



IEA Technology Collaboration Programme
on Energy Efficient End-Use Equipment

Task 7 Smart Lighting – New Features impacting the Energy Consumption

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Toulouse 25th October 2023

Agenda

1. Dimming and change of CCT – Analysis for Domestic sector and Offices
2. Dissemination after finalisation of the 2nd report including
 - 8-10 June 2023 Peer-review paper and keynote presentation at IEEE Sustainable Smart Lighting conference in Mumbai, India
 - 9th October 2023 SSL Webinars 9 Oct. 2023 – Participation and Questions
3. Co-operation with EDNA
4. IEC/CIE Standardisation
5. Smart Lighting News
6. Future Activities - Expert input and discussion

1.1.1 Misleading Smart Lighting Design?

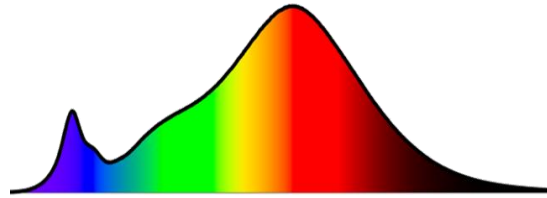


Actually, with the level of product information, Lighting Designers might assume:

- Energy consumption is linear with dimming light output
- Luminous flux and consumption is constant when changing CCT
- The flicker measures might be constant when dimming

For some smart lighting products, the Customers might experience “Not good Lighting”

1.1.2 Smart Lighting Performance

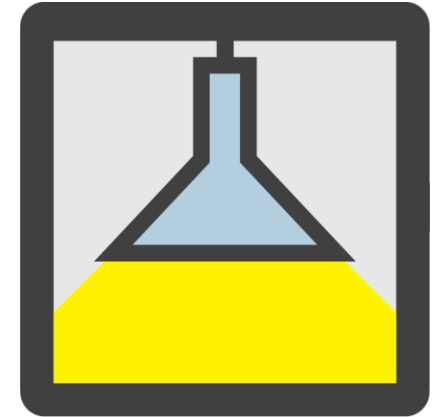


Colour Quality?

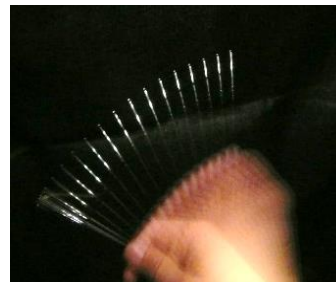


Standby Power?

Efficacy?



Flicker



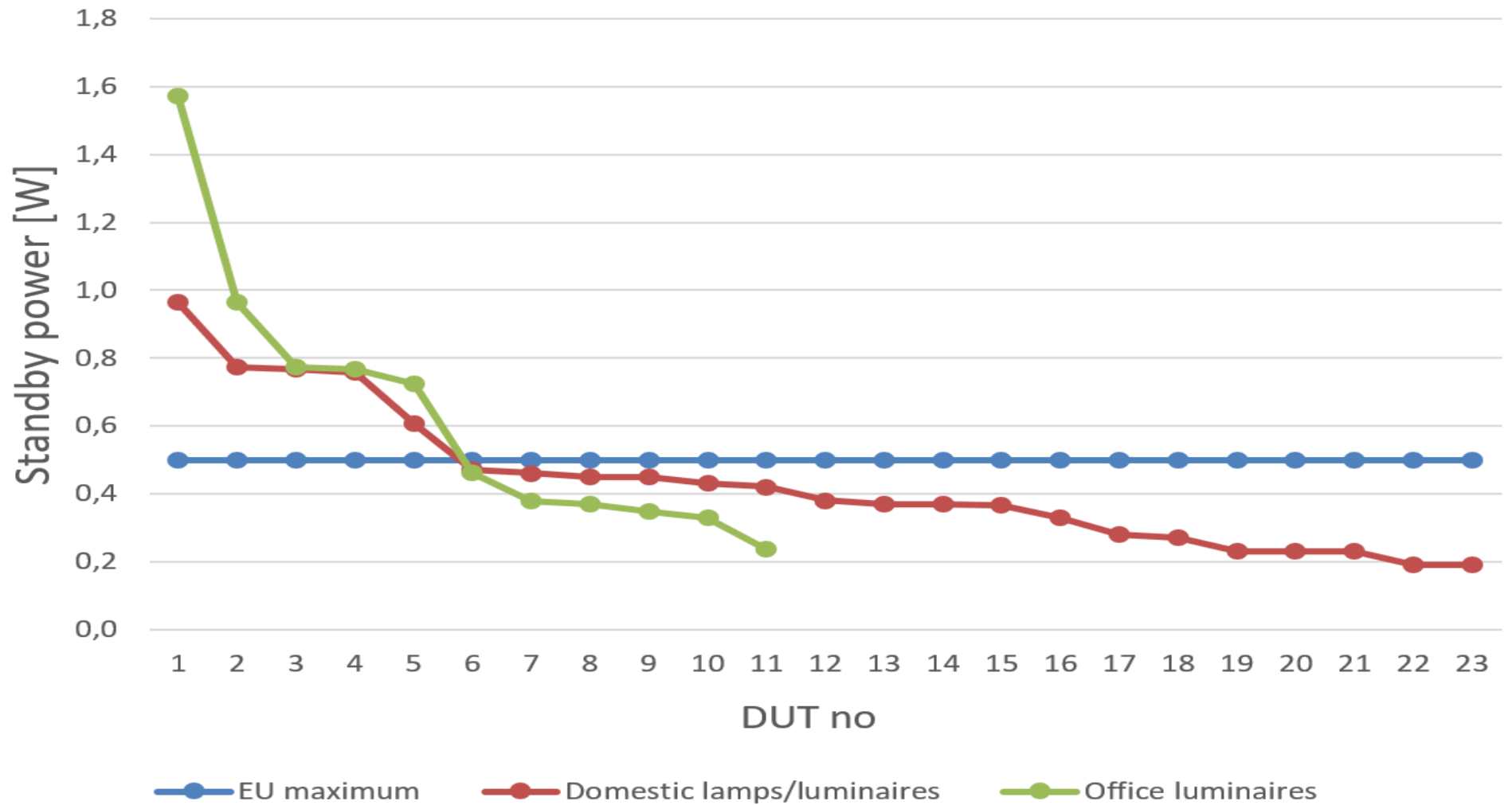
1.2 DK R&D Project Measurements and Analysis

| Segment | Type | Number | Rated power [W] | Rated luminous flux [lm] |
|---------------------|--------------------------------------------------------------------|--------|-----------------|--------------------------|
| Domestic lamps | E27, GU10 | 15 | 4,5 – 12 | 250 – 1000 |
| Domestic luminaires | panel, cylinder, ring and build-in spot | 8 | 4,5 – 24 | 300 – 2800 |
| Office Luminaires | panel, cylinder, ring, build-in spot, long pendant lamp, desk lamp | 11 | 3,5 – 36 | 300 - 3980 |

