

## Design and Modernization of Road Lighting in Bulgarian Cities

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### INTRODUCTION

The rational use of electrical energy for road lighting has a considerable potential for energy saving in Bulgaria. Research in this country shows that road lighting has great resources of energy efficiency as a result is introducing modern light sources and luminaries. When the existing road lighting systems are to be replaced by new energy efficient sodium lamps, optimum design is required, which takes into account the geometric parameters. Over the last seven years projects in fifteen cities have been developed and implemented by the authors.

### LIGHTING DESIGN

The preliminary energy research of the existing road lighting involves studying the location of transformers and the electrical network for road lighting, lighting control, measurement and consumption of electrical energy, identification of the existing location of road luminaries posts on a digital layout of the city. The type of luminaries and lamps is also investigated – Figure 1.

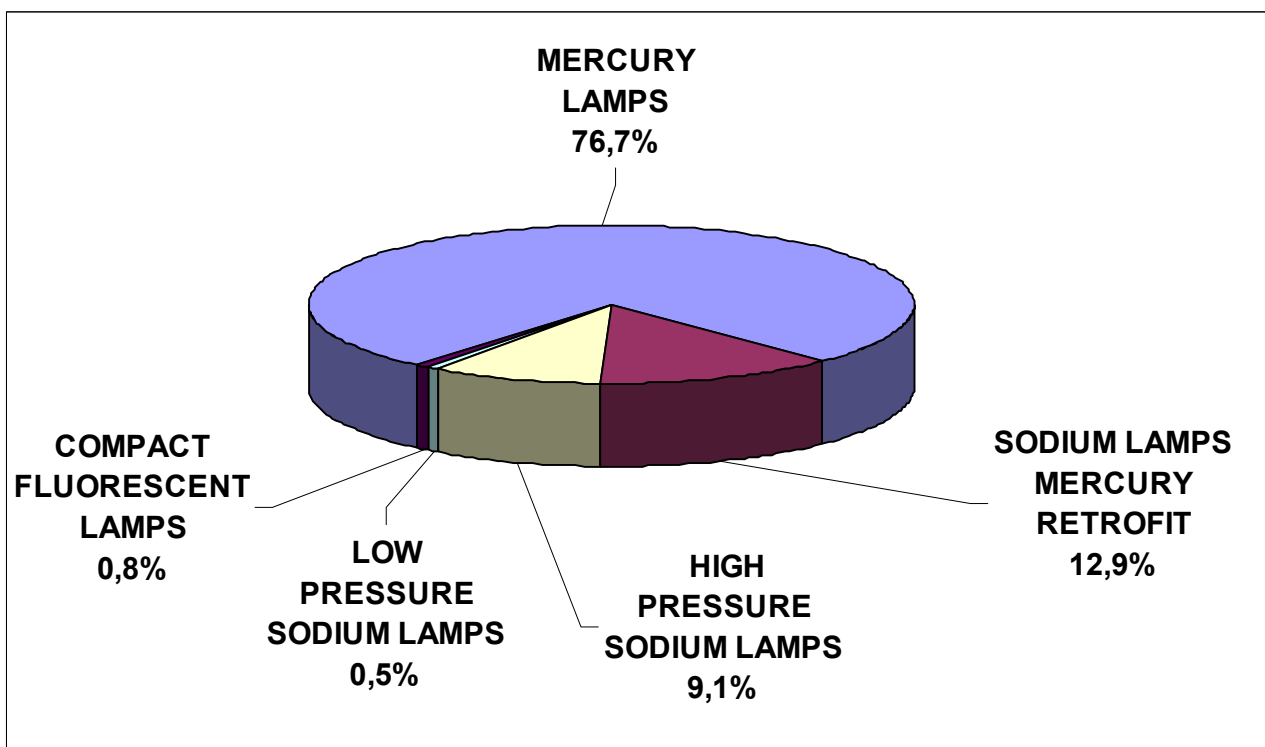


Figure 1.

