Analysis of Compact Fluorescent Light Bulbs (CFLs) Usage for Domestic Lighting in Serbia

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1. Abstract

Compact fluorescent light bulbs (CFLs) usage varies significantly from one to another country. Data of CFLs usage for domestic lighting in Serbia are presented in this paper. Reasons for difference in usage of CFLs per capita in Serbia comparing to EU countries is also analysed. Questionnaire for inhabitants has been prepared with an aim to estimate energy saving potential in domestic lighting. Data about number of tenants, structure of tenants, house size in square meters, house structure, number of electric light sources (ELS), types of ELS, and total installed electric power for lighting, is obtained from the questionnaire. One of the most important parameter, beside the economical, which influences usage of CFLs is their availability on the market. Consumers' habits of purchasing ELSs in supermarkets, specialised lighting stores or the nearest store are evaluated by the questionnaire. Beside that, availability of CFLs in different shops is also evaluated.

2. Introduction

Lighting uses 19% of all electricity consumption world wide - source International Energy Agency (IEA). Energy efficient lighting is one of the keystones of sustainable energy strategies. Due to that domestic, lighting is an area which has been studied a lot in the past period [1-5]. The average number of electric light sources (ELSs) is 24 per house across the EU. The majority (at least 70%) are incandescents, with the remainder being fluorescents (strip or compact fluorescent lamps - CFLs) and halogens. In the EU 54% of households currently have at least one CFL, with those households that own them having an average of five or six [2]. Important data is the average number of CFLs in household, ranging from 1 in Finland and Greece to 6,5 in Germany, where several promotion campaigns took place. In the new Member States the number of CFLs per household is substantially lower than in the EU-15 Member States, with the exception of the Czech Republic [2]. Major barrier for CFLs usage in Germany is still the 'high' purchase price when compared to incandescent lamps, even though 96 % of interviewed people know that CFLs save energy, 86 % know that CFLs last much longer than incandescent lamps and even though 69 % know that the CFL has short pay back periods [2]. Across Europe, the main advantages of CFLs are seen as environmental or lower running costs [1].

Based on the results of the realized projects all around the world, different policies and measures were issued in order to increase usage of CFLs in residential sector. One of the first policy actions at EU level was to introduce the mandatory energy label for lamps. The relevant Commission Directive (98/11/EC) was adopted in 1998 and came into force in

1999. [6-7]. For example a CFLs are a high efficient lamps (usually in class B or A), and that an incandescent lamps are a low efficiency lamps (usually in class G to F), with some halogen lamps a little more efficient (in class E) [2].

Some governments are considering stronger measures to encourage adoption of CFLs or even entirely displace incandescents; some proposed efforts involve tax measures [8-11]. Australia has announced a plan to phase out the use of incandescent lamps by 2010 [8]. Canada has also committed to phasing out incandescent lamps starting in 2012. In February 2007, the 18seconds campaign was launched with leaders from business and US Government to increase awareness of energy-efficient lamps as a way to slow global climate change. The coalition was named 18seconds to reflect the amount of time it takes for one person to change a lamp. Yahoo has created a Web site 18seconds.org. In South Africa the main electricity supply company Eskom in February 2007 has launched a program to exchange incandescent lamps for CFLs for free. Its aim is to reduce the electrical demand at peak times. In Germany, in period from 19th to 23rd of March 2007, OSRAM gave free of charge 250.000 CFLs to the inhabitants in cooperation with Bild am Sonntag magazine and Bauhaus market centres. In the United Kingdom the Co-operatives (The Union of UK's Co-operative Enterprises) have stopped selling incandescent lamps in 50 pilot stores, with a view to withdrawing them completely in the future. They have also reduced the prices of their CFLs to make them more attractive in the short term.

The first initiative to estimate lighting electric energy consumption in the Republic of Serbia has started in 2006. Main goals of the project are to refer results of projects realised in other countries, to estimate current state of lighting electric energy consumption in the Republic of Serbia, as well as to give recommendation for policies for energy saving in residential lighting. Part of the results that have been obtained in the frame of this project is presented in this paper.