- **Dimming: 100%, 75%, 50% and 25%**
- **CCT: min. (2200K), 2700K, 4000K, 5000K, and max. (6500K)**
- **Flicker: PstLM and SVM**
- **Standby Power**

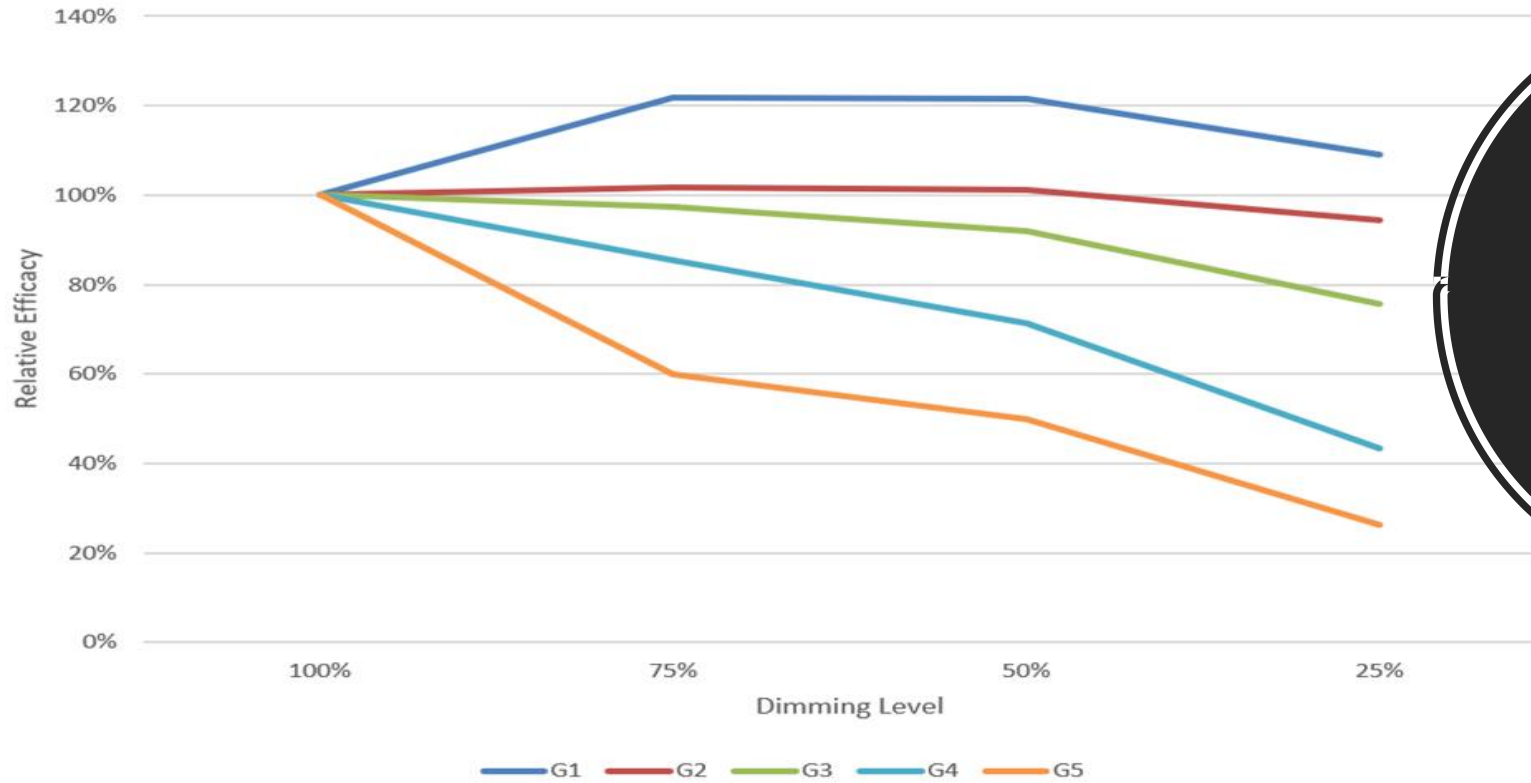


1.3 Standby power



1.4.1 Luminous Efficacy when Dimming

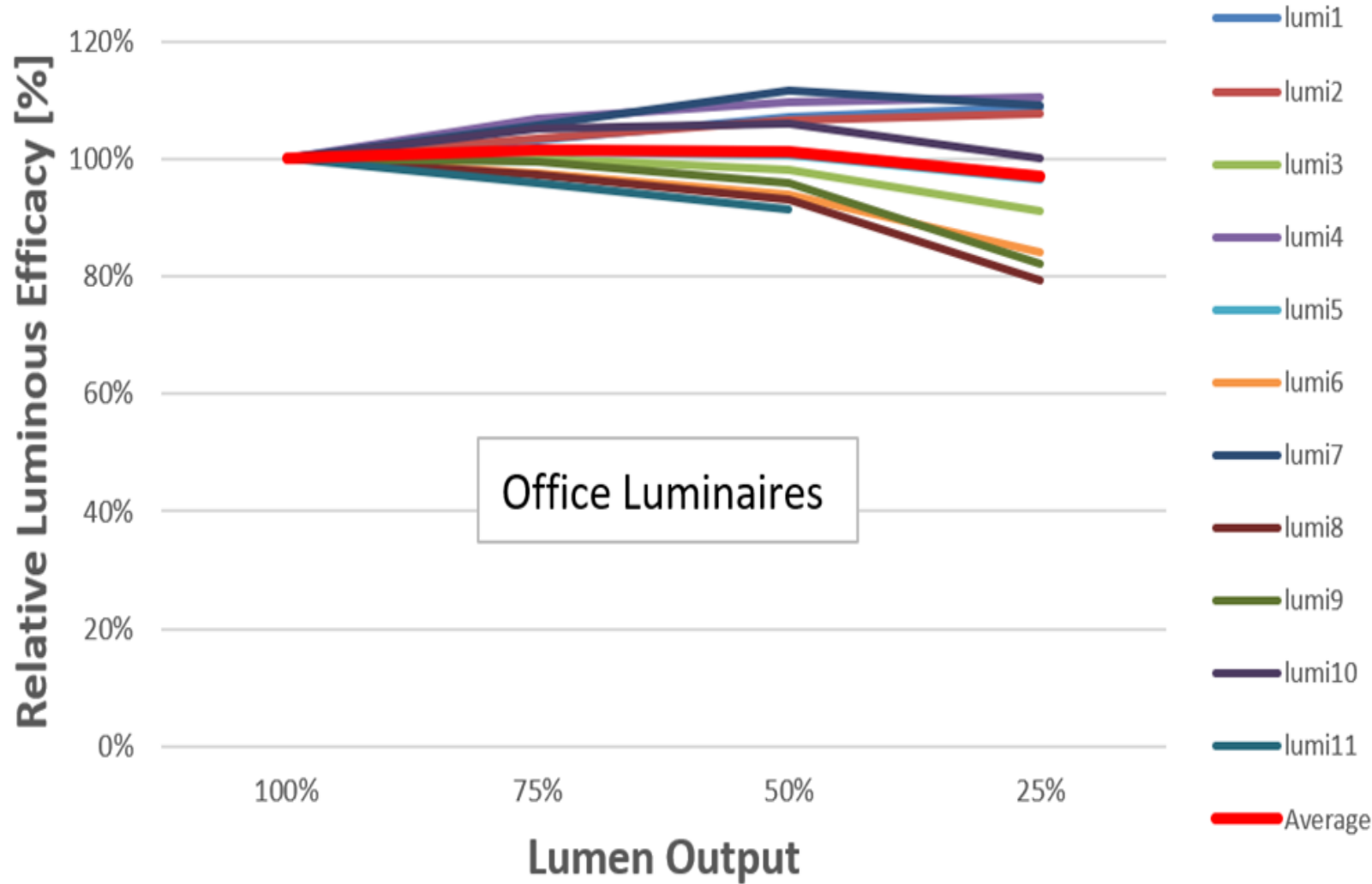
Efficacy relative to the efficacy without dimming



Efficacy when Dimming DOMESTIC light sources

G4 and G5 (24% of the products): Little or no energy savings by dimming.

