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EU green public procurement criteria for road lighting and traffic signals

EU GPP criteria for road lighting and traffic signals

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1 INTRODUCTION

EU green public procurement (GPP) criteria are designed to make it easier for public authorities to purchase goods, services and works with reduced environmental impacts. The use of the criteria is **voluntary**. The criteria are formulated in such a way that they can, if deemed appropriate by the individual authority, be (partially or fully) integrated into the authority's tender documents with minimal editing. Before publishing a call for tender, public authorities are advised to check the available offer of the goods, services and works they plan to purchase on the market where they are operating. When a contracting authority intends to use the criteria suggested in this document, it shall do so in a manner which ensures compliance with the requirements of EU public procurement legislation (see, for instance, Articles 42, 43, 67(2) or 68 of Directive 2014/24/EU¹ and similar provisions in other EU public procurement legislation). Practical reflections on this matter are also provided in the 2016 handbook on buying green, available at http://ec.europa.eu/environment/gpp/buying_handbook_en.htm.

Contracting authorities should also be aware of the fact that public procurers for central government institutions are obliged, under Article 6 of the Energy Efficiency Directive², to purchase only products that comply with energy efficiency benchmarks specified in implementing measures if a product is covered by such an implementing measure under the Ecodesign Directive³. With regards to road lighting, Regulation 245/2009⁴ is currently in force and will be later repealed by a new Commission Regulation. The current draft proposal⁵ does set luminous efficacy requirements for LED lighting (120 lm/W) that are not more stringent than those specified in the EU GPP criteria.

¹ Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC. (OJ L 94, 28.3.2014, p.65).

² Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012, on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (OJ L 315, 14.11.2012, p.1)

³ Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products (OJ L 285, 31.10.2009, p.10)

⁴ Regulation (EC) No 245/2009 of 18 March 2009 implementing Directive 2005/32/EC of the European Parliament and of the Council with regard to ecodesign requirements for fluorescent lamps without integrated ballast, for high intensity discharge lamps, and for ballasts and luminaires able to operate such lamps, and repealing Directive 2000/55/EC of the European Parliament and of the Council. (OJ L 76, 24.3.2009, p.17).

⁵ [Draft Commission Regulation laying down ecodesign requirements for light sources and separate control gears pursuant to Directive 2009/125/EC of the European Parliament and of the Council and repealing Commission Regulations \(EC\) No 244/2009, \(EC\) No 245/2009 and \(EU\) No 1194/2012](#)

This document provides the EU GPP criteria for the product group ‘road lighting and traffic signals’.

The environmental aspects covered by EU GPP criteria for road lighting are split into three broad sections: energy consumption, light pollution and lifetime. An accompanying technical report and a guidance document provide further rationale supporting the selection of these criteria and references for further information. The procurement of traffic signals is considered separately using criteria that are predominantly centred on life cycle costs.

The criteria are made up of selection criteria, technical specifications, award criteria and contract performance clauses. They may be divided into two levels:

- **Core criteria** — *these are designed for easy application of GPP, focusing on the key area(s) of environmental performance of a product and aimed at keeping administrative costs for companies to a minimum.*
- **Comprehensive criteria** — *which take into account more aspects or higher levels of environmental performance, for use by any authorities that want to go further in supporting environmental and innovation goals.*

The wording ‘same for core and comprehensive criteria’ appears if the criteria are identical for both categories.

Road lighting equipment within the scope of the product group may vary substantially in nature and is rapidly evolving. For this reason, a number of criteria carry conditional clauses stating the circumstances under which the criteria should be considered relevant enough to include in the invitation to tender (ITT).

The criteria contained in this document are of potential interest to any public authority that owns or manages road lighting installations and/or needs to procure new road lighting equipment. Ultimately, national or regional planning laws determine whether a road needs to be lit and, if so, to what light level (see Figure 15 in the technical report). Prior to deciding on publishing any call for tender, it is strongly recommended that the public authority assesses any current lighting equipment used in its infrastructure and compares the existing technical performance and cost factors with products available on the market. If a preliminary life cycle cost indicates that major savings in energy/maintenance costs are possible, incorporating EU GPP criteria becomes especially relevant. Depending on the situation (e.g. new installation, retrofit and redesign of an installation, simple retrofit of an installation, retrofit of controls only, or like-for-like relamping only), different criteria assume different degrees of relevance (see Figure 4 in the technical report).

1.1 Definition and scope

Road lighting: These criteria cover the procurement of lighting equipment for:

- road lighting in new lighting installations;
- retrofitting of different luminaires to existing lighting installations;
- retrofitting of different light sources or controls to existing luminaires; or
- the simple replacement of light sources, lamps or luminaires on a like-for-like basis in existing lighting installations.

In accordance with standard EN 13201-1, the term 'road lighting' refers to fixed lighting installations intended to provide good visibility to users of outdoor public traffic areas during the hours of darkness to support traffic safety, traffic flow and public security.

It specifically excludes lighting installations for tunnels, toll stations, canals and locks, parking lots, commercial or industrial sites, sports installations, monuments and building facades.

The following technical definitions are provided to help apply the criteria (please refer to the technical report for details and further technical definitions):

'luminaire efficacy': ratio between luminous flux output from the luminaire (in lumens) and power consumption (in Watts)

Traffic signals: Red, yellow and green signal lights for road traffic with 200mm and 300mm roundels, in line with standard EN 12368, are included. Portable signal lights are specifically excluded.

1.2 General note on verification

For some criteria, the proposed means of verification involves using test data or reports. For each of these criteria, the relevant test methods are indicated wherever possible. It is up to the public authority to decide whether test results should be provided before or after the awarding of the

contract. In general, it does not seem necessary to require all tenderers to provide all test results from the outset. To reduce the burden on tenderers and public authorities, a self-declaration could be considered sufficient when submitting bids. Subsequently, the different options below could determine if and when tests might be required.

a) At tendering stage:

For *one-off supply contracts*, the bidder with the most economically advantageous tender could be required to provide this proof. If the proof is deemed to be sufficient, the contract can be awarded. If the proof is deemed insufficient or non-compliant, then:

- i) where the means of verification concerns a technical specification, the proof would be requested from the next highest scoring bidder, who would then be considered for contract award;
- ii) where the means of verification concerns an award criterion, the additional points awarded would be removed and the tender ranking would be recalculated, with all the ensuing consequences.

A test report verifies that a sample product has been tested for certain requirements, not the items actually delivered under the contract. For framework contracts, the situation may be different. This scenario is covered further in the next point on contract execution and in the additional explanations below.

b) During contract execution:

Test results could be requested for one or several items delivered under the contract, either in general or if there are doubts about false declarations. This is particularly important for framework contracts which do not stipulate an initial order.

Explicitly setting contract performance clauses is advisable. These should stipulate that the contracting authority is entitled to carry out random verification tests at any time during the term of the contract. If the test results show that the delivered products do not meet the criteria, the contracting authority is entitled to apply penalties and may terminate the contract. Some public authorities include conditions under which, if the tests show that the product meets their requirements, the testing costs must be borne by the public authority, but if not, the supplier must bear the costs.

For *framework agreements*, the point at which proof has to be provided will depend on the specific contract set-up:

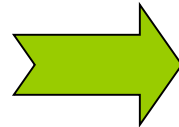
- i) for framework agreements with a single operator where the individual items to be delivered are identified when awarding the framework agreement, and where it is just a question of how many units will be needed, the same considerations apply as for the one-off supply contracts described above;
- ii) for framework agreements that pre-select several potential suppliers with ensuing competitions among them, tenderers will only need to show at this initial pre-selection stage their capability to deliver items meeting the minimum performance requirements of the framework agreement. For ensuing call-down contracts (or orders) that are awarded following the competition among the pre-selected suppliers, in principle the same considerations as under a) and b) above apply, if additional requirements have to be proven under the competition. If the competition is decided only on the basis of price, a check at the contract execution stage should be considered.