3. Methodology and results

In order to obtain data for analysis of CFLs usage for domestic lighting in the Republic of Serbia the questionnaire has been prepared and was applied on the City of Nis representative sample (urban area and suburb). The following data have been obtained for each household:

- number of tenants,
- house size in square meters,
- number of rooms,
- ELS purchase habit,
- electric energy consumption per month (winter and summer),
- are tenants informed about usage of energy saving ELSs,
- main reasons for obtaining CFL among their users,
- number of luminaires per house hold,
- number and wattages of ELSs.

General statistic data about representative sample are given in Figs. 1- 4, as well as in Table 1. Data presented in figures are organised as follows: Fig. 1 shows locations of houses comprehended in the questionnaire in percentage (urban 90%, suburbs 10%); Fig. 2 shows building types that occurred in the questionnaire campaign; Fig. 3 shows house structure - number of rooms (including living room, bedrooms and children rooms); and Fig. 4 shows structure of household tenants. The data about average number of tenants, house area and electric energy consumption are given in the Table 1.

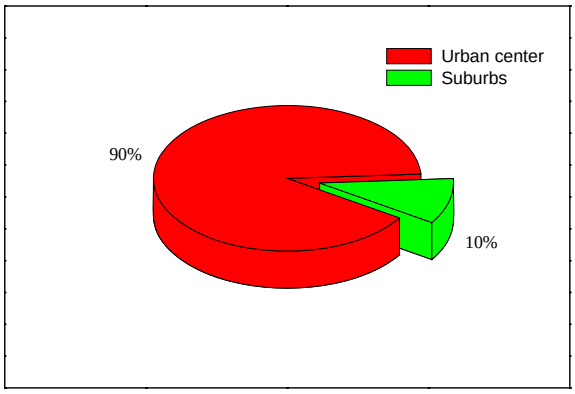

Fig. 1: Location of houses

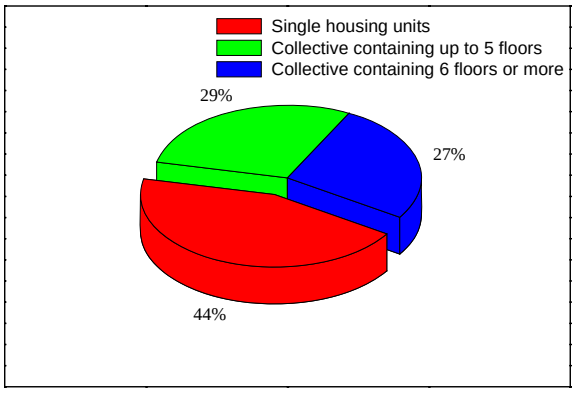

Fig. 2: Type of building

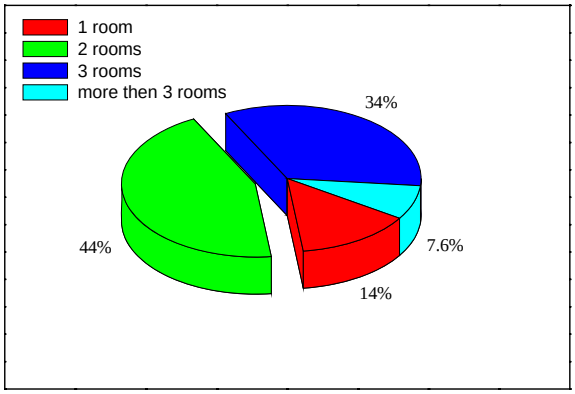

Fig. 3: Number of rooms
(living room, bedrooms and children rooms)