1.4.2 Luminous Efficacy when Dimming

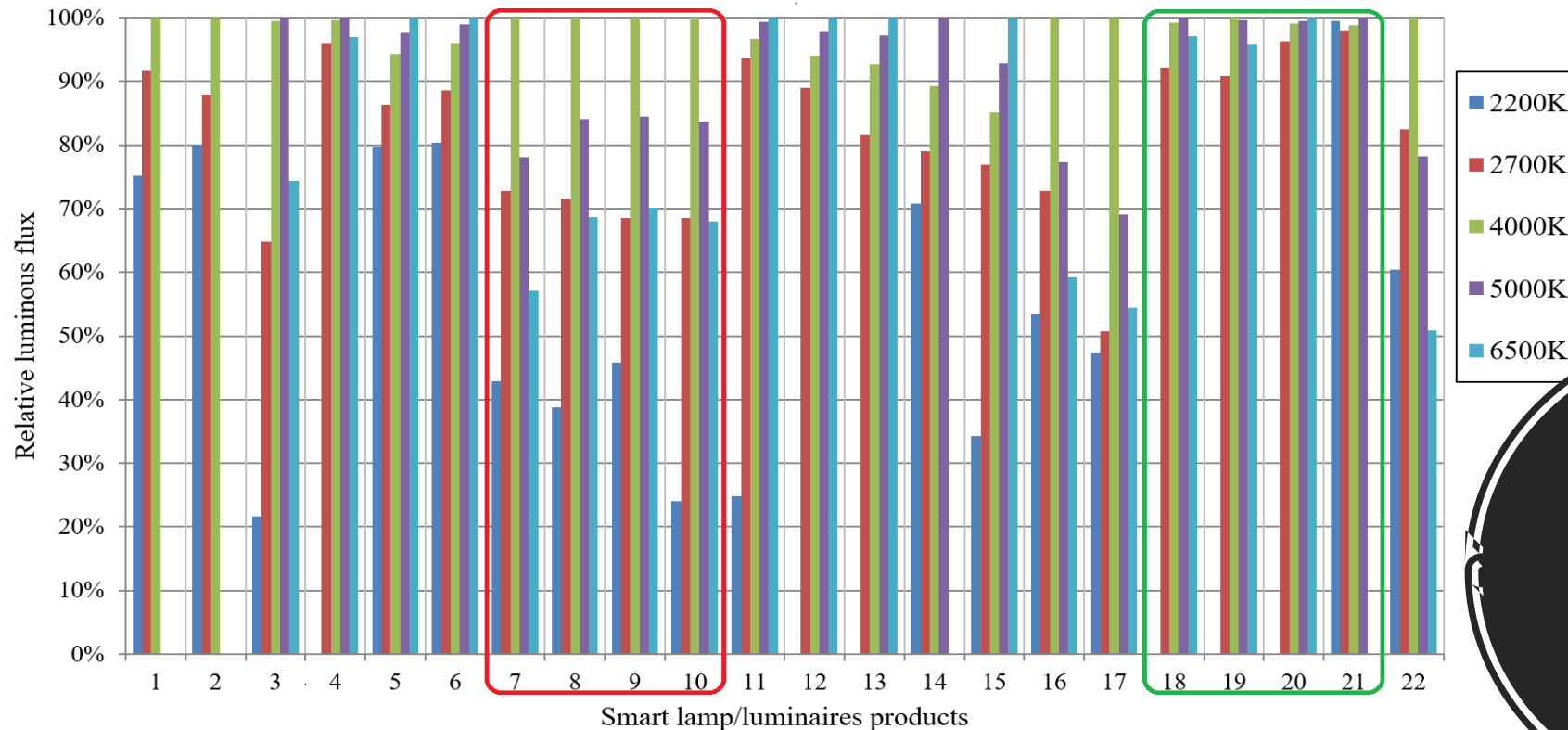


Efficacy when Dimming OFFICES light sources

Office Luminaires

Relatively small issue for office luminaires

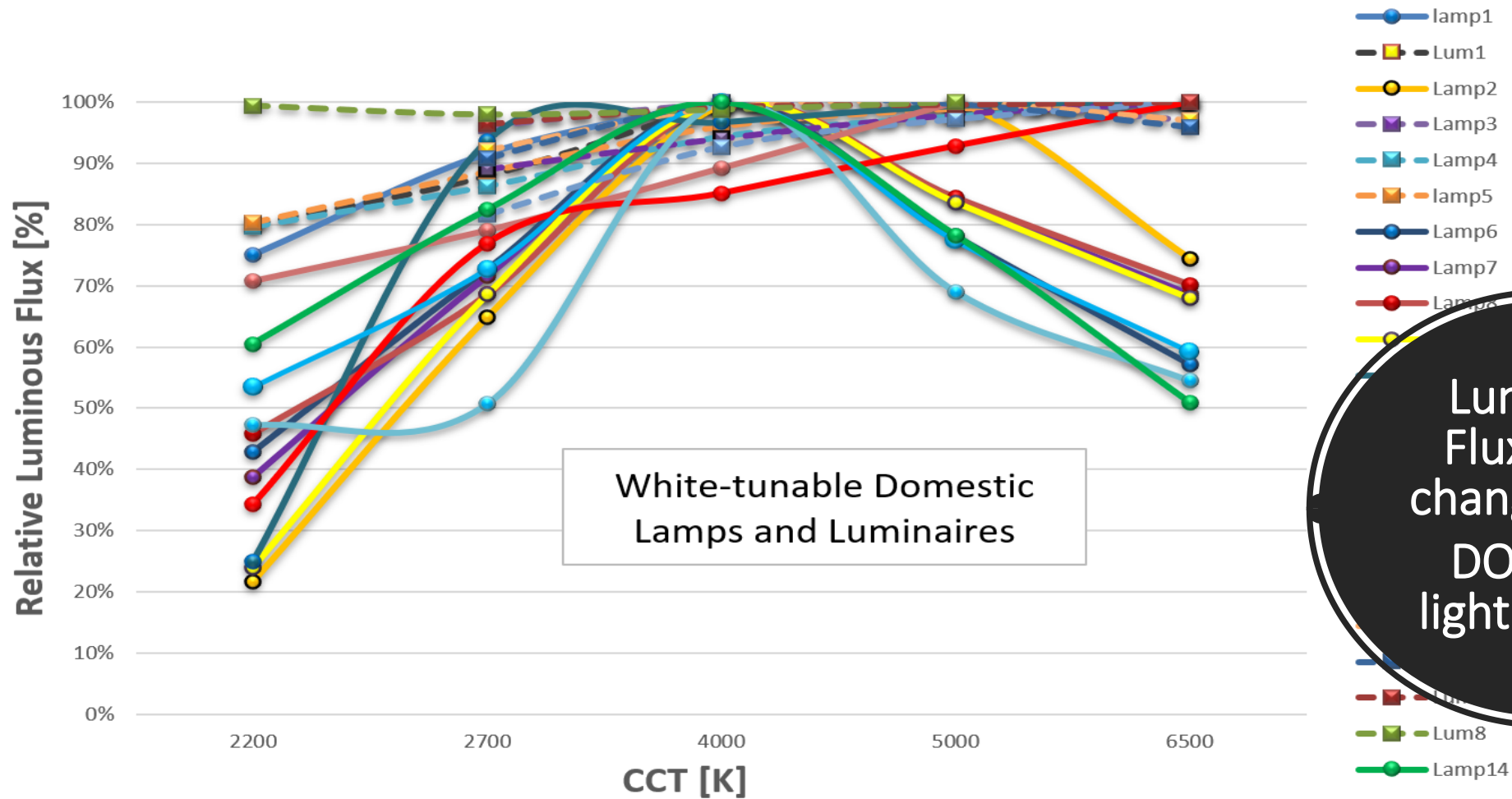
1.5.1 Luminous flux for 5 white Colours



Luminous Flux when changing CCT DOMESTIC light sources

Product 18-21: Lumen output closed to the claimed for all CCT's,
Product 7-10: Lumen output much lower than claimed for some CCT's.

