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Supported by
Intelligent Energy Europe

Intelligent Road and Street Lighting in Europe (E–Street)

Grant Agreement: EIE/05/157/SI2.419662

WP 3: Market penetration and procurement activities

D 3.3: Report on Forum for Intelligent Street Lighting

WP Leader: BSREC

20 November 2007, Oslo/Sofia

Intelligent Energy Europe

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Mandate

The Forum for Intelligent Street Lighting should offer possibilities for **gathering information and enabling discussions** about the following topics:

1. The acting standards for street lighting in the project partner-countries and intentions for harmonization with the European standards.
2. The acting in each country European directives related to the announcement and participation in tenders for street lighting and the legislation fundamentals of the partner countries.
3. The applied methods for quality, technical and economical assessment of the luminaries' construction in the field of the street lighting, information about the used materials, for the lighting, electric, energy – efficiency, maintenance and ecological parameters, design.
4. The state-of-the-art of the street lighting and the future expectations in the partner-countries.
5. A data-base of providers of lighting equipment in the partner countries.
6. Sample documents for on-going tenders from different countries.
7. Detailed information concerning the lighting, energy, economic and maintenance parameters of the new system for intelligent street lighting.
8. Information about the management system and the ownership rights of the street lighting (property of the municipalities, concession or other?!)
9. Implemented methods for the assessment of the street lighting renovation – pay-back period, discounted cash flow (DCF), present values (PV), internal rate of return (IRR) or other.

Establishment of Forum for Intelligent Streetlight

The Forum was established during the project 2nd progress meeting in Prague in June 2006. The first meeting was performed only for E-street partners. The minutes stated:

> "A street light forum was established at the project meeting. It was decided that BSREC, STIO and Javna shall make a draft for the mandate form for the forum. The forum should include street light owners, stake holders etc."

Membership

The E-street forum offers free of charge membership during the E-street project period. The forum is open to all interested parties as long as this is related to street lighting. The WP 3 leader in cooperation with the coordinator of the E-street projects holds the membership list.

A detailed membership list is annexed.

Forum meetings, status

The first forum meeting (Prague)
The first forum meeting, where the forum was established was performed in Prague 09.06.2006. The mandate and membership was discussed.

The 2nd forum meeting (Berlin)
The second forum meeting was held in Berlin 28th of November 2006 at the 3-th progress meeting. The Forum had its first technical meeting also including external participants, 22 in numbers. The forum consisted of three technical presentations as well as an interesting discussion. The forum also discussed further developments, incl expanding the membership list.

The 3rd forum meeting (Oslo)
The third meeting in the street light forum was held the 9th of May in Oslo 2007, Norway. The following topics were highlighted:

- Communication: power line, radio, W-lan etc
- Protocols: Lon-works, Zigbee, Dali and others
- Technology: Hardware, software, implementation, plug and play

40 persons attended the street light forum. The following companies gave a presentation; Norconsult (NO), Norwegian road authorities(NO), LCI(DE), Luminext(NL/NO), IWT(US), PowerOne(IT) and UMPI(IT).

All the partners except BSREC attended the forum meeting. The partners were satisfied with the meeting, and the presentations were interesting and detailed. There could have been some more discussions at the end of the meeting.

Workshop Street light forum 9th of May 2007
Venue: Norconsult, Vestfjordgaten 4, 1338 Sandvika, Oslo
12.30 Lunch
13.15 Welcome and a short presentation of E-street - Hafslund
13.30 Presentation of existing and new members - All
13.45 EU's initiatives to promote energy efficiency in street lighting –Mr.Mjøs
14.00 Presentation street light owner, Road authorities – Mr. Per Ole Wanvik
14.20 Presentation of adaptive street lighting – Mr. Axel Stockmar
14.30 Presentation of technology Luminext – Mr. Henk Walraven
15.00 Break

15.20 Presentation of technology IWT - Mr. Phil Carrier
15.50 Presentation of technology PowerOne – Mr. Leonardo Botti
16.20 Presentation of technology UMPI – Mr. Cecchini and Mr. Grossi
16.50 Discussions
17.15 Closing the meeting

The 4th forum meeting (Sofia)

The forth forum meeting was originally decided to be held in Amsterdam back to back with the LON World conference (14-15 November 2007). Later, it became clear that several of the subjects would have occurred in both agendas, and the Forum meeting was cancelled. This decision was made also in respect of the Forum-meeting in Sofia later the same month.

