Energiteknologisk udvikling og demonstration

Energy piano

Global LED Harmonisering

EUDP 2014-I 64011-0117

Final Report

16. January 2020

Efficient Electrical End-Use Equipment
International Energy Agency

iea Energy Technology Network

1.1 Project details

Project title	**GLOBAL LED HARMONISERING**
Project identification (program abbrev. and file)	2014 I 64014-0117
Name of the programme which has funded the project	EUDP International collaboration (IEA)
Project managing company/institution (name and address)	**Energy piano,** L F Cortzensvej 3, DK 2830 Virum
Project partners	
CVR (central business register)	21537381
Date for submission	16-01-2020

1.2 Short description of project objective and results

LED lighting includes a huge potential for energy saving. Substantial variation in quality at the LED market may destroy consumer confidence and delay the market penetration of LED high quality products and thus reduce the energy savings. In 2010, the IEA 4E SSL Annex was started in order to obtain higher global harmonization and lighting quality. This report describes the harmonization and lighting quality results obtained in the 2nd term of the IEA SLL work for the period 2014 - 2019. Efforts to increase the application of the new standard CIE S 025 for testing of LED lamps and luminaires has been a key activity. Harmonised use of this standard for directional lamps has been improved by an inter-laboratory comparison. The IEA SSL quality and performance tiers created in 1st period are maintained and developed. Best practice campaign experience is compiled. Test of different types of lighting sources has documented that new higher requirements for temporal light modulation are feasible. Finally is developed a new test method for smart lighting and raised awareness to use of smart lighting might increase the electricity consumption considerable unless regulation sets limits for the standby consumption.

Kort beskrivelse af projektets formål og opnåede resultater

LED belysning rummer et kæmpe potentiale for energibesparelse. Der er meget stor variation i kvaliteten for LED lyskilder, hvilket kan ødelægge forbrugernes tillid, forlænge indtrængningen af LED kvalitetsprodukter og dermed mindske elbesparelserne. IEA 4E startede derfor i 2010 et samarbejde om global harmonisering og høj lyskvalitet for LED lyskilder. Denne rapport beskriver resultaterne opnået i samarbejdets anden periode 2014-19. Der er arbejdet for brug af den nye test standard CIE S 025 for LED lyskilder og armaturer. For retningsbestemte lyskilder er dette fremmet via en ny inter-laboratorie sammenligning af målinger med goniofotometre. IEA SSL's sæt af krav til lyskvalitets- og ydeevne (tiers) er videreudviklet. Der er indsamlet erfaringer vedrørende LED kampagner. Resultater fra test for flimmer fra diverse typer af LED lyskilder har betydet, at der i den nye EU lovgivning bliver stillet højere krav for at undgå flimmer. Endelig er der udviklet en ny test metode for smart lys og opstillet forslag til krav for maksimalt standby forbrug, således at man undgår, at smart belysning øger elforbruget betydeligt.

1.3 Executive summary

The IEA 4E SSL Annex was formed in 2010. Casper Kofod has participated in the work from the start as DEA's expert concerning lighting policy/regulation and SSL quality. This report concerns the second term of the work for the period 2014-19. The work was organised with ten different tasks and biannual meetings. Casper Kofod is leader of task 7 Smart Lighting and new features that impact the energy consumption. In between the meetings, testing, studying and report writing is done. The work is governed by the SSL Annex MC (Management Committee, see the Annex in the end of this report) that have telephone meeting nearly every month. DEA is member of the MC with assistance by Casper Kofod.

The most important SSL Annex results from the second term are:

- Application of the CIE test method (based on the work in the first term of the annex including an inter-laboratory comparison of 155 lighting lighting laboratories around the world and preparing the way for accreditation of lighting laboratories),
- Support of harmonised use of the CIE standard for testing of directional lighting sources by execution of a new inter-laboratory test and comparison using goniophotometres.
- Temporal light modulation (flicker) measurements and reporting.
- Maintenance and development of the quality and performance tiers.
- Development of a method for testing of smart lighting, analysis and recommendation for regulation to limit the new standby increasing energy consumption.

Widespread dissemination has been executed globally as well as nationally against Danish stakeholders. The MC and the participating countries energy authorities are very pleased with the results obtained and have used them in the ongoing regulation. The IEA SSL work is thus supporting harmonisation of SSL quality requirements around the world. The MC has decided to continue the SSL Annex with a third term period 2019 - 24.

1.4 Project objectives

During the second term period, LED technology has become the primary lighting technology. Anyway, there is still a lack of standards for several quality parameters and test samples plus market surveillance show that many LED products do not perform as stated by the manufactures. There is not always a relation between quality and price. Such a market may destroy the consumer confidence and acceptance plus realization of the full potential for energy savings due to sales of products with low performance.

Below is listed the tasks for the second term work:

1. Application of new CIE test method,
2. Characterization of product lifetime,
3. Guidance on lifetime testing,
4. Inter-laboratory comparison,
5. Market lessons learned,
6. Quality and performance tiers,
7. New features that impact energy consumption,
8. Benchmarking performance,
9. Lighting facts international database
10. Best practice in MV&E.

1.5 Project results and dissemination of results

1.5.1 Application of new CIE Test Method

Task Leader: Yoshi Ohno, NIST (USA)

Description

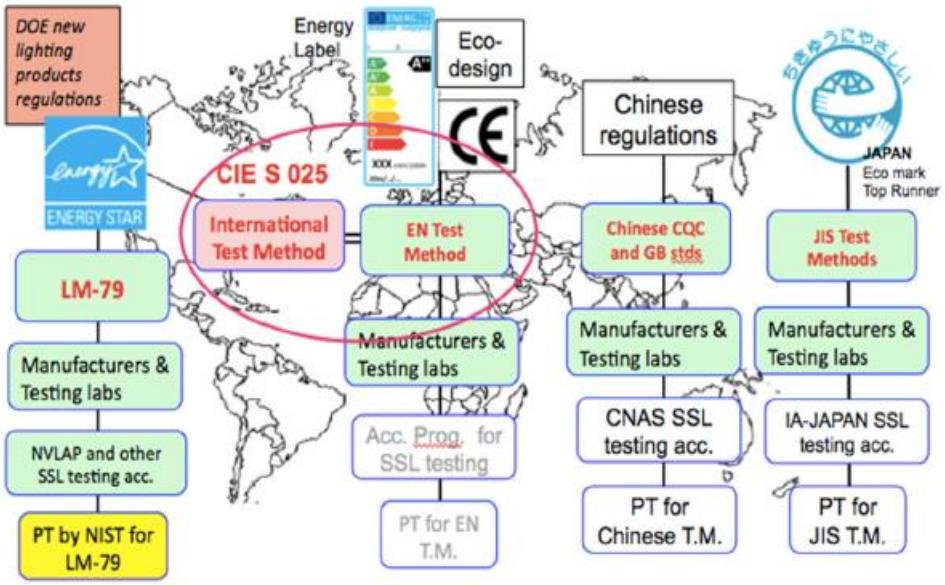
The international lighting standard body Commission Illumination l'Eclariage (CIE) has issued the standard CIE S 025/E:2015, Test Methods for LED Lamps, Luminaires and Modules for measuring quality and performance aspects of LED lighting products for regulators and accreditation bodies around the world in order to harmonise the testing and accreditation of LED products. This IEA SSL task looks at the application and relevance of this new test standard to determine its potential as test standard for governments and product regulators, answering questions like: which parameters can it test, how reliable are the results, what sample sizes are necessary, what tolerance values are assigned to measurements, and so on.

Results

The main output from this task is the final report that assess the scope of coverage of CIE S 025/E2015, compare to other existing test standards in use and discusses the findings of the evaluation and a recommendation on how the new test standard can be used effectively by governments. The report includes analysis of the use of the standard and the coverage of products, performance measurements, equipment and test requirements. The report concludes the CIE standard can be used in the new IEA SSL global inter-laboratory comparison of goniophotometry measurements (task 4, see 1.5.4).

