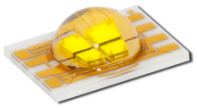
Publishable JRP Summary Report for Project ENG05 Lighting "Metrology for Solid State Lighting"

Solid-State Lighting (SSL) has the potential to **revolutionize the efficiency, appearance and quality of lighting** as we know it. SSL is evaluated as the **most efficient lighting technology**; it is predicted to be typically twice as energy efficient as fluorescent lamps and more than ten times as efficient as incandescent lamps, although current products are still in their early stages. As the world electricity consumption for lighting is one fifth of the global grand total, considerable reduction of energy consumption is obtained when replacing conventional lighting products by SSL technology. **However, both professional users and consumers have so far been reluctant to embrace solid-state lighting**, often due to unjustifiable or simply false claims about SSL product performance, partially relating to poor metrology.


Presently an extensive program to assure market acceptance of energy saving alternatives is missing and the realization of unambiguous data on SSL is not feasible with existing photometric guidelines. As a result (inter)national fact-based policy making in sustainable lighting infrastructure is not feasible. Existing conventional photometric guidelines work well for incandescent lighting sources. However, when used for SSL, the **present state-of-the-art does not provide unambiguous data** concerning essential data such as efficacy, light intensity distribution, lifetime and colour rendering/spectra. To assure the uptake of innovative next generation SSL technology new measurement methods, characterization facilities and guidelines are needed. Also it is essential that product awareness is increased and market surveillance programs are executed.

This project will support the large scale implementation and application of energy saving SSL through the development, validation and dissemination of adequate metrology for the unambiguous and reliable characterization of solid state lighting products. A three-legged **metrological framework will be implemented based on**:

- Unambiguous information, based on **new technical guidelines and methods** for SSL,
- Fact-based policy, provided through metrological **platform on SSL in Europe**, and
- **Awareness of the peculiarities and possibilities** of SSL

The approach chosen to build this metrological framework for SSL is multi-facetted. On the one hand, essential measurement facilities and basic measurement methods are developed, which at this moment are lacking for SSL. On the other hand, research into applications and interaction with stakeholders will provide input as to practical problems and relevant quality metrics. By combining both aspects, a metrological infrastructure is created which is both sound from a scientific perspective and corresponding to the real needs of the users. The work in the project is performed along five aspects, which are detailed on the next page.

EMRP European Metrology Research Programme ▸ Programme of EURAMET

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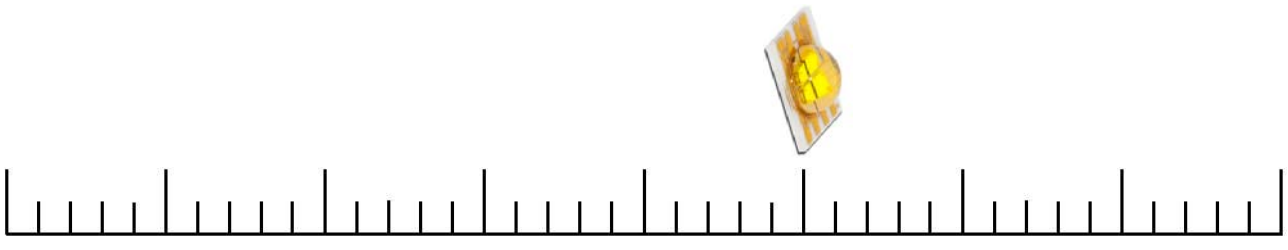
Traceability
First traceability must be established. The development and validation of traceable measurement facilities and traceability routes aimed specifically at SSL include for example those that relate to determining pulsed efficacy and colour, spectral spatial distribution, near field geometry, colour rendition and environmental conditions. Recent work has focused on the traceable measurement of electrical power and power factor of SSL products, including the impact of the source impedance on current waveform and the high frequency current emission of such sources. Another example of recent work concerns the development of reference photometers for mesopic and scotopic measurements (i.e. relating to 'nighttime' vision).

Methods
Using the above mentioned traceable facilities, basic measurement methods for the characterization of SSL products are then developed and validated. The development and validation of basic measurement methods for the characterization of SSL products include for example electrical power up to 200 kHz, efficacy (including its dependence on relative humidity and temperature) and the characterization of sources under pulsed operation. Both single devices and complete systems will be considered. For this purpose sources have been carefully identified and purchased. Various measurement systems are currently under development, or are already being validated. Also a detailed measurement scheme to study the ageing of SSL is in progress.

Perception
As the human perception to SSL products is significantly different from conventional lighting sources, this project gives specific attention to colour rendition, visual comfort and mesopic vision. Recently framework descriptions have been drafted that address all aspects of visual quality assessment of interior and exterior lighting including colour rendering and visual comfort. Also subjective experiments, and the required facilities, are being detailed.

Specifications
The existing measurands that should unambiguously describe the performance and optimal use of SSL products are evaluated and validated along laboratory tests and field trials for most typical lighting applications. In addition new quality metrics will be developed and validated for applications such indoor-lighting, street lighting, greenhouse lighting. Currently first drafts of documents are being proposed, considering also the standardization work carried out in CEN and CIE.

Impact
The impact of this research and general acceptation can only be realized by involving end users and a stakeholders committee in the definition, implementation, and validation of the new methods and quality metrics. The impact of the developed methods, quality metrics and field assessments will be disseminated through user and forum groups and fed into the international standardization and accreditation process. As an example of involvement on the national level, through this project a UK SSL metrology network has been started.



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CSIC	Spain	SP	Sweden
EJPD	Switzerland	Trescal	Denmark
INRIM	Italy	VSL	The Netherlands
IPQ	Portugal	CCR	Italy
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