The agenda for the Sofia meeting is set to:

Street light forum 26th of November 2007, City of Sofia

12.30 Lunch
13.15 Welcome and a short presentation of E-street - BSREC
13.45 Presentation of existing and new members - All
14.00 Organization of streetlight owners and contractors/Gothenburg, Ingemar Johansson, SE
14.30 Presentation of administration system for street lighting/Hafslund
15.00 Metering and billing /ELTODO, Ludek Hladky, CZ
15.30 Break
16.00 Upgrading of streetlight installations Users guide /Norconsult, Tor Mjøs, NO
16.45 Procurement procedures, financial instruments /IB, Wilfred Gabler, DE
17.30 Presentation of adaptive street lighting in Finland/ Henri Mabille, FR
17.45 Discussions
18.00 Closing the meeting

By 20.11.2007 the participant list exceeds 60 people.

Information supported by partners.

Information from Germany:

1. Equipment providers and Tender documents

1.1 Providers in www.strassenlicht.de:

Manufacturers of lamps:
www.strassenbeleuchtung.de/adressi/index.php?cat=6 or
www.strassenbeleuchtung.de/adressi/index.php?cat=1

Manufacturers of control systems:
www.strassenbeleuchtung.de/adressi/index.php?cat=13

Manufacturers of electrical equipment, ballast etc.
www.strassenbeleuchtung.de/adressi/index.php?cat=29

… more important links, i.e. discussion forum, masts manufacturers, etc.
www.strassenbeleuchtung.de/adressi/

1.2 www.schreder.com
Tender documents, street lighting luminaries technical datasheets

1.3 www.siteco.de
Tender documents, street lighting luminaries technical datasheets

1.4 The web-site of the company Trilux-Lenze Gmbh (www.trilux.de) provides further information and many downloads.


uebersicht.htm

planning software.htm
[Anhang "trilux-leuchten.pdf"]

1.5 www.osram.com
Technical documents for lamps and luminaries
Tender documents focussed on electronic control gear:
[Anhang "tender_documents.pdf"]

1.6 www.industria-beleuchtung.de
Luminaries, control-systems

1.7 www.hess-form-licht.de/de/Produkte_Beleuchtung/
Tender documents for luminaries (also in combination with projects)
Only in German language

1.8 www.philips.com
Tender documents for lamps, luminaries and ballast

1.9 www.astralux.net
Tender documents for lamps

2. Technical standards

2.1 Developing a framework for energy efficiency Improvement in the EU:
[Anhang "en2-05.pdf"]

2.2 Standard lamps
www.licht.de
[Anhang "Artificial Light.pdf"]
[Anhang "street-light.pdf"]

2.3 Project ENERLIN
The E-Street project can use information from the ENERLIN project
- CFL- quality standards
- Guidelines for lighting services
- Good practice examples

Presentation by the Berlin Energy Agency:
[Anhang "E-STREET_PPT_060307_engl.ppt"]

2.4 Life behaviour of discharge lamps
[Anhang "LifetimeZVEI.pdf"]

3. Technical standards in projects for street lighting (reference and refurbishment)

3.1 Project "OPTIMON-SBL" (Austria), finished in 2004
(in German language)
- 11 different municipalities,
- Providers
- Information about standards (technical) and guidelines (planning)
- Survey on standards - basic information
- Monitoring of energy consumption
- Documentation for maintenance

3.2 Project "Lighting package - Lichtpaket" (Austria); to finish in 2006 (www.lea.at)
(in German language)
8 different municipalities

3.3 Information from Philips
[Anhang "street lighting refurbishment.pdf"]

3.4 www.eu-enlight.org
- review of the current status,
- evaluation criteria for efficient outdoor lighting,
- efficient measures,
- guidelines,
- project partners,
- good practice reconstruction projects,
- street-lighting glossary,
- awareness raising, etc.

[Anhang "EnLight-Zwischenbericht.pdf"]
[Anhang "EnLight-Leitfaden.pdf"]

This information is in German language, but the main technical data can be useful.