Dissemination

The final report was finalised and published in 2017. By letter IEA SSL did inform regulatory agencies and relevant organisations about CIE S 025/E:2015 including encouragement for consideration of use of this standard in regulations. Attached to the letter was a test method comparison table explaining the differences between CIE S 025/E:2015 and existing national test standards from China, Japan, Korea and USA. Europe adopted a harmonised standard with identical technical content to CIE S 025/E:2015 by CEN in 2015: EN 13032 Lighting Applications — Measurement and presentation of photometric data of lamps and luminaires — Part 4: LED lamps, modules and luminaires. China has adopted CIE S 025/E:2015 as its national standard test method for SSL products.



The following are a sample of some of the outreach activities conducted by the SSL Annex to raise awareness about CIE S 025/E:2015 and the value of having a global, harmonised test method for LED lamps, luminaires and modules:

- IEA fremmer global LED harmonisering, Casper Kofod, Artikel i LYS, 2014.
- News item and final report for IC 2013 published, "Worldwide comparison of 110 LED testing laboratories: Results Presented" by IEA 4E SSL Annex on 10 September 2014. http://ssl.iea-4e.org/news/2013-ic-final-report
- Article published, "110 labs in world's largest inter-laboratory comparison of LED test labs – improving testing competency to support market transformation," in: eceee 2015 Summer Study on Energy Efficiency proceedings, June 2015. https://www.nist.gov/node/796401
- SSL Annex Expert, Dr. Yoshi Ohno, lectured in Beijing on "*Photometric Measurement Based on CIE S 025*" at an Industry Workshop on April 21, 2015 and at the UNEP-lites.asia Laboratory Training Workshop, April 22-24, 2015 in Beijing, China.
- SSL Annex Expert, Steve Coyne, provided training for the UN Environment's en.lighten initiative in conjunction with lites.asia on CIE S 025/E:2015 in Jakarta, Indonesia, August 2014. http://www.lites.asia/downloads/in-country-training
- SSL Annex Expert, Dr. Yoshi Ohno, assisted CIE Australia President, Tony Bergen (AU), for UNEP's webinar on CIE S 025, for approximately 100 participants.
  CIE Division 2 organized the CIE Tutorial and Expert Symposium *on CIE LED measurement standard S 025*" in Braunschweig, Germany, November 25-26, 2015. Ohno lectured on integrating sphere measurements: http://div2.cie.co.at/?i_ca_id=974
  The 2nd CIE Tutorial and Expert Symposium on CIE S 025/E:2015 held in Braunschweig, Germany in November, 2015.
- SSL Annex Expert, Dr. Yoshi Ohno presented a talk entitled "Light quality – international standards" on test methods and light quality of SSL products at the "Nordic Light Quality - International standards" conference at the Technical University of Denmark, (DTU) Roskilde, Denmark in November 7, 2016.
- SSL Annex Expert, Dr. Yoshi Ohno presented a talk at the CIE Division 2 meeting, Tutorial and Practical Workshop on LED Lamp and Luminaire Testing to CIE S 025 on 8-11 May 2017, METAS Bern-Wabern, Switzerland.
- International IEA SSL Seminar on Certification, Standards and Requirements of Solid State Lighting, 4 April 2019 in Seoul.

1.5.2 Characterisation of Product Lifetime

Task Leader: Operating agent Nils Borg (former: Wei Zhang, NLTC (China) followed by Georges Zissis, University of Toulouse (France)).

Description:

Lifetime issues for LED products. It is a meta-study of papers published by academic researchers, international associations/societies (e.g., IES, CIE, etc.) and testing laboratories. The task has to synthesise the information and prepare a summary of the findings explaining key features as product lifetime definition, metrics and information for evaluation and testing of product lifetime in a format and recommendations for policy makers.

Results

The work was started in 2015 by NLTC (China). In 2017, NLTC presented a draft report but shortly after NLTC unfortunately withdraw from the Annex. Spring 2018, a revised draft report on accelerated lifetime testing was prepared and circulated by Toulouse University, France. At the expert meeting at this time was anyhow concluded, a new structure and updating of too old data was necessary. In the beginning of 2019, France informed they did not have enough resources to finalise the work. The MC decided then to hire a consultant to do a new lifetime literature review in order to complete task 2. Terms of reference for the work is made. This work is scheduled to be finalised by the end of 2019/start of 2020 as an activity leading from Term 2 to Term 3.

1.5.3 Guidance on Lifetime Testing

Task Leader: Georges Zissis (France) assisted by Steve Coyne (Australia) (former: Elena Revtova, VSL (Netherlands) plus Wei Zhang, NLTC (China))

Description

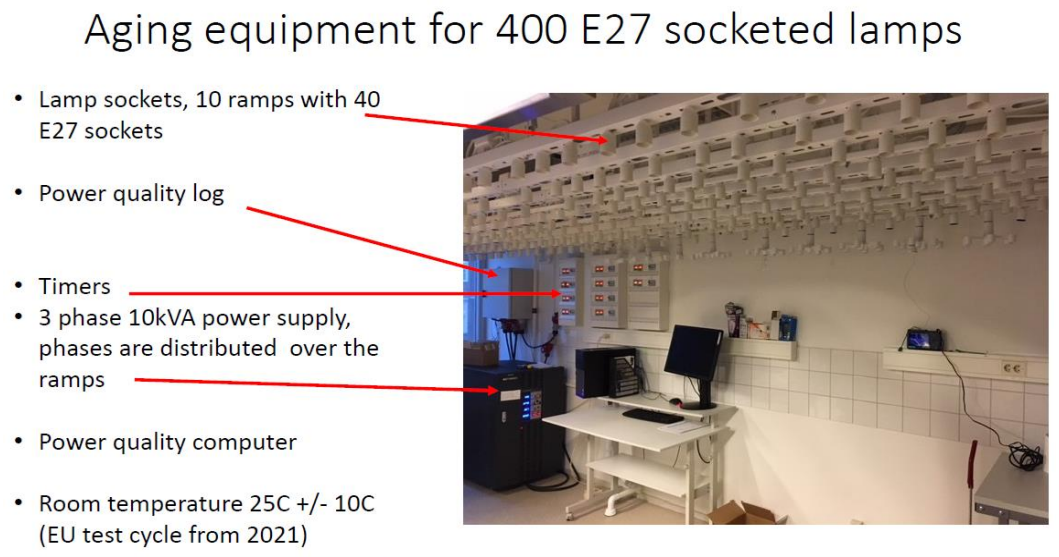
This task is building on the findings in Task 2. Task 3 is to review the best methods for accelerated test of luminous flux maintenance and colour maintenance of SSL products (available from IEC SSL product performance standards and regional test method standards on SSL products and their components), influence of ambient temperature on light output, uncertainties and colour shift over life time.