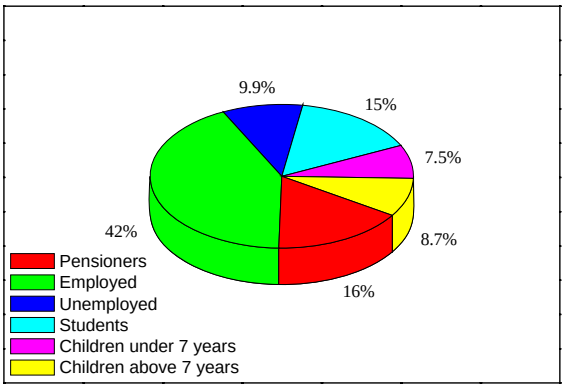

Fig. 4: Structure of tenants

Number of luminaires per household is 9.9, while the number of ELSs per household is 14.1. Rated power of installed ELSs per household is 1023 W, while its value per m^2 is 15.3 W/m^2. The number of CFLs per household is 0.44.

Fig. 5 shows that 86% of all residential ELSs are incandescent general lighting service (GLS) bulbs, while fluorescent ELSs (CFLs and strips) participate with 8.6%. The most used wattages of GLS bulbs are 100 W and 60 W. GLS bulbs are predominant in all locations which can be seen from Fig. 7. In the same figure is shown that CFLs are mostly used in ceiling mounted luminaires, while fluorescent strips are mostly used in ceiling

Table 1. Questionnaire results

Description	Data
Number of tenants per household	3.2
Average house size	67 m^2
Electric energy consumption per winter month and per household	776 kWh
Electric energy consumption per summer month and per household	501 kWh
Number of luminaires per household	9.9
Number of ELSs per household	14.1
Rated power of installed ELSs per household	1023 W
Rated power of installed ELSs per m^2	15.3 W/m^2
Number of CFL per household	0.44
Number of CFL per owning household	2.33