3.5 www.eu-greenlight.org

Good practice examples on street lighting projects (lighting-contracting)

Information from Norway:

The delivery shall meet all the relevant EU-directives now in effect, and it is the responsibility of the contractor to keep up-to-date with such directives. Products that are required to carry a CE label in accordance with the CE labeling directive, but are not CE labeled, may be rejected.

Documentation of the lighting calculations shall be attached to the tender, and will be given considerable weight in the evaluation of the tenders.

In the event that the road standard requirements pertaining to evenness, glare, lighting intensity, etc., cannot be met, then this shall be disclosed in the tender document. Such information will be used as the basis of new standards with respect to CEN prEN 13201 1-4.

The light source installation shall be able to meet safety requirements up to temperatures related to IEC 62035.

Information from Portugal:

In Portugal, outdoor lighting installations are grouped by classes (A, B and C), depending on the characteristics of each road, the nature and the importance of traffic and the frequency of pedestrians:

CLASS A
Lighting for main roads, with fast and intense traffic, for which it is important to have in mind questions related to security, speed and comfort conditions during traffic circulation.

CLASS B
Lighting for important roads, with significant flux of vehicles and pedestrians and for which it is important to have in mind, besides the vehicles circulation, also the interests of pedestrians and local stores and, also, urban aesthetics.

CLASS C
Lighting for residential areas, manly local traffic and with minor importance.

The classes A and B were divided in two subclasses, 1 and 2, according to the importance of the road. Table 1 establishes the link between the outdoor lighting installations and the type of roads.

The presented recommendations concern manly the lighting plan for major routes and other roads of relevant importance.

Table 1 – Recommendations for outdoor lighting in different types of roads.

Class of the outdoor lighting installation	**Type of road**		**Average level of illuminance in wet pavement [cd/m^2]**	**Uniformity of luminance in wet pavements**	**Glare**	**Type of luminaries**	
A1	Highways		2	Very good	Strictly reduced	Preferred	Accepted
A1	Roads in open field	Intense traffic				Limited distribution (Cut-off)	Semi-limited distribution (Semi cut-off)
A2		Considerable traffic	1	Good			
-		Reduced traffic	Without outdoor lighting system				
A1	Urban roads	Ring roads	2	Very good	Reduced	Limited distribution (Cut-off)	Semi-limited distribution (Semi cut-off)
B1		Main arteries (local traffic)	1	Good	Moderated	Limited or semi-limited distribution (Cut-off or semi cut-off)	Non limited distribution (No cut-off)
B2		Secondary streets (local traffic)	0,5	Satisfactory			

- **Philips Portuguesa, S.A.**
  http://www.philips.pt
- **Osram - Empresa de Aparelhagem Eléctrica Lda**
  http://www.osram.pt/
- **Schréder Iluminaçao SA**
  http://www.schreder.com/language.aspx
- **Paralux - Sociedade de Iluminação, Lda**
  http://www.paralux.pt/
- **Indalux – Equipamentos Eléctricos, Lda.**
  http://www.indalux.es/contenidos/cpcontent.asp?contentid=2098&nodeid=1050
- **Salicru Electronics**
  http://www.salicru.com
- **Atersa Electricidad Solar**
  http://www.atersa.com

Information from Slovenia:

STANDARDIZATION

Road and street lighting

All new lighting installations shall be in accordance with SIST EN 13201. Standard is original EN 13 201 with the reference to SIST (Slovenian Institute for Standardization) – the standard was adopted by the method of translating the title of the document.

In Slovenia also SIST EN TC 13201 Part 1 was adopted as a basic guide how to determine lighting classes.

Slovenian lighting society published Recommendations for Road Lighting.

The document is in accordance with SIST EN 13 201 with additional comments and recommendations and widely accepted in professional society.

Light pollution

Concerning light pollution, in Slovenia there is a law under preparation, which would become fully effective at the end of 2006.

The efforts to prepare the law concerning light pollution started a long time ago by the astronomers, so the first drafts were quite ridiculous prepared by people not knowing anything about lighting.

The recent draft is more reasonable, so the Slovenian experts are trying to comply all the new lighting installations with the requirements given in this draft document.

Applicable standards for the equipment - luminaries

The basic requirements for the luminaries are given in the standard EN 60 598, issued in Slovenia as SIST EN 60 598.