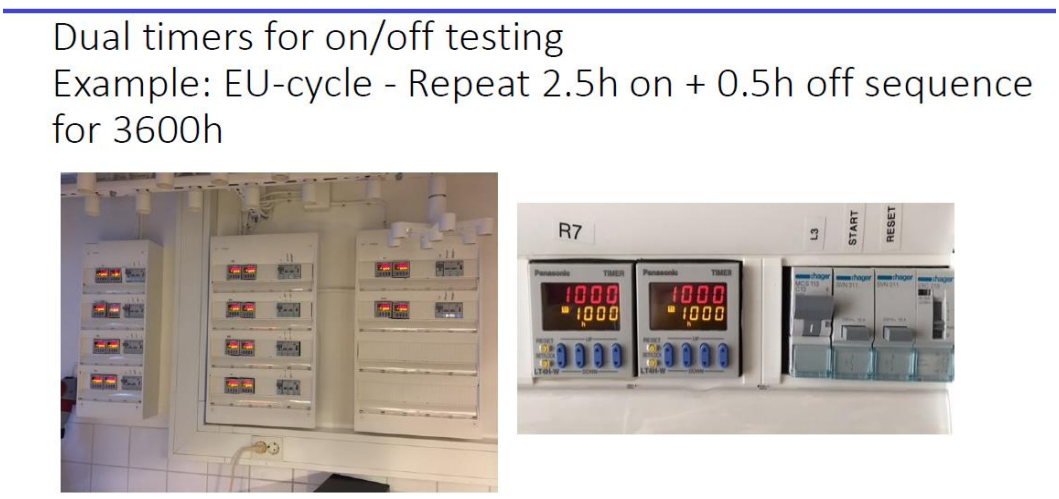
Results

This task is to provide guidance to member country governments on lifetime testing of SSL products. Due to the development for Task 2, the MC has transferred this to Term 3 where will be accelerated lifetime testing in some of the participating countries (equipment used for testing of 400 lamps is shown below).

Dissemination:

- Update on recent Life Cycle Assessments that are looking at LED lighting products in general illumination applications; comparison to traditional light sources, Georges Zissis, University of Toullouse, Promoting High Quality Energy-Efficient Lighting Conference, Sydney, 30 Nov. 2017.



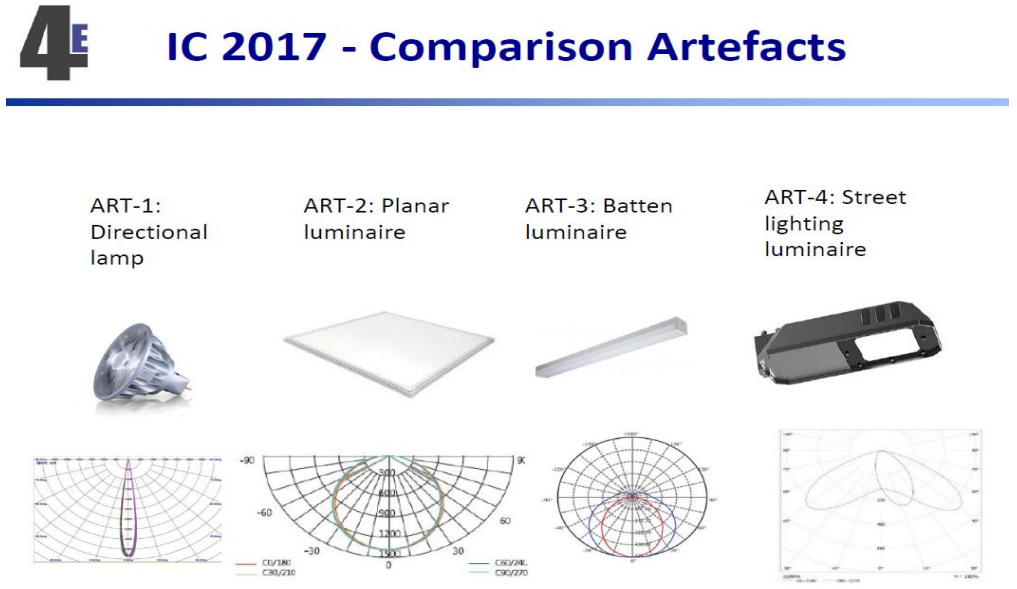


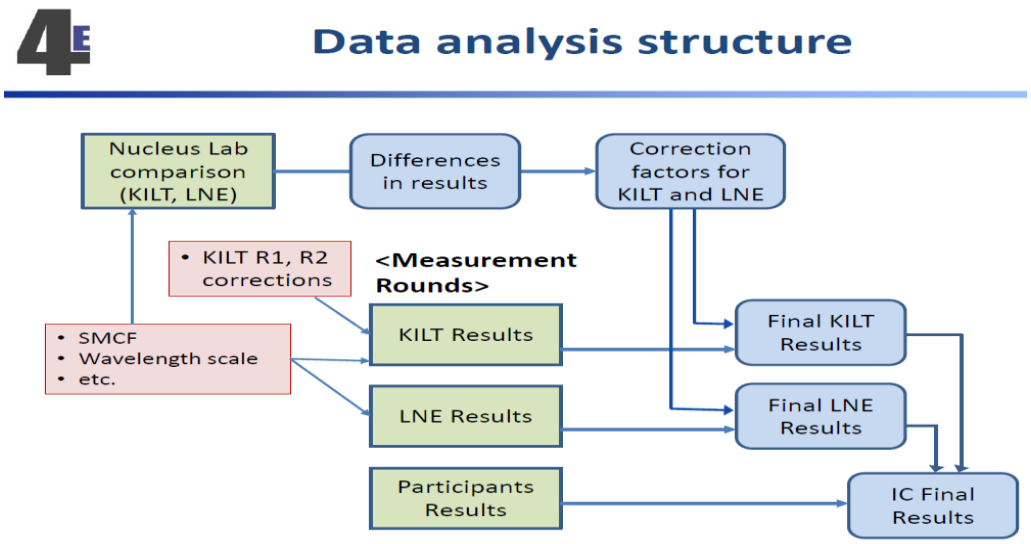
1.5.4 Inter-laboratory Comparison (Gonio)

Task Leader: Yoshi Ohno, NIST (USA)

Description

This task conducts a second global inter-laboratory comparison test programme using goniophotometers (both near-field and far-field goniophotometers in compliance with IEC/ISO 17043) and a carefully chosen set of artefacts. In 2016, the task was delayed due China and their nucleus lab left the Annex. South Korea and their lab KILT toke over and everything had to be redone with NIST and the other two nucleus lab LNE (France).





Results

Comprehensive preparation was executed including protocol, test method and quality policy. The selected artefacts were bought and the nucleus lab comparison was executed. 30/6 2017, the invitation was announced. The test was done for 43 goniophotometers in 37 labs in 18 countries. Unfortunately, the goniophotometer at KILT had to be repaired and all measurements for the Nucleus lab comparison had to be repeated giving the project a delay. Every lab received a testing reply. The final inter-laboratory comparison report will published early 2020.

Dissemination

There will be dissemination as for the first inter-laboratory comparing (see part 1.5.1).

1.5.5 Market Lessons Learned

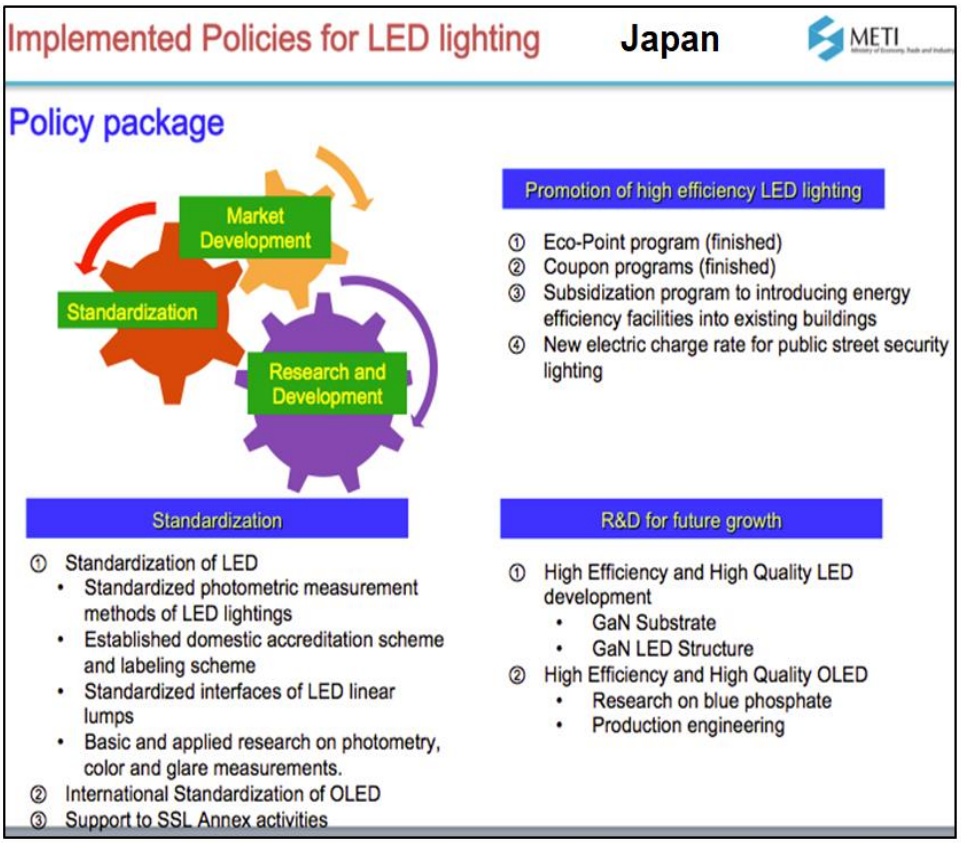
Task Coordinator: Michael Scholand, Operating Agent assistance