Based on the light engineering classification of road categories and in accordance with the Bulgarian and the new European standard EN 13201, requirements have been accepted for the average road surface luminance  $L_{ave}$ , the overall uniformity ratio  $U_0$ , the lengthwise uniformity ratio  $U_l$ , threshold increment  $TI$  and surround ratio  $SR$ .

The light engineering calculations present the decisions for the choice of the most suitable light source and luminaire for modernizing the road lighting. The calculations have been carried out using specialized software products. The characteristics of luminaires manufactured by twelve Bulgarian and foreign companies have been used and multi-version comparative calculations have been performed with them for each of the streets. Light-technical optimization of the geometric configuration of road light system has been carried out. When a light system is reconstructed, the tilt and the height of luminaires are optimized, whereas in case of designing a new light system, the luminaire spacing is optimized.

The final design solutions are visualized graphically on the cadastre of the city. Over the years the plotting of graphics has evolved starting from working on paper, through working on scanned drawings of the site, up to working on a digital model of the city in AutoCAD environment. Figures 3 and 4 show part of the computer graphic digital model developed by using AutoCAD.

In the latest developments of this team of designers, a graphic information system has been introduced. It provides a dynamic connection between the AutoCAD graphic model and the Microsoft Access data base containing technical parameters about road light system components: posts, luminaires, electric power supply lines, transformers (Figure 2). The graphic information system allows automatic marking of the objects in the graphic model, graphic information retrieval, table lookup and makes data sheets and inquiries. A software product for operation and maintenance of a road light system has been developed in Delphi environment using the data base (Fig. 5).

