POSSIBILITIES FOR ENERGY SAVINGS IN THE REPUBLIC OF MACEDONIA USING ENERGY–EFFICIENT LIGHTING SOURCES

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Abstract

The main purpose of this paper is to boost the awareness of the lighting professionals in the Republic of Macedonia, as well as the government agencies of the real potential and the effects of more efficient usage of the electricity for lighting purposes. Since most of the estimates are based on assumptions and comparison to similar countries, the paper does not pretend to provide definite answers. Hopefully, it will initiate further research that can lead to projects similar to PELP, or most recently launched IFC/GEF project ELI (Efficient Lighting Initiative).

INTRODUCTION

In the last twenty years several energy–efficient lighting technologies have been developed. For the huge residential consumer market, most significant are the compact fluorescent lamps (CFL), particularly CFLs with integrated ballast circuitry. CFLs, compared to incandescent (General Lighting Service – GLS) lamps, offer a significant number of advantages. Among those, most notables are lower power consumption and much longer lamp life. However, due to their disadvantages (higher price, and limited compactness and dimmability), CFLs have not gained a significant portion of the market. The later is especially true for the developing countries that have relatively low electricity prices.

There are several benefits from using more efficient light sources: lower electricity consumption, lower power load on the power system, less pollution, and prolonged usage of non-renewable energy sources. According to the beneficiaries, the benefits can be grouped into three categories: a) consumers, b) utility companies, and c) the community.

The most noteworthy benefit for the first group is lower power consumption that will result in lower electricity bill. This benefit alone can payback the initial cost of replacing ordinary GLS lamp with CFL. However, the payback period depends on factors such as cost of CFLs compared to the cost of GLS lamps, price of electricity, and usage. Unfortunately, the first two factors have an adverse effect on the wide acceptance of CFLs in the developing countries.

In the second group of beneficiaries are the utility companies. The reduction on power load can be easily recognized since the need for investment in new production, and transmission and distribution capacities will be lower. Interestingly, utilities don't have to invest anything, yet they will benefit from greater usage of efficient light sources. Also, the community will benefit from lower pollution, prolonged usage of the non–renewable energy sources, and higher income due to higher taxes collected from purchase of more expensive commodities (CFLs in comparison to GLS lamps).

Practically, if the utilities and the government do not do anything towards wider acceptance of energy efficient light sources, the burden lies mostly on the ordinary consumers. Perhaps that is why CFLs had not gained much popularity until some years ago. And this is true for most countries, regardless of the level of their economic development. CFL sales had not risen up until some involvement by the utilities and/or government occurred. There are many examples that a well-coordinated effort counts more than the intensity of the effort itself, in terms of money, as well as in human resources. Among others, most acknowledged programs and projects are the South California Edison (SCE) rebate program and PELP (Polish Efficient Lighting Project). Obviously, the burden should not be left on the ordinary consumers only, since the benefits are shared by all.

In order to make a wise decision one must very well informed. The same rule applies if the goal is to determine the benefits and responsibilities (investment) of introducing wider usage of more efficient light sources. Unfortunately, up until recently most countries in the world didn't have real figures about electricity usage for lighting purposes. For example, until the DELight project commenced, the estimated figures for lighting consumption for in UK were somewhat twice as low compared to the actual measurements [1].

So far, there have been no real attempts to estimate lighting consumption in the residential market in Macedonia. This paper tries to estimate these figures, as well as the possibilities for energy conservation by greater usage of CFLs in the residential sector. The focus of this paper is directed towards the integrated ballast CFLs since their usage can be much easier accepted by the general public. The other possibilities (CFLs that require external ballast circuitry and dedicated fixtures, or the new metal halide lamps) were not investigated.

THE RESIDENTIAL SECTOR IN THE REPUBLIC OF MACEDONIA

The population of the Republic of Macedonia for 1997 was estimated at 1,997,000. The residential sector (RS), for the same year, consists of approximately half a million households (hh). The power consumption of the RS for the year 1998 was 2556.3 GWh. The basic figures for the RS and its power consumption are presented in Table I. Unfortunately, there are no valid data for the contribution of RS in the peak load in Macedonia, which for 1997 was approximately 1120 MW. Also, there are no real data or estimates for the lighting contribution in RS consumption, or for that matter, the contribution of lighting in the system peak. Therefore, an attempt will be made to estimate these factors comparing the RS in Macedonia with the RS in Bulgaria. As data in Table I show RS in Bulgaria and Macedonia, in terms of their size and average consumption per capita, are very alike. However, the 50% difference in consumption per household can be explained with substantial usage of power for space heating in Macedonia.