Please also note that, according to Article 44(2) of Directive 2014/24/EU, contracting authorities must accept other appropriate means of proof. This could include a technical dossier from the manufacturer, where the economic operator concerned had no access to test reports or no possibility of obtaining them within the relevant time limits. In this case, the economic operator must demonstrate that it was not responsible for the lack of access and that the works, supplies or services it provided meet the requirements or criteria set out in the technical specifications, the award criteria or the contract performance conditions. If there is a reference to a certificate/test report drawn up by a specific conformity assessment body for the execution of the tests, the contracting authorities must also accept certificates/test reports issued by other equivalent assessment bodies.

KEY ENVIRONMENTAL IMPACTS

Based on the available scientific evidence, the main environmental impacts of road lighting and traffic signals from the life cycle perspective are summarised in the table below (for further details, see the technical report). The same table also presents the EU GPP approach to mitigate or reduce those impacts.

Key environmental impacts during road lighting life cycle	Proposed EU GPP road lighting approach
<ul style="list-style-type: none"> • CO₂ and other greenhouse gas emissions as a result of electricity consumption in the use of road lighting. • Emission of acidifying gases as a result of electricity consumption in the use of road lighting. • Loss of star visibility caused by upward light output from unshielded luminaires and reflection from the ground. • Disruption of nocturnal species' behaviour with potential adverse effects on biodiversity, especially with blue light. • Poor resource efficiency in cases where products or components need to be replaced before the end of their stated lifetime due to, for instance use of lower quality (and cheaper) LED chips and difficulties with repair or to poor installation 	<ul style="list-style-type: none"> • Procure luminaires, lamps or light sources that exceed minimum luminaire efficacies. • Encourage the use of dimming and metering to ensure that energy consumption of a particular lighting installation can be optimised and monitored in real time. • Require that all luminaires have 0.0% upward light output ratio and, at comprehensive level, to ensure that 97% of all light falls within a downward angle of 75.5° to the vertical for the reduction of obtrusive light and glare. • Encourage obligatory dimming in areas of concern and to set limits on the proportion of blue light (G-index) in lamp/luminaire output. • Procure durable and fit-for-use road lighting equipment that is repairable and covered by a warranty or extended warranty. • Set minimum requirements for the person responsible for signing off the lighting installation.



The order of impacts does not necessarily reflect their magnitude.

Further information about the environmental impacts of road lighting and traffic signals can be found in the technical report.

2 EU GPP CRITERIA FOR THE CONTRACTING OF DESIGN SERVICES, PURCHASE OF LIGHTING EQUIPMENT AND/OR CONTRACTING OF INSTALLATION WORKS FOR ROAD LIGHTING

2.1 Preliminary assessment of existing lighting infrastructure and installation of dedicated metering

SUBJECT MATTER

The criterion in section 3.1 relates specifically to the assessment and auditing of existing road lighting infrastructure, lamps, ancillary equipment and records of maintenance and electricity consumption.

CONTRACT PERFORMANCE CLAUSES

CPC1. Preliminary assessment of existing lighting infrastructure and installation of dedicated metering

(Same for core and comprehensive criteria.)

(This contract should be considered a standalone preliminary procedure. It is not directly linked to any subsequent procurement exercises for the purchase of road lighting equipment or to the EU GPP criteria set out later in this document. This preliminary assessment should apply only when the procuring authority identifies the need to improve knowledge about their existing installed road lighting assets; when there is a need to install road lighting-specific electricity metering; or when the procurer decides not to use in-house staff to carry out this assessment.)

The currently installed road lighting assets identified by the procurer within a defined area must be assessed for the following aspects:

- mapping of light points and assignment of unique light point ID numbers (if not already done);
- luminaire model, efficacy, ratio of upward light output and year of installation (where information is available);
- lamp technology, rated power, correlated colour temperature (CCT) and year of installation;

- presence/absence of dimming controls.

The entire lighting network shall be split into sub-areas (if not already previously done by the procuring authority) and each sub-area shall be assessed to determine if specific metering of road lighting electricity consumption is in place.

In cases where specific metering is not in place, new meters and, if necessary, junction boxes shall be installed.

Once the appropriate metering has been installed, records shall be kept of the electricity consumption attributable to road lighting operation in each defined sub-area. This information shall then be used by the procurer as a basis for any future cost-benefit analyses when considering the procurement of new lighting equipment.

2.2 Selection criteria (SC) and relevant contract performance clauses (CPC)

SUBJECT MATTER
<p>The criteria in section 3.2 relate specifically to the competency and experience of the design and/or installation team for the services and/or works to be provided. These selection criteria may be fully or partly applicable to any contracts involving the subject matter defined later in section 3.3 (purchase of energy efficient road lighting equipment), section 3.4 (purchase of low light pollution road lighting equipment) and section 3.5 (purchase of good quality and durable road lighting equipment).</p>

Core criteria	Comprehensive criteria
SELECTION CRITERIA	
<p>SC1. Competencies of the design team <i>(Same for core and comprehensive criteria.)</i> <i>(Applies when a lighting design is requested in the procurement exercise.)</i></p> <p>The tenderer shall demonstrate that the design will be checked and approved by staff with the following minimum experience and qualifications:</p> <ul style="list-style-type: none"> • at least three years' experience in lighting design, dimensioning of electrical circuits and electrical distribution networks, • involvement in the design of at least three different outdoor lighting installations, • a certified level of competency in the use of lighting design software for power density indicator (PDI) and annual energy consumption indicator (AECI) calculations (e.g. European Lighting Expert certificate), 	

- experience with the use of validated lighting calculation software (e.g. according to CIE 171, road surface reflectance tables or other relevant standards),
- holding a suitable professional qualification in lighting engineering or membership of a professional body in the field of lighting design.

Verification: The tenderer shall supply a list of the person(s) who will be responsible for the project should the tender be successful, indicating their educational and professional qualifications, relevant design experience in real projects and, if relevant, experience in and the name of any lighting design software used. This should include persons employed by subcontractors if design work is to be subcontracted.

The procuring authority, at its own discretion, may accept experience in less than three lighting installation designs if the scale of the design project(s) was sufficiently large (i.e. amounting to at least 70% of the scale of the design project that is the subject of the invitation to tender), and the duration was sufficiently long (i.e. amounting to at least three years).

SC2. Competencies of the installation team

(Same for core and comprehensive criteria.)

(Applies when responsibility for installation is not assumed by the procuring authority's own maintenance staff.)

The tenderer shall demonstrate that the installation works will be planned, checked and approved by personnel with the following minimum experience and qualifications:

- at least three years' relevant experience in the installation of outdoor lighting systems,
- involvement in the installation of at least three different installation projects,
- a suitable professional qualification in electrical engineering and membership of a professional body relevant to the work they are undertaking (e.g. certified lighting technician). The list of relevant installed lighting systems with the relative 'scale of the project' should be reported.

Verification:

The tenderer shall supply a list of person(s) responsible for the installation works should the tender be successful, indicating their educational and professional qualifications, training logs and relevant installation experience in real projects. This should include persons employed by subcontractors if installation work is to be subcontracted.

The procuring authority, at its own discretion, may accept experience in less than three lighting installation works if the scale of the works was sufficiently large (i.e. amounting to at least 70 % of the scale of the design project that is the subject of the invitation to tender), and the duration was sufficiently long (i.e. amounting to at least three years).

CONTRACT PERFORMANCE CLAUSES

CPC2. Assurance of adequately qualified staff to carry out contracted tasks

(Applies to SC1 and SC2.)

(Same for core and comprehensive criteria.)

The successful tenderer (contractor) shall ensure that the personnel mentioned in the documentation provided to demonstrate compliance with SC1 and/or SC2 are indeed involved in the works covered by the contract.

In cases when the personnel originally assigned to the project are not available, the contractor must communicate this to the procuring authority and provide a substitute or substitutes of equivalent or higher experience and competency.

Proof of the qualifications of any substitute personnel shall be submitted in the same manner as described in SC1 and/or SC2, as appropriate.