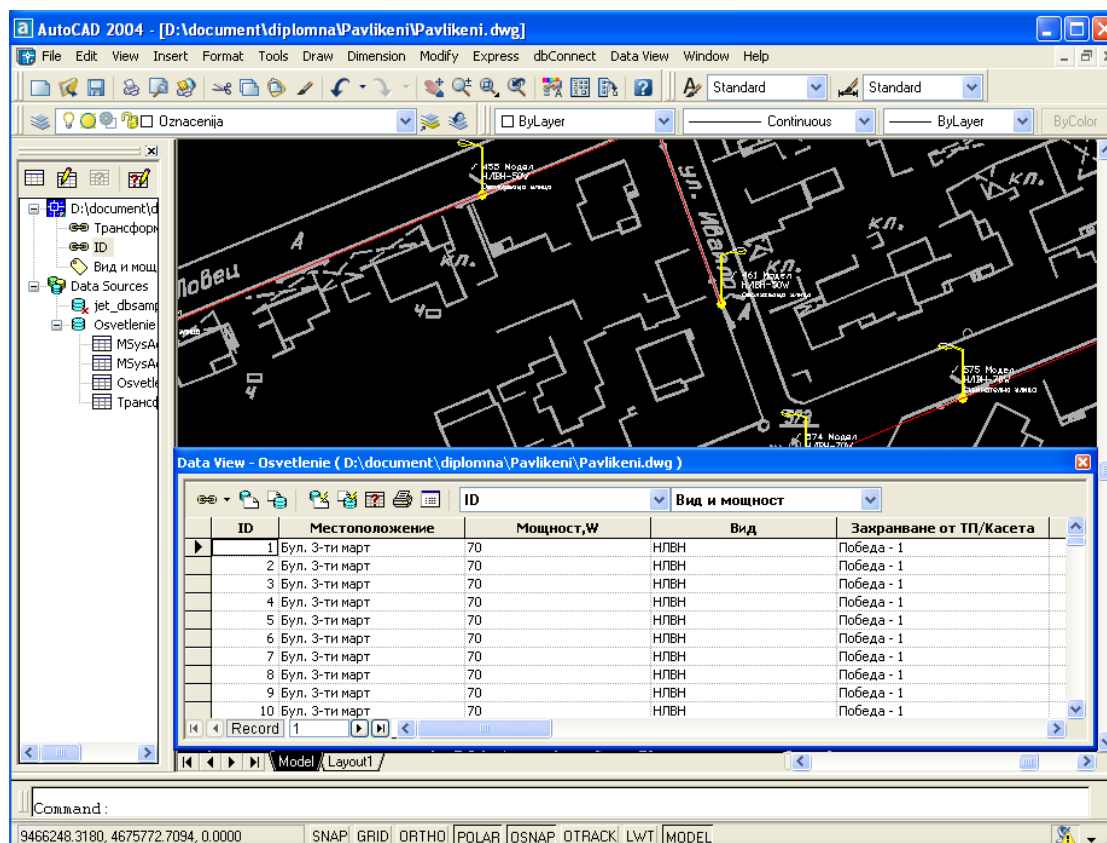


Figure 2

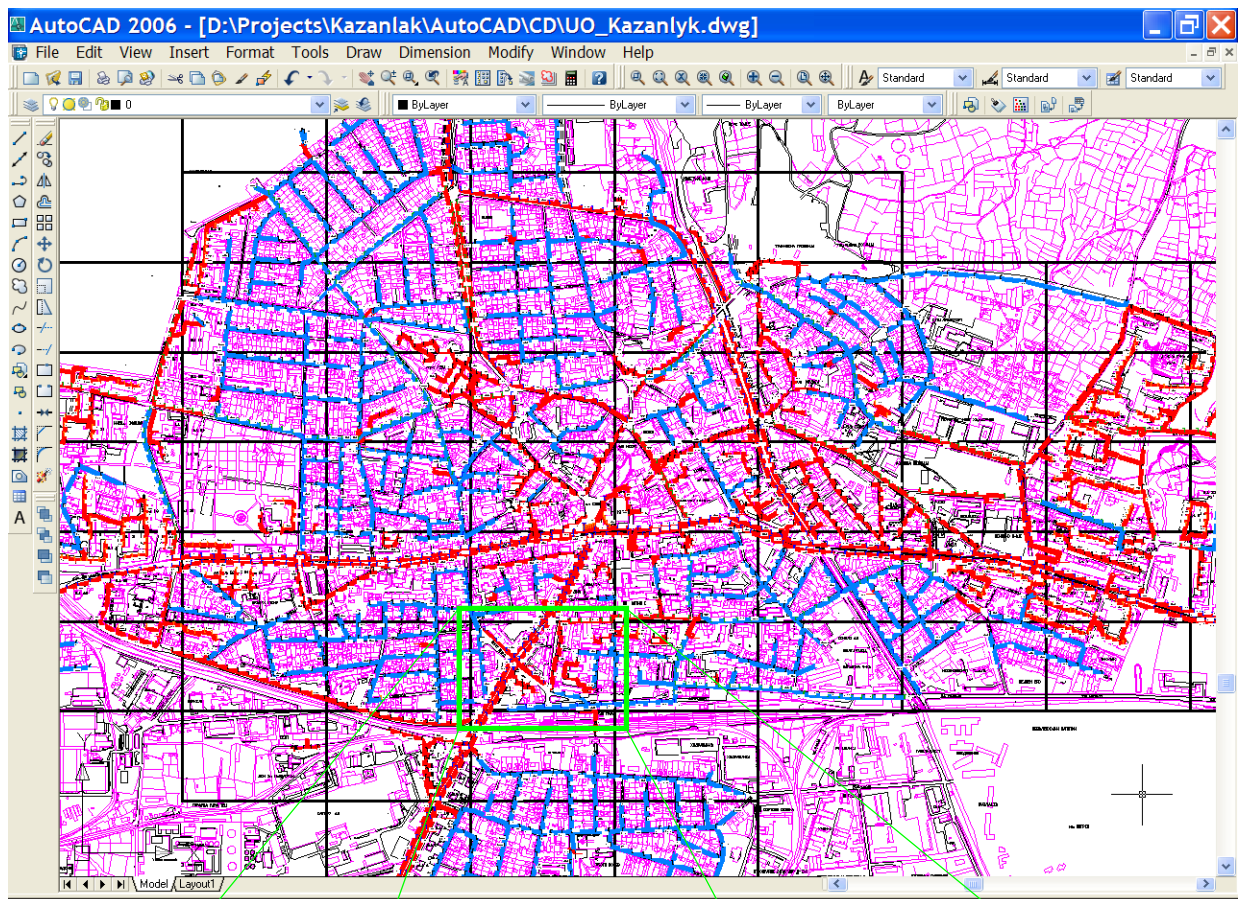


Figure 3

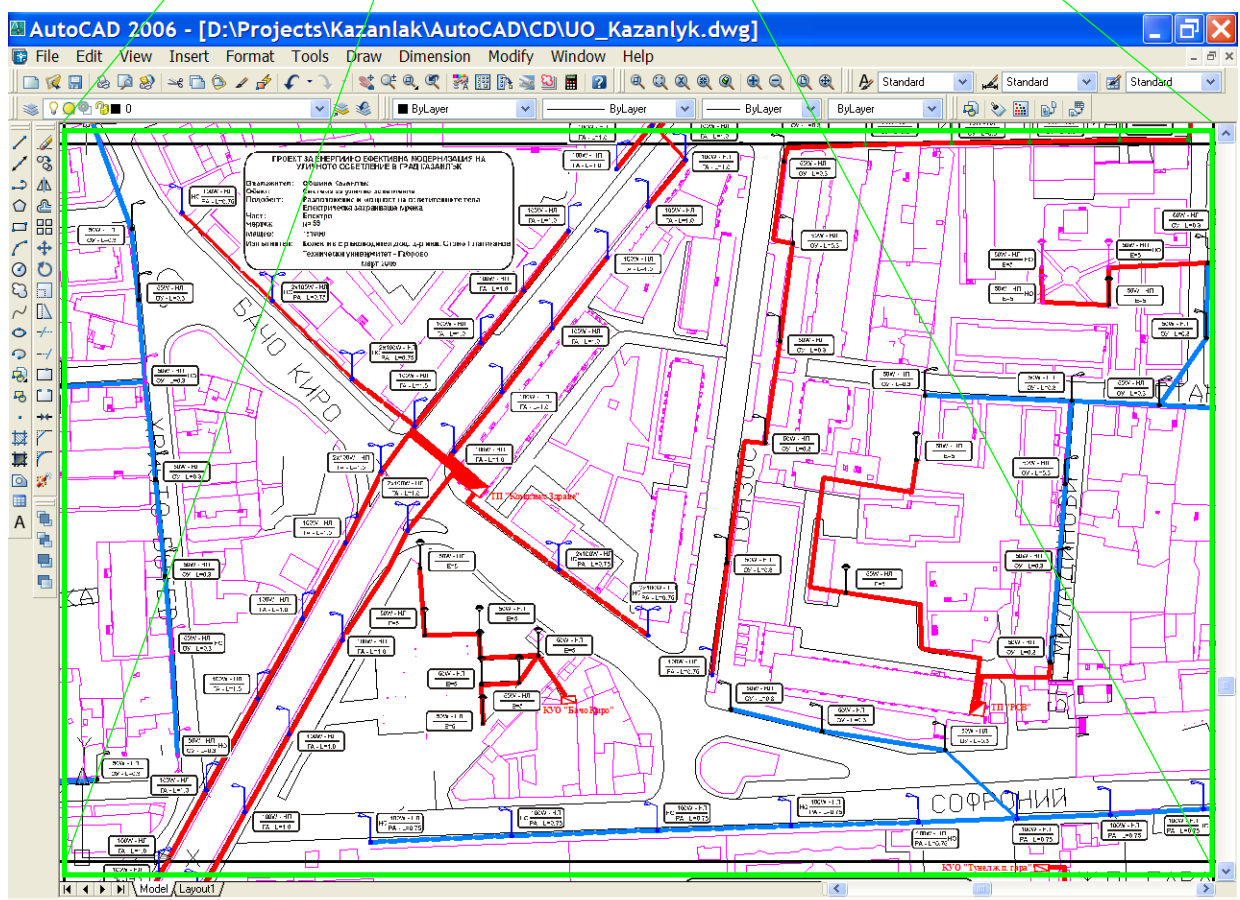


Figure 4

Осветители

Осветители | Справки по Местоположение | Справки по Трансформатори | Редактиране/Добавяне | Помощни Таблицы | Справки | SQL Справк