Description

Review Annex member government's introduction of SSL products and the market development extracting lessons learned, pitfalls to avoid and how to obtain use of quality SSL products in the market.

Results

Market lesson learned subtracted from country updates at experts meeting, literature and policy study (example for Japan below) and interviews of the MC members.



The task report is focusing on three core themes: communication/education, market preparation and manufacturer support. It provides an overview including a huge amount of political initiatives for bringing LED lighting source at the market. The report attempts to inform and bring inspiration for development of policies and programs worldwide accelerating the use of LED products of high quality. The report includes also quality ensuring mechanisms, market monitoring and test; tailor-made communication concepts for respectively end users and business; manufacturer/supplier cooperation and incitements for end users and business. Spring 2017, the task report was finalised and approved by the MC. In the 2017 midterm evaluation of the SSL Annex second term, the MC decided that work done was sufficient and closed this task.

Dissemination

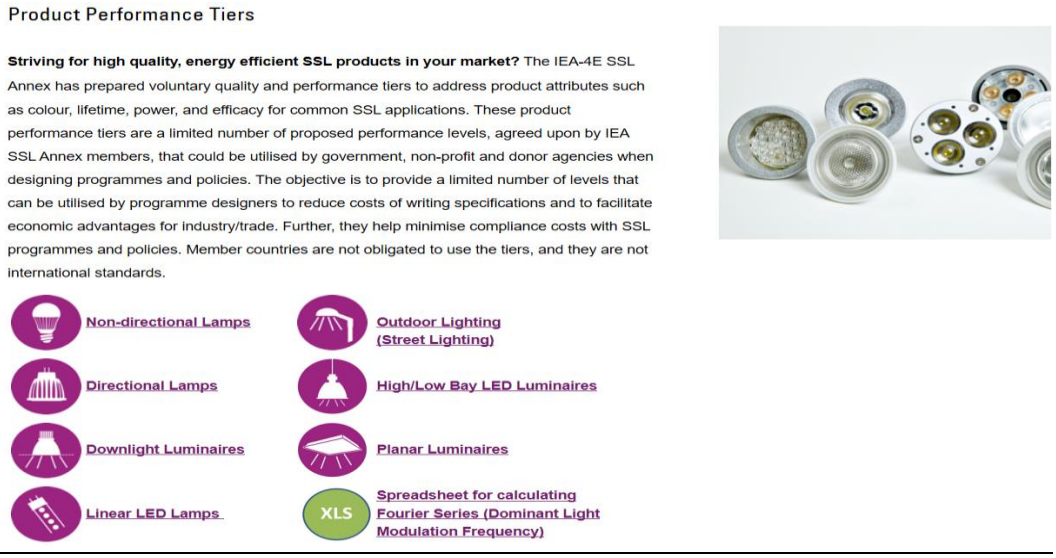
An executive-level summary report was made for the Ministers meeting at COP21 (Dec 2015) including the market introduction "story" and lessons learned. When the final report was completed in 2017, it was distributed to policy makers in the participating countries to support their work to promote quality SSL products in their respective markets.

1.5.6 Quality and Performance Tiers

Task Leader: Steve Coyne (Australia) (former Georges Zissis, University of Toulouse).

Description

The voluntary quality and performance tiers are established as an effort for obtaining global harmonised requirements for SSL products including parameters as lm, efficacy. Lifetime, colour temperature and colour rendering. The tiers cover both lamps and luminaires with 7 categories as shown in the figure below. For each category, there are three set of performance tiers: minimum, regulation quality and the best quality in the market. The tiers can be used by programme designers to ensure a good quality of lighting and by governments and ngo's in their policy and new/updated regulation.



Results

The tiers were stablished in the first term of Annex. This task has maintained and expanded the Annex's set of products. The setting of the performance and quality levels are based on analysis of products at the market plus research e.g. concerning life-cycle assessment and health-related issues, and information about off-grid lighting, where appropriate.

The tiers were revised and updated in November 2016. A new revision and updating has been going on during 2019 and is expected to be implemented in the start of 2020.

Dec 2018 – Oct 2019 a new metrics and threshold values for flicker has been defined including an intensive measurement programme. This programme has support the same is made in the new EU regulation that will come into force 1/9 2019.

Dissemination

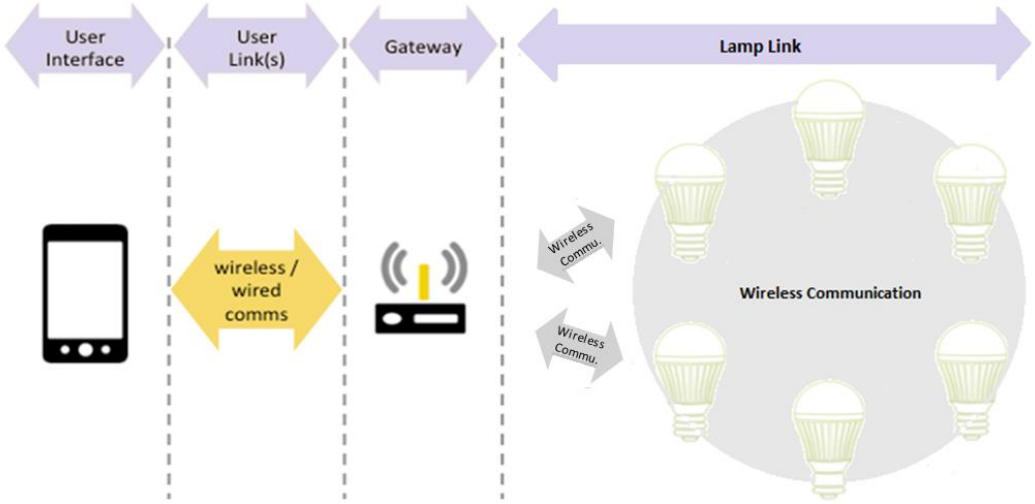
- Flicker and safety issues in SSL, Christophe Martinsons, Nordic Light Quality – International Standards – LED Conference, 7 Nov. 2016, Roskilde, Denmark.
- Assessment of filament LED bulbs with respect to temporal light artefacts, Carsten Dam-Hansen and others, Smarter lighting for better Life" conference, CIE, 2017.
- Nyt om Farvegengivelse, Carsten Dam-Hansen og Johannes Linden, LYS nr. 1, 2019.
- Cognitive and eye Movement Effect on Viewers of Temporal Light Modulation, Jennifer Veith, Proceedings of the 29th CIE Session, Washington, June 2019.
- Detection of the Stroboscopic Effect Under Low Levels of the Stroboscopic Visibility Measure, J. Veith and C. Martinsons, Proceedings of the 29th CIE Session, Washington, June 2019.
- "Beat Flicker – A temporal Light Artefact due to Multiple Sources of Time Modulated Light", Carsten Dam-Hansen and others, Proceedings of the 29th CIE Session, Washington, 2019.
- "Measuring and Comparing Waveforms of Temporal Light Modulation", Anders Thorseth and others, Proceedings of the 29th CIE Session, Washington, June 2019.