1.5.2 Luminous Flux when Changing CCT

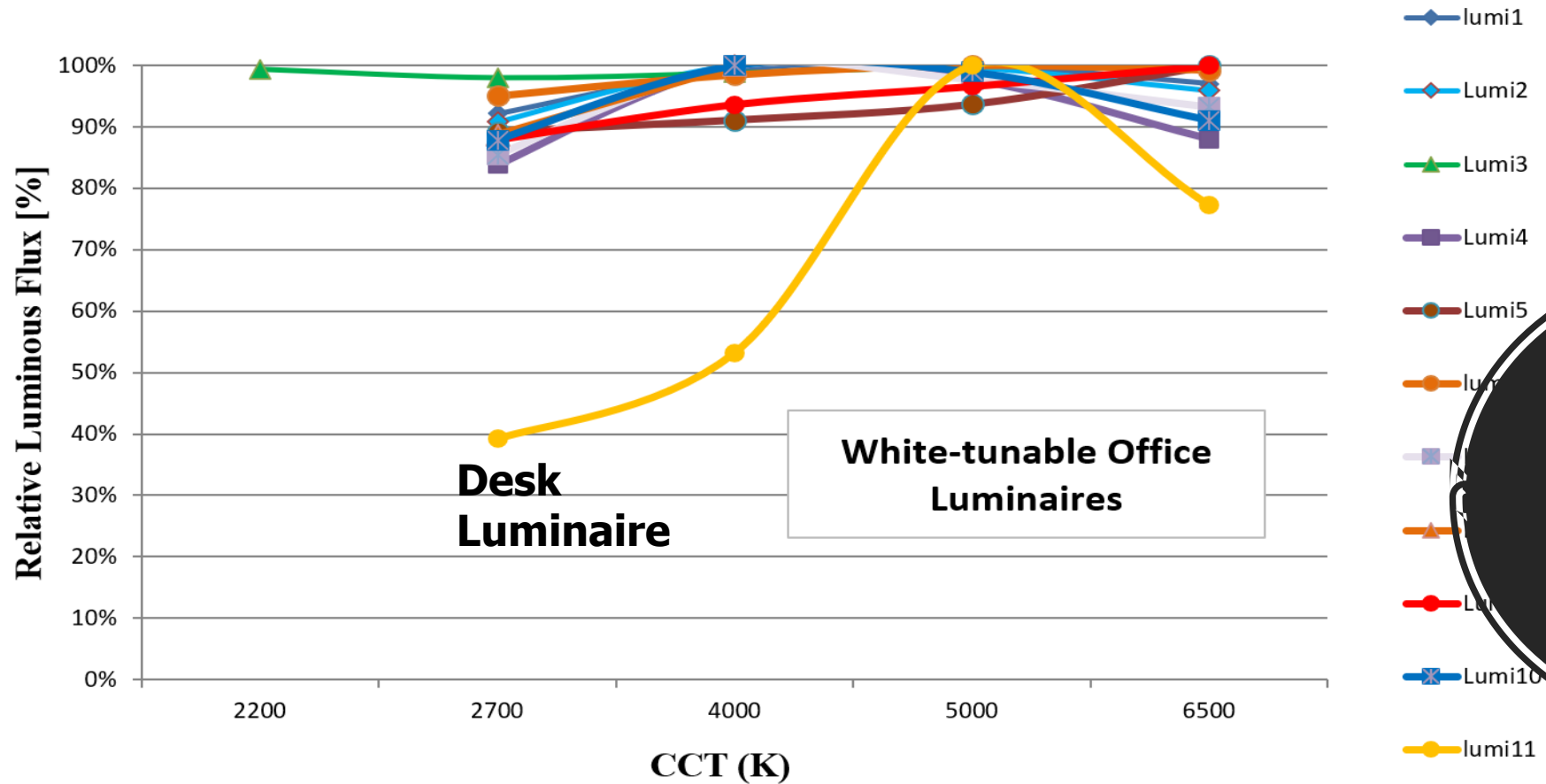


Luminous Flux when changing CCT DOMESTIC light sources

At 2200K, down to 22% of the rated flux