№ 1

Модел Осветител SGS101/50T

Тип на Лампата НЛВН

Брой Лампи 1

Мощност 50

Консумирана Мощност 59,5

Тип на Осветителя Уличен

Светлинен участък Бул. 3-ти март (Събирателна улица)

Местоположение Бул. 3-ти март

Светлотехническа Категория Събирателна улица

Дата на Поставяне 31.12.1999 г.

Тип на Електрическата Мрежа Кабелна

Режим на Работа Целонощно

Захранващ Тр-р Победа - 1

Тр-р/Касета Касета

№ на Захранващият извод 3

Смени Днес

Добави осветител

Потвърди промените

№	Модел Осветител	Тип на Лампата	Мощност	зумирана Мощ	Тип на Осветителя	Брой Лампи	стоположен
1	SGS101/50T	НЛВН	50	59,5	Уличен	1	Бул. 3-ти ма
2	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
3	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
4	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
5	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
6	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
7	SGS101/50T	НЛВН	50	59,5	Уличен	1	Бул. 3-ти ма
8	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
9	SGS101/70T	НЛВН	70	80	Уличен	1	Бул. 3-ти ма
10	SGS101/50T	НЛВН	50	59,5	Парков	1	Бул. 3-ти ма

Покажи Карта

Figure 5

## SUMMARIZED RESULTS

Fig. 6 presents the results of decreasing the number of street luminaires in the 15 cities where the authors have developed designs, and Fig. 7 presents the summarized results and power distribution of the new high pressure sodium lamps introduced.