1.5.7 Smart Lighting - New Features that Impact Energy Consumption

Task Leader: Casper Kofod, Energy Piano (Denmark)

Description

LED products along with wireless control e.g. via the mobile phone give a lot of opportunities for bringing new features to the market along with the lighting e.g. colour-tunability, music from the lamp, security camera in the lamp and WiFi extender. There are also possibilities for functions as active thermal control or regulation of the current or voltage in order to maintain a constant light output over the lifetime. This task focuses on identifying and measuring the energy consumption (such as standby power) associated with the new features that are being incorporated into SSL products. Examination of the lamps and luminaires, gateway (for some products as sown in the figure below) and protocol provides an evidence base for making policy recommendations to the governments.



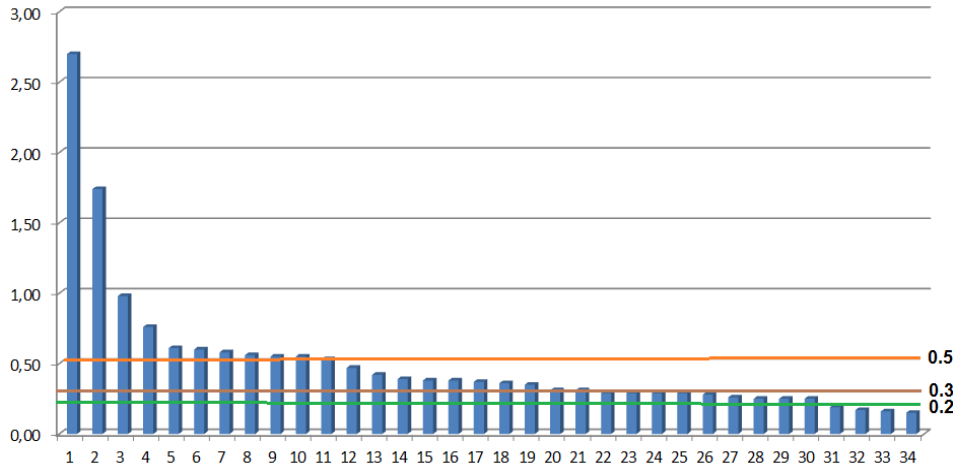
Results

The task has reported by conference/seminar presentations (first one Nov. 2015), half yearly presentations (based on new measurements) at each expert meetings and a first report (https://ssl.iea-4e.org/files/otherfiles/0000/0085/SSL_Annex_Task_7_-_First_Report_-_6_Sept_2016.pdf) published Sep. 2016. This report includes specification of a new measurement method, data to measure, the first measurements and analysis.

Bases on the obtained practical experience, was in 2018/19 made an update of the measurement method including a template for data collection also including the new features that had been added to the products. This template defines which parameters (e.g. luminous flux, CCT, chromaticity coordinates, CRI and efficacy in ON state and standby power in standby mode for the lamp/luminaire and additional control gear as the gateway) and settings (e.g. which tunable white settings and dimming levels) are mandatory to test plus a number of optional settings it also could be interesting to test.

Indicative measurements by laboratories in the participating countries have been performed. The first report from 2016 included 34 products which has increased to more than 150 products by the end of the second term. The sample size per product is 1-3 lamps but several models are tested at different laboratories and in different years which gives a better basis and more knowledge e.g. about if some manufactures have lowered their standby consumption by better component and/or control strategy.

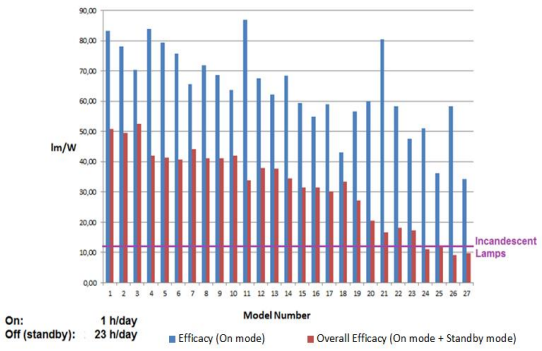
The analysis in the first report revealed that the standby consumption for the 34 different lamp models varies substantially from 0.15 W to 2.71 W.

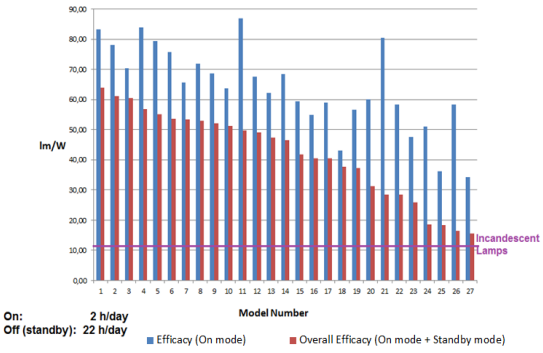


During the year, domestic lamps typically are used 1-2 hours/day and with this usage the yearly standby consumption is larger than the active lighting consumption for close to half of the lamps. For the ON mode, the efficacy range between 34 and 87 lm/W which is lower than for standard LED lamps and due to the additional internal electronical component associated with the smartness. In order to include the standby consumption in comparison of smart lamps the Annex has defined new key term “overall efficacy”:

$$Overall\ Efficacy = \frac{Luminous\ flux\ x\ Time_{ON}}{Power_{ON}\ x\ Time_{ON} + Power_{STANDBY}\ x\ Time_{STANDBY}}$$

The overall time period has to minimally be per day, but the accuracy improves with longer periods such as a week or a full year. Below the normal efficacy and the overall efficacy is shown for 27 lamps proving 200 – 1000 lm.





When the lamp operation time is 1 hour per day (and 23 hours in standby mode), the overall efficacy (see section 2.1) varies between 9 and 51 lm/W, with an average 30 lm/W. For four of the lamp models tested, the overall efficacy is lower than the efficacy of incandescent lamps. When the lamp operation time is increased to 2 hours per day (and 22 hours in standby mode), the overall efficacy varies between 16 and 64 lm/W, with an average of 40 lm/W.

In the future is expected to be many smart lamps in practically every home which many more smart features and connectivity to other smart appliances and services. The lamp network might also be used a communication network for other services than lighting with communication by LiFi. The IEA SSL Annex will in the Third Term continue to measure, analyse and raise attention to awareness of the standby consumption and other extra energy consumption of the new non-light services. There exists technical solution for lowering the standby consumption substantial. In raising the awareness, manufactures will be

encouraged to make design improvements that lower the energy consumption which else might introduce a large "not very smart" extra energy consumption.

The IEA SSL Annex has a country participant in the ongoing new standardisation group IEC PT54103 Apparatus for lighting purposes – Non-active mode power measurements. This group is started in order to try to handle a situation with different types of standby consumption (off mode, standby mode and network standby mode) and possible standby energy consumption from several functions/features added including connected lighting.

The Annex has an open dialogue and co-operation with the IEA 4E EDNA Annex in relation to connected lighting/IoT.

The results from task 7 indicates that smart lighting may increase the lighting energy consumption considerably (particularly in residential applications) with the ongoing huge manufacture investments, new features/services added all the time and falling product prices. The coming EU regulation includes only a general requirement of maximum 0.5 W standby power while it is 0.3 W in California. There exist technical possibilities for a much lower standby consumption.

There is a need for efficiency based metrics that adequately capture the potential functionality and standby modes of smart lamps and the non-lighting functions/services. Further regulation at an early stage is desirable, but without unduly limiting innovation. This clearly presents a significant challenge for the policy makers having in mind that that these products have a long lifetime.