The standard is not intended as performance standard. Compliance with the standard would mean to meet the requirements of the LV Directive.

Luminaries should also meet the requirements of Electromagnetic Compatibility Regulations.

The particular performance requirements for the luminaries are given in the tender documents.

Main equipment providers in Slovenia

- Siteco
- Schreder

Contractors and lighting design offices

- Javna razsvetljava
- Nigrad Maribor
- Elektrosignal Celje

Information from Sweden:

No information about providers or standardization.

Information from the project meeting in Prague:
The EN 13201 for road lighting has been implemented.

Information from Poland:

No information about providers or standardization.

THE POLISH PUBLIC PROCUREMENT LAW could *be given as attachment*.

Information from the project meeting in Prague:
The standard EN 13201 is voluntary and it is now under translation.

Information from the Czech Republic:

Environmental aspects and legislation

1. PCB directives

Among others, the Act on Waste No.185/2001 from 15th May 2001 deals with PCB definition for the purposes of this Act, furthermore sets its limits, correct removing and evidence of the devices containing PCB. Transformers and capacitors are the main objectives of the focus in public lighting.

The Directive 2002/96/EC on waste electrical and electronic equipment (WEEE) sets selective treatment for materials and components. Among others, PCB containing capacitors have to be removed from any separately collected WEEE.

The Directive 2002/95/EC on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment deals with products coming up to market after 01.07.2006. They cannot consist of chromium, cadmium, PBB and PBDE and imposes significant limitation of lead.

2. Light pollution

Light pollution generally represents a complex of unfavourable aspects of artificial outdoor lighting. This term is implemented to the Czech Act No. 472/2008 - O ochraně ovzduší "Air Protection". Definition of the light pollution is stated in **§2,** chapter 1, letter r: "Light pollution is visible radiation of artifical light sources, which can annoy persons and animals, implicate them health detriment or disturb some activities and comes out from location of these sources in outdoor atmosphere or from the light sources, whose radiation is purposely directed to outdoor atmosphere". Further in the law (**§50,** chapter 3, letter c) is the control responsibility shifted to municipality, which can by generally binding regulation reduce projection of light advertisement and effects at the sky.

The light pollution phenomenon is tackled in the technical report CIE 126:1997 „Guidelines for minimizing sky glow" and gives general guidance for lighting designers and policy makers on the reduction of the sky glow. The report discusses briefly the theoretical aspects of sky glow and it gives recommendations about maximum permissible values for lighting installations in relation to the needs of astronomical observations - casual sky viewing included. These values must be regarded as limiting values. Lighting designers should do all possible to meet the lowest specifications for the design unless the specific installation requires relaxation. Other uses of the open air areas at night will usually result in less stringent

sky-glow requirements. Other aspects of light obtrusion are covered in detail by CIE TC 5-12 "Obtrusive light".

Another significant direction is CIE 150:2003 „Guide on the limitation of the effects of obtrusive light from outdoor lighting installations. The purpose of this guide is to help formulate guidelines for assessing the environmental impacts of outdoor lighting and to give recommended limits for relevant lighting parameters to contain the obtrusive effects of outdoor lighting within tolerable levels. As the obtrusive effects of outdoor lighting are best controlled initially by appropriate design, the guidance given is primarily applicable to new installations; however, some advice is also provided on remedial measures which may be taken for existing installations. This Guide refers to the potentially adverse effects of outdoor lighting on both natural and man-made environments for people in most aspects of daily life, from residents, sightseers, transport users to environmentalists and astronomers.

Both directions CIE 126:1997, CIE 150:2003 are used for evaluting of light parametres of the illuminating advertisement surface on surroundigs. Significant parameter is the luminance of the billboard surface and illuminace of the neighbouring dwellings facade. Both parametrs are measured in real applications or calculated in lighting softwares to prevent undesirable influences onusers of the neighbourhood

Significant producers and suppliers on the Czech market	
Luminaires	Schréder, Philips, grupo INDAL,Siteco, Thorn, iGuzzini, Gewiss, FIVEP, Nordex, Mareco Luce, Artmetal, Gaash, Elektrosvit Svatobořice a.s., ELTODO - Power, Ing. Vyrtych - Elektrotechnický závod,
Discharge lamps	Ge, Philips, Osram, Narva, Sylvania

“Tender forms“ could be given as an attachment.