At 2700K and 6500K down to 50% of the rated flux

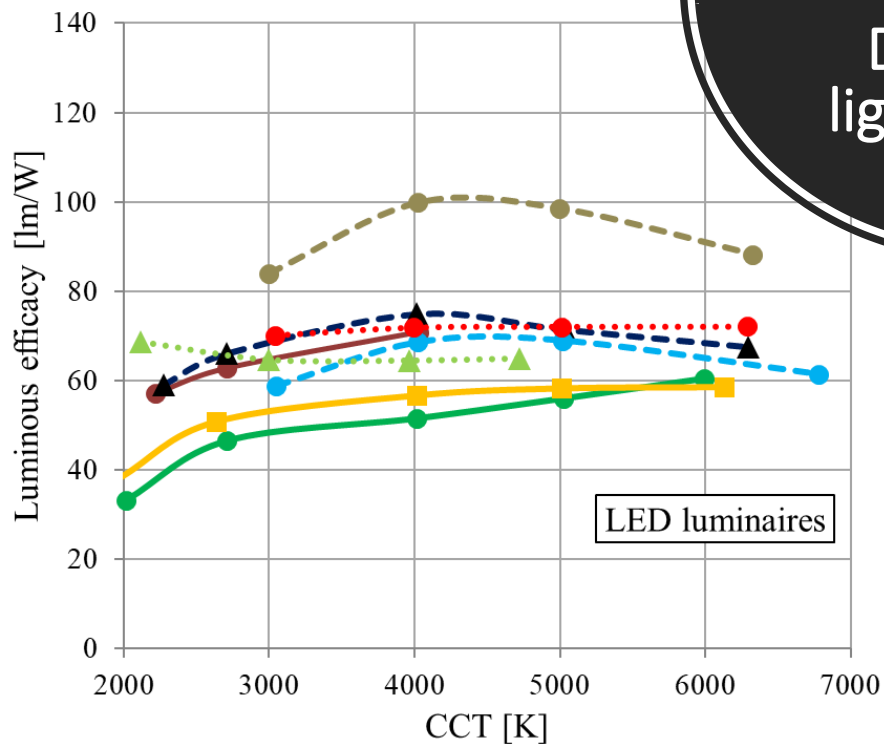
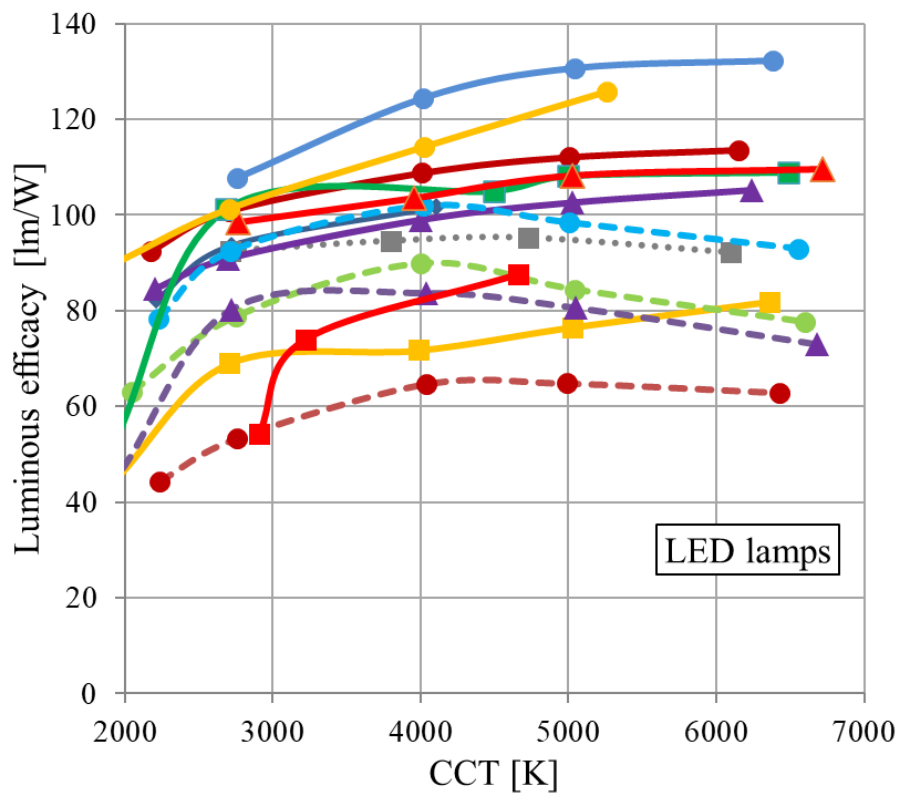
1.5.3 Luminous Flux when Changing CCT