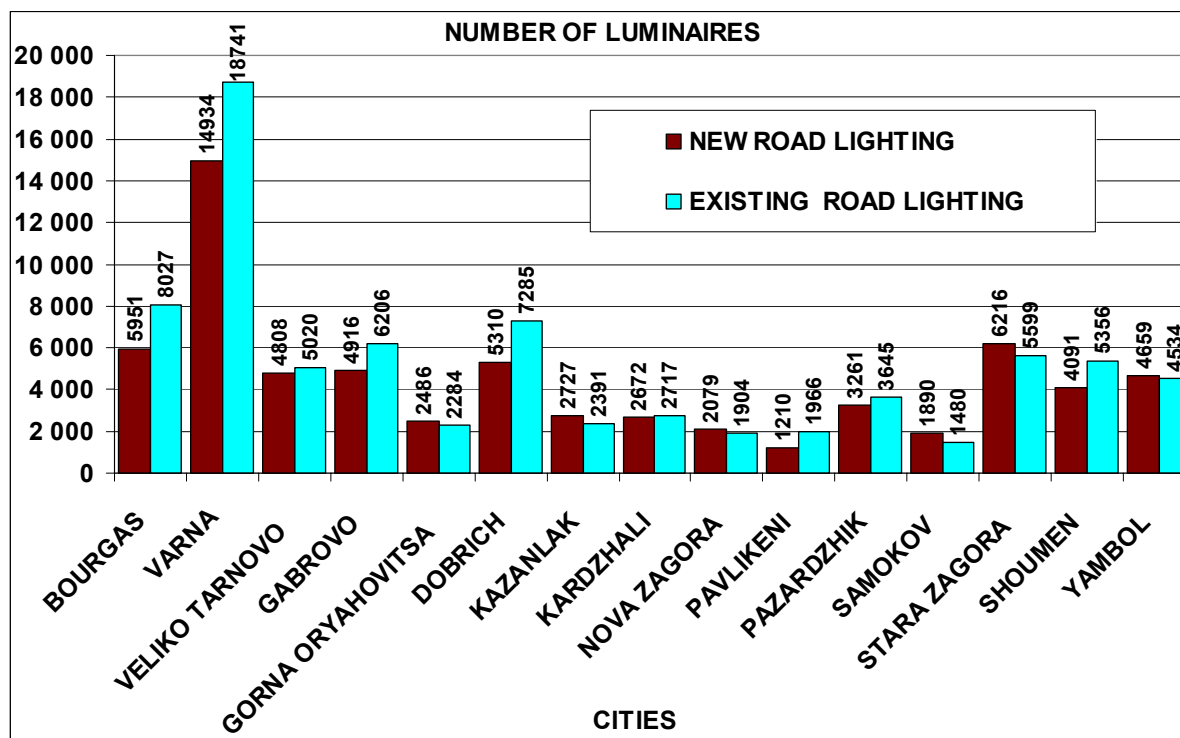


Figure 6

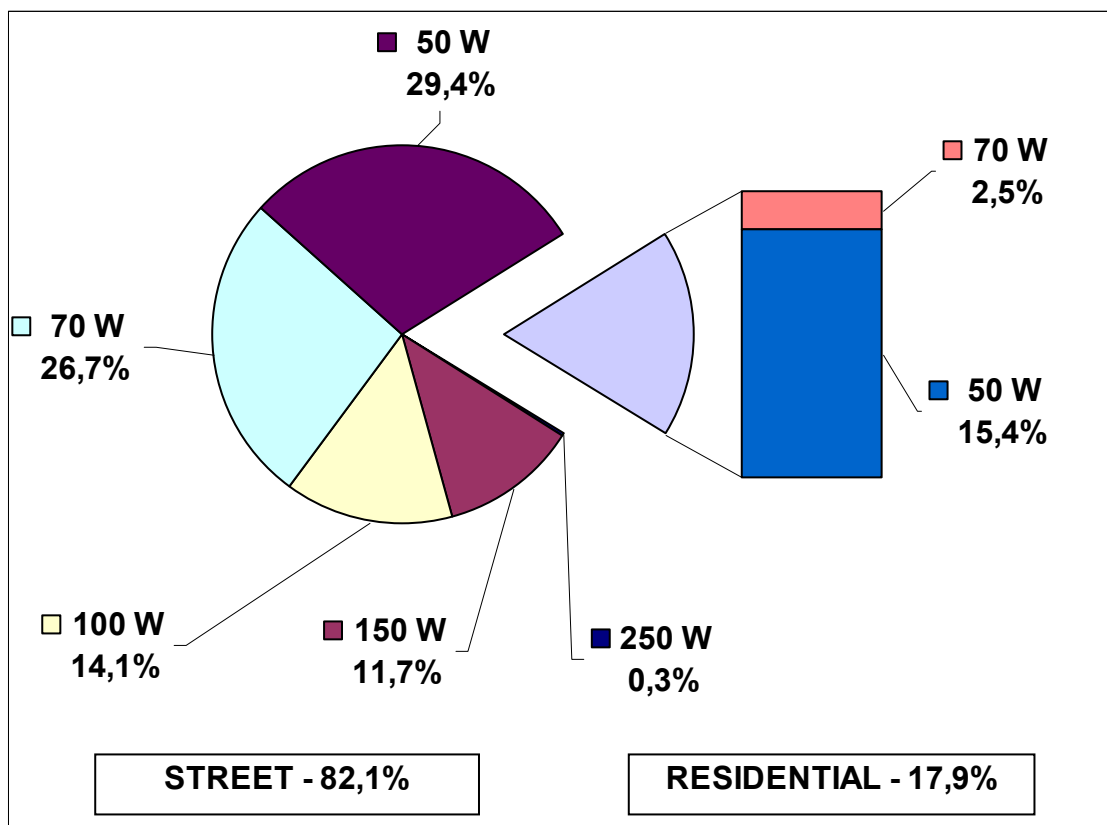


Figure 7

Figure 8 presents the installed power before and after the modernization of road lighting in the fifteen Bulgarian cities.