Recent findings [2] confirm that lighting consumption per household in Bulgaria account for ~10% of total power consumption, or ~350 kWh/year/household. Accordingly, the lighting consumption in the RS of Macedonia can be estimated at 300÷400 kWh/year/household.

Table I Comparison of general data for the residential sectors of Bulgaria and Macedonia

		Bulgaria [2]	Macedonia [3,4]
Households	$\times 10^6$	3	0.5
Size of average household	m^2	66	70
Residential customers	$\times 10^6$	3	0.5
Population	$\times 10^6$	8.402	1.9947
Total residential consumption	GWh/year	9805	2556.3
Consumption per household	kWh/year	3268	5113
Consumption per capita	kWh/year	1167	1282

Furthermore, the total number of lamps in the RS in Macedonia can be estimated at 6 millions (500.000 hh × ~12 lamps/hh). In [5] it was estimated that in the Polish RS about 12% of the GLS lamps can be cost–effectively retrofitted with CFLs. Using much more conservative position, let us assume that over a period of five years only 5.5% of the total number of lamps in the RS (~333,000 lamps) are replaced with CFLs. In other words, this assumes that over the observed period 1/3 of the households would replace in average 2 GLS lamps with CFLs. Most likely the replaced bulbs will be

of higher wattage (> 60W) and longer daily usage, leading to an estimate that the average size of the replaced bulbs could be 75W. Although the CFL manufacturers claim 5:1 reduction in power consumption in favor of CFLs, assuming only 4:1 reduction in power, leads to a total reduction of the installed lighting capacity in the RS in Macedonia just over 18 MW.

It is fair to assume that at the beginning CFLs will replace most used lamps in the households. As it was suggested in [1,5] the average daily usage of those lamps can be estimated at 3÷4 hours. Therefore, in the last year of the five year period the energy equivalent of the power reduction can be estimated between 20÷27 GWh/year. Of course, many of the lamps will be out of service at the end of that period. However, as it was confirmed by various studies, the tendency of buying CFLs again among CFL users is very high.

Finally, once again using very conservative approach and if only half of the CFLs will be used at the system peak, their contribution can be estimated at approximately 10 MW.

The above figures for peak reduction are significantly lower compared to estimates for other countries. But, bearing in mind the size of the power system in Macedonia, these figures are not that insignificant. For example, the investment cost for the hydro power plant project Matka 2 (near Skopje) considered for construction in the near future are in the neighborhood of €38 million. The proposed HPP has rated power of 33 MW and production capacity of 53 GWh/year. This comparison does not suggest that the estimated replacement of GLS lamps with CFLs will itself eliminate the need for construction of this or any other new production capacity, but at least it will delay similar projects for a number of years.

ECONOMIC EVALUATION

The figures for power and energy reduction estimated above, even if they are conservative, are not likely to happen under the present market conditions in Macedonia. There are two major reasons why the average consumer does not have the incentive to replace GLS lamps with CFLs: relatively high retail price of electronic ballast CFLs and low electricity prices. Besides that, the general public is unaware of the benefits of CFLs, and perhaps concerned about the "safety" issues in terms of "how fluorescent light is unhealthy."

The Republic of Macedonia, as a country in transition and under development, has all the disadvantages in the process: low income per capita (GDP less than €1,400/capita), very low electricity prices (in average, residential sector pays €0.03/kWh), very high retail prices for electronic ballast CFLs (€18÷20/piece), relatively small percentage for lighting in the average residential electricity bill (a great number of customers use electricity for space heating, and almost all customers for water heating), and worldwide level of investment costs for the equipment in the production capacities in the power industry (~€1,000/kW).