Luminous Flux when changing CCT OFFICE Luminaires

Small variation except a desk luminaire

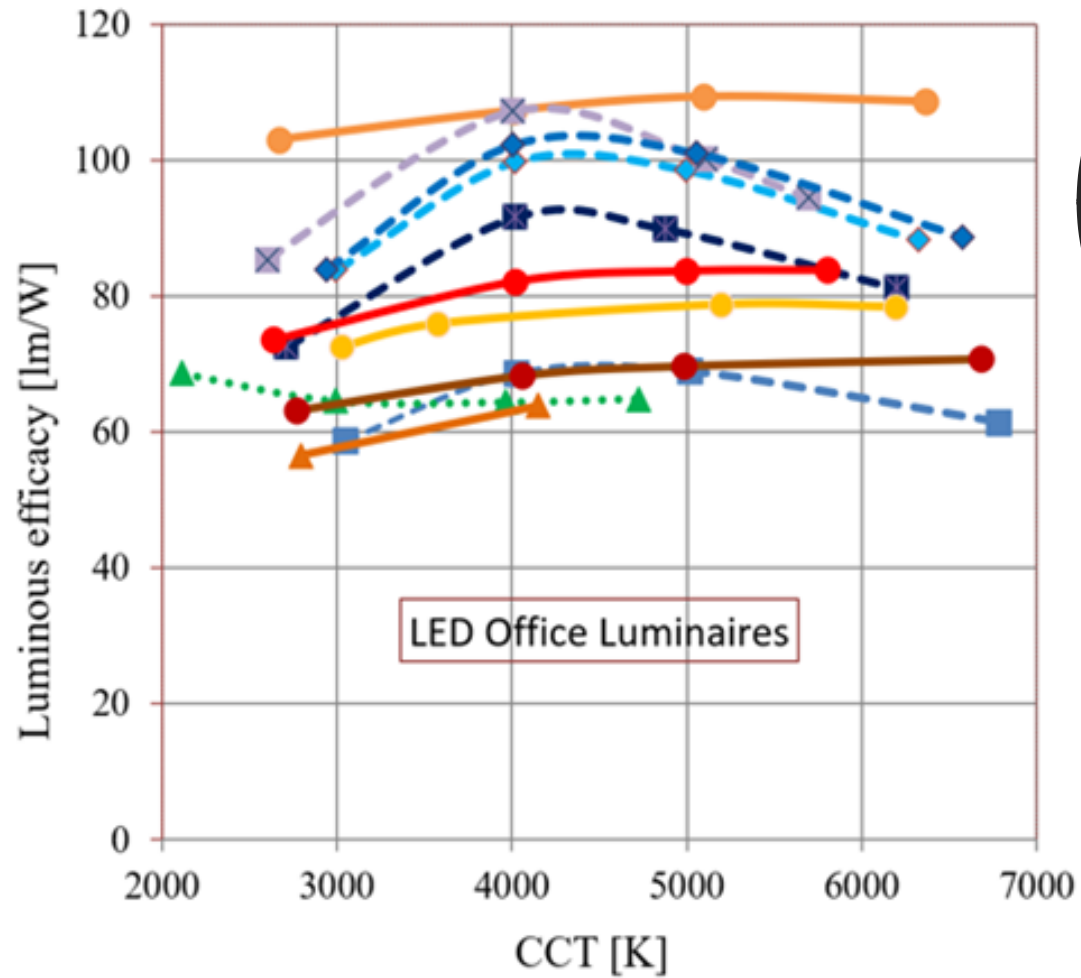
1.6.1 Luminous Efficacy when Changing CCT