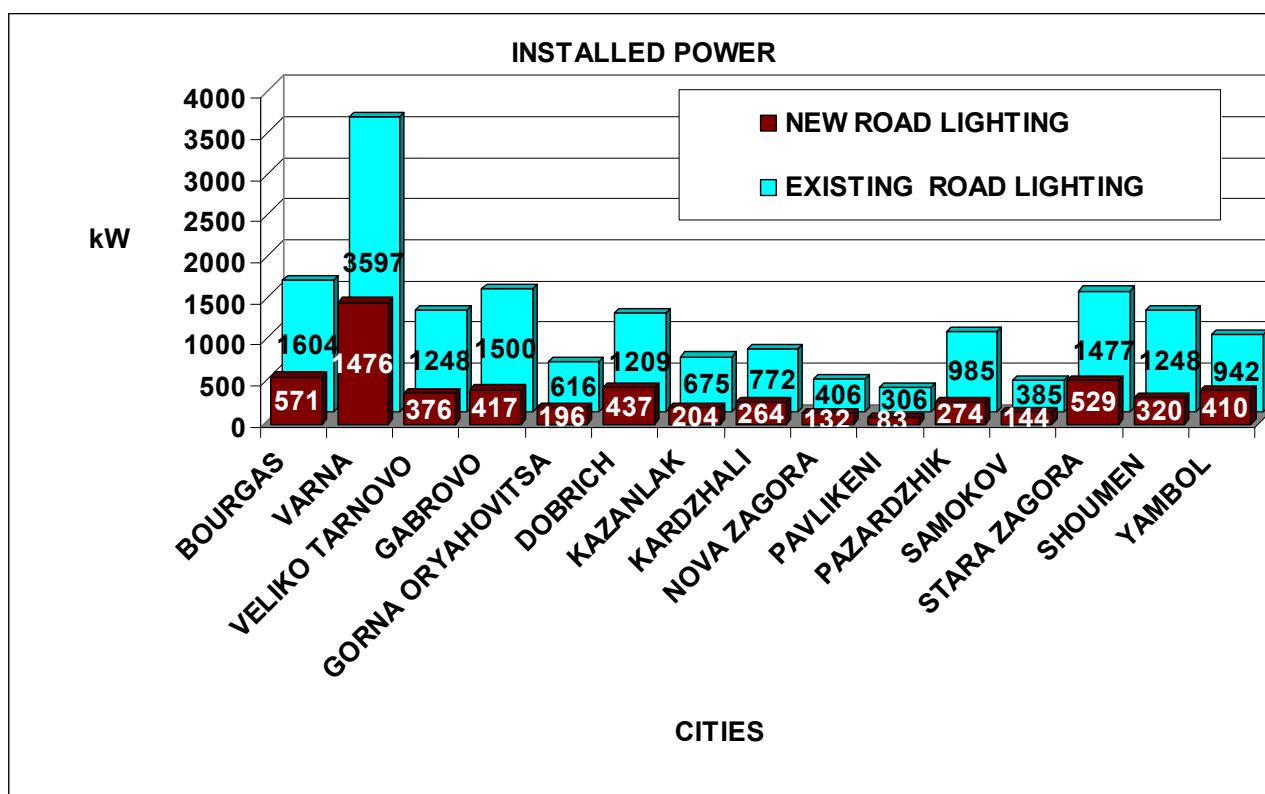


Figure 8

## CONCLUSIONS

The summarized result of the modernization carried out in the fifteen cities shows a 2.9-fold decrease in the installed power, the quantitative and qualitative requirements of road lighting being satisfied. The saving of electric energy for road lighting can be further enhanced by introducing modern technical solutions into the control and operation of road lighting.

## REFERENCES

- [1] EN 13201 Road Lighting
- [2] Bulgarian State Standard 5504-82 "Lighting of Streets and Pedestrian zones"
- [3] Eckert M., U. Carraro, Lichtanwendung in der Außenbeleuchtung, Ilmenau, 2003
- [4] Omura J., Mastering AutoCAD 2004 and 2004 LT, Sofia, SoftPress, 2004