Information from Finland:

No information about providers or standardization.

Information from the project meeting in Prague:
Parts 2, 3 and 4 are being used and must be followed. Part 1 is a guideline. There is a brand new national guideline for public road lighting based on EN 13201 where the national conditions have been added.

Information from Ireland:

No information about the providers.

A description of “Object Specific Technical Description Lighting” and “Orientating description of the central control- and surveillance system” could be given as an attachment.

RELEVANT PUBLICATIONS AND STANDARDS:

British Standards: www.bsi.org.uk		BS 5489-1: 2003 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas BS EN 13201-2:2003 Road lighting – Part 2: Performance requirements BS EN 13201-3:2003 Road lighting – Part 3: Calculation of performance BS EN 13201-4:2003 Road lighting – Part 4: Methods of measuring lighting performance. BS EN 12193: 2003 Light and lighting – Sports lighting
Countryside Commission/DOE www.odpm.gov.uk		Lighting in the Countryside: Towards good practice (1997) *(Out of Print)*
CIBSE/SLL Publications: www.cibse.org	CoL LG1 LG4 LG6 FF7	Code for Lighting (2002) The Industrial Environment (1989) Sports (1990+Addendum 2000) The Exterior Environment (1992) Environmental Considerations for Exterior Lighting (2003)
CIE Publications: www.cie.co.at	01 83 92 115 126 129 136 150 154	Guide lines for minimizing Urban Sky Glow near Astronomical Observatories (1980) Guide for the lighting of sports events for colour television and film systems (1989) Guide for floodlighting (1992) Recommendations for the lighting of roads for motor and pedestrian traffic (1995) Guidelines for minimizing Sky glow (1997) Guide for lighting exterior work areas (1998) Guide to the lighting of urban areas (2000) Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003) The Maintenance of outdoor lighting systems (2003)
Department of Transport www.defra.gov.uk		Road Lighting and the Environment (1993) (Out of Print)
ILE Publications: www.ile.org	TR 5 TR24 GN02	Brightness of Illuminated Advertisements (2001) A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999) Domestic Security Lighting, Friend or Foe
ILE/CIBSE Joint Publications ILE/CSS Joint Publications		Lighting the Environment - A guide to good urban lighting (1995) Seasonal Decorations – Code of Practice (2005)
Campaign for Dark Skies (CfDS) www.dark-skies.org		

Information from Bulgaria:

PROVIDERS

Osram – BG - http://www.osram.bg/;, Philips – BG - http://www.philips.bg/; GE, Sylvania, Radium, Siteco, Beghelli, Tridonic, Helvar, Alanod, Schreder, Eltodo – BG, Trilux, Thorn

Bulgarian providers:

Denima 2001 Ltd - http://www.denima2001.com/;
Megalux Ltd - www.**megalux**bg.com;
Polaris Lighting Ltd - **URL:** polaris.business.bg;
Dimov Company Ltd - http://www.dimov.co.uk/;
Teletek - http://www.teletek.bg/;
ROS Ltd - http://www.ros-bg.com/;
HIT Ltd – Gorna Oriahovitza - http://www.hitlighting.com/;
Filcab – Plovdiv – www.filkab.com;
Luminex Ltd – Haskovo - http://www.luminex.hit.bg;
Ecoenerguia – St. Zagora, Electrostart – Varchetz, Neosvet – St. Zagora

REFERENCE STANDARDS:

BSS	EN	60188/2002+ A1, A5	High pressure mercury lamps.
BSS	EN	60192/2002+A4, A5	Low pressure sodium lamps.
BSS	EN	60529	Degree of protection. Marking. Testing methods.
BSS	EN	60598-1/2002+A1, A12, A13, A14	Luminaries. Part 1: General requirements for testing.
BSS	EN	60598-2-3/2002+A1, A2	Luminaries. Part 2: Specific requirements. Section 3: Luminaries for illumination of streets and roads.
BSS	EN	60662/2002+ A10, A4, A5, A6, A7, A9	High pressure sodium lamps.
BSS	EN	61167/2002/A1, A2, A3	Metal – halide lamps
BSS	EN	61347-1/2003	Lamp control gear. Part 1: General requirements and safety requirements (IEC 61347-1:2000)

BSS 5504-82 - Illumination of streets and pedestrian zones. Technical requirements.