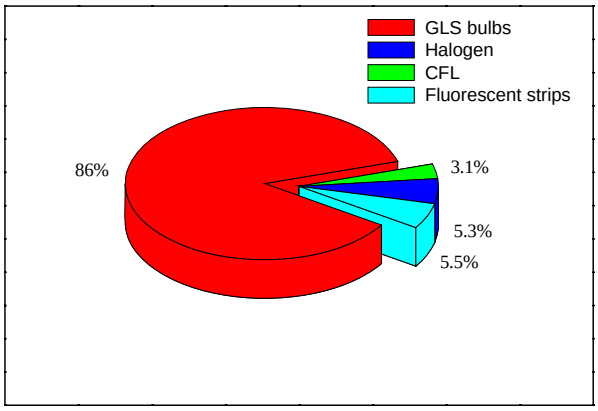

Fig. 5: Usage of different ELS types

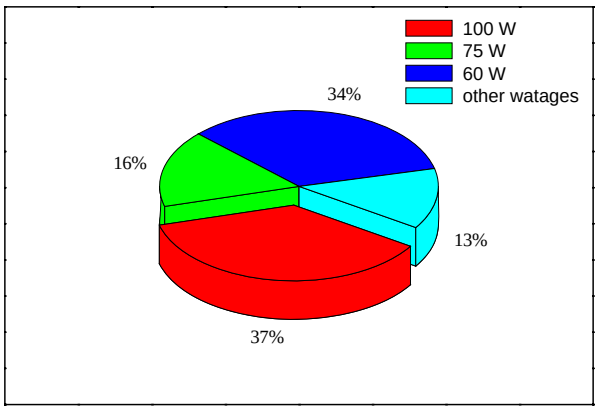

Fig. 6: Usage of different incandescent ELS wattages

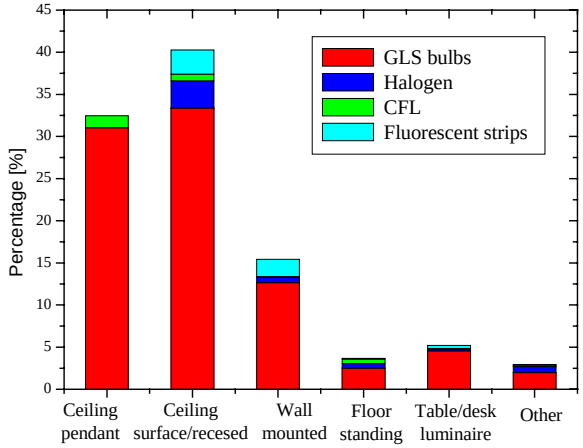

Fig. 7: Usage of different ELS and luminaire types

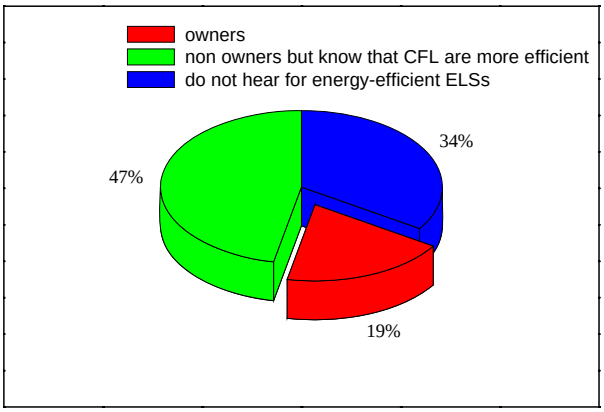

Fig. 8: Usage of energy-efficient ELSs

surface, as well as wall mounted, luminaires. As it is shown in Fig. 8, percentage of households having at list one CFL is 19 % which is less then 30% in EU countries. The households that own them have an average of two or three CFLs (three or four in EU). Usage of different ELS types, considering their number and electric power, in different locations is given in the Table 2. From this table it can also be seen that CFLs are the most frequently used in dining and living rooms. The greatest installed power of ELSs is in living rooms and cellars-basements, followed by bedrooms and children rooms.

As a reason for CFL usage around 60% of households state saving money, 27% quality of light (CFLs with color temperature 2700K are mainly used), while 13% longer lifetime. One of the most important parameter, beside the economical one, which influences usage of CFLs is their availability on the market. CFLs availability on the market as well as consumer habits of purchasing ELSs in supermarkets, specialised lighting shops or the nearest store are evaluated by the questionnaire. Consumer habits for ELSs purchasing are shown in Fig. 9. CFLs can be purchased in supermarkets (3 out of 4 largest supermarkets in the City of Niš sell CFLs) and lighting specialised stores. Supermarkets mainly sell CFLs with lifetime in the range of 5000 to 8000 h. Price of CFLs in supermarkets is about 18 times higher then the price of GLS bulbs. Additionally, there are only few lighting specialised stores, and this is the reason why only 17.7% of the costumers purchases ELSs in these stores. Neighbourhood stores, in which 28% of consumers purchase ELSs, sell only GLS bulbs.