2.3 Energy efficient lighting equipment: technical specifications (TS), award criteria (AC) and associated contract performance clauses (CPC)

SUBJECT MATTER
The criteria in section 3.3 relate specifically to the purchase of energy efficient road lighting equipment for: new lighting installations, refurbishment of existing lighting installations, the retrofitting of new luminaires to existing installations or the retrofitting of new light sources or controls to existing luminaires. The AECI criterion (TS4) involves the contracting of design services as well.

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>TS1. Luminaire efficacy <i>(Applicable when light sources or luminaires are to be replaced in an existing lighting installation and no redesign is carried out. These ambition levels should not be applied when light sources are also requested to be rated with CCT ≤2700K.)</i></p>	<p>TS1. Luminaire efficacy <i>(Applicable when light sources or luminaires are to be replaced in an existing lighting installation and no redesign is carried out. These ambition levels should not be applied when light sources are also requested to be rated with CCT ≤2700K.)</i></p>

The lighting equipment to be installed shall have a luminaire efficacy higher than the relevant reference value stated below.

Year of ITT*	Efficacy (lm/W)
2018-19	120
2020-21	137
2022-23	155

Verification:

The tenderer shall provide a standard photometric file that is compatible with common light planning software and that contains technical specifications on the light output and energy consumption of the luminaire, measured by using reliable, accurate, reproducible and state-of-the-art measurement methods. Methods shall respect relevant international standards, where available.

**Due to the rapid technological developments in luminaire efficacy of LED-based lighting, it is proposed that the reference values stipulated here for invitations to tender (ITTs) should increase over the next 6 years, to avoid them becoming obsolete before the EU GPP criteria are due for revision again.*

The lighting equipment to be installed shall have a luminaire efficacy higher than the relevant reference value stated below.

Year of ITT*	Efficacy (lm/W)
2018-19	130
2020-21	147
2022-23	165

Verification:

The tenderer shall provide a standard photometric file that is compatible with common light planning software and that contains technical specifications on the light output and energy consumption of the luminaire, measured by using reliable, accurate, reproducible and state-of-the-art measurement methods. Methods shall respect relevant international standards, where available.

**Due to the rapid technological developments in luminaire efficacy of LED-based lighting, it is proposed that the reference values stipulated here for invitations to tender (ITTs) should increase over the next 6 years, to avoid them becoming obsolete before the EU GPP criteria are due for revision again.*

TS2. Dimming control compatibility

(Applicable to all calls for tender.)

(Same for core and comprehensive criteria.)

The lighting installation shall be compatible with dimming controls and allow for programmed switch-off during periods of low night-time road use intensity.

Verification:

The tenderer shall explain how the proposed lighting installation is compatible with programmed dimming and switch-off. This explanation should include any relevant documentation from the manufacturer(s) of the light sources and luminaires proposed for use by the tenderer.

In cases where controls are not integrated into the luminaire, the documentation should state what control interfaces can be used for dimming.

The documentation shall also state what dimming methods are compatible, for example:

- dimming based on pre-set period of expected low night-time road use intensity,
- initial dimming of over-designed lighting installations to compensate for gradual decreases in lumen output,
- variable dimming to maintain a target illuminance in variable weather conditions.

TS3. Minimum dimming performance

(Applicable to all calls for tender, unless it is clear that dimming controls would lead to a higher total cost of ownership. Procurers should clearly define the desired dimming performance in the ITT.)

All light sources and luminaires shall be installed with fully functional dimming controls that are programmable to set at least one pre-set level of dimming down to at least 50 % of maximum light output.

TS3. Minimum dimming performance

(Applicable to all calls for tender, unless it is clear that dimming controls would lead to a higher total cost of ownership. Procurers should clearly define the desired dimming performance in the ITT.)

All light sources and luminaires shall be installed with fully functional dimming controls that are programmable to set at least two pre-set levels of dimming, down to at least 10 % of maximum light output.

<p>Verification:</p> <p>The tenderer shall provide documentation from the manufacturer(s) of the light sources and luminaires that are proposed for use by the tenderer, showing that they are compatible with dimming controls.</p> <p>The documentation shall also state what dimming controls are incorporated, for example:</p> <ul style="list-style-type: none"> • pre-set dimming, or • variable dimming based on weather conditions or traffic volume. <p>The documentation shall also clearly provide a power curve of light output versus power consumption, state the maximum dimming possible and provide instructions about how to programme and re-programme the controls.</p>	<p>Verification:</p> <p>The tenderer shall provide documentation from the manufacturer(s) of the light sources and luminaires that are proposed for use by the tenderer, showing that they are compatible with dimming controls.</p> <p>The documentation shall also state what dimming controls are incorporated, for example:</p> <ul style="list-style-type: none"> • pre-set dimming, or • variable dimming based on weather conditions or traffic volume. <p>The documentation shall also clearly provide a power curve of light output versus power consumption, state the maximum dimming possible and provide instructions about how to programme and re-programme the controls.</p>
<p>TS4. Annual Energy Consumption Indicator (AECI)</p> <p><i>(Applicable when a new lighting installation is being designed or when a redesign is required due to the refurbishment of an existing lighting installation or the retrofitting of new luminaires. Procurers should pay particular attention to the numbers submitted for the maintenance factor and utilisation from the designer/tenderer and make sure that they are realistic and justifiable.)</i></p> <p><i>(Same for core and comprehensive criteria, although PDI reference values are higher for comprehensive level approach – see Technical Annex I.)</i></p> <p>The procurer shall provide technical drawings of the road layout, together with the areas to be lit and the illuminance/luminance requirements. For M-class roads, the procurer shall define the surface reflectivity coefficient of the road, which tenderers should use in their luminance calculations.</p> <p>To aid tenderers in their assumptions for design maintenance factors, the procurer should define with what frequency the luminaires will be cleaned.</p>	

For the average maintained illuminance/luminance defined by the procurer, the AECI of the design shall comply with the equation below:

$$AECI_{\text{design}} \leq PDI_{\text{ref}} \times E_m \times F_D \times T \times 0.001$$

Where:

PDI is the power density indicator, in units of $W.lx^{-1}.m^{-2}$

E_m is the maximum maintained illuminance (lx)

F_D is the dimming factor for any programmed dimming

T is the operating time ($h.yr^{-1}$)

0.001 is the number of kW in 1W

The PDI_{ref} value used shall depend on the road width and year as listed in Technical Annex I. Lower PDI_{ref} values than those listed in Technical Annex I are justified in cases where light sources with CCT $\leq 2700K$ are also specified.

Verification:

The tenderer shall state what lighting software has been used to calculate the PDI value and provide a clear calculation, where the values for the luminaire efficacy, maintenance factor and utilisation factor of their proposed design are visible. The calculation results must include the measurement grid and calculated illuminance/luminance values.

TS5. Metering

(Applicable to all tenders where no dedicated meter is yet in place for the lighting installation.)

The procurer shall state any specific technical requirements for the metering system in the ITT.

TS5. Metering

(Applicable to all tenders where no dedicated meter is yet in place for the lighting installation.)

The procurer shall state any specific technical requirements for the metering system in the ITT.

<p>The tenderer shall provide details of the proposed metering equipment and any ancillary equipment required in order to monitor electrical consumption at the lighting installation level for the same lighting installation that is the subject matter of the ITT.</p> <p>Verification: The tenderer shall provide the technical specifications of the metering and measurement system and provide clear instructions on how to operate and maintain this system. A calibration certificate compliant with Measuring Instruments Directive 2004/22/EC shall be provided for each control zone.</p>	<p>The tenderer shall provide details of the proposed metering equipment and any ancillary equipment required in order to monitor electrical consumption at the lighting installation level for the same lighting installation that is the subject matter of the ITT.</p> <p>The metering device must be capable of logging data on a 24-hour basis that can later be manually or remotely downloaded.</p> <p>Verification: The tenderer shall provide the technical specifications of the metering and measurement system and provide clear instructions on how to operate and maintain this system. A calibration certificate compliant with Measuring Instruments Directive 2004/22/EC shall be provided for each control zone.</p>
<p>TS6. Power factor <i>(Applicable when LED luminaires are being procured.)</i></p> <p>The power factor for the luminaire to be installed shall be ≥ 0.90.</p> <p>Verification: The tenderer shall provide a declaration of compliance with the criterion for the lighting equipment they intend to supply, supported by a declaration from the manufacturer and results from tests carried out in accordance with IEC 61000-3-2.</p>	<p>TS6. Power factor <i>(Applicable when LED luminaires are being procured.)</i></p> <p>The power factor for the luminaire to be installed shall be ≥ 0.95.</p> <p>Verification: The tenderer shall provide a declaration of compliance with the criterion for the lighting equipment they intend to supply, supported by a declaration from the manufacturer and results from tests carried out in accordance with IEC 61000-3-2.</p>

AWARD CRITERIA

AC1. Enhanced luminaire efficacy

(Applies to TS1.)