BSS CEN/ TR13201-1:2004	Road lighting - Part 1: Selection of lighting classes
BSS EN 13201-2:2003	Road lighting - Part 2: Performance requirements
BSS EN 13201-3:2003	Road lighting - Part 3: Calculation of performance
BSS EN 13201-4:2003	Road lighting - Part 4: Methods of measuring lighting performance

Table for the quality assessment of the lighting products, experimented last years in Bulgaria

	Points
Q_1 – accounting the degree of protection concerning the luminaries optical system	
- IP65	10
- IP54	8
- IP43	3
- IP23	0
Q_2– accounting the degree of protection concerning the luminaries electrical system	
- IP65	6
- IP54	4
- IP43	2
- IP23	0
Q_3– accounting the reflector type	
- from aluminium with facets and anodized	10
- Cast aluminium, anodized	7
- Mounted in the luminaries body reflecting elements from anodized aluminium	6
- The luminary's body fulfils the reflecting functions, anodized	5
- Not anodized aluminium	0
Q_4– accounting the material of the diffuser	
- From polycarbonate, shock resistant, UV-stabilized	8
- From special thermo resistant glass	10
- From Plexiglas	5
Q_5 – accounting the material of the luminary's body	

- Cast aluminium with holding (plastic or special paint)	10
- Cast aluminium	8
- Fiber glass from polyester	6
- Aluminium with holding	6
- Fiber glass with polyethylene holding	3
- Aluminium without holding	5
Q_6 – accounting the ballast type	
- With thermal switch	5
- Without thermal switch	0
Q_7 - accounting the type of the ignitor	
- with switching out panel	5
- without switching out panel	0
Q_8 – for luminaries with CFLs	
- With electronic control gear with filters for radio disturbance, against tension increases and cos φ correction	5
- With electronic control gear without filters for radio disturbance, against tension increases and cos φ correction	0
Q_9– accounting the complexity of the luminaries maintenance	
- easy exploitation	5
- complicated exploitation	0
Q_{10}– accounting the guarantee term of the lamps	
- With 48 months guarantee term	10
- With 36 months guarantee term	5
- With 24 months guarantee term	0
Q_{11}–accounting the guarantee term of the luminaries	
- With guarantee term greater than 10 years	10
- With guarantee term less than 10 years	0
Q_{12} – accounting the lighting pollution of the atmosphere	
- Light emission only downwards	8
- Poor emission upwards	4
- Globe luminaries (without stop for the light emission upwards)	0
Q_{13} accounting the safety service when the luminary is open	
- the control gear is not under tension	6
- the control gear is under tension	0
Q_{14}– accounting the luminary efficiency - η	
- $\eta \geq 85$	8
- $\eta \geq 80$	6
- $\eta \geq 70$	5
- $\eta < 70$	4
Q_{15}–accounting the luminary design	
- design and scale map of the luminary in conformity with the street profile	10
- not contemporary and appropriate design for the street profile	0
Q_{16}–accounting the blinding influence of the luminary	
- $I_\alpha \leq 500$ cd for $\alpha = 90°$ and $I_\alpha \leq 1000$ cd for $\alpha = 80°$	10
- $I_\alpha > 500$ cd for $\alpha = 90°$ and $I_\alpha > 1000$ cd for $\alpha = 80°$	0
Q_{17} –accounting the possibility for regulation of the optical system	
- could be regulated	5
- no regulation	0

Topic for discussion in the street lighting forum:

1. Is the existing legislation of each country harmonized with the Directives of the EC for preparation of tender documents?
2. Which norms for street lighting and lighting equipment are acting in the partner-countries - national and/or European? In some of the countries the first part of the EN 13201, connected with the streets categorization has been adopted!
3. It is necessary to co-ordinate the minimum price thresholds for the organization of street lighting tenders.
4. Is the elaboration of common methods for the efficiency assessment of the foreseen street lighting reconstruction, accounting the initial investments and the maintenance expenses possible?
5. Quantity assessment of the lighting, technical, electric energy and exploitation parameters of the lighting equipment is particularly difficult. In Bulgaria, the table for quality assessment of the products shown above has been experimented in several tenders. To a certain degree this assessment is subjective!