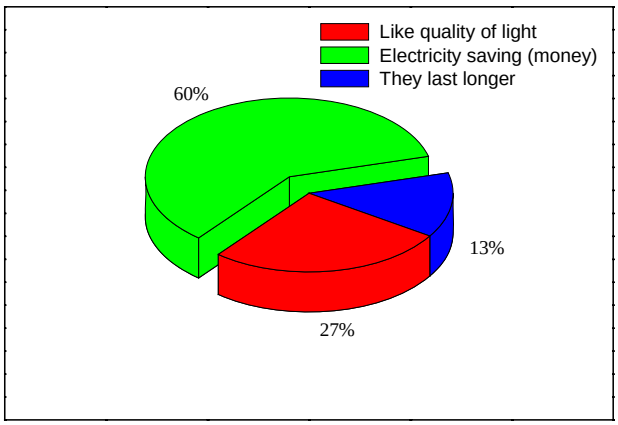

Fig. 8: Main reasons for obtaining CFLs among owners

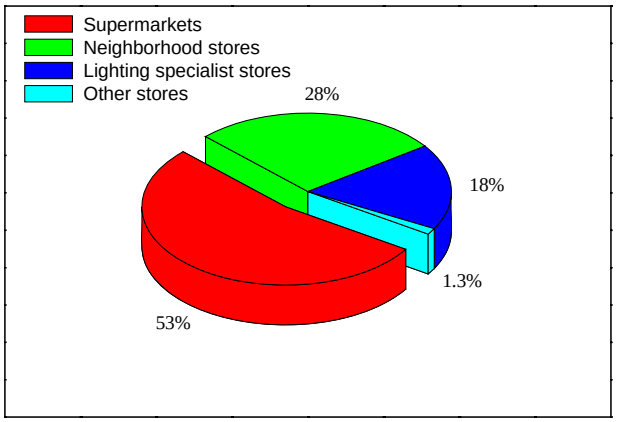

Fig. 9: Consumer habits for ELS purchasing

Table 2. Usage of different ELS types, considering their number and power, in percentage.

Location	Wattage [W]	Incandescent				Fluorescent			
		GLS [%]		Halogen [%]		CFL [%]		strips [%]	
		No.	el. power	No.	el. power	No	el. power	No.	el. power
Living room	201.4	82.4	86.2	7.9	9.9	6.5	1.9	3.2	2.0
Kitchen with/without dining room	126.8	79.1	88.3	13.9	8.3	0.8	0.2	6.2	3.2
Dining room	102.8	86.4	95.4	0.0		9.1	2.3	4.5	2.3
Bedroom	144.4	86.8	93.6	5.5	3.3	3.6	0.8	4.1	2.2
Children room	143.8	87.1	91.6	5.7	4.0	1.5	0.2	5.7	4.2
Hall	90.9	92.3	97.4	1.9	1.1	4.8	1.3	1.0	0.2
Bathroom	96.6	84.2	90.6	5.9	3.1	0.0		9.9	6.3
Balcony	99.7	97.5	98.2	0.0		0.0		2.5	1.7
Auxiliary construction	119.6	70.0	83.3	0.0		0.0		30.0	16.7
Porch – covered balcony	88.4	100.0		0.0		0.0		0.0	
Staircase	118.6	100.0		0.0		0.0		0.0	
External – Home ground	133.2	100.0		0.0		0.0		0.0	
Toilet	87.3	100.0		0.0		0.0		0.0	
Basement - Cellar	221.2	100.0		0.0		0.0		0.0	
Other		72.2	85.2	0.0		3.7	1.8	24.1	13.0
Total		**86.1**	**92.1**	**5.3**	**4.1**	**3.1**	**0.8**	**5.5**	**3.0**

4. Conclusions

Usage of CFL in the Republic of Serbia is less then in EU countries (only 5.3% of ELSs are CFLs, which is equal to 0.44 CFLs per household). Only 19 % of households involved in the inquiry use CFLs, where the households that do use them have approximately 2.33 CFLs.

There are many reasons for low level of CFLs usage in Serbia. The main one is that GLS incandescent bulbs are very cheap (more then 18 times cheaper then CFLs). Costumers are not informed about saving potential of CFL's usage, and there is low offer of CFLs on the market. CFLs are only available in supermarkets and specialised stores whose number is still small in Serbia. Beside that low quality (and probably lower cost) CFLs are still available on the Serbian market, and customers buying these devices due to the attractive

price are very rapidly disappointed by the reduced lifetime, bad lumen output due to wrong information from manufactures about how to replace incandescent lamps, and bad lumen maintenance of these lamps. Many of the CFL lamps which can be found in supermarkets are not suitable for applications with short on-off cycles as this reduces lamp life; therefore it is necessary to educate the customer on how to use them effectively. Finally customers are not informed about colour temperature which is followed by the purchase of ELSs that do not satisfied their needs-wishes.

On contrary to the EU there are not policies for stimulating usage of energy-efficient ELSs in the Republic of Serbia. Free or heavily subsidised CFLs is the most effective way of getting the first of these bulbs into the 81% of homes currently without one. Retail staff should be qualified to educate the public on how to use CFLs. The quality of CFL products on the market needs to be guaranteed, with continuity and compatibility of technologies. The Energy Label provides a good basis for this, possibly in combination with a 'quality list' of CFLs.

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