Dissemination

The task has raised widespread attention with press releases, report and presentations around the world where the most important are:

1. New Features impacting LED Energy Consumption, Casper Kofod, Joint workshop at IEA 4E EXCO meeting, 5. Nov. 2014, Jeju Island, South Korea,
2. Press release 22. April 2015 https://ssl.iea-4e.org/news/smart-lighting
3. Is Smart Lighting Energy Smart, Casper Kofod, EEDAL, 8th international conference on Energy Efficiency in Domestic Appliances and Lighting", 26-28/8 2015, Lucerne, Switzerland.
4. New Features impacting Energy Consumption, Prepared for and presented by Nils Borg at IEA 4E EXCO Breakout Meeting, 5 October 2015, Tokyo, Japan.
5. Is Smart Wireless Lighting also Energy Smart, Casper Kofod, Strategies in Lighting Europe, 18 Nov 2015, London, UK
6. Press release 6. Sep. 2016 https://ssl.iea-4e.org/news/stand-by-of-smart-lamps
7. Smart lamps – New Features impacting Energy Consumption, Casper Kofod, 6. Sep. 2016, https://ssl.iea-4e.org/files/otherfiles/0000/0085/SSL_Annex_Task_7_-_First_Report_-_6_Sept_2016.pdf
8. Smart Lighting Impacting Energy Consumption, Casper Kofod, Nordic Light Quality – International Standards – LED Conference, 7 Nov. 2016, Roskilde, Denmark.
9. Smart Lighting – New Applications and Power Use, IEA SSL conference, Promoting High Quality Energy-efficient SSL, 23 Nov. 2017, Sydney, Australia.
10. Smart Lighting and Lighting Systems, Casper Kofod, IEA 4E workshop, 12 Nov. 2019, Brussels, Belgium.

It was scheduled to published a new report by the end of the second term but this postponed to 2020 when the MC decided to continue the work in the IEA SSL Annex with a third term. The new timing makes it possible to include delayed measurements from some countries as well as new data about connectivity. All measurements and analysis done in second term will be carried over to the third term.

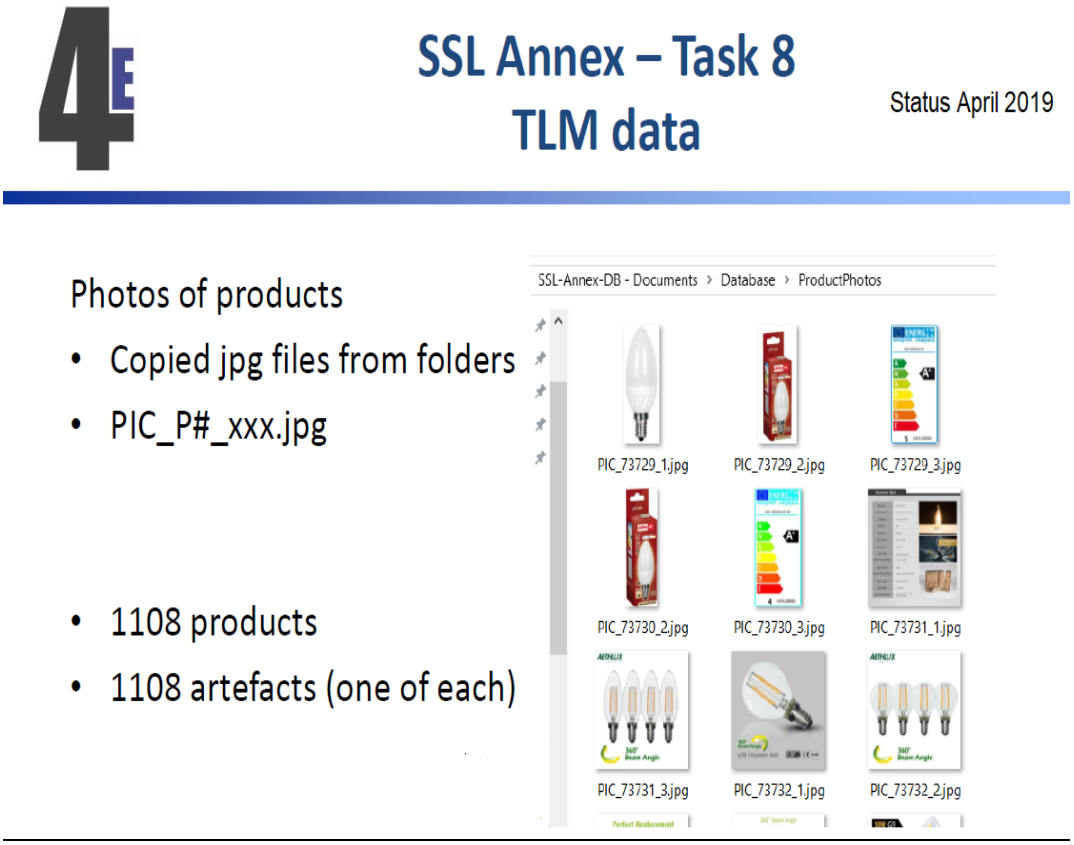
1.5.8 Benchmarking Performance of SSL Products

Task Coordinator: Carsten Dam Hansen, DTU Fotonik, Denmark (former Nils Borg, Operating Agent)

Description

The original goal was to establish an internal benchmark performance database of SSL products to enable the sharing of 1) claimed performance data and 2) test results on these products sampled and tested by accredited, independent laboratories. This internal database should be for Annex member governments only to produce brief trend reports based on data generated primarily through member government on-going independent testing programmes. This approach was much more complicated to develop than expected.

In the mid-term MC review of the IEA SSL activities, the MC decided to change to a more simple Excel approach including measurements primarily from member government testing programmes (performance, lifetime, flicker and smart lighting) done by accredited, independent laboratories. The database is for internal use and will provide member governments with an on-going, independent assessment of SSL product performance over time.



Results

October 2019, the Excel database is developed and data from the Annex different tasks (mainly task 6 and 7) are about to be included in the database.

Dissemination

The database is an internal tool only for the countries participating in the Annex. The database will be used for analysis and dissemination in other tasks.

1.5.9 Lighting Facts International Database

Task Leader: Marc Ledbetter, PNNL (US DOE)

Description

The objectives were to transfer the US DOE's Lighting Facts database to a global platform that any government could opt-in in order to use it for domestic SSL promotion programmes with customised, country-specific user interfaces. The resulting Lighting Facts International database should follow the same quality control criteria as the US Lighting Facts and be refreshed and updated on an on-going basis. It was the intension to use it for a six-monthly briefing on product trends in connection to every expert meeting. The plan was to spend one year for preparation and starting the international on-line database in the second year. Hereafter was scheduled marketing both to manufacturers to list their products as well as to governments of non-Annex countries to support their SSL market development.