(Same for core and comprehensive criteria.)

A score of up to X points shall be awarded to tenderers that are able to provide light sources or luminaires which exceed the minimum luminous efficacy defined in TS1.

Maximum points (X) will be awarded to the tender with the highest luminous efficacy value and points will be proportionately awarded to any other tenders whose light sources or luminaires exceed the minimum requirements of TS1 but do not reach the value of the highest efficacy tender.

AC2. Enhanced AECI

(Applies to TS4.)

(Same for core and comprehensive criteria.)

A score of up to X points shall be awarded to tenderers that are able to provide designs that result in a lower AECI than the maximum limit defined in TS4.

Maximum points (X) will be awarded to the tender with the lowest AECI value and points shall be proportionately awarded to any other tenders whose designs are lower than the maximum limit in TS4 but do not reach the value of lowest energy consuming tender.

CONTRACT PERFORMANCE CLAUSE

CPC3. Dimming control

(Applies to TS2 and TS3.)

(Same for core and comprehensive criteria.)

If, for whatever reason, the contractor changes the light sources and/or luminaires from those specified in the successful tender, the new light sources and/or luminaires shall be at least

- equally compatible with dimming controls as the originals,
- have the same programmable flexibility,
- be able to achieve at least the same maximum dimming, and
- have a similar power curve.

Agreement on this matter shall be settled by the provision of similar documentation from the manufacturer(s) of the new light sources and/or luminaires that would justify the selection of the new luminaires and/or light sources.

CPC4. Commissioning and correct operation of lighting controls

(Applies to TS2 and TS3.)

(Same for core and comprehensive criteria.)

The successful tenderer (contractor) shall ensure that new or renovated lighting systems and controls are working properly.

- Any daylight linked controls shall be calibrated to ensure that they switch off the lighting when daylight is adequate.
- Any traffic sensors shall be tested to confirm that they detect vehicles, bicycles and pedestrians, as appropriate.
- Any time switches, CLO drivers and dimming controls shall be shown to be able to meet any relevant specifications defined by the procuring authority in the ITT.

If after the commissioning of the system, the lighting controls do not appear to meet the relevant requirements above, the contractor shall be liable

to adjust and/or recalibrate the controls at no additional cost to the procuring authority.

The contractor shall deliver a report detailing how the relevant adjustments and calibrations have been carried out and how the settings can be used.

Note: For large utilities the new or renovated installation may simply have to be compatible with the existing control systems used for the wider lighting network. In this situation, this CPC would also refer to the compatibility of the controls with the existing control system.

CPC5. Provision of originally specified lighting equipment

(Applies to TS1-6 and AC1-2.)

(Same for core and comprehensive criteria.)

The contractor shall ensure that the lighting equipment (including light sources, luminaires and lighting controls) is installed as specified in the original tender.

If the contractor changes the lighting equipment from that specified in the original tender, explanations must be provided in writing for this change and any replacement equipment must match or exceed the technical specifications of the original lighting equipment (e.g. luminaire efficacy, dimming functionality, R_{ULO} etc.).

In either case, the contractor shall deliver a schedule of the actually installed lighting equipment, together with manufacturer invoices or delivery notes in an appendix.

If alternative lighting equipment is installed, test results and reports for luminous efficacy from the manufacturer(s) of any new light sources and luminaires shall be provided, along with relevant documentation stating the performance of any new lighting controls.

CPC6. Compliance of actual energy efficiency and lighting levels with design claims

(Only recommended for large installations with a significant amount of installed power in non-urban environments.)

Where relevant, a suitable non-urban road sub-area shall be selected by the procurer where the luminaire positioning is in line with the PDI photometry study for in-situ photometric measurements (according to EN 13032-2) and energy consumption measurements (according to EN 13201-5) during an agreed period of one week.

The selected sub-area must be free of significant interference to lighting from trees, bus stops or parked vehicles and from background light levels caused by advertising boards or buildings.

For M-class roads with luminance requirements, it shall be acceptable to provide illuminance data instead, if concerns about the effect of real road surface reflectivity deviating significantly from design assumptions are justifiable.

The parameters influencing the uncertainty in illuminance measurements mentioned in Annex F to EN 13201-4 should be considered. It is advisable to use automated illuminance measurement systems and to agree on the illuminance and data point tolerances before the project ($\pm 10\%$ is suggested).

During the same one-week period peak power [W] and energy consumption [kWh] shall be measured and/or calculated for the relevant light points.

	<p>The in-situ measured values of PDI and AECI shall be $\pm 10\%$ of the design AECI value and $\pm 15\%$ of the design PDI value.</p> <p>Note: The consequences of non-compliance with the design values for PDI and/or AECI should be defined in the ITT. Options could include:</p> <ul style="list-style-type: none">• Remedial works to be undertaken at no additional cost to the procurer.• Financial penalties in proportion to the degree of non-compliance (perhaps related to foreseeable additional electricity costs over a defined period caused by the poorer performing installation). <p>In cases where non-compliance is disputed, the contractor may repeat the measurements on the same sub-area or, if it can be argued that the sub-area was not suitable for measurement, select another sub-area. The procurer shall not be liable for the cost burden of any additional measurements.</p> <p>If the performance is actually better than the design predictions, financial bonuses may apply if the procurer chooses to define them in the ITT.</p>
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2.4 Low light pollution lighting equipment: technical specifications (TS), award criteria (AC) and associated contract performance clauses (CPC)

SUBJECT MATTER
The criteria in section 3.4 relate specifically to the purchase of low light pollution road lighting equipment for: new lighting installations; the refurbishment of existing lighting installations; the retrofitting of new luminaires to existing installations; or the retrofitting of new light sources or controls to existing luminaires.

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>TS7. Ratio of Upward Light Output (RULO) and obtrusive light <i>(Applicable to all contracts where new luminaires are purchased.)</i></p> <p>All luminaire models purchased shall be rated with a 0.0 % RULO. If it is necessary to use a boom angle, either to optimise the pole distribution or due to site constraints in pole positioning, the 0.0 % RULO shall be maintained even when the luminaire is tilted at the required angle.</p> <p>Verification: The tenderer shall provide the photometric file(s). This shall include the photometric intensity table from which the RULO is calculated according to EN 13032-1, EN 13032-2, EN 13032-4, Annex D of IEC 62722-1 or other relevant international standards. In cases where luminaires are not installed horizontally, the photometric</p>	<p>TS7. Ratio of Upward Light Output (RULO) and obtrusive light <i>(Applicable to all contracts where new luminaires are purchased. In situations where glare or obtrusive light is a concern, procurers should consider specifying a requirement for C3 flux codes.)</i></p> <p>All luminaire models purchased shall be rated with a 0.0 % RULO and with a C3 flux code of ≥ 97 according to photometric data. If it is necessary to use a boom angle, either to optimise the pole distribution or due to site constraints in pole positioning, the 0.0 % RULO shall be maintained even when the luminaire is tilted at the required angle.</p> <p>Verification: The tenderer shall provide the photometric file(s). This shall include the photometric intensity table from which the RULO is calculated</p>

