the amount of electric equipment per household but also on the age of the equipment.
Table 1 below was presented in the Commissions’ paper on policy instruments mentioned above.

Table 1: Electronic equipment's energy consumption when in standby / off position

Equipment	Watts
TV set	1 - 13
VCR	5 - 19
Compact audio	0 - 18
IRDs	8 - 20
Clock radio	1 - 3
Microwave oven	2 - 6
Battery charger	2 - 4
Answering machine	2 - 4
Cordless and cellular phones	2 - 7
Hi-fi system	0 - 12
Audio portable	0 - 5
Plug-in power supply	1 - 3

Source: Policy Instruments to Reduce Stand-by Losses of Consumer Electronic Equipment, COM (99) 120 final. European Commission. 15.03.1999.

In the table above, low voltage lighting is not included. Still the report says that 39 TWh, equivalent to 21 MT CO_2 per year can be saved in the Community by year 2010 if the Community and Member States adopt adequate policies and programmes.

In a study carried out by Eje Sandberg, the standby losses in a Swedish one-family house, were measured to 475 kWh per year. The standby losses from an ordinary low-voltage lamp were between 1,8 and 1,1 Watts. The standby losses per item are shown in table 2 below.

Table 2: Standby energy in a Swedish one-family house

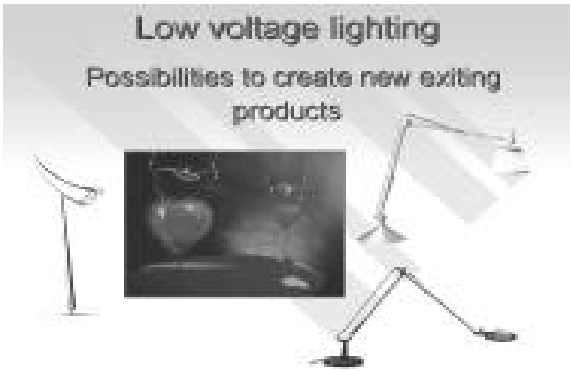
Equipment	Watts	KWh/year
TV set (living room)	4	15
TV set (old)	9.7	81
VCR	8	67
Radio	1.7	15
Radio (bedroom2)	1.5	12
Radio (kitchen)	1.3	10
Stereo (bedroom3)	16.8	25
Stereo	3.5	30
Amplifier (attic)	1.6	11
Line sep.	2.3	19
Play station	1.0	8
CD	1.7	14
Computer	4.9	9
Drill charger (cellar)	3.0	26
Dust-buster charger	2.0	25
Main switch	10.2	56
Lamp 1	1.3	10
Lamp 2	1.8	14
Lamp 3	1.1	8
Charger	0.9	8
Charger	1.4	12
Total	**79.4**	**475**

5. ENERGY LOSSES FROM LOW VOLTAGE LIGHTING IN STANDBY POSITION

The low voltage lighting was introduced on the market at the beginning of the eighties. The 12V 20W halogen G4 light bulb was presented as a comparatively energy efficient light source with about 50% higher Lm/W compared to normal E27 or B26 light bulbs. It’s small size opened new possibilities for designers and manufactures to produce exciting new products.

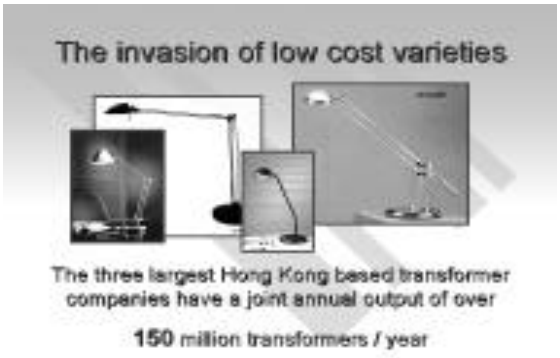
The simplest way to solve the problem of power supply was to use a conventional AC plug-in transformer. By this the lamp became entirely a low voltage construction. This meant that the manufacturers did not have to comply with any of national electrical safety regulations as long as they used a transformer that was widely approved by the testing bodies.

Picture 1: Light and simple design with AC plug-in transformers



Within the European community there is an existing stock of more than 300 million low-voltage light fittings. More than 150 million fittings are produced annually of which at least 30 millions are exported to the European countries. This means that the market of low-voltage lighting increases rapidly and consequently the standby losses. The losses arise when the light fitting is switched off since the plug in transformer is permanently attached to the net with its primary winding and the switch is situated at the secondary side of the transformer.
The average standby loss from this type of transformers is 2 Watts. The lamps are being used as bedside lamps, as office tabletop lamps, as decorative lights and many other applications.

Picture 2: Imports from low cost countries



6. MARKET DEVELOPMENT

What is the transformer and lamp industry doing about the losses of energy? The answer is simply nothing. The kind of conventional low voltage lighting that is described here, is very popular among producers as well as among consumers. It is the most cost-effective method to produce a lamp and new exiting models constantly flood the market. They are produced in the Far East, in the economic zones of Mainland China and on Taiwan.

The industrial ventures often were initialised as joint ventures with foreign partners but nowadays most manufacturers are local. Hard competition has led to production of transformers of poor quality at lower costs. Examples of this fact can easily be found in the group of large-scale wholesalers.

A small number of very large producers furnish the lighting industry with plug in transformers. The three biggest Hong Kong based companies have a joint output of 100 million units/year. There are several other large-scale producers in the area of China and Taiwan. If there shall be an end to this mass waste, the distributors must be forced to choose transformers with a technique without any or with a minimum of standby-loss.