Every investment to be cost–effective must pay back itself during the life span of the equipment, and it must provide sufficient profit to the investor. Although in this case no profit is expected, 23 W CFL replacing a 100 W GLS lamp barely pays itself back over a period of 7 years. The total net savings over that period are €0.7.[1]

Obviously, either one of the following measures should be done in order to make CFLs cost–effective in comparison to incandescent bulbs: reduction of the prices of CFLs or increase of the price of electricity. The first measure is unlikely to happen without any incentive given to the lamp manufacturers. Most of their production is aimed at markets where RS customers have much greater purchasing power. For example, the same CFL in Germany (under the same assumptions) will pay back itself in just under two years. The only difference in these two cases is the electricity price – in Germany, residential sector pays approximately €0.16/kWh [1].

The second measure is also very unlikely to happen in a relatively short timeframe, given the social structure of the population and the economic conditions in Macedonia, although there is a long–term tendency of increasing the electricity prices.

As noted earlier, consumers are not the only beneficiaries in this process. Therefore, they must be helped by the government and the power utility company. The government can help by introducing tax incentives for energy efficient lamps (not restricted only to integral ballast CFLs). At present, the sales tax on lamps is 25%. If zero or 5% sales tax is applied to energy efficient lamps, the retail price of CFLs will fall down to €14÷16/piece. This measure alone can increase the consumer net savings up to €4.5 for the observed period. The role of the government does not end here. At present, in the Republic of Macedonia, there are no CFL manufacturers, and all CFLs are imported, so the government can also consider lowering the import duties on energy efficient lamps.

The most notable boost in customer incentive to switch to CFLs can be accomplished by lowering the wholesale prices of CFLs [5,6]. Assuming a 50% mark–up and 25% sales tax, the manufactures price for a €20 CFL is approximately €10.5. Only a €4 direct manufacturers subsidy would lower the retail price down to €10÷13, depending on the sales tax reduction. At this price level, consumer net savings rise to approximately €9 over seven years, or a single 23 W CFL will repay itself in just over half of its life time.

At this point, the question rises who will be the principal subsidizer. Since the SCE program proved to be very successful, there is no doubt that similar results can be expected if the power utility company in Macedonia sponsors (partly or in full) such initiative. At €260,000/year over five years the utility can expect reduction in peak load of about 10 MW, which is significantly lower than the investment in new production capacities.

After the period of five years, the price of CFLs would rise back as the subsidy program ceases to exist. However, it is most likely that this time prices will not be as high as prior to the subsidy program [6]. In addition, after this period the public awareness and acceptance of these energy efficient light sources should be at much greater level.

The organizational aspect of such project must not be ignored since it can play a determining role for the final success. The project must be well prepared, publicized, and advertised in order to accomplish the expected goals. No doubt that the worldwide experience, accumulated in the last several years, can be of great assistance if and when such project is considered.

CONCLUSIONS

The main purpose of this paper is to boost the awareness of the lighting professionals in the Republic of Macedonia, as well as the government agencies of the real potential and the effects of more efficient usage of the electricity for lighting purposes. Since most of the estimates are based on assumptions and comparison to similar countries, the paper does not pretend to provide definite answers. Hopefully, it will initiate further research that can lead to projects similar to PELP, or most recently launched IFC/GEF project, ELI (Efficient Lighting Initiative).

Although the absolute values of estimated reduction in power and energy are far from what was achieved or expected by similar projects or programs, they can not be ignored bearing in mind the size of the power system of the Republic of Macedonia, and the country itself.

Finally, the paper has dealt only with the issues concerning the power industry sector and the benefits to the consumers. No effort has been made to even speculate about the benefits of the other advantages of more efficient energy usage, most notably the environmental issues. If these benefits are added to the benefits discussed earlier, the final effects will be much more valuable.

[1] The calculation uses the following assumptions: €20/CFL; €0.5/GLS lamp; 12% discount rate; electricity price €0.032/kWh with a 2%/year increase; lamp usage 4 hours/day; and 10,000 hours CFL life time, compared to 1,000 hours of GLS lamp.

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EXISTING STATE OF LIGHTING EDUCATION IN JAPAN

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СЪЩЕСТВУВАЩОТО СЪСТОЯНИЕ НА ОБУЧЕНИЕТО ПО ОСВЕТЛЕНИЕ В ЯПОНИЯ

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