<p>file shall demonstrate that either:</p> <ul style="list-style-type: none"> - tilting the data by the same tilt angle to be used with the luminaire still results in a 0.0 % RULO, or - additional shielding has been fitted to the luminaire and the shielded luminaire found to show a 0.0 % RULO when tilted at the design installation angle. 	<p>according to EN 13032-1, EN 13032-2, EN 13032-4, Annex D of IEC 62722-1 or other relevant international standards.</p> <p>In cases where luminaires are not installed horizontally, the photometric file shall demonstrate that either:</p> <ul style="list-style-type: none"> - tilting the data by the same tilt angle to be used with the luminaire still results in a 0.0 % RULO and a C3 flux code of ≥ 97, or - additional shielding has been fitted to the luminaire and the shielded luminaire found to show a 0.0 % RULO and a C3 flux code of ≥ 97 when tilted at the design installation angle.
<p>TS8. Annoyance <i>(The CCT value is directly related to human perception and so should be specified when human annoyance is a concern.)</i> <i>(Same for core and comprehensive criteria.)</i></p> <p>In residential areas, in order to reduce the risk of human annoyance, the CCT of light sources shall be $\leq 3000\text{K}$ and a dimming or switch-off programme shall be implemented*.</p> <p>Verification: If requested, the tenderer shall provide the light spectra of all lamps to be provided. The tenderer shall provide measurements of CCT reported in accordance with CIE 15. With dimming, the tenderer shall provide details of the proposed dimming controls and the range of dimming capabilities, which shall at least permit dimming or switch-off based on an astronomical clock. *As per the procurer's specifications (potentially defined in TS3 if that is included in the ITT).</p>	

TS9. Ecological light pollution and star visibility

(The G-index value is directly related to blue light content, and so should be specified when light pollution effects on wildlife or on star visibility are a concern.)

In parks, gardens and areas considered by the procurer to be ecologically sensitive, the G-index shall be $\geq 1.5^*$.

A dimming programme** shall be implemented for parks and gardens that are open during night-time hours.

A switch-off programme shall apply to any relevant closing hours for parks and gardens.

A dimming and/or switch-off programme** shall be implemented for any other ecologically sensitive areas.

Verification:

The tenderer shall provide measurements of the G-index***.

**If it is not possible to calculate the G-index, CCT may be used as an orientation, it always being understood that its use as a metric for blue light is not perfect. A G-index of ≥ 1.5 would generally (but not always) equate to a CCT of $\leq 3000K$.*

***As per the procurer's specifications (potentially defined in TS3 if that is included in the ITT).*

****The G-index can be quickly and easily calculated using the same photometric data used to calculate the CCT via an excel spreadsheet available at this website:*

TS9. Ecological light pollution and star visibility

(The G-index value is directly related to blue light content, and so should be specified when light pollution effects on wildlife or on star visibility are a concern. Procurers should be aware that luminaires complying with this requirement are unlikely to meet TS1 for luminaire efficacy.)

In parks, gardens, areas considered by the procurer to be ecologically sensitive or any area within a 30km radius of an urban optical astronomy observatory or within a 100km radius of a major optical astronomy observatory, the G-index shall be $\geq 2.0^*$.

A dimming programme** shall be implemented for parks and gardens that are open during night-time hours.

A switch-off programme shall apply to any relevant closing hours for parks and gardens.

A dimming and/or switch-off programme** shall be implemented for any other ecologically sensitive areas or areas within the defined radii of relevant optical observatories.

Verification:

The tenderer shall provide measurements of the G-index***.

**If it is not possible to calculate the G-index, CCT may be used as an orientation, it always being understood that its use as a metric for blue light is not perfect. A G-index of ≥ 2.0 would generally (but not always) equate to a CCT of $\leq 2700K$.*

<http://www.juntadeandalucia.es/medioambiente/cieloandaluzindiceg>

***As per the procurer's specifications (potentially defined in TS3 if that is included in the ITT).*

****The G-index can be quickly and easily calculated using the same photometric data used to calculate the CCT via an excel spreadsheet available at this website:*

<http://www.juntadeandalucia.es/medioambiente/cieloandaluzindiceg>

2.5 Good quality and durable lighting equipment: technical specifications (TS), award criteria (AC) and associated contract performance clauses (CPC)

SUBJECT MATTER
The criteria in section 3.5 relate specifically to the purchase of good quality and durable road lighting equipment for: new lighting installations; the refurbishment of existing lighting installations; the retrofitting of new luminaires to existing installations; or the retrofitting of new light sources or controls to existing luminaires.

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
<p>TS10. Provision of instructions <i>(Applicable when the equipment and/or controls in the particular lighting installation requested in the ITT are different from the normal equipment installed elsewhere on the wider lighting network operated by the procurer.)</i> <i>(Same for core and comprehensive criteria.)</i></p> <p>The tenderer shall provide the following information with the installation of new or renovated lighting systems:</p> <ul style="list-style-type: none"> • disassembly instructions for luminaires; • instructions on how to replace light sources (where applicable), and which lamps can be used in the luminaires without decreasing the energy efficiency; • instructions on how to operate and maintain lighting controls; • for daylight linked controls, instructions on how to recalibrate and adjust them; and • for time switches, instructions on how to adjust the switch-off times, and advice on how best to do this to meet visual needs without excessive increase in energy consumption. 	

Verification:

The tenderer shall provide a declaration of compliance with this criterion, supported by examples of written instructions that will be provided to the contracting authority should the tender be successful.

TS11. Waste recovery

(Same for core and comprehensive criteria.)

The tenderer shall implement appropriate environmental measures to reduce and recover the waste produced during the installation of a new or renovated lighting system.

All waste lamps and luminaires and lighting controls shall be separated and sent for recovery in accordance with the WEEE directive⁶. Any other waste materials that are expected to be generated and that can be recycled shall be collected and delivered to appropriate facilities.

Verification:

The tenderer shall provide details of the waste handling procedures in place and identify suitable sites to which WEEE and other recyclable materials can be taken to for separation, recycling and heat recovery, as appropriate.

TS12. Product lifetime, spare parts and warranty

(The thresholds defined here are applicable to LED-based light sources, lamps and luminaires.)

Any LED-based light sources shall have a rated life at 25°C of:

- L96 at 6 000 hours,
- L70 at 50 000 hours (projected),
- C0 at 3 000 hours or C10 at 6 000 hours,
- C50 at 50 000 hours (projected).

TS12. Product lifetime, spare parts and warranty

(The thresholds defined here are applicable to LED-based light sources, lamps and luminaires.)

Any LED-based light sources shall have a rated life at 25°C of:

- L96 at 6 000 hours,
- L70 at 100 000 hours (projected),
- C0 at 3 000 hours or C10 at 6 000 hours,
- C50 at 100 000 hours (projected).

⁶Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) recast (OJ L 197, 24.7.2012, p.38).

The repair or provision of relevant replacement parts of LED modules suffering abrupt failure shall be covered by a warranty for a period of 5 years from the date of installation.

Verification:

Test data regarding the maintained lumen output of the light sources shall be provided by an International Laboratory Accreditation Cooperation-accredited laboratory that meets IES LM-80* for actual data and IES TM-21* for projected data.

The tenderer shall provide a copy of the minimum 5-year warranty to be signed if the tender is successful.

The contractor shall provide a copy of the warranty that will apply if the tender is successful and provide the necessary contact details (phone and email as a minimum) for dealing with any related queries or potential claims.

For clarity, the warranty shall, as a minimum, cover the repair or replacement costs of faulty LED module parts within a reasonable timeframe after notification of the fault (to be defined by the procurer in the ITT), either directly or via other nominated agents. Replacement parts should be the same as the originals, but if this is not possible, equivalent spare parts that perform the same function to the same or to a higher performance level may be used.

The warranty shall not cover the following:

- a) faulty operation due to vandalism, accidents or other extreme weather

The repair or provision of relevant replacement parts of LED modules suffering abrupt failure shall be covered by a warranty for a period of 7 years from the date of installation.

Verification:

Test data regarding the maintained lumen output of the light sources shall be provided by an International Laboratory Accreditation Cooperation-accredited laboratory that meets IES LM-80* for actual data and IES TM-21* for projected data.