It is worth commenting the efforts of the more serious lighting industry. The new small halogen light bulbs for 230V have eliminated the need for transformers. Drawbacks for the low-price retail industry are a technically more demanding product, with other standards for insulation and safety.

A light fitting with integrated transformer where the switch is on the primary side of the transformer eliminates the standby losses. All fixed installations of low voltage lighting are of this construction. Also great deals of low price consumer lamps are of this construction.

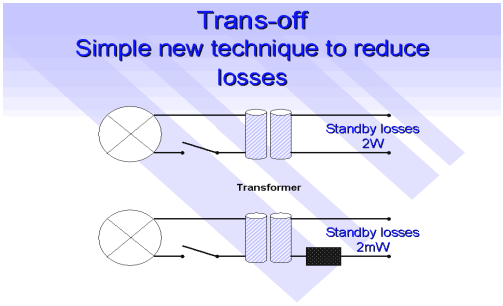
New switch mode plug in transformers have considerably lower losses than the conventional E-transformers. They can deliver more power and are smaller. Due to higher price and difficulties to comply with the EMC regulations regarding radio interference they cannot compete with the conventional E-core transformer.

Toroidal wound transformers have a standby consumption of just 0.2 W, about the same as for switch mode transformers. Turning the industry into the production of this kind transformer would mean very large investments, the capacity is far too small and since the production calls for more manual labour it is not an ideal industrial product.

7. INVENTION OF A NEW AND SIMPLE TECHNIQUE

The Swedish engineering company Artektron has invented TRANS-OF, which consists of a small IC with a simple external circuitry, which in connection with any type of power-supply transformer reduces the standby losses to less than one part per thousand – by **factor 1000**.

A tiny pilot-current is led through the transformers´ primary winding and it detects when the secondary winding is closed. By this detection the primary side is opened to the net according to a well-defined curve of about 10 periods of the AC. The pilot-current is less than 0.002W, which is a true standby function.



A spin-off effect with TRANS-OFF is the considerably improved durability of the switching-mechanisms and the light bulbs due to the electronically controlled soft start-up sequence. This means lower LCC (Life Cycle Costs) for these units.

The technique is developed for the lighting industry but can be adopted for battery-chargers and some electronic equipment such as DECT telephones. TRANS-OFF is not suitable for equipment like PC: s or FAX machines because these are in need of supply power by standby mode. Recent components like Philips “GREEN-CHIP” or Analogue Devices “TINY SWITCH” are especially developed for this kind of applications. Alan Meier from LBL, recently presented tiny Switch on CNN. The manufacturer claims that the energy use in equipments that require standby mode can be cut by 90 %.

8. ENERGY SAVING POTENTIAL

In a study initiated by Artektron, the light-fixture on average was in use less than four hours per day, which indicates 20 hours per day of standby loss. Based on 40 Watt-hours and 365 days, the annual losses amount to 15 kWh per unit. 300.000.000 transformers within the Community cause 4.5 TWh of annual losses. The market of transformers is increasing by 10 per cent per year and consequently the losses are increasing by the same amount.

The energy saving potential is enormous provided all producers of new plug in-transformers for low voltage lighting were forced to comply with new regulations. With an annual growth of 30 million transformers within the European Union, the stand-by losses will by year 2010 amount to 10 TWh.

TRANS-OFF, as it was mentioned before, reduces stand-by losses to less than one part per thousand, from 2 W to 0,002 W. Consequently, with TRANS-OFF in existing and new transformers, the energy saving potential would be almost as big as the energy losses.

9. MARKET TRANSFORMATION

The plug-in transformer will undoubtedly become more costly by the added electronic circuitry. Voluntary efforts by the distributors are not likely to take place. For the consumer the extra euro would however soon prove profitable, as the pay-off time is less than two years.

For a successful market transformation and CO_2 reduction, it is important for the member countries' governments to introduce a range of different policies and programmes. As presented above, there is already an existing technology for reduction of standby losses. It is however difficult to make consumers aware of the problem and the savings per household are not large enough to awake their interest. For this type of product, an incentive would not make any difference. It is not the final consumer that must be convinced but the producer of transformers and their clients. This can only be done by minimum efficiency performance standards, MEPS, and by energy labelling.

Experience from energy efficiency programs in Sweden show that it is very difficult to transform the market without a big carrot or by legislation. In Sweden, consumers are not prepared to invest in energy efficient equipment unless they get some kind of incentive. In the building sector less than ten percent of the buyer groups have adopted any kind of least cost calculation thinking and thus are not prepared to build in or buy an energy saving product if it is more expensive than the cheapest on the market.

10. CONCLUSIONS

Standby power consumption is an increasing fraction of the total energy use. In this paper we have added up the energy saving potential within the Community. On a worldwide basis the potential is enormous as the consumption of electronic equipment in the rest of the world increases more rapidly.

Standby losses on a European level or on a global level are substantial but too small on an individual level to become interesting. Therefore, it is up to the member countries governments and to the European Parliament to introduce efficient instruments as quickly as possible for reduction of standby losses and to stimulate research in this area.

Voluntary agreements and technology procurement are often successful. As far as standby losses are concerned, we believe, that other measures that are proven to give quicker market transformation, such as legislation or other legal actions, are recommended.

Australian governments have recently adopted a one-watt standby target for all products. Consequently, policies are designed that ensure that the maximum standby power consumption of all appliances manufactured in our imported into Australia is one watt. This statement of principle sends a clear message to industry and provides coherence to a diverse range of policies designed to combat standby power consumption. So why are we waiting?

11. REFERENCES

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