Luminous Efficacy when changing CCT DOMESTIC light sources

Efficacy down to 20-50% of rated efficacy

1.6.2 Luminous Flux when Changing CCT

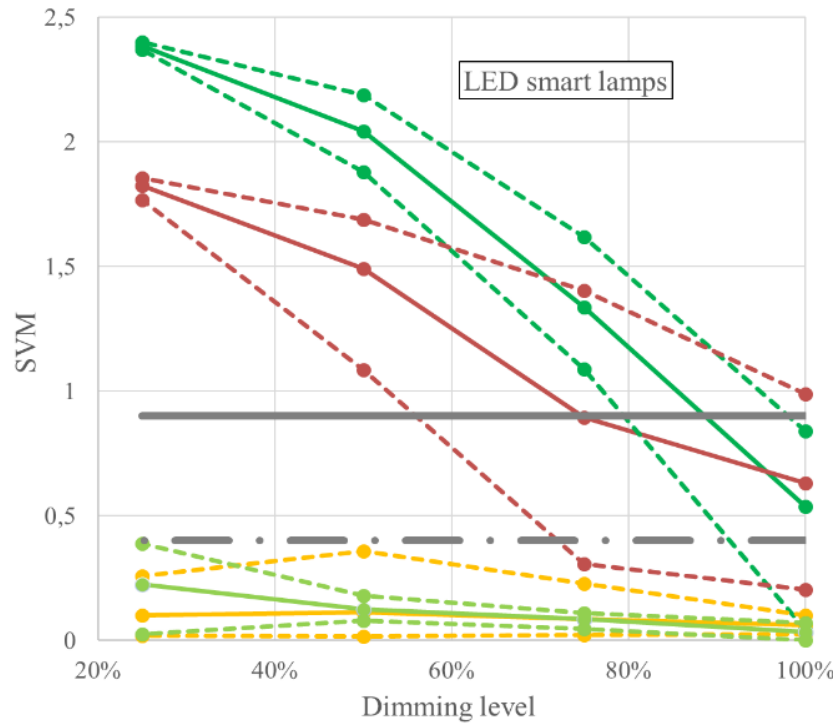


Luminous Efficacy when changing CCT
OFFICE Luminaires

For some CCT's, the Efficacy might be down to 20% of rated efficacy ¹³

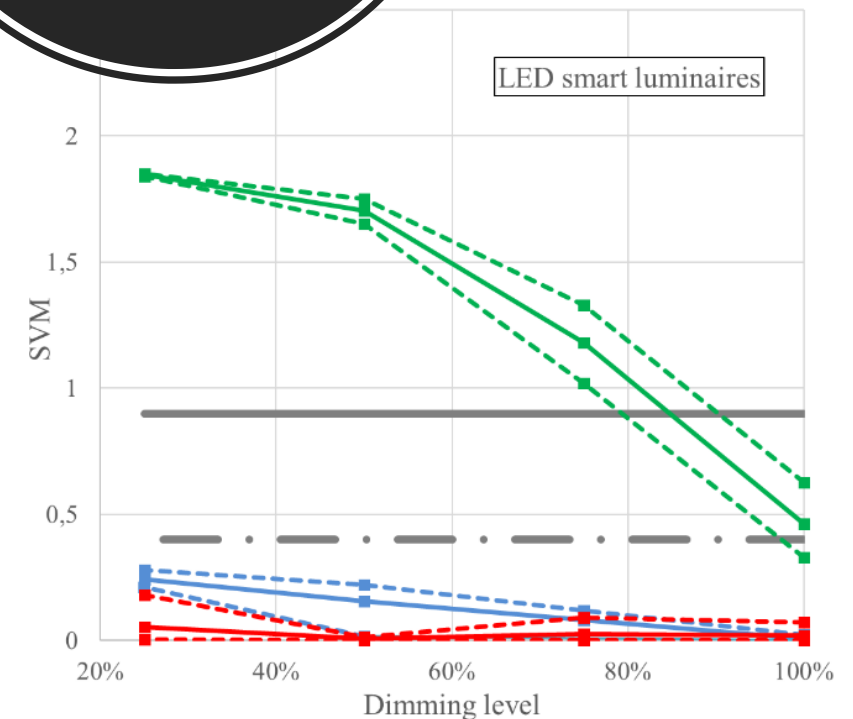
1.7 Stroboscopic Visibility Measure when Dimming

OBS: Results found by analysis in 2023 (thus not included in IEA SSL report from Nov. 2022).



Flicker when Dimming DOMESTIC light sources

*Solid lines: Average for five CCTs
Dashed lines: Max + Min for five CCTs*



1.8 Better Characterisation and Data sharing



- How shall the dynamic smart light sources be **characterised**? **Which** lighting **parameters** and how many **settings** shall the characterisation include?
- **How to share the increased amount of data** with all stakeholders to enable efficient and accurate lighting design, energy calculation and light system simulations?

1.9 and Regulation - Characterisation



- **Actually**, manufactures only has to provide measured performance for **one setting** at **full load** (often not specifying the CCT for this “factory setting”)
- Data for design and simulation is typically provided in IES and/or EULUMDAT **files** formats only including **one setting**
- American standards ANSI/IES TM-33-18 provides a format that allows adding data for **more settings** and ANSI/IES TM-38-21 specify measurement **for CCT** tunable light sources. But these standards are **not widely adopted**.
- CIE TC 2-97 is **currently revising CIE S 025** which seems to come to include **better characterisation** of smart lighting

2.1 Dissemination after 2nd Smart Lighting Report



1. 18-21/10 2022 Presentation at IEA Future Buildings Forum Think Tank Workshop, Ottawa, Canada
2. 28/2 2023 Presentation at National LED Seminar, DTU Risø, Denmark
3. 27/3 2023 Presentation at International Seminar, Stockholm, Sweden
4. 10/6 2023 Peer-review Paper and Keynote Speech at IEEE Sustainable Smart Lighting World Conference and EXPO, Mumbai, India
5. 9/10 2023 IEA 4E SSL Two Webinars about Smart Lighting



IEEE
BOMBAY
SECTION

LS:18
IEEE

Sustainable Smart Lighting
World Conference & Expo



MUMBAI 08-10 JUNE 2023

**IEEE SUSTAINABLE SMART
LIGHTING WORLD CONFERENCE
& EXPO (LS:18)**



**Detailed Characterisation for
Smart Dynamic Lighting**

*Casper
Kofod* 18

2.2 9th October 2023 Smart Lighting Webinars



- Europe/Asia 40 participants (61 regi- started). Questions about revision of EU regulation – Leo Wierda told that review is not started yet, Leo thanked for “the interesting presentation – we will surdently take this on board”. Wei (NLTC) asked about the measurement uncertainty and also asked for our recommendation for revision of IEC 63103 – CK mentioned handling and avoiding “mixed standby” measurements. There was also two questions dealing with different appliances standby power in home automation systems.
- America 20 participants (already IEEE presentations at Round-Table webinar and IEEE conference). Two Signify people commented on: 1) Our recommendations for standby limits for different features, 2) If the basic standby is higher with many features included anyhow they are switchd off, 3) if wake-up radio may slow the start so it conflicts with regulation for start-up (I suppose for CFLs), 4) Verify 0.01W can be meet by measurements, 5) if 0.08 W (from 2018) was obtained without wake-up – yes it seems to come purely from using better expensivie electronics.