The tenderer shall provide a copy of the minimum 7-year warranty to be signed if the tender is successful.

The contractor shall provide a copy of the warranty that will apply if the tender is successful and provide the necessary contact details (phone and email as a minimum) for dealing with any related queries or potential claims.

For clarity, the warranty shall, as a minimum, cover the repair or replacement costs of faulty LED module parts within a reasonable timeframe after notification of the fault (to be defined by the procurer in the ITT), either directly or via other nominated agents. Replacement parts should be the same as the originals, but if this is not possible, equivalent spare parts that perform the same function to the same or to a higher performance level may be used.

The warranty shall not cover the following:

- a) faulty operation due to vandalism, accidents or other extreme

<p>events;</p> <p>b) lamps or luminaires that have been working for a significant time under abnormal conditions (e.g. used with the wrong line voltage), insofar as this can be proven by the contractor.</p> <p><i>*To be updated to LM-84 and TM 28 when these versions are published.</i></p>	<p>weather events;</p> <p>b) lamps or luminaires that have been working for a significant time under abnormal conditions (e.g. used with the wrong line voltage), insofar as this can be proven by the contractor.</p> <p><i>*To be updated to LM-84 and TM 28 when these versions are published.</i></p>
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TS13. Reparability
(Same for core and comprehensive criteria.)

The tenderer shall make sure that it is feasible and practical for a professional to access components (e.g. light source, lamp, LED module, driver) after the luminaire has been put into service.

Components must be identifiable, accessible and removable without damaging the component or the luminaire.

Replacement of components shall be able to be performed on site (i.e. at luminaire mounting height), without tools (i.e. plug and play) or with one of the following types of screwdriver:

- standard, Pozidriv, Phillips, Torx, Allen key or combination wrench.

Verification:

The tenderer shall provide a technical manual, which shall include an exploded diagram of the luminaire illustrating the parts that can be accessed and replaced. The parts covered by service agreements under the warranty must also be indicated.

TS14. Ingress Protection (IP) rating

(Same for core and comprehensive criteria.)

Luminaires for M- and C-class roads shall have an optical system with an ingress protection rating of IP65 or higher, depending on the local conditions.

Luminaires for P-class roads shall be IP55 or higher, depending on the local conditions.

Verification:

The tenderer shall provide the technical specifications, demonstrating that this criterion has been met according to IEC 60598-1 clause 9.

Note: The tests for the ingress of dust, solid objects and moisture specified in IEC 60598-1 are not all identical to the tests in IEC 60529 because of the technical characteristics of luminaires. An explanation of the IP numbering system is given in Annex J of the standard.

TS15. Failure rate of control gear

The specified control gear failure rate shall be lower than 0.2 % per 1000 h and be covered by an 8-year warranty for control gear.

Verification:

The tenderer shall provide a declaration of compliance with the above failure rate for any control gear it intends to supply. The declaration shall be supported by relevant industry-standard testing procedures.

TS15. Failure rate of control gear

The specified control gear failure rate shall be lower than 0.1 % per 1 000 h and be covered by a 10-year warranty for control gear.

Verification:

The tenderer shall provide a declaration of compliance with the above failure rate for any control gear it intends to supply. The declaration shall be supported by relevant industry-standard testing procedures.

TS16. Labelling of LED luminaires

(Applicable when new LED luminaires are installed.)

(Same for core and comprehensive criteria.)

The luminaires proposed to be installed by the tenderer shall carry, as a minimum, the following technical information:

- manufacturer's name, code, serial number and date of manufacture;
- input power rating;
- luminous flux at 25°C;
- upward Light Ratio;
- CIE flux codes;
- correlated colour temperature (CCT);
- G-index;
- indication of the dimming control technology (if applicable).

The information should be included in the luminaire and, where possible, also in a part of the light pole that is accessible from ground level. The tenderer should specify how exactly this information will be displayed (e.g. on a label with a QR code, a label with written information or a metal plate with engravings).

Verification:

The tenderer shall provide a sample description of the label they propose to provide with their lighting equipment if their tender is successful.

AWARD CRITERIA

AC3. Extended Warranty

(Applies to TS12.)

(Same for core and comprehensive criteria.)

A maximum of X points shall be awarded to tenderers that are willing to provide initial warranties that go beyond the minimum warranty periods stated in TS12 and whose cost is already included in the bid price. Points shall be awarded in proportion to how long the warranty exceeds the minimum requirements, as follows:

- Minimum + 1 year: 0.2X points
- Minimum + 2 years: 0.4X points
- Minimum + 3 years: 0.6X points
- Minimum + 4 years: 0.8X points
- Minimum + 5 years or more: X points

Tenderers may also optionally provide quotations for extended warranties that are not included in the bid price, although points shall not be awarded for this. In such cases, no payment for any extended warranty will be required until the final year of the initial warranty, after which the procurer will make annual payments to the successful tenderer at the beginning of each year of the extended warranty.

Furthermore, the procurer will have the option to initiate or reject the offer of an extended warranty right up until the final year of the initial warranty; the costs of the extended warranty will be those initially proposed, plus inflation.

CONTRACT PERFORMANCE CLAUSES

CPC7. Commitment to waste recovery and transport to suitable sites

(Applies to TS11.)

(Same for core and comprehensive criteria.)

The contractor shall provide a schedule of the waste collected during the project. In addition, the contractor shall provide details of any sorting that has been applied prior to transport to suitable sites identified in the original tender or to other suitable sites where waste can be sorted, processed, recycled and, if relevant, subject to heat recovery.

Delivery invoices shall be submitted as proof of delivery.

CPC8. Labelling of LED luminaires

(Applies to TS16.)

(Same for core and comprehensive criteria.)

The contractor shall commit to providing labels for the luminaires they supply that contain at least the minimum information specified in TS16.

3 EU GPP CRITERIA FOR THE PURCHASE OF TRAFFIC SIGNALS

3.1 Technical specifications (TS) and award criteria (AC)

SUBJECT MATTER
The criteria in section 4.1 relate specifically to the purchase of lighting equipment for traffic signalling and the cost of its operation and maintenance over a defined timeframe.

Core criteria	Comprehensive criteria
TECHNICAL SPECIFICATIONS	
TS1. Life cycle cost (LCC) <i>(Same for core and comprehensive criteria.)</i>	
The life cycle cost shall be calculated based on the specifications set by the procurer, which should include:	
<ul style="list-style-type: none">• the timeframe (e.g. 8 years);• an inventory of the traffic signals required (e.g. red ball signals, amber ball signals, green ball signals, green arrow signals, pedestrian stop signals and pedestrian go signals);• the average duty cycle of each traffic signal (e.g. red signal 55 %, amber signal 2 %, green signal 43 %); and• the electricity rate (e.g. EUR 0.12/kWh).	
The tenderer shall provide the following details in order to complete the life cycle cost assessment:	

- the period of time that bulbs are covered by warranty for abrupt failure;
- the rated lifetime of the lamp (i.e. the time when lamp lumen output is expected to fall to 70 % of the original output);
- the purchase cost for lamps (both at the beginning and for any necessary replacement during the defined timeframe);
- the purchase cost for any ancillaries;
- the purchase cost for any poles, foundations and new electrical connections; and
- the installation cost (hours of labour multiplied by labour rates, plus any costs for lifting equipment, etc.).

Verification:

The procurer shall provide the tenderers with a common spreadsheet-based life cycle cost calculator in which the information required from the procurer has already been entered.

The tenderer shall submit a copy of the completed spreadsheet, together with a declaration confirming that these costs are valid at least for a defined period covering the original timescale planned for the execution of the contract after selection of the successful tenderer.