Results

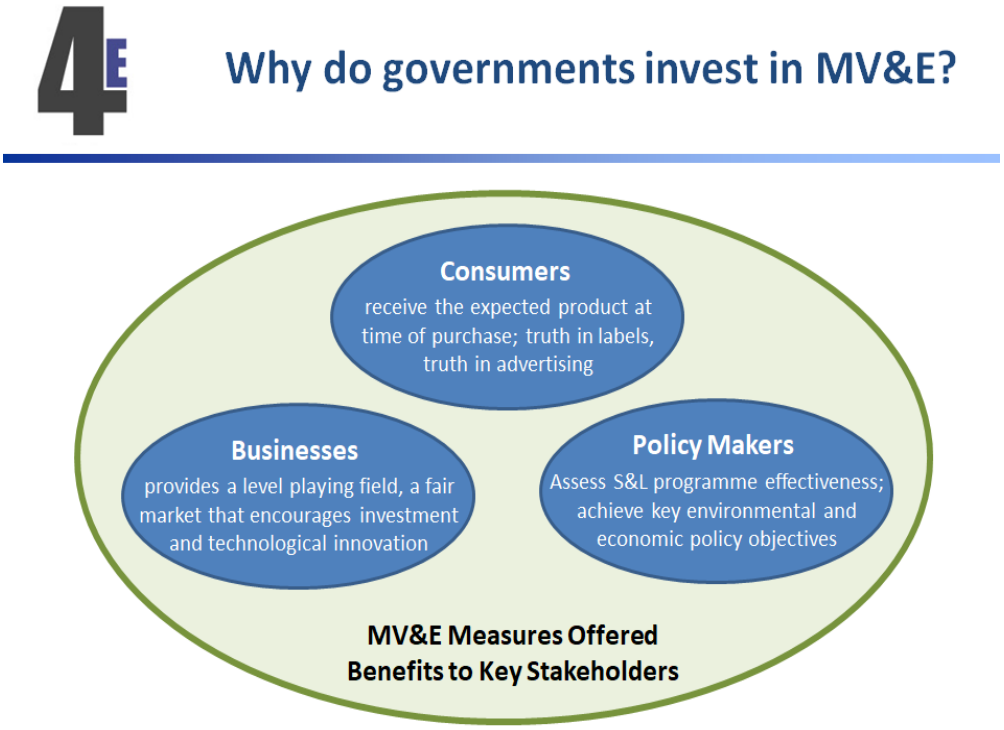
At the start of the IEA SSL second term period, US DOE informed that the US Lighting Fact database was to be downscaled and they were for the time being not able to implement the development of an international database. The IEA SSL then followed the development. Later DOE, USA stopped to support the US database and the MC cancelled this task.

1.5.10 Best Practice in International MV&E

Task Leader: OA + Maureen Kienle Jorgensen, Navigant/DOE (former Wei Zhang, NLTC (China))

Description

The objectives are to support member governments develop more cost-effective and efficient Monitoring, Verification and Enforcement (MV&E) activities. The focus is to gather and share information and best practice on MV&E programmes globally. The output from this work is intended to serve as a guide for policy makers based on collected experience of running MV&E including information on cost, test methods, sample sizes, performance metrics, results variability and so-on. A final report is intended to present 'best practice' of MV&E programmes around the world.



Results

The activity was started early in the term gathering information with an aim to prepare and issue a report in Year 3. In 2016, NLTC presented the first analysis of MVE including experience from Australia, China, Europe and USA plus 6 UNEP guidance notes. A report outline was presented.

Later in 2016, NLTC (China) withdraw from the Annex. The MC reviewed the task, gave it low priority and appointed the OA plus USA as new task leaders. Nov. 2017 was at the expert meeting given a presentation of what could be the content of a brief final report. Shortly after, the MC made a midterm evaluation of all tasks in IEA SSL and decided to close this task.

Dissemination

The power point presentation at the experts meeting in Nov. 2017 is the final product as the task was closed hereafter by MC decision.

1.5.11 Communications and Outreach

Task Coordinator: Nils Borg, Operating Agent

Description

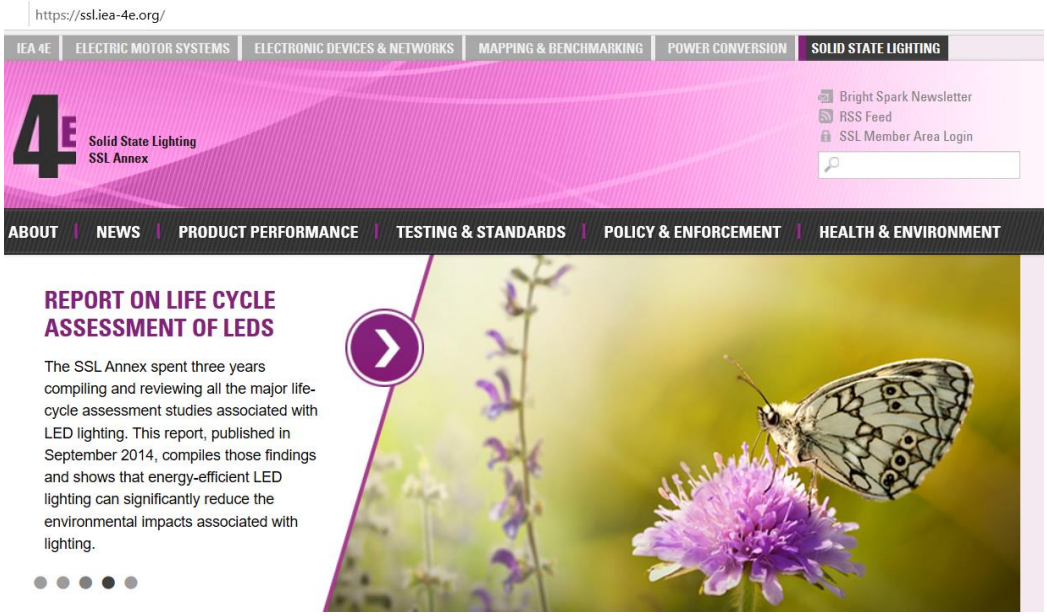
A cross-cutting communications and outreach activity which is intended to formalise a strategy targeting four key groups – (1) policy-makers and regulators; (2) standardisation bodies; (3) international lighting organisations and (4) lighting industry. This task involves both general and specific communications activities that will engage experts and decision-makers in the market to make them aware of the Annex's work.

Results

- Task reports and notes (following approval procedures)
- Task progress reporting provided at every expert meeting
- Operating Agent calls with Task Leaders on work coordination and progress
- Internal policy progress newsletter to MC
- Management Committee conference calls every 4-8 weeks
- Assistance on SEAD Lighting Award competition requirements.

Dissemination

- Dissemination of the task reports with press releases promoting them.
- Local conferences/seminars arranged in connection to the expert meetings. The presentations for each venue are available at the website, e.g. for the conference 22 Nov. 2017 in Sydney at **https://ssl.iea-4e.org/news/sydney-conference**. In Denmark has been arranged two seminars at DTU Risø Campus respectively 7/11 2016 (around 100 participants) and 7/10 2019 (with around 50 participants).
- Press release inviting stakeholders to webinars e.g. on CIE S 025/E:2015 the 29 April 2016
- Newsletters and newsletter updates
- "Policy Brief's" e.g. encouragement of harmonisation with Task 6 Tier Levels
- Speaking engagements
- Papers at conferences e.g. eceee Summer Study (2015, 2017 and 2019), Strategies in Lighting (2015), EEDAL (2015), SPARC (Sydney, May 2016) etc.
- SSL Annex private briefing of members of e.g. IEC TC 34 (Lamps) on 25 May 2016
- Public website **http://ssl.iea-4e.org/**
- Web site updates
- SSL Annex promotional video at the web site.



1.6 Utilization of project results

At the global level, the industry has by the activity of the SSL annex obtained valuable information on how to get and execute more reliable and consistent measurements for SSL products. This is gained by the annex's activity for application of the international CIE S025 LED test standard which is adopted in Europe by the identical standard CEN EN13032-04.

Globally, many laboratories are using non-compliant goniophotometer systems to measure on directional LED lamps and luminaires. In the SSL Annex IC 2017 comparison, is tested if they get equivalent results compared to the reference laboratory and hence demonstrate compliance to the test standard. This comparison is including Danish laboratories.

The Danish testing and industrial laboratories have through the two IEA SSL inter-laboratory comparisons (IC 2013 for non-directional lighting and IC 2017 for directional lighting) tested their proficiency in measurements of SSL lamps and luminaires.

During the second term period, new regulations for SSL have been defined e.g. in EU and Australia + New Zealand. In this process the IEA SSL Quality and Performance Tiers are valuable for the Danish Energy Agency and the Danish secretariat for ecodesign and energy labelling. The tiers are also useful for staff responsible for procurement and guidance of the consumers and professional customers.