3. Co-operation with EDNA

EDNA has not been doing working on smart lighting this year.

4. IEC/CIE Standardisation

- Already mention: the ongoing revision of **CIE S 025** including characterisation and data formats.
- Already mentioned: Wei contact about revision of IEC 63103
- In March 2023, Steve mentioned there has been a proposed Work Item (**PWI 34-2 ED1**) ***Intelligent lighting products for lighting systems*** which started Dec. 2017 was abandoned in August 2022 without any documents produced. Maybe this could be taking up again as an amendment or a new performance standard?



5.1 Market News: LiFi Battle



- March 2019, ITU-T G.9991 (also called ITU-T G.vlc) was ratified by the United Nation's International Telecommunication Union. Used by e.g. by Signify with its TruLiFi brand.
- 2023, IEEE ratified the Li-Fi standard 802.11bb.
- Edinburgh based pureLiFi believes that 802.11bb (applies both to LED and laser) will make a big difference in it ensuring interoperability where Li-Fi and Wi-Fi hand off to each other.
- Signify: At this time, we're not convinced of 802.11bb's benefits for large-scale commercial use. The standard's theoretical re-use of existing Wi-Fi 6 (802.11ax) chipsets (radio or light) is far from being a practical reality, as baseband signals are not directly accessible in today's chipsets. We are convinced that the ITU-T G.vlc standard offer the best possible solution”.
- France's Oledcomm: “The IEEE 802.11bb is a good step but will only be significant when Intel, Broadcom, Qualcomm ... integrate the 802.11b function on their roadmaps,”
- Neither of the approaches has yet led to mass adoption of Li-Fi and Li-Fi chips have is thus still high compared to Wi-Fi chips. Device makers have not yet embedded Li-Fi chips the way they have with ubiquitous Wi-Fi. Users thus have to attach inconvenient dongles to use Li-Fi.
- pureLiFi and Oledcomm both see LiFis future in lasers (faster speed than LED). Signify will not share their technology roadmap. “We will explore all new options”.
- Li-Fi vendors say Li-Fi will help offload the crowded Wi-Fi spectrum with better security e.g. for hospitals and factory floors with problems with electromagnetic interference of Wi-Fi's radio waves.

5.2 Market News: HUE/WIZ

LED Magazine, Aug. 1 2023

With actual slumping HUE sales, the LED magazine question if Signify can continue to price HUE notably higher than the competition with actual slumping HUE sales?

CEO Eric Rondolat, Signify,: “Most of the downturn in Digital Products came from “connected” products, which are the smart lamps, panels, strips, luminaires, and connectivity gear that Signify sells under two brands — Philips Hue (most) and the less expensive WiZ”. The consumers who bought HUE in the stay-at-home COVID days are now spending their money on other things. “There’s a little bit of downtrading on the connected part of the market, where we see customers going for lower-cost offers and less to premium brand offers”.

New Signify features:

- If there’s an intruder, then all your lights are going to turn flashing red. The lights can be seen from a long distance while sound alarms can’t be heard from a distance.
- Smart home monitoring WiZ indoor camera is the first of many home monitoring products to come - planning to extend this also into HUE this year.

Amazon (UK) list Hue lamps listed for £64.99 for a pack of two, whereas two Lepro lamps cost £15.99, two Avatar lamps cost £16.99, two Govee lamps cost £18.99, and a pack of six Aigostar lamps cost £29.99.

6.1 Future: We make a difference IF we MEASURE!

Table 6. Testing of Smart Lighting Products in SSL Annex Member Country Lighting Laboratories

| Year | Country ¹ | Number of Products Tested | | | Characteristics Measured for the Products Tested | | | | |
|----------------|----------------------|---------------------------|------------|------------|--------------------------------------------------|------------|----------------|-----------|---------------|
| | | Lamps | Luminaires | Total | Standby | Efficacy | Lamp link info | Dimming | Different CCT |
| 2015 | Report 1 | 34 | 0 | 34 | 34 | 34 | 34 | | |
| 2016 | Canada | 15 | 0 | 15 | 15 | 15 | 14 | | |
| 2017 | France | 16 | 0 | 16 | 16 | 6 | 15 | 6 | |
| 2018 | Canada | 29 | 0 | 29 | 29 | 29 | 28 | | |
| 2018 | USA | 77 | 0 | 77 | 77 | 75 | 77 | | |
| 2017-19 | Denmark | 7 | 1 | 8 | 8 | 8 | 8 | 8 | |
| 2019 | Australia | 4 | 0 | 4 | 4 | 4 | 4 | 4 | |
| 2019 | South Korea | 3 | 0 | 3 | 3 | 3 | 3 | | 3 |
| 2020 | | 7 | 6 | 13 | 13 | 13 | 13 | 6 | 6 |
| 2018-20 | Sweden | 13 | 3 | 16 | 16 | 16 | 15 | 13 | 7 |
| 2020 | Denmark | 12 | 5 | 17 | 17 | 17 | 17 | 17 | 13 |
| 2020 | Australia | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| 2015-20 | TOTAL | 217 | 19 | 236 | 236 | 224 | 231 | 57 | 62 |



¹ Australia, Canada and Denmark appear twice because the data was delivered separately in different [years](#)

2021-23 **Denmark** 16 7 23 Detailed dimming and CCT change measurements

6.2 Future Activities

Limitations for the activity next half year due low remaining budget for 3rd Term and budget for 4th Term will come a half year into 2024.

1. Measurements in the pipeline?
2. Small Consumer Guide on what to aware of when buying smart lighting sources
3. Eventually Brief on Characterisation of Domestic and Office lighting sources including (coordinate with CIE S 025 revision):
 - Dimming variation (light output 100%, 75%, 50% and 25%)
 - CCT variation (2200 K, 2700K, 4000K, 5000 and 6500K).

7. Expert Input and Discussion