<p>TS2. Product lifetime, spare parts and warranty <i>(The thresholds defined here are applicable to LED-based light sources, lamps and luminaires.)</i></p> <p>Any LED-based light sources shall have a rated life at 25°C of:</p> <ul style="list-style-type: none"> • L96 at 6 000 hours, • L70 at 50 000 hours (projected), • L0C0 at 3 000 hours or C10 at 6 000 hours, • C50 at 50 000 hours (projected). <p>The repair or provision of relevant replacement parts of LED modules suffering abrupt failure shall be covered by a warranty for a period of 5 years from the date of installation.</p> <p>Verification:</p> <p>Testing and verification shall be conducted by an International Laboratory Accreditation Cooperation-accredited laboratory that meets IES LM-80* for actual data and IES TM-21* for projected data.</p> <p>The tenderer shall provide a copy of the minimum 5-year warranty to be signed if the tender is successful.</p> <p>The contractor shall provide a copy of the warranty that will apply if the tender is successful and provide the necessary contact details (phone and email as a minimum) for dealing with any related queries or potential</p>	<p>TS2. Product lifetime, spare parts and warranty <i>(The thresholds defined here are applicable to LED-based light sources, lamps and luminaires.)</i></p> <p>Any LED-based light sources shall have a rated life at 25°C of:</p> <ul style="list-style-type: none"> • L96 at 6 000 hours, • L70 at 100 000 hours (projected), • L0C0 at 3 000 hours or C10 at 6 000 hours, • C50 at 100 000 hours (projected). <p>The repair or provision of relevant replacement parts of LED modules suffering abrupt failure shall be covered by a warranty for a period of 7 years from the date of installation.</p> <p>Verification:</p> <p>Testing and verification shall be conducted by an International Laboratory Accreditation Cooperation-accredited laboratory that meets IES LM-80* for actual data and IES TM-21* for projected data.</p> <p>The tenderer shall provide a copy of the minimum 7-year to be signed if the tender is successful.</p> <p>The contractor shall provide a copy of the warranty that will apply if the tender is successful and provide the necessary contact details (phone and email as a minimum) for dealing with any related queries or potential</p>
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<p>claims.</p> <p>For clarity, the warranty shall, as a minimum, cover the repair or replacement costs of faulty LED module parts within a reasonable timeframe after notification of the fault (to be defined by the procurer in the ITT), either directly or via other nominated agents. Replacement parts should be the same as the originals, but if this is not possible, equivalent spare parts that perform the same function to the same or to a higher performance level may be used.</p> <p>The warranty shall not cover the following:</p> <p>a) faulty operation due to vandalism, accidents or other extreme weather events;</p> <p>b) lamps or luminaires that have been working for a significant time under abnormal conditions (e.g. used with the wrong line voltage), insofar as this can be proven by the contractor.</p> <p><i>*To be updated to LM-84 and TM 28 when these versions are published.</i></p>	<p>claims.</p> <p>For clarity, the warranty shall, as a minimum, cover the repair or replacement costs of faulty LED module parts within a reasonable timeframe after notification of the fault (to be defined by the procurer in the ITT), either directly or via other nominated agents. Replacement parts should be the same as the originals, but if this is not possible, equivalent spare parts that perform the same function to the same or to a higher performance level may be used.</p> <p>The warranty shall not cover the following:</p> <p>a) faulty operation due to vandalism, accidents or other extreme weather events.</p> <p>b) lamps or luminaires that have been working for a significant time under abnormal conditions (e.g. used with the wrong line voltage), insofar as this can be proven by the contractor.</p> <p><i>*To be updated to LM-84 and TM 28 when these versions are published.</i></p>
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AWARD CRITERIA

AC1. Lowest life cycle cost
(Applies to TS1.)
(Same for core and comprehensive criteria.)

A maximum of X points shall be awarded to the tenderer whose proposal is shown to have the lowest life cycle cost.
Points shall be awarded to other tenderers in proportion to how their life cycle cost compares to the lowest cost using the following formula:

$$\text{Points awarded to tender A} = X \times \frac{\text{lowest LCC of all tenders}}{\text{LCC of tender A}}$$

Verification:

Once all tenders have been received, the procurer shall be able to determine which tender provides the lowest life cycle cost and use this to determine how many points should be applied to each tender.

AC2. Extended warranty

(Applies to TS2.)

(Same for core and comprehensive criteria.)

A maximum of X points shall be awarded to tenderers that are willing to provide initial warranties that go beyond the minimum warranty periods stated in TS2 and whose cost is already included in the bid price. Points shall be awarded in proportion to how long the warranty exceeds the minimum requirements, as follows:

- Minimum + 1 year: 0.2X points
- Minimum + 2 years: 0.4X points
- Minimum + 3 years: 0.6X points
- Minimum + 4 years: 0.8X points
- Minimum + 5 years or more: X points

Tenderers may also optionally provide quotations for extended warranties that are not included in the bid price, although points shall not be awarded for this. In such cases, no payment for any extended warranty will be required until the final year of the initial warranty, after which the procurer will make annual payments to the successful tenderer at the beginning of each year of the extended warranty.

Furthermore, the procurer will have the option to initiate or reject the offer of an extended warranty right up until the final year of the initial warranty; the costs of the extended warranty will be those initially proposed, plus inflation.

AC3. Dimming controls

(Applicable to all calls for tender, unless it is clear that dimming controls would lead to a higher total cost of ownership. Procurers should clearly define the desired dimming performance in the ITT.)

(Same for core and comprehensive criteria.)

Points shall be awarded to tenderers that specify light sources and luminaires with fully functional dimming controls that are programmable to implement dimming during periods of low night-time road use intensity.

Verification:

The tenderer shall provide documentation from the manufacturer(s) of the light sources and luminaires that are proposed for use by the tenderer, showing that they are compatible with dimming controls.

The documentation shall also provide a power curve of light output versus power consumption, state the maximum dimming possible and provide instructions about how to programme and re-programme the controls.

4 LIFE CYCLE COSTING

Life cycle costing is a hugely relevant topic for road lighting. The dominant life cycle cost for traditional High Intensity Discharge (HID) technologies has always been electricity consumption during the use phase. LED technologies are more efficient but, although their cost has rapidly decreased during the last five years, they are also more expensive to buy. That is why public authorities need to be able to make the best objective decision for them from an economic perspective. This matter is especially sensitive, since the conversion of a road lighting installation from HID to LED typically requires a high capital outlay greater than a public authority's annual road lighting budget. Consequently, demonstrating lower life cycle costs may actually be a pre-requisite for obtaining financing to convert to a LED installation.

A number of life cycle cost comparisons have been carried out in US cities and towns, where LED uptake for road lighting installations began. Some are briefly described below.

- The City of Portland invested \$18.5 million in replacing 45 000 HPS light points with LED with 50 % lower energy consumption — leading to savings of \$1.5 million per year in reduced energy and maintenance costs. That equates to a payback period of eight years when discount rates are factored in ([Portland, 2015](#)).
- The City of Los Angeles invested \$57 million in replacing 140 000 HPS light points with LED with 3 % lower energy consumption ([Los Angeles, 2013](#)). The energy savings were initially expected to be around 40 %, but advances in LED technology ahead of the project resulted in greater savings. The study also noted rapidly falling unit costs (e.g. between March and September 2012, the cost fell from \$495 to \$309). Annual savings of \$2.5 million in maintenance costs alone are expected, due to the lower failure rate of LED (0.2 % for LED versus 10 % for HPS). Together with \$7.5 million savings in electricity costs, the total annual savings of \$10 million should result in a payback period of five to six years. However, the study urged caution in procuring LED solutions, when it was found that only 84 of 244 LED units met the quality specifications set out by the Bureau of Street Lighting website ([BSL, 2018](#)).
- Charlotte County considered the costs in 2016 of changing their 2 145 light points from HPS to LED lighting. Their existing maintenance costs were assumed to be between \$28 and \$55 per light point, depending on the type. The power cost of an HPS light was around \$12/month and a LED light assumed to be \$6/month (a 50 % reduction). Current energy and maintenance costs (for HPS) are \$310 000 and \$80 000 respectively. The costs they quoted for different types of luminaire were as follows: cobra head (HPS \$345, LED \$780) and decorative head (HPS \$1 200, LED \$1 800). It was assumed that an HPS lamp would be replaced every 5 years, the LED power module (\$150) would be replaced every 5

years as well, and the LED optical module (\$750) would need to be replaced every 20 years. They concluded that costs for HPS and LED were similar over a 20-year period, but that falling LED costs would soon make it the more economical option.