The SSL Annex has provided input to the regulation process especially concerning Temporal Light Modulation (Flicker). Countries participating in the Annex have executed measurements to verify that a considerable share of product with different types of lighting sources can meet the new requirements. This documentation caused the new stronger quality requirements are adopted in the new EU regulation published in the EU Official Journal 5/12 2019 and coming into force 1/9 2021.

For the rapidly growing area smart lighting, the countries in the SSL Annex has performed measurements every year showing that many smart lamps has an all too high standby consumption. By reporting and presentations at conferences/seminars is raised awareness about the potential large increase in the energy consumption. Many manufactures has decreased the standby consumption in their products but there is still a huge variation in the standby consumption and new products plus features are appearing with large speed.

The new EU regulation includes a standby limit of maximum 0.5W but this can potentially be reduced to a fraction of this value by use of combination of two power supplies.

Smart lamps and luminaires with many new features (e.g. music from the lamp, security camera in the lamp, WIFI extender, control by voice, communication via LIFI, connectivity, serving as network for other smart appliances, connection and control by smart home systems from Google, Amazon, …) might increase the energy consumption if the systems are not energy smart. The SSL Annex is therefore following this area with measurements in the Annex's third term 2019-24.

There are developed new power supply systems solutions that can lower the standby consumption considerable. The IEA SSL Annex intends to continue to raise attention and do dissemination concerning this topic.

1.7 Project conclusion and perspective

EUDP has provided the funds for participation in the IEA SSL expert group including biannual expert meetings, leadership of Task 7 smart lighting, data analysis, writing documents and reports, commenting on draft reports from other tasks, presentations, assistance to DEA concerning new EU regulation and assistance concerning DEA's participation in the MC (Management Committee).

Widespread dissemination of the IEA SSL results are done towards Danish and international stakeholders by seminar/conference presentations, workshops and articles e.g. in LYS. In Denmark, was 7/11 2016 arranged a seminar at DTU Risø Campus including around 100 participants where the IEA SSL results were placed in the context of Nordic light Quality. A second Danish seminar was arranged 7/10 2019 at DTU Risø Campus including around 50 participants. The second seminar included presentations of recent international research on LED quality metrics and new lighting regulation in EU.

In the dissemination, the application of the new international CIE S025 has been one of the main focus points. For task 7 smart lighting, Casper Kofod has presented the results widespread at conferences/seminars in Australia, Denmark, Japan (prepared by CK but presented by the OA for the Annex), South Korea, Switzerland, and UK.

The MC member countries are pleased with the work and results in the second term of the IEA SSL Annex. As there are still many challenges concerning quality and performance of SSL lighting systems, the MC decided in 2019 to continue the IEA SSL Annex with a third term 2019-24 including the following tasks:

1. Human Centric Lighting, health and Comfort. Conduct an update to the health study published in the first term.
2. Lifetime of SSL Lamps and Luminaires. Continuing the work from the second term of the SSL Annex, review and conduct accelerated aging tests.
3. Lighting and Environment. Conduct an update to the environmental study published in the first term including LCA's and disposal/recycling issues while also considering wider environmental impacts of artificial light.
4. Inter-laboratory Comparison for Temporal Light Modulation. Provide labs around the world with an opportunity to gain accreditation to new IEC test methods IEC TR 61547-1 for P_{st}^{LM} and IEC TR 63158 for SVM.
5. Test Method assessment. Review metrics and requirements set-out in existing lighting regulations and the test standards that underpin those regulations to assess the principal accuracy and cost.
6. Quality and Performance Tiers. Maintain and adjust the SSL Annex's existing tiers for the most popular LED lamps and luminaires in the market.
7. Smart SSL Lighting – New features that impact the energy consumption. Identify and measure the energy consumption associated with the rapidly increasing amount of new features incorporated into SSL products. Casper Kofod is appointed to continue as task leader for Task 7.
8. SSL Annex product Database. Maintain/update the internal benchmarking product database including test results for LED lamps and luminaires

In Denmark, the work will support Danish Energy Agency and include collaboration with the Danish Safety Agency that responsible for Danish market monitoring, verification and enforcement. Danish partners in the SSL Annex are DTU Photonic (responsibility for measurements), Danish Centre for Lighting (responsibility for dissemination) and Energy piano (responsibility for product quality requirements and regulation).

Annex

Reports produced in the second term

1. Smart Lighting – New Features Impacting Energy Consumption, Casper Kofod, 6 Sep. 2016, https://ssl.iea-4e.org/files/otherfiles/0000/0085/SSL_Annex_Task_7_-_First_Report_-_6_Sept_2016.pdf
2. Application Study of CIE S 025/E:2015, Yoshi Ohno, June 2017, https://ssl.iea-4e.org/files/otherfiles/0000/0110/Task_1_Application_Study_-_Final_Report.pdf
3. Lessons Learned bringing LEDs to the Market, Michael Scholand, June 2017, https://ssl.iea-4e.org/files/otherfiles/0000/0106/Task_5_-_Lessons_Learned__Report_v9_final.pdf
4. IC 2017, Technical Protocol, version 1.0, Yoshi Ohno, Sangkyoo Jeon, Jimmy Dubard, 30. June 2017, https://ssl.iea-4e.org/files/otherfiles/0000/0117/IC_2017_Technical_Protocol_v.1.0_final.pdf
5. IC 2017, Nucleus Laboratory Comparison Report, Yoshi Ohno, Jun Seok Oh, Sangkyoo Jeon, Jean Guademer, Jimmy Dubard, 30. September 2019, https://ssl.iea-4e.org/news/nucleus-lab-comparison-report-ic-2017
6. Vitual Perception under Energy-Efficient Light Sources – Detection of the Stroboscopic Effect under low levels of SVM, Jennifer Veitch, Christophe Martinsons, 31. July 2019, https://ssl.iea-4e.org/news/SVM-Detection-Study-Final-Report

IEA SSL Quality and Performance Tiers: https://ssl.iea-4e.org/product-performance

IEA SSL web site: https://ssl.iea-4e.org/

IEA SSL Management Committee (for 2nd term)

Country	Name	Organisation	Email	Phone
Australia	David Boughey (Acting Chair)	Department of the Environment and Energy	David.Boughey@environment.gov.au	+61-2-6274 1982
Canada	Katherine Delves	Natural Resources Canada	katherine.delves@canada.ca	+1 613 947 1207
Denmark	Signe Friis Christensen	Danish Energy Agency	sfc@ens.dk	+45 3392 6748
France	Bruno Lafitte	ADEME	bruno.lafitte@ademe.fr	+33 4 93 95 72 56
Republic of Korea	Hyung Chanwoo (Chanu)	Korea Energy Agency	cuhyung@energy.or.kr	+82-31-260-4243
Sweden	Peter Bennich	Swedish Energy Agency	peter.bennich@ energimyndigheten.se	+46 16 544 22 78
United Kingdom	Suleiman Faruqi	Department for Business, Energy & Industrial Strategy	suleiman.faruqi@beis.gov.uk	+44 20 72 153 127 (ext. 63127)
USA (not in 3rd Term)	John Cymbalsky	Department of Energy	john.cymbalsky@ee.doe.gov	+1 202 628 5000

IEA SSL Experts' Committee (for 2nd Term)

Country	Experts
Australia	David Boughey; Steve Coyne
Canada	Rob Singlehurst; Pierre Gallant
Denmark	Carsten Dam-Hansen; Casper Kofod
France	Christophe Martinsons; Georges Zissis
Republic of Korea	Sangkyoo (SK) Jeon; Jun-Suk (JS) Oh
Sweden	Christofer Silfvenius; Jonas Pettersson; Peter Bennich
United Kingdom	Suleiman Faruqi; Arthur Montagu
USA	Yoshi Ohno (in 3rd Term member of the Swedish delegation)