- In Minnesota (City of Chanhassen) in 2012, simple payback periods of 8-12 years were estimated for converting from HID to LED lighting ([Swanson and Carlson, 2012](#)). Lifetimes of 6 years (21 000 hours) and 22 years (78 000 hours) were estimated for HID and LED lamps respectively (based on 3 550 hours' operation per year). The authors found that the pricing for LED luminaire purchase varied significantly depending on the efficacy required, the size of the order and the length of the supply chain. For batches of 500 luminaires, the prices ranged from \$250 to \$1 325 per LED luminaire. A new HPS lamp was estimated to cost \$11 and a new pole \$800. To install a new HPS lamp or a new LED luminaire was estimated to cost \$110 and the installation of a new pole \$1 500. A 60 % saving in energy consumption was assumed for LED and total service costs of LED over 22 years were estimated at \$220. Different discount rates of 2 %, 4 % and 8 % were applied, an electricity rate of \$0.046/kWh was assumed and three different leasing rates were considered. In almost all cases, the LED option was cheaper than the HID option from an LCC perspective. The higher the discount rate, the less attractive the LED option.
- In Phoenix, the conversion of almost 95 000 HPS light points to LED was considered in 2013 ([Silsby, 2013](#)). Over a period of 10 years, they considered HPS and LED with the following characteristics: energy cost per light per year (HPS \$72.36, LED \$32.88); fixture cost (HPS \$250, LED \$475); fixture installation (HPS \$29, LED \$29); and lamp life (HPS 20 000 hours, LED 50 000 hours). In conclusion, they found that LED was around 20 % cheaper over a period of 10 years. Applied to the City of Phoenix, this equated to around \$5 million per year once the whole system was converted. For a \$1 million investment in LED, a 9-year simple payback period was calculated.

Examples of a number of different procurement scenarios have been included in Technical Annex IV to the technical report accompanying these EU GPP criteria; the scenarios use the LCC calculator from the Swedish National Agency for Public Procurement. Readers who are interested in consulting more examples of LCC in road lighting procurement should consult the technical report for further reading.

5 TECHNICAL ANNEX I: PDI AND AECI REFERENCE VALUES

	Year	Ambition level and road width (to be lit)												
		Core ≤5m	Comp ≤5m	Core 5-6m	Comp 5-6m	Core 6-7m	Comp 6-7m	Core 7-8m	Comp 7-8m	Core 8-9m	Comp 8-9m	Core ≥9m	Comp ≥9m	
PDI reference values W.lx ⁻¹ .m ⁻² =1 / (lum. eff. x MF x utilance)	2018-19	0.023	0.018	0.020	0.016	0.018	0.015	0.016	0.013	0.014	0.012	0.014	0.012	
	2020-21	0.021	0.016	0.018	0.015	0.015	0.013	0.014	0.011	0.012	0.011	0.012	0.011	
	2022-23	0.018	0.014	0.016	0.013	0.014	0.012	0.012	0.010	0.011	0.010	0.011	0.010	
AECI 'base values' kWh.m ⁻² .yr ⁻¹ .lx ⁻¹ (basically PDI x 0.001kW/W x 4015h/y and x 1.00 (core) or 0.73 (comp.) dimming factor)	2018-19	0.094	0.053	0.081	0.048	0.071	0.044	0.063	0.038	0.057	0.035	0.057	0.035	
	2020-21	0.083	0.047	0.071	0.042	0.062	0.039	0.055	0.033	0.050	0.031	0.050	0.031	
	2022-23	0.074	0.042	0.063	0.038	0.055	0.035	0.049	0.030	0.044	0.028	0.044	0.028	
Actual AECI reference values, which are simply the AECI base values above multiplied by the illuminance (lux). <i>*C0 or C1 levels must be able to meet to AECI based on 20lux (e.g. via improved dimming).</i> <i>Note that for M-class roads, the luminance needs to be specified, which will be influenced by the surface reflectivity of the road (luminance = illuminance x reflectivity).</i>	C0*, C1*, C2 (avg. 20 lux)	2018-19	1.874	1.057	1.607	0.961	1.406	0.881	1.250	0.755	1.125	0.705	1.125	0.705
		2020-21	1.654	0.935	1.418	0.850	1.240	0.779	1.103	0.668	0.992	0.623	0.992	0.623
		2022-23	1.470	0.833	1.260	0.757	1.103	0.694	0.980	0.595	0.882	0.555	0.882	0.555
	C3 / P1 (avg. 15 lux)	2018-19	1.406	0.793	1.205	0.721	1.054	0.661	0.937	0.566	0.843	0.529	0.843	0.529
		2020-21	1.240	0.701	1.063	0.637	0.930	0.584	0.827	0.501	0.744	0.467	0.744	0.467
		2022-23	1.103	0.625	0.945	0.568	0.827	0.520	0.735	0.446	0.662	0.416	0.662	0.416
	C4 / P2 (avg. 10 lux)	2018-19	0.937	0.529	0.803	0.480	0.703	0.440	0.625	0.378	0.562	0.352	0.562	0.352
		2020-21	0.827	0.467	0.709	0.425	0.620	0.389	0.551	0.334	0.496	0.312	0.496	0.312
		2022-23	0.735	0.416	0.630	0.379	0.551	0.347	0.490	0.297	0.441	0.278	0.441	0.278
	C5 / P3 (avg. 7.5 lux)	2018-19	0.703	0.396	0.602	0.360	0.527	0.330	0.469	0.283	0.422	0.264	0.422	0.264
		2020-21	0.620	0.351	0.532	0.319	0.465	0.292	0.413	0.250	0.372	0.234	0.372	0.234
		2022-23	0.551	0.312	0.473	0.284	0.413	0.260	0.368	0.223	0.331	0.208	0.331	0.208
	P4 (avg. 5 lux)	2018-19	0.469	0.264	0.402	0.240	0.351	0.220	0.312	0.189	0.281	0.176	0.281	0.176
		2020-21	0.413	0.234	0.354	0.212	0.310	0.195	0.276	0.167	0.248	0.156	0.248	0.156
		2022-23	0.368	0.208	0.315	0.189	0.276	0.173	0.245	0.149	0.221	0.139	0.221	0.139
	P5 (avg. 3 lux)	2018-19	0.281	0.159	0.241	0.144	0.211	0.132	0.187	0.113	0.169	0.106	0.169	0.106
		2020-21	0.248	0.140	0.213	0.127	0.186	0.117	0.165	0.100	0.149	0.093	0.149	0.093
		2022-23	0.221	0.125	0.189	0.114	0.165	0.104	0.147	0.089	0.132	0.083	0.132	0.083
	P6 (avg. 2 lux)	2018-19	0.187	0.106	0.161	0.096	0.141	0.088	0.125	0.076	0.112	0.070	0.112	0.070
		2020-21	0.165	0.093	0.142	0.085	0.124	0.078	0.110	0.067	0.099	0.062	0.099	0.062
		2022-23	0.147	0.083	0.126	0.076	0.110	0.069	0.098	0.059	0.088	0.056	0.088	0.056

The differences in PDI values for different years are based on a tiered increase in luminaire efficacy that is expected to be delivered by the LED industry, or 17 lm/W every two years between 2018 and 2023. The starting luminaire efficacies are 120 lm/W (core) and 130 lm/W (comp.) in 2018. A simplified calculation of the PDI reference values has been made, where $PDI = 1 / (\text{luminaire efficacy} \times \text{maintenance factor} \times \text{utilance})$.

For all PDI reference values a maintenance factor (MF) of 0.85 is assumed. The utilance values vary as a function of road width and criterion ambition level as follows:

Core/Comp: ≤5m wide (U=0.42/0.5); 5-6m wide (U=0.49/0.55); 6-7m wide (U=0.56/0.6); 7-8m wide (U=0.63/0.7); 8-9m wide (U=0.7/0.75); ≥9m wide (U=0